LCP CHEMICALS, INC. SUPERFUND SITE

NEXUS SUMMARY FOR LCP CHEMICALS - NEW JERSEY, INC./ LCP CHEMICALS & PLASTICS, INC./ LINDEN CHLORINE PRODUCTS, INC. AND ITS INDIVIDUAL OPERATORS

Introduction

LCP Chemicals-New Jersey, Inc./LCP Chemicals & Plastics, Inc./Linden Chlorine Products, Inc. ("LCP") is liable as the owner and operator of the LCP Site at the time of disposal, see 42 U.S.C. § 9607(a)(2), and as a party that arranged for disposal of hazardous substances at the LCP Site, see 42 U.S.C. §9607(a)(3). Individuals who operated the facility are also liable under 42 U.S.C. § 9607(a)(2).

Ownership

GAF Corporation conveyed the LCP Site to Linden Chlorine Products, Inc. in 1972.[1] Linden Chemicals & Plastics, Inc. (formerly Linden Chlorine Products, Inc. and later Hanlin Group, Inc.) conveyed the LCP Site to LCP Chemicals - New Jersey, Inc. in 1979.[2] LCP Chemicals - New Jersey, Inc. conveyed the LCP Site to Cherokee LCP Land, LLC in 2013.[3]

Operations and Disposal

After acquiring the LCP Site from GAF Corporation in 1972, Linden Chlorine Products, Inc. continued to operate the existing chlor-alkali (chlorine manufacturing) plant, with a mercury-cell chlorine process area, a hydrogen gas processing plant, and a sodium hypochlorite manufacturing area. Linden Chlorine Products, Inc. changed its name to Linden Chemical & Plastics, Inc. and continued the operation until 1979, when it conveyed the LCP Site to LCP

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[1] Bargain and Sale Deed (August 24, 1972) (Exhibit A).

[2] Deeds (December 14, 1979) (Exhibit B); Certificate of Amendment of Restated Certificate of Incorporation of LCP Chemicals & Plastics, Inc. (Exhibit C).

[3] Deed (September 19, 2013) (Exhibit D).

Chemicals - New Jersey, Inc., which continued the operation until 1985. LCP Chemicals - New Jersey, Inc. continued to use the LCP Site as a terminal facility until 1991, when its parent, Hanlin Group, Inc., declared bankruptcy.[4]

The LCP business was operated by Christian Hansen, who was the company's Chief Executive Officer and the Chairman of its Board of Directors until 1993.[5] Karl DeVoe also helped to run the plant, and was retained as a consultant to monitor conditions at the LCP Site after operations there ceased.[6] Mr. Hansen and his son, Randall Hansen, were convicted in 1999 of various environmental crimes in connection with the company's operations in Brunswick, Georgia.[7]

LCP produced chlorine, sodium hydroxide, hydrochloric acid and anhydrous HCl. LCP used a mercury cell electrolytic process.[8] The mercury cell system split sodium chloride (salt) to produce chlorine gas, passing an electric current through a salt solution (brine) between a graphite anode and a mercury cathode to produce chlorine gas and sodium. The sodium dissolved into the mercury, and the sodium-mercury mixture reacted with water to produce sodium hydroxide (caustic soda), hydrogen gas, and elemental mercury, which was returned to the mercury cells. All materials from this process, including the spent brine, hydrogen gas, and sodium hydroxide, were contaminated with mercury, which had to be removed from the useful

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[4] Record of Decision (February 2014) (Exhibit E) at 1; Administrative Order on Consent for Remedial Investigation and Feasibility Study ("AOC") (May 13, 1999) (Exhibit F) ¶¶ 8, 14; Hanlin Group 104(e) Response (June 3, 1998) (Exhibit G) at 1, 4-5.

[5] Hanlin Group 104(e) Response (June 3, 1998) (Exhibit G) at 6 ("The person in charge of operations at Linden was Christian Hansen, the former CEO of the company."); id. at 3 (Hansen was Chairman until 1993). Hanlin Group's 104(e) Response was submitted by its Secretary and Treasurer, Alan C. Margulies.

[6] Hanlin Group 104(e) Response (June 3, 1998) (Exhibit G) at 1.

[7] Based on a recent records search, it is believed that Christian Hansen is deceased.

[8] Hanlin Group 104(e) Response (June 3, 1998) (Exhibit G) at 5.

products. In particular, the mercury-sodium mixture was hydrolyzed to form elemental mercury, a sodium hydroxide solution, and hydrogen gas.[9]

The brine that was used in the chlorine production process was heated and purified in a precipitation process that produced up to 20 tons per day of brine mud or "sludge." The sludge was disposed of (along with wastewater treatment sludge) in an onsite brine sludge lagoon first constructed in the 1960s. The supernatant from the lagoon was heated and discharged to South Branch Creek. Untreated liquid from the lagoon also reached South Branch Creek and the ground surface via overflows. There were also discharges to groundwater. Sludge accumulated in the lagoon for more than twenty years before the lagoon was closed in the early 1980s. At that time, it contained some 30,900 cubic yards of sludge and occupied about 30,000 square feet.[10]

Violations and Enforcement History

In addition to the routine disposal of hazardous substances, there were significant documented releases as a result of LCP's operations, including but not limited to: supernatant overflows from the brine sludge lagoon in 1972 and 1974; a nine-hour discharge of the contents of the lagoon into South Branch Creek in 1975; the release into South Branch Creek of 10,000 to 20,000 gallons of brine, containing 8.6 ppm of mercury, in 1979, and other releases of brine or brine sludge from tanks or trucks. LCP was also cited and fined for violations on numerous

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[9] Brown & Caldwell, Remedial Investigation Report, LCP Chemicals, Inc. Superfund Site, Linden, New Jersey (July 2013) ("RIR") (July 2013) (Exhibit H) at 1-4 to 1-5; URS Corporation, Final Work Plan, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey (April 12, 2001) ("RI/FS Work Plan") (Exhibit I) at 1-4 to 1-5; Site Summaries (Exhibits T and U).

[10] Hanlin Group 104(e) Response (June 3, 1998) (Exhibit G) at 8-9; RI/FS Work Plan (Exhibit I) at 1-4 to 1-5, 1-9 to 1-10; Removal Site Evaluation (August 12, 1996) (Exhibit J) at 3; AOC (Exhibit F) ¶9; Eder Associates, Description of Current Conditions, RCRA Facility Investigation Task I ("Eder Report") (January 1992) (Exhibit K) at 17, 25; Closure and Post-Closure Plan for Brine-Sludge Lagoon (July 16, 1982) (Exhibit L) at 1; Groundwater Discharge permits (Exhibit M); Letter from Ronald J. Burkett to David Beema (November 23, 1988) (Exhibit N); Remedial Site Assessment Decision (July 25, 1995) (Exhibit O).

occasions.[11] For example, in September 1975, LCP was fined for discharges of supernatant from the brine sludge lagoon to South Branch Creek, and on May 4, 1982, LCP received an Order to cease a November 5, 1981 violation related to a ruptured muffler plate on the brine sludge roaster that allowed mercury emissions to the atmosphere.[12] EPA issued LCP an order concerning its hazardous waste treatment and disposal practices in 1981, and ordered the plant closed in 1982.[13]

Conclusion

LCP owned and operated at the LCP Site when disposal of hazardous substances took place there. The record also suggests that LCP arranged for the disposal of hazardous substances at the LCP Site. It is therefore a potentially responsible party under CERCLA and should be issued a General Notice Letter ("GNL") and be required to contribute toward the investigation and cleanup of the LCP Site. In addition, Randall Hansen, a convicted environmental criminal, is believed to have run the LCP operation along with his late father, Christian Hansen. Randall Hansen should be issued a GNL and be required to contribute toward the investigation and cleanup of the LCP Site.

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[11] RI/FS Work Plan (Exhibit I) at 1-12 to 1-15; Removal Site Evaluation (Exhibit J) at 4; Eder Report (Exhibit K) at 10-13; Letter from Luther L. Dunn to James Reidy (June 27, 1975) (Exhibit P); Facility Inspection Reports (Exhibit Q).

[12] RI/FS Work Plan (Exhibit I) at 1-12. LCP also received several Notices of Violation and citations related to administrative matters (*e.g.* failure to submit required reports). See id. at 1-13.

[13] Administrative Consent Order (September 18, 1981) (Exhibit R); Site Inspection Report, Executive Summary (May 21, 1985) (Exhibit S).

Exhibit A

8/17/72

39372

BARGAIN AND SALE DEED
(Covenants against Grantor)

THIS DEED, made this 24th day of August, 1972, between GAF CORPORATION, a Delaware corporation, with an office at 140 West 51st Street, New York, New York 10020, hereinafter called "GRANTOR", and LINDEN CHLORINE PRODUCTS, INC., a Delaware corporation, with an office at Foot of South Wood Avenue (P.O. Box 464) Linden, New Jersey, 07036 hereinafter called "GRANTEE";

WITNESSETH, That the said GRANTOR, for and in consideration of the sum of Five Hundred Thirty One Thousand ($531,000) Dollars to it in hand paid by the GRANTEE, at or before the ensealing and delivery of these presents, the receipt whereof is hereby acknowledged, doth grant and convey unto the said GRANTEE, and to its successors and assigns forever, all those certain tracts or parcels of land and premises situate in the City of Linden in the County of Union, and State of New Jersey, described in Exhibit A attached hereto and forming part hereof and which are hereinafter sometimes referred to collectively as the "Premises."

TOGETHER and with all and singular the buildings, improvements, ways, waters, profits, rights, privileges and advantages with the appurtenances to the same belonging or in any wise appertaining;

COUNTY OF UNION
CONSIDERATION 531,000.-
REALTY TRANSFER FEE 531.-
DATE 8-25-72 BY

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ALSO all the estate, right, title, interest, property, claim and demand, whatsoever, of the GRANTOR of, in and to the same and of, in and to every part and parcel thereof which is hereby conveyed to the GRANTEE.

SUBJECT TO THE FOLLOWING:

1. Facts disclosed by survey by Grassmann, Kreh & Mixer, dated February 15, 1972, latest revision dated June 14, 1972.

2. Matters set forth in Exhibit B attached hereto and forming part hereof.

3. Rights or estate, if any, of the United States of America in and to that portion of the property lying waterward of the high water mark of Arthur Kill. Rights or estate, if any, of the State of New Jersey in lands and creeks lying below the original mean high water mark or to that portion of the property deemed to be meadowlands heretofore flowed by tide.

TO HAVE AND TO HOLD, all and singular, the abovementioned and described premises, together with the appurtenances, unto the said GRANTEE, its successors and assigns forever, subject as aforesaid.

AND the said GRANTOR covenants with the said GRANTEE, its successors and assigns that it has not made, done, committed,

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executed or suffered any act or acts, thing or things whatsoever, whereby or by means whereof the above mentioned and described premises, or any part or parcel thereof, now are, or at any time hereafter shall or may be impeached, charged or encumbered, in any manner or way whatsoever, except and subject as aforesaid.

IN WITNESS WHEREOF, the GRANTOR has hereunto caused its corporate seal to be affixed and these presents to be signed by its duly authorized officers the day and year first above written.

GAF CORPORATION

By _____
T.A. Dent
Vice President

ATTEST:

_____
Secretary

GAF CORPORATION CORPORATE SEAL 1929 DELAWARE

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6/14/72

EXHIBIT A

Description of Property to be Conveyed
to Linden Chlorine Products, Inc.
by GAF Corporation
City of Linden, Union County, New Jersey

BEGINNING at the terminus of the Second Course of the Second Tract in a deed from Central Railroad Company of New Jersey to General Aniline & Film Corporation dated January 19, 1967, and recorded on January 20, 1967 in Deed Book 2794 on Page 745 in the Union County Register's Office; Thence

(1) North 58°-57'-30" East, seventeen feet (17.00) to a point;

Thence (2) North 31°-02'-30" West, three hundred ten feet and fifty eight one-hundredths of a foot (310.58) to a point;

Thence (3) North 28°-58'-40" West, eighty seven feet and seven one-hundredths of a foot (87.07) to a point of curve;

Thence (4) Curving to the right along a curve having a Radius of three hundred forty feet and ninety one one-hundredths of a foot (340.91) an arc distance of one hundred fifty three feet and twenty five one-hundredths of a foot (153.25) to a point of tangency;

Thence (5) North 3°-13'-20" West, sixty nine feet and thirty two one-hundredths of a foot (69.32) to a point;

Thence (6) Curving to the right along a curve having a Radius of one thousand four hundred seven feet and sixty nine one-hundredths of a foot (1,407.69) an arc distance of one hundred ninety five feet and seventy one one-hundredths of a foot (195.71) to a point;

Thence (7) North 75°-50'-28" East, two hundred nineteen feet and seventy four one-hundredths of a foot (219.74) to a point;

Thence (8) South 64°-52'-17" East, nine hundred eighty three feet and twelve one-hundredths of a foot (983.12) to a point in the Pierhead and Bulkhead line of the Arthur Kill;

Thence (9) North 2°-42'-17" West, along the said Pierhead and Bulkhead line of the Arthur Kill, eighty six feet and forty one-hundredths of a foot (86.40) to a point;

Thence (10) North 18°-11'-43" East, continuing along the said Pierhead and Bulkhead line of the Arthur Kill, forty three feet and ninety two one-hundredths of a foot (43.92) to a point;

Thence (11) North 64°-52'-17" West, six hundred five feet and twenty seven one-hundredths of a foot (605.27) to a point of curve;

Thence (12) Curving to the right along a curve having a Radius of two hundred fifty feet (250.00) an arc distance of one hundred ninety five feet and forty two one-hundredths of a foot (195.42) to a point of tangency;

Thence (13) North 20°-05' West, five hundred seventy five feet and one one-hundredth of a foot (575.01) to a point;

Thence (14) North 74°-55' West, two hundred six feet and nineteen one-hundredths of a foot (206.19) to a point;

Thence (15) North 15°-05' East, one hundred sixty four feet and forty one-hundredths of a foot (164.40) to a point;

Thence (16) North 74°-52' West, three hundred seventy two feet and ten one-hundredths of a foot (372.10) to a point;

Thence (17) North 15°-17' East, forty four feet and fifty nine one-hundredths of a foot (44.59) to a point;

Thence (18) North 74°-55' West, twenty seven feet and eighty four one-hundredths of a foot (27.84) to a point;

Thence (19) South 64°-23'-30" West, one hundred thirty three feet and twenty eight one-hundredths of a foot (133.28) to a point;

Thence (20) South 15°-46' West, one hundred three feet (103.00) to a point;

Thence (21) North 87°-03'-11" West, forty one feet and eighty nine one-hundredths of a foot (41.89) to a point;

Thence (22) North 75°-25' West, seventy five feet and fifty four one-hundredths of a foot (75.54) to a point;

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Thence (23) North 54°-36' West, one hundred seventeen feet and forty seven one-hundredths of a foot (117.47) to a point;

Thence (24) North 79°-38'-10" West, two hundred thirty three feet and eighty three one hundredths of a foot (233.83) to a point;

Thence (25) North 82°-00'-12" West, ninety four feet and sixty seven one-hundredths of a foot (94.67) to a point;

Thence (26) South 37°-56' West, three hundred feet (300.00) to a point in the Sixth Course of the First Tract in the recorded deed mentioned hereinbefore;

Thence (27) South 52°-18' East, along part of said Sixth Course in the recorded deed mentioned hereinbefore, seven hundred eighty two feet and forty two one-hundredths of a foot (782.42) to a point;

Thence (28) South 46°-03'10" East, along the Seventh Course in the recorded deed mentioned hereinbefore, five hundred twenty two feet and seventy seven one-hundredths of a foot (522.77) to a point;

Thence (29) South 31°-07'-30" East, three hundred twenty feet and sixty five one-hundredths of a foot (320.65) to a point;

Thence (30) South 58°-52'-30" West, two feet and ninety six one-hundredths of a foot (2.96) to a point;

Thence (31) South 31°-02'-30" East, five hundred thirty feet (530.00) to the point and place of BEGINNING.

8/16/72

EXHIBIT B

Reservation by Central Railroad of New Jersey of the right of ingress and egress in common with GAF Corporation and others, over a 24 foot wide driveway, in Deed Book 2356, Page 634, in Union County. Union Carbide and Carbon Corporation (Linde Division) has been granted a right to use said driveway.

Grant of easement to Elizabethtown Water Company, in Deed Book 2739, Page 990, and in Deed Book 2917, Page 226, in Union County, New Jersey.

Grant of easement to Elizabethtown Consolidated Gas Company in Deed Book 2608, Page 138, and in Deed Book 2611, Page 213, in Union County, New Jersey.

Grant of right of way and easement to City of Linden, in Deed Book 533, Page 233, Deed Book 533, Page 589, Deed Book 588, Page 499, and relocated in Deed Book 2681, Page 225, Deed Book 2924, Page 209, and Deed Book 2946, Page 162, in Union County, New Jersey.

Sidetrack agreements and the operating agreement between The Central Railroad Company of New Jersey and General Aniline & Film Corporation, in Deed Book 2795, Page 925.

The parties understand that sidetrack agreements and operating agreement or agreements are being prepared by The Railroad Company to cover railroad tracks on respective lands of parties.

Grant to Linden Roselle Sewerage Authority in Deed Book 1898, Page 168, in Union County, New Jersey.

Grants of rights of way to Elizabethtown Water Company for 12 inch water line along and east of former Sound Shore Railroad Company. (Not recorded.)

Grant to Union Carbide and Chemical Company of a right of way for a nitrogen pipeline, dated November 3, 1967, recorded January 2, 1968, in Deed Book 2821, Page 929.

Railroad License Agreement and Road Agreement in Deed Book 1847, Page 79, in Union County, New Jersey.

Rights granted to the Linden Roselle Sewerage Authority for a 24 inch force main and 30 inch storm sewer.

Agreements, dated January 17, 1956, April 6, 1970 and January 27, 1971, with Public Service Company of New Jersey relating to certain encroachments and for rights to install electric lines and to install road lighting on poles along the road and in the area of the substation.

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Lease agreement with Union Carbide & Carbon Corporation dated March 22, 1957 as amended and grant of easement rights to Union Carbide & Carbon Corporation for hydrogen, steam, brackish water, fresh water pipelines and sewer lines. (Not recorded.)

The rights, easements and rights of way granted pursuant to the Agreement of June 16, 1972 between the parties and to be executed at the Closing.

Easement Agreement with Central Railroad of New Jersey in Deed Book 2771, Page 858, in Union County.

Easement Agreement with Sinclair Refining Company in Deed Book 2802, Page 542, in Union County.

Assignment Agreement in Deed Book 2802, Page 839, in Union County.

Pipeline Easement in Deed Book 2821, Page 929, in Union County.

Grant to Elizabethtown Gas Company in Deed Book 2909, Page 697, in Union County.

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STATE OF NEW YORK)
) ss.:
COUNTY OF NEW YORK)

BE IT REMEMBERED, that on this 24th day of August, Nineteen hundred and seventy-two before me the subscriber, a Notary Public for said County and State, personally appeared T. A. DENT, who being by me duly sworn on his oath, says that he is a VICE PRESIDENT of GAF CORPORATION, the Grantor named in the foregoing instrument; that he well knows the corporate seal of said corporation; that the seal affixed to said instrument is the corporate seal of said corporation; that the foregoing instrument was signed and delivered by T. A. DENT who was at the date thereof a VICE PRESIDENT of said corporation, in the presence of this deponent, and said VICE PRESIDENT, at the same time acknowledged that he signed, sealed and delivered the same as his voluntary act and deed, and as the voluntary act and deed of said corporation, by virtue of authority from its Board of Directors, and that deponent, at the same time, subscribed his name to said instrument as an attesting witness to the execution thereof, and that the full and actual consideration paid or to be paid for the transfer of title to realty evidenced by the within deed, as such consideration as defined in P. L. 1968, c. 49, 1 (c) is $581,000.

SWORN AND SUBSCRIBED BEFORE ME
AT NEW YORK, NEW YORK THE DATE
AFORESAID.

Violet R. Roncace
Notary Public

VIOLET R. RONCACE
NOTARY PUBLIC, State of New York
No. 03-8632830
Qualified in Bronx County
Certificate filed in New York County
Commission Expires March 30, 1974

This instrument prepared by
Edward S. Menapace, 140 West 51 Street,
New York, New York 10020

VIOLET R. RONCACE • NOTARY PUBLIC • STATE OF NEW YORK

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END OF DOCUMENT

Exhibit B

104—DEED - BARGAIN AND SALE (COVENANT AGAINST GRANTOR) CORP. TO IND. OR CORP. GRVST COPYRIGHTD 1966 BY ALL-STATE LEGAL SUPPLY CO. 269 SHEFFIELD STREET, MOUNTAINSIDE, N.J. 07092

10110

This Deed, *made the* 14 *day of* December 1979,

Between LINDEN CHEMICALS & PLASTICS, INC. (formerly Linden Chlorine Products, Inc.),

a corporation existing under and by virtue of the laws of the State of Delaware, *having its principal office at* 14 Commerce Drive *in the* Township *of* Cranford *in the County of* Union *and State of* New Jersey *herein designated as the Grantor,*

And

LCP CHEMICALS--NEW JERSEY, INC., a Delaware Corporation

residing or located at 14 Commerce Drive *in the* Township *of* Cranford *in the County of* Union *and State of* New Jersey *herein designated as the Grantees;*

Witnesseth, *that the Grantor, for and in consideration of* FIVE HUNDRED NINETEEN THOUSAND FOUR HUNDRED SIXTY NINE ($519,469.00)----------DOLLARS

lawful money of the United States of America, to it in hand well and truly paid by the Grantees, at or before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, and the Grantor being therewith fully satisfied, does by these presents grant, bargain, sell and convey unto the Grantees forever,

All that certain *tract or parcel of land and premises, situate, lying and being in the* City *of* Linden *in the County of* Union *and State of New Jersey, more particularly described as follows:*

SEE SCHEDULE "A" ATTACHED.

L43
BLK 587
FM 712 C

COUNTY OF UNION
CONSIDERATION 519,469.
REALTY TRANSFER FEE 1818.25
DATE 12-14-79 BY 68

712 C

RECEIVED & RECORDED
UNION COUNTY, N.J.
Dec 14 11 01 AM '79
BOOK 3207 PAGE 82
Richard P. Nagel
REGISTER

SCHEDULE A

BEGINNING at the terminus of the Second Course of the Second Tract in a deed from Central Railroad Company of New Jersey to General Aniline & Film Corporation dated January 19, 1967, and recorded on January 20, 1967 in Deed Book 2794 on Page 745 in the Union County Register's Office;

Thence (1) North 58°-57'-30" East, seventeen feet (17.00) to a point;

Thence (2) North 31°-02'-30" West, three hundred ten feet and fifty eight one-hundredths of a foot (310.58) to a point;

Thence (3) North 28°-58'-40" West, eighty seven feet and seven one-hundredths of a foot (87.07) to a point of curve;

Thence (4) Curving to the right along a curve having a Radius of three hundred forty feet and ninety one one-hundredths of a foot (340.91) an arc distance of one hundred fifty three feet and twenty five one-hundredths of a foot (153.25) to a point of tangency;

Thence (5) North 3°-13'-20" West, sixty nine feet and thirty two one-hundredths of a foot (69.32) to a point;

Thence (6) Curving to the right along a curve having a Radius of one thousand four hundred seven feet and sixty nine one-hundredths of a foot (1,407.69) an arc distance of one hundred

ninety five feet and seventy one one-hundredths of a foot (195.71) to a point;

Thence (7) North 75°-50'-28" East, two hundred nineteen feet and seventy four one-hundredths of a foot (219.74) to a point;

Thence (8) South 64°-52'-17" East, nine hundred eighty three feet and twelve one-hundredths of a foot (983.12) to a point in the Pierhead and Bulkhead line of the Arthur Kill;

Thence (9) North 2°-42'-17" West, along the said Pierhead and Bulkhead line of the Arthur Kill, eighty six feet and forty one-hundredths of a foot (86.40) to a point;

Thence (10) North 18°-11'-43" East, continuing along the said Pierhead and Bulkhead line of the Arthur Kill, forty three feet and ninety two one-hundredths of a foot (43.92) to a point;

Thence (11) North 64°-52'-17" West, six hundred five feet and twenty seven one-hundredths of a foot (605.27) to a point of curve;

Thence (12) Curving on the right along a curve having a Radius of two hundred fifty feet (250.00) an arc distance of one hundred ninety five feet and forty two one-hundredths of a foot (195.42) to a point of tangency;

Thence (13) North 20°-05' West, five hundred seventy five feet and one one-hundredths of a foot (575.01) to a point;

Thence (14) North 74°-55' West, two hundred six feet and nineteen one-hundredths of a foot (206.19) to a point;

Thence (15) North 15°-05' East, one hundred sixty four feet and forty one-hundredths of a foot (164.40) to a point;

Thence (16) North 74°-52' West, two hundred thirty four feet (234.00) to a point;

Thence (17) South 15°-08' West, two hundred sixty five feet (265.00) to a point;

Thence (18) North 74°-52' West, eighty six feet and seventy three one-hundredths of a foot (86.73) to a point;

Thence (19) South 69°-17'-40" West, forty three feet and twenty eight one-hundredths of a foot (43.28) to a point;

Thence (20) North 74°-52' West, twenty nine feet and two one-hundredths to a foot (29.02) to a point;

Thence (21) North 15°-08' East, one hundred twenty six feet and forty seven one-hundredths of a foot (126.47) to a point;

Thence (22) South 74°-51' East, twelve feet (12.00) to a point;

Thence (23) North 15°-08' East, twenty seven feet and ninety two one-hundredths of a foot (27.92) to a point;

Thence (24) North 74°-52' West, twelve feet (12.00) to a

point;

Thence (25) North 15°-08' East, eighty eight feet and seventy two one-hundredths of a foot (88.72) to a point;

Thence (26) South 74°-52' East, six feet (6.00) to a point in the Sixth Course of the First Tract in the recorded deed mentioned hereinbefore;

Thence (27) North 15°-08' East, along part of said Sixth Course in the recorded deed mentioned hereinbefore, ninety one feet and eighty one one-hundredths of a foot (91.81) to a point;

Thence (28) North 74°-55' West, along the Seventh Course in the recorded deed mentioned hereinbefore, twenty feet and ninety nine one-hundredths of a foot (20.99) to a monument found;

Thence (29) South 64°-23'-30" West, two feet and seventy one-hundredths of a foot (2.70) to a point;

Thence (30) South 15°-09' West, ninety feet and twenty five one-hundredths of a foot (90.25) to a point;

Thence (31) South 74°-51' East three feet (3.00) to a point;

Thence (32) South 15°-09'-00" West, eighty feet and seventy one one-hundredths of a foot (80.71) to a point;

Thence (33) North 74°-51' West thirteen feet (13.00) to a point;

Thence (34) South 15°-09' West, twenty feet and fifty nine

one-hundredths of a foot (20.59) to a point;

Thence (35) South 74°-51' East, thirteen feet (13.00) to a point;

Thence (36) South 15°-09' West, seventy two feet and ninety seven one-hundredths of a foot (72.97) to a point;

Thence (37) North 74°-51' West ten feet (10.00) to a point;

Thence (38) South 15°-09' West, fifteen feet and sixty six one-hundredths of a foot (15.66) to a point;

Thence (39) South 74°-51' East ten feet (10.00) to a point;

Thence (40) South 15°-09' West, fifty two feet and ninety six one-hundredths of a foot (52.96) to a point;

Thence (41) North 74°-52' West seventy nine feet and sixty one one-hundredths of a foot (79.61) to a point;

Thence (42) North 00°-06' East, twenty four feet and six one-hundredths of a foot (24.06) to a point;

Thence (43) North 51°-52' West, forty two feet and twelve one-hundredths of a foot (42.12) to a point;

Thence (44) North 36°-58'-40" East, twenty one feet and eighty one-hundredths of a foot (21.80) to a point;

Thence (45) North 29°-02'-05" East, sixty one feet and thirty five one-hundredths of a foot (61.35) to a point;

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Thence (46) North 15°-46' East, twenty six feet and seventy four one-hundredths of a foot (26.74) to a concrete monument;

Thence (47) North 86°-32'-41" West, forty three feet and forty one one-hundredths of a foot (43.41) to a point;

Thence (48) North 75°-25' West, seventy five feet and fifty four one-hundredths of a foot (75.54) to a point;

Thence (49) North 54°-56' West, one hundred seventeen feet and forty seven one-hundredths of a foot (117.47) to a point;

Thence (50) North 79°-38'-10" West, two hundred thirty three feet and eighty three one-hundredths of a foot (233.83) to a point;

Thence (51) North 82°-00'-12" West, ninety four feet and sixty seven one-hundredths of a foot (94.67) to a point;

Thence (52) South 37°-56' West, three hundred feet (300.00) to a point in the Sixth Course of the First Tract in the recorded deed mentioned hereinbefore;

Thence (53) South 52°-18' East, along part of said Sixth Course in the recorded deed mentioned hereinbefore, seven hundred eighty two feet and forty two one-hundredths of a foot (782.42) to a point;

Thence (54) South 46°-3'-10" East, along the Seventh Course in the recorded deed mentioned hereinbefore, five hundred twenty two feet and seventy seven one-hundredths of a foot (522.77) to a point;

Thence (55) South 31°-07'-30" East, three hundred twenty feet and sixty five one-hundredths of a foot (320.65) to a point;

Thence (56) South 58°-52'-30" West, two feet and ninety six one-hundredths of a foot (2.96) to a point;

Thence (57) South 31°-02'-30" East, five hundred thirty feet (530.00) to the point and place of BEGINNING.

The above described tract contains 24.22 acres.

BEING known and designated as Tax Lot 3.01 in Block 587 as shown on the Tax Map of the City of Linden.

The foregoing description is in accordance with that certain Resubdivision Map of Lot 3 in Block 587 of the Tax Map of the City of Linden, Union County, New Jersey, into three lots prepared by Grassmann, Kreh and Mixer, Surveyors, of Union, New Jersey, which subdivision Map was recorded June 16, 1977 in the Office of the Register of Union County as Map No. 712-C and is also in accordance with the survey also prepared by Grassmann, Kreh and Mixer, dated February 15, 1972, revised to April 4, 1973.

SUBJECT to all easements and rights-of-way agreements, license and road agreements, and other leases or agreements of record, riparian rights, rights public and private, if any, and paramount rights of the United

States of America respecting any portion, if any, of the subject premises lying waterward or easterly of the high water mark of the Arthur Kill.

EX 3207 90

Together *with all and singular the buildings, improvements, ways, woods, waters, watercourses, rights, liberties, privileges, hereditaments and appurtenances to the same belonging or in anywise appertaining; and the reversion and reversions, remainder and remainders, rents, issues and profits thereof, and of every part and parcel thereof;* **And also** *all the estate, right, title, interest, use, possession, property, claim and demand whatsoever, of the Grantor both in law and in equity, of, in and to the premises herein described, and every part and parcel thereof, with the appurtenances.* **To Have and to Hold** *all and singular, the premises herein described, together with the appurtenances, unto the Grantees and to Grantees' proper use and benefit forever.*

And *the Grantor covenants that it has not done or executed, or knowingly suffered to be done or executed, any act, deed or thing whatsoever whereby or by means whereof the premises conveyed herein, or any part thereof, now are or at any time hereafter, will or may be charged or encumbered in any manner or way whatsoever.*

In all references herein to any parties, persons, entities or corporations, the use of any particular gender or the plural or singular number is intended to include the appropriate gender or number as the text of the within instrument may require.

Wherever in this instrument any party shall be designated or referred to by name or general reference, such designation is intended to and shall have the same effect as if the words "heirs, executors, administrators, personal or legal representatives, successors and assigns" had been inserted after each and every such designation.

In Witness Whereof, *the Grantor has caused these presents to be signed and attested by its proper corporate officers and its corporate seal to be hereto affixed the day and year first above written.*

LINDEN CHEMICALS & PLASTICS, INC.

ATTEST:

John Kandravy *Secretary* — By: C. A. Hansen, Jr. *President*

State of New Jersey, County of Essex } ss.: **Be it Remembered,** *that on* December 14th, 19 79, *before me, the subscriber,* a Notary Public of the State of New Jersey *personally appeared* John Kandravy

who, being by me duly sworn on his *oath, deposes and makes proof to my satisfaction, that he is the* Secretary *of* Linden Chemicals & Plastics, Inc. *the Corporation named in the within Instrument; that* C.A. Hansen, Jr. *is the President of said Corporation; that the execution, as well as the making of this Instrument, has been duly authorized by a proper resolution of the Board of Directors of the said Corporation; that deponent well knows the corporate seal of said Corporation; and that the seal affixed to said Instrument is the proper corporate seal and was thereto affixed and said Instrument signed and delivered by said President as and for the voluntary act and deed of said Corporation in presence of deponent, who thereupon subscribed* his *name thereto as attesting witness; and that the full and actual consideration paid or to be paid for the transfer of title to realty evidenced by the within deed, as such consideration is defined in P.L. 1968, c. 49, Sec. 1(c), is* $ 519,469.00.

Sworn to and subscribed before me, the date aforesaid.

Mae S. Barbiere — John Kandravy

Notary Public of New Jersey — JOHN KANDRAVY

MAE S. BARBIERE
A Notary Public of New Jersey
My Commission Expires Mar. 21, 1982

Prepared by: James H. Freis, Esq.

END OF DOCUMENT

#3207- 92

101.10

Deed

LINDEN CHEMICALS & PLASTICS, INC.
(Formerly Linden Chlorine Products, Inc.)

A corporation of
the State of Delaware

TO

LCP CHEMICALS--NEW JERSEY, INC.

Dated December 14th, 19 79

[redacted] Return to:

James H. Freis, Esq.
Shanley & Fisher
550 Broad Street
Newark, New Jersey 07102

1818.25 17.25 M.

104—DEED - BARGAIN AND SALE (COVENANT AGAINST GRANTOR) CORP. TO IND. OR CORP. G R V S T COPYRIGHTED 1966 BY ALL-STATE LEGAL SUPPLY CO. 269 SHEFFIELD STREET, MOUNTAINSIDE, N.J. 07092

58

101-11

This Deed, *made the* 14th *day of* December 19 79

RECEIVED & RECORDED DEC 14 1979 UNION COUNTY, N.J. 3207-93 03 PM '79 Richard P. Hardin

Between LINDEN CHEMICALS & PLASTICS, INC. (formerly Linden Chlorine Products, Inc.),

a corporation existing under and by virtue of the laws of the State of Delaware, *having its principal office at* 14 Commerce Drive *in the* Township *of* Cranford *in the County of* Union *and State of* New Jersey, *herein designated as the Grantor,*

And LCP CHEMICALS--NEW JERSEY, INC., a Delaware Corporation,

~~XXXXXXXX~~ *located at* 14 Commerce Drive *in the* Township *of* Cranford *in the County of* Union *and State of* New Jersey *herein designated as the Grantees;*

Witnesseth, *that the Grantor, for and in consideration of* TWENTY THOUSAND ONE HUNDRED AND SIXTY ONE ($20,161.00)----------DOLLARS

lawful money of the United States of America, to it in hand well and truly paid by the Grantees, at or before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, and the Grantor being therewith fully satisfied, does by these presents grant, bargain, sell and convey unto the Grantees forever,

All that/ certain *tract or parcel of land and premises, situate, lying and being in the* City *of* Linden *in the County of* Union *and State of New Jersey, more particularly described as follows:*

BEGINNING at an iron pipe in the fence line between the lands of Linden Chemicals & Plastics, Inc. (formerly Linden Chlorine Products, Inc.) and GAF Corporation said iron pipe being located South 74°52'00" west, 234.00 feet from a monument in the northwesterly side line of the 50-foot right-of-way of the Sound Shore Branch of the Central Railroad of New Jersey, and proceeding, thence;

1. Northwest 74°52'00" west, 138.10 feet to a concrete monument, said monument being the 16th course of the metes and bounds description of a survey, schedule "A" made by Grassmann, Kreh and Mixer, Inc., Engineers and Surveyors, 1034 Salem Road, Union, New Jersey, February 15, 1972, continued to April 4, 1973, and being a portion of a tract and a certain deed of conveyance from the Central Railroad of New Jersey to General Aniline and Film Corporation, dated June 19, 1967, in the Register's Office of Union County, New Jersey, June 20, 1967 in Deed Book No. 2794, Page 745, thence;

2. North 15°17'00" East, 44.59 feet to a concrete monument, thence;

3. North 74°55'00" West 6.85 feet to a point, thence;

4. Paralleling the railroad siding, South 15°08'00" West, 91.81 feet to a point, thence;

5. North 74°52'00" West 6.00 feet to a point, thence;

6. Paralleling the railroad siding, South 15°08'00" West, 88.72 feet to a point, thence;

7. South 74°52'00" East 12.00 feet to a point, thence;

8. Paralleling the railroad siding, South 15°08'00" West, 27.92 feet to a point, thence;

9. North 74°51'00" West 12.00 feet to a point, thence;

COUNTY OF UNION
CONSIDERATION 20,161.-
REALTY TRANSFER FEE 71.75
DATE 12-14-79 BY SH

10. Paralleling the railroad siding, South 15°08'00" West, 126.47 feet to a point, thence;

11. South 74°52'00" East 29.02 feet to a point, thence;

12. North 69°17'40" East, 43.28 feet to a point, thence;

13. South 74°52'00" East, 86.73 feet to a point, thence;

14. Paralleling the right-of-way of the lands of Sound Shore Branch of the Central Railroad of New Jersey, North 15°08'00" East, 265.00 feet to the point and place of BEGINNING.

The above-described tract includes .94 acres.

Being known and designated as Tax Lot 3.03 in Block 587 as shown on the Tax Map of the City of Linden.

The foregoing description is made in accordance with that certain Resubdivision Map of Lot 3 in Block 587 of the Tax Map of the City of Linden, Union County, New Jersey, into three lots prepared by Grassmann, Kreh and Mixer, Surveyors, of Union, New Jersey, which Subdivision Map was recorded on June 16, 1977 in the office of the Register of Union County as Map No. 712-C.

Being part of those premises described in the Deed dated August 24, 1972 from GAF Corporation, a Delaware Corporation, to Linden Chlorine Products, Inc., a Delaware Corporation and the Grantor named herein, which Deed was recorded August 25, 1972 in Book 2954, at Page 273 in the Office of the Register, Union County, New Jersey.

Subject to easements, rights-of-way, restrictions, and aggreements of record.

Together *with all and singular the buildings, improvements, ways, woods, waters, watercourses, rights, liberties, privileges, hereditaments and appurtenances to the same belonging or in anywise appertaining; and the reversion and reversions, remainder and remainders, rents, issues and profits thereof, and of every part and parcel thereof;* **And also** *all the estate, right, title, interest, use, possession, property, claim and demand whatsoever, of the Grantor both in law and in equity, of, in and to the premises herein described, and every part and parcel thereof, with the appurtenances.* **To Have and to Hold** *all and singular, the premises herein described, together with the appurtenances, unto the Grantees and to Grantees' proper use and benefit forever.*

And *the Grantor covenants that it has not done or executed, or knowingly suffered to be done or executed, any act, deed or thing whatsoever whereby or by means whereof the premises conveyed herein, or any part thereof, now are or at any time hereafter, will or may be charged or encumbered in any manner or way whatsoever.*

In all references herein to any parties, persons, entities or corporations, the use of any particular gender or the plural or singular number is intended to include the appropriate gender or number as the text of the within instrument may require.

Wherever in this instrument any party shall be designated or referred to by name or general reference, such designation is intended to and shall have the same effect as if the words "heirs, executors, administrators, personal or legal representatives, successors and assigns" had been inserted after each and every such designation.

In Witness Whereof, *the Grantor has caused these presents to be signed and attested by its proper corporate officers and its corporate seal to be hereto affixed the day and year first above written.*

ATTEST:

LINDEN CHEMICALS & PLASTICS, INC.

John Kandravy, *Secretary*

By: C. A. Hansen, Jr., *President*

State of New Jersey, County of Essex | **ss.:** **Be it Remembered,** *that on* December 14th, 19 79, *before me, the subscriber,* a Notary Public of the State of New Jersey *personally appeared* John Kandravy

who, being by me duly sworn on h is *oath, deposes and makes proof to my satisfaction, that he is the* Secretary *of* Linden Chemicals & Plastics, Inc. *the Corporation named in the within Instrument; that* C. A. Hansen, Jr. *is the President of said Corporation; that the execution, as well as the making of this Instrument, has been duly authorized by a proper resolution of the Board of Directors of the said Corporation; that deponent well knows the corporate seal of said Corporation; and that the seal affixed to said Instrument is the proper corporate seal and was thereto affixed and said Instrument signed and delivered by said President as and for the voluntary act and deed of said Corporation, in presence of deponent, who thereupon subscribed h name thereto as attesting witness; and that the full and actual consideration paid or to be paid for the transfer of title to realty evidenced by the within deed, as such consideration is defined in P.L. 1968, c. 49, Sec. 1(c), is* $ 20,161.00.

Sworn to and subscribed before me, the date aforesaid.

Mae S. Barbiere

Notary Public of New Jersey

John Kandravy

MAE S. BARBIERE
A Notary Public of New Jersey
My Commission Expires Mar. 31, 1982

Prepared by: James H. Frels, Esq.

101.11

Deed

LINDEN CHEMICALS & PLASTICS, INC. (Formerly Linden Chlorine Products, Inc.)

A corporation of

the State of Delaware

TO

LCP CHEMICALS-NEW JERSEY, INC.

Dated December 14th, *19* 79

~~Prepared by~~ Return to:

James H. Freis, Esq.
Shanley & Fisher
550 Broad Street
Newark, New Jersey 07102

71.75 10,250A

END OF DOCUMENT

#3207 96

104—DEED - BARGAIN AND SALE (COVENANT AGAINST GRANTOR) CORP. TO IND. OR CORP. GRVST COPYRIGHTD 1966 BY ALL-STATE LEGAL SUPPLY CO. 269 SHEFFIELD STREET, MOUNTAINSIDE, N.J. 07092

10112

This Deed, made the 14th day of December 1979,

Between LINDEN CHEMICALS & PLASTICS, INC. (formerly Linden Chlorine Products, Inc.),

a corporation existing under and by virtue of the laws of the State of *having its principal office at* 14 Commerce Drive *in the* Township of Cranford Union *and State of* New Jersey *in the County of* *herein designated as the Grantor,*

And LCP CHEMICALS--NEW JERSEY, INC., a Delaware Corporation,

residing or located at 14 Commerce Drive *in the* Township of Cranford Union *and State of* New Jersey *in the County of* *herein designated as the Grantees;*

Witnesseth, *that the Grantor, for and in consideration of* FOURTEEN THOUSAND THREE HUNDRED AND SEVENTY ($14,370.00)----------DOLLARS

lawful money of the United States of America, to it in hand well and truly paid by the Grantees, at or before the sealing and delivery of these presents, the receipt whereof is hereby acknowledged, and the Grantor being therewith fully satisfied, does by these presents grant, bargain, sell and convey unto the Grantees forever,

All that certain *tract or parcel of land and premises, situate, lying and being in the* City of Linden *County of* Union *and State of New Jersey, more particularly described as follows:*

BEGINNING at a point being south 64°23"30' West, 2.70 feet distant from a concrete monument, said monument being the 19th course of a metes and bounds description of a survey, schedule "A", made by Grassmann, Kreh and Mixer, Inc., Engineers and Surveyors, 1034 Salem Road, Union, New Jersey, dated February 15, 1972, continued to April 4, 1973, also being a portion of a tract in a certain deed of conveyance from the Central Railroad Company of New Jersey to General Aniline and Film Corporation dated June 19, 1967, in the Register's Office of Union County, New Jersey, June 20, 1967, in deed book 2794, Page 745, thence;

1. South 64°23'30" West, 128.60 feet to a concrete monument, thence;
2. South 15°46'00" West, 103.00 feet to a concrete monument, thence;
3. Continuing South 15°46'00" West, 26.74 feet to a point, thence;
4. South 29°02'05" West, 61.35 feet to a point, thence;
5. South 36°58'40" West, 21.80 feet to a point, thence;
6. South 51°52'00" East, 42.12 feet to a point, thence;
7. South 00°06'00" West, 24.06 feet to an iron pipe, thence;
8. South 74°52'00" East, 79.61 feet to a point, thence;
9. Paralleling the railroad siding, North 15°09'00" East, 52.96 feet to a point, thence;
10. North 74°51'00" West, 10.00 feet to a point, thence;
11. Paralleling the railroad siding, North 15°09'00" East, 15.66 feet to a point, thence;
12. South 74°51'00" East, 10.00 feet to a point, thence;
13. Paralleling the railroad siding, North 15°09'00" East, 72.97 feet to a point, thence;

COUNTY OF UNION
CONSIDERATION 14,370
REALTY TRANSFER FEE 56.75
DATE 12-10-79 BY

14. North 74°51'00" West, 13.00 feet to a point, thence;

15. Paralleling the railroad siding, North 15°09'00" East, 20.59 feet to a point, thence;

16. South 74°51'00" East, 13.00 feet to a point, thence;

17. Paralleling the railroad right-of-way, North 15°09'00" East, 80.71 feet to a point, thence;

18. North 74°51'00" West, 3.00 feet to a point, thence;

19. Paralleling the railroad siding, North 15°09'00" East, 90.25 feet to the point and place of BEGINNING.

The above-described tract contains .67 acres.

Being known and designated as Tax Lot 3.02 in Block 587 as shown on the Tax Map of the City of Linden.

The foregoing description is made in accordance with that certain Resubdivision Map of Lot 3 in Block 587 of the Tax Map of the City of Linden, Union County, New Jersey, into three lots prepared by Grassman, Kreh and Mixer, Surveyors, of Union, New Jersey, which Subdivision Map was recorded on June 16, 1977 in the Office of the Register of Union County as Map No. 712-C.

Being part of those premises described in the Deed dated August 24, 1972 from GAF Corporation, a Delaware Corporation, to Linden Chlorine Products, Inc., a Delaware Corporation and the Grantor named herein, which Deed was recorded August 25, 1972 in Book 2954, at Page 273 in the Office of the Register, Union County, New Jersey.

SUBJECT to easements, rights-of way, restrictions, and agreements of record.

Together with all and singular the buildings, improvements, ways, woods, waters, watercourses, rights, liberties, privileges, hereditaments and appurtenances to the same belonging or in anywise appertaining; and the reversion and reversions, remainder and remainders, rents, issues and profits thereof, and of every part and parcel thereof; **And also** all the estate, right, title, interest, use, possession, property, claim and demand whatsoever, of the Grantor both in law and in equity, of, in and to the premises herein described, and every part and parcel thereof, with the appurtenances. **To Have and to Hold** all and singular, the premises herein described, together with the appurtenances, unto the Grantees and to Grantees' proper use and benefit forever.

And the Grantor covenants that it has not done or executed, or knowingly suffered to be done or executed, any act, deed or thing whatsoever whereby or by means whereof the premises conveyed herein, or any part thereof, now are or at any time hereafter, will or may be charged or encumbered in any manner or way whatsoever.

In all references herein to any parties, persons, entities or corporations, the use of any particular gender or the plural or singular number is intended to include the appropriate gender or number as the text of the within instrument may require.

Wherever in this instrument any party shall be designated or referred to by name or general reference, such designation is intended to and shall have the same effect as if the words "heirs, executors, administrators, personal or legal representatives, successors and assigns" had been inserted after each and every such designation.

In Witness Whereof, the Grantor has caused these presents to be signed and attested by its proper corporate officers and its corporate seal to be hereto affixed the day and year first above written.

ATTEST:

LINDEN CHEMICALS & PLASTICS, INC.

John Kandravy — Secretary

By: C. A. Hansen, Jr. — President

State of New Jersey, County of Essex } ss.: **Be it Remembered,** that on December 14th, 1979, before me, the subscriber, a Notary Public of the State of New Jersey personally appeared John Kandravy

who, being by me duly sworn on h oath, deposes and makes proof to my satisfaction, that he is the Secretary of Linden Chemicals & Plastics, Inc. the Corporation named in the within Instrument; that C. A. Hansen, Jr. is the President of said Corporation; that the execution, as well as the making of this Instrument, has been duly authorized by a proper resolution of the Board of Directors of the said Corporation; that deponent well knows the corporate seal of said Corporation; and that the seal affixed to said Instrument is the proper corporate seal and was thereto affixed and said Instrument signed and delivered by said President as and for the voluntary act and deed of said Corporation, in presence of deponent, who thereupon subscribed h name thereto as attesting witness; and that the full and actual consideration paid or to be paid for the transfer of title to realty evidenced by the within deed, as such consideration is defined in P.L. 1968, c. 49, Sec. 1(c), is $ 14,370.00.

Sworn to and subscribed before me, the date aforesaid.

Mae S. Barbiere — Notary Public of New Jersey

MAE S. BARBIERE
A Notary Public of New Jersey
My Commission Expires Mar. 21, 1982

John Kandravy — JOHN KANDRAVY

Prepared by: James H. Preis, Esq.

3207-- 99

101-12

Deed

LINDEN CHEMICALS & PLASTICS, INC.
(Formerly Linden Chlorine Products, Inc.)
A corporation of

the State of Delaware

TO

LCP CHEMICALS--NEW JERSEY, INC.

Dated December 14th, 19 79

~~XXXXXXXXXXXX~~ Return to:
James H. Freis, Esq.
Shanley & Fisher
550 Broad Street
Newark, New Jersey 07102

56.75

10.25

END OF DOCUMENT

#3207 100

Exhibit C

State of Delaware

Office of Secretary of State

I, MICHAEL HARKINS, SECRETARY OF STATE OF THE STATE OF DELAWARE DO HEREBY CERTIFY THE ATTACHED IS A TRUE AND CORRECT COPY OF THE CERTIFICATE OF AMENDMENT OF LCP CHEMICALS & PLASTICS, INC. FILED IN THIS OFFICE ON THE FIFTH DAY OF JANUARY, A.D. 1988, AT 10 O'CLOCK A.M.

: : : : : : : : : :

DEPARTMENT OF STATE
OFFICE OF THE SECRETARY OF STATE
1897 '93 1970
DELAWARE

729264044

Michael Harkins, Secretary of State

AUTHENTICATION: 12345564

DATE: 09/21/1989

11/5/55

CERTIFICATE OF AMENDMENT OF RESTATED CERTIFICATE OF INCORPORATION OF LCP CHEMICALS & PLASTICS, INC.

LCP Chemicals & Plastics, Inc., a corporation organized and existing under and by virtue of the General Corporation Law of the State of Delaware, does hereby certify:

FIRST: That at a meeting of the Board of Directors of LCP Chemicals & Plastics, Inc., resolutions were duly adopted setting forth a proposed Amendment to the Restated Certificate of Incorporation of said Corporation, declaring the said Amendment to be advisable and directing that the proposed Amendment be submitted to the shareholders of said Corporation for consideration thereof. The resolutions setting forth the proposed Amendment are as follows:

> RESOLVED, that the Restated Certificate of Incorporation of the Corporation be amended by changing the Article numbered "1", so that, as amended, said Article shall read as follows:
>
> **"The name of the Corporation is HANLIN GROUP, INC."**
>
> FURTHER RESOLVED, that the above proposed Amendment be submitted to the stockholders for their approval as required by law.
>
> FURTHER RESOLVED, that upon approval of the above proposed Amendment by the stockholders of the Corporation, the proper officers of this Corporation be and they are hereby authorized and directed to file the necessary Certificate effecting said Amendment with the Secretary of State of the State of Delaware and to cause a copy thereof, certified by said Secretary of State, to be recorded with the Recorder of Deeds of New Castle County, Delaware, and also to file the necessary documents if any, concerning said

Amendment with the appropriate filing officers in all jurisdictions where the Corporation has heretofore qualified to do business as a foreign corporation.

SECOND: In lieu of a meeting and vote of stockholders, stockholders owning not less than a majority of the outstanding capital stock entitled to vote have given written consent to said Amendment in accordance with the provisions of Section 228 of the General Corporation Law of the State of Delaware, and written notice of the adoption of the Amendment has been given as provided in Section 228 of the General Corporation Law of the State of Delaware to every stockholder entitled to such notice.

THIRD: That said Amendment was duly adopted in accordance with the provisions of Section 242 of the General Corporation Law of the State of Delaware.

FOURTH: That the capital of said Corporation shall not be reduced by reason of the said Amendment.

IN WITNESS WHEREOF, LCP Chemicals & Plastics, Inc. has caused its corporate seal to be hereunto affixed and this Certificate to be signed by its Chairman of the Board and attested by its Secretary, this 22 day of December, 1987.

LCP CHEMICALS & PLASTICS, INC.

ATTEST:

John Kandravy, Secretary

By: C. A. Hansen, Jr.
Chairman of the Board

Exhibit D

R+R:
Cherokee Group
133 Maple Avenue
Red Bank, NJ 07701

Deed

Prepared by:
Jay Wolfkind

This **Quitclaim** Deed is made on September 19, 2013,

BETWEEN

LCP Chemicals - New Jersey, Inc. f/k/a **LCP Chemicals & Plastics, Inc.**, PO Box 484, Linden NJ, division(s) of **The Hanlin Group, Inc.**, a Delaware corporation, whose last corporate address was 3100 Woodbridge Ave, Edison NJ, referred to as "GRANTOR" or "LCP";

AND

Cherokee LCP Land, LLC, a New Jersey Limited Liability Company, whose address is 133 Maple Ave, Red Bank, New Jersey 07701, referred to as "GRANTEE" or "CHEROKEE".

Transfer of Ownership. LCP grants and conveys the Subject Properties described herein to CHEROKEE. This transfer is made for the sum of One (**$1.00**) Dollar and other consideration, the receipt and sufficiency of which LCP acknowledges.

Tax Map Reference. (N.J.S.A. 46:15-1.1) Linden City, Tax Block 587, Lots 3.01, 3.02 and 3.03

Property. The Subject Properties consist of the land, buildings, improvements and contents in **Linden** City, **Union** County, New Jersey, Block **587**, Lots **3.01, 3.02** and **3.03** (a/k/a 3.1, 3.2 and 3.3)

BEING COMMONLY known and designated as **Foot of Wood Avenue South** and **Between GAF & LCP**, in **Linden**, New Jersey.

BEING the same premises conveyed to the GRANTOR by deeds recorded Dec. 14, 1979 in Union County Deed **Book 3207**, pg **82** (Lot 3.01/3.1), pg **93** (Lot 3.03/3.3) and pg **97** (Lot 3.02/3.2).

Quit Claim. This Deed is called a **Quit Claim** Deed. LCP makes **no** promises and **no** representations as to ownership, title, occupancy, or condition except as expressly stated herein. LCP simply transfers whatever interest LCP may have to CHEROKEE, absolutely "**as is**".

Winding Up Corporate Affairs. This transfer is made pursuant to N.J.S.A. 14A:12-9, as part of the winding up of the corporation's affairs. LCP makes this deed to cooperate with and facilitate the remediation and reuse of the Subject Properties.

CHEROKEE GROUP
133 MAPLE AVENUE
RED BANK
NJ 07701
Deed
Recording Fee 83.00
RT Fee .00
Paid
Inst.# 245946

James F. Mathis

James F. Mathis,
the last Acting CEO / Board Chairperson
The Hanlin Group, Inc.

STATE OF TEXAS
COUNTY OF HARRIS:

I CERTIFY that on this 24th day of October, 2013, **James F. Mathis** personally came before me and stated to my satisfaction, that he is:

(a) The maker(s) of this Quitclaim Deed;
(b) Executed this Quitclaim Deed on behalf of the GRANTOR, pursuant to N.J.S.A. 14A:12-9; AUTHORIZED
(c) Made this Quitclaim Deed for the full and actual consideration paid, or to be paid, for the transfer of title. (Such consideration is defined in N.J.S.A. 46:15-5.); and
(d) Executed this Quitclaim Deed voluntarily and without duress.

NOTARY PUBLIC STATE OF TEXAS
ROYCELYNN ANN WEBB
My Commission Expires
August 9, 2016

Roycelynn Ann Webb

Received & Recorded
Union County, NJ
10/29/2013 10:55
Joanne Rajoppi
County Clerk
Operator
AZYDZIK

Deed-1
Inst# **245946**
Pgs-3
Consider. 1.00
RT Fee .00

DB5978-0078

Exhibit E

RECORD OF DECISION

LCP Chemicals Inc, Superfund Site,

Linden, Union County, New Jersey

United States Environmental Protection Agency

Region 2

February 2014

241403

DECLARATION STATEMENT

RECORD OF DECISION

SITE NAME AND LOCATION

LCP Chemicals, Inc., Superfund Site (EPA ID# NJD079303020)
Linden, Union County, New Jersey

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedy to address contamination in groundwater, soil, sediments and building material at the LCP Chemicals, Inc., Superfund Site (Site), in Linden, Union County, New Jersey. The selected remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record established for this Site.

The State of New Jersey New Jersey Department of Environmental Protection (NJDEP) concurs with the components of the selected remedy. However, NJDEP does not concur with the contingency remedies for treating elemental mercury as discussed further below. NJDEP believes the contingency remedy should be excavation and off-site removal of the principal threat waste (PTW). In addition, NJDEP believes that the existing data on contamination in Arthur Kill sediments is insufficient to determine cleanup levels for the Northern Off-Site Ditch and South Branch Creek sediments.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) is necessary to protect public health or the environment from actual or threatened releases of hazardous substances from the Site into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy described in this document represents the first and only planned remedial phase, or operable unit, for the LCP Chemicals, Inc., Superfund Site.

The major components of the selected remedy include:

- Installation of a capping system to prevent direct contact

with soils and exposure to mercury vapor;

- Treatment of the soil containing visible elemental mercury by mixing with it sulfur to convert the mercury to mercuric sulfide;

- Excavation and on-site disposal of sediments and marsh soils from the Northern Off-Site Ditch and the downstream portion of the South Branch Creek;

- Restoration of the excavated areas;

- Controlled demolition of the Site's buildings, recycling of non-porous material and placement of porous material under the cap;

- Containment and collection of the overburden groundwater layer by a barrier wall and collection/disposal system;

- Groundwater monitoring; and

- Implementation of institutional controls, in the form of a deed notice and Classification Exception Area (CEA).

EPA recognizes that the selected remedy includes a treatment approach for addressing visible elemental mercury that is innovative; therefore EPA is also identifying two contingency remedies in the event that the selected remedy does not meet performance criteria. Further information regarding these contingency remedies can be found in the Decision Summary.

DECLARATION OF STATUTORY DETERMINATIONS

Part 1: Statutory Requirements

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective and utilizes permanent solutions and alternative treatment technologies (or resource recovery) to the maximum extent practicable.

Part 2: Statutory Preference for Treatment

Conversion of visible mercury in soils to mercuric sulfide satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Part 3: Five-Year Review Requirements

Because the remedy will result in hazardous substances, pollutants, or contaminants remaining above levels that allow for unlimited use and unrestricted exposure, a five-year review will be required.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the administrative record file for the Site.

- Chemicals of concern and their respective concentrations may be found in the Site Characteristics section.
- Baseline risk represented by the chemicals of concern may be found in the Summary of Site Risks section.
- A discussion of cleanup levels may be found in the Remedial Action Objectives section.
- A discussion of materials constituting principal threats may be found in the Principal Threat Waste section.
- Current and reasonably-anticipated future land use assumptions are discussed in the Current and Potential Future Site and Resource Uses section.
- A discussion of potential uses of the Site as a result of the selected remedy is discussed in the Remedial Action Objectives section.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs are discussed in the Description of Alternatives section.

- Key factors that led to selecting the remedy (i.e., how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decisions) may be found in the Comparative Analysis of Alternatives and Statutory Determinations sections.

Walter E. Mugdan, Director
Emergency and Remedial Response Division
EPA - Region 2

FEB. 25, 2014
Date

DECISION SUMMARY

LCP Chemicals, Inc. Superfund Site

Linden, Union County, New Jersey

United States Environmental Protection Agency

Region 2

February 2014

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SITE NAME, LOCATION AND BRIEF DESCRIPTION

The LCP Chemicals, Inc., Superfund Site (Site) is located in an industrial area on the Tremley Point peninsula in Linden, Union County, New Jersey. The twenty-six acre Site is bordered by the Arthur Kill to the east; the former GAF Corporation site to the north; and Northville Industries, BP Corporation, and Mobil to the northeast, south, and west, respectively. South Branch Creek, a man-made drainage ditch that empties into the Arthur Kill, flows through a portion of the Site (Figures 1a and 1b).

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Beginning in the 1880s and into the 1950s, Tremley Point's tidal wetlands were filled to allow for industrial development. Most of the industrial production facilities in the region are no longer operating. The primary current use of the area is bulk storage and transport of petroleum products and aggregates.

In 1955, the General Aniline & Film Corporation (GAF) constructed and began operating a chlor-alkali plant on the Site. By 1956, the core buildings required for chlorine production were present, including Buildings 220 and 230 (Figure 1a). The twenty-six acre property and the chlor-alkali operation were purchased in 1972 by Linden Chlorine Products, Inc. At some point, the company became known as the LCP Chemicals, Inc., a division of the Hanlin Group, Inc. An additional mercury cell building (Building 240) and other buildings were added by the company in the early 1970s.

Portions of the LCP property were leased to other companies for the operation of related manufacturing operations. In 1957 a western portion of the property was leased to Union Carbide Corporation (UCC) to house a hydrogen plant operation that used by-products of the chlorine production. That facility, known as the Linde Division hydrogen plant, operated until 1990. In addition, Kuehne Chemicals, Inc., leased an area on the northern portion of the property to manufacture sodium hypochlorite.

The chlor-alkali manufacturing operations ceased by 1985 and the facility was then used as a terminal for products produced at other locations. In 1991, Hanlin Group, Inc., filed a petition under Chapter 11 of the bankruptcy code, and liquidated its assets by 1994. As part of the bankruptcy, Hanlin Group abandoned the LCP property; ownership reverted to the bankruptcy estate.

In August 1994, EPA conducted a Site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional and that the property was vacated by LCP employees. The Site was placed on the National Priorities List in 1998. In 1999, a potentially responsible party (PRP), ISP-ESI and EPA entered into an Administrative Order to perform a remedial investigation and feasibility study (RI/FS).

Under the oversight of EPA, the PRP's consultants sampled and analyzed soil, sediments, groundwater, surface water and biota. The results of the sampling events, which can be found in the RI report, formed the basis for the FS. The RI and FS reports, which are summarized in this Record of Decision (ROD), can be found in the administrative record for the Site or online at: http://epa.gov/region02/superfund/npl/lcpchemicals/

The LCP property has been abandoned since the last tenant, Active Water Jet, Inc., (a pipe cleaning facility) vacated in 2000. Currently the Site is fenced and secured. The buildings, in particular the mercury cell buildings, are in an advanced state of disrepair.

On October 21, 2013, EPA was informed that James Mathis, the last acting chief executive officer of the Hanlin Group, Inc., signed a quit claim deed on September 19, 2013. The quit claim deed purports to transfer ownership of the LCP property to Cherokee LCP Land, LLC.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

On August 21, 2013, EPA released the RI/FS, a Proposed Plan for Site remediation, and supporting documentation for comment. These documents were made available to the public in the administrative record repositories maintained at the EPA Region 2 office (290 Broadway, New York, New York 10007) and the Linden Public Library, (31 East Henry Street, Linden, New Jersey). The documents were also made available online. EPA published a notice of availability involving the above-referenced documents in the Home News Tribune on August 21, 2013. The public comment period was scheduled from August 21, 2013 to September 20, 2013. On September 17, 2013, the public comment period was extended to October 21, 2013, based on a request from an environmental group.

On August 28, 2013, EPA held a public meeting at the Tremley Point Recreation Building, to inform local officials and

interested citizens about the Superfund process, to discuss the findings of the RI/FS, to present the remedial alternatives for the Site, and to respond to questions and comments from area residents and other attendees.

Responses to the comments received at the public meeting and in writing during the public comment period are included in the Responsiveness Summary section of this ROD (see Appendix V).

SCOPE AND ROLE OF OPERABLE UNIT

This action, referred to as operable unit one (OU1) will be the only action for the Site. It addresses contaminated soils, sediments, building material and groundwater.

The selected remedy will treat soil that contains visible elemental mercury. The remedy will also capture, contain and monitor contaminated groundwater, excavate and contain contaminated sediments, and cap areas of contaminated soil.

SUMMARY OF SITE CHARACTERISTICS

The RI field investigation was performed at the Site in two major phases between July 2001 and May 2008. The Phase I field investigation was conducted between July 2001 and April 2002. It included the collection and analysis of samples from soil, groundwater, surface water and sediments at locations throughout the Site. Data were also collected to provide a geologic, hydrologic and hydrogeologic interpretation of the Site.

The Phase II field investigation was performed at the Site from August 2006 to June 2007. Additional samples were collected in May 2008. The Phase II investigation included samples from soil, soil vapor, groundwater, surface water, sediment and biota. Other work included hydrogeologic testing, habitat assessment and a wetlands assessment.

Soil:

The entire upland area of the Site is covered with about 300,000 cubic yards of anthropogenic fill, which ranges in thickness from approximately 0.7 feet to as much as 17 feet, with an average thickness of roughly nine feet. The fill consists of a heterogeneous mix of soil, ash, wood, brick and glass. Below the fill is a layer of tidal marsh deposits ranging in thickness from five to ten feet. Peat (i.e., loose, soft fibrous material) comprises the upper portion of the tidal marsh deposits and

grades to organic silt and clay. Underlying the tidal marsh deposits is a layer of fine-grained glacial till comprised primarily of silts and clays. The glacial till ranges in thickness from 18.5 feet to 20.5 feet. Finally, below the glacial till is bedrock of the Passaic Formation. The upper portion of the bedrock is highly weathered residual soil composed of fine-grained silts and clays with shale fragments, similar to the overlying glacial till. The layer transitions to competent bedrock with depth.

Two hundred and seventy two surficial and 153 subsurface soil samples were collected during the RI. In addition, horizontal drilling was used to collect 27 soil samples from beneath the dilapidated buildings.

The Site soils are contaminated with constituents including mercury, arsenic and other metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated naphthalenes (PCNs), as well as volatile organic chemicals (VOCs) at levels above the New Jersey non-residential soil remediation standards. The RI found that mercury, at unacceptable concentrations, was dispersed across this entire twenty-six acre Site (Figures 2a-2d). EPA considers mercury to be the primary contaminant of concern (COC), due to its persistence, toxicity and overall mass at the Site. Mercury is typically in the elemental or mercuric sulfide form and at the highest levels (>7,000 milligrams/kilogram (mg/kg)) in the anthropogenic fill. In areas near the chlor-alkali cell buildings, free elemental mercury is present down to a depth of about 17 feet. EPA considers the soil with visible mercury (about 24,000 cubic yards) to be the Site's principal threat waste (PTW) as described later in this document.

South Branch Creek/Northern Off-Site Ditch:

South Branch Creek is a man-made drainage ditch placed in its current location in the early 1970s. It originates in the central portion of the Site and flows east for about 1,200 feet before emptying into the Arthur Kill. The Arthur Kill is a ten-mile long tidal strait, with multiple industrial contaminant sources, that connects Raritan Bay with Newark Bay (Figure 1b). The upstream portion of the South Branch Creek is about 15 feet wide, expanding to about 30 feet wide where it enters the Arthur Kill. It has roughly a five foot tidal range, and becomes dry over most of its course during low tides. The South Branch Creek banks contain a relatively narrow strip of low marsh soils

classified by the New Jersey Department of Environmental Protection (NJDEP) as "intermediate value" wetlands.

Twenty-five surface water samples were collected from the Creek, which showed exceedances of state surface water standards for a number of substances including mercury and arsenic. Mercury was not detected in filtered samples; however, the concentrations in unfiltered samples ranged from 3 parts per billion (ppb) to almost 30 ppb, with the highest concentrations detected during low tides. This seems to indicate that Site-related mercury, attached to suspended sediments, enters the South Branch Creek water column due to tidal stream velocities (Figure 3). Low marsh soils adjacent to the South Branch Creek contained high levels of mercury (maximum concentration of 3,000 mg/kg). Mercury was also detected in the tissue from the six fish (mummichog) and twelve fiddler crabs analyzed, with a mean total mercury concentration of 2.6 mg/kg and 70 mg/kg in fish and fiddler crabs tissue, respectively (Figure 4).

Fifty-eight sediment samples were collected from seven transects across the South Branch Creek and adjacent to the Creek's mouth in the Arthur Kill. Mercury, arsenic, barium and total PCBs were the most frequently detected COCs in the South Branch Creek sediments. Mean concentration of mercury in the sediments was 196 mg/kg, with a high concentration of 901 mg/kg (Figure 5a-5d). Similar to the findings in soils, mercury speciation showed the most common type of mercury was elemental and mercuric sulfide.

The Northern Off-Site Ditch is a man-made ditch located south of the LCP property that empties into the South Branch Creek. Three transects of sediment samples were collected from the Northern Off-Site Ditch. The mercury results indicate that the Ditch was impacted by overland flow from the LCP Site (Figure 6).

Groundwater:

Groundwater at the Site is found in two layers separated by an aquitard consisting of silt and clay. The shallower layer (overburden zone) is within the fill and the peat subunit of the tidal marsh deposits. The deeper layer (bedrock zone) is within the upper portion of the bedrock.

Samples of the overburden groundwater were collected from twenty-one wells and showed exceedances of the applicable state groundwater standards for several constituents, including

mercury, arsenic and some VOCs (Figure 7a-7d). Dissolved mercury concentrations ranged from non-detect (ND) to 164 ppb. Concentrations of other constituents, such as chlorobenzene (from ND to 16,200 ppb), benzene (ND to 848 ppb) and arsenic (up to 275 ppb), showed high levels of exceedances. The overburden groundwater is classified as Class II-A, meaning existing New Jersey Groundwater Quality Standards (NJGWQS) are applicable. However, due to the shallow depth and low production potential of the zone, it could not be used as a source of potable water in New Jersey.

Due to naturally occurring levels of total dissolved solids and chloride, the bedrock zone has been reclassified by the State of New Jersey to Class III-B groundwater, meaning it cannot be used as a source of potable water. Due to the high levels of TDS (i.e., greater than 10,000 parts per million), EPA would also consider this aquifer non-potable. According to NJ regulations (N.J.A.C. 7:9C-1.7(f)), Class III-B groundwater requires the development of site-specific criteria. The criteria shall be more stringent than necessary to ensure that there will be no: impairment of existing uses of groundwater; resulting violation of surface water quality standards; release of pollutants to the ground surface, structures or air in concentrations that pose a threat to human health; or violation of constituent standards for downgradient classification areas to which there is a significant potential for migration of groundwater pollutants.

Those site specific criteria have not yet been developed, so currently the bedrock zone has no applicable standards. In order to protect downgradient surface water, while site specific groundwater criteria are being developed, the NJDEP has suggested using state surface water standards as the bedrock zone's interim criteria.

Sample results from 10 bedrock wells show that mercury and other constituents exceed surface water standards in the bedrock zone. The highest concentrations of mercury, benzene and chlorobenzene were 11 ppb, 383 ppb and 14 ppb, respectively. Potentiometric studies indicate that the groundwater in the bedrock zone underlying the Site is currently being controlled by a pump and treat remedy at the adjacent GAF Corporation site (Figure 8).

Building Debris:

Over ten buildings and structures remain on the LCP property. The buildings are in a state of disrepair and in the case of the

former mercury cell buildings, unsafe to enter. Anecdotal evidence suggests that the buildings' porous material contains free elemental mercury. The amount of building material on Site is roughly 32,000 cubic yards (61,000 tons).

Soil Vapor:

Fourteen soil vapor samples were collected throughout the Site as part of the RI field investigation. Samples from 10 probes were tested for VOCs and samples from 4 probes were tested for mercury vapors.

Mercury vapors were detected in each of the 4 samples that were tested. The concentrations ranged from 0.2 to 2.5 micrograms per cubic meter ($\mu g/m^3$).

The VOCs detected in the soil vapor are similar to those that were detected in the soil. The VOCs in soil vapor include chlorobenzene; benzene, toluene, ethylbenzene and xylenes (BTEX) compounds; hexachlorobutadiene; chloroform and TCE.

Conceptual Site Model

A conceptual site model was developed to integrate all the different types of information collected during the RI.

Contaminants associated with the Site media fall into three general categories:

1) Contaminants associated with Site operations either directly from the chlor-alkali process or from spilled or discharged contaminants related to general facility operations
2) Contaminants that are incidental to anthropogenic fill
3) Contaminants from other sources, such as storm-water runoff or sediment transport from the Arthur Kill

Site-related contamination originated in the upland manufacturing facility area. During the period of chlor-alkali operation, mercury was discharged to the environment atmospherically or to the ground through spills or waste disposal. While the concentrations vary, mercury is a pervasive contaminant dispersed continuously across the Site. High concentrations of mercury remain in soils, including visual evidence of elemental mercury. Vertical migration of mercury in soils beneath the fill appears to have been relatively limited.

The deeper fill contains substantially lower total mercury concentrations than the shallow fill, with only half as many exceedances of the applicable soil standard (New Jersey nonresidential direct contact soil remediation standard, 65 mg/kg). Seventy-five percent of the native material underlying the fill (tidal marsh deposits and the glacial till) contained mercury below that standard.

Six of the twenty unfiltered samples from the overburden groundwater exceeded the New Jersey Groundwater Quality Standard (GWQS) for mercury (2 ppb) (Figure 7a) while only two of the filtered samples exceeded 2 ppb (Figure 9. In addition, dissolved (i.e., filtered samples) levels of mercury were undetected in most of the samples located between the production area and South Branch Creek.

This pattern of mercury groundwater detections appears to indicate that there is a general absence of lateral migration of mercury in overburden groundwater.

Only three of the unfiltered bedrock groundwater samples contained detectable mercury (Figure 10) and those are likely related to an off-site source (i.e., the GAF site). These bedrock mercury detections were limited to the western portion of the LCP Site. Based on the potentiometric surface contours, it appears that pumping from the adjacent GAF Site is effectively capturing the bedrock groundwater under the LCP Site (Figure 8).

These soil and groundwater observations are consistent with the presence of mercury in an insoluble form. The results of the sequential extraction analyses performed on soils confirm that the majority of mercury exists in Site soils as insoluble species (mercuric sulfide and elemental mercury). For this reason, migration in groundwater has been limited and minimal further migration is anticipated.

The mercury detected at high concentrations in South Branch Creek and the Northern Off-Site Ditch (both sediments and the low marsh soils adjacent to the creeks, which reflect sediment deposition during tidal surges or storm events) is likely due to soil-bound mercury moving via advective flow into the nearest surface water body.

The presence of elevated mercury in soils along the alignment of the historic South Branch Creek channel and the southern

boundary of the LCP Site is consistent with the overland release migration mechanism. Both uncontrolled stormwater run-off and piped discharges are likely to have contributed to transport. Mercury that was atmospherically deposited to near-facility surface soils could also have been transported via run-off. Subsequent tidal mixing and continuous suspension/redeposition may explain why clearer gradients with sediment depth are not uniformly observed.

Changes in Site drainage patterns after 1976 and the cessation of chlor-alkali manufacturing activities in 1985 would have dramatically decreased the quantity of overland releases to South Branch Creek after that time. Furthermore, the flat gradient at the Site and lack of drainage structures provide for minimal ongoing stormwater discharge to South Branch Creek.

There is a tendency for elemental mercury to appear at the ground surface during rain events; however, elemental mercury is highly insoluble and should experience negligible entrainment given the minimal run-off overall from the Site to South Branch Creek. Since groundwater is a negligible source of mercury to surface water, the transport of mercury to South Branch Creek can be considered largely historic.

Mercury in South Branch Creek sediments (Figures 5a through 5d) and adjacent low marsh soils is present at the highest concentrations in the areas closest to the former manufacturing facility (Transect A) and the possible drainage inputs from the large concrete pipe that drains at Transect C. The correlation of the existing pattern of mercury presence with historical inputs known to have ceased decades ago strongly indicates that outward mercury migration from the channel is now limited. The attenuation of mercury concentrations in sediments as South Branch Creek reaches the Arthur Kill provides further support for limited sediment transport, since extensive mixing over time would have reduced or eliminated the clear concentration gradient.

Stormwater drainage from the southern portion of the LCP Site, adjacent to the Northern Off-Site Ditch appears to have remained consistent throughout the operational history at the LCP plant. The spatial distribution of mercury found in the Northern Off-Site Ditch sediments is consistent with an overland migration of contaminants in stormwater runoff from the former hydrogen plant area.

The migration of low levels of mercury that suspend in surface water may be environmentally significant because mercury can be of concern in the environment at low concentrations. However, this pathway is unlikely to serve as a mechanism for moving or altering the bulk mass of mercury present in sediments.

There may be some solubilization, chemical transformation, and volatilization of the small amount of mercury that resides in the water column. Again, these processes affect a vanishingly small proportion of the mercury load in sediments and are not significant from a bulk transport perspective. However the small amount (approximately 0.1 to 0.2 percent) of mercury in surface water that has become methylated will have a high bioconcentration factor, meaning it could impact biota even at relatively low concentrations. Sediments are also likely contributing to biological accumulation, as evidenced by the elevated concentrations of mercury in the fiddler crab.

Both fish and crab serve as prey species that can contribute to mercury biomagnifications up the food chain. Therefore, while the significance of this pathway from a bulk transport perspective is unknown, movement from sediment into biota is an environmentally significant migration pathway.

PCBs, PCNs, hexachlorobenzene (HCB), and polychlorinated dibenzodioxins/polychlorinated dibenzofurans (PCDDs/PCDFs) originating in soils adjacent to the former facility, would be expected to behave in a similar manner as mercury, traveling primarily via run-off adsorbed onto solids. PCBs were generally low in South Branch Creek sediments (undetected or at part-per-billion levels), but demonstrated a similar pattern to mercury, with the highest concentrations at Transects A and C (Figure 11). PCBs were not detected in Arthur Kill sediments, indicating attenuation with distance from the Site. HCB movement appears to have been minimal, as this compound was undetected in South Branch Creek samples except for one occurrence of 1.5 mg/kg in the 0.5-1.0-foot sediments at Transect C and two detections under 0.2 mg/kg in low marsh soils at Transect. HCB was also not detected in the Northern Off-Site Ditch.

Lower-chlorinated chlorobenzenes appear to have migrated to South Branch Creek and the Northern Off-Site Ditch via the same mechanism of adsorption/run-off. These constituents, which have higher solubility than the other COCs, have also partitioned into groundwater, as has benzene. A portion of what is observed in South Branch Creek and the Northern Off-Site Ditch may be

attributable to the localized discharge of chlorobenzenes in shallow groundwater. However, this mechanism is unlikely to account for more than a small proportion of what is observed in sediments. These more soluble COCs have relatively short residence times in surface water due to volatilization and their higher aqueous solubility results in less partitioning to sediment. Thus, relatively little benzene and chlorobenzene is observed in sediment compared with the higher-chlorinated compounds, which are more likely to have migrated adsorbed to solids.

The presence of contaminants in soils not associated with Site operations is attributable to anthropogenic fill, regional contamination, or other historic sources to South Branch Creek.

The markedly elevated arsenic noted in sediments (concentrations greater than the maximums detected in any of the soil units) appears to be related to a local source likely other than the LCP Site. South Branch Creek received inputs from other nearby facilities, including the GAF site.

CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES:

Groundwater Uses: As described previously, the groundwater at the Site is found in two layers separated by a silt/clay aquitard. The shallower overburden layer is considered by New Jersey to be Class II-A, a source of potable water; however, the water cannot be used as a potable resource. The bedrock zone has been reclassified by New Jersey to be Class III-B groundwater, which means it is unsuitable for potable use.

LCP Property uses: The LCP Site, which includes the LCP property and the Off-Site Ditch area, is currently unused, but is zoned for commercial and industrial uses. EPA has consulted with local municipal authorities and the Site is being considered as part of an area-wide industrial/commercial redevelopment plan. The redevelopment plan would not change the zoning.

SUMMARY OF SITE RISKS

As part of the RI, a baseline risk assessment was conducted to estimate the current and future effects of contaminants on human health and the environment. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects of releases of hazardous substances from a site in the absence of any actions or controls to mitigate such releases,

under current and future land and groundwater uses.

Human Health Risk Assessment

A Baseline Human Health Risk Assessment (BHHRA) was conducted to estimate current and future effects of contaminants on human health. A BHHRA is an analysis of the potential adverse human health effects caused by hazardous substance exposure in the absence of any actions to control or mitigate these exposures under current and future Site uses. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site. Tables 1 through 6 provide a summary of relevant information from the BHHRA (i.e. exposure pathways and chemicals found to pose unacceptable risk to human health).

The risk assessment document for this Site, entitled *Final Human Health Risk Assessment,* dated May 2011 is available in the administrative record file and Site repository.

A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios, as follows.

Hazard Identification - uses the analytical data collected to identify the contaminants of potential concern (COPCs) at the Site for each medium, with consideration of a number of factors explained below.

Exposure Assessment - estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the pathways (*e.g.*, ingesting contaminated soil) by which humans are potentially exposed.

Toxicity Assessment- determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of effect (response).

Risk Characterization - summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site-related risks. The risk characterization also identifies contamination with concentrations that exceed acceptable levels, defined by

the NCP as an excess lifetime cancer risk greater than 1 x 10^{-6} - 1 x 10^{-4} or a Hazard Index greater than 1.0; contaminants at these concentrations are considered COCs and are typically those that will require remediation at the Site. Also included in this section is a discussion of the uncertainties associated with these risks.

Hazard Identification
In this step, analytical data collected during the RI was used to identify contaminants of potential concern (COPCs) in the soil, sediment, surface water and groundwater at the Site based on factors such as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants as well as their mobility and persistence.

Surface (less than two feet deep) and subsurface (greater than two feet deep) soil, overburden groundwater, South Branch Creek sediment/bank soil and soil vapor samples were collected between July 2001 and May 2008 as part of the remedial investigation. A comprehensive list of all Site COCs can be found in the Table 2 series of the May 2011 Final Human Health Risk Assessment report.

Exposure Assessment
In this step, the different exposure scenarios and pathways through which people might be exposed to the contaminants identified in the previous step were evaluated.

Consistent with Superfund policy and guidance, the BHHRA is a baseline human health risk assessment and therefore assumes no remediation or institutional controls to mitigate or remove hazardous substance releases. Cancer risks and noncancer hazard indices were calculated based on an estimate of the reasonable maximum exposure (RME) expected to occur under current and future conditions at the Site. The RME is defined as the highest exposure that is reasonably expected to occur at a Site.

The exposure assessment identified potential human receptors based on a review of current and reasonably foreseeable future land use at the Site. The Site is located on Tremley Point in Linden, a heavily industrialized peninsula in Union County, New Jersey. Land use surrounding the Site is primarily industrial. The Site is currently zoned heavy industrial. In February of 2009, bedrock groundwater was reclassified to Class III-B non-potable groundwater. Based on the Class III-B reclassification, drinking water wells cannot be drilled and narrative groundwater

criteria would apply to bedrock groundwater in the affected area. NJDEP classified overburden groundwater below the Site as Class II-A groundwater; therefore, future potable use of groundwater was evaluated. Groundwater is not currently used for drinking water at the Site. Future potable use of bedrock groundwater is prohibited and in the overburden is highly unlikely.

Based on information gathered during the RI, such as zoning and demographic information, several exposure scenarios for the Site were selected. For current land use scenario, the following exposure scenario was evaluated:

- adolescent trespassers contacting/ingesting surface water/sediment in South Branch Creek.

For potential future land uses, the following exposure scenarios were evaluated:

- commercial/industrial workers contacting/ingesting surface soil, or inhaling vapors from surface soil;
- site-specific workers contacting/ingesting/inhaling surface soil;
- construction/utility workers contacting/ingesting/inhaling surface/subsurface soil;
- commercial/industrial workers ingesting overburden groundwater;
- construction/utility workers contacting/ingesting/inhaling vapors from shallow groundwater;
- adolescent trespassers contacting/ingesting/inhaling surface soil;
- adolescent trespassers contacting/ingesting surface water/sediment in South Branch Creek; and
- indoor workers inhaling vapors migrating from the subsurface into indoor air.

Table 2 presents all exposure pathways considered in the BHHRA, and the rationale for the selection or exclusion of each pathway. Since the South Branch Creek is generally unsuitable for fish species that are used for human consumption, and considering the industrial setting and substantial barriers to fishing access (i.e., small boat via the Arthur Kill and only during high tide), the fish/shellfish consumption pathway for

South Branch Creek is considered incomplete and was not evaluated in the HHRA.

Toxicity Assessment

In this step, the types of adverse health effects associated with contaminant exposures and the relationship between magnitude of exposure and severity of adverse health effects were determined. Potential health effects are contaminant-specific and may include the risk of developing cancer over a lifetime or other noncancer health effects, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health effects.

Under current EPA guidelines, the likelihood of carcinogenic risks and noncancer hazards due to exposure to Site chemicals are considered separately. Consistent with current EPA policy, it was assumed that the toxic effects of the Site-related chemicals would be additive. Thus, cancer and noncancer risks associated with exposures to individual COPCs were summed to indicate the potential risks and hazards associated with mixtures of potential carcinogens and non-carcinogens, respectively.

Toxicity data for the human health risk assessment were provided by the Integrated Risk Information System (IRIS) database, the Provisional Peer Reviewed Toxicity Database (PPRTV), or another source that is identified as an appropriate reference for toxicity values consistent with EPA's directive on toxicity values. Toxicity values can be found in Tables 3 and 4. Additional toxicity information for all COPCs is presented in the Table 5 and 6 series of the May 2011 Final HHRA.

Risk Characterization

This step summarized and combined outputs of the exposure and toxicity assessments to provide a quantitative assessment of Site risks. Exposures were evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen, using the cancer slope factor (SF) for oral and dermal exposures and the inhalation unit risk (IUR) for inhalation exposures. Excess lifetime cancer risk for oral and dermal exposures is calculated

from the following equation, while the equation for inhalation exposures uses the IUR, rather than the SF:

Risk = LADD x SF

Where: Risk = a unit-less probability (1×10^{-6}) of an individual developing cancer
LADD = lifetime average daily dose averaged over 70 years (mg/kg-day)
SF = cancer slope factor, expressed as [1/(mg/kg-day)]

The likelihood of an individual developing cancer is expressed as a probability that is usually expressed in scientific notation (such as 1×10^{-4}). For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk"; or one additional cancer may be seen in a population of 10,000 people as a result of exposure to Site contaminants under the conditions explained in the Exposure Assessment. Current Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk) with 10^{-6} being the point of departure.

For noncancer health effects, a hazard index (HI) is calculated. The HI is determined based on a comparison of expected contaminant intakes and benchmark comparison levels of intake (reference doses, reference concentrations). Reference doses (RfDs) and reference concentrations (RfCs) are estimates of daily exposure levels for humans (including sensitive individuals) which are thought to be safe over a lifetime of exposure. The estimated intake of chemicals identified in environmental media (*e.g.*, the amount of a chemical ingested from contaminated drinking water) is compared to the RfD or the RfC to derive the hazard quotient (HQ) for the contaminant in the particular medium. The HI is obtained by adding the hazard quotients for all compounds within a particular medium that impacts a particular receptor population.

The HQ for oral and dermal exposures is calculated as below. The HQ for inhalation exposures is calculated using a similar model that incorporates the RfC, rather than the RfD.

HQ = Intake/RfD

Where: HQ = hazard quotient
Intake = estimated intake for a chemical (mg/kg-day)

RfD = reference dose (mg/kg-day)

The intake and the RfD will represent the same exposure period (*i.e.*, chronic, subchronic, or acute).

The key concept for a noncancer HI is that a "threshold level" (measured as an HI of less than 1) exists below which noncancer health effects are not expected to occur.

The HI is calculated by summing the HQs for all chemicals for likely exposure scenarios for a specific population. An HI greater than 1.0 indicates that the potential exists for non-carcinogenic health effects to occur as a result of Site-related exposures, with the potential for health effects increasing as the HI increases. When the HI calculated for all chemicals for a specific population exceeds 1.0, separate HI values are then calculated for those chemicals which are known to act on the same target organ. These discrete HI values are then compared to the acceptable limit of 1.0 to evaluate the potential for noncancer health effects on a specific target organ or system. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

The highest noncancer (HI=190) risk was calculated be a future industrial or commercial worker on the unremediated Site. Specific cancer and noncancer risks are summarized in Tables 5 and 6. Exposure to mercury (elemental and inorganic), vanadium and furan in soil and arsenic, cobalt, iron, manganese, mercury, methyl mercury, vanadium, furan, p-chloroaniline, benzene, chlorobenzene and dioxin in shallow groundwater posed an unacceptable human health risk.

EPA anticipates that the remedy will reduce exposure to mercury and other Site COCs in soil, sediment, groundwater and building material, resulting in the interruption of unacceptable risks to trespassers, commercial/industrial workers, site-specific workers, and construction/utility workers.

Ecological Risk Assessment

A part of the RI, ecological risk was evaluated to determine the likelihood that adverse ecological effects are occurring or may potentially occur as a result of the Site-related contamination.

The risk assessment was performed in accordance with EPA's

Ecological Risk Assessment Guidance for Superfund eight step approach. As part of that approach, a Screening Level Ecological Risk Assessment (SLERA) was conducted to identify potential environmental risks associated with the Site. The SLERA indicated there was a potential for adverse ecological effects. Therefore a more thorough study, called a Baseline Ecological Risk Assessment (BERA), was performed.

The BERA evaluated the following potentially complete receptor exposure pathways (and representative receptors):

- Exposure of benthic macroinvertebrates to contaminated sediment/bank soil in South Branch Creek;
- Exposure of estuarine fish to contaminated sediment and surface water in South Branch Creek;
- Exposure of omnivorous mammals (raccoon; *Procyon lotor*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of piscivorous mammals (mink; *Mustela vison*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of sediment-probing birds (spotted sandpiper; *Actitis macularia*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of piscivorous birds (great blue heron; *Ardea herodias*) to contaminated sediment/bank soil, surface water, and prey items in South Branch Creek;
- Exposure of invertivorous mammals (short-tailed shrew; *Blarina brevicauda*) to contaminated soil and prey items in the upland area of the Site;
- Exposure of carnivorous mammals (red fox; *Vulpes vulpes*) to contaminated soil and prey items in the upland area of the Site;
- Exposure of invertivorous birds (American woodcock; *Scolopax minor*) to contaminated soil and prey items in the upland area of the Site; and

- Exposure of carnivorous birds (red-tailed hawk; *Buteo jamaicensis*) to contaminated soil and prey items in the upland area of the Site.

Potential risks to benthic macroinvertebrate communities were primarily evaluated by comparing sediment COC concentrations in South Branch Creek to sediment benchmarks; additionally, bulk sediment toxicity testing was performed for lethality and growth (acute toxicity tests). Potential risks to estuarine fish communities in South Branch Creek were evaluated by comparing fish tissue COC concentrations to tissue toxicity reference values (TRVs). Potential risks to populations of upper trophic level (wildlife) receptors at the Site were evaluated using food chain models to calculate dietary doses, which were compared to dietary TRVs to yield a quantitative estimate of risk.

Two exposure levels were considered for evaluating potential ecological risks. The RME scenario considered exposure to upper-bound exposure point concentration (EPC) estimates (95 percent upper confidence levels or maximum concentrations) and the central tendency exposure (CTE) scenario considered mean concentrations.
Note that EPCs did not account for visible elemental mercury as it was not possible to analyze these samples using conventional methods; however, it is assumed that areas with visible elemental mercury pose unacceptable risks to potential ecological receptors. If available, multiple effects levels were also considered. A range of screening levels and tissue toxicity reference values (TRVs) that correspond to various effects were considered for benthic macroinvertebrates and estuarine fish, respectively. For wildlife receptors, both 'no observable adverse effect level' (NOAEL) and 'lowest observed adverse effect level' (LOAEL) TRVs were considered.

The results of the BERA support the following conclusions:

- Several COCs in South Branch Creek sediment have the potential to result in adverse ecological effects to benthic macroinvertebrates as determined by comparison to marine sediment screening levels. Arsenic, barium, mercury, and methyl mercury are expected to be the primary risk drivers. South Branch Creek sediment acute toxicity testing results also indicated a potential for reduced benthic invertebrate survival.

- Fish tissue concentrations measured in South Branch Creek were within the range of tissue TRVs identified in the primary literature, indicating that South Branch Creek COCs are not bioaccumulating to a level likely to adversely affect populations of estuarine fish.

- Ecological risks for omnivorous mammals (raccoons), piscivorous mammals (mink), and piscivorous birds (great blue herons) exposed to COCs in South Branch Creek were below established risk levels. However, there is a potential for ecological risk to sediment-probing birds (spotted sandpiper) exposed to COCs in South Branch Creek. Primary risk drivers are arsenic, barium, and mercury.

Areas of visible elemental mercury contamination in the upland area of the Site could not be quantitatively evaluated. For the purposes of the BERA, areas with visible elemental mercury were assumed to present unacceptable risk for potential ecological receptors.

- No unacceptable risks were identified for carnivorous mammals (red foxes) exposed to COCs in the upland area of the Site. There is a potential for ecological risk to insectivorous mammals (short tailed shrews), invertivorous birds (American woodcocks), and carnivorous birds (red-tailed hawks). Although the Site may serve as a wildlife corridor for terrestrial species, significant ecological exposure to soil is not expected to occur given the highly disturbed habitat, lack of prey species and vegetation, limited exposure potential due to buildings, pavement and gravel on Site, and anticipated future land use. Based on calculated risk estimates, primary risk drivers in the upland area are mercury and hexachlorobenzene.

In summary, elevated HQ risks were estimated in the BERA for benthic invertebrates and sediment probing birds for exposure to several COCs in South Branch Creek. These risks are consistent with the reduced survival in the acute toxicity sediment testing results. These data support the premise that Site contaminants in sediment are sufficient to cause adverse alterations to the functioning of benthic invertebrate communities. Elevated concentrations of the COCs are generally higher in samples closer to the former facility. Arsenic, barium, and mercury are the primary risk drivers in South Branch Creek.

Elevated HQ risks were estimated in this BERA for terrestrial mammals (invertivores) and birds (invertivores and, to a lesser extent, carnivores). Primary risk drivers are mercury (including visible elemental mercury) and hexachlorobenzene. Concentrations tend to be focused in areas near the former operational areas of the Site.

Uncertainties

The procedures and inputs used to assess risks in these evaluations, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- environmental chemistry sampling and analysis
- environmental parameter measurement
- fate and transport modeling
- exposure parameter estimation
- toxicological data

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is uncertainty as to the actual levels present. Environmental chemistry analysis error can stem from several sources, including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the risk assessment provides upper-bound estimates of the risks to populations near the Site, and is highly unlikely to underestimate actual risks related to the Site.

More specific information concerning public health and environmental risks, including a quantitative evaluation of the

degree of risk associated with various exposure pathways, is presented in the HHRA and BERA reports, which can be found in the administrative record for this Site. The response action selected in this ROD is necessary to protect public health and the environment from actual or threatened releases of hazardous substances to the environment.

REMEDIAL ACTION OBJECTIVES:

Remedial Action Objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards such as Applicable and Relevant or Appropriate Requirements (ARARs) and risk-based levels established in the risk assessment.

The Site is a former industrial property in the midst of other industrial properties that have been subject to separate remedial actions. Thus EPA considered remedies that manage waste in place (a "waste management area") consistent with remedies at neighboring properties.

The RAOs are:

- Reduce or eliminate potential current and future unacceptable risks to human and ecological receptors resulting from ingestion and dermal contact with soils and groundwater.

- Reduce or eliminate potential current and future unacceptable risks to human receptors resulting from inhalation of mercury vapors emanating from soils and marsh deposits

- Reduce or eliminate migration of soil contamination to groundwater or surface water.

- Prevent or minimize migration of contaminated groundwater, and, to the extent practicable, remediate to applicable standards outside the waste management area.

- Reduce or eliminate unacceptable risks to human and ecological health as a result of ingestion or dermal contact with Site sediments.

- Reduce or eliminate human exposure to contaminated building materials and physical hazards that may result in potentially unacceptable risk.

The cleanup levels for the Site's soil (Table 7) including for mercury (65 mg/kg) and other COCs (other than naphthalene), are based on the New Jersey Soil Remediation Standard for direct contact to non-residential soils. For naphthalene, a risk-based cleanup goal has been developed.

EPA has concluded that soil containing visually observable elemental mercury is considered principal threat waste (PTW). The Arthur Kill has numerous sources of mercury contamination; the mercury contamination in the Arthur Kill near the LCP Site does not appear to be distinguishable from the levels found throughout the Arthur Kill/Newark Bay complex. Since any areas of remediated Site sediments in the South Branch Creek and Northern Off-Site Ditch are likely to be impacted by contaminated sediments in the Arthur Kill, the cleanup levels for the sediments will be set at levels consistent with those found in the Arthur Kill.

For groundwater, the cleanup goal for the overburden zone is the New Jersey Groundwater Quality Standard for Class IIA groundwater. The bedrock zone has been classified Class III-B, which requires the development of state approved site specific criteria. The cleanup levels for the COCs in the bedrock aquifer will be the New Jersey Surface Water Standards for saline waters. Should the State proceed with developing criteria for this Class III-B aquifer, EPA will assess the remedy at that time to ensure protectiveness.

DESCRIPTION OF ALTERNATIVES:

Section 121 (b)(1) of CERCLA (42 U.S.C. 9621(b)(1)) requires that each remedial alternative be protective of human health and the environment, be cost-effective, comply with other statutory laws, and utilize permanent solutions and alternative treatment technologies and resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility or volume of hazardous substances.

Potential applicable technologies were identified and screened using effectiveness, implementability and cost as the criteria, with the most emphasis on the effectiveness of the remedial action. Those technologies that passed the initial screening were then assembled into five remedial alternatives.

Except for the No Action alternative (Alterative 1), each remedial alternative would be coupled with institutional controls to limit the potential exposure of the public to the Site contaminants. Institutional controls are typically restrictions placed to minimize human exposure, while allowing continued monitoring. Institutional controls are generally used in conjunction with remedial technologies. Consistent with expectations set out in the Superfund regulations, none of the remedies rely exclusively on institutional controls to achieve protectiveness.

The time frames below for construction do not include the time for designing the remedy or the time to procure necessary contracts. Because all the alternatives result in contamination remaining on the Site above levels that would allow for unlimited use and unlimited exposure, a review will be conducted every five years (five-year reviews).

Alternative 1 - No Action

Total Capital Cost	$0
Operation and Maintenance	$0
Total Present Net Worth	$0
Timeframe	0 years

The No Action alternative was retained for comparison purposes as required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the regulation under which EPA implements the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). No remedial actions would be implemented as part of the No Action alternative. This alternative does not include institutional controls.

Alternative 2 - Partial Containment (Treatment Cap)

Total Capital Cost	$19.9 million
Operation and Maintenance	$ 1.1 million[1]
Total Present Net Worth	$21.0
Timeframe	2 Years

1 Operation and maintenance costs for the remedial alternatives are presented as the 30-year present worth of this work.

An impermeable cap would be installed over virtually the entire Site to both prevent direct contact with contaminated soils, prevent overland transport of contamination and to interrupt the potential for inhalation exposure to mercury vapor. The area under the cap, including the overburden layer of groundwater, would be considered the waste management area. The cap would incorporate a soil layer, and a three-inch thick treatment layer of sulfur placed under an impermeable geosynthetic membrane. The geosynthetic membrane (and the sulfur layer for mercury) would serve to prevent vaporization of mercury (and other contaminants) as well as prevent rainwater infiltration into the underlying groundwater.

Since the sediments would likely be recontaminated by sediments from the Arthur Kill, source reduction would be the focus of the sediment remedy. The cleanup level for the South Branch Creek and Northern Off-Site Ditch sediments would be set at levels consistent with Site COC concentrations found in the Arthur Kill sediments. Sediments with unacceptable levels of contaminants in the downstream portion of the South Branch Creek as well as in the Northern Off-Site Ditch would be excavated and placed in the upstream portion of the South Branch Creek. The upstream portion would then be placed under the cap. The downstream portion and the Northern Off-Site Ditch would be restored with clean sediment, and the adjacent wetlands reconstructed. In addition, wetlands mitigation would be implemented at another location for the area that has been lost under the cap.

The buildings on Site would be demolished in a controlled manner. Steel and other non-porous material would be segregated, decontaminated and recycled. Porous material that has visible signs of contamination would be treated with sulfur. The debris would be processed to reduce its size before being placed under the cap.

Alternative 2 would also include collection of groundwater from the overburden aquifer layer. A shallow system would be installed along the limits of the cap. The collected groundwater would be either piped to the adjacent GAF site for treatment, or sent to the local publicly owned treatment works for appropriate treatment and disposal. Groundwater monitoring would be performed in the overburden aquifer to confirm that there is an inward gradient to the Site and in the bedrock aquifer to confirm that the deeper groundwater is not being impacted by the LCP Site, and continues to be captured by the GAF wells.

This remedy would require air monitoring during building demolition and work where the soil or sediments are disturbed. In addition, this remedy would include institutional controls (e.g., a CEA and a deed notice) to prevent exposure to contaminated groundwater and to restrict the property to industrial or commercial use. A long-term monitoring program would be developed to ensure the continued protectiveness of the remedy and also to assess potential migration and natural degradation of the contaminated groundwater.

Alternative 3 Full Containment (Treatment Cap and Barrier Wall)

Total Capital Cost	$23.8 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$24.9 million
Timeframe	3 years

The Alternative 3 remedy for soils is the same as Alternative 2, except it includes a barrier wall, such as sheet piling, to further limit the potential for lateral migration of contaminants off-Site. The low permeability barrier wall would be installed along the limits of the soil cap and tied into the top of the glacial till layer (approximately 15 feet below ground surface (bgs)).

Like Alternative 2, Alternative 3 would include collection of groundwater from the overburden aquifer layer. However, for Alternative 3, the shallow collection system would be installed along the interior limits of the barrier wall. The system would likely consist of a collection pipe with pump stations as needed. Groundwater monitoring would be performed as described in Alternative 2.

Alternative 3 includes the same remedial components for sediments and building materials as Alternative 2, including institutional controls and long-term monitoring.

Alternative 4a and 4b - Full Containment and Partial/Full Depth PTW Stabilization

Alternative 4a

Total Capital Cost	$33.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$34.3 million
Timeframe	4 years

Alternative 4b

Total Capital Cost	$35.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$36.3 million
Timeframe	4 years

Alternative 4a and 4b contains all the components of Alternative 3. Alternatives 4a and 4b also include treatment of the PTW soils through stabilization. Stabilization would be accomplished by in-situ mixing of sulfur with PTW soil through the use of specialized mixing equipment (e.g., augers). The amount of sulfur per volume of soil will be determined during the pre-design studies. Also, specific measures of success will be developed during the design phase. The measures of success would be used to determine if the full scale stabilization remedy was effective at converting the elemental mercury to mercuric sulfide.

The primary goal of stabilization would be to convert the elemental mercury to mercuric sulfide. Mercuric sulfide (i.e., cinnabar) is insoluble, does not generate vapors and is a solid at ambient temperatures. Two approaches were analyzed for this alternative, Alternative 4b is treatment to the full depth of the PTW area (up to 17 feet bgs) and Alternative 4a includes treatment of only the shallower soils (up to 6 feet bgs). The shallower soils contain the majority (more than 80 percent) of the elemental mercury.

Alternative 5 - Full Containment and Partial/Full Depth PTW Excavation and Off-Site Disposal

Alternative 5a

Total Capital Cost	$84.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$85.3 million
Timeframe	3 years

Alternative 5b

Total Capital Cost	$96.2 million
Operation and Maintenance	$ 1.1 million
Total Present Net Worth	$97.3 million
Timeframe	3 years

Alternative 5 (i.e., 5a and 5b) contains all the components of Alternative 3. Alternative 5 also includes removal and off-site

disposal of the PTW, and some of the contaminated building debris. Post excavation sampling would be performed. Similar to Alternative 4, two approaches were considered, removal to the full depth of the PTW area (up to 17 feet bgs (5b)) and removal of only the shallower (up to 6 feet bgs (5a)) soils.

COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy, EPA considered the factors set out in CERCLA §121, 42 U.S.C. §9621, by conducting a detailed analysis of the viable remedial response measures pursuant to the NCP, 40 CFR §300.430(e)(9) and OSWER Directive 9355.3-01. The detailed analysis consisted of an assessment of the individual response measure against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each response measure against the criteria.

Threshold Criteria *- The first two criteria are known as "threshold criteria" because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.*

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1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 would not provide protection of human health or the environment, since uncontained contamination would persist in the soils, sediments, groundwater and building material. Potential and existing routes of exposure to humans and animals would be unrestricted. Also, there would be no mechanism to monitor the migration of the contamination.

Alternatives 2 through 5 would provide protection of human health and the environment by preventing exposure to contaminated media through installation of an impermeable cap. Alternatives 2 through 5 would also provide protection of human health through implementation of institutional controls to interrupt potential future exposure. The barrier wall included

in Alternatives 3 through 5 would further limit the potential for lateral migration of groundwater contamination.

2. Compliance with applicable or relevant and appropriate requirements (ARARs)

Section 121(d) of CERCLA and NCP '300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy would meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

Concentrations of contaminants exist at levels above the applicable groundwater and soil standards (e.g., the New Jersey Groundwater Quality Standards and the New Jersey Soil Remediation Standards). Except for Alternative 1, all alternatives would address the contaminated soil through containment and address the overburden groundwater through capture, containment and treatment. All alternatives except

Alternative 1 would comply with location and action-specific ARARs.

A list of ARARs can be found in Table 8.

Primary Balancing Criteria *- The next five criteria, criteria 3 through 7, are known as Aprimary balancing criteria@. These criteria are factors with which tradeoffs between response measures are assessed so that the best option will be chosen, given site-specific data and conditions.*

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3. Long-term effectiveness and permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Alternative 1 would not be effective or permanent, since the contaminants would not be monitored and there would be no mechanism to prevent future exposure. In general, the relative degrees of effectiveness and permanence associated with Alternatives 2, 3, 4a and 4b, and 5a and 5b are comparable; however, Alternatives 4a and 4b would provide an additional component of protection by further reducing the potential mercury vapor pathway through the conversion of the PTW elemental mercury to mercuric sulfide. EPA expects that conversion will be permanent. Similarly, Alternatives 5a and 5b would provide additional protection over Alternatives 2 and 3 by removing the area of PTW.

4. Reduction of toxicity, mobility, or volume

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternative 1 would not reduce the toxicity, mobility and volume (TMV) through treatment as no active treatment occurs. All the action alternatives would reduce the mobility of the contamination through containment, as well as potentially reducing some of the toxicity and mobility through conversion of

elemental mercury at the cap's "treatment layer." Alternatives 3, 4a and 4b and 5a and 5b afford additional reduction of mobility through the use of a barrier wall.

Alternatives 4a and 4b would best meet this criterion by reducing the toxicity and mobility of the mercury through treatment of the visible mercury to convert it to mercuric sulfide. Mercuric sulfide is less toxic, less soluble and less volatile than elemental mercury.

Alternatives 5a and 5b would reduce the mobility, but not toxicity and volume of elemental mercury at the Site through removal and disposal rather than treatment.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

For Alternative 1, protection of the community and workers during remedial activities would not be applicable as no remedial action is occurring.

Alternatives 2, 3 and 5a and 5b would have approximately the same construction period of about two to three years. Alternative 4a and 4b would have the longest construction period (three to four years) due to the time required to perform in-situ mixing, as well as to perform the necessary pilot studies.

All the action alternatives would result in a temporary increase in short-term mercury vapor emissions over baseline conditions. Alternative 5a and 5b would have the largest increase in emissions during the implementation (estimated at between 101 and 197 pounds). In addition, Alternative 5a and 5b would require between 1,000 and 2,000 trucks to first remove the PTW soil and debris, and then to bring in substrate to backfill the excavated areas. Thus, Alternative 5a and 5b is the only option that would significantly increase the truck traffic through the local community.

During the remedial work, Alternative 4a and 4b would have the smallest increase in mercury vapor emissions (0.5 to 0.8 pounds released) because of the widespread use of a sulfur compound.

Vapor emissions could impact on-site construction workers and the local community. Alternatives 2 and 3 would have an increase of an estimated 7.7 pounds.

Health and Safety Plans, which would include air monitoring, engineering controls and appropriate worker personal protective equipment (PPE), would be used to protect the community and workers for Alternatives 2 through 5.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All the action alternatives are implementable with conventional materials and equipment. Alternatives 2 and 3 would be the easiest to implement.

Alternative 4a and 4b would require specialized equipment to mix the soil, as well as methods to address subsurface obstructions. Alternative 4b would be more difficult to implement due to the greater depth and the associated subsurface obstacles.

Alternative 5a and 5b would require disposal of elemental mercury wastes. Currently a single facility, located in Canada, has been identified that can accept this waste stream. Some uncertainty still exists on whether the facility can handle the mass from this Site.

In addition, the Mercury Export Ban Act (MEBA) may place further constraints on how this waste stream can be handled. Signed into law in 2008, MEBA is intended to prevent elemental mercury originating in the United States from reaching foreign markets. In this case, MEBA would also ban elemental mercury recovered from Site soils or sediments from being reused or sold even domestically.

7. Cost

Includes estimated capital and O&M costs, and net present worth value of capital and O&M costs.

Each action alternative includes long-term operation and

maintenance. Therefore, a seven percent discount rate was used to derive each alternative's present net worth cost.

Alternative 1 incurs no cost but provides no protection to human health. Except for Alternative 1, Alternative 2 is the least expensive of the alternatives. Alternatives 5a and 5b are the most expensive alternatives. Alternative 4a and 4b are relatively close in price to Alternatives 2 and 3. The level of operation and maintenance required was similar for each active remedial alternative, so this long-term management cost was not an important factor for comparing casts at the Site.

Modifying Criteria - The final two evaluation criteria, criteria 8 and 9, are called "modifying criteria" because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.

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8. State acceptance

Indicates whether based on its review of the RI/FS reports and the Proposed Plan, the state supports, opposes, and/or has identified any reservations with the selected response measure.

The NJDEP concurs with the components of the selected remedy. However, NJDEP does not concur with the contingency remedies for treating elemental mercury as discussed further below. NJDEP believes the contingency remedy should be excavation and off-site removal of the PTW. In addition, NJDEP believes that the existing data on contamination in Arthur Kill sediments is insufficient to determine cleanup levels for the Northern Off-Site Ditch and South Branch Creek sediments.

9. Community acceptance

Summarizes the public's general response to the response measures described in the Proposed Plan and the RI/FS reports. This assessment includes determining which of the response measures the community supports, opposes, and/or has reservations about.

EPA solicited input from the community on the remedial response measures proposed for the Site. Verbal comments were recorded

from attendees of the public meeting. Several written comments were received.

Generally, the comments received during the public meeting did not express any particular concerns regarding the preferred alternative. A number of commenters were concerned that if a large storm surge were to occur during the remedial action, their homes could be exposed to Site contaminants entrained within the tidal waters. Some of the written comments expressed preference for removal and disposal of the PTW soils (Alternative 5a or 5b).

In Appendix V, the Responsiveness Summary addresses all comments received; it also includes copies of the written comments and a transcript from the public meeting.

PRINCIPAL THREAT WASTE

Principal threat wastes are considered source materials, i.e., materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. The Superfund Law requires that treatment of PTW be considered wherever practicable.

At the LCP Site, soil containing visible mercury is a PTW and will be treated through the implementation of the selected remedy.

SELECTED REMEDY

Based upon consideration of the results of the investigations, the requirements of CERCLA, the detailed analysis of the remedial alternatives and public comments, EPA has determined that Alternative 4b is the appropriate remedy for the Site. This remedy best satisfies the requirements of CERCLA Section 121 and the NCP's nine evaluation criteria for remedial alternatives, 40 CFR §300.430(e)(9).

The major components of the selected remedy include:

- Installation of a capping system to prevent direct contact with soils and exposure to mercury vapor;

- Treatment of the soil containing visible elemental mercury by mixing it with sulfur to convert the mercury to mercuric

sulfide;

- Excavation and on-Site disposal of sediments and marsh soils from the Northern Off-Site Ditch and the downstream portion of the South Branch Creek;

- Restoration of the excavated areas;

- Controlled demolition of the Site's buildings, recycling of non-porous material and placement of porous material under the cap;

- Containment and collection of the overburden groundwater layer by a barrier wall and collection collection/disposal system;

- Groundwater monitoring; and

- Implementation of institutional controls in the form of a deed notice and a CEA.

A capping system will be installed to both prevent direct contact with soils on a Site-wide basis and to interrupt the potential for inhalation exposure to mercury vapor (Figure 12). The cap will incorporate a soil layer, and a three-inch thick treatment layer of sulfur placed under an impermeable geosynthetic membrane. The treatment layer will be placed over areas of mercury-contaminated soil that are not otherwise treated.

The geosynthetic membrane will serve to prevent vaporization of mercury (and other contaminants) as well to prevent rainwater infiltration into the underlying groundwater. A low permeability barrier wall will be installed along the limits of the soil cap and tied into the top of the glacial till layer (about 15 feet deep). Areas with PTW will be treated by mixing the contaminated soil with sulfur to convert the elemental mercury to mercuric sulfide to a depth of approximately 15 feet. A pilot study, with clearly defined treatment goals, will be performed prior to full implementation of the remedy.

Sediments with unacceptable levels of contamination in the Northern Off-Site Ditch and in the downstream portion of the South Branch Creek will be excavated and placed under the cap. The excavated sediment areas and the adjacent wetlands would be

reconstructed. In addition, wetlands mitigation will be implemented at another location for the area that has been lost under the cap. During the design phase, EPA will determine cleanup levels for the sediments that are consistent with existing levels in the Arthur Kill.

The buildings on Site will be demolished in a controlled manner. Steel and other non-porous material will be segregated, decontaminated and recycled. Porous material that has visible signs of mercury contamination will be treated with sulfur. The debris will be processed to reduce its size then placed under the cap. Air monitoring will be required during building demolitions, and also during other activities where the soil or sediments are disturbed.

Aside from the containment afforded by the barrier wall, the selected remedy will include collection of groundwater from the overburden layer. A shallow system would be installed along the interior limits of the barrier wall. The system would likely consist of a shallow collection pipe with pump stations as needed. The collected groundwater will be either piped to an adjacent site for treatment, or sent to the local POTW. Groundwater monitoring of the overburden aquifer will be performed to ensure that there is an inward gradient to the Site. After the cap is installed, EPA expects the overburden area under the cap to dewater in less than 10 years. Groundwater monitoring in the overburden aquifer and in the bedrock aquifer will be performed to confirm that the contamination is being contained in the waste management unit. In addition, monitoring will determine whether the neighboring GAF site remedy continues to capture the bedrock groundwater underlying the LCP Site.

While the financial costs of the selected alternative are relatively high, the costs are due to the many components and complex nature of this single operable unit. The cost of this remedy is significantly lower than the excavation/off-site removal alternative, so it is the more cost effective of the two alternatives that specifically address the PTW.

The selected remedy will prevent human and ecological exposure to Site contaminants in the soil, sediments, groundwater and building material. In addition, the selected remedy's cap will allow for future commercial use of the property. As contamination above acceptable risk levels will remain on the Site, five-year reviews will be performed.

The remedy was selected over other alternatives principally because it is expected to achieve substantial and long-term risk reduction through treatment of the PTW, as well as containment.

Based on information currently available, EPA believes the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the selected remedy will satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

Consistent with EPA Region 2's Clean and Green policy, EPA will evaluate the use of sustainable technologies and practices with respect to implementation of the selected remedy.

EPA recognizes that the selected remedy includes a treatment approach for PTW that is innovative; therefore, EPA is also identifying two contingency remedies in case the selected remedy does not meet the measures of success, which will be developed during the pre-design studies.

CONTINGENCY REMEDIES

If, after reviewing the pilot study results, EPA determines that treating the PTW to full depth is not technically practicable, EPA will use the first contingency remedy. The first contingency would be Alternative 4a, treatment of the PTW to mid-depth. If EPA determines that the treatment of the PTW waste is not meeting pre-set goals at any depth, then EPA will use the second contingency remedy, Alternative 3. Alternative 3 is the same as the preferred alternative, except without treatment of the PTW.

If EPA chooses to implement one of the contingency remedies, EPA will issue a decision document to record this change in the remedial approach.

Green Remediation Considerations

Green remediation practices can be incorporated into the selected remedy's planning and implementation of pre-design investigation and remediation as follows:

- Minimize number of field mobilizations
- Use local labor to reduce fuel consumption associated with driving to the Site
- Use ultra-low sulfur diesel or fuel-grade biodiesel as fuel for construction vehicles
- Schedule shipments of sulfur and clean fill to minimize the uses of fuel
- Dispose of steel at recycling facility if possible
- Use non-phosphate detergents for decontamination
- Use direct push technology, if feasible, for soil sampling to minimize waste production (drill cuttings) and the uses of fuel
- Schedule sampling to minimize shipping

STATUTORY DETERMINATIONS

As was previously noted, CERCLA §121(b)(1) mandates that a remedial action must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ treatment to permanently and significantly reduce the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants at a site. CERCLA §121(d) further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4).

Protection of Human Health and the Environment

The selected remedy, Alternative 4b, will be protective of human health and the environment through the containment of certain Site contamination. The planned capping system will prevent direct contact with contaminated soils thereby eliminating the risk posed by dermal contact and ingestion. The cap will also significantly reduce the potential for inhalation exposure to mercury vapor.

An impermeable geosynthetic membrane will be incorporated in the cap and will further prevent vaporization of mercury (and other contaminants) as well preventing rainwater infiltration into the underlying groundwater. A barrier wall will further enhance the containment afforded by the impermeable cap.

Sediments with unacceptable levels of contamination in the Northern Off-Site Ditch and in the downstream portion of the South Branch Creek will be excavated and placed under the cap thereby further reducing ecologic risk.

The selected remedy also will be protective of human health and the environment through the treatment of principal threat waste and overburden groundwater.

Areas with principal threat waste will be treated by mixing the contaminated soil with sulfur to convert the elemental mercury to mercuric sulfide to a depth of approximately 15 feet.

Long-term monitoring of the containment remedy and enforcement of institutional controls will ensure that remaining wastes will not impact human health and the environment through direct contact or impact to groundwater.

The selected remedy will provide adequate long-term control of risks to human health and the environment through treatment, capping, institutional controls and long-term monitoring. The selected remedy presents the fewest short-term risks of all action alternatives.

Compliance with ARARs

The selected remedy will comply with ARARs.

A list of ARARs can be found in Appendix Table 8 of this document.

Cost Effectiveness

EPA has determined that the selected remedy is cost-effective and represents a reasonable value. In making this determination, the following definition was used: A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 C.F.R. §300.430(f)(1)(ii)(D)).

EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (*i.e.*, were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short-term effectiveness).

Overall effectiveness was then compared to costs to determine cost-effectiveness.

The cost of implementing the selected remedy, Alternative 4b, is approximately $11.4 million more than the cost of implementing Alternative 3. The increased cost of Alternative 4b is related largely to the in-situ stabilization of the elemental mercury. This aspect of the selected remedy greatly increases the long-term effectiveness and permanence of the remedy in that the sulfur treatment ensures the reduction of the risk of exposure to the most dangerous levels of mercury even in the event of a failure of the containment system. The overall effectiveness secured by the additional cost of the selected remedy, over remedies that achieve protectiveness through containment only, was determined by EPA to be proportional to costs and hence the selected remedy represents a reasonable value for the money to be spent.

EPA evaluated Alternative 4b against Alternatives 5a and 5b for cost effectiveness. Alternatives 5a and 5b exceed the cost of the selected remedy by $49 million and $61 million, respectively. While excavation and off-site disposal of the PTW provides for long-term effectiveness and permanence in addressing Site risks, these remedies fall short of the goal of reducing toxicity, mobility and volume through treatment attained by Alternative 4b. Furthermore, the short-term negative impact of the excavation and off-site disposal is considerably greater than the negative impact which will be attributed to the treatment phase of the selected remedy.

EPA found that the additional benefits derived from the off-site disposal remedies do not justify the significant increased costs over the selected remedy and, therefore, EPA determined that the selected remedy is cost effective as it has been determined to provide the greatest overall protectiveness for its present worth costs.

Utilization of Permanent Solutions and Alternative Treatment Technologies

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs to the extent practicable, EPA has determined that the selected remedy provides the best balance

of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and State and community acceptance.

The selected remedy will provide adequate long-term control of risks to human health and the environment through containment of Site-related containments, treatment of the principal threat wastes, long-term monitoring and institutional controls. The selected remedy has the least short-term risks of the action alternatives. The selected remedy employs an innovative technology that could be applied at other sites having soils impacted with high levels of elemental mercury.

Preference for Treatment as a Principal Element

Through the use of sulfur to convert elemental mercury to mercuric sulfide, the selected remedy meets the statutory preference for the use of remedies that employ treatment that reduces toxicity, mobility or volume as a principal element to address the principal threats at the Site.

Five-Year Review Requirements

The selected remedy will result in contamination remaining above levels that allow for unlimited use and unrestricted exposure. Therefore, a statutory review will be conducted within five years of construction completion for the Site to ensure that the remedy is, or will be, protective of human health and the environment.

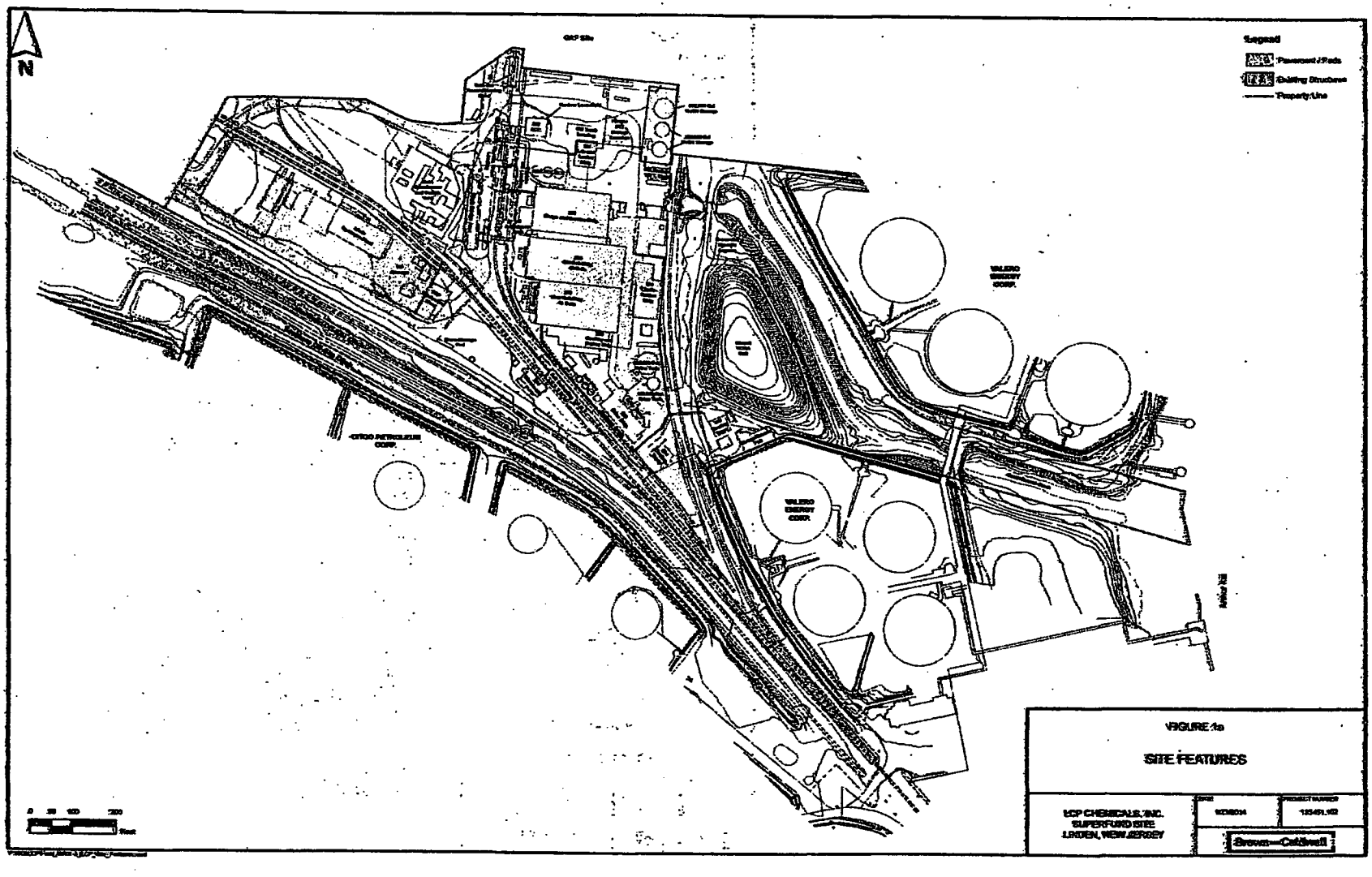
DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the LCP Site was released for public comment on August 21, 2013. An extension was requested by interested parties. On September 17, 2013, EPA granted an extension of the comment period. The comment period closed on October 21, 2013.

The Proposed Plan identified Alternative 4b (full containment and full depth PTW stabilization) as EPA's preferred alternative. EPA reviewed all written and verbal comments submitted during the public comment period. The comments received are documented in the Responsiveness Summary. EPA made no significant changes to the remedy as originally identified in the Proposed Plan.

APPENDIX 1

FIGURES


N
Legend
Pavement / Pads
Existing Structures
Property Line
VALERO ENERGY CORP.
VALERO ENERGY CORP.
CITGO PETROLEUM CORP.
Arthur Kill
0 50 100 200
Feet
FIGURE 1a
SITE FEATURES
UCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
Brown—Caldwell

R2-0062896

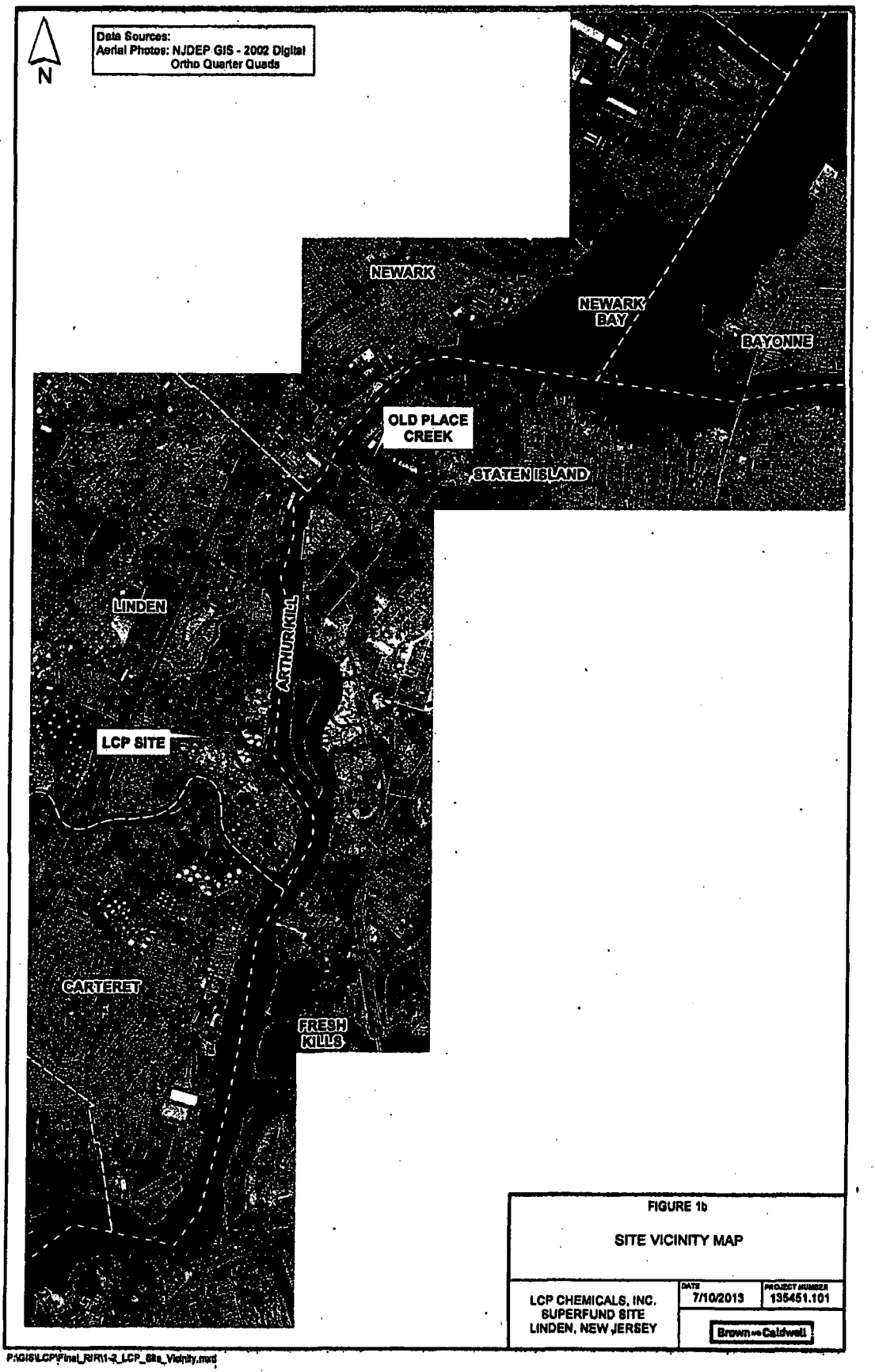
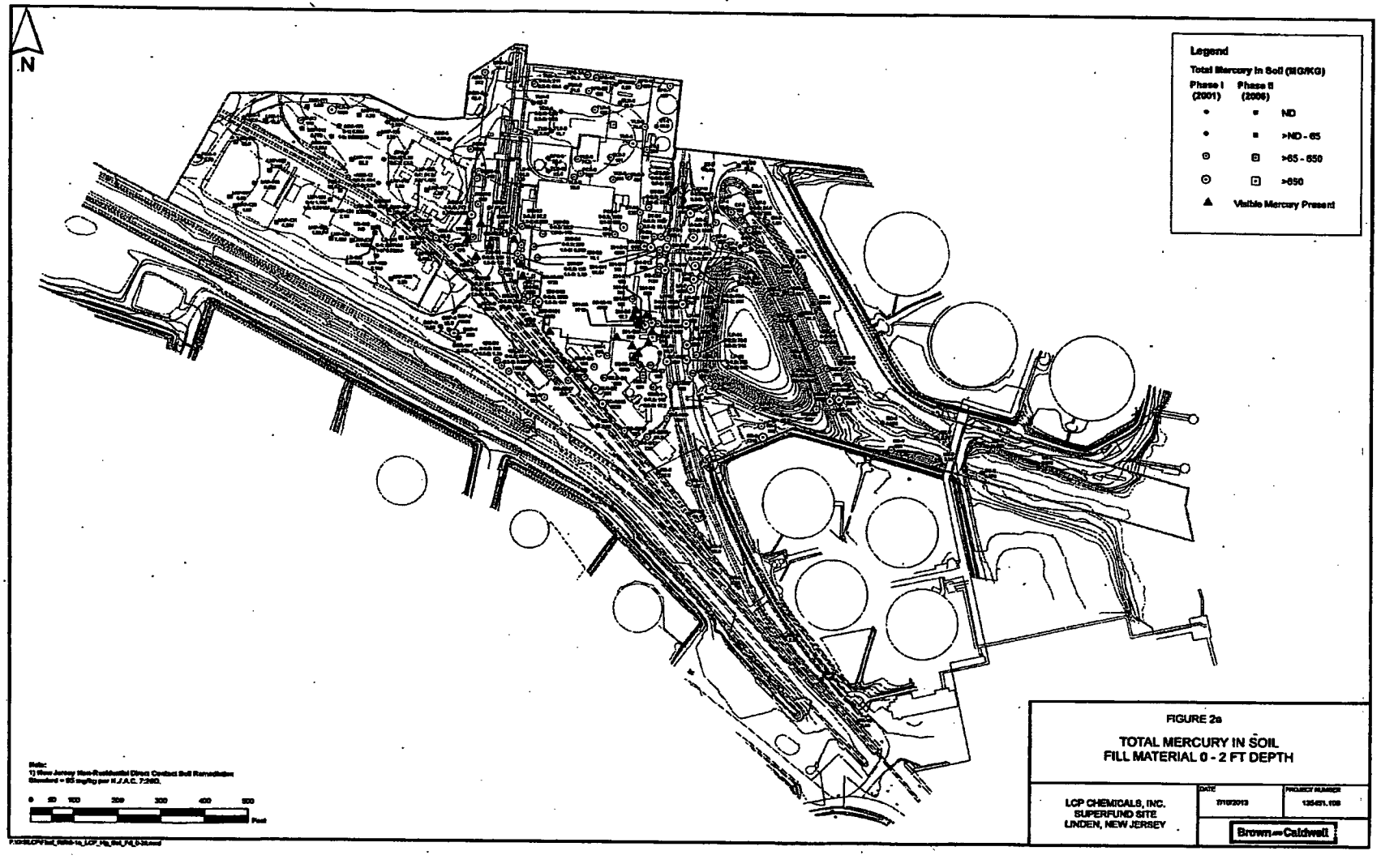


FIGURE 1b

SITE VICINITY MAP

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 7/10/2013	PROJECT NUMBER 135451.101
	Brown AND Caldwell	

P:\GIS\LCP\Final_RI\R\1-2_LCP_Site_Vicinity.mxd


N
Legend
Total Mercury in Soil (MG/KG)
Phase I (2001)
Phase II (2006)
ND
>ND - 65
>65 - 650
>650
Visible Mercury Present
Note:
1) New Jersey Non-Residential Direct Contact Soil Remediation Standard = 65 mg/kg per N.J.A.C. 7:26D.
0 50 100 200 300 400 500
Feet
FIGURE 2a
TOTAL MERCURY IN SOIL
FILL MATERIAL 0 - 2 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
PROJECT NUMBER
Brown AND Caldwell

R2-0062898

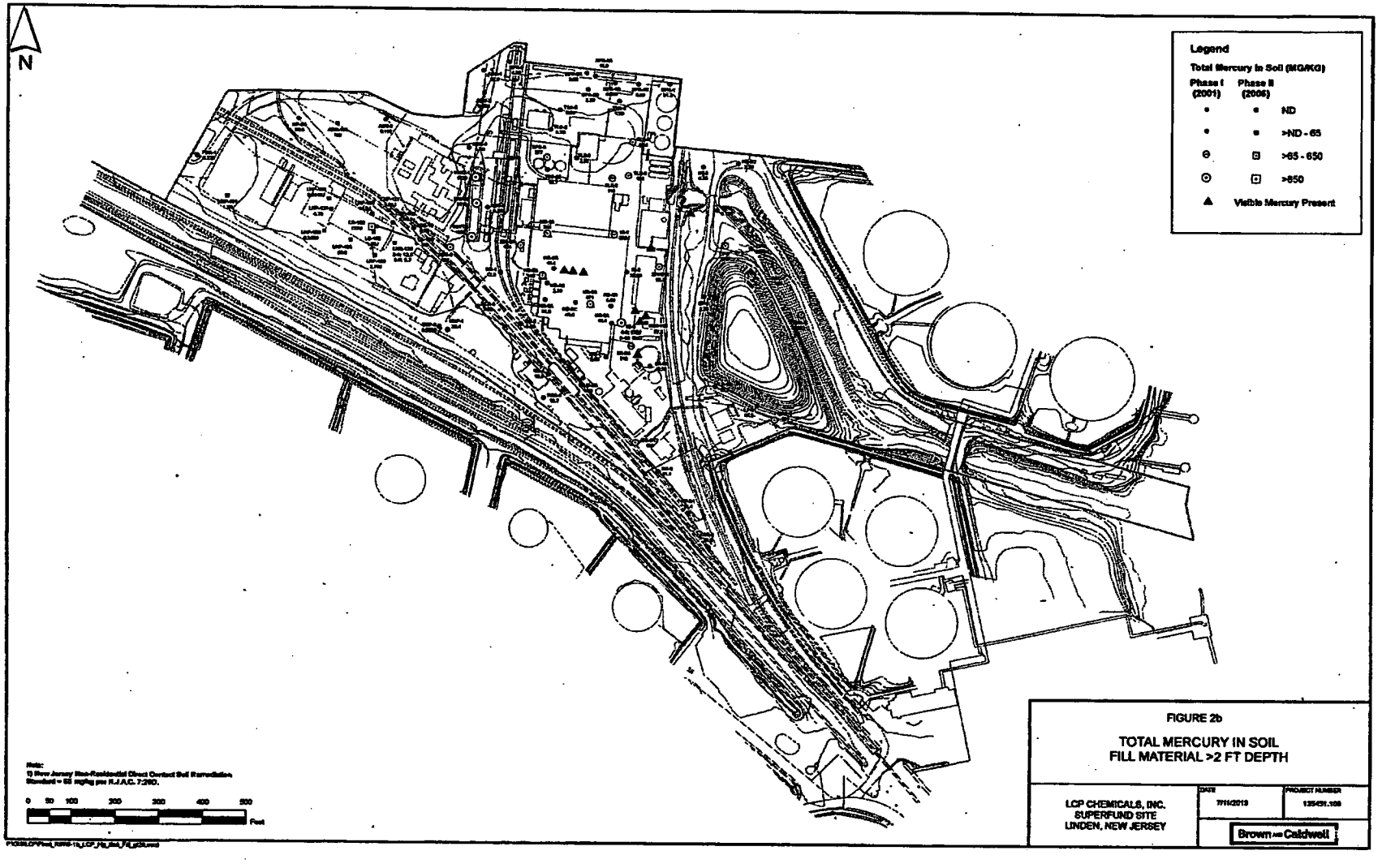


FIGURE 2b

TOTAL MERCURY IN SOIL
FILL MATERIAL >2 FT DEPTH

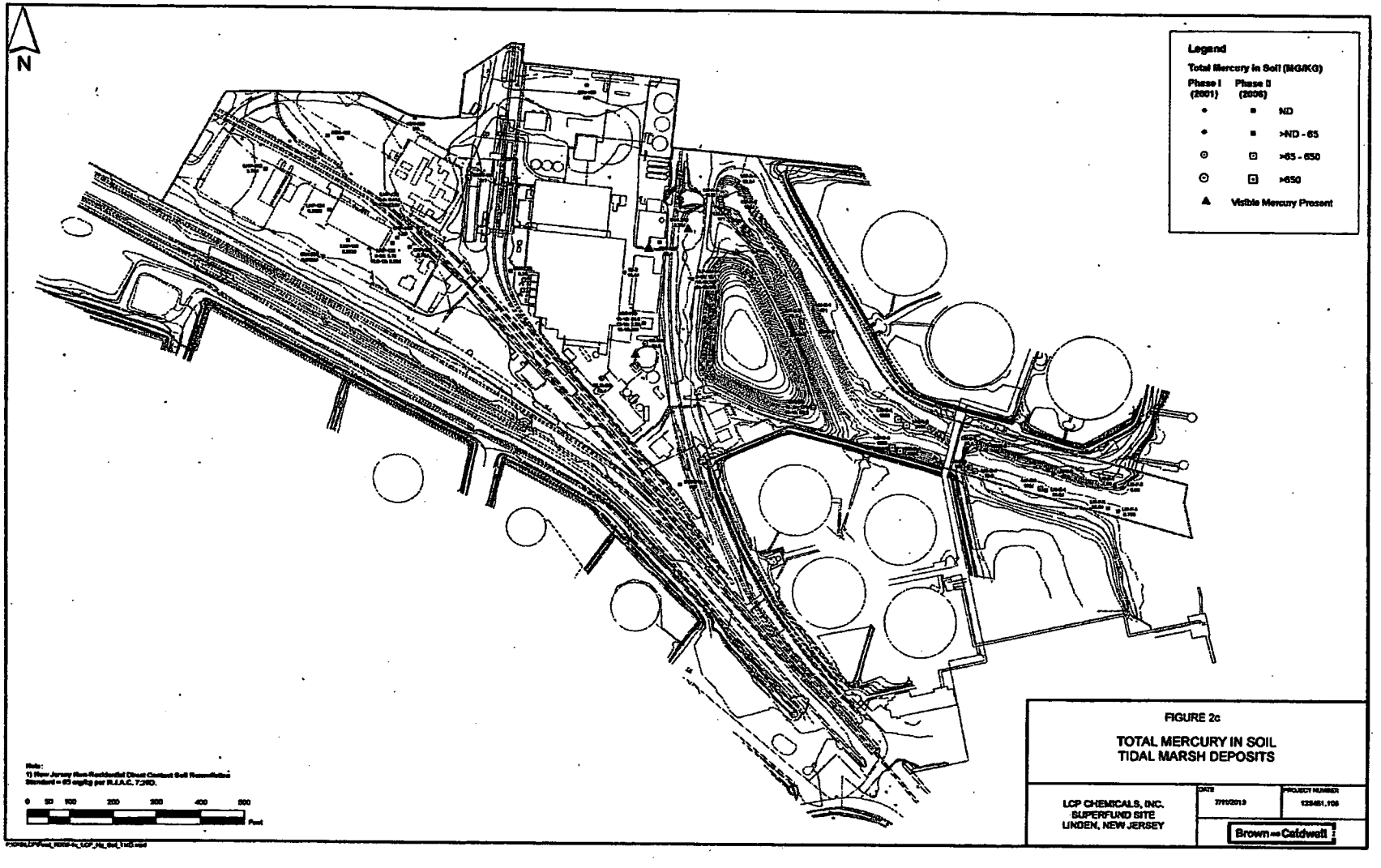
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 7/11/2019

PROJECT NUMBER 135431.100

Brown AND Caldwell

R2-0062899


N
Legend
Total Mercury in Soil (MG/KG)
Phase I (2001)
Phase II (2006)
ND
>ND - 65
>65 - 650
>650
Visible Mercury Present
Note:
1) New Jersey Non-Residential Direct Contact Soil Remediation Standard = 65 mg/kg per N.J.A.C. 7:26D.
0 50 100 200 300 400 500
Feet
FIGURE 2c
TOTAL MERCURY IN SOIL
TIDAL MARSH DEPOSITS
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
7/11/2013
PROJECT NUMBER
Brown AND Caldwell

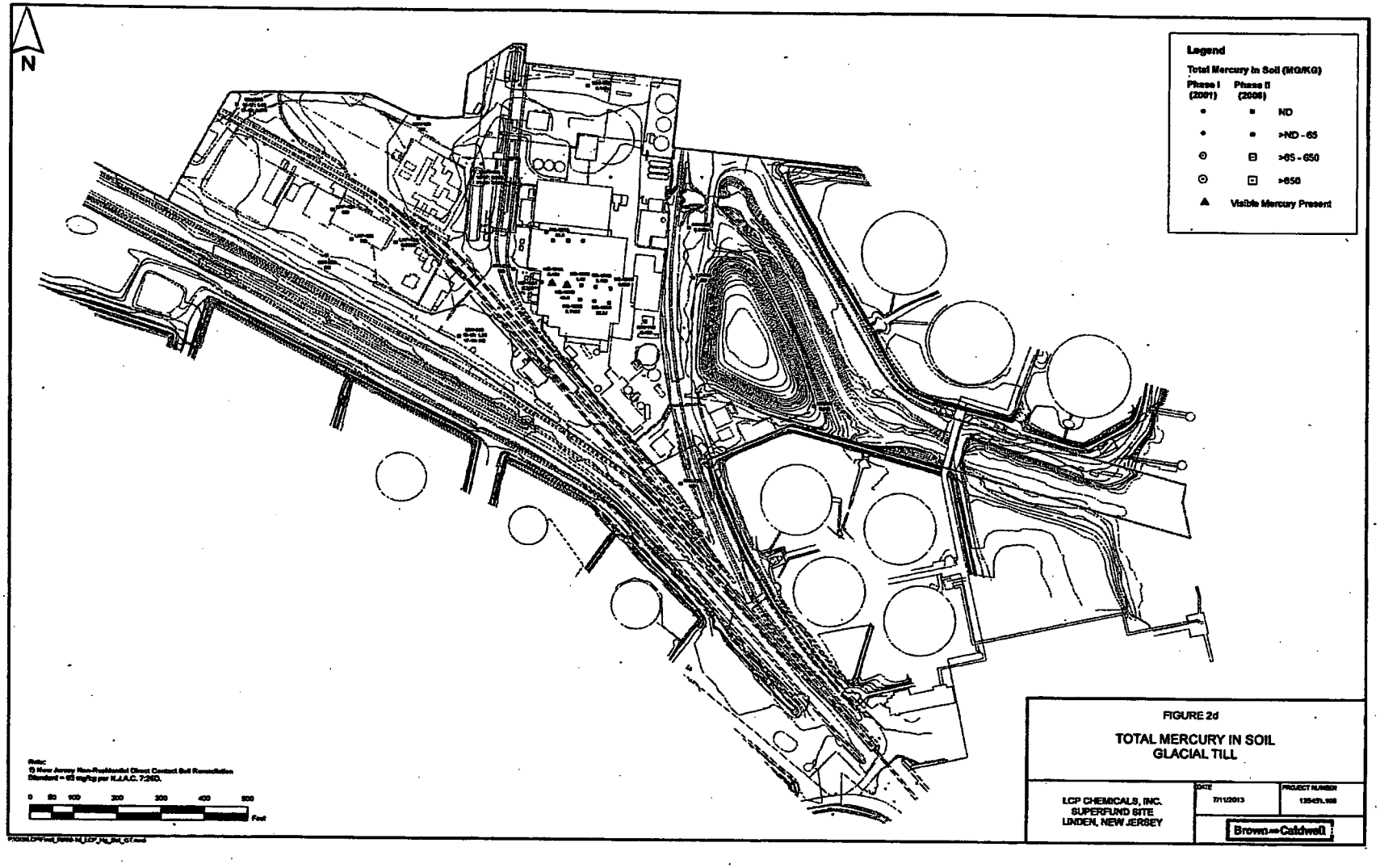
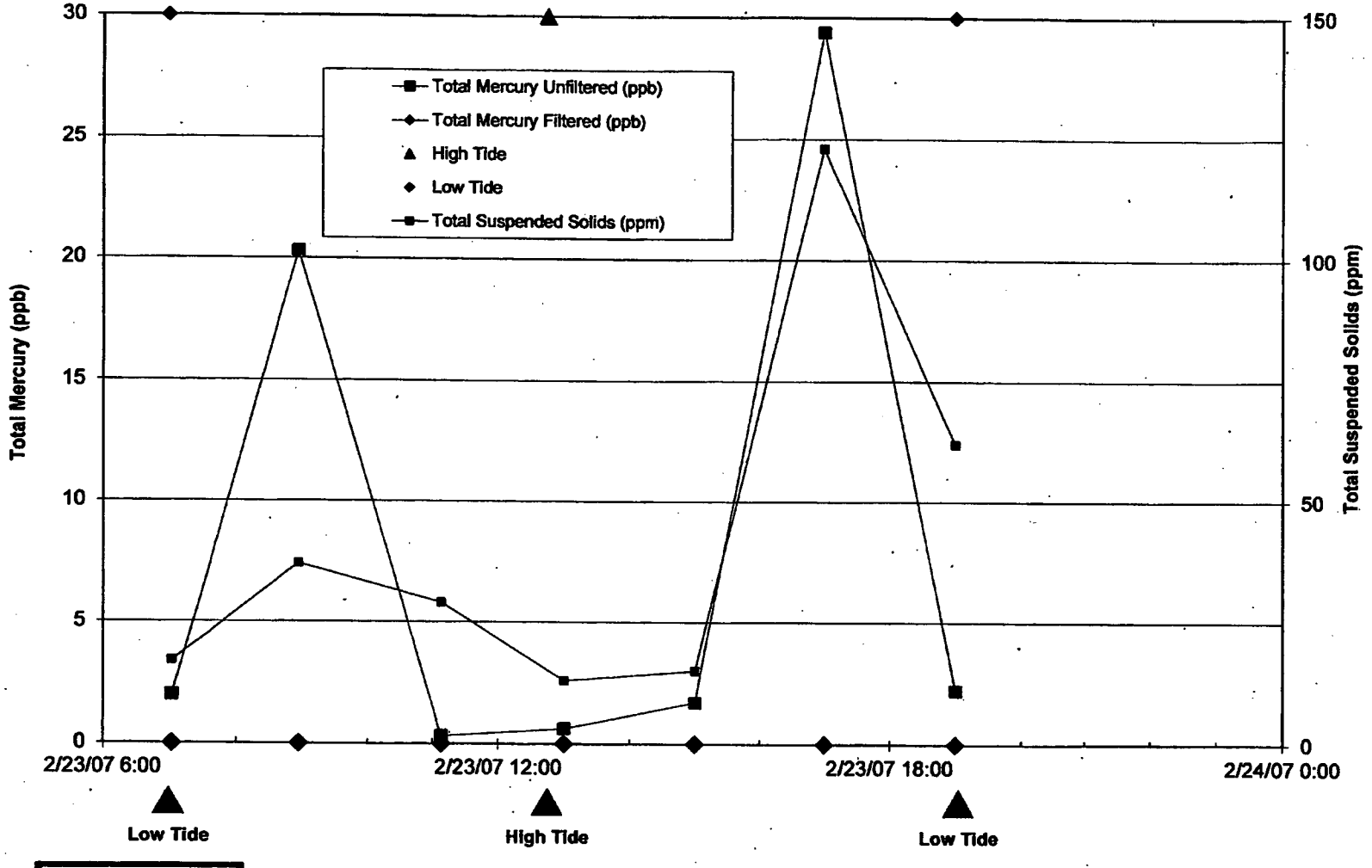

N
Legend
Total Mercury in Soil (MG/KG)
Phase I (2001)
Phase II (2008)
ND
>ND - 65
>65 - 650
>650
Visible Mercury Present
Notes:
1) New Jersey Non-Residential Direct Contact Soil Remediation Standard = 65 mg/kg per N.J.A.C. 7:26D.
0 50 100 200 300 400 500
Feet
FIGURE 2d
TOTAL MERCURY IN SOIL
GLACIAL TILL
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
7/11/2013
PROJECT NUMBER
135431.100
Brown AND Caldwell

FIGURE 3
Relationship Between Tide and Mercury Concentration in Surface Water
LCP Chemicals Inc., Linden, New Jersey



Brown AND Caldwell

P:\LCP\137005(Final_RI_Report)\Final_RIR_Document\Figures\Section_6\Source_Files\3_SW_Hg_Tide.xlsx\Chart - Lab Data
8/16/2013

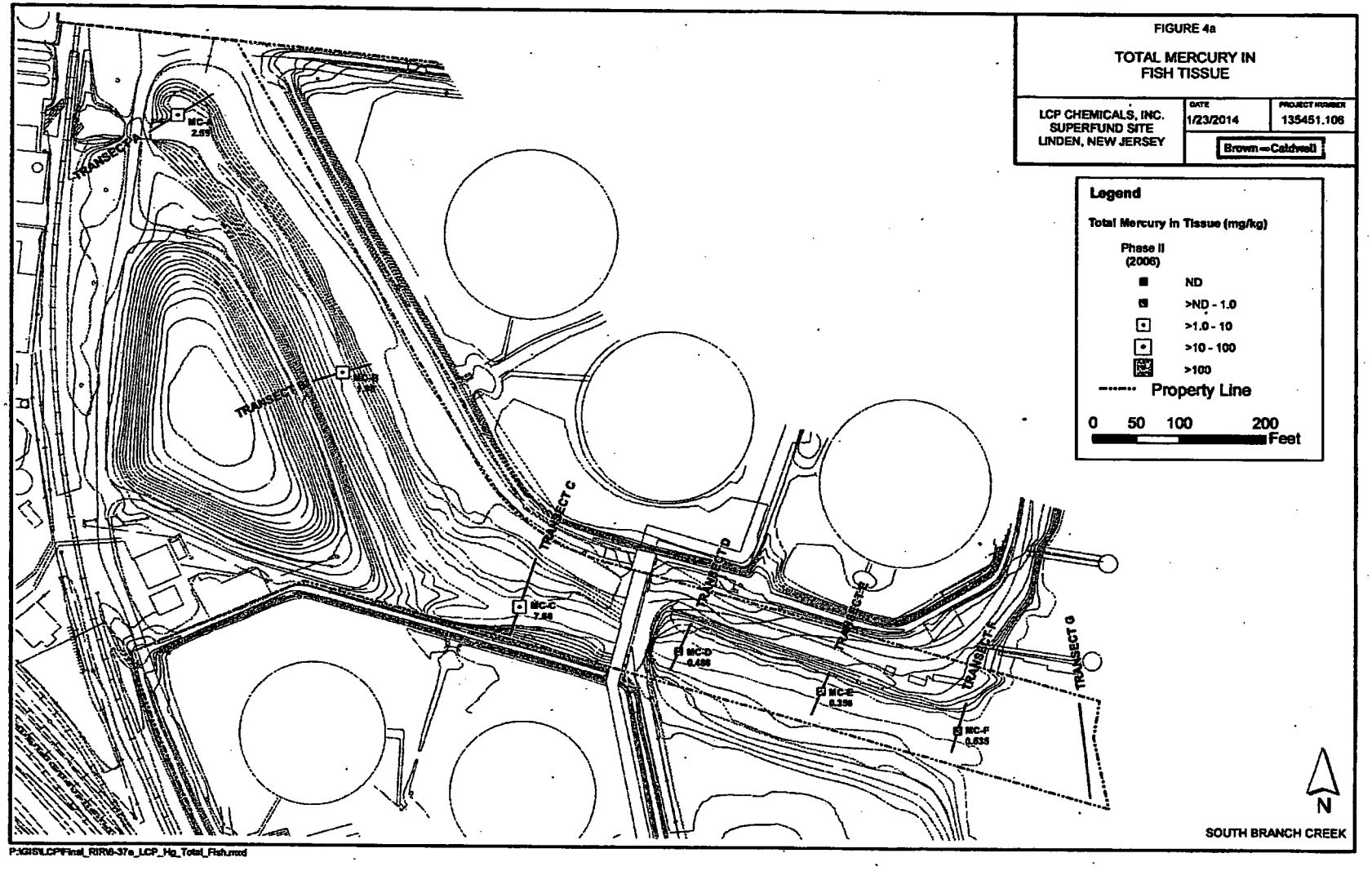
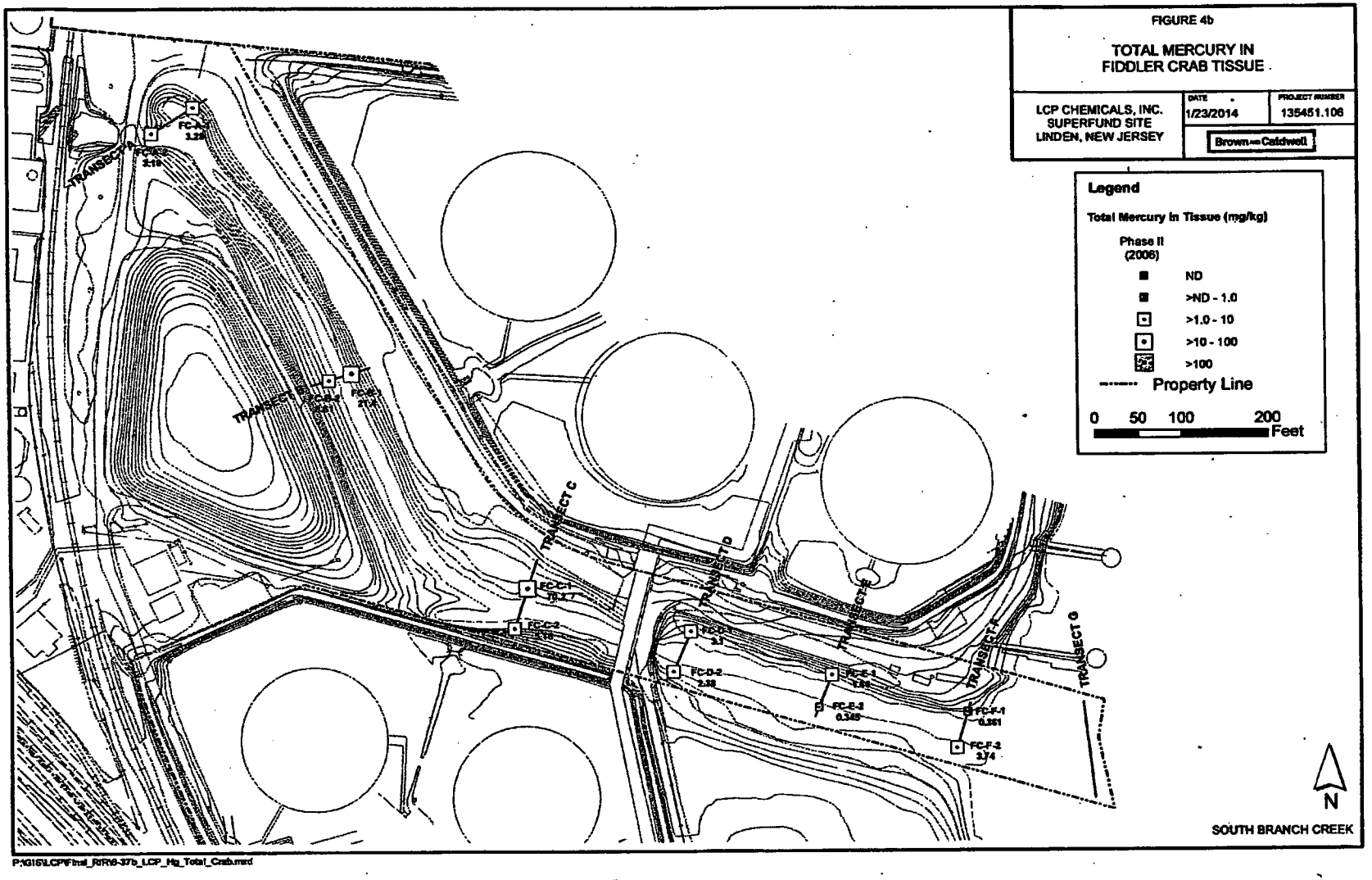


FIGURE 4a
TOTAL MERCURY IN FISH TISSUE
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total Mercury in Tissue (mg/kg)
Phase II (2006)
ND
>ND - 1.0
>1.0 - 10
>10 - 100
>100
Property Line
0 50 100 200 Feet
N
SOUTH BRANCH CREEK
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
MC-A 2.69
MC-B 1.98
MC-C 7.68
MC-D 0.496
MC-E 0.356
MC-F 0.635
P:\GIS\LCP\Final_RIR\6-37a_LCP_Hg_Total_Fish.mxd



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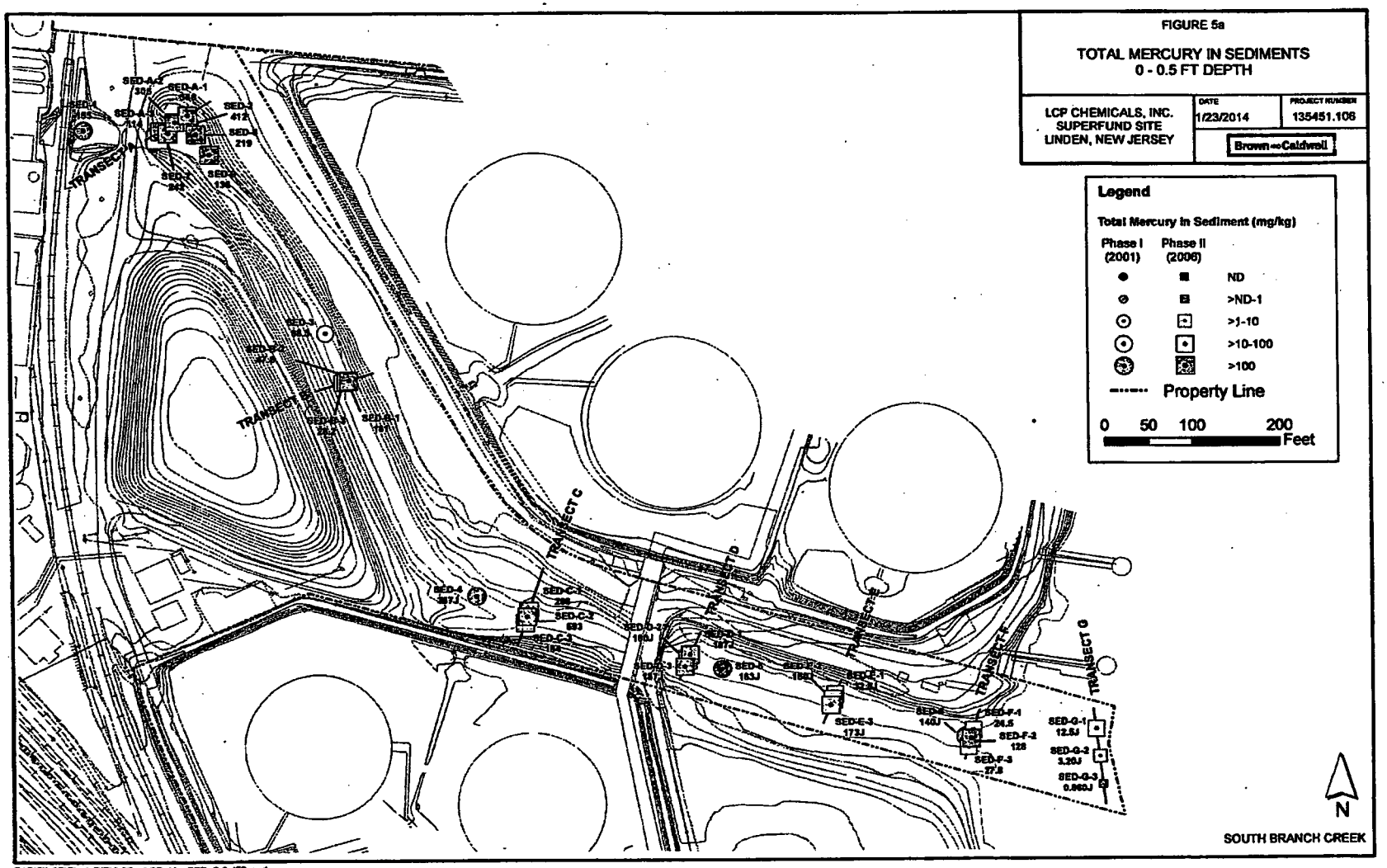


FIGURE 5a
TOTAL MERCURY IN SEDIMENTS
0 - 0.5 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total Mercury in Sediment (mg/kg)
Phase I (2001)
Phase II (2006)
ND
>ND-1
>1-10
>10-100
>100
Property Line
0 50 100 200
Feet
N
SOUTH BRANCH CREEK
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
SED-A-1
SED-A-2
SED-A-3
SED-A-4
SED-B-1
SED-B-2
SED-B-3
SED-C-1
SED-C-2
SED-C-3
SED-D-1
SED-D-2
SED-D-3
SED-E-1
SED-E-2
SED-E-3
SED-F-1
SED-F-2
SED-F-3
SED-G-1
SED-G-2
SED-G-3
SED-1
SED-2
SED-3
SED-4
P:\GIS\LCP\Final_RIR\6-25a_LCP_Hg_SED_0-0pt5ft.mxd

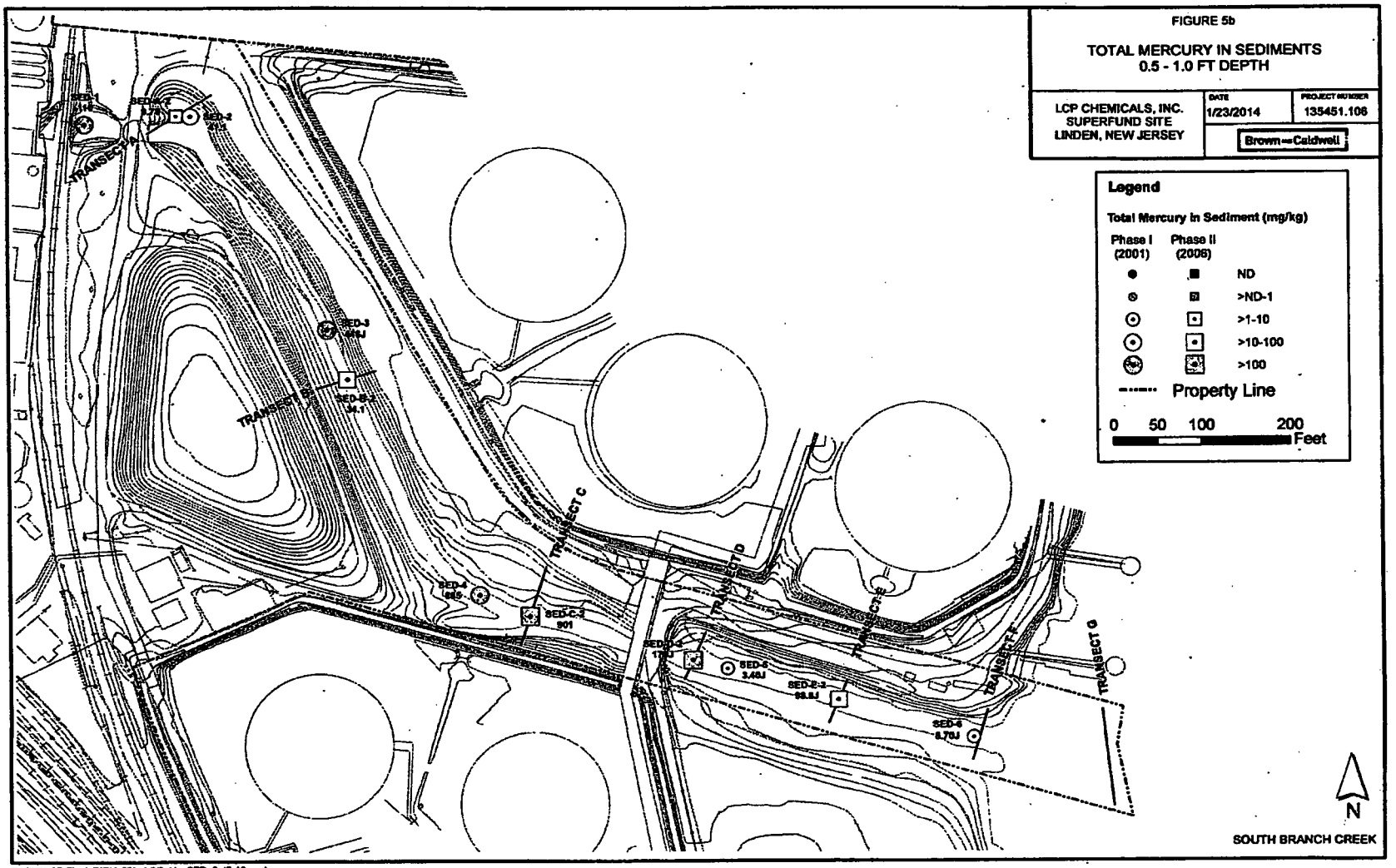


FIGURE 5b

TOTAL MERCURY IN SEDIMENTS
0.5 - 1.0 FT DEPTH

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 1/23/2014	PROJECT NUMBER 135451.106
	Brown AND Caldwell	

Legend

Total Mercury in Sediment (mg/kg)

Phase I (2001)	Phase II (2006)	
●	■	ND
⊗	⊡	>ND-1
⊙	⊡	>1-10
⊙	⊡	>10-100
⊙	⊡	>100

Property Line

0 50 100 200 Feet

P:\GIS\LCP\Final_RIR\9-25b_LCP_Hg_SED_0pt5-1ft.mxd

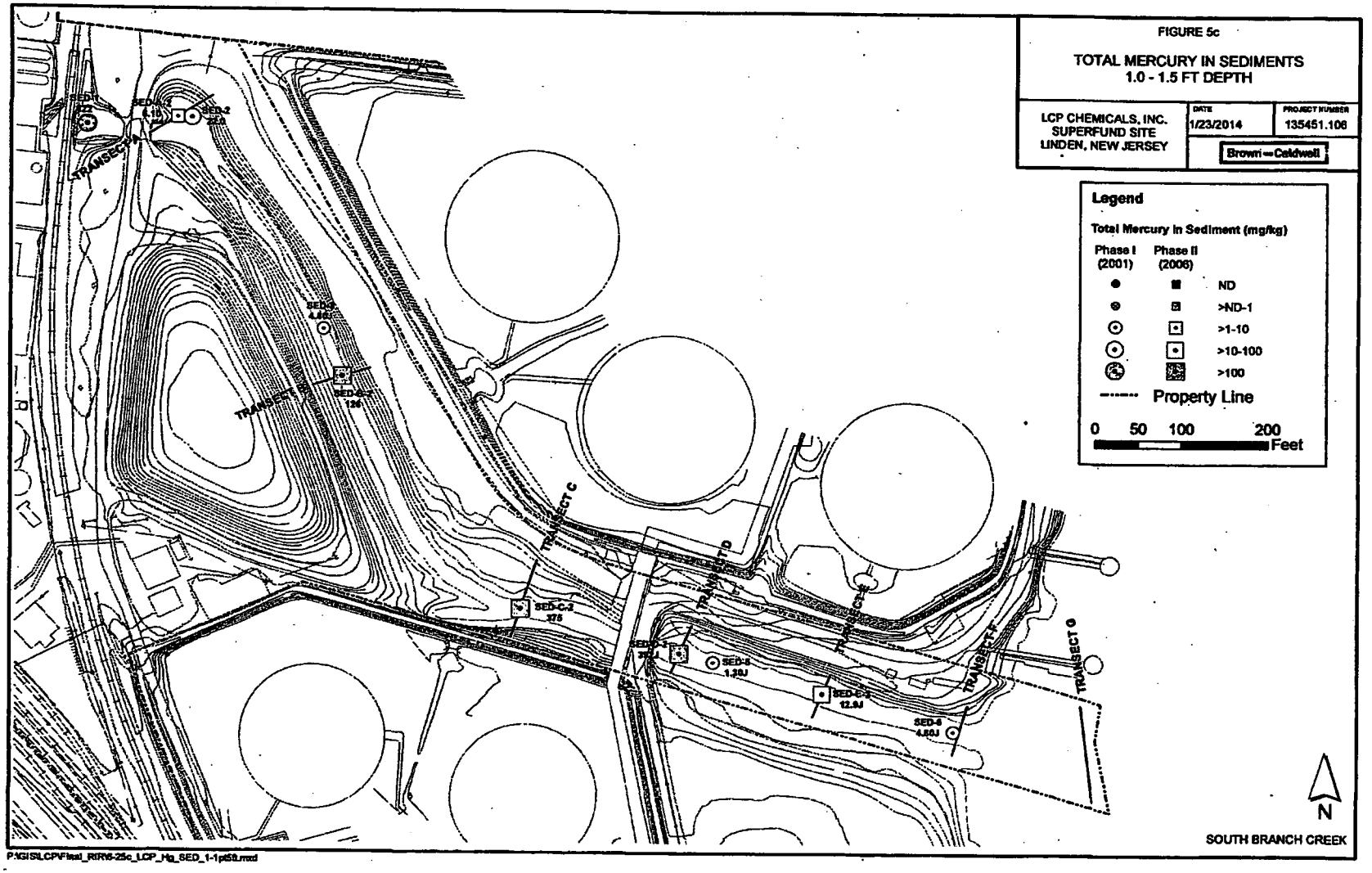


FIGURE 5c
TOTAL MERCURY IN SEDIMENTS
1.0 - 1.5 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total Mercury in Sediment (mg/kg)
Phase I (2001)
Phase II (2006)
ND
>ND-1
>1-10
>10-100
>100
Property Line
0 50 100 200
Feet
N
SOUTH BRANCH CREEK
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
SED-1
SED-2
SED-3
SED-4
SED-5
SED-6
SED-7
SED-8
SED-C-2
SED-C-3
SED-C-4
P:\GIS\LCP\Final_RIR\5-25c_LCP_Hg_SED_1-1pt5ft.mxd

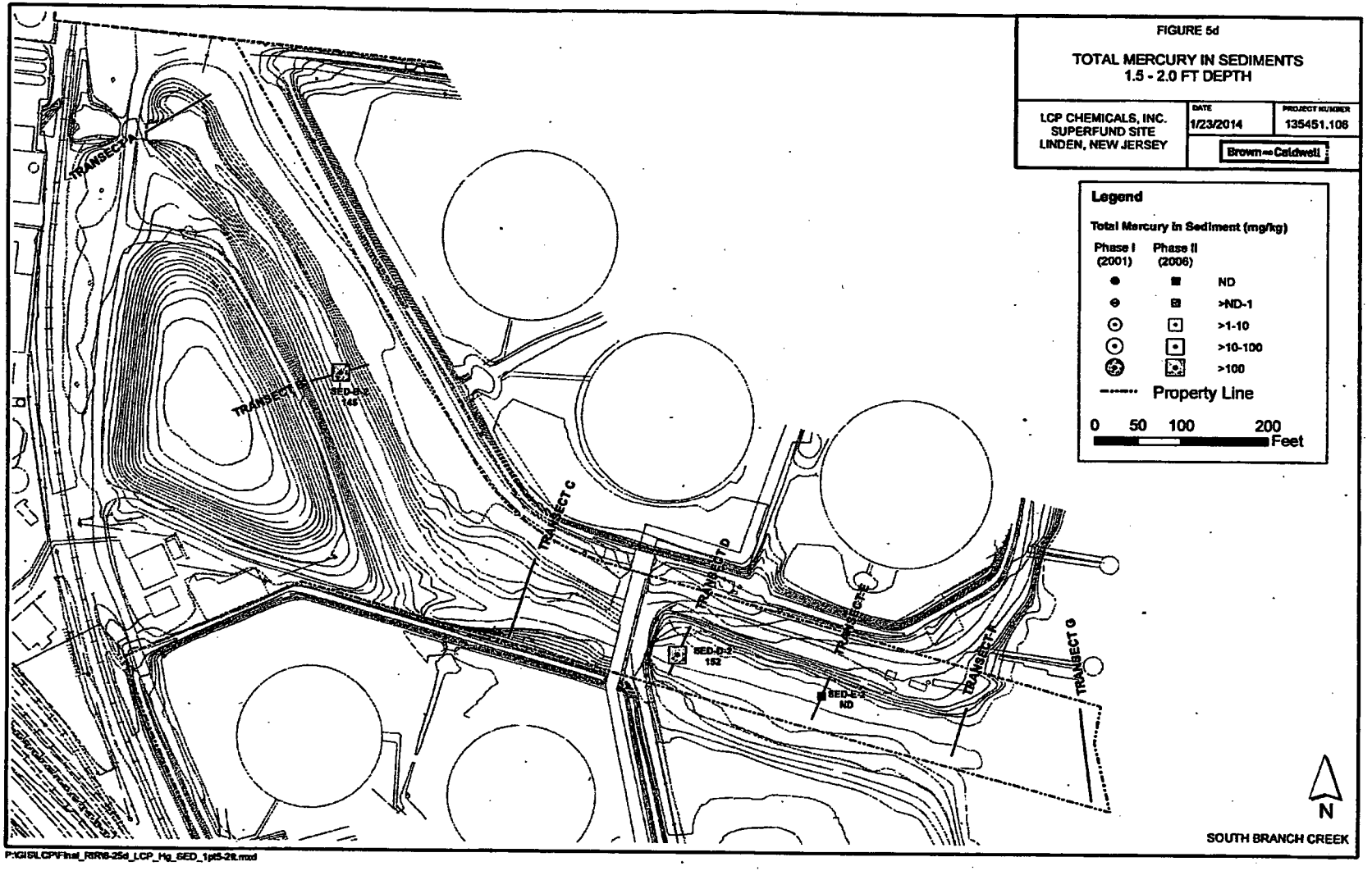


FIGURE 5d

TOTAL MERCURY IN SEDIMENTS
1.5 - 2.0 FT DEPTH

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 1/23/2014	PROJECT NUMBER 135451.108
	Brown AND Caldwell	

P:\GIS\LCP\Final_RIR\6-25d_LCP_Hg_SED_1pt5-2ft.mxd

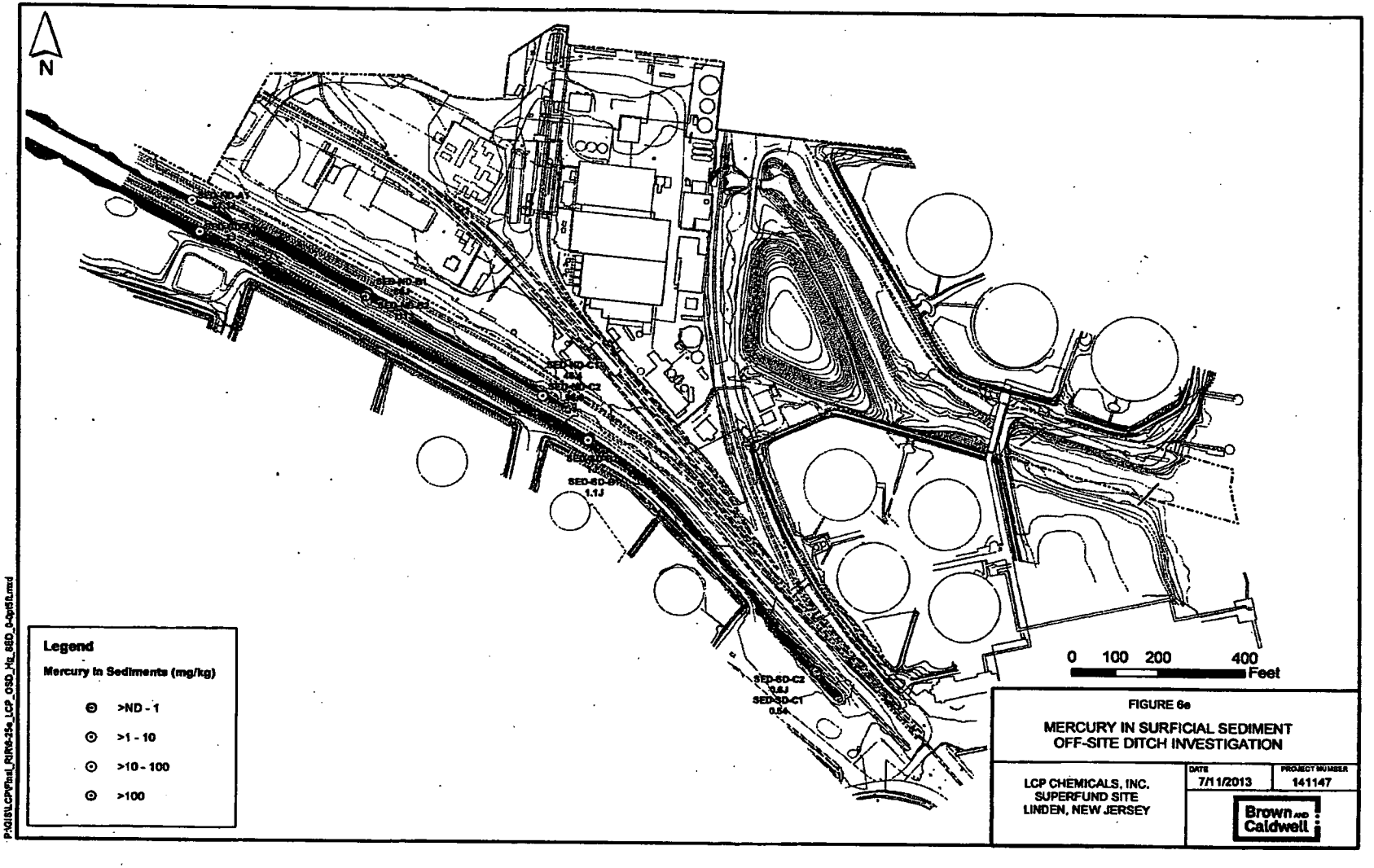


FIGURE 6e

MERCURY IN SURFICIAL SEDIMENT
OFF-SITE DITCH INVESTIGATION

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
7/11/2013	141147

Brown AND Caldwell

P:\GIS\LCP\Final_RI\R4-25a_LCP_OSD_Hg_SSD_0-qpt5.mxd

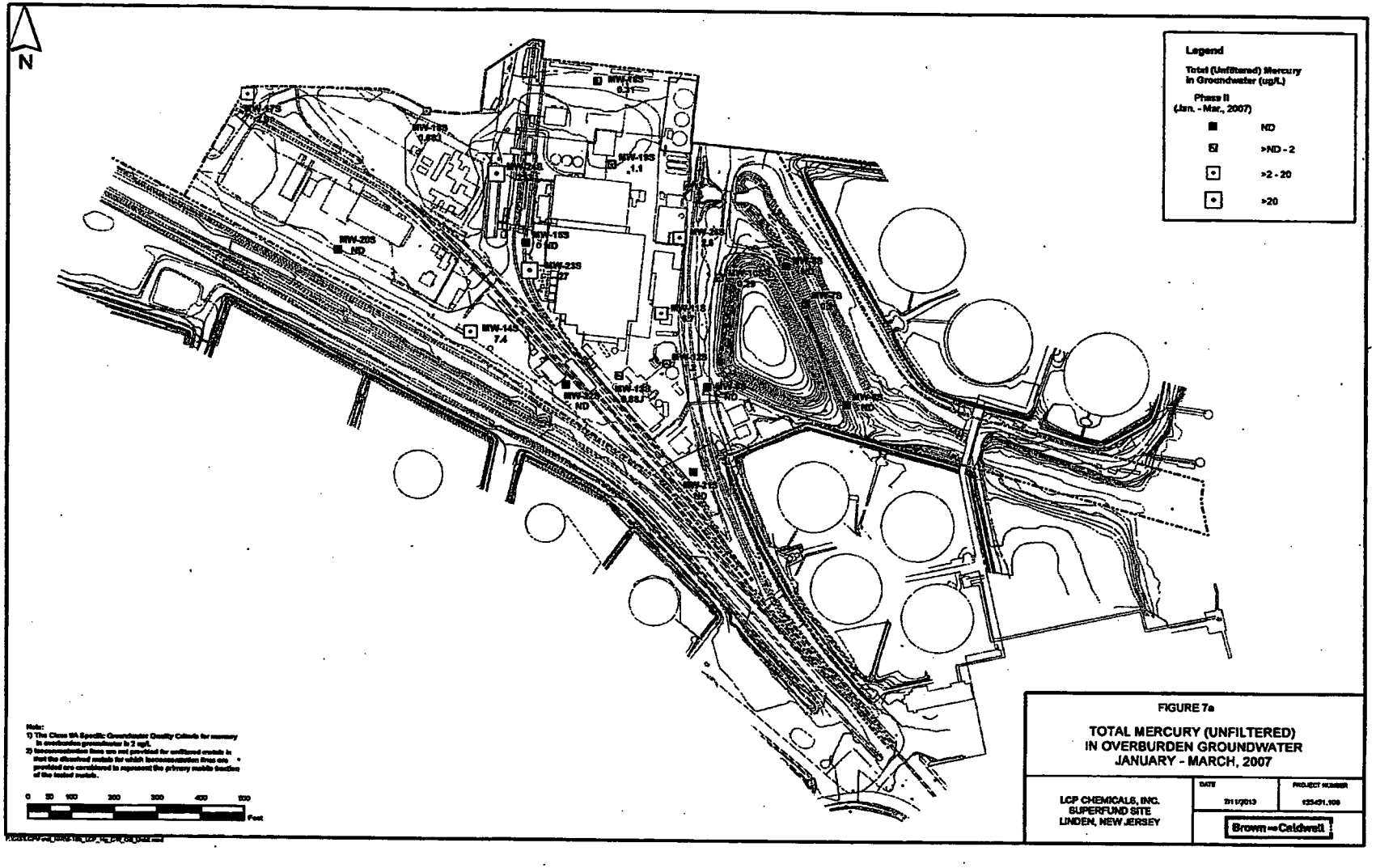


FIGURE 7a

TOTAL MERCURY (UNFILTERED) IN OVERBURDEN GROUNDWATER JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 7/11/2013

PROJECT NUMBER 135491.109

Brown AND Caldwell

R2-0062910

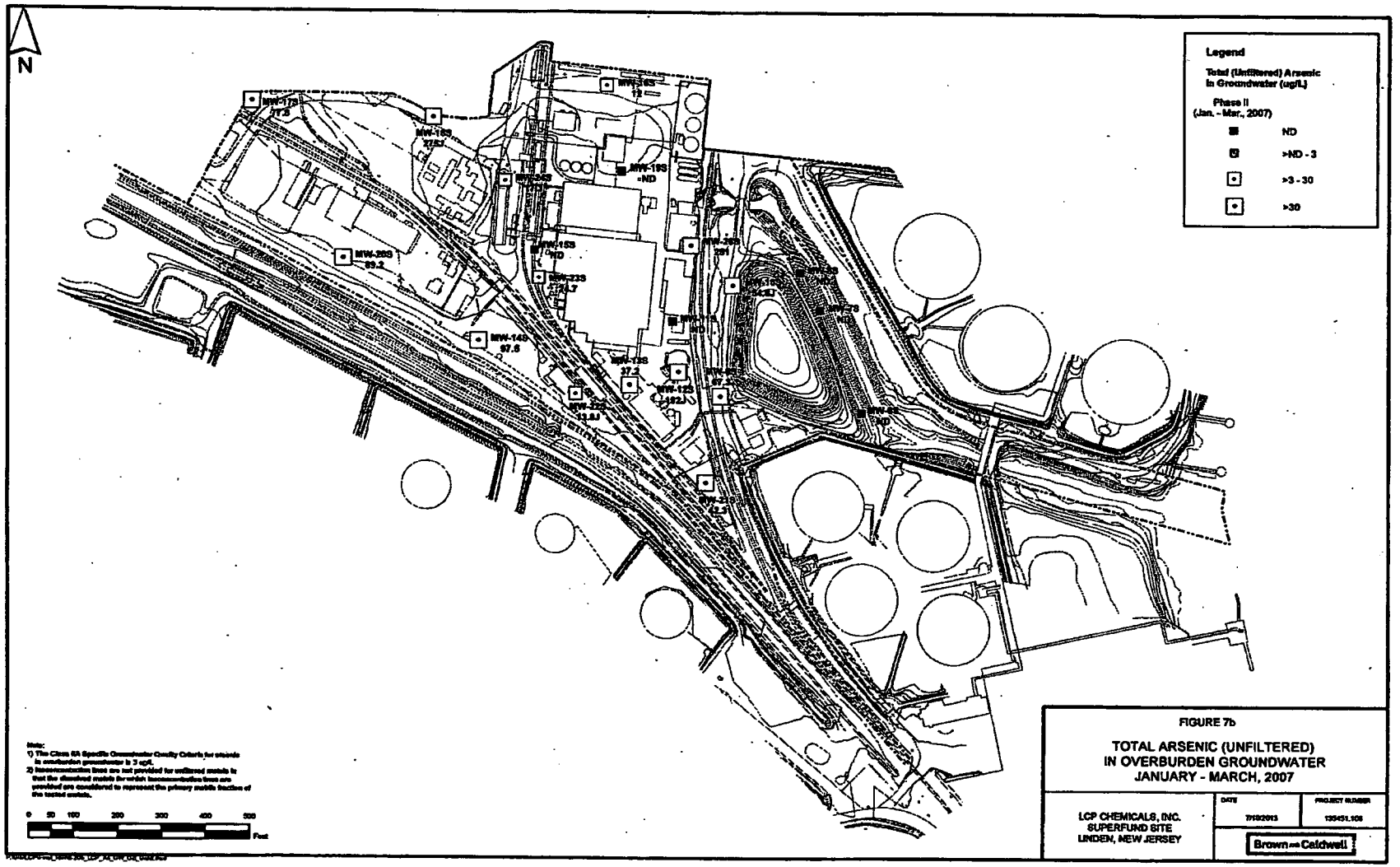


FIGURE 7b

TOTAL ARSENIC (UNFILTERED)
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 7/13/2013	PROJECT NUMBER 135451.105
	Brown AND Caldwell	

R2-0062911

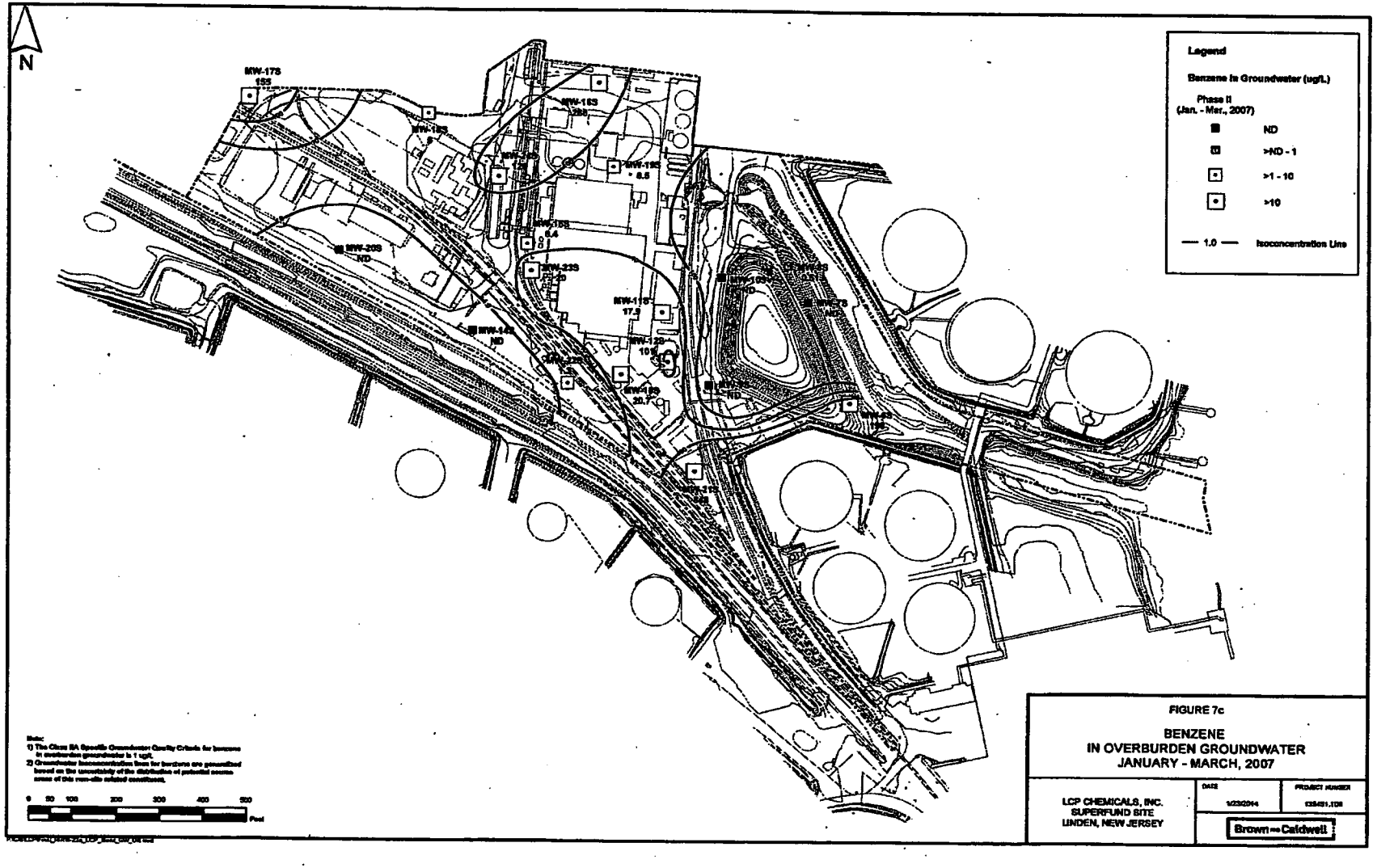


FIGURE 7c

BENZENE
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 1/23/2014

PROJECT NUMBER 03451.T08

Brown AND Caldwell

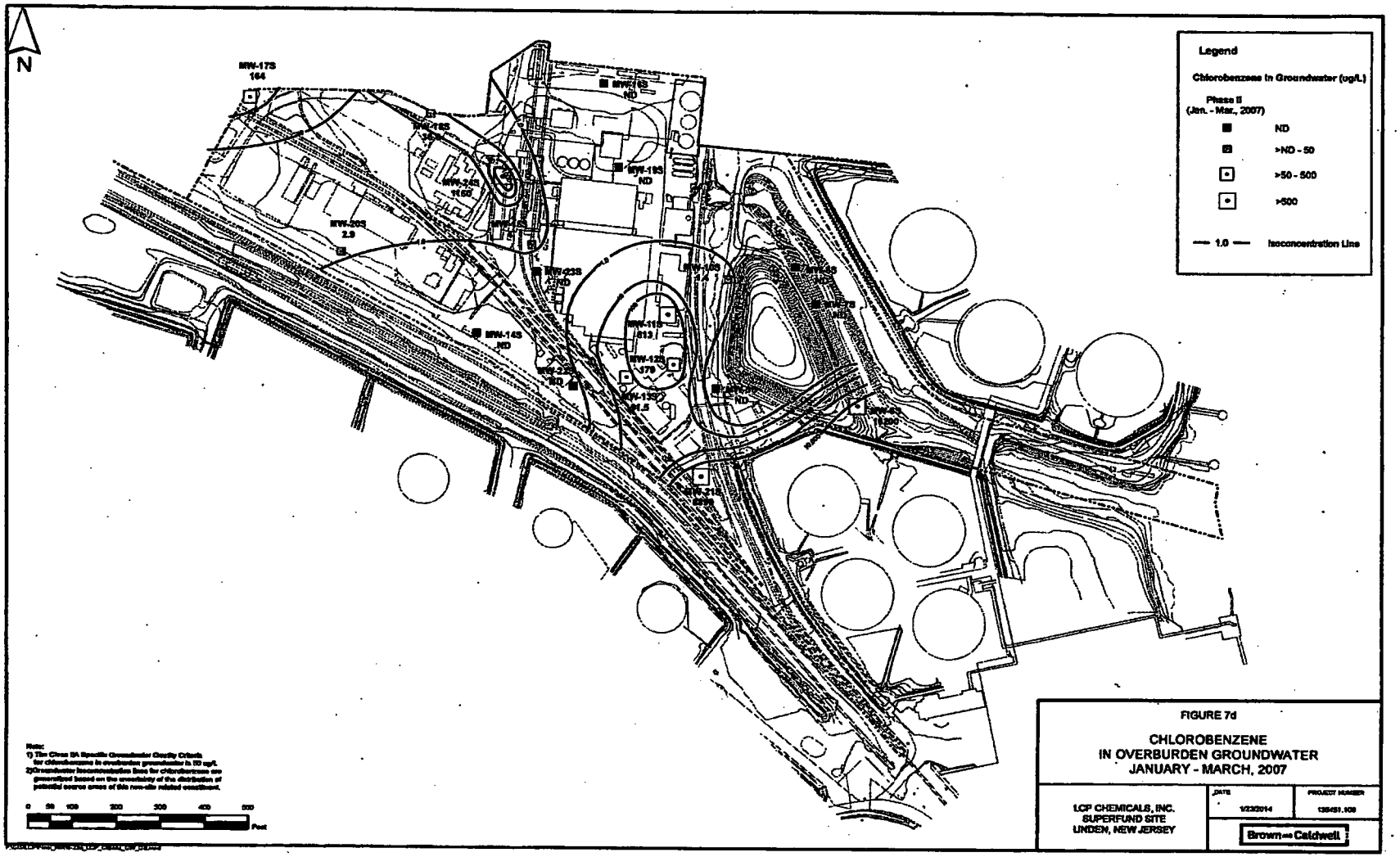


FIGURE 7d

CHLOROBENZENE
IN OVERBURDEN GROUNDWATER
JANUARY - MARCH, 2007

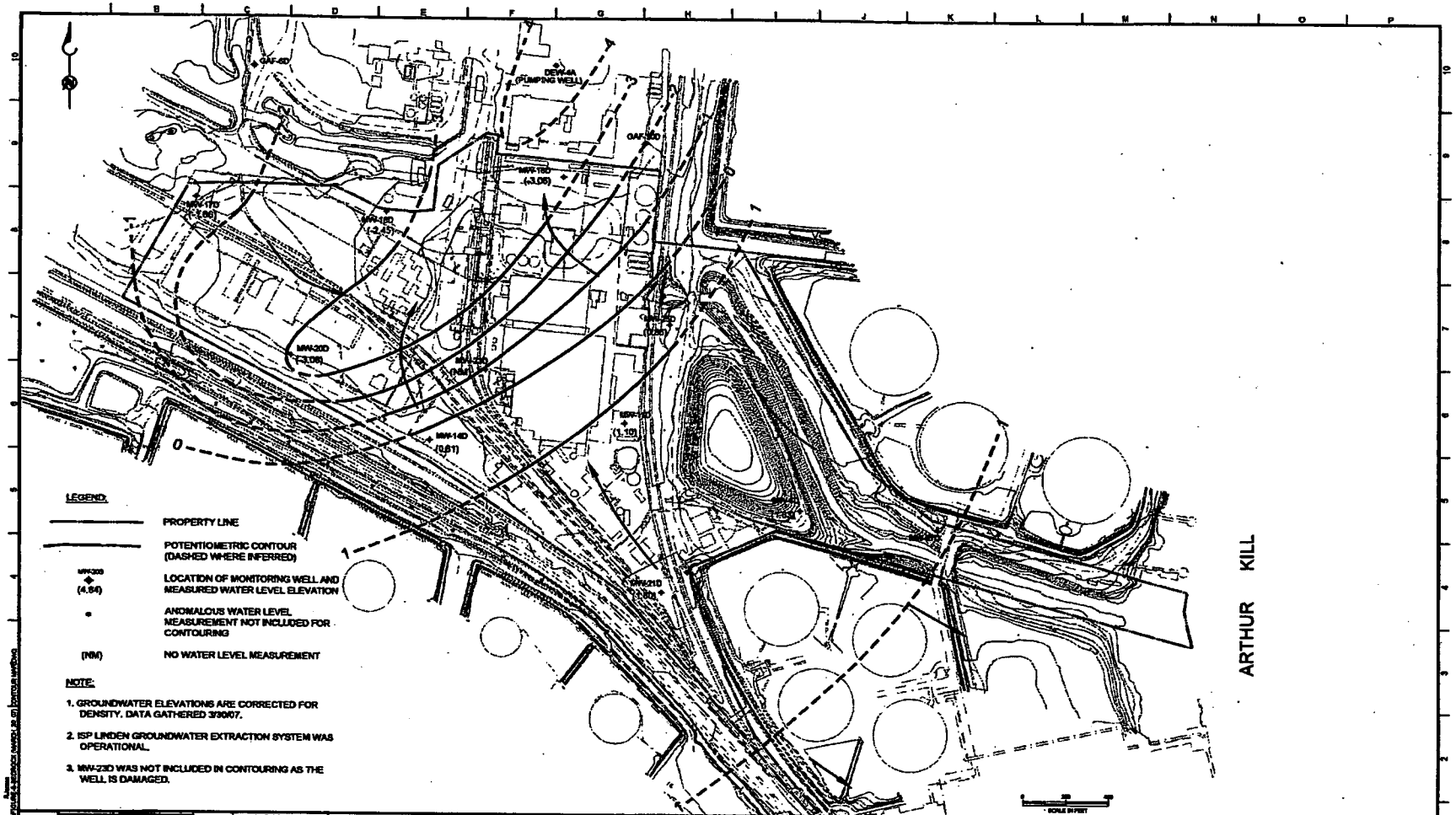
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE 1/23/2014

PROJECT NUMBER 135491.109

Brown AND Caldwell

R2-0062913



Brown AND Caldwell
UPPER SADDLE RIVER, NEW JERSEY
N.J. C.A. 24GA28043100

LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

FIGURE 6
CORRECTED[1] POTENTIOMETRIC SURFACE CONTOUR MAP
BEDROCK WATER BEARING ZONE
(MARCH 30, 2007)
LCP REMEDIAL INVESTIGATION

R2-0062914

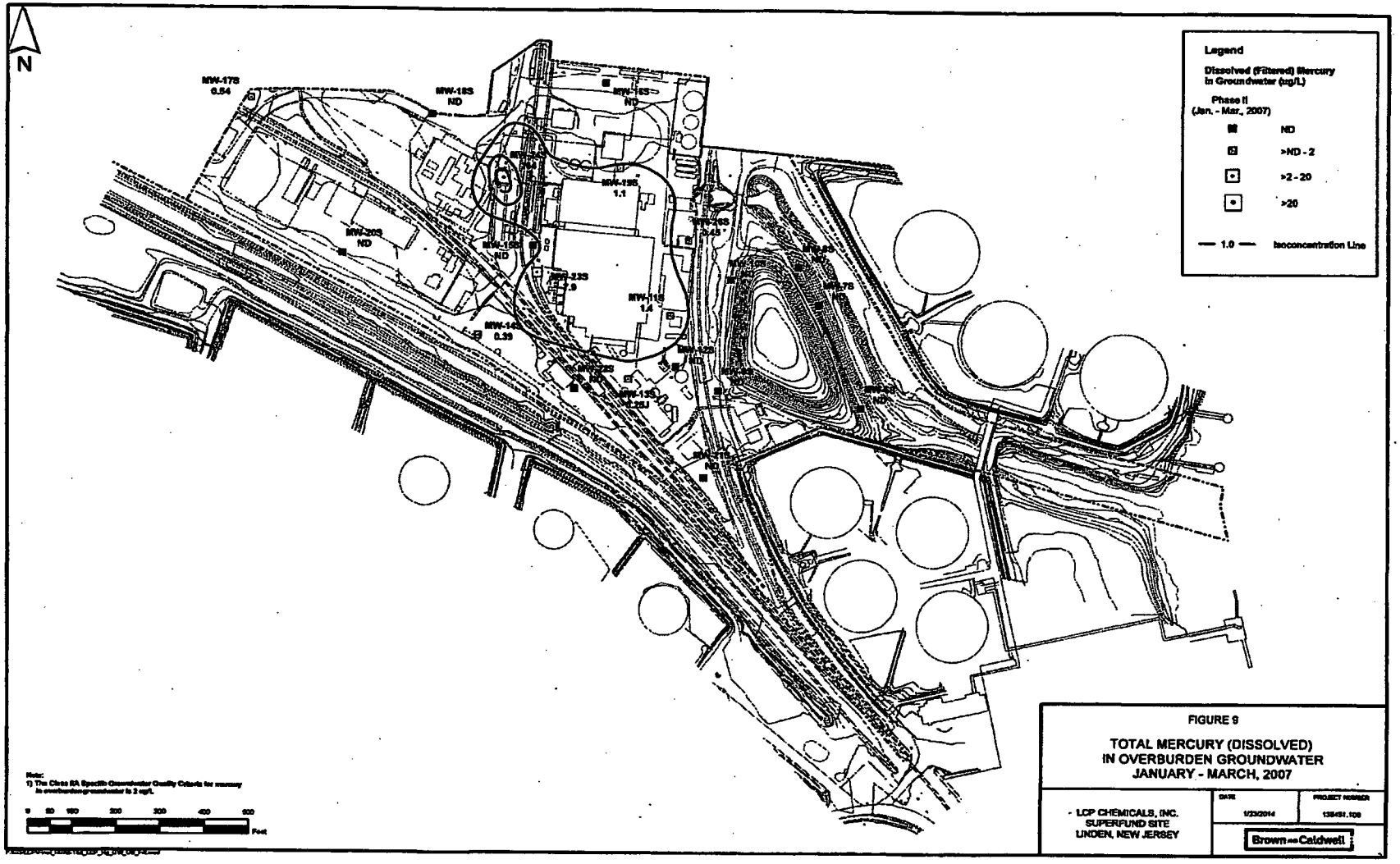


FIGURE 9

TOTAL MERCURY (DISSOLVED) IN OVERBURDEN GROUNDWATER JANUARY - MARCH, 2007

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
1/23/2014	139451.109

Brown AND Caldwell

R2-0062915

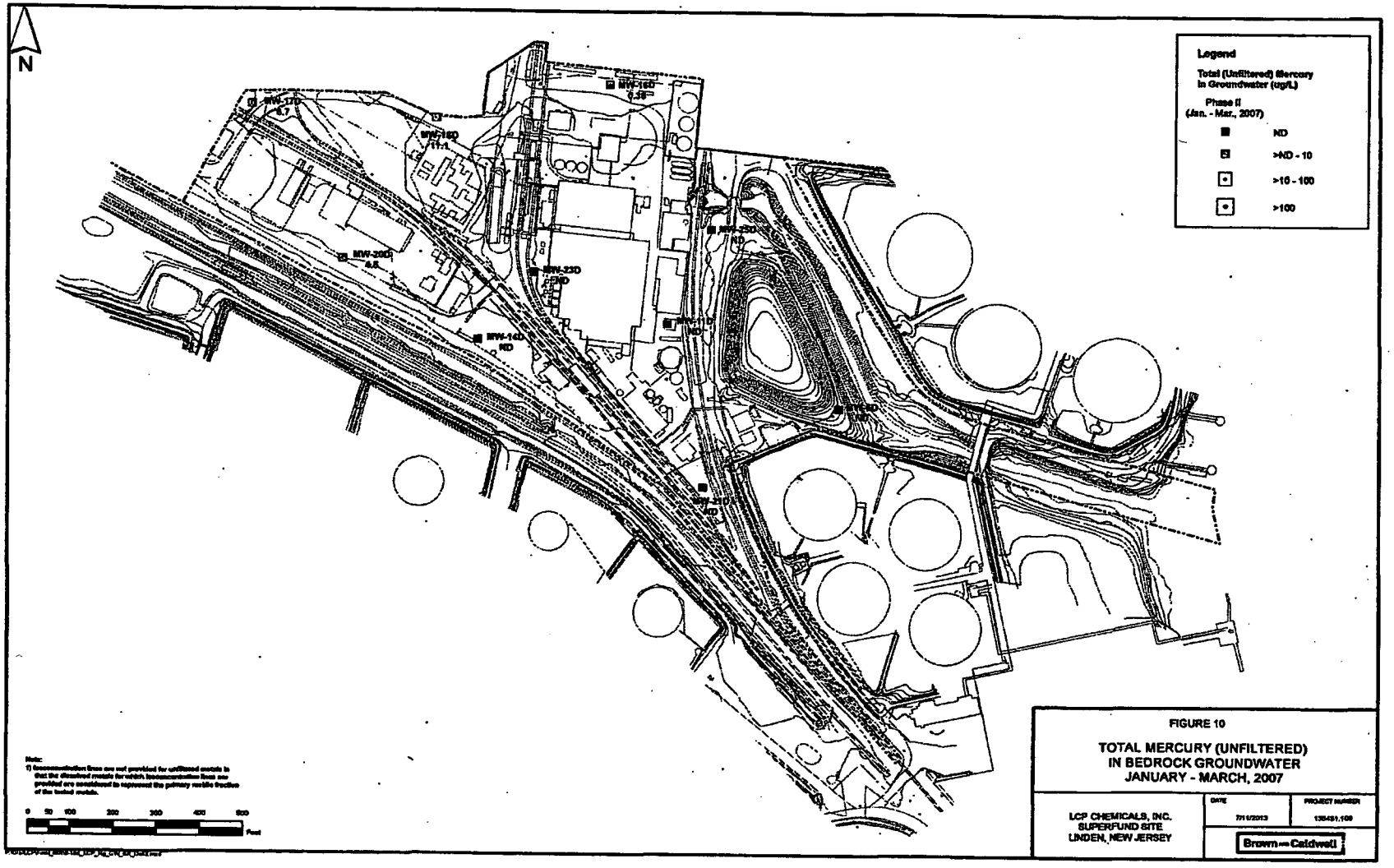


FIGURE 10

TOTAL MERCURY (UNFILTERED) IN BEDROCK GROUNDWATER JANUARY - MARCH, 2007

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 7/16/2013	PROJECT NUMBER 135451.100
	Brown AND Caldwell	

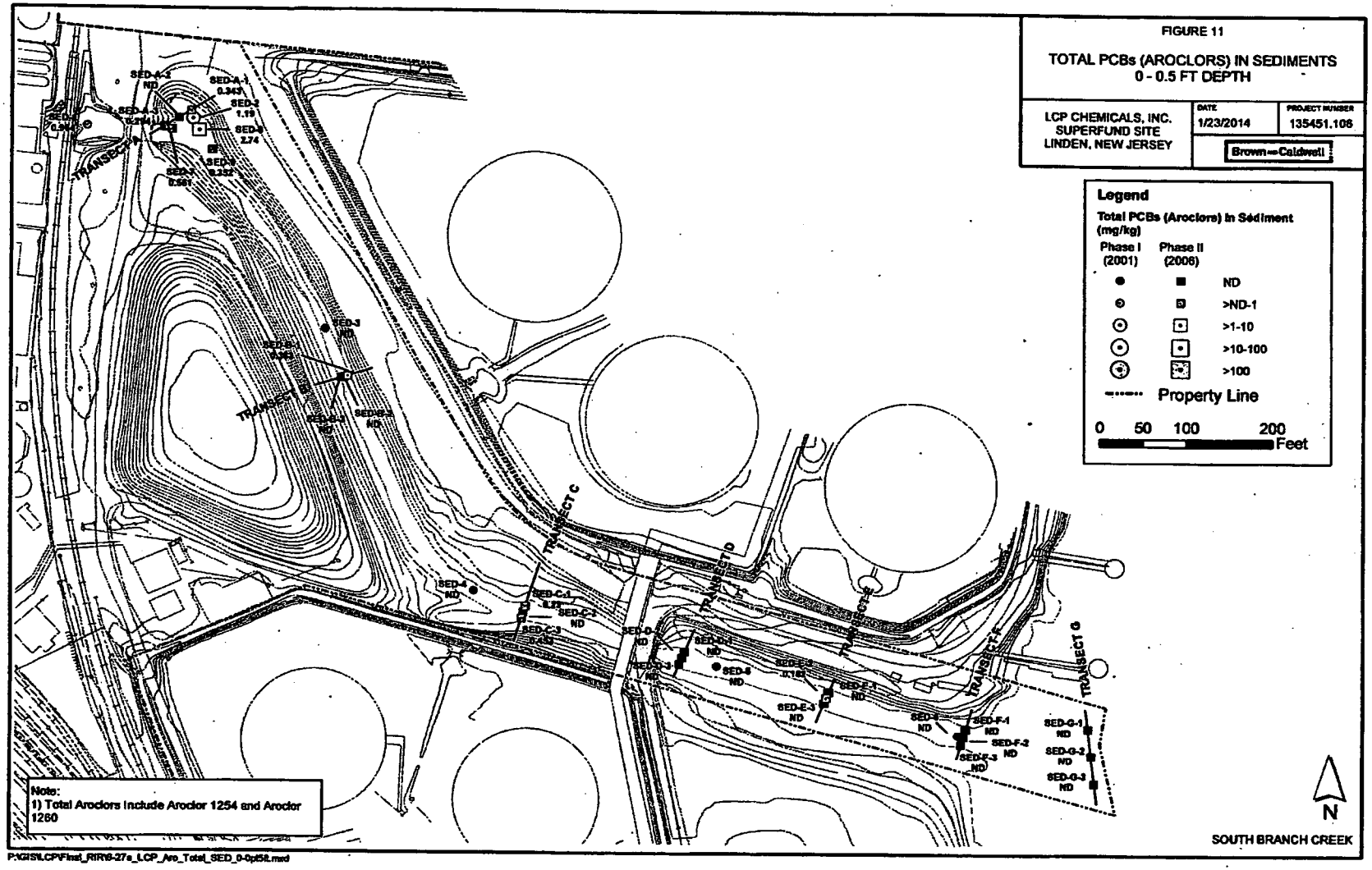
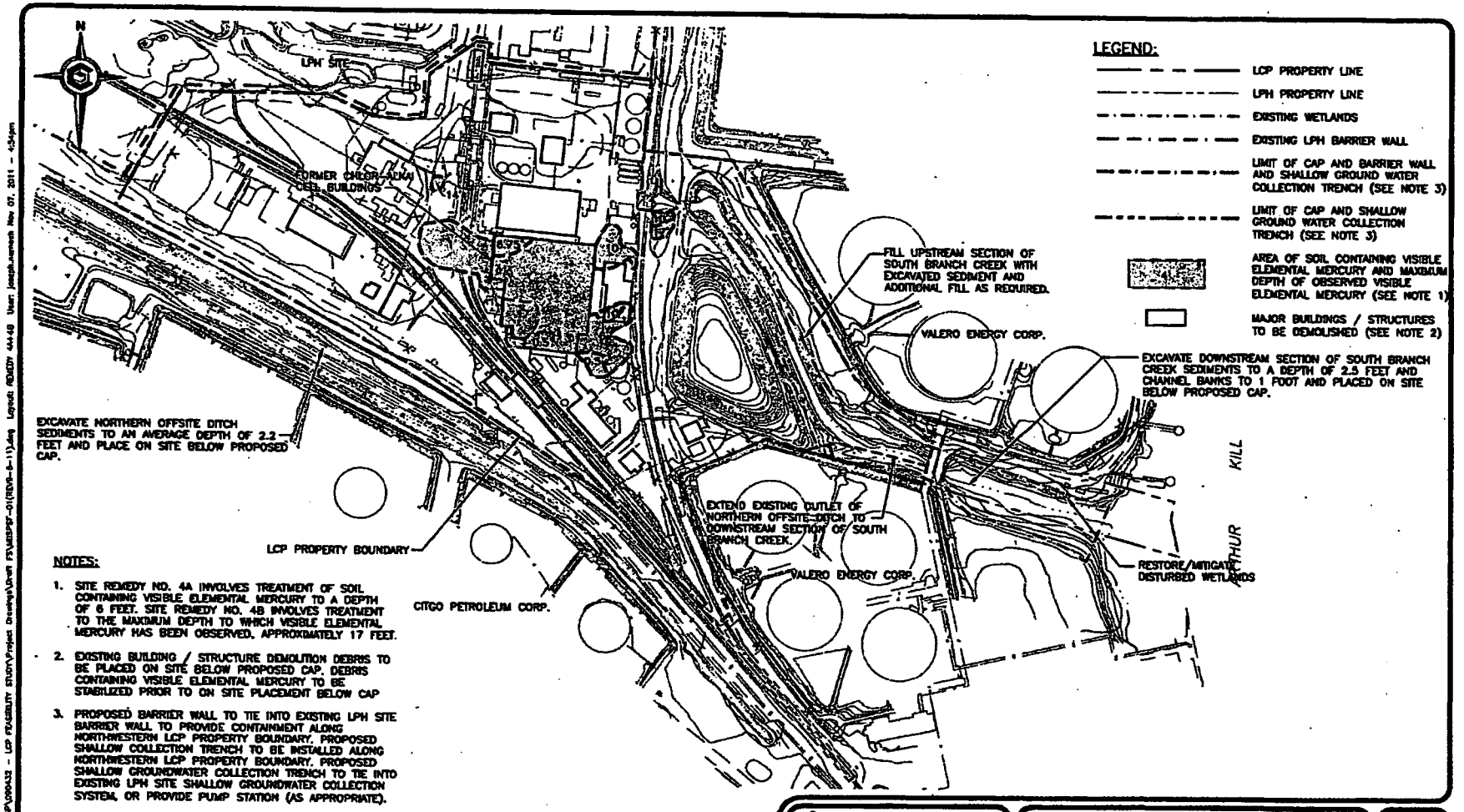


FIGURE 11
TOTAL PCBs (AROCLORS) IN SEDIMENTS
0 - 0.5 FT DEPTH
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY
DATE
1/23/2014
PROJECT NUMBER
135451.106
Brown AND Caldwell
Legend
Total PCBs (Aroclors) in Sediment (mg/kg)
Phase I (2001)
Phase II (2006)
ND
>ND-1
>1-10
>10-100
>100
Property Line
0 50 100 200
Feet
Note:
1) Total Aroclors include Aroclor 1254 and Aroclor 1260
TRANSECT A
TRANSECT B
TRANSECT C
TRANSECT D
TRANSECT E
TRANSECT F
TRANSECT G
SED-A-3 ND
SED-A-1 0.343
SED-2 1.19
SED-A-2 0.274
SED-4 2.74
SED-1 0.567
SED-3 0.332
SED-3 ND
SED-B-1 0.351
SED-B-1 ND
SED-B-2 ND
SED-4 ND
SED-C-1 0.17
SED-C-2 ND
SED-C-3 0.130
SED-D-1 ND
SED-D-2 ND
SED-D-3 ND
SED-5 ND
SED-E-1 ND
SED-E-2 0.180
SED-E-3 ND
SED-6 ND
SED-F-1 ND
SED-F-2 ND
SED-F-3 ND
SED-G-1 ND
SED-G-2 ND
SED-G-3 ND
N
SOUTH BRANCH CREEK
P:\GIS\LCP\Final_RIR\6-27a_LCP_Aro_Total_SED_0-0p5ft.mxd

R2-0062917



NOTES:

1. SITE REMEDY NO. 4A INVOLVES TREATMENT OF SOIL CONTAINING VISIBLE ELEMENTAL MERCURY TO A DEPTH OF 6 FEET. SITE REMEDY NO. 4B INVOLVES TREATMENT TO THE MAXIMUM DEPTH TO WHICH VISIBLE ELEMENTAL MERCURY HAS BEEN OBSERVED, APPROXIMATELY 17 FEET.
2. EXISTING BUILDING / STRUCTURE DEMOLITION DEBRIS TO BE PLACED ON SITE BELOW PROPOSED CAP. DEBRIS CONTAINING VISIBLE ELEMENTAL MERCURY TO BE STABILIZED PRIOR TO ON SITE PLACEMENT BELOW CAP
3. PROPOSED BARRIER WALL TO TIE INTO EXISTING LPH SITE BARRIER WALL TO PROVIDE CONTAINMENT ALONG NORTHWESTERN LCP PROPERTY BOUNDARY. PROPOSED SHALLOW COLLECTION TRENCH TO BE INSTALLED ALONG NORTHWESTERN LCP PROPERTY BOUNDARY. PROPOSED SHALLOW GROUNDWATER COLLECTION TRENCH TO TIE INTO EXISTING LPH SITE SHALLOW GROUNDWATER COLLECTION SYSTEM, OR PROVIDE PUMP STATION (AS APPROPRIATE).

CORNERSTONE Engineering Group, LLC

FEASIBILITY STUDY – LCP CHEMICALS, INC.
SUPERFUND SITE, LINDEN, NEW JERSEY
SITE REMEDY NOs. 4A & 4B
FULL CONTAINMENT AND
SELECTIVE STABILIZATION

FIGURE NO. 12
PROJECT NO. 090432

File: X:\PROJECTS\GP\090432 - LCP FEASIBILITY STUDY\Project Drawings\Draft FS\WEBPDF-01(REV0-8-11).dwg Layout: REMEDY 4A+4B User: joseph.wenech Nov 07, 2011 - 4:34pm

R2-0062918

APPENDIX II

TABLES

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Future
Medium: Surface Soil (0-2 ft bgs)
Exposure Medium: Surface Soil (0-2 ft bgs)

Exposure Point	Chemical of Concern	Concentration Detected		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Surface Soil (0 to 2 ft bgs)	Mercury (elemental)	0.041	787	mg/kg	234 / 237	123	mg/kg	99% KM (Chebyshev) UCL
	Mercury (inorganic)	0.369	7,083	mg/kg	234 / 237	1,103	mg/kg	99% KM (Chebyshev) UCL

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: Mixed Soil (0-10 ft bgs)
Exposure Medium: Mixed Soil (0-10 ft bgs)

Exposure Point	Chemical of Concern	Concentration		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration	Statistical Measure
		Min	Max					
Mixed Soil (0 to 10 ft bgs)	Mercury (elemental)	0.063	787	mg/kg	76 / 77	114	mg/kg	99% Chebyshev (Mean, Sd) UCL
	Mercury (inorganic)	0.567	7,083	mg/kg	76 / 77	1,022	mg/kg	99% Chebyshev (Mean, Sd) UCL
	Vanadium	9.7	126	mg/kg	79 / 83	44.8	mg/kg	95% KM (BCA) UCL
	Furan 2,3,7,8-TCDD TEQ	1.41E-06	8.85E-04	mg/kg	5 / 5	7.23E-04	mg/kg	99% Chebyshev (Mean, Sd) UCL

Table 1
Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Concern	Concentration		Concentration Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration	Statistical Measure
		Min	Max					
Overburden Groundwater	Arsenic	12	275	µg/L	14 / 20	275	µg/L	Maximum
	Cobalt	190	190	µg/L	1 / 20	190	µg/L	Maximum
	Iron	103	346,000	µg/L	20 / 20	346,000	µg/L	Maximum
	Manganese	27.6	219,000	µg/L	18 / 20	219,000	µg/L	Maximum
	Mercury	0.2	233	µg/L	13 / 20	233	µg/L	Maximum
	Methyl Mercury	0.000635	168	µg/L	3 / 3	168	µg/L	Maximum
	Vanadium	54.6	136	µg/L	2 / 20	136	µg/L	Maximum
	Dioxin 2,3,7,8-TCDD TEQ	1.90E-05	1.90E-05	µg/L	1 / 1	1.90E-05	µg/L	Maximum
	Furan 2,3,7,8-TCDD TEQ	1.62E-04	1.62E-04	µg/L	1 / 1	1.62E-04	µg/L	Maximum
	Chloroaniline, p-	1.6	4,460	µg/L	9 / 19	4,460	µg/L	Maximum
	Benzene	0.51	848	µg/L	14 / 19	848	µg/L	Maximum
	Chlorobenzene	1.4	16,200	µg/L	11 / 19	16,200	µg/L	Maximum

Table 2
Selection of Exposure Pathways

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Soil [1]	Surface Soil	Surface Soil	Commercial/ Industrial Worker	Adult	Ingestion	Quant [2]	Commercial/industrial workers may incidentally ingest surface soil.
						Dermal Contact		Commercial/industrial workers may have exposed skin come into contact with surface soil.
		Outdoor Air	Particulates and Vapors (P&V) in Outdoor Air	Commercial/ Industrial Worker	Adult	Inhalation	Quant [2]	Commercial/industrial workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Surface Soil [1]	Surface Soil	Surface Soil	Site-Specific Worker [3]	Adult	Ingestion	Quant [2]	Site-specific workers may incidentally ingest surface soil.
						Dermal Contact		Site-specific workers may have exposed skin come into contact with surface soil.
		Outdoor Air	P&V in Outdoor Air	Site-Specific Worker [3]	Adult	Inhalation	Quant [2]	Site-specific workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Surface Soil [4]	Surface Soil	Surface Soil	Construction/ Utility Worker	Adult	Ingestion	Quant [2]	Construction/utility workers may incidentally ingest surface soil.
						Dermal Contact		Construction/utility workers may have exposed skin come into contact with surface soil.
		Outdoor Air	P&V in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Quant [2]	Construction/utility workers may inhale particulates in fugitive dust generated from surface soil or inhale vapors that migrate from surface soil to air.
	Subsurface Soil [4]	Subsurface Soil	Subsurface Soil	Construction/ Utility Worker	Adult	Ingestion	Quant [2]	Construction/utility workers may incidentally ingest subsurface soil.
						Dermal Contact		Construction/utility workers may have exposed skin come into contact with subsurface soil.
		Outdoor Air	P&V in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Quant [2]	Construction/utility workers may inhale particulates in fugitive dust generated from subsurface soil or inhale vapors that migrate from subsurface soil to air.

Future	Groundwater	Overburden Groundwater [5]	Overburden Groundwater	Commercial/ Industrial Worker	Adult	Ingestion	Quant	Future commercial/industrial worker ingestion of groundwater was quantitatively evaluated to support remedial decisions-making and risk management processes.
		Shallow Groundwater [6]	Shallow Groundwater	Construction/ Utility Worker	Adult	Ingestion	Qual	Construction/utility worker incidental ingestion of shallow (overburden) groundwater while conducting construction/excavation activities near the water table is likely to be relatively insignificant in comparison to dermal contact with groundwater; therefore, this pathway is qualitatively evaluated as part of the uncertainty analysis.
		Shallow Groundwater [6]	Shallow Groundwater	Construction/ Utility Worker	Adult	Dermal Contact	Quant	Construction/utility workers may have exposed skin come into contact with shallow (overburden) groundwater while conducting construction/excavation activities near the water table.
		Shallow Groundwater [6]	Vapors in Outdoor Air	Construction/ Utility Worker	Adult	Inhalation	Qual	Construction/utility worker inhalation of vapors from shallow (overburden) groundwater while conducting construction/excavation activities near the water table is likely to be relatively insignificant in comparison to dermal contact with groundwater; therefore this pathway is qualitatively evaluated as part of the uncertainty analysis. Areas of the Site containing visible elemental mercury are assumed to present an unacceptable risk.
Future	Surface Soil [3]	Surface Soil	Surface Soil	Adolescent Trespasser	Adult	Ingestion Dermal Contact	Qual	Under future land use conditions, the likelihood for trespassing may increase if current barriers to access (e.g., fencing) are removed. Thus, future trespassers may incidentally ingest, have dermal contact with,
		Outdoor Air	P&V in Outdoor Air	Adolescent Trespasser	Adult	Inhalation	Qual	
Current/Future	Surficial Sediment in/along South Branch Creek	Surficial Sediment in /along SBC	Surficial Sediment in/along SBC	Adolescent Trespasser	Ages 7-16	Ingestion Dermal Contact	Quant	Trespassers may incidentally ingest sediment. Trespassers may have exposed skin come into contact with sediment.

Current/Future	Surface Water in South Branch Creek	Surface Water in SBC	Surface Water in SBC	Adolescent Trespasser	Ages 7-16	Ingestion	Qual	Trespassers may incidentally ingest surface water; however, this pathway is evaluated qualitatively as part of the uncertainty analysis as trespasser exposure to surface water is likely to be insignificant relative to sediment exposure.
						Dermal Contact		Trespassers may have exposed skin come into contact with surface water; however, this pathway is evaluated qualitatively as part of the uncertainty analysis as trespasser exposure to surface water is likely to be insignificant relative to sediment exposure.
Future	Subsurface Soil Vapors (8)	Subsurface Soil Vapors	Vapors in Indoor Air	Indoor Worker	Adult	Inhalation	Quant (2)	Indoor workers may inhale vapors that migrate from the subsurface to indoor air via diffusion, advection, or as a result of heating and ventilation systems.

Notes:

(1) Surface soil includes all soil from the interval 0 to 2 feet below ground surface (ft bgs) not associated with South Branch Creek (SBC).

(2) Areas of visible elemental mercury contamination could not be quantitatively evaluated. For the purposes of this baseline risk assessment, areas with visible elemental mercury were assumed to present an unacceptable risk based on potential direct contact and vapor intrusion pathways. Risks attributed to these areas are based on current (i.e., unremediated) Site conditions.

(3) In addition to the full-time commercial/industrial worker, a reduced-frequency commercial/industrial ("site-specific") worker was also evaluated. Although this scenario is hypothetical, and it is acknowledged that such future land use would require institutional controls, the evaluation of this receptor supports remedial decision–making and risk management process.

(4) Subsurface soil includes all soil from the interval 2 to 10 ft bgs not associated with SBC.

given the salinity and New Jersey regulations. However, the overburden water-bearing zone remains classified as Class II-A (potable). Therefore, future commercial/industrial worker ingestion of overburden groundwater was quantitatively evaluated to provide risk managers with information needed to evaluate the impact of any future changes in groundwater use at the Site.

(6) Future construction/utility workers are assumed to be exposed to shallow groundwater while conducting intrusive activities at the Site. For the purposes of the risk assessment, "shallow" groundwater was assumed to include all overburden groundwater.

(7) Sediment includes all solid media (sediment, bank soil, marsh soil) associated with SBC collected from the interval 0 to 0.5 ft bgs.

(8) Because elemental mercury (which is expected to be the primary risk driver for indoor air) is not soluble, modeling risks from groundwater to indoor air is inappropriate as it would likely result in a gross underestimation of risks from vapor intrusion. Rather, exposure to indoor air was evaluated using soil vapor data and the Johnson and Ettinger (J&E; 1991) vapor intrusion model.

(9) With the exception of subsurface soil vapors, risk associated with environmental media at the Site are presented herein in tabular form in accordance with the standard tables of RAGS Part D. Risks associated with exposure to soil vapors are presented in Attachment E.

Table 3
Non-Cancer Toxicity Data Summary

Pathway: Ingestion/Dermal

Chemicals of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Absorp. Efficiency (Dermal	Adjusted RfD (Dermal)	Adj. Dermal RfD Units	Primary Target Organ	Combined Uncertainty	Sources of RfD Target	Dates of RfD
Arsenic	Chronic	3.0E-04	mg/kg-day	0.03	3.0E-04	mg/kg-day	Cardio/Derm	3	I	Nov 2011
Cobalt	Chronic	3.0E-04	mg/kg-day	--	3.0E-04	mg/kg-day	Blood/Resp/Der	--	P	Nov 2011
Iron	Chronic	7.0E-01	mg/kg-day	--	7.0E-01	mg/kg-day	GI	--	P	Nov 2011
Manganese	Chronic	2.4E-02	mg/kg-day	--	9.6E-04	mg/kg-day	CNS	1.0	I	Nov 2011
Mercury (elemental)	Chronic	1.6E-04	mg/kg-day	--	1.6E-04	mg/kg-day	CNS	--	C	Nov 2011
Mercury (inorganic)	Chronic	3.0E-04	mg/kg-day	--	2.1E-05	mg/kg-day	Immuno/Kidney	--	I	Nov 2011
Methyl Mercury	Chronic	1.0E-04	mg/kg-day	--	1.0E-04	mg/kg-day	CNS/Develop	10	I	Nov 2011
Vanadium	Chronic	7.0E-05	mg/kg-day	--	1.8E-06	mg/kg-day	Blood	--	P	Nov 2011
Furan 2,3,7,8-TCDD TEQ	Chronic	1.0E-09	mg/kg-day	0.03	1.0E-09	mg/kg-day	/Develop/Reprod	--	A	Nov 2011
Chloroaniline, p-	Chronic	4.0E-03	mg/kg-day	0.1	4.0E-03	mg/kg-day	Spleen	3,000	I	Nov 2011
Benzene	Chronic	4.0E-03	mg/kg-day	--	4.0E-03	mg/kg-day	Blood/Immuno	300	I	Nov 2011
Chlorobenzene	Chronic	2.0E-02	mg/kg-day	--	2.0E-02	mg/kg-day	Liver	1,000	I	Nov 2011

Pathway: Inhalation

Chemicals	Chronic/	Inhalation	Inhalation	Primary	Combined	Sources	Dates of RfC
Manganese	Chronic	5.0E-05	mg/m^3	CNS	1,000	I	Nov 2011
Mercury (elemental)	Chronic	3.0E-04	mg/m^3	CNS	30	I	Nov 2011
Vanadium	Chronic	1.0E-04	mg/m^3	Blood	--	A	Nov 2011
Dioxin 2,3,7,8-TCDD TEQ	Chronic	4.0E-08	mg/m^3	velop/Reg	--	C	Nov 2011
Furan 2,3,7,8-TCDD TEQ	Chronic	4.0E-08	mg/m^3	velop/Reg	--	C	Nov 2011
Chlorobenzene	Chronic	5.0E-02	mg/m^3	Liver	--	P	Nov 2011

Notes:

RfDo and values obtained from USEPA Regional Screening Level (RSL) Tables for Chemical Contaminants at Superfund Sites (updated November 2010).
The RSL Tables cite the following primary sources:

I = IRIS; USEPA's Integrated Risk Information System available at: http://cfpub.epa.gov/ncea/iris/index.cfm

P = PPRTV; the Provisional Peer Reviewed Toxicity Values derived for the USEPA Superfund program (not publicly available). P(X) indicates a withdrawn value.

A = ATSDR; the Agency for Toxic Substances and Disease Registry Minimal Risk Levels (MRLS) available at: http://www.atsdr.cdc.gov/mrls/

C = California EPA toxicity values available at: http://www.oehha.ca.gov/risk/ChemicalDB/index.asp

Table 4 Cancer Toxicity Data Summary							
Pathway: Ingestion/ Dermal							
Chemical of Concern	**Oral Cancer Slope Factor**	**Units**	**Adjusted Cancer Slope Factor (for Dermal)**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline**	**Source**	**Date**
Arsenic	1.5E+00	1/(mg/kg-day)	1.5E+00	1/(mg/kg-day)	A	I	Nov 2011
Chloroaniline, p-	2.0E-01	1/(mg/kg-day)	2.0E-01	1/(mg/kg-day)	--	P	Nov 2011
Benzene	5.5E-02	1/(mg/kg-day)	5.5E-02	1/(mg/kg-day)	A	I	Nov 2011

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil (0 to 2 ft bgs)	Surface Soil (0 to 2 ft bgs) and P&V in Outdoor Air	Mercury (elemental)	CNS	7.5E-01	--	4.2E+00	5.0E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (inh)	3.6E+00	--	1.2E-02	3.6E+00
							Exposure Medium Total	1.0E+01
Groundwater	Overburden Groundwater	Potable Groundwater	Arsenic	Cardio/Derm	9.0E+00	--	--	9.0E+00
			Cobalt	Blood/Resp/Derm	6.2E+00	--	--	6.2E+00
			Iron	GI	4.8E+00	--	--	4.8E+00
			Manganese	CNS	8.9E+01	--	--	8.9E+01
			Mercury	CNS/Immuno/Kidney	7.6E+00	--	--	7.6E+00
			Methyl Mercury	CNS/Develop	1.6E+01	--	--	1.6E+01
			Vanadium	Blood	1.9E+01	--	--	1.9E+01
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	1.6E+00	--	--	1.6E+00
			Chloroaniline, p-	Spleen	1.1E+01	--	--	1.1E+01
			Benzene	Blood/Immuno	2.1E+00	--	--	2.1E+00
			Chlorobenzene	Liver	7.9E+00	--	--	7.9E+00
							Exposure Medium Total	1.8E+02

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Site-Specific Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure
Surface Soil	Surface Soil	Surface Soil	Mercury (elemental)	CNS	3.0E-01	--	1.7E+00	2.0E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (inh)	1.4E+00	--	5.0E-03	1.4E+00
							Exposure Medium Total	4.1E+00

Table 5
Risk Characterization Summary - Non-Carcinogens

Scenario Timeframe: Future
Receptor Population: Construction/Utility Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Primary target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure
Mixed Soil	Mixed Soil	Mixed Soil	Mercury (elemental)	CNS	1.2E+00	--	2.0E+00	3.2E+00
			Mercury (inorganic)	Immuno/Kidney/CNS (nth)	5.7E+00	--	6.0E-03	5.7E+00
			Vanadium	Blood	1.1E+00	--	7.9E-05	1.1E+00
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	1.2E+00	1.1E-01	3.2E-06	1.3E+00
							Exposure Medium Total	1.3E+01
Groundwater	Shallow	Shallow	Manganese	CNS	--	3.1E+01	--	3.1E+01
			Mercury	CNS/Immuno/Kidney	--	1.5E+00	--	1.5E+00
			Vanadium	Blood	--	1.0E+01	--	1.0E+01
			Dioxin 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	--	2.1E+00	--	2.1E+00
			Furan 2,3,7,8-TCDD TEQ	Immuno/Develop/Reprod/Dermal	--	1.4E+01	--	1.4E+01
			Chlorobenzene	Liver	--	3.1E+00	--	3.1E+00
							Exposure Medium Total	6.4E+01

Table 6
Risk Characterization Summary - Carcinogens

Scenario Timeframe: Future
Receptor Population: Commercial/Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical Of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Overburden Groundwater	Potable Groundwater	Arsenic	1.4E-03	-	-	1.4E-03
			Chloroaniline, p-	3.1E-03	-	-	3.1E-03
			Benzene	1.6E-04	-	-	1.6E-04
						Exposure Medium Total	4.9E-03

TABLE 7
EDC CLEANUP GOALS

COPC	SOIL	OVERBURDEN GROUNDWATER CLASS IIA	SEDIMENT
	NJDEP NON-RESIDENTIAL RAM, STD	NJDEP GW STD	PRG[1]
Units	mg/kg	ug/L	mg/kg
Aluminum		2.0E+02	
Antimony	4.5E+02	6.0E+00	
Arsenic	1.9E+01	3.0E+00	8.2
Barium	5.9E+04	6.0E+03	48
Beryllium	1.4E+02		
Cadmium	7.8E+01	4.0E+00	1.2
Chromium		7.0E+01	81
Cobalt	5.9E+02	-	
Copper			34
Iron	-	3.0E+02	-
Lead	8.0E+02	5.0E+00	47
Manganese		5.0E+01	260
Mercury	6.5E+01	2.0E+00	0.15
Nickel		1.0E+02	21
Selenium	5.7E+03		
Silver			1
Vanadium	1.1E+03	6.0E+01	57
Zinc	1.1E+05		150
Acenaphthene			0.016
Acenaphthylene			0.044
alpha-chlordane	1.0E+00		
Aniline		6.0E+00	
Anthracene			0.085
Benz(a)anthracene	2.0E+00	-	0.261
Benzo(a)pyrene TEQ	2.0E-01		0.43
Benzo(b)fluoranthene	2.0E+00		
Benzo(k)fluoranthene	2.3E+01		
Carbazole		-	
Chloroaniline, p-		3.0E+01	
Chrysene			0.384
Dibenz(a,h)anthracene	2.0E-01		0.063
Fluoranthene			0.6
Fluorene			0.019
Dichlorobenzene, 1,2-		6.0E+02	
Dichlorobenzene, 1,4-	1.3E+01	7.5E+01	
Dichlorophenol, 2,4-		2.0E+01	
Dinitrotoluene, 2,4-	3.0E+00		
Dinitrotoluene, 2,6-	3.0E+00		
Hexachlorobenzene	1.0E+00	2.0E-02	
Hexachlorobutadiene	2.5E+01	1.0E+00	
Indeno(1,2,3-c,d) Pyrene	2.0E+00		
Naphthalene	1.7E+01	3.0E+02	0.16
Nitrobenzene		6.0E+00	
Methylnaphthalene, 2-		-	0.07
PCBs	1.0E+00		0.005
PCDDs		1.0E-05	
PCDFs	-	-	-
Pentachlorophenol		3.0E-01	
Phenanthrene			0.24
Pyrene			0.665
Trichlorobenzene, 1,2,4-	8.2E+02	9.0E+00	
Benzene		1.0E+00	
Chlorobenzene		5.0E+01	
Chloroform	2.0E+00		
Dibromoethane, 1,2-	4.0E-02		
DBCP	2.0E-01		
Ethylbenzene		7.0E+02	
Methylene Chloride	9.7E+01	3.0E+00	
Tetrachloroethylene (PCE)	5.0E+00	1.0E+00	
Trichloroethylene (TCE)	2.0E+01		
Vinyl Chloride		1.0E+00	

Note:
1. Or to levels consistent with Arthur Kill Sediments

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
FEDERAL					
Air: Clean Air Act	42 USC 7401, Section 112	Action specific	Establishes limits on emissions to atmosphere from industrial and commercial activities.	Applicable	Applicable to alternatives that may emit pollutants to the air.
National Ambient Air Quality Standards (NAAQS)	40 CFR Part 50	Action specific	Establishes emissions limits for primary and secondary NAAQS	Applicable	Applicable to alternatives that may emit pollutants to the air
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61.01, 61.14	Action specific	Establishes limits on hazardous emissions to the atmosphere	TBC	Applicable to alternative that may emit pollutants to the air. Sets requirements for public exposure to hazardous airborne emissions.
Vapor Intrusion Guidance	OSWER Draft Guidance Document	Chemical specific	Provides soil vapor, indoor air screening levels	TBC	Potentially applicable depending on ultimate redevelopment of the site (i.e., redeveloped with buildings)
Fish and Wildlife: Fish and Wildlife Coordination Act	16 USC 661, 662, 663 40 CFR 6.302(g)	Location specific	Provides protection of fish and wildlife from actions resulting in the control or structural modification of natural streams and water bodies.	Relevant and Appropriate	Potentially applicable to alternatives involving placement of fill in South Branch Creek.
Groundwater: Maximum Contaminant Levels (MCLs)	40 CFR 141.11, 141.31	Chemical specific	Maximum permissible levels of contaminants in water that is delivered to any user of a public water system.	Relevant and Appropriate	Applicable to determining whether groundwater if used from the Site for drinking would require treatment to reduce concentrations to levels below the MCLs. Groundwater at the site is not anticipated to be used.
Identification and Listing of Hazardous Waste	40 CFR Part 261.3, 261.6, 261.10, 261.11, 261.24	Chemical specific	Defines those wastes, which are subject to regulation as hazardous wastes, and lists specific chemical and industry-source wastes.	Applicable	Applicable to determining whether wastes are hazardous, and to brine sludge in closed RCRA unit.
Generators of Hazardous Waste	40 CFR 262 Subparts A,B,C,D,E	Chemical specific	Establishes requirements for generators of hazardous waste (EPA ID numbers and manifests).	Applicable	Applicable to remedial activities that involve the management of a hazardous waste.
Transportation of Hazardous Wastes.	40 CFR 263 Subpart B 49 CFR 107, 171-180	Action specific	Established standards for the transportation of hazardous wastes and/or materials.	Applicable	Applicable to remedial activities that involve the off-site transportation of hazardous waste.

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR 264 Subparts B, D,E,K	Action, location, and chemical specific	Establishes the minimum standards for the management of hazardous waste and includes regulations for land disposal units.	Applicable	Applicable to remedial activities that include disposal of hazardous wastes, or treatment of hazardous waste at the site.
Land Disposal Restrictions	40 CFR 268	Chemical specific	Identifies hazardous wastes which are restricted from land disposal and identifies treatment requirements prior to disposal	Applicable	Applicable to remedial activities that include disposal of hazardous wastes.
Soil: Mercury Export Ban Act	Public Law 110-414 (122 STAT. 4341 – 4348)	Action and chemical specific	Establishes export and resale ban of elemental mercury containing materials. Remediation wastes may be exported for treatment/disposal but not for sale or reuse of any recovered mercury.	Applicable	Applicable to remedial activities that include international, off-site disposal of elemental mercury.
Surface Water: Clean Water Act (CWA)	33 USC 1342	Action and chemical specific	Sets standards for the restoration and maintenance of chemical, physical and biological characteristics of surface water.	Applicable/ TBC	Applicable for selected remedial technologies (e.g., surface water discharge), and potentially assessment of South Branch Creek.
National Pollutant Discharge Elimination System	40 CFR 122	Action and chemical specific	Requires permits for the discharge of pollutants from any point source into waters of the United States	Applicable	Applicable for selected remedial technologies (e.g., surface water discharge of treated groundwater)
Wetlands and Costal Zone: Section 404 CWA	33 CFR 330	Location and Action Specific	Regulates discharge of dredged or fill material into waters of the United States	Applicable	Applicable to remedial actions that may involve placement of fill in South Branch Creek.
Wetland Permits	40 CFR 230 – 233	Location specific	Provides wetland permitting requirements for actions in and around wetlands and waters of the United States	Applicable	Applicable to remedial actions that may impact wetlands and/or placement of fill in South Branch Creek.
STATE OF NEW JERSEY					

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Air: Permits and Certificates for Minor Facilities	NJAC 7:27-8	Action specific	Governs permits and certificates for facilities classified as minor air pollution sources.	Applicable	Applicable if the selected remediation system qualifies as a minor air pollution source (e.g., groundwater treatment of VOCs).
Ambient Air Quality Standards	NJAC 7:27-13	Action and chemical specific	Establishes air quality standards for the protection of public health and the preservation of ambient air quality.	Applicable	Applicable to remedial alternatives that result in air emissions (e.g., groundwater treatment of VOCs).
Vapor Intrusion Guidance	NJDEP Guidance Document, March 2013	Chemical specific	Provides soil vapor, indoor air, rapid action, and health department notification screening levels	TBC	Potentially applicable depending on ultimate redevelopment of the site.
Groundwater Quality Standards	NJAC 7:9C	Chemical specific	Lists the maximum permissible levels of contaminants in groundwater.	Applicable	Applicable to groundwater remedial alternatives.
Hazardous and Solid Waste: Identification and Listing of Hazardous Waste	NJAC 7:26G-5	Chemical specific	Describes methods for identifying hazardous wastes and lists known hazardous wastes.	Applicable	Applicable to determining whether wastes are hazardous.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities	NJAC 7:26G-8	Action specific	Establishes permit requirements and construction and operations standards.	Applicable	Applicable if remedial activities include the treatment, storage, and/or disposal of hazardous waste.
Land Disposal Restrictions	NJAC 7:26G-11	Action and chemical specific	Identifies hazardous wastes that are subject to land disposal restrictions	Applicable	Applicable if remedial activities include the disposal of hazardous waste
Transportation of Hazardous Materials	NJAC 16:49	Action specific	Regulates shipping/transport of hazardous materials.	Applicable	Applicable if action includes off-site transport of hazardous materials

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Solid Waste Regulations And Recycling	NJAC 7:26 Subchapter 1, 2 NJAC 7:26A-1	Action specific	Regulates non-hazardous waste management.	Applicable	Applicable if action includes generation or management of solid wastes.
Sediment Guidance for Sediment Quality Evaluations	NJDEP Ecological Evaluation Technical Guidance August 2012	Chemical specific	Establishes guidance for sediment evaluation to be used in ecological risk assessment process under Site Remediation Program	TBC	Provides basis for determining sediment cleanup criteria for remedial actions
Surface Water: Storm Water Management	NJAC 7:8	Action specific	Establishes requirements for managing and controlling storm water from the site.	Applicable	Applicable if conditions are altered for remedial activities.
Surface Water Standards	NJAC 7:9B	Chemical specific	Sets standards for the restoration and maintenance of chemical, physical and biological characteristics of surface water.	Applicable	Applicable to certain remedial technologies (e.g., surface water discharge), and potentially assessment of South Branch Creek.
Flood Hazard Area Control	NJAC 7:13	Location specific	Controls and limits development in flood plains	Applicable	Applicable to remedial activities in a flood plain.
New Jersey Pollutant Discharge Elimination System Rules	NJAC 7:14A	Action and chemical specific	Establishes standards for surface water discharge for site remediation projects. Takes precedence over National Pollution Discharge Elimination System regulations (40 CFR 122 and 125)	Applicable	Potentially applicable if remedial activities include discharge to surface water.
Treatment Works Approval	NJAC 7:14A-22,23	Action and chemical specific	Regulates the construction and operation of industrial and domestic wastewater collection, conveyance, and treatment facilities.	Relevant and Appropriate	Potentially applicable if remedial activities include a treatment plant or pre-treatment plant with discharge to POTW.
Soil: Soil Erosion and Sediment Control/Mitigation	NJAC 7:13-3.3, 3.4	Action specific	Requires controls for erosion and sediment transport.	Applicable	Applicable to construction activities that disturb soils.

Table 8
Site-Specific ARARs
LCP Chemicals, Inc. Superfund Site
Feasibility Study

Standard, Requirement, or Criterion	Citation or Reference	Type	Description	Status	Comments
Remediation Standards	NJAC 7:26D	Chemical specific	Soil site-specific cleanup levels. Includes guidance on development of impact to groundwater soil remediation standards. Regulations also include remediation standards for groundwater and surface water.	Applicable	Provides soil, groundwater, and surface water cleanup objectives.
Wetlands and Costal Zone: Freshwater Wetland Protection Act Rules	NJAC 7:7A	Location specific	Establishes requirements for the protection of freshwater wetlands.	Applicable	Applicable to remedial actions that affect wetland areas, such as adjacent to South Branch Creek.
Coastal Permit Program Rules	NJAC 7:7	Location specific	Establishes requirements for the protection of coastal areas.	Applicable	Applicable to remedial actions that occur within a coastal zone. Coastal zone (CAFRA) is not present adjacent to the site, however, waterfront development requirements would apply.
Other:					
Technical Requirements for Site Remediation	NJAC 7:26E	Action specific	Specifies requirements for remedial activities within New Jersey.	Applicable	State program for implementation of remedial activities and part of Licensed Site Remediation Professional program.
Well Construction and Maintenance, Sealing of Abandoned Wells	NJAC 7:9D	Action specific	Specifies requirements for installation and abandonment of wells.	Applicable	Applicable to remedial action that involve construction or abandonment of wells.

Table 7-7
LCP Chemicals, Inc. Superfund Site, Feasibility Study
Combined Site Remedy No. 4b
Full Containment and Full Depth Stabilization
Detailed Cost Estimate

Capital Costs				Cost Range	
Item	Unit	Unit Price	Quantity	Min	Max
Soil Remedy Components (Alternative 6S-2)					
Mobilization / Demobilization	LS	$105,000	-	$105,000	$105,000
Misc. Site Preparation & Clearing	Ac	$4,600	24.2	$111,000	$111,000
In-situ Stabilization	CY	$80	23,600	$1,888,000	$1,888,000
Stabilization Reagent at 5% S0 Loading	Ton	$500	1,800	$900,000	$9,000,000
Capping	Ac	$250,000	21.9	$6,046,000	$6,046,000
Establish Use Restrictions (Deed Notice)	LS	$50,000	-	$50,000	$50,000
Soil Erosion and Sediment Control/Site Restoration	Ac	$5,000	24.2	$121,000	$121,000
Miscellaneous (HASP, permits, survey)	LS	$50,000	-	$50,000	$50,000
Groundwater Remedy Components (Alternative 2GW)					
Mobilization / Demobilization	LS	$75,000	-	$75,000	$75,000
Misc. Site Preparation & Clearing	Ac	$4,600	24.2	$111,000	$111,000
Barrier Wall	LF	$700	3,900	$2,730,000	$2,730,000
Shallow Groundwater Collection System	LF	$220	5,300	$1,166,000	$1,166,000
Soil Erosion and Sediment Control/Site Restoration	Ac	$5,000	6.1	$30,000	$30,000
Miscellaneous (HASP, permits, survey)	LS	$50,000	-	$50,000	$50,000
Establish Use Restrictions (CEA)	LS	$50,000	-	$50,000	$50,000
Sediment Remedy Components (Alternative 3SD)					
Mobilization / Demobilization	LS	$25,000	-	$25,000	$25,000
Misc. Site Preparation & Clearing	Ac	$4,600	1.3	$6,000	$6,000
Excavate Sediments	CY	$25	4,100	$103,000	$103,000
Stabilization/Solidification*	CY	$150	2,050	$308,000	$308,000
Additional Backfill Upstream Portion of Creek	CY	$28	2,200	$62,000	$62,000
On-Site Disposal	CY	$13	4,100	$53,000	$53,000
Northern Off-Site Ditch Outlet Extension	LS	$50,000	-	$50,000	$50,000
Restore/Mitigate Wetlands	Ac	$150,000	1.3	$200,000	$200,000
Building Remedy Components (Alternative 2B)					
Mobilization / Demobilization	LS	$25,000	-	$25,000	$25,000
Building Demolition	CF	$0.64	5,740,000	$3,674,000	$3,674,000
Debris Processing (crushing, etc.)	CY	$30	32,000	$960,000	$960,000
Stabilization	CY	$150	8,000	$1,200,000	$1,200,000
On-Site Disposal	CY	$13	32,000	$416,000	$416,000
0		$0	-	$0	$0
Subtotal				$20,665,000	$28,665,000
Engineering and Administration	%	10%		$2,067,000	$2,867,000
Subtotal				$22,732,000	$31,532,000
Contingencies	%	30%		$6,797,000	$9,460,000
Total Capital				$29,409,000	$40,992,000
Annual Operation, Maintenance & Monitoring Costs					
Soil Remedy Components (Alternative 6S-2)					
Cap Maintenance	LS	$8,100	-	$8,100	
Maintenance of Institutional Controls (Deed Notice Certification)	LS	$7,500	-	$7,500	
Reporting, 5-year reviews, etc.	LS	$4,300	-	$4,300	
Groundwater Remedy Components (Alternative 2GW)					
Maintenance of Institutional Controls (Deed Notice Certification)	LS	$7,500	-	$7,500	
Reporting, 5-year reviews, etc.	LS	$4,300	-	$4,300	
Quarterly Groundwater Monitoring	LS	$30,000	-	$30,000	
Groundwater Treatment (POTW Discharge)	GAL	$0.0011	315,360	$340	
Sediment Remedy Components (Alternative 3SD)					
Maintenance of Wetlands	LS	$5,200	-	$5,200	
Reporting	LS	$3,000	-	$3,000	
Subtotal				$66,000	
Contingencies	%	30%		$20,000	
Total Annual OM&M				$86,000	
Net Present Worth Annual OM&M (7%, 30 yrs)				$1,092,000	
Total 30 Year Net Present Worth				$30,501,000	$42,084,000

Note:
[1] Range in cost representative of a range of potential sulfur loading in the soil stabilization process between 5% to 50% by weight sulfur per ton of soil

R2-0006988

R2-0062935

APPENDIX III

ADMNISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

DRAFT
08/19/2013

Site Name: LCP CHEMICALS INC.
CERCLIS ID: NJD879303020
OUID: 01
SSID: 02HU
Action:

REGION ID: 02

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Beginning Bates:	Ending Bates:	Addressee Name:	Addressee Organization:	Author Name:	Author Organization:
689020	08/20/2013	COMPREHENSIVE ADMINISTRATIVE RECORD INDEX FOR OU1 FOR THE LCP CHEMICALS INCORPORATED SITE	7	[INDEX]			[]	[]	[,]	[US ENVIRONMENTAL PROTECTION AGENCY]
101550	1111-01-01 00:00:00.0	LCP CHEMICALS, INC. SITE, ADMINISTRATIVE RECORD FILE, INDEX OF DOCUMENTS.	4	[INDEX]			[]	[]	[NOT AVAILABLE, NOT AVAILABLE]	[EPA, REGION 2]
101551	1111-01-01 00:00:00.0	LCP CHEMICALS, INC. SITE, ADMINISTRATIVE RECORD FILE UPDATE, INDEX OF DOCUMENTS.	2	[INDEX]			[]	[]	[NOT AVAILABLE, NOT AVAILABLE]	[EPA, REGION 2]
113600	11/01/1985	Report: Preliminary Assessment for RCRA Corrective Action Program, GAF Linden, Dupont Rd, Foot of Wood Ave., Linden, Union County, NJ, prepared by the Division of Waste Management, Bureau of Hazardous Waste Planning & Classification, prepared...	114	[REPORT]	101359	101472	[,]	[NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[,]	[Bureau of Hazardous Waste Planning & Classification]
113593	09/09/1994	Memorandum to File, U.S. EPA, Region II, from Mr. Nick Magriples, CHMM, On-Scene Coordinator, Technical Support Section, U.S. EPA, Region II, re: Removal Site Evaluation for LCP Corp. (Linden Chemicals and Plastics), Division of Hanlin Group, Linden...	2	[MEMORANDUM]	100001	100002	[FILE,]	[UNKNOWN]	[MAGRIPLES, NICK]	[EPA]
113596	07/24/1995	Report: Final Draft, Site Inspection, LCP Chemicals, Inc., Linden, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 1 of 4, submitted by Mr. David S. Kahlenberg, Site...	158	[REPORT]	100026	100183	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113597	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 2 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steven T. McNulty, Task Leader...	412	[REPORT]	100184	100595	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

DRAFT
08/19/2013

Site Name: LCP CHEMICALS INC.
CERCLIS ID: NJD079303020
OUID: 01
SSID: 02HU
Action:

REGION ID: 02

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Beginning Bates:	Ending Bates:	Addressee Name:	Addressee Organization:	Author Name:	Author Organization:
113598	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 3 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steven T. McNulty, Task Leader...	397	[REPORT]	100596	100990	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113599	07/24/1995	Report: LCP Chemical, Linden, Union County, New Jersey, Site Inspection Report, Prepared Under Work Assignment No. 019-2JZZ, Contract No. 68-W9-0051, Volume 4 of 4, submitted by Mr. David S. Kahlenberg, Site Manager, Mr. Steveh T. McNulty, Task Leader...	368	[REPORT]	100991	101358	[]	[]	[KAHLENBERG, DAVID S, MCNULTY, STEVEN T, SPLENDORE, JOHN]	[MALCOLM PIRNIE, INC.]
113594	08/12/1996	Memorandum to File, U.S. EPA, Region II, from Mr. Nick Magriples, CHMM, On-Scene Coordinator, U.S. EPA, Region II, re: Removal Site Evaluation for LCP Chemicals, Inc., Division of Hanlin Group, Linden, Union County, New Jersey, August 12, 1996...	21	[CHART / TABLE, MAP, MEMORANDUM]	100003	100023	[FILE,]	[UNKNOWN]	[MAGRIPLES, NICK]	[EPA]
113595	10/25/1996	Memorandum to Ms. Kathleen Callahan, Director, Emergency & Remedial Response Division, U.S. EPA, Region II, from Mr. Conrad Simon, Director, Air & Waste Management Division, U.S. EPA, Region II, re: Referral...	2	[MEMORANDUM]	100024	100025	[CALLAHAN, KATHLEEN]	[EPA, REGION II]	[SIMON, CONRAD]	[EPA]
113601	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2JZZ, Contract No. 68-W9-0051, Volume 1 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	120	[FIGURE, MAP, REPORT]	101473	101592	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]

R2-0062938

ADMINISTRATIVE RECORD INDEX OF DOCUMENTS

DRAFT

08/19/2013

Site Name: LCP CHEMICALS INC.
CERCLIS ID: NJD079303020
OUID: 01
SSID: 02HU
Action:

REGION ID: 02

DocID:	Doc Date:	Title:	Image Count:	Doc Type:	Beginning Bates:	Ending Bates:	Addressee Name:	Addressee Organization:	Author Name:	Author Organization:
113602	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2/ZZ, Contract No. 68-W9-0051, Volume 2 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	184	[FIGURE, MAP, REPORT]	101593	101776	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113603	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2/ZZ, Contract No. 68-W9-0051, Volume 3 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	363	[CHART / TABLE, FIGURE, LETTER, MAP, MEMORANDUM, REPORT]	101777	102138	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113604	02/01/1997	Report: Final Hazard Ranking System Evaluation, LCP Chemicals, Inc., Linden Township, Union County, New Jersey, Prepared Under Work Assignment No. 038-2/ZZ, Contract No. 68-W9-0051, Volume 4 of 4, submitted by Ms. Lisa Greco, Site Manager, Mr. Steven...	395	[CHART / TABLE, FIGURE, FORM, LETTER, MAP, REPORT]	102139	102533	[]	[]	[GRECO, LISA D, GREENLAW, ALAN , MCNULTY, STEVEN T]	[MALCOLM PIRNIE, INC.]
113608	04/26/1999	Letter to ISP Environmental Services Inc., c/o Dennis Toft, Esq., Wolff & Samson, from Muthu S. Sundram, Esq., Assistant Regional Counsel, New Jersey Superfund Branch, U.S. EPA, Region II, re: LCP Chemicals, Inc., Superfund Site, Linden, Union...	49	[ADMIN. ORDER , LEGAL DOCUMENT, LETTER]	700001	700049	[ISP ENVIRONMENTAL SERVICES, IN, , TOFT, DENNIS M]	[NONE, WOLFF & SAMSON]	[SUNDRAM, MUTHU S]	[EPA, REGION 2]
113607	06/01/1999	Report: Statement of Qualifications, LCP Chemicals, Inc., Superfund Site, Linden, Union County, New Jersey, prepared by URS Greiner Woodward Clyde, prepared for ISP Environmental Services, Inc., June, 1999.	102	[CHART / TABLE, REPORT]	300001	300102	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS GREINER, INC.]
113605	08/14/2000	Plan: Work Plan, Interim Removal Action (IRA) for LCP Chemicals, Inc., Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services, Inc., August 14, 2000.	36	[CHART / TABLE, REPORT]	200001	200036	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]

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113606	09/07/2000	Plan: Health and Safety Plan, Interim Removal Action (IRA) for LCP Chemicals, Inc., Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services, Inc., September 7, 2000.	317	[CHART / TABLE; FIGURE, FORM, REPORT]	300037	300940	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113611	10/16/2000	Letter to Ms. Patricia Simmons, Emergency and Remedial Response Division, U.S. EPA, Region II, from Mr. Thomas Pisciotta, Project Manager, URS Corporation, re: Interim Removal Action Addendum, Subcontractor Health and Safety Plan, and Notification	139	[LETTER, REPORT]	300597	300735	[SIMMONS, PATRICIA]	[EPA]	[PISCIOTTA, THOMAS]	[URS CORPORATION]
113612	11/01/2000	Memorandum to Mr. Tarek Khouri, URS Greiner Woodward Clyde, from Mr. Frank Quinton, Health and Safety Manager, Integrated Technical Services, Inc., re: LCP Chemical HASP (Attachment: Material Safety Data Sheet)	23	[MEMORANDUM, REPORT]	300736	300758	[KHOURI, TAREK]	[URS GREINER, INC.]	[QUINTON, FRANK.]	[INTEGRATED TECHNICAL SERVICES, INC.]
113609	04/12/2001	Report: Final Sampling and Analysis Plan, Field Operations Plan, Part I, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental	193	[REPORT]	300103	300295	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113610	04/12/2001	Report: Final Quality Assurance Project Plan, Field Operations Plan, Part II, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental	301	[REPORT]	300296	300596	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
113613	04/12/2001	Report: Final Work Plan, Remedial Investigation and Feasibility Study for the LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS Corporation, prepared for ISP Environmental Services Inc.	225	[REPORT]	300759	300983	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]

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113614	04/16/2001	Report: Final Report, Interim Removal Action (IRA) for LCP Chemicals, Inc. Superfund Site, Linden, New Jersey, prepared by URS, prepared for ISP Environmental Services Inc.	191	[REPORT]	300984	301174	[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
198983	10/06/2000	FINAL REMEDIAL INVESTIGATION / FEASIBILITY STUDY WORK PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	210	[PLAN]			[]	[]	[,]	[URS CORPORATION]
198984	02/12/2001	FINAL SAMPLING AND ANALYSIS PLAN - PART 1 OF THE FIELD OPERATIONS PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	183	[PLAN]			[]	[]	[,]	[URS CORPORATION]
198985	04/12/2001	FINAL QUALITY ASSURANCE PROJECT PLAN - PART 2 OF THE FIELD OPERATIONS PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	293	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[URS CORPORATION]
198986	10/12/2001	ADDENDUM NO. 1 TO THE FIELD OPERATIONS PLAN FOR CASED DEEP BORINGS FOR THE LCP CHEMICALS INCORPORATED SITE	4	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198987	11/01/2001	ADDENDUM NO. 2 TO THE FIELD OPERATIONS PLAN FOR SUBSURFACE UTILITY CLEARANCE FOR THE LCP CHEMICALS INCORPORATED SITE	5	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198988	03/01/2002	ADDENDUM NO. 3 TO THE FIELD OPERATIONS PLAN FOR SAMPLING BENEATH BUILDINGS 230 AND 240 FOR THE LCP CHEMICALS INCORPORATED SITE	25	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198990	09/01/2006	HEALTH AND SAFETY PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	131	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]
198989	10/01/2006	REVISED SUPPLEMENTAL WORK PLAN: SEDIMENT TOXICITY TESTING (SOUTH BRANCH CREEK) - PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	13	[PLAN]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[BROWN AND CALDWELL]

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198993	10/01/2006	REVISED ADDENDUM NO. 1 (SOIL AND GROUNDWATER) WORK PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	58	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198994	10/01/2006	REVISED ADDENDUM NO. 2 (SOUTH BRANCH CREEK AND ECOLOGICAL ISSUES) WORK PLAN FOR PHASE II REMEDIAL INVESTIGATION FOR THE LCP CHEMICALS INCORPORATED SITE	36	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198995	10/01/2006	REVISED ADDENDUM NO. 4 FIELD OPERATIONS PLAN (BEDROCK MONITORING WELLS, SOIL VAPOR TESTING, AND GROUNDWATER SAMPLING) FOR THE LCP CHEMICALS INCORPORATED SITE	29	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198996	10/01/2006	REVISED ADDENDUM NO. 5 FIELD OPERATIONS PLAN (ECOLOGICAL SAMPLING) FOR THE LCP CHEMICALS INCORPORATED SITE	12	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198991	10/05/2006	QUALITY ASSURANCE PROJECT PLAN ADDENDUM FOR SOIL VAPOR SAMPLING FOR THE LCP CHEMICALS INCORPORATED SITE	58	[PLAN]			[FARANCA, FRANK , GORIN, JONATHON]	[EPA, REGION 2, NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[MACMILLIN, SCOTT D]	[BROWN AND CALDWELL]
198992	10/13/2006	REVISED QUALITY ASSURANCE PROJECT PLAN ADDENDUM FOR SOUTH BRANCH CREEK - AUGUST 23, 2006 FOR THE LCP CHEMICALS INCORPORATED SITE	506	[PLAN]			[FARANCA, FRANK , GORIN, JONATHON]	[EPA, REGION 2, NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION]	[MACMILLIN, SCOTT D, SORELL, TAMARA]	[BROWN AND CALDWELL]
688391	12/17/2008	TECHNICAL MEMORANDUM FOR THE IDENTIFICATION OF CANDIDATE TECHNOLOGIES FOR THE LCP CHEMICALS INCORPORATED SITE	31	[REPORT]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
198981	05/14/2010	REVISED SCOPE OF WORK - CHARACTERIZATION OF OFF-SITE DITCHES FOR THE LCP CHEMICALS INCORPORATED SITE	13	[LETTER]			[GORIN, JON]	[EPA, REGION 2]	[MACMILLIN, SCOTT D, THORN, PAUL J.]	[BROWN AND CALDWELL]
198982	11/01/2010	REVISED QUALITY ASSURANCE PROJECT PLAN FOR THE LCP CHEMICALS INCORPORATED SITE	980	[PLAN]			[ ]	[ISP ENVIRONMENTAL SERVICES, INC.]	[ ]	[BROWN AND CALDWELL]
688390	05/27/2011	REMEDIAL INVESTIGATION REPORT - APPENDIX P: FINAL HUMAN HEALTH RISK ASSESSMENT - VOLUME 5 OF 6 FOR THE LCP CHEMICAL COMPANY SITE	373	[REPORT]			[]	[]	[ ]	[GEOSYNTEC CONSULTANTS]

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198980	08/01/2013	FINAL FEASIBILITY STUDY REPORT FOR THE LCP CHEMICALS INCORPORATED SITE	359	[REPORT]			[,]	[ISP ENVIRONMENTAL SERVICES, INC.]	[,]	[CORNERSTONE ENGINEERING GROUP LLC]

APPENDIX IV

STATE LETTER OF CONCURRANCE

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
SITE REMEDIATION
Mail Code 401-06
P. O. Box 420
Trenton, New Jersey 08625-0420
Tel. #: 609-292-1250
Fax. #: 609-777-1914

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

BOB MARTIN
Commissioner

FEB 19 2014

Mr. Walter Mugdan, Director
Emergency and Remedial Response Division
USEPA-Region 2
290 Broadway, Floor 19
New York, NY 10007-1866

Re: LCP Chemicals, Inc. Superfund Site
Record of Decision

Dear Mr. Mugdan:

The New Jersey Department of Environmental Protection (Department) completed its review of the "draft Record of Decision, LCP Chemicals, Inc, Superfund Site, Linden, Union County, New Jersey" prepared by the U.S. Environmental Protection Agency (EPA) Region II in December, 2013. The Department concurs with the proposed concept of in-situ stabilization of the free mercury to a depth of free mercury of 17 feet which includes a multi-layer cap, shallow ground water treatment system, groundwater monitoring and the removal of contaminated sediments in North Off-Site Ditch and the lower part of South Branch Creek. However, the Department cannot concur with the full remedy for the following reasons:

- A treatability study of the in-situ stabilization technology was not performed to determine if the technology would be effective at the LCP site for the selected remedy or the first contingency remedy of treatment to 6 feet. In addition, it has not been determined if there are any obstructions at depth which might hinder in-situ stabilization to 17 feet.

- The Department's position is that the contingency remedy should be excavation and off-site disposal of the free mercury (Alternative 5B). While costly, this alternative appears implementable. Containment alone, which is one of the proposed contingencies, does not address the free mercury.

- The draft ROD states that EPA will determine clean-up levels for the sediments that are consistent with existing levels in the Arthur Kill (i.e. background) or the preliminary

remediation goals determined for the site, if they are higher. EPA has indicated that additional data will not be collected to determine the sediment clean–up level. The Department position is that sufficient data has not been collected in the Arthur Kill to determine background. Once background is determined, additional delineation and possibly remediation may be necessary in the Arthur Kill.

In conclusion, for the reasons listed above, the Department does not concur with the selected remedy in the December 2013 draft Record of Decision. If you have any questions, please contact me.

Sincerely,

Mark J. Pedersen
Acting Assistant Commissioner
Site Remediation Program

c: Jon Gorin, USEPA
Anne Pavelka, NJDEP

APPENDIX V

RESPONSIVENESS SUMMARY

APPENDIX V

RESPONSIVENESS SUMMARY
LCP Chemicals, Inc., Superfund Site
Linden, New Jersey

INTRODUCTION

This Responsiveness Summary provides a summary of the public's comments and concerns regarding the Proposed Plan for the LCP Chemicals, Inc., Superfund Site's preferred remedy, and EPA's responses to those comments. All comments summarized in this document have been considered in EPA's final decision for the selection of remedial alternatives for the Site.

This Responsiveness Summary is divided into the following sections:

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS: This section provides the history of community involvement and interests regarding the Site.

II. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, CONCERNS AND RESPONSES: This section contains summaries of oral comments received by EPA at the public meeting, EPA's responses to these comments, as well as responses to written comments received during the public comment period.

The last section of this Responsiveness Summary includes attachments, which document public participation in the remedy selection process for this site. They are as follows:

Attachment A contains the Proposed Plan that was distributed to the public for review and comment;

Attachment B contains the public notices that appeared in the Home News Tribune;

Attachment C contains the transcripts of the public meeting; and

Attachment D contains the written comments received by EPA during the public comment period.

I. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

On August 21, 2013, EPA released the Proposed Plan and supporting documentation for the proposed remedy to the public for comment. EPA made these documents available to the public in the administrative record repositories maintained at the EPA Region 2 office (290 Broadway, New York, New York) and the Linden Public Library (31 East Henry Street, Linden, New Jersey). EPA published a notice of availability of these documents in the Home News Tribune newspaper on August 21, 2013. EPA opened a public comment period which ran from August, 21 2013, until September 20, 2012. Due to a request

for a public comment period extension, on September 17, 2013, EPA extended the public comment period to October 21, 2013.

On August 21, 2013, EPA held a public meeting at the Tremley Point Recreation Building, in Linden, NJ to inform local officials and interested residents about the Superfund process, to present the preferred remedial alternatives for the Site, solicit oral comment, and respond to any questions.

II. COMPREHENSIVE SUMMARY OF MAJOR QUESTIONS, COMMENTS, CONCERNS, AND RESPONSES

PART 1: Verbal Comments

This section summarizes comments received from the public during the public comment period along with EPA's responses.

A. SUMMARY OF QUESTIONS AND EPA's RESPONSES FROM THE PUBLIC MEETING CONCERNING THE LCP CHEMICALS INC. SUPERFUND SITE

A public meeting was held August 28, 2013, at 7:00 p.m. in the Tremley Point Recreation Building, in Linden, New Jersey. In addition to a brief presentation of the investigation findings, EPA presented the Proposed Plan and preferred alternative for the Site, received comments from meeting participants, and responded to questions regarding the remedial alternatives under consideration. Attachment C includes the entire transcript of the public meeting.

A summary of comments raised by the public following EPA's presentation is presented below:

Comment #1: *One commenter asked what PTW stood for.*

EPA Response: Principal threat waste, which is the area on Site with visible mercury in soil.

Comment #2: *One commenter asked whether the local sewer authority can handle the overburden groundwater discharge.*

EPA Response: Since it will not be a lot of water, EPA expects that the sewer authority can easily handle the discharge. Also, if they say they cannot accept the water, there are other options such, as treating it at the adjacent GAF site.

Comment #3: *One commenter asked where the mercury, once removed from the water, would be sent.*

EPA Response: The mercury in the groundwater is at a low concentration, so there would not be much mercury removed from the water. Whatever mercury is removed will be disposed of with the sludge by whatever method the selected facility (e.g., sewer authority) uses to dispose of waste.

Comment #4: *Once commenter asked if the plan is to simply bury the contaminated soil.*

EPA Response: No. Some soil (the PTW) will be treated and contained on Site. Other soil, with high levels of mercury but not considered PTW, will also be contained.

Comment #5: *One commenter pointed out that in its presentation EPA referred to a risk number and said it was over a hundred which is high, and should be less than one. What is it a hundred of?*

EPA Response: The number is based on a human health risk calculation for non carcinogens called a "hazard index." One is an acceptable number, anything above one is unacceptable. The hazard index at the site is 190. This is for the quantifiable soil concentrations, not the PTW which is hard to quantify. However, EPA believes that the HI for PTW would be substantially higher than 190. In brief, if someone were working on the Site they would be exposed to an unacceptable level of risk.

Comment #6: *One commenter asked what a geosynthetic membrane is and whether it is impermeable.*

EPA Response: A geosynthetic membrane is essentially a thick piece of plastic. It is commonly used at hazardous waste sites and landfills. In general, the cap will probably consist of a base aggregate, the membrane, some stone, soil and grass or perhaps asphalt. The geosynthetic membrane is basically impermeable and is in compliance with New Jersey regulations.

Comment #7: *Several commenters asked if the remedy, combined with the proposed impermeable cap on a nearby property would increase floodwater problems in the area.*

EPA Response: The EPA staff at the public meeting were not aware of the other cap the commenters were discussing. However, caps are impermeable and issues like rainwater drainage need to be addressed during the design phase. The rainwater running through the stone on top of the cap will not be contaminated, so run-off options could include discharge to the Arthur Kill, for example. The final design would ensure that run-off does not cause additional flooding problems in the area.

Comment #8: *One commenter asked what happens if the responsible parties decide they do not want to pay for the selected remedy and instead they decide to select the less expensive option.*

EPA Response: The responsible parties do not select the remedy. EPA makes that choice and we ask the parties if they want to implement EPA's selected remedy. The parties typically respond positively, because they believe they can do it more effectively and cheaper than EPA. If they refuse, EPA has various enforcement options it can consider.

Comment #9: *One commenter asked about the barrier wall's location, what it's going to be made of and how high will it be.*

EPA Response: EPA can tell where the barrier wall will be, but EPA has yet determined what it will be made of. The wall be installed around the Site, and it will be tied to the glacial till layer. The decision on what it will be made of will be part of the remedial design process, and subject to EPA approval. Typically, barrier walls are made from steel sheeting or bentonite however EPA can accept other options that will hold contaminants on Site. The wall will be below the ground, so it will not be visible from the surface. That will make it easier for the Site to be reused in the future.

Comment #10: *One commenter asked if the sulfur/mercury treatment process has been done elsewhere.*

EPA Response: The process has been recently been tested at other sites, like the Mercury Refining Site in upstate New York. A pilot study is being performed at that site, as we will be performing one at this Site. EPA researchers have confirmed that, chemically, the process should work. The main issue at the

Site is the type of soil we will need to treat. The soil is mainly fill and rubble, where effective mixing will be difficult. That is an engineering issue that will be addressed during the pilot study.

Comment #11: *One commenter asked to see the NRRB comments and the responses.*

EPA Response: The NRRB stands for the National Remedy Review Board. The NRRB reviews proposed Superfund cleanup decisions that meet cost-based review criteria to assure they are consistent with Superfund law, regulations, and guidance. After each review, the board prepares a memo with their findings and recommendations to the region.

The NRRB memo and Region 2's responses can be found at the following:
http://www.epa.gov/superfund/programs/nrrb/pdfs/LCP_Memo.pdf
http://www.epa.gov/region02/superfund/npl/lcpchemicals/pdf/lcp_nrrb_region_2_response_memo.PDF

Comment #12: *One commenter wanted to know if the risk assessment was done prior to Superstorm Sandy, and several commenters wanted to know if the Tremley Point area has been tested after the storm to see if contamination in the Arthur Kill or South Branch Creek affected the area. The commenter wondered whether the residents in the area should be concerned.*

EPA Response: All the investigatory work was done prior to the Storm. EPA is not aware of anyone who has tested the area for effects from the Storm. EPA believes it is unlikely that contamination was spread from the Site, even due to Superstorm Sandy's surge. The reason is that the mercury has stayed in place for over 30 years, including during other storm events, such as Hurricane Gloria and the 1992 Nor'easter. EPA will consider sampling a few adjacent properties to determine if Site contaminants may have migrated.

Comment #13: *One commenter wondered if there was a reason to clean up the Site if it doesn't affect the community.*

EPA Response: Under the Superfund land, EPA has the authority to cleanup sites that pose a current or potential future risk to human health and the environment. There are several reasons to address Site contamination such as to: allow future reuse of the Site for industrial purposes; prevent additional mercury from entering the Arthur Kill; and prevent additional mercury from entering the atmosphere.

Comment #14: *One commenter asked if the people who caused this will be profiting from the cleanup by having their property reused and are the vapors from the mercury putting people are risk.*

EPA Response: The owner has abandoned the Site. The owner is the Hanlin Group. EPA expects someone will take over the Site and redevelop it. EPA has identified an entity that has responsibility for the Site, and they are paying for it. However, they do not own the property.

Data collected on Site, even during hot days when vaporization is highest, do not show an unacceptable risk to the community from atmospheric mercury migrating from the Site.

Comment #15: *One commenter asked the name of the entity paying for the cleanup and whether they own the Site.*

EPA response: Originally it would been LCP, however their liability was passed to ISP and now it is with Ashland Chemical. To date, ISP and Ashland have paid for the remedial work. While Ashland is responsible for the Site cleanup, it does not own the property.

Comment #16: *Several commenters asked how Ashland became responsible.*

EPA Response: Typically what happens is one company buys another company or a piece of another company. As part of that purchase, they have to take over certain liabilities, such as cleaning up a Superfund site.

Comment: *One commenter asked if EPA considered open space or recreation areas for the Site.*

EPA Response: No. The Site is located in an industrial area, surrounded by sites being used or planned to be used for industrial purposes. The Site has limited access. EPA recognizes the remedy will impact a limited area of wetlands near the South Branch Creek. To address this impact, wetland remediation and mitigation will be implemented.

Comment 18: *One commenter asked if the Army Corps or EPA will be remediating the wetlands.*

EPA Response: EPA is not sure at this point who would be doing it, however EPA expects that the responsible party will be paying for the wetlands remediation.

Comment #19: *One commenter asked who is policing the Site, and why the pollution wasn't stopped earlier.*

EPA Response: EPA is the lead regulatory agency in charge of the Site. There are a number of reasons why this Site has taken so long to reach this point. One key issue is the technical complexity of analyzing solutions to address the Site's principal threat waste.

Comment #20: *One commenter asked who has been investigating the adjacent sites, such as the El du Pont property.*

EPA Response: EPA doesn't know who has been investigating those sites. Since they are apparently covered or capped, they are further ahead in the remedial process than LCP.

Comment #21: *One commenter asked how the stabilization will be implemented, and how deep will the remediation go, and will vapors have to be collected.*

EPA Response: The remedy has not been designed yet, but EPA expects the stabilization will incorporate mixing the sulfur and PTW in place. A key question is the amount of sulfur needed per volume of soil. EPA expects to go full depth, as much as 17 feet. However, there is a lot that remains unknown about the depth and the types of debris or pilings that will be encounter. If going to a depth of 17 feet cannot be accomplished, EPA has proposed a contingency to go down to 6 feet. That contingency depth will still address the majority of the visible mercury. A decision on the need for vapor collection will be made during the design.

Comment #22: *One commenter asked about the legal instrument EPA will use to compel the PRPs to perform the remedy especially when the PRP has changed.*

EPA Response: When ISP sold a portion of their company to Ashland, the responsibility to perform the Site investigation and feasibility study – per an Administrative Order on Consent - went with it. After the ROD is signed, EPA will offer Ashland the opportunity to perform the remedy through a Consent Decree. EPA expects they will perform the remedy.

Comment #23: *One commenter asked if the sulfur could convert some chemical in the soils into a chemical that's hazardous.*

EPA Response: EPA does not expect it will happen and EPA will be monitoring the air during the work phases.

Comment #24: *One commenter asked what happens with the mercury in the building, and if there are other chemicals in the building.*

EPA Response: A key to the design and remedial action will be dust and vapor control during demolition as the buildings' porous material is likely heavily contaminated with mercury. The dust/vapor control processes used for buildings demolition are pretty well known and EPA does not expect to find high levels of contaminants aside from mercury.

Comment #25: *One commenter mentioned that he did a demolition project at a site that had used mercury and found the bricks were heavily contaminated with mercury, and vaporization became an issue during hot weather. They stopped work and decided to wait until winter. The commenter also asked where the bricks from the LCP Site would be sent. The commenter was concerned that crushing the brick would release more mercury vapor. Further, the commenter asked if EPA would consider doing the mixing under a bubble or some type of spring form.*

EPA Response: EPA noted the same sort of experience - high levels of mercury in porous brick - during the demolition of a building at a Superfund site in Hoboken, New Jersey. The bricks from LCP's buildings will be treated with sulfur and placed under the cap. EPA recognizes that crushing the brick could release vapor to an unacceptable level, therefore the design will have to account for and prevent that possibility. EPA will consider doing the work inside a temporary structure.

Comment #26: *One commenter asked how long the project will take and if it will be done in all seasons.*

EPA Response: EPA expects the work to go on all year. EPA believes it will take a year and a half for the pilot study, a year for the design, and another year and a half to two years for the construction work to be completed.

Comment #27: *One commenter asked if there was an estimate of the amount of mercury that may have vaporized from the Site over the last thirty years.*

EPA Response: EPA has never made that estimate, but recognizes that vaporization has and continues to occur, which is why EPA would like to implement the remedy as soon as possible.

Comment #28: *One commenter asked how EPA predicted the land use for the risk assessments when there is no land owner.*

EPA Response: For the risk assessments, EPA assumed the land use would be commercial/industrial, which is what the land is currently zoned for. If the Site were to be used for residential purposes, the risk assessment would have found a greater potential risk. Either way, EPA would have decided that the risk posed by the Site needed to be addressed.

Comment #29: *One commenter asked what EPA would have done if this were in a residential area.*

EPA Response: EPA only considered current and potential future uses for the Site, which does not include residences.

Comment #30: *One commenter asked what would happen if during the remedial phase a storm floods the site.*

EPA Response: Based on the nature of mercury, it is unlikely to spread much even during a storm such as Superstorm Sandy. However there will be some contingencies built into the design of the remediation, just in case a hurricane or nor'easter hits while work is underway.

Comment #31: *One commenter asked if, in the future, all water entering the LCP site during rain events, will discharge to the Arthur Kill.*

EPA Response: EPA cannot say that the all the stormwater on Site will eventually discharge to the Arthur Kill. However, the requirements of a New Jersey storm water permit would have to be met by the final design.

Comment #32: *One commenter asked if the South Branch Creek and Northern Offsite Ditch are going to use different cleanup standards due to their proximity to the Arthur Kill. The commenter also expressed concerns that EPA's proposed remedy was inconsistent with EPA's approach to other areas impacting Raritan Bay, where cleanups are performed to prevent further contamination of the Bay. The commenter indicated he was not just concerned about mercury, but also benzene, etc.*

EPA Response: Unlike soil, there are no promulgated standards in New Jersey for sediments. In some cases National Oceanic and Atmospheric Administration screening levels are used for sediments. Those levels are very low. If EPA were to clean up to that level, the sediments would be re-contaminated by the Arthur Kill over a few tide cycles. Therefore, EPA decided to clean the Creek and Ditch to levels consistent with those found in the Arthur Kill. Cleanup of the Creek and Ditch will achieve contaminant levels far below levels currently found in the sediments. This cleanup will interrupt sources of mercury from the Site into the environment. Benzene and the other contaminations in the overburden groundwater will be contained, pumped and treated.

Comment #33: *One commenter asked about a 2002 state bill that required a mercury alert notice throughout the areas, and whether there has been compliance. The commenter indicated that this bill would require signs to be posted in every medical office.*

EPA Response: EPA does not regulate or enforce that state law. EPA's focus is the Site remediation.

Comment #34: *One commenter asked how EPA plans on containing contamination during the remediation that is on worker's feet or on trucks running through the neighborhood.*

EPA Response: That is a concern on nearly every site cleanup, and is addressed through a site-specific health and safety plan. Rules will be in place for people and equipment entering "exclusion zones" and being cleaned of waste before exiting those zones.

Comment #35: *One commenter asked about the mercury ban.*

EPA Response: The mercury ban refers to a restriction in the United States, which prevents movement of elemental mercury across our international borders.

Comment #36: *One commenter asked whether there are birds at the Site eating the contaminated crabs and fish.*

EPA Response: Yes, however, unlike crabs and fish, bird tissue was not sampled. Nevertheless, modeling performed during the risk assessment demonstrated that there is an unacceptable risk to birds, insects and small mammals from the Site contamination.

Comment #37: *One commenter asked about endangered species in the wetlands.*

EPA Response: There is no evidence of any federally endangered species on the Site. However, as part of the remedy, EPA will interrupt exposure to Site contaminants for all species of birds. EPA will be filling in some wetlands on Site but rebuilding them in an area more inviting to wildlife.

Comment #38: *Several commenters asked if there was a government agency that could sample the homes.*

EPA Response: EPA will attempt to find someone who can answer this request, and if found we will put that information up on EPA's website for the Site. EPA notes the concern residents have is not just from the Site, but rather from the water from the Arthur Kill and other local water bodies that may have impacted their homes.

Comment #39: *One commenter asked if the Site might be passed to the NJDEP.*

EPA Response: EPA does not expect that to happen, but if it does EPA and NJDEP will announce it publically.

Comment #40: *One commenter asked whether the 32,000 cubic yard estimate of buildings was their actual space or the amount of total expected debris.*

EPA Response: That is he estimate for the total amount of building material debris expected once the buildings are demolished.

Comment #41: *One commenter asked since the ban went into effect, is EPA doing any kind of work for mercury extraction as a remediation method. Meaning, if something were to come up in 2 or 3 years, could EPA use that instead of the proposed stabilization approach?*

EPA Response: EPA did a thorough search and could not find a practical technology for treatment, aside from the one proposed. However, if something were developed over the next few years, EPA will look at it. EPA can change a remedy if appropriate.

Comment #42: *One commenter asked for a realistic timeframe to begin the remedial action, and whether EPA believes the ROD will be issued in 2013.*

EPA Response: Optimistically, remediation is likely to start approximately four years after the ROD is issued. At the meeting, EPA state an expectation that the ROD would be issued in 2013.

Comment #43: *One commenter asked if EPA considered doing the South Branch Creek remedy while performing the treatability studies.*

EPA Response: Remediating the South Branch Creek as an interim remedy was an idea put forth by the responsible parties during the remedial investigation. After discussions with NOAA and the State, EPA decided to wait until the ROD is issued. However, EPA will consider performing the sediment cleanup while the pilot studies for soils are underway.

Comment #44: *One commenter asked if study results would be accessible during the RD and RA phases.*

EPA Response: The studies will be made available on-line and EPA will have other public meetings or availability sessions to explain results or findings.

Comment #45: *One commenter asked if hard copies could be sent to the library as she had difficulty accessing the information off the discs.*

EPA Response: Libraries generally prefer discs, as the RI/FS documents take up an enormous amount of shelf space. EPA will meet with the Linden librarians to make sure the electronic documents are accessible.

Comment #46: *One commenter asked whether mercury levels will increase by the time the remedy starts.*

EPA Response: No, the Site production is shut down, so there is currently no source adding mercury to the soils or sediments.

Comment #47: *One commenter asked whether the PRPs are responsible for anyone impacted from consuming contaminated fish caught in the Arthur Kill.*

EPA Response: The LCP Site is one of several other sources of mercury to the Arthur Kill, and a limited amount of mercury is still migrating to the Arthur Kill from LCP. Therefore, EPA would prefer to have the remediation completed as soon as possible.

PART 2: Written Comments

Comments from Edison Wetlands Associations et al.:
Comment #1: *Consistency in Superfund Cleanups: LCP Chemicals has been a responsible party at other Superfund sites, and therefore, the selected remedy must be consistent with cleanup remedies. LCP Chemicals had contaminated a similar site in New York adjacent to the Onondaga Lake. The former Linden Chemical and Plastics (LCP) site was a major source of mercury contamination in Geddes Brook,*

Nine Mile Creek and Onondaga Lake. As part of the site remediation, more than eight tons of mercury was removed from the plant property. Additional upland sites, for which there are other responsible parties, are also in various stages of remediation. As of 2010, Records of Decision (ROD) have been signed for cleanup plans at eight Superfund subsites. http://www.dec.ny.gov/chemical/8668.html We strongly recommend that USEPA select Alternative 5a/b (Removal and off---site disposal of the Principal Threat Waste and contaminated building debris). This remedy selection is consistent with other remedy selections like the Geddes brook, Nine Mile Creek and Onondaga Lake cleanup. The current proposed plan contains significant deficiencies in the protectiveness to human health and the environment.

The choosing of Alternative 5a/5b would provide the best of the possible remedies proposed as well as provide consistency with the cleanup of LCP's Superfund Site mercury contamination in Geddes Brook, Nine Mile Creek and Onondaga Lake. As part of the site remediation, more than 8 tons of mercury was removed from the plant property. This important regional resource in the Arthur Kill is no less important than the cleanup of Geddes Brook, Nine Mile Creek and Onondaga Lake.

Alternative 5a/b is the only alternative that offers long---term protection from these hazardous wastes that directly threaten human health and the environment and also provide permanent cleanup of the Principal Threat Waste (PTW) at LCP Chemicals Superfund Site. Cleanup of the PTW is one of the decision making tools used by the USEPA to decide on the Superfund selection remedy process and its ARARs. Only Alternative 5a/b addresses the PTW and provides a permanent cleanup of PTW, mercury, which is a direct threat human health and the environment. Along with the selection of Alternative 5a/b we also want additional mercury cleanup in the sediments that bio-accumulate in wildlife and biota.

EPA Response: The Site to which the commenter refers is the LCP Bridge Street site, located near Syracuse, NY. The remedy at the LCP Bridge Street site called for treatment of the PTW soils through soil washing. As explained in the feasibility study and this ROD, due to the nature of the Site's fill, soil washing would not work at the LCP Linden Site. Also, it should be noted that the eight tons of mercury recovered from soil at Bridge Street. went into the commercial market. As of January 2013, federal agencies are prohibited from selling or distributing elemental mercury under their control or jurisdiction. So even if soil washing were technically feasible at the LCP Linden Site, it would be administratively impracticable to select the treatment approach used at the Bridge Street site.

The LCP Bridge Street site treated a portion of its contaminated soil, specifically the PTW, through soil washing. LCP Linden will treat a portion of its contaminated soils, the PTW, through in-situ stabilization. At both sites, treated soils as well as untreated contaminated soils/sediments are contained on site. Like the LCP Linden Site's selected remedy, the LCP Bridge Street site's containment uses a barrier wall and an impermeable cap. Therefore, fundamentally the LCP Bridge Street site remedy is similar to the remedy selected for LCP Linden, the key difference being the Bridge Street site remedy treated a portion of the soils ex-situ through soil washing, while LCP Linden Site remedy will treat a portion of the soils in-situ through stabilization.

The Geddes Brook and Nine Mile Creek are small water bodies containing mercury contaminated sediments. Those sediments are being excavated and placed under the LCP Bridge Street cap. This is the same approach selected for the Northern Off-Site Ditch and bottom third of the South Branch Creek of the LCP Linden Site. Again, the remedies to which the commenter referred are similar to the remedy selected at LCP Linden.

Alternative 5b is not similar to the remedy at the LCP Bridge Street ste. Rather than treatment,

Alternative 5b called for excavation and off-site disposal of the PTW soils. Alternative 5b was not selected for a number of reasons, such as cost and increased short-term impacts to the community. More importantly, EPA also found that there is a lack of disposal options for soils with visible mercury. Land disposal of soil containing elemental mercury concentrations of over 260 ppm (i.e., all the PTW) is prohibited by the RCRA Land Disposal Restrictions (LDR). Under the LDR, the soils would have to be treated, using high-temperature mercury recovery, before disposal. Once recovered from the waste, elemental mercury has typically been returned to the commercial market as product.

While there are facilities in the United States that can accept and treat soil containing greater than 260 ppm of mercury, none of them could handle the amount of PTW soil requiring treatment at the LCP Site. EPA located only one North American facility (Stablex in Canada) that may be able to handle the quantity of PTW at LCP. However, the facility was not able to say for certain that they could handle the mass.

Comment #2: *NOAA Policy: According to a March 2004 National Oceanic and Atmospheric Administration (NOAA) report, under "Threats and Contaminants Preliminary sampling of soil, surface water, and sediment", it revealed elevated levels of mercury, and other metals. Site contaminants are potentially impacting the Arthur Kill, which is used for recreational boating and fishing. The peregrine falcon, northern harrier, great blue heron, and little blue heron, all state---listed species, are reported to either breed or hunt in the salt marshes near the site. Prall's Island, located approximately 1,000 feet east of the mouth of the South Branch Creek, is a breeding area and rookery for some of these birds. In 1990, the New Jersey Conservation Foundation and the NJ Audubon Society conducted an inventory of the river in which they identified around 200 bird species including nearly 90 species that breed in this area.*

Alternative 4b violates National Estuary Program that was established by Congress in the 1987 amendments to the Clean Water Act. Its purpose is to promote the development and implementation of comprehensive management plans for estuaries of national significance that are threatened by pollution. At the request of the governors of New York and New Jersey, USEPA accepted the New York---New Jersey Harbor & Estuary into the National Estuary Program in 1988. Since that time, it has been an effective partnership for advancing regional efforts to achieve the goals of the Clean Water Act for fishable and swimmable waters throughout the nation.

USEPA's selection of Alternative 4b also violates NOAA's policies on cleaning up and restoring sites in New Jersey. The Office of Response and Restoration's Coastal Protection and Restoration Division (OR&R/CPRD) partners with other agencies and responsible parties to ensure that waste site cleanups not only reduce risk, but also restore natural resources and improve the quality of the environment. NOAA Coastal Resource Coordinators (CRCs) get involved early in site cleanups to:

- *ensure that ecological assessments and the entire cleanup process evaluate and mitigate any risk to sensitive species and habitats;*
- *incorporate environmental restoration into cleanup actions;*

The New Jersey Resource Trustees, which includes the USEPA as a member, states the following in its mission:

> Protecting and Restoring Coastal and Marine Resources: NOAA's Coastal Protection and Restoration Division (CPRD) protects and restores natural resources in marine and coastal environments that are affected by hazardous waste sites. NOAA Coastal Resource Coordinators

(CRCs) work with the U.S. Environmental Protection Agency (EPA), the State of New Jersey, and other trustee agencies to identify risks to natural resources, recommend site cleanups that protect habitat and wildlife, and design projects to restore injured resources and habitats.

USEPA must choose Alternative 5 a/b or they will violate their mandate, through the Congressional National Estuary Program and the Federal Clean Water Act, to protect coastal resources.

EPA Response: A NOAA Regional Resource Coordinator (formally known as a Coastal Resource Coordinator) is represented on EPA Region 2's Biological Technical Assistance Group (BTAG), which reviewed and commented on the Site's investigations, including ecological risk assessments, through a multi-year iterative process. NOAA has not indicated that the selected remedy's containment of contaminated soils and groundwater would fail to comply with any NOAA policies.

The Harbor Estuary Program's (HEP) Comprehensive Conservation and Management Plan and the subsequent 2011-2015 HEP Action Plan seek to reduce toxic contamination to the estuary through a variety of actions, including Superfund site cleanups. Mercury is one of the toxics of concern for HEP. Since the selected remedy will protect human health and the environment in part by reducing mercury contamination to the estuary, it is consistent with the National Estuary Program in general and the HEP specifically.

Comment #3: *Mercury Contamination in the Arthur Kill Estuary: The contamination that has occurred on the LCP Chemicals Superfund Site is of regional importance to New Jersey's waterways and its ecologically sensitive receptors found in the Arthur Kill Estuary and on the receiving end of the Raritan Bay. Due to the proximity of this site to the Arthur Kill and a residential neighborhood, it is of critical importance to properly remediate this site and remove all contamination found on site. The Arthur Kill is currently one of the most heavily contaminated bodies of water found in New Jersey and will continue to be unless action to reduce any further contamination is taken.*

This violation of protecting America's waters has led to the poisoning of biota that is found in the Arthur Kill and has allowed contaminants such as mercury, arsenic, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), volatile organic chemicals (VOCs), chlorobenzene, benzene, and other contaminants to enter the food chain. Fully cleaning up the PTW from LCP Chemicals Superfund site would demonstrate USEPA's mandate to protect human health and the environment is still a core principle of the Superfund Program.

Extensive research has been done on mercury and results were found that in fetuses, infants, and children, the primary health effect of methylmercury is impaired neurological development. Methylmercury exposure in the womb, which can result from a mother's consumption of fish and shellfish that contain methylmercury, can adversely affect a baby's growing brain and nervous system. Impacts on cognitive thinking, memory, attention, language, and fine motor and visual spatial skills have been seen in children exposed to methylmercury in the womb.

The LCP Chemicals Superfund site and its PTW have contributed to the contamination of the Arthur Kill Estuary. This ongoing contamination has become so problematic that the New Jersey Department of Environmental Protection (NJDEP) & the Department of Fish and Wildlife have restricted the consumption of fish and crabs due to the overwhelming contamination of the biota found in the water. This is a clear violation of the Clean Water Act of 1972 and a violation of the Public Trust Doctrine which were passed to ensure the protection of America's waters and access to the water by the public. While in

theory this restriction would provide some protection of public health, the majority of those directly impacted don't speak English and those whose cultural heritage is to fish and crab continue to use the Arthur Kill Estuary as a food source for their families.

EPA Response: EPA agrees and has stated that the contamination at the Site currently puts the local ecology at risk. EPA recognizes that the Site is one of the numerous sites that have impacted the Arthur Kill. EPA also agrees that there would be a risk to human health if people were to work or trespass on the unremedied Site. EPA does not agree that the only way the Site's risks can be interrupted is through removal of the contamination to some other location.

Available data indicate that only a limited mass of mercury is emanating from the Site, mainly through vaporization and possibly sediment transport. The prime driver of risk is direct contact with the soils or sediments on the LCP property. The selected remedy would not only prevent vaporization and sediment transport through treatment and containment, it would also be an excellent and proven way to interrupt direct contact exposure. It should be noted that all the potential alternatives for the Site, including the one with a removal component (Alternative 5a/b), has containment as a principal element.

Comment #4: *Flooding and Severe Weather Storms: USEPA's Proposed Plan will continue to threaten residents who live in this area and who experienced flooding from severe storms and hurricanes just like Hurricanes Irene and Sandy. The contamination from Superfund Sites, like the LCP Chemicals site, have entered the Arthur Kill and then brought back inland after flood waters from the already contaminated Arthur Kill submerged most of this area. With the recent severe weather events in New Jersey, it is important to select remedies for contaminated sites that will not have the potential of creating complications or breaking in the future. Remedy selection 5a/b is the only remedy that provides any protection against future natural disasters.*

These waters have posed a threat to the residents who live in this area and who experience flooding from storms and hurricanes just like Hurricanes Irene and Sandy. The contamination that has come off of sites, such as the LCP Chemicals site, has entered the Arthur Kill and was then brought back inland after flood waters from the already contaminated Arthur Kill submerged most of this area.

EPA Response: EPA recognizes that the Site's remedy will have to be designed and constructed with the understanding that severe flooding will occur on Site sometime in the future. Containment remedies, such as the one at the Scientific Chemical Processing Superfund Site in Carlstadt, New Jersey, have proved to work successfully in flood prone areas, even during the recent storm.

Comment #5: *Incomplete Proposed Alternatives: The USEPA presents several pros to choosing alternative 5a/b yet does not present alternative 5a or 5b as a proposed alternative. In the USEPA's Proposed Plan and evaluation of alternatives, the agency shows that 5a/b meets the criteria for selecting a remedy. Alternative 5a/b meets the following criterion:*

1. *Overall protective of the environment and human health*
2. *Compliance with applicable or relevant appropriate requirements (ARARs)*
3. *Long---term effectiveness and permanence*
4. *Reduction of Toxicity Mobility or Volume Through Treatment*
5. *Short term effectiveness*
6. *Implementability*

7. *Cost*
8. *State/Support Agency Acceptance*
9. *Community Acceptance*

The USEPA states that, "In addition, Alternative 5a and 5b would require between 1,000 and 2,000 trucks to first remove the PTW soil and debris, then to bring in substrate to backfill the excavated areas. Thus Alternative 5a and 5b is the only option that would significantly increase the truck traffic through the local community." However, USEPA has overlooked the possibility of using rail lines to take the contaminated material off site. This area has a plethora of freight rail lines and has the Chemical Coast Sector adjacent to the area. The use of rail lines will highly reduce truck traffic and at the same time reduce the cost of the remediation. This mode of transport has been utilized by USEPA at other Superfund sites such as Horseshoe Road Superfund Site, Atlantic Resources Superfund Site in Sayreville NJ, and Chemical Insecticide Superfund Site in Edison, New Jersey to remove hazardous materials, reduce truck traffic, and drive the remediation cost down as well.

Even if the USEPA must use trucks, this area is well suited to handle the traffic, and the tradeoff of removing the PTW is well worth the use of trucks. This amount of trucks is relatively small in comparison to the removal of this high toxic waste. The area has many major truck routes that already have significant truck traffic.

The volume of trucks is relatively small in comparison to other Superfund site remediations that have been selected in Region 2 where full removal of PTW has been selected. The Ringwood Mines Superfund site in Ringwood, New Jersey is an example where USEPA selected removal of the O'Connor Disposal Area (12,519 truck trips or about 6,260 trucks) for the remedy selection at that site. The remedy selected for the Ringwood Mines Superfund site would generate significantly more trucks on smaller residential roads than Remedy 5 a/b at the LCP Superfund site. USEPA chose the full clean up at that site because of the same exact issues that we are stating for the selection of the remedy at the LCP Chemicals Superfund site.

EPA Response: The criteria "short term-effectiveness" requires considerations of short-term community impacts. Sending several thousand additional trucks through areas of Linden would impact the community through air and noise pollution and the increased risk of accidents. However, that was only one of, and not a key, reason that Alternative 4b was considered preferable to Alternative 5b. Alternative 5b had other short-term community impacts such as increased mercury vaporization. Alternative 5b was also significantly more expensive (criteria 7) and had logistical issues related to implementability (criteria 6) that appeared to be intractable. So even if trains could be used or trucks could somehow bypass the community, it would not have altered EPA's decision.

Comment #6: *Environmental Justice: USEPA states that environmental justice considerations will impact all decision---making the agency does. If this is true, and the USEPA uses environmental justice as a benchmark for their decision---making process, then they must select alternative 5a/b for the remedy at this site. This selected remedy would provide at least a measure of protection for this environmental justice community as it removes the PTW and does not leave it in place for future generations of people and wildlife to suffer its impact. The fact that the public still uses this area for its food source and that these people that live in this community are already suffering from disproportionate amounts of contamination in their air, water, and food makes this environmental justice issue of the highest magnitude. The Tremley Point section of Linden is already a state-recognized Environmental Justice area, one of five cities to get this special assignment.*

As we see with the recent federal government shutdown, assurances that USEPA will be here in perpetuity to maintain a cap that would cover this very toxic waste is not something that can be assured. The federal government shutdown and the funding issues that the United States faces clearly demonstrates that we need to take care of this threatening toxic waste now while we have USEPA to address it. USEPA cannot provide any assurances that they will be funded nor have the mandate in the future to continue to maintain the cap on this operable unit adjacent to the Arthur Kill.
We strongly suggest that USEPA reconsider Alternative 5a/b for a thorough cleanup for the LCP Chemicals Superfund Chemicals Site. Alternative 5a/b is the only alternative that removes the majority of the risk from this site and is protective of human health and the environment. It is also the only alternative that is consistent with other LCP chemical site cleanups throughout the country. USEPA has done the community a disservice if they do not at least remove the main threats of this site and seek to address sediments and other contaminants when funding allows.

We support the vision of the Edison Wetlands Association (EWA), its goal to reduce environmental contamination, reduce the effect that this site on both the Arthur Kill and Raritan Bay, the protection and remediation of public resources, the increase of access to the public, and the long term protection of human health. We would like the full restoration of this area in order to provide a clean and safe habitat for all biota and a fair cleanup for the people marginalized by companies and their pollution. In an area that already experiences flooding and is in close proximity to the Arthur Kill, it is important to provide an avenue which will reduce flooding and provide a vital public service.

We strongly suggest that USEPA select Alternative 5a/b because it is the only alternative that removes the majority of the risk from this site and is protective of human health and the environment. The selection of this remedy ensures the future protection for generations to come and provides a complete and reliable remediation alternative to utilize and implement. Our collective organizations, including our many thousands of members fully support the selection of Alternative 5a/b to remove the mercury and other waste from the LCP Chemicals Superfund site.

EPA Response: EPA understands that in 2005 the Tremley Point Alliance submitted an Environmental Justice Petition for Linden to New Jersey's Environmental Justice Task Force (EJTF). The Petition was conditionally approved contingent on the Alliance submitting an Action Plan. It is unclear whether that action plan was submitted. Nevertheless, the petition highlighted the community's main issues:

- *Performance of a health survey and air quality monitoring in Linden due to the high incidence of asthma and other respiratory illnesses indentified by children and senior citizens.*
- *Protection of wildlife that exists in pockets of habitat and foraging areas in the Seventh Ward by reclassifying the wetland in the area of Linden's Piles Creek and banks of the Rahway River as "exceptional wetlands."*
- *Prior to approval of any projects in the Seventh Ward, i.e., Tremley Point, that have potential to impact human health and/or the environment, an Environmental Impact Study/Statement and meaningful public participation must be required.*

Of all the action alternatives, the selected remedy will have the fewest impacts to local air quality. The selected remedy will not impact wetlands around Piles Creek or the Rahway River. The CERCLA (i.e., Superfund) selection process has meaningful public participation and is considered functionally equivalent to the Environmental Impact Statement process. Therefore, EPA believes the selected

remedy addresses the main concerns of the Environmental Justice Petition.

All of the alternatives considered included a cap requiring long-term operation and maintenance (O&M). The long term O&M of the cap will be performed either by the potentially responsible party (PRP), the future site tenant or the site owner as described by an EPA approved O&M plan and as legally mandated by an institutional control, such as a deed notice. Even if EPA were unfunded in the future, the cap will still be maintained.

Comments from Cherokee LCP Land, LLC
The comment letter (attached) from Cherokee contained summaries of comments provided in more depth by their environmental consultant Impact Environmental. EPA's responses to those can be found under the Comments from Impact Environmental section (directly following this section).

Comments from Impact Environmental, a consultant employed by Cherokee LCP Land, LLC:
Comment #7: *Change Site Name: The site name under Superfund and on the CERCLIS is the "LCP Chemicals, Inc., Superfund Site, Linden, NJ". Comment 1 is a recommendation to change the site name to the "**Ashland** LCP Site, Linden, NJ". This change seems appropriate for framing corporate responsibilities and for general accuracy. There have been many instances in which the name of a Superfund site was changed to reflect changing conditions as a result of public feedback.*

EPA Response: Changing the name of the Site would lead to confusion and is of little value considering the Site has been on the National Priorities List for fifteen years. EPA declines this suggestion.

Comment #8: *At the public hearing and within all of the investigative documents it was established that free, "elemental", mercury was present in the surface soils of the Ashland site. It was indicated that this mercury could be readily observed by visual survey methods. Maps contained within the documents are clear on this matter. Inasmuch as Super-Storm Sandy impacted the site after the mercury in the soil was mapped, and given that no follow-up inspection has been performed, I believe that it is prudent for Ashland to perform this survey again to gauge the impacts of the storm on this surface that is/was laden with elemental mercury. Moreover, as verbalized more than a dozen times at the public hearing, isn't there a responsibility for the PRP to ascertain if mercury concentrations were transported to surrounding residential areas due to the storm-related flooding? At the hearing, an Agency staff member, indicated that similar testing was done by the Agency at and around the areas of the Gowanus Canal in New York, where the staff member lived. My research shows that mercury is much more toxic than any contaminants currently known to exist in the Gowanus Canal.*

Is there a reason why the logic of community-impact testing pertains only to affluent New York City communities and not to the community of Linden - is there an environmental justice issue associated with this site? In recognition of this, I demand the following:

a) *Voluntary testing of Linden residents yard soils by a New Jersey Certified (ELAP) Environmental Testing Laboratory for total mercury. I have performed the necessary re-search and have identified a laboratory that would be willing to test samples, using USEPA test method 6010, at the reduced cost of $35 per sample, inclusive of glassware. While sampling would be performed by the residents, we are prepared to provide a "how-to" website to help ensure a high degree of sampling precision and quality control. The samples could be picked up weekly for a month (on a Friday) at the community recreation center. Screening could also be performed using a hand-held XRF meter that can be rented for several days at a cost that is less than one-thousand dollars.*

b) *The Agency help Impact Environmental coordinate the Edison Wetlands Association and other local community groups interested in the LCP/Ashland site, to provide public notice of the aforementioned volunteer testing program. This can be done in both print and internet media spots.*

c) *The Agency help Impact coordinate local community groups, and offer assistance to-ward obtaining a Technical Assistance Grant (TAG) so that we can interpret and help the community understand technical information about the Ashland site.*

d) *The Agency should demand that a new survey of the Ashland site be performed to understand what, if any, changes occurred to impact the concentration and distribution of elemental mercury as a result of Super-Storm Sandy. As this is somewhat a visual-driven survey, this is a minor expense and inconvenience for the PRP.*

EPA Response: The Gowanus Canal passes through several neighborhoods of variable income levels, including Environmental Justice areas. However, the decision to perform limited sampling of properties adjacent to the Canal was not related to the local demographics.

The Gowanus Canal is 1.8 miles long, 100 feet wide and over 15 feet deep at low tide, with private homes in close proximity to its shoreline. In comparison, LCP's South Branch Creek is an approximately 1000 feet long, six feet wide, one foot deep drainage ditch that lies over a half mile from the nearest home. The flooding of homes/commercial properties along the Gowanus Canal came directly from water in the Gowanus Canal, while the flooding of homes in Linden came from the Arthur Kill and other local waterways, not from the South Branch Creek or Northern Off-Site Ditch.

EPA does not expect that contaminated sediments from the South Branch Creek (or the Northern Off-Site Ditch) could have impacted homes a half mile away in Linden. If Sandy spread LCP contamination off-site, those sediments would be found at one of the adjacent properties. At the public meeting, EPA agreed to sample or oversee sampling of one or more adjacent properties in order to determine if Site related contaminants were spread during the storm. In addition, the LCP Site will be re-surveyed and re-sampled during the remedial design phase.

While EPA has no plans to initiate volunteer sampling at the Site, EPA welcomes and encourages the community to apply for a Technical Assistance Grant. Please contact Wanda Ayala or Natalie Loney to get more information on the EPA's TAG process. Ms Ayala's number is 212 637-3676 and Ms. Loney's number 212 637-3639.

Comment #9: *I believe that both Ashland and ISP have a history of acting as both PRP and cleanup contractor/consultants. My belief stems from the fact that they have staff environmental scientists and chemists, and the name "ISP Environmental Services, Inc". Some current Ashland executives were previously executives at ISP. This appears to represent a conflict of interests, which creates ethical and perception concerns, as the PRP's staff have been integral in guiding investigation and cleanup activities. How can the area residents and Cherokee trust that this process has not been compromised for the purpose of reducing liabilities and on-site remedial costs for ISP to facilitate a sale to Ashland, or by Ashland to mitigate the cleanup and closure costs? In recognition of this, I demand the following:*

a) *Please provide me with information on third-party quality control testing (split samples, sample duplicates, trip blanks, etc.) that the Agency has had performed to insure that design goals were*

executed and reported with the integrity that is paramount to the protection of residents of Linden, Cherokee and the environment.

b) *Please provide information on the number and location of Superfund sites that ISP and Ashland, by extension, are named PRPs. If possible, provide comment on who the contractors of choice were for these projects.*

EPA Response: ISP Environmental Services, Inc., entered into an Administrative Order on Consent with EPA and performed the RI/FS, under EPA oversight, pursuant to and in compliance with that Order. In any of the matters under EPA oversight, if the PRPs have qualified personnel "in house" to perform the studies, that arrangement would be acceptable to EPA. Therefore, the relationship between a PRP and its consultants or contractors is inconsequential.

EPA has not ascertained the number of sites for which Ashland or ISP is a party, nor has EPA contacted the ISP or Ashland requesting names of contractors they use or have used elsewhere.

EPA hired CDM Federal to do field oversight during sampling events performed by ISP's contractors during the Remedial Investigation. CDM collected some split samples during the RI. The split sample results can be found at http://www.epa.gov/region2/superfund/npl/lcpchemicals

Comment #10: *Paramount to the study and the absolute direction of the logic tree used in its remedy selection is that mercury contaminated soil that is hazardous has no off-site legal disposal option. This fact that guides the remedy decision is erroneous. My staff has identified several disposal options for mercury hazardous waste. Many of these options are economical and make excavation of the impacted areas a more economically viable option.*

In recognition of this, I demand the following:

a) *Additional time is necessary to reevaluate this option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.*

EPA Response: While the commenter did not name the facilities to which he refers, EPA recognizes there are facilities in the United States that can handle high concentration mercury wastes. However there are no existing facilities in the United States that could handle the amount of high mercury waste found at the LCP Site. No additional time is required to reevaluate this option.

Comment #11: *It was identified that the transport of mercury waste could lead to community impacts during transport. If the material was transported in sealed drums this exposure potential could be entirely abated. This procedure has been utilized for decades for the removal of excavated soils in many Superfund Sites. In recognition of this, I demand the following:*

a) *Additional time is necessary to re-evaluate this remedial option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.*

b) *PRP should be prompted to identify what soils would need to be removed for acute exposure concerns and the removal should be performed immediately as an Interim Remedial Measure. This is particularly necessary as it is clear that the process of identifying and performing*

appropriate remedial measures is going to require additional delay. Failure to act could result in the dispersion of these contaminants from other acts of god or unintended incidents that could lead to dispersion of these toxic contaminants into the surrounding residences.

EPA response: Driving a few thousand trucks through a community has impacts unrelated to the type of freight the trucks are carrying. Those impacts (e.g., traffic, noise, air pollution, etc) are discussed in the feasibility study, specifically under the short-term impacts section. Rather than abating those impacts, the commenter's suggestion would increase truck traffic to allow for the additional volume required to haul waste in approximately 90,000 individual drums.

In addition, if an excavation remedy (Alternative 5 a/b) were selected, it would have other short-term potential risks to the community and workers, such as increased mercury vapor releases caused by excavating and handling the soil on Site. Since filling drums would require more handling of the PTW, it would likely increase, rather than abate, potential short-term vapor risks to workers and the community. No additional time is required to allow consideration of hauling waste soil in drums.

Comment #12: *It was identified that both the USEPA and the PRP contacted Brookhaven National Laboratory (BNL) for remedy selection. I contacted BNL and they have indicated that contact with the BNL staff was not officially engaged to work on the project. Comment provided by BNL indicated that the decision to dismiss Solidification/Stabilization was "flawed". No follow-up was performed by the Agency or the PRP since this "flawed" assessment was rendered by BNL. Moreover, since 2010, nobody performed any follow-up with BNL. BNL has indicated that they have successfully optimized its patented Sulfur Polymer Stabilization/Solidification Process (SPSS) since 2010 (see attached draft white paper prepared by Dr. P. Kalb of BNL). The SPSS process returned excellent results in the Department of Energy Y-12 site Cleanup. The use of this technology for insitu applications needs a serious re-evaluation. In recognition of this, I request the following:*

a) *Additional time is necessary to re-evaluate this remedial option. Revisions are necessary to the Feasibility Study document, and the logic associated with remedy selection to expand on this excluded information.*
b) *BNL needs to be engaged for its true opinion on how this site would be best remedied using its patented techniques. It is my opinion that the Remedial Investigation/Feasibility study is suggesting methods that will infringe upon some of BNL's Patents.*

EPA Response: Researchers at BNL are developing an interesting and promising approach to stabilize and solidify mercury contaminated soils. The process (SBSS) first uses sulfur to convert elemental mercury to mercury sulfide. The mercury sulfide is then solidified through a specific process, which could further reduce dispersion and permeability.

EPA considered this approach; however, after several discussions with BNL and EPA's Office of Research and Development, EPA's project team determined that since the SBSS had not yet been field tested, and protocols for field testing have not yet fully developed, it is too early to consider testing the technology. It is EPA's understanding (confirmed by the commenter's "white paper" submittal) that the process has not been used or even tested at the Y-12 site, rather it has been tested at the bench scale level on Y-12 site's contaminated soils.

In addition, considering the type of substrate at LCP, and the fact that – through the selected remedy -

the PTW will not only be converted to mercury sulfide but contained within a barrier wall/cap, EPA believes any potential decrease in permeability from BNL's process will not significantly increase this remedy's over-all protectiveness.

The commenter does not explain for how he believes the selected remedy may be imposing on BNL patents.

Comment #13: *It seems that the toxicity of mercury is being lost somewhere in the toxicity assessments. While mercury is not carcinogenic, it is an acute toxin. Contact with mercury has immediate and irreversible impacts upon various human organs, in particular the central nervous system. This makes it much more dangerous than other volatile contaminants such as benzene; a mere carcinogen. People are exposed to benzene routinely during fill ups, but several laws exist to eliminate any potential for mercury exposure. The entire body of risk assessment work contained within the Feasibility Study appears to be is flawed due to this failure of simple risk-assessment principle. In recognition of this, I demand the following:*

> *a. The risk assessment needs to be re-written with input from medical professionals who can offer alternate risk exposure assessment information for mercury. This includes staff from the Union County and NJ State Health Departments.*
>
> *b. This site, in its current state, appears to represent a severe health hazard. Greater work needs to be performed to insure that mercury dispersion is not occurring daily due to wind, water, wildlife, trespassers, etc. This site requires a 24 hour guard and temporary covering with an impermeable material (HDPE). If stockpiles of soil from residential tank pulls are required to be temporarily covered by New Jersey DEP, then why wouldn't a highly toxic surface require an impermeable cover? This may represent a health emergency and requires immediate emergency response.*
>
> *c. Public notice must be made to identify the danger this site represents. At the public comment meeting two separate participants from the community indicated that they not only walk the area, but partake in recreation hunting and fishing on the areas adjacent to or adjoining the adjacent properties. Why is this site not being treated for the clear and present danger it represents? Why are signs not posted warning people as they are at other Agency administered cleanup sites?*
>
> *d. The selected remedy does little, if anything to treat groundwater impacted by mercury from entering the Arthur Kill. In 1990, the NJ Conservation Foundation and the NJ Audubon Society conducted an inventory of the river and stream corridor, identifying nearly 200 bird species including about 90 species that breed in the watershed.*

EPA Response: EPA assesses both carcinogenic and non-carcinogenic risks during remedy selection. The commenter's assertion that the toxicity risk from mercury was "lost" in the pertinent documents seem perplexing in light of the fact EPA considers elemental mercury to be the Site's primary risk driver and the key contaminant of concern. Additionally, the principal threat waste at the Site is soil with visible mercury.

The commenter gave no specific reasons why he believes the risk assessment, which was conducted by the responsible party's contractor and reviewed by EPA's risk assessment experts, needs input from

other health professionals, such as those employed at state health agencies. Nevertheless EPA notes that Federal and State health agencies have performed an independent analysis of the Site risks. In 1999, the Agency of Toxic Substances and Disease Registry (ATSDR) and the NJ Department of Health and Senior Services (NJDHSS) released a health assessment for the Site. Their conclusions are consistent with the findings of the risk assessments. The report can be found at: http://www.atsdr.cdc.gov/HAC/pha/PHA.asp?docid=446&pg=1#disc

In brief, ATSDR and NJDHSS concluded:

> *Based on the information reviewed, the ATSDR and NJDHSS have concluded that the Linden Chemicals and Plastics (LCP) site currently poses no apparent public health hazard. This evaluation is the result of an absence of any completed human exposure pathway associated with the site.*
>
> *Fishing advisories/restrictions are currently promulgated by the New Jersey Department of Environmental Protection for the South Branch Creek and the Arthur Kill (as part of the Newark Bay Complex). Site data and information indicate that the LCP site may have contributed to the overall contamination problem of these surface water features.*
>
> *Although the ATSDR and the NJDHSS have not identified completed human exposure pathways associated with the LCP site, on-site soil contamination is present at levels of potential public health concern.*

Since the areas of visible mercury are surrounded by dilapidated buildings, there is no way to currently place an HPDE cover. While preventing release of mercury into the atmosphere is part of the overall goal of the selected remedy, air monitoring on and at the perimeter of the Site have not demonstrated an immediate or even long term risk to local residents.

The Site is surrounded by several layers of fencing and locked gates, and there is signage indicating admittance to the Site is not permitted. EPA will consider adding additional locks and installing more fencing.

EPA strongly disagrees with the assertion that the selected remedy does little if anything about the mercury impacted groundwater. The selected remedy will surround the area of Site contaminated groundwater with a barrier wall, and cover the area with an impermeable cap. The groundwater will then be collected and properly disposed. EPA expects the area to effectively dry out in less than a decade, in the meantime the barrier wall will prevent groundwater from migrating off- Site.

Comment #14: *The Feasibility Study fails to identify the impacts that leaving such a high concentration lode of mercury contaminated soil will have on the redevelopment of the Ashland/LCP site. The current intended land-use for the site is commercial/industrial. Cherokee has identified interest in constructing warehousing with 10% office space. The Feasibility Study needs to address if, and how, the building can be constructed without poisoning the construction workers, and future employees. In recognition of this, I demand the following:*

a) *The study must propose a remedy to prevent impacts of the mercury on building occupants. This should include real-time monitoring instruments to detect the efficacy of the remedy ad-infinitum.*

b) *The study must propose a remedy that will allow construction workers to work on the Ashland site without being exposed to mercury during activities such as excavation for drainage, utility and foundation installation, structural pile installation (down to 90') and surface landscaping/hardscaping.*

c) *The remedy must propose a long term Construction Health and Safety Plan for the Ashland site, and attach the plan to the title as part of the Institutional Controls.*

d) *A fund must be established that insures that monies will be available from the PRP to address any and all escalations in construction costs associated with the toxicity of the Ashland site.*

EPA Response: The primary purpose of an FS is to provide information to allow comparison of several remedial alternatives against each other and against the nine criteria. The purpose of an FS is not to design a remedy or to develop health and safety or monitoring protocols for a future owner or tenant.

Since the buildings the purported owner wishes to construct do not presently exist, it's unclear how the FS could perform real-time air monitoring of those buildings. Regardless, impermeable caps are a commonly used element of a hazardous site remedy. It is not uncommon to construct buildings on top of those caps. How the cap can be designed, in general, to accommodate a future use will be considered during the remedial design. Likewise, future buildings would need to be designed so as not to impact the remedy.

As for comments b and c, if the commenter means health and safety requirements for the remedial work need to be developed prior to implementation of the remedy, EPA agrees and those plans will be part of the overall remedial design. However, if the commenter means that the remedy should allow workers to perform sub-cap construction activities after the remedy is implemented, then EPA needs to point out that once the cap is installed, institutional controls will be put in place to prevent current or future owners or lessees from compromising the containment, such as through excavation or pile installation.

In response to comment d, EPA generally requires that PRPs provide financial assurance - such as through a surety performance bond (or other mechanism) – proving that they can complete the work described in EPA's ROD.

Comment #15: *The Feasibility Study fails to identify the impacts that leaving such a high concentration lode of mercury contaminated soil will have on the redevelopment of the Ashland site. The current intended land-use for the site is commercial industrial. Cherokee has identified interest in constructing a warehouse with a minimum of 10% offices. The Feasibility Study needs to address if, and how, the building can be constructed, and after construction, how it can be sustainably operated. In recognition of this, I demand the following:*

a. *The closure plan must identify how the remedy selection will couple with the intended redevelopment of the Ashland/LCP site by Cherokee. This must include a clear plan for soil stabilization for parking areas. Currently, the plan as proposed will render the site unbuildable due to the heavily disturbed condition that it will leave the soils. Will the soils be able to be compacted enough to support roads and driveways? What about footings, basements, etc.?*

b. *The study must include a clear plan for providing drainage for storm water and roof precipitation runoff. The remedy selection does not allow any means for direction runoff to the water table. Where will the runoff go? Will it be contained for Ashland to have removed on a weekly basis, ad-infinitum? The remedy selection, as it stands currently, will not support any other option.*

c. *The study must propose a long term Operations and Maintenance Plan for the Ashland site, and attach the plan to the title as part of the Institutional Controls.*

d. *A fund must be established that insures that monies will be available from the PRP to effect the necessary secondary or tertiary remediation when other unanticipated impacts are encountered at the LCP/Ashland site.*

EPA Response: The types of plans discussed above, such as an O&M plan or a plan for site run-off are developed either in the design phase or after the remedial action has been implemented. Potential impacts of the remedy on future redevelopment can be considered during the remedial design phase.

Comments from Ashland Inc.:
Comment #16: *Mobilization of mercury from the LCP Site as a result of flooding during Hurricane Sandy; it is unlikely that flooding during the Hurricane Sandy caused remobilization of site contaminants, including mercury, to other off-site, inland locations. The LCP site and other nearby industrial properties have been flooded on multiple occasions by extreme weather events prior to and during the course of the RI, such as Hurricane Floyd (1999). Furthermore, the RI data demonstrate (e.g., off-site ditch sampling) that site contaminants in shallow soils were not distributed any significant distance off site in an inland direction, even after the prior flooding known to have occurred. Conditions during Sandy are not likely to have been sufficiently different than prior flooding events with respect to floodwater velocities such that it is unlikely that Sandy flooding would have caused additional off-site contaminant transport from the site in an inland direction. As such, IES, does not believe that there is a need for off-site sampling associated with the LCP site, as was suggested at the public meeting.*

EPA Response: EPA agrees it is unlikely that Superstorm Sandy spread Site contaminants in any significant amount. However, due to the size of the storm and public concern, EPA believes it is prudent to conduct some limited off-site analyses.

Comment #17: *Contaminant sources in the bedrock groundwater; there is no mention in the proposed plan that the RI demonstrated that most groundwater constituents in bedrock are undetectable except in the northwest area of the site, upgradient of the LCP production area, and that these upgradient impacts are associated with the adjacent GAF (LPH) site. Soluble mercury, benzene and chlorobenzenes are detected within an area in which the GAF groundwater extraction system has been shown to induce bedrock groundwater flow from the neighboring GAF site onto the LCP site. However, bedrock groundwater with in this area is subsequently captured and treated by the adjacent GAF groundwater remediation system. In summary, the soluble mercury and other organic constituents from the adjacent GAF site are the likely source of these constituents in the LCP bedrock wells and this mercury is being captured by the GAF groundwater extraction and treatment system. This is an important distinction relative to the remedy including only groundwater monitoring in the bedrock water bearing zone.*

EPA Response: The ROD describes the findings of the RI with respect to the bedrock groundwater. In addition, EPA discussed the bedrock aquifer and likely causes of its contamination (i.e., the GAF site) during the public meeting.

Comment #18: *Selection of Alternative No. 3 "Full Containment"; while IES understands the preference under SARA for remedies that include treatment, the evaluations performed in the USEPA-approved Feasibility Study support selection of Alternative No. 3, Full Containment, as the preferred remedy. It fully controls the sediment/surface water, groundwater and direct contact pathways. In the case of the LCP Site, available and practicable treatment technology is limited to chemical conversion of elemental mercury to mercuric sulfide. Yet, this technology is unproven and more importantly, alters only the form of mercury; the total mass of mercury remains the same. Therefore, without the benefit of the containment components of the remedy, the Site would still exceed the risk benchmarks (for mercury and other contaminants) for protection of human health and the environment. Therefore, the treatment components of Alternative Nos. 4a and 4b add substantial cost without corresponding, meaningful benefit.*

As also indicated in the Feasibility Study, the off-site disposal options, Alternatives No. 5a and 5b, do no provide any more practicable of an alternative. As researched during preparation of the Feasibility Study, and confirmed by the USEPA during the public meeting on August 28, 2013, a practicable disposal facility for the principal threat waste at the LCP Site has not been identified. And, even if one were, such as the USEcology/Stablex facility in Canada, the ultimate management of the mercury would still be via containment; perhaps outside of the US where less stringent regulations would apply (i.e., the land disposal restrictions do not apply in Canada), and the containment remedy (Alternative No. 3) would still be necessary because of the other contaminants associated with the anthropogenic fill and past site operations.

EPA Response: EPA agrees that Alternative 3 is a protective remedy and would employ tested containment features that have been used at other contaminated sites. EPA, however, disagrees with the commenter that the added cost of the treatment components of Alternative 4a and b are not worth the value added. The stabilization of the elemental mercury greatly increases the long-term effectiveness and permanence of the remedy in that the sulfur treatment ensures the reduction of the risk of exposure to the highest levels of mercury even in the event of a failure of the containment system. The overall effectiveness secured by the additional cost of the selected remedy, over remedies that achieve protectiveness through containment only, was determined by EPA to be warranted and hence the selected remedy represents a reasonable value for the money to be spent.

While there may be uncertainties with the selected remedy's treatment component, the prospect of converting a large volume of elemental mercury to mercury sulfide would not only allow compliance with NCP requirements, it would afford additional protection for direct contact and inhalation risks over containment alone.

Comment #19: *Bedrock water-bearing zone points of compliance; the USEPA's proposed plan, dated August 2013, on Page 2 indicates that surface water standards could be applied to the bedrock aquifer (designated Class IIIB) because numerical Class IIIB groundwater quality standards have not been developed by the NJDEP. Surface water standards should not and could not be an ARAR for groundwater. However, as a practical matter, surface water standards can be a reasonable ARAR for groundwater if applied only at the point of discharge of the groundwater to surface water. This would mean comparing groundwater quality to surface water standards only at the down-gradient perimeter of the site adjacent to the surface water body, not at any portions of the aquifer within the interior of the site.*

EPA Response: NJDEP reclassified the bedrock layer as Class IIIB groundwater, so therefore Class IIA groundwater standards do not apply and new site specific standards need to be developed. Until those standards are developed, NJDEP indicated saline surface water standards were to be used as the applicable criteria. When site specific alternative standards are developed, they will become applicable to the bedrock zone.

Comment #20: *Use of vacuuming and sulfur treatment; the USEPA's "Summary of the preferred alternative" on page 10 of the Proposed Plan, states the "Porous material that has visible signs of mercury contamination will be vacuumed and treated with sulfur." The Feasibility Study does not include vacuuming as a component of Alternative No. 4b on an equivalent basis to the addition of sulfur. Rather the FS, in Section 6.4 describing the building materials alternatives, includes vacuuming "...or other similar technique" for visible elemental mercury, only to the extent practicable.*

The limitations on vacuuming are substantial. The cell buildings, where mercury has been observed, are unsafe to enter and so vacuuming cannot be performed prior to demolition. Following demolition, the resultant porous debris (e.g., masonry units) is likely to be crushed and it would be impracticable to vacuum. As such, while the FS does include vacuuming to the extent practicable, it should only be included as a contingent component. This distinction is important to a practicable implementation approach for the alternative. Conversely, where visible elemental mercury may be present in porous building debris, the intent is to add sulfur and then place the material beneath the cap. The sulfur addition is not contingent component.

EPA Response: EPA agrees. The ROD does not include a requirement to vacuum building debris before treatment with sulfur.

Comments from the New Jersey Department of Environmental Protection:
Comment #21: *The Department concurs with the preferred remedial alternative which includes full containment of the contaminated soils and sediments; full stabilization, to a depth of 17 feet, of principal threat wastes; capture and treatment/disposal of overburden groundwater; partial restoration of South Branch Creek; and demolition of Site buildings. A key element of the remedy will be institutional controls and groundwater monitoring. The remedy is the final remedy for the Site and addresses the following contaminated media: soils, soil vapor, sediments and groundwater (Alternative 4b).*

EPA Response: EPA notes NJDEP's concurrence.

Comment #22: *The Department agrees that there should be a contingency remedy. However, it is the Department's position that the contingency remedy should be removal (Alternative 5b) which while more costly, appears implementable. Containment alone, which is one of the contingencies, does not address the principal threat waste.*

EPA Response: NJDEP is correct that EPA's second contingency remedy, Alternative 3, would not use treatment to address the principal threat waste. The NCP makes clear that when treatment is not practicable, engineering controls, such as containment, should be used. EPA found that excavation/disposal of the PTW has limited implementability. Therefore, the only contingency that would be both reasonably implementable and protective is Alternative 3.

Comment #23: *The Department's position is that a backgrounds study that is reviewed/approved by all partner agencies should be conducted during the design phase in accordance with USEPA 1997, USEPA*

1994 and NJDEP 2012. Background concentrations should be established for all contaminants and media for which site-specific ecological risk-based PRGs have been established (e.g., sediment and fish tissue). Ecological remediation goals should be the higher of the site-specific ecological risk-based PRGs or background. Ecological remediation goals should be used to delineate contamination in the Arthur Kill and determine the extent of the remediation in the Arthur Kill.

EPA Response: The Site is primarily a mercury site and mercury is the prime site contaminant found in the Northern Off-Site Ditch and South Branch Creek. Yet, sampling during the RI seems to indicate that levels of mercury found just outside the South Branch Creek's mouth are consistent with levels found elsewhere in the Arthur Kill and in tributaries of the Arthur Kill. Data also indicate it would not be possible to distinguish LCP's mercury from other mercury sources to the Arthur Kill. In addition, it is important to note that Region 2 is about to begin Phase 3 of the Newark Bay Study, which will likely include portions of the Arthur Kill adjacent to the LCP Site. Decisions related to further sampling or remediation of the Arthur Kill would be premature until the boundaries of Phase 3 are settled.

Comment #24: *More specifically, on page 6 (Remedial Action Objectives) and page 10 (Summary of the Preferred Alternative) of the final proposed plan, the text states that because sediments will be recontaminated by the Arthur Kill, EPA will determine a sediment cleanup level that is consistent with existing levels in the Arthur Kill or nearby tributaries during the design phase.*

a. *The phrase "a sediment cleanup level" implies one numeric goal. For the protection of ecological receptors, site-specific ecological risk-based PRGs should be established for all feeding guild/receptor groups and all contaminants for which elevated risk was indicated in the BERA, including mercury and barium (and possibly additional contaminants). The Departments assumes "existing levels in the Arthur Kill" means "background contaminant concentrations." Background data serve as default remediation goals if PRGs are below background levels and aid in contaminant delineation. The ROD should list the PRGs. The design document should list PRGs and justification for reverting to background levels.*

b. *The Department also requests the phrase "will be recontaminated" be revised in the ROD. While contaminants may enter the remediated zone, they would not be expected to reach pre-remedial levels. Additionally, the Department requests that the word "tributaries" be removed. As per the Department's Ecological Evaluation Technical Guidance (EETG NJDEP 2012), tributaries should be excluded from background investigations if data from the smaller, typically more contaminated water body are not representative of prevailing contaminant levels that may re-enter the remediated sediment site form tidal influences. Specially for the South Branch Creek remedy, use of data from nearby tributaries are not appropriate for background, since the nearest tributary, Piles Creek, contains high-level mercury sediment contamination (and other contaminants) from a LCP-related Responsible Party.*

EPA Response: For clarification, EPA recognizes (as did EPA's National Remedy Review Board) that contamination in the Arthur Kill will likely impact the South Branch Creek/Off-Site Ditch after the sediment remedy is implemented. Therefore, the action will focus on remedying the Creek/Ditch to levels consistent with those found in the Arthur Kill (or PRGs if they are higher). Those levels will be determined during the RD either with existing data or, if necessary, additional data.

EPA agrees, the phrase "a sediment cleanup level" indicates that there is only one numeric goal. That is not correct. The ROD makes that clear and a table of PRGs will be included in the final ROD.

The phrase "will be recontaminated" was not meant to imply recontaminated to existing levels. NJDEP's comment on the tributaries is correct. Reference to using the tributaries for development of sediment cleanup levels was not included in the ROD.

EPA is unaware of any evidence that Piles Creek was impacted by the LCP Chemicals, Inc., Superfund Site.

Exhibit F

Copy of Signed Order

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

IN THE MATTER OF:	:
LCP CHEMICALS, INC. SUPERFUND SITE	:
ISP Environmental Services, Inc.	:
Respondent	:
Proceeding Under Sections 104, 122(a), and 122(d)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (42 U.S.C §§ 9604, 9622(a), and 9622(d)(3)).	: Index No. II CERCLA-02-99-2015

ADMINISTRATIVE ORDER ON CONSENT
FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

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I. INTRODUCTION

1. This Administrative Order on Consent ("Consent Order") is entered into voluntarily by the United States Environmental Protection Agency ("EPA") and ISP Environmental Services, Inc. ("Respondent"). This Consent Order concerns the preparation of, performance of, and reimbursement for all costs incurred by EPA in connection with a remedial investigation and feasibility study (hereinafter, the "RI/FS") at the LCP Chemicals, Inc. Superfund site (hereinafter, the "Site") located in Linden, Union County, New Jersey, as well as the recovery of past response costs.

II. JURISDICTION

2. This Consent Order is issued to Respondent under the authority vested in the President of the United States by Sections 104, 122(a) and 122(d)(3) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §§ 9604, 9622(a) and 9622 (d)(3) ("CERCLA"). This authority was delegated to the Administrator of EPA on January 23, 1987, by Executive Order 12580, 52 Fed. Reg. 2926 (1987), and further delegated to the Regional Administrators on September 13, 1987, by EPA Delegation No. 14-14-C.

3. Respondent agrees to undertake all actions required by the terms and conditions of this Consent Order. Respondent consents to and agrees not to contest the authority or jurisdiction of the Regional Administrator of EPA Region II to issue or enforce this Consent Order, and also agrees not to contest the validity or terms of this Consent Order in any action to enforce its provisions.

III. PARTIES BOUND

4. This Consent Order shall apply to and be binding upon EPA and shall be binding upon Respondent, and the agents, successors, assigns, officers, directors and principals of the Respondent. No change in the ownership or corporate status of Respondent or ownership of the Site shall alter Respondent's responsibilities under this Consent Order.

5. Respondent shall provide a copy of this Consent Order to any subsequent owners or successors before ownership rights or stock or assets in a corporate acquisition are transferred. Respondent shall provide a copy of this Consent Order to all contractors, subcontractors, laboratories, and consultants which are retained to conduct any work performed under this Consent Order, within fourteen (14) days after the effective date of this Consent Order or the date of retaining their services, whichever is later. Respondent shall condition any such contracts upon satisfactory compliance with this Consent Order. Notwithstanding the terms of any contract, Respondent is responsible for compliance with this Consent Order and for ensuring that its subsidiaries, employees, contractors, consultants, subcontractors, agents and attorneys comply with this Consent Order.

IV. STATEMENT OF PURPOSE

6. In entering into this Consent Order, the objectives of EPA and Respondent are: (a) to conduct a remedial investigation ("RI") to determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release

of hazardous substances, pollutants or contaminants at or from the Site; (b) to determine and evaluate alternatives, through the conduct of a feasibility study ("FS"), to remediate said release or threatened release of hazardous substances, pollutants, or contaminants; (c) to provide for the reimbursement to EPA of response and oversight costs incurred by EPA with respect to the Site; and (d) to provide for reimbursement to EPA of response costs incurred by EPA at the Site prior to the effective date of this Consent Order.

7. The activities conducted under this Consent Order are subject to approval by EPA and shall provide all appropriate necessary information for the RI/FS, with the exception of the risk assessment performed by EPA, and for a record of decision that is consistent with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), 40 C.F.R. Part 300. The activities conducted by or on behalf of Respondent under this Consent Order shall be conducted in compliance with all applicable EPA guidances, policies, and procedures.

V. EPA'S FINDINGS OF FACT AND CONCLUSIONS OF LAW

8. The Site is located off of South Wood Avenue on the Tremley Point Peninsula, in Linden, Union County, New Jersey. The Site, which occupies 26 acres on filled marshland in an industrial area, is bordered by South Branch Creek to the east, ISP Environmental Services, Inc. to the north, and Northville Industries, BP Corporation, and Mobil to the northeast, south, and west, respectively. South Branch Creek, a tributary to the Arthur Kill, flows through a portion of the Site via engineered conveyance structures on the north side of the property. GAF Corporation purchased the Site from E. I. du Pont de Nemours and Company on or about September 15, 1949, filled an area of marshland and lowland, and developed it. GAF Corporation produced chlorine (using mercury cell electrolysis) and sodium hydroxide at this location from 1952 to 1972. LCP Chemicals Inc. (a subsidiary of the Hanlin Group, Inc.) of Edison, New Jersey purchased the Site from GAF Corporation in 1972 and continued to produce chlorine until 1985, when production at the plant ceased permanently. Sludge containing mercury from the chlorine production process was discharged to a brine sludge lagoon located on the property. There are approximately thirty-eight residences in the vicinity of the Site, with the nearest residential home being approximately one-half mile west on South Wood Avenue. The peregrine falcon, northern harrier, great blue heron, and little blue heron, all considered to be either threatened or endangered species, are reported to either breed or hunt in the salt marshes near the Site. Prall's Island, located approximately 1,000 feet east of the mouth of the South Branch Creek, is a breeding area and rookery for some of these birds.

9. There have been several documented releases of hazardous substances at the Site, including overflows from the brine sludge lagoon onto the ground surface and into South Branch Creek, which flows adjacent to the Site. In 1981, the New Jersey Department of Environmental Protection ("NJDEP") entered into an Administrative Consent Order with LCP Chemicals, Inc. This Consent Order called for the closure of the brine sludge lagoon and implementation of air, soil, and groundwater monitoring. Analytical results from soil samples collected in 1982 by LCP Chemicals, Inc., revealed elevated levels of mercury at 0-2 feet in depth, with concentrations ranging from 36 milligrams per kilogram (mg/kg) to 772 mg/kg. Surface soil samples collected from the perimeter of the lagoon at that time indicated mercury levels ranging from 27 mg/kg to 1,580 mg/kg. These

results are summarized in a February 1982 report, prepared by Geraghty & Miller, Inc. for LCP Chemicals, Inc., entitled *Waste Lagoon Ground-Water Monitoring*. In January 1995, EPA collected several surface soil, surface water, and sediment samples during a pre-remedial investigation. The highest level of mercury noted in the surface soils was 110 mg/kg. The average concentration of mercury in the sediments downstream of South Branch Creek was 500 mg/kg, with the highest concentration being 1,060 mg/kg. Mercury was detected in the surface water at 93 micrograms per liter (µg/l) near the facility's outfall. Arsenic was also present in most of the samples. The arsenic concentration in the surface water and sediment were 336 mg/l and 318 mg/kg, respectively. The highest level of arsenic in the soil was 17 mg/kg. Zinc (maximum concentration, 833mg/kg) and lead (maximum concentration, 304 mg/kg) were also noted in these samples. These results are summarized in a June 1995 report entitled *Final Draft Site Inspection, LCP Chemicals, Inc.*, prepared by Malcolm Pirnie, Inc. for the EPA.

10. Currently, the contaminated soil and sediment remain unmitigated. Leaching of contaminants into South Branch Creek is possible. The flow of contaminants into the Arthur Kill has not been defined as of yet. Prall's Island, a breeding area and rookery, located approximately 1,000 feet from the South Branch Creek discharge into the Arthur Kill, could be impacted. Groundwater may be impacted from leakage of contaminants into the subsurface. The actual and potential contaminant migration pathways listed above only include those pathways which have currently been identified. Additional actual or potential release or contaminant migration pathways may be identified as a result of subsequent studies.

11. Mercury poses a potential threat to human health. In addition, there is a potential for downstream acute effects to aquatic biota and contamination could be introduced into the food chain via aquatic species.

12. On July 27, 1998, the Site was included on the National Priorities List ("NPL"), established under Section 105 (a) (8) (B) of CERCLA, 42 U.S.C. § 9605 (a) (8) (B), and set forth at 40 C.F.R. Part 300, Appendix B.

13. Respondent to this Consent Order is ISP Environmental Services, Inc.(which has assumed the liabilities of GAF Corporation), 1361 Alps Road, Wayne, NJ 07470, incorporated in the State of Delaware. In addition to ISP Environmental Services, Inc., the following five (5) corporations were also identified as potentially responsible parties (PRPs) for the Site: (a) Caleb Brett (USA), Inc., 5051 Westheimer, Suite 1700, Houston, TX 77056, incorporated in the state of Louisiana; (b) Kuehne Chemical Company, Inc., 86 Hackensack Avenue, South Kearney, NJ 07032, incorporated in the state of New Jersey; (c) Praxair, Inc., Industrial Avenue, P.O. Box 237, Keasbey, NJ 08832, incorporated in the state of Delaware; (d) Union Carbide Corporation, 39 Old Ridgebury Road, Danbury, CT 06817, incorporated in the state of New York, and (e) LCP Chemicals, Inc. (a division of the Hanlin Group, Inc.), c/o McCarter & English, Four Gateway Center, 100 Mulberry Street, P.O. Box 652, Newark, NJ 07101, incorporated in the state of Delaware.

14. Each of the six (6) PRPs, noted in paragraph 13 above, operated at the Site at various times between the years of 1952 and 1996 as follows:

A. GAF Corporation owned the 26-acre property, and operated a chlorine production facility at the Site from 1952 until 1972.

B. Caleb Brett (USA), Inc. operated at the Site, from 1988 at least until 1995, storing various materials including fuel products, asphalt products, vegetable oils, pot ash, and caustic soda.

C. Kuehne Chemical Company operated at the Site, from 1973 at least until 1981, receiving chlorine gas and caustic soda via a pipeline from LCP Chemicals, Inc. to produce sodium hypochlorite.

D. Praxair, Inc. (formerly known as Liquid Carbonic Industries Corporation) operated at the Site, from 1988 at least until 1996, distributing carbon dioxide gas.

E. Union Carbide Corporation operated a hydrogen gas filling and repackaging plant at the Site from 1957 at least until 1990. Union Carbide transferred ownership of their gas filling and repackaging business to Praxair, Inc. in 1992.

F. LCP Chemicals, Inc. purchased the 26-acre property from GAF Corporation in 1972, and continued to operate the chlorine production facility until 1985, when all operations ceased at the Site.

15. Through the years, there have been several documented significant releases at the Site. Overflows of supernatant material from the brine sludge lagoon to the South Branch Creek were observed by the NJDEP in 1972 and 1974. In 1975, a brine recycle pump failed and a breach in the brine sludge lagoon occurred. In 1979, a sodium chloride solution contaminated with inorganic mercury overflowed from the process and the wastewater system, resulting in a release of an estimated 10,000 to 20,000 gallons of this material into South Branch Creek. Releases from piping near a 500,000 gallon tank located on the property were observed in 1980, 1981, and 1982. The volume and nature of the released liquid are unknown.

16. The Site is a "facility" as that term is defined in Section 101(9) of CERCLA, 42 U.S.C. § 9601(9).

17. Each of the chemicals detected at the Site, as identified in paragraphs 9 and 15, above, is a "hazardous substance," as that term is defined in Section 101(14) of CERCLA, 42 U.S.C. §9601(14) or is a "pollutant or contaminant" that may present an imminent and substantial danger to public health or welfare under Section 104(a)(1) of CERCLA.

18. The presence of hazardous substances at the Site or the past, present or potential migration of hazardous substances currently located at or emanating from the Site, constitute actual and/or threatened "releases" as defined in section 101(22) of CERCLA, 42 U.S.C. §9601(22).

19. Respondent is a "person" as defined in section 101(21) of CERCLA.

20. Respondent is a responsible party under Sections 104, 107, and 122 of CERCLA, 42 U.S.C. §§ 9604, 9607, and 9622.21. The actions required by this Consent Order are necessary to protect the public health or welfare or the environment, are in the public interest, are consistent with CERCLA and the National Contingency Plan, 40 C.F.R. Part 300 (as amended) ("NCP") and are expected to expedite effective remedial action and minimize litigation.

22. Respondent was given an opportunity to discuss with EPA the basis for issuance of this Consent Order and its terms. Unless otherwise expressly defined in this Consent Order, any terms used in this Consent Order which are defined in CERCLA or in regulations promulgated pursuant to CERCLA shall have the meaning set forth for them in CERCLA or in regulations promulgated pursuant to CERCLA.

VI. NOTICE

23. By providing a copy of this Consent Order to NJDEP, EPA is notifying the State of New Jersey (the "State") that this Consent Order is being issued and that EPA is the lead agency for coordinating, overseeing, and enforcing the response action required by the Consent Order. The attached document entitled "Appendix 1 - RI/FS Statement of Work" is hereby incorporated by reference into and is enforceable as a part of this Consent Order.

VII. WORK TO BE PERFORMED

24. All work performed under this Consent Order shall be under the direction and supervision of qualified personnel. Within thirty (30) days of the effective date of this Consent Order, Respondent shall notify EPA in writing of the names, titles, and qualifications of the personnel, including contractors, subcontractors, consultants and laboratories to be used in carrying out such work. The qualifications of the persons undertaking the work for Respondent shall be subject to EPA's review, for verification that such persons meet minimum technical background and experience requirements. This Consent Order is contingent upon Respondent's demonstration to EPA's satisfaction that Respondent is qualified to perform the actions set forth in this Consent Order. If EPA disapproves in writing of any person(s)' technical qualifications, Respondent shall notify EPA of the identity and qualifications of the replacements within thirty (30) days of the written notice. If EPA subsequently disapproves of the replacements, EPA reserves the right to terminate this Consent Order and to conduct a complete RI/FS, and to seek reimbursement for costs and penalties from Respondent. During the course of the RI/FS, Respondent shall notify EPA in writing of any changes or additions in the personnel used to carry out such work, providing their names, titles, and qualifications. EPA shall have the same right to approve changes and additions to Personnel as it has hereunder regarding the initial notification.

25. Respondent shall conduct the work required hereunder in accordance with CERCLA, the NCP, and EPA guidance including, but not limited to, the "Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (OSWER Directive No. 9355.3-01) (hereinafter, the "RI/FS Guidance"), "Guidance for Data Useability in Risk Assessment" (OSWER Directive #9285.7-05) and guidances referenced therein, as they may be amended or modified by

EPA. The general activities that Respondent is required to perform are identified below, followed by a list of deliverables. The tasks that Respondent must perform are also described in the attached Statement of Work ("SOW") and more fully in the guidance documents, and will be described in detail in an RI/FS work plan to be submitted as a deliverable under this Consent Order. The activities and deliverables identified below shall be developed as provisions in such work plan, and shall be submitted to EPA as provided. All work performed under this Consent Order shall be in accordance with the schedules herein, and in full accordance with the schedules, standards, specifications, and other requirements of the work plan and sampling and analysis plan, as initially approved by EPA, and as they may be amended or modified by EPA. For purposes of this Consent Order, day means calendar day unless otherwise noted in this Consent Order.

A. Task I: Scoping. EPA has determined the site-specific objectives of the RI/FS and has devised a general management approach for the Site, as stated below and in the attached Statement of Work. Respondent shall conduct the remainder of scoping activities as described in the attached Statement of Work and referenced guidances. As part of the scoping activities, Respondent shall provide EPA with the following deliverables:

1. RI/FS Work Plan and Schedule. Within thirty (30) days of gaining access to the Site as provided in Paragraph 50 of this Consent Order, Respondent shall submit to EPA a work plan for the performance of the RI/FS (hereinafter, the "RI/FS Work Plan") which includes, among other things, a detailed schedule for the RI/FS. The work plan shall provide for the completion of the final FS report not more than eighteen (18) months following approval of the FOP. If EPA disapproves of or requires revisions to the RI/FS Work Plan in whole or in part, Respondent shall amend and submit to EPA a revised work plan which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments. Respondent may invoke the dispute resolution procedures set forth in Section XVII below, in the event of a dispute between Respondent and EPA regarding EPA's disapproval of, or required revisions to, the RI/FS Work Plan.

2. Field Operations Plan. All sampling and monitoring shall be performed in accordance with the *CERCLA Quality Assurance Manual, Revision 1, EPA Region II*, dated October 1989, and any updates thereto, or an alternate EPA-approved test method, and the guidelines set forth in this Consent Order. All testing methods and procedures shall be fully documented and referenced to established methods or standards.

Within thirty (30) days of EPA's approval of the RI/FS Work Plan, Respondent shall submit to EPA a field operations plan ("FOP"). This plan shall consist of a sampling and analysis plan ("SAP"), a quality assurance project plan ("QAPP"), and a site health and safety plan ("HSP"). If EPA disapproves of or requires revisions to the FOP, in whole or in part, Respondent shall amend and submit to EPA a revised FOP which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments. Respondent may invoke the dispute resolution procedures set forth in Section XVII below, in the event of a dispute between Respondent and EPA regarding EPA's disapproval of, or required revisions to, the FOP.

a. The SAP shall address the components described in the attached SOW.

b. The QAPP shall include:

i. Project description;

ii. Project organization and responsibilities, including *curricula vitae* of key personnel;

iii. Quality assurance objectives for measurement;

iv. Sample custody;

v. Calibration procedures;

vi. Analytical procedures;

vii. Data reduction, validation and reporting;

viii. Internal quality control;

ix. Performance and systems audits;

x. Preventive maintenance;

xi. Data assessment procedures;

xii. Corrective actions; and,

xiv. Quality assurance reports.

c. The QAPP shall be completed in accordance with the EPA publication *Test Methods for Evaluating Solid Waste* ("SW846") (November 1986, or as updated) and the EPA documents entitled, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, USEPA QAMS-005/80, and *Guidance for Preparation of Combined Work/Quality Assurance Project Plans for Environmental Monitoring* (USEPA, Office of Water Regulations and Standards, May 1984).

Respondent shall use Quality Assurance/Quality Control ("QA/QC") procedures in accordance with the QAPP submitted and approved by EPA pursuant to this Consent Order, and shall use standard EPA Chain of Custody procedures, as set forth in the *National Enforcement Investigations Center Policies and Procedures Manual*, as revised in November 1984, the *National Enforcement Investigations Center Manual for*

the Evidence Audit, published in September 1981, and SW-846, for all sample collection and analysis activities conducted pursuant to this Consent Order. In addition, Respondent shall:

1. Ensure that all contracts with laboratories used by Respondent for analysis of samples taken pursuant to this Consent Order provide for access for EPA personnel and EPA-authorized representatives to assure the accuracy of laboratory results related to the Site;

2. Ensure that laboratories utilized by Respondent for analysis of samples taken pursuant to this Consent Order perform all analyses according to accepted EPA methods. Accepted EPA methods consist of EPA Drinking Water Method 524.2 and those methods which are documented in the "Contract Lab Program Statement of Work for Inorganic Analysis" and the "Contract Lab Program Statement of Work for Organic Analysis," dated February 1988 (or as updated), or any alternative method that has been approved by EPA for use during this project;

3. Ensure that all laboratories used by Respondent for analysis of samples taken pursuant to this Consent Order participate in an EPA Contract Lab Program ("CLP"), or CLP-equivalent, QA/QC program;

4. Ensure that the laboratories used by Respondent for analysis of samples taken pursuant to this Consent Order perform satisfactorily on Performance Evaluation samples that EPA may submit to those laboratories for purposes of insuring that the laboratories meet EPA-approved QA/QC requirements; and,

5. For any analytical work performed, including that done in a fixed laboratory, in a mobile laboratory, or in on-site screening analyses, Respondent must submit to EPA a "Non-CLP Superfund Analytical Services Tracking System" document for each non-CLP laboratory utilized during a sampling event, within thirty (30) days after acceptance of the analytical results. Upon completion, such documents shall be submitted to the EPA Project Coordinator, with a copy of the transmittal letter to:

Regional Sample Control Coordinator Task Monitor
USEPA-Edison Field Office
Environmental Services Division
2890 Woodbridge Avenue
Edison, NJ 08837

d. Site Health and Safety Plan. The HSP shall conform to 29 CFR §1910.120, "OSHA Hazardous Waste Operations Standards," and the EPA guidance document, "Standard Operating Safety Guidelines" (OSWER, 1988).

3. Following approval or modification by EPA, the RI/FS Work Plan and the FOP shall be deemed to be incorporated into this Consent Order by reference.

B. Task II: Community Relations Plan. EPA will prepare a community relations plan, in accordance with EPA guidance and the NCP. Respondent shall provide information, as requested by EPA, supporting EPA's community relations programs. As requested by EPA, Respondent shall participate in the preparation of all appropriate information disseminated to the public and in public meetings which may be held or sponsored by EPA to explain activities at or concerning the Site.

C. Task III: Site Characterization. Following EPA's written approval or modification of the RI/FS Work Plan and the FOP, Respondent shall implement the provisions of these plans to characterize the nature, quantity, and concentrations of hazardous substances, pollutants, or contaminants at the Site. Respondent shall provide EPA with validated analytical data within sixty (60) days of each sampling activity, in an electronic format (i.e., an IBM-compatible computer disk) in a form showing the location, medium and results. Within seven (7) days of completion of field activities, Respondent shall so advise EPA in writing. Within sixty (60) days of completion of validation of the final set of field data, Respondent shall submit to EPA a Site Characterization Summary Report, as described in the RI/FS SOW. Respondent shall address any comments made by EPA on the Site Characterization Summary Report in the draft RI Report.

D. Task IV: Identification of Candidate Technologies. Within forty-five (45) days of Respondent's receipt of the last set of validated analytical results, Respondent shall submit a Technical Memorandum for the Identification of Candidate Technologies. The candidate technologies identified shall include innovative treatment technologies (as defined in the RI/FS Guidance) where appropriate. If EPA disapproves of or requires revisions to the technical memorandum identifying candidate technologies, in whole or in part, Respondent shall amend and submit to EPA a revised technical memorandum, identifying candidate technologies, which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments.

E. Task V: Treatability Studies. At EPA's request, Respondent shall conduct treatability studies, except where Respondent can demonstrate to EPA's satisfaction that they are not needed. The major components of the treatability studies shall include a determination of the need for and scope of studies, the design of the studies, and the completion of the studies. If requested by EPA to undertake treatability studies, Respondent shall provide EPA with the following deliverables:

1. Treatability Testing Statement of Work. If EPA determines that treatability testing is required and so notifies Respondent, Respondent shall, within thirty (30) days thereafter, submit to EPA a Treatability Testing Statement of Work.

2. Treatability Testing Work Plan. Within thirty (30) days of EPA's approval of the Treatability Testing Statement of Work, Respondent shall submit a Treatability Testing Work Plan, including a schedule. Upon its approval by EPA, said schedule shall be deemed incorporated into this Consent Order by reference. If EPA disapproves of or requires revisions to the Treatability Testing Work Plan, in whole or in part, Respondent shall amend and submit to EPA a revised Treatability Testing Work Plan which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments.

3. Treatability Study QAPP, HSP, and SAP. Within thirty (30) days of the identification by EPA of the need for a separate or revised QAPP, HSP, and/or SAP, Respondent shall submit to EPA a revised QAPP, HSP and/or SAP, as appropriate. If EPA disapproves of or requires revisions to the revised QAPP, HSP, and/or SAP, in whole or in part, Respondent shall amend and submit to EPA a revised treatability study QAPP, HSP, and/or SAP, which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments.

4. Treatability Study Evaluation Report. Within thirty (30) days of completion of any treatability testing, sampling, and analysis, Respondent shall submit a Treatability Study Evaluation Report to EPA. If EPA disapproves of or requires revisions to the Treatability Study Evaluation Report, in whole or in part, Respondent shall amend and submit to EPA a revised Treatability Study Evaluation Report which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments.

F. Task VI: EPA's Baseline Risk Assessment. EPA will prepare a baseline risk assessment, which shall be incorporated by Respondent into the RI. Respondent shall make good faith efforts in assisting EPA in the preparation of the Baseline Risk Assessment. The major components of the Baseline Risk Assessment include contaminant identification, exposure assessment, toxicity assessment, and human health, and ecological risk characterization.

EPA will provide sufficient information concerning the baseline risks such that Respondent can begin drafting the Feasibility Study report. This information will normally be in the form of two or more Baseline Risk Assessment memoranda prepared by EPA. One memorandum will generally include a list of the chemicals of concern for human health and ecological effects and the corresponding toxicity values. Another memorandum will list the current and potential future exposure scenarios, exposure assumptions, and exposure point concentrations that EPA plans to use in the Baseline Risk Assessment. Respondent may comment on these memoranda. However, EPA is obligated to respond only to significant comments that are submitted during the formal public comment period.

After considering any significant comments received, EPA will prepare a Baseline Risk Assessment report based on the data presented in the Site Characterization Summary Report. The Baseline Risk Assessment report will be provided to Respondent. EPA will release this report to the public at the same time it releases the final RI report. Both reports will be put into the Administrative Record for the Site.

EPA will respond to all significant comments on the memoranda or the Baseline Risk Assessment that are submitted during the formal comment period in the Responsiveness Summary of the Record of Decision.

G. Task VII: Presentation on Preliminary Findings of the RI, Development of Remedial Action Objectives and Development and Screening of Remedial Alternatives. Respondent shall develop remedial action objectives and develop and screen remedial alternatives. Within sixty (60) days after EPA's submittal of the Baseline Risk Assessment report to Respondent, or within sixty (60) days after EPA's approval of Respondent's Treatability Study Evaluation Report, if treatability studies are undertaken, whichever is later, Respondent shall make a presentation to EPA and the State during which the Respondent shall summarize the preliminary findings of the RI, identify the remedial action objectives, and summarize the development and preliminary screening of remedial alternatives. Respondent shall address any comments made by EPA during this presentation in the appropriate document.

H. Task VIII: Remedial Investigation Report. Within thirty (30) days of the Task VII presentation to EPA, Respondent shall submit to EPA a draft RI report consistent with the RI/FS Work Plan and FOP. If EPA disapproves of or requires revisions to the RI report, in whole or in part, Respondent shall amend and submit to EPA a revised RI report which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's comments.

I. Task IX: Feasibility Study Report. Within sixty (60) days of the Task VII presentation to EPA, Respondent shall submit a draft FS report. Respondent shall refer to the RI/FS Work Plan and the RI/FS Guidance for report content and format. Within twenty-one (21) days of submitting the draft FS report, Respondent shall make a presentation to EPA and the State at which Respondent shall summarize the findings of the draft FS report and discuss EPA's and the State's preliminary comments and concerns associated with the draft FS report. If EPA disapproves of or requires revisions to the draft FS report, in whole or in part, Respondent shall amend and submit to EPA a revised draft FS report which is responsive to the directions in all EPA comments, within thirty (30) days of receiving EPA's written comments.

26. EPA reserves the right to comment on, modify and direct changes for all deliverables required pursuant to this Consent Order. At EPA's sole discretion, Respondent must fully correct all deficiencies and incorporate and integrate all information and comments supplied by EPA either in subsequent or resubmitted deliverables.

27. Respondent shall not proceed further with any subsequent activities or tasks until receiving EPA approval for the following deliverables: RI/FS work plan and FOP, and Treatability Testing Work Plan and Treatability Study FOP (if treatability study work is required to be undertaken). While awaiting EPA approval on these deliverables, Respondent shall proceed with all other tasks and activities which may be conducted independently of these deliverables, in accordance with the schedule set forth in this Consent Order.

28. Upon receipt of the draft FS report, EPA will evaluate, as necessary, the estimates of the risk to the public and environment that are expected to remain after a particular remedial alternative has been completed.

29. For all remaining deliverables not enumerated in the previous paragraph, Respondent shall proceed with all subsequent tasks, activities and deliverables without awaiting EPA approval on the submitted deliverable. EPA reserves the right to stop Respondent from proceeding further, either temporarily or permanently, on any task, activity or deliverable at any point during the RI/FS process.

30. EPA may comment on any report, plan or other submittals by Respondent, and at its discretion, require changes to such report, plan, or other submittals. EPA, in its sole discretion, may subsequently disapprove any revised submissions from Respondent. If the subsequent submittals do not fully reflect any changes recommended by EPA, then EPA, in its sole discretion, may seek stipulated or statutory penalties; perform its own studies, complete the RI/FS (or any portion of the RI/FS) under CERCLA and the NCP, and seek reimbursement from Respondent for their costs; and/or seek any other appropriate relief.

31. In the event that EPA takes over some of the tasks, but not the preparation of the RI and FS reports, Respondent shall incorporate and integrate information supplied by EPA into the final RI and FS reports.

32. Neither failure of EPA to expressly approve or disapprove of Respondent's submissions within a specified time period, nor the absence of comments, shall be construed as approval by EPA. Whether or not EPA gives express approval for Respondent's deliverables, Respondent is responsible for preparing deliverables acceptable to EPA.

33. Respondent shall, prior to any off-Site shipment of hazardous substances from the Site to an out-of-state waste management facility, provide written notification to the appropriate state environmental official in the receiving state and to EPA's Project Coordinator of such shipment of hazardous substances. However, the notification of shipments shall not apply to any such off-Site shipments when the total volume of such shipments will not exceed ten (10) cubic yards.

A. The notification shall be in writing, and shall include the following information, where available: (1) the name and location of the facility to which the hazardous substances are to be shipped; (2) the type and quantity of the hazardous substances to be shipped; (3) the expected schedule for the shipment of the hazardous substances; and (4) the method of transportation. Respondent shall notify the receiving state of major changes in the shipment plan, such as a decision to ship the hazardous substances to another facility within the same state, or to a facility in another state.

B. The identity of the receiving facility and state will be determined by Respondent following the award of the contract for the RI/FS. Respondent shall provide all relevant information, including information under the categories noted in subparagraph (a) above, on the off-Site shipments, as

soon as practical after the award of the contract and before the hazardous substances are actually shipped.

VIII. NOTIFICATION AND REPORTING REQUIREMENTS

34. All reports and other documents submitted by Respondent to EPA (other than the monthly progress reports referred to below) which purport to document Respondent's compliance with the terms of this Consent Order shall be signed by a responsible official(s) for Respondent. For purposes of this Consent Order, a responsible corporate official is an official who is in charge of a principal business function.

35. Until the termination of this Consent Order, Respondent shall prepare and provide EPA with written monthly progress reports which: (1) describe the actions which have been taken toward achieving compliance with this Consent Order during the previous month; (2) describe all actions, data and plans which are scheduled for the following two months and provide other information relating to the progress of work as is customary in the industry; (3) include information regarding percentage of completion, all delays encountered or anticipated that may affect the future schedule for completion of the work required hereunder, and a description of all efforts made to mitigate those delays or anticipated delays; and (4) identify the net worth of the funding mechanism required pursuant to this Consent Order and contain a statement as to whether such net worth is sufficient as required by this Consent Order. These progress reports shall be submitted to EPA by Respondent by the tenth (10th) day of every month following the month of the effective date of this Consent Order.

36. Upon the occurrence of any event during performance of the work required hereunder which event, pursuant to Section 103 of CERCLA, 42 U.S.C. § 9603 requires reporting to the National Response Center, Respondent shall, within twenty-four (24) hours, orally notify the EPA Project Coordinator (or, in the event of the unavailability of the EPA Project Coordinator, the Chief of the Central New York Remediation Section of the Emergency and Remedial Response Division of EPA Region II), in addition to the reporting required by said Section 103. Within twenty (20) days of the onset of such an event, Respondent shall furnish EPA with a written report setting forth the events which occurred and the measures taken, and to be taken, in response thereto.

37. All work plans, reports, notices and other documents required to be submitted to EPA under this Consent Order shall be sent by certified mail, return receipt requested, by overnight delivery or courier to the following addressees:

7 copies: (including 1 unbound copy)	Chief, Central New York Remediation Section Emergency and Remedial Response Division United States Environmental Protection Agency 290 Broadway, 20th Floor New York, New York 10007-1866

Attention: Patricia Simmons, Remedial Project Manager

1 copy: Chief, New Jersey Superfund Branch
Office of Regional Counsel
United States Environmental Protection Agency
290 Broadway, 17th Floor
New York, New York 10007-1866

Attention: Muthu S. Sundram, Esq., Assistant Regional Counsel

4 copies: New Jersey Department of Environmental Protection
401 East State Street
CN-028
Trenton, New Jersey 08625-0028

Attention: Robert Marcolina, Project Manager

1 copy: New Jersey Department of Health and Senior Services
P.O. Box 360
Trenton, New Jersey 08625-0360

Attention: Steven Miller, Ph.D., Project Manager

In addition, when submitting to EPA any written communication required hereunder, Respondent shall simultaneously submit one (1) copy of that communication (unless the given document is a plan or report) to:

New Jersey Department of Environmental Protection
401 East State Street
CN-028
Trenton, New Jersey 08625-0028

Attention: Robert Marcolina, Project Manager

38. Respondent shall give EPA at least fourteen (14) days advance notice of all field work or field activities to be performed by Respondent pursuant to this Consent Order.

IX. MODIFICATION OF THE WORK PLAN

39. If at any time during the RI/FS process, Respondent identifies a need for additional data, a memorandum documenting the need for additional data shall be submitted to the EPA Project Coordinator within twenty (20) days of identification. EPA in its discretion will determine whether the additional data will be collected by Respondent and whether it will be incorporated into reports and deliverables required pursuant to this Consent Order.

40. In the event of conditions posing an immediate threat to human health or welfare or the environment, Respondent shall notify EPA and the New Jersey Department of Environmental

Protection immediately. In the event of unanticipated or changed circumstances at the Site, Respondent shall notify the EPA Project Coordinator (or, in the event of the unavailability of the EPA Project Coordinator, the Chief of the Central New York Remediation Section of the Emergency and Remedial Response Division of EPA Region II) by telephone within twenty-four (24) hours of discovery of the unanticipated or changed circumstances. In addition to the authorities in the NCP, in the event that EPA determines that the immediate threat or the unanticipated or changed circumstances warrant changes in the RI/FS Work Plan and/or FOP, EPA will modify or amend the RI/FS Work Plan and/or FOP in writing accordingly. Respondent shall implement the RI/FS Work Plan and/or FOP as modified or amended.

41. EPA may determine that in addition to tasks defined in the initially-approved RI/FS Work Plan, other additional work may be necessary to accomplish the objectives of the RI/FS. EPA may require, pursuant to this Consent Order, that Respondent perform these response actions in addition to those required by the initially-approved RI/FS Work Plan, including any subsequently approved modifications, if EPA determines that such actions are necessary for a complete RI/FS. Subject to EPA resolution of any dispute pursuant to Section XVII, Respondent shall implement the additional tasks which EPA determines are necessary. The additional work shall be completed according to the standards, specifications and schedule set forth or approved by EPA in a written modification to the RI/FS Work Plan or written RI/FS Work Plan supplement. EPA reserves the right to conduct the work itself at any point, to seek reimbursement for the costs associated with the work from Respondent, and/or to seek any other appropriate relief.

X. FINAL RI/FS, PROPOSED PLAN, PUBLIC COMMENT, RECORD OF DECISION

42. EPA retains the responsibility for the release to the public of the RI and FS reports. EPA retains responsibility for the preparation and release to the public of the proposed remedial action plan and record of decision in accordance with CERCLA and the NCP.

43. EPA will provide Respondent with the proposed remedial action plan, and record of decision.

44. EPA will determine the contents of the administrative record file for selection of the remedial action. Respondent shall submit to EPA documents developed during the course of the RI/FS upon which selection of the remedial action may be based. Respondent shall provide copies of plans, task memoranda including documentation of field modifications, recommendations for further action, quality assurance memoranda and audits, raw data, field notes, laboratory analytical reports, and other reports. Respondent shall additionally submit any previous studies conducted under state, local or other federal authorities relating to selection of the response action and all communications between Respondent and state, local or other federal authorities concerning selection of the response action.

XI. PROJECT COORDINATORS, OTHER PERSONNEL

45. EPA has designated the following individual as its Project Coordinator with respect to the Site:

Patricia Simmons, Remedial Project Manager
Emergency and Remedial Response Division
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, New York 10007-1866
(212) 637-3865

Not later than seven (7) days after the effective date of this Consent Order, Respondent shall select its own Project Coordinator and shall notify EPA in writing of the name, address, qualifications, job title and telephone number of that Project Coordinator. He or she shall have technical expertise sufficient to adequately oversee all aspects of the work contemplated by this Consent Order. Respondent and EPA's Project Coordinators shall be responsible for overseeing the implementation of this Consent Order and shall coordinate communications between EPA and Respondent. EPA and Respondent may change their respective Project Coordinators. Such a change shall be accomplished by notifying the other party in writing at least ten (10) days prior to the change where possible, and concurrently with the change or as soon thereafter as possible in the event that advance notification is not possible.

46. EPA's Project Coordinator shall have the authority lawfully vested in a Remedial Project Manager and On-Scene Coordinator by the NCP. In addition, EPA's Project Coordinator shall have the authority, consistent with the NCP, to halt any work required by this Consent Order, and to take any necessary response action when she/he determines that conditions at the Site may present an immediate endangerment to public health or welfare or the environment. The absence of the EPA Project Coordinator from the area under study pursuant to this Consent Order shall not be cause for the stoppage or delay of work.

47. All activities required of Respondent under the terms of this Consent Order shall be performed only by qualified persons possessing all necessary permits, licenses, and other authorizations required by applicable law.

XII. OVERSIGHT

48. During the implementation of the requirements of this Consent Order, Respondent and its contractors and subcontractors shall be available for such conferences and inspections with EPA as EPA may determine are necessary for EPA to adequately oversee the work being carried out and/or to be carried out.

49. Respondent and its employees, agents, contractors and consultants shall cooperate with EPA in its efforts to oversee Respondent's implementation of this Consent Order.

XIII. SAMPLING, ACCESS AND DATA AVAILABILITY/ADMISSIBILITY

50. If any area to which access is necessary to perform work under this Consent Order is owned in whole or in part by parties other than those bound by this Consent Order, Respondent shall obtain, or use best efforts to obtain, access to the Site within sixty (60) days of the effective date of this

Consent Order. Such agreements shall provide access for EPA, its contractors and oversight officials, NJDEP and its contractors, and Respondent or its authorized representatives, and agreements for such access shall specify that Respondent is not EPA's representative with respect to liability associated with Site activities. Copies of such agreements shall be provided to EPA within ten (10) days of their execution. If access agreements are not obtained within the time referenced above, Respondent shall immediately notify EPA of its failure to obtain access. EPA may, in its sole discretion, obtain access for Respondent, perform those tasks or activities with EPA contractors, or terminate this Consent Order in the event that Respondent cannot obtain access agreements. In the event that EPA performs those tasks or activities with EPA contractors and does not terminate this Consent Order, Respondent shall reimburse EPA for all costs incurred in performing such activities and shall perform all other activities not requiring access to the given property. Respondent additionally shall integrate the results of any such tasks undertaken by EPA into its reports and deliverables. Furthermore, Respondent agrees to indemnify the United States as specified in paragraph 92 of this Consent Order. Respondent shall also reimburse EPA pursuant to paragraph 76 for all costs and attorney fees incurred by the United States in its efforts to obtain access for Respondent.

51. At all reasonable times, EPA and its authorized representatives shall have the authority to enter and freely move about all property at the Site and off-Site areas where work, if any, is being performed, for the purposes of inspecting conditions, activities, the results of activities, records, operating logs, and contracts related to the Site or Respondent and their contractor pursuant to this Consent Order; reviewing the progress of Respondent in carrying out the terms of this Consent Order; conducting tests as EPA or its authorized representatives deem necessary; using a camera, sound recording device or other recording equipment; and verifying the data submitted to EPA by Respondent. Respondent agrees to provide EPA and its designated representatives with access to inspect and copy all records, files, photographs, documents, sampling and monitoring data, and other writings related to work undertaken in carrying out this Consent Order. EPA and its authorized representatives with access to the Site under this paragraph shall comply with all approved health and safety plans.

52. All data, records, photographs and other information created, maintained or received by Respondent or its agents, contractors or consultants in connection with implementation of the work under this Consent Order, including but not limited to contractual documents, quality assurance memoranda, raw data, field notes, laboratory analytical reports, invoices, receipts, work orders and disposal records, shall, without delay, be made available to EPA on request. EPA shall be permitted to copy all such documents and other items.

53. Upon request by EPA, or its designated representatives, Respondent shall provide EPA or its designated representatives with duplicate and/or split samples of any material sampled in connection with the implementation of this Consent Order, or, at EPA's option, allow EPA or its designated representatives to take such samples.

54. Respondent may assert a claim of business confidentiality under 40 C.F.R. § 2.203, covering part or all of the information submitted to EPA pursuant to the terms of this Consent Order, provided such claim is allowed by section 104(e)(7) of CERCLA, 42 U.S.C. § 9604(e)(7). This claim shall

be asserted in the manner described by 40 C.F.R. § 2.203(b) and substantiated at the time the claim is made. Information determined to be confidential by EPA will be given the protection specified in 40 C.F.R. Part 2. If no such claim accompanies the information when it is submitted to EPA, it may be made available to the public by EPA or the State without further notice to Respondent. Respondent agrees not to assert confidentiality claims with respect to any data related to Site conditions, sampling, or monitoring.

55. Notwithstanding any other provision of this Consent Order, EPA hereby retains all of its information gathering, access and inspection authority under CERCLA, RCRA, and any other applicable statute or regulation.

56. In entering into this Consent Order, Respondent waives any objections to any validated data gathered, generated, or evaluated by EPA, NJDEP or Respondent in the performance or oversight of the work that has been verified according to the quality assurance/quality control (QA/QC) procedures required pursuant to this Consent Order. If Respondent objects to any other data relating to the RI/FS and which is submitted in a monthly progress report in accordance with paragraph 35 herein, Respondent shall submit to EPA a report that identifies and explains its objections, describes its views regarding the acceptable uses of the data, if any, and identifies any limitations to the use of the data. The report must be submitted to EPA within thirty (30) days of the monthly progress report containing the data.

XIV. OTHER APPLICABLE LAWS

57. Respondent shall comply with all laws that are applicable when performing the RI/FS. No local, state, or federal permit shall be required for any portion of the work, including studies, required hereunder which is conducted entirely on-site, where such work is carried out in compliance with Section 121 of CERCLA, 42 U.S.C. § 9621; however, Respondent must comply with the substantive requirements that would otherwise be included in such permits. For any off-Site work performed pursuant to this Consent Order, Respondent shall obtain all permits necessary under applicable laws and shall submit timely applications and requests for any such permits. This Consent Order is not, nor shall it act as, a permit issued pursuant to any federal or state statute or regulation.

XV. RECORD PRESERVATION

58. All records and documents in Respondent's possession that relate in any way to the Site shall be preserved during the conduct of this Consent Order and for a minimum of ten (10) years after commencement of construction of any remedial action which is selected following the completion of the RI/FS. Respondent shall acquire and retain copies of all documents that relate to the Site and are in the possession of its employees, agents, accountants, contractors, or attorneys. After this ten (10)-year period, Respondent shall notify EPA at least ninety (90) days before the documents are scheduled to be destroyed. If EPA requests that the documents be saved, Respondent shall, at no cost to EPA, give the documents or copies of the documents to EPA.

XVI. COMMUNITY RELATIONS

59. Respondent shall cooperate with EPA in providing information relating to the work required hereunder to the public. To the extent requested by EPA, Respondent shall participate in the preparation of all appropriate information disseminated to the public and make presentations at, and participate in, public meetings which may be held or sponsored by EPA to explain activities at or concerning the Site.

XVII. DISPUTE RESOLUTION

60. Any dispute concerning activities or deliverables required under this Consent Order, excluding the baseline risk assessment, shall be resolved as follows: The dispute shall in the first instance be the subject of informal negotiations between EPA and the Respondent and the period for such informal negotiation shall not exceed twenty (20) days from the time the dispute arises. In the event that the parties cannot resolve a dispute by informal negotiations under the preceding sentence, the position advanced by EPA shall be considered binding unless, Respondent notifies EPA's Project Coordinator, in writing, of its objections within five (5) days of after the conclusion of the informal negotiation period. Respondent's written objections shall define the dispute, state the basis of Respondent's objections, and be sent to EPA by certified mail, return receipt requested. EPA and Respondent then have an additional fourteen (14) days to reach agreement. If an agreement is not reached within the fourteen (14) days, Respondent may, within seven (7) days of the conclusion of the aforementioned fourteen (14)-day period, request a determination by the Chief of the New York Remediation Branch of the Emergency and Remedial Response Division, EPA Region II (hereinafter, the "Chief"). Such a request by Respondent shall be made in writing. The Chief's determination is EPA's final decision. Respondent shall proceed in accordance with EPA's final decision regarding the matter in dispute, regardless of whether Respondent agrees with the decision. If Respondent does not agree to perform or does not actually perform the work in accordance with EPA's final decision, EPA reserves the right in its sole discretion to conduct the work itself and seek reimbursement from Respondent of the costs of that work, to seek enforcement of the decision, to seek stipulated penalties, and/or to seek any other appropriate relief. Stipulated penalties, provided in Section XVIII of this Consent Order, with respect to the disputed matter shall continue to accrue but payment shall be stayed pending resolution of the dispute as provided in this paragraph. Notwithstanding the stay of payment, stipulated penalties shall accrue from the first (1st) day of noncompliance with any applicable provision of this Consent Order. In the event that Respondent does not prevail on the disputed issue, stipulated penalties shall be assessed and paid as provided in Section XVIII of this Consent Order.

61. Respondent is not relieved of its obligations to perform and conduct activities and submit deliverables on the schedules which are approved by EPA and applicable to the work required pursuant to this Consent Order, while a matter is pending in dispute resolution. The invocation of dispute resolution does not stay the accrual of stipulated penalties under this Consent Order.

XVIII. DELAY IN PERFORMANCE/STIPULATED PENALTIES

62. For each day that Respondent fails to complete a deliverable in a timely manner or fails to produce a deliverable of acceptable quality, or otherwise fails to perform in accordance with the requirements of this Order, Respondent shall be liable for stipulated penalties. Penalties begin to accrue on the day that performance is due or a violation occurs, and shall continue to accrue until the noncompliance is corrected. Where a revised submission by Respondent is required by EPA, stipulated penalties shall continue to accrue until a deliverable satisfactory to EPA is produced. EPA will provide written notice for violations that are not based on timeliness; nevertheless, penalties shall accrue from the day a violation commences. Payment shall be due within thirty (30) days of receipt of a demand letter from EPA.

63. Respondent shall pay interest on any amount due to EPA. The interest shall begin to accrue at the end of the thirty (30)-day period referred to in the previous paragraph, at the rate established by the Department of Treasury pursuant to 31 U.S.C. §3717. Respondent shall further pay a handling charge of one (1) percent, to be assessed at the end of each thirty-one (31)-day period, and a six (6) percent per annum penalty charge, to be assessed if the penalty is not paid in full within ninety (90) days after it is due.

64. Respondents shall make all payments by forwarding a cashier's or certified check to:

U.S. Environmental Protection Agency
EPA - Region 2
Attn: Superfund Accounting
P.O. Box 360188M
Pittsburgh, PA 15251

Checks shall identify the name of the Site, the site identification number, the account number, and the index number of this Order. A copy of the check and of the accompanying transmittal letter shall be sent to the first two addressees listed in paragraph 37 above.

As an alternative, payment may also be provided to our account at Mellon Bank via electronic funds transfer ("EFT"). To effect this payment via EFT, please provide the following information to your bank:

1. Amount of payment
2. Title of Mellon Bank account to receive the payment: EPA
3. Account code for Mellon Bank receiving the payment: 9108544
4. Mellon Bank ABA routing number: 043000261
5. Name of remitter: ISP Environmental Services, Inc.
6. Site identifier: 02HU

Along with this information, please instruct your bank to remit payment in the agreed upon amount via EFT to EPA's account with Mellon Bank.

To ensure that your payment is properly recorded, you should send a letter, within one week of the EFT, which references the date of the EFT, the payment amount, the name of the site, the case number, and your name and address to:

John E. La Padula, Chief
New York Remediation Branch
United States Environmental Protection Agency
290 Broadway - 20th Floor
New York, New York 10007-1866

as well as to:

Walter Mugdan, Regional Counsel
United States Environmental Protection Agency
290 Broadway - 17th Floor
New York, New York 10007-1866

65. For the following deliverables, stipulated penalties shall accrue in the amount of $2,500 per day, per violation, for the first seven (7) days of noncompliance; $5,000 per day, per violation, for the eighth (8th) through fourteenth (14th) day of noncompliance; and $7,500 per day, per violation, for the fifteenth (15th) day through the thirtieth (30th) day of noncompliance, and $10,000 per day, per violation, for any violations lasting for more than thirty (30) days:

A. An original and any revised RI/FS work plan.

B. An original and any revised SAP, QAPP, or HSP.

C. An original and any draft RI report.

D. An original and any revised Treatability Testing Work Plan, if required.

E. An original and any revised Treatability Study SAP, QAPP, and/or HSP, if required.

F. An original and any revised Treatability Study Evaluation Report, if required.

G. An original and any revised draft FS Report.

66. For the following deliverables, stipulated penalties shall accrue in the amount of $1,250 per day, per violation, for the first seven (7) days of noncompliance; $2,500 per day, per violation, for the eighth (8th) through fourteenth (14th) day of noncompliance; and$3,750 per day, per violation, for the fifteenth (15th) day through the thirtieth (30th) day of noncompliance, and $5,000 per day, per violation, for all violations lasting beyond thirty (30) days.

A. An original and any revised Site Characterization Summary Report.

B. An original and any revised Identification of Candidate Technologies Memorandum.

C. An original and any revised Treatability Testing Statement of Work.

D. Presentation regarding Findings of RI, Remedial Action Objectives, and Development and Preliminary Screening of Alternatives.

E. Presentation regarding draft FS Report.

F. Certificate of Insurance.

67. For the monthly progress reports, stipulated penalties shall accrue in the amount of $625 per day, per violation, for the first seven (7) days of noncompliance; $1,250 per day, per violation, for the eighth (8th) through fourteenth (14th) day of noncompliance; and $1,875 per day, per violation, for the fifteenth (15th) day through the thirtieth (30th) day, and $2,500 per day, per violation, for all violations lasting beyond thirty (30) days.

68. Respondent may dispute EPA's right to the stated amount of penalties by invoking the dispute resolution procedures under Section XVII herein. Penalties shall accrue but need not be paid during the dispute resolution period. If Respondent does not prevail upon resolution, all penalties shall be due to EPA within thirty (30) days of resolution of the dispute. If Respondent prevails upon resolution, no such penalties shall be payable.

69. In the event that EPA requires that corrections to an interim deliverable be reflected in the next deliverable, rather than requiring that the interim deliverable be resubmitted, no stipulated penalties for that interim deliverable shall accrue.

70. The stipulated penalties provisions of this Consent Order do not preclude EPA from pursuing any other remedies or sanctions which are available to EPA because of Respondent's failure to comply with this Consent Order, including but not limited to conduct of all or part of the RI/FS by EPA. Payment of stipulated penalties does not alter Respondent's obligation to complete performance under this Consent Order.

XIX. FORCE MAJEURE

71. "Force majeure", for purposes of this Consent Order, is defined as any event arising from causes entirely beyond the control of Respondent and of any entity controlling, controlled by, or under common control with Respondent, including Respondent's contractors and subcontractors, that delays the timely performance of any obligation under this Consent Order notwithstanding Respondent's best efforts to avoid the delay. The requirement that Respondent exercise "best efforts to avoid the delay" includes using best efforts to anticipate any potential force majeure event and best efforts to address the effects of any potential force majeure event (1) as it is occurring and (2) following the potential force majeure event, such that the delay is minimized to the greatest extent practicable. As a way of example, but not as a way of limitation, increased costs or expenses of any work to be performed under this Consent Order or the financial difficulty of Respondent to perform such work are not considered force majeure events.

72. If any event occurs or has occurred that may delay the performance of any obligation under this Consent Order, whether or not caused by a force majeure event, Respondent shall notify by telephone the EPA Project Coordinator or, in his or her absence, the Chief of the Central New York Remediation Section of the Emergency and Remedial Response Division of EPA Region II, within forty-eight (48) hours of when Respondent knew or should have known that the event might cause a delay. Within five (5) business days thereafter, Respondent shall provide in writing: the reasons for the delay; Respondent's rationale for interpreting the circumstances as constituting a force majeure event (should that be Respondent's claim); the anticipated duration of the delay; all actions taken or to be taken to prevent or minimize the delay; a schedule for implementation of any measures to be taken to mitigate the effect of the delay; and a statement as to whether, in the opinion of Respondent, such event may cause or contribute to an endangerment to public health, welfare or the environment. Such written notice shall be accompanied by all available pertinent documentation including, but not limited to, third-party correspondence. Respondent shall exercise best efforts to avoid or minimize any delay and any effects of a delay. Failure to comply with the above requirements may preclude Respondent from asserting any claim of force majeure.

73. If EPA agrees that the delay or anticipated delay is attributable to force majeure, the time for performance of the obligations under this Consent Order that are directly affected by the force majeure event will be extended for a period of time, determined by EPA, not to exceed the actual duration of the delay caused by the force majeure event. An extension of the time for performance of the obligation directly affected by the force majeure event shall not, of itself, extend the time for performance of any subsequent obligation.

74. If EPA does not agree that the delay or anticipated delay has been or will be caused by a force majeure event or if Respondent objects to the length of the extension determined by EPA pursuant to paragraph 73 above, the issue shall be subject to the dispute resolution procedures set forth in Section XVII of this Consent Order. In order to qualify for a force majeure defense, Respondent shall have the burden of demonstrating by a preponderance of the evidence that the delay or anticipated delay has been or will be caused by a force majeure event, that the duration of the delay was or will be warranted under the circumstances, that Respondent did exercise or is exercising due diligence by using its best efforts to avoid and mitigate the effects of the delay, and that Respondent complied with the requirements of paragraph 72.

75. Should Respondent carry the burden set forth in paragraph 74, the delay at issue shall not be deemed a violation of the affected obligation of this Consent Order.

XX. REIMBURSEMENT

76. Respondent shall reimburse the United States for all response costs which are incurred by the EPA after the effective date of this Consent Order and which relate to this Consent Order. The response costs which Respondent agrees to reimburse EPA for include, but are not limited to, oversight costs, direct and indirect costs, payroll costs, contractor costs, travel costs, laboratory costs and all other costs identified in paragraph 77., below, which are incurred by EPA after the effective date of this Consent Order.

77. EPA will periodically send Respondent billings for response costs. Those billings will be accompanied by a printout of cost data in EPA's financial management system, supplemented, if necessary, by a letter report(s) documenting additional costs incurred by EPA which are not reflected in that printout. The billings will also be accompanied by a calculation of EPA's indirect costs. Such costs may include, but are not limited to, costs incurred by the United States Government in overseeing Respondent's implementation of the requirements of this Consent Order and activities performed by the United States Government as part of the RI/FS and community relations, including any costs incurred while obtaining access. Such costs will include both direct and indirect costs, including but not limited to, time and travel costs of EPA personnel and associated indirect costs, contractor costs, cooperative agreement costs, costs of compliance monitoring, including the collection and analysis of split samples, inspection of RI/FS activities, Site visits, discussions regarding disputes that may arise as a result of this Consent Order, review and approval or disapproval of reports, costs of performing the baseline risk assessment, and costs of redoing any of Respondent's tasks. Respondent shall, within thirty (30) days of receipt of each such billing, remit a cashier's or certified check for the amount of those costs, made payable to the "Hazardous Substance Superfund," or provide payment to EPA's account at Mellon Bank via EFT, following the instructions listed in paragraph 64, above.

78. Respondent shall mail the payments required pursuant to this Section to the following address:

EPA - Region II
Attn: Superfund Accounting
P.O. Box 360188M
Pittsburgh, PA 15251

or provide payment to EPA's account at Mellon Bank via EFT following the instructions listed in paragraph 64, above.

Checks shall include the name of the Site, and the index number of this Consent Order. A copy of each check and of the accompanying transmittal letter shall be sent to the first two addressees listed in paragraph 37, above.

79. Respondent shall pay interest on any amounts overdue under paragraph 76. Such interest shall begin to accrue on the first day that the respective payment is overdue. Interest shall accrue at the rate of interest on investments of the Hazardous Substances Superfund, in accordance with Section 107(a) of CERCLA, 42 U.S.C. § 9607(a).

XXI. RESERVATIONS OF RIGHTS AND REIMBURSEMENT OF OTHER COSTS

80. EPA reserves the right to bring an action against Respondent (and/or any other responsible parties) under Section 107 of CERCLA, 42 U.S.C. § 9607, for recovery of all response costs incurred by the United States relating to the Site that are not reimbursed by Respondent, including, but not limited to, all response costs which were incurred by EPA prior to the effective date of this Consent Order, any costs which may be incurred in the event that EPA performs the RI/FS or any

part thereof and all response costs incurred by the United States after the effective date of this Consent Order for response actions relating to the Site.

81. EPA reserves the right to bring an action against Respondent to enforce the requirements of this Consent Order, to collect stipulated penalties assessed pursuant to Section XVIII of this Consent Order, and to assess penalties pursuant to Section 109 of CERCLA, 42 U.S.C. § 9609, or any other applicable provision of law.

82. Except as expressly provided in this Consent Order, each party reserves all rights and defenses it may have. Nothing in this Consent Order shall be construed to limit, in any way, EPA's response or enforcement authorities including, but not limited to, the right to seek injunctive relief, stipulated penalties, statutory penalties, and/or punitive damages.

83. Performance of the work required under the terms of this Consent Order, shall not release Respondent from liability for any response actions, including liability for any removal action(s), remedial design(s), remedial action(s), or any other response actions which may be required at or related to the Site, which are not required by and performed pursuant to the terms of this Consent Order.

XXII. DISCLAIMER

84. By signing and taking actions under this Consent Order, Respondent does not necessarily agree with the Findings of Fact and Conclusions of Law contained herein. Furthermore, the participation of Respondent in this Consent Order shall not be considered an admission of liability and is not admissible in evidence against Respondent in any judicial or administrative proceeding other than a proceeding by the United States, including EPA, to enforce this Consent Order or a judgment relating to it. Respondent retains the right to assert claims against other potentially responsible parties at the Site. However, Respondent agrees not to contest the validity or terms of this Consent Order, or the procedures underlying or relating to it in any action brought by the United States, including EPA, to enforce its terms.

XXIII. OTHER CLAIMS

85. In entering into this Consent Order, Respondent waives any right to seek reimbursement, under Section 106(b) of CERCLA, 42 U.S.C. § 9606(b). Respondent also waives any right to present a claim with respect to such costs under Section 111 or 112 of CERCLA, 42 U.S.C. §§ 9611 or 9612. This Consent Order does not constitute any decision on preauthorization of funds under Section 111(a)(2) of CERCLA, 42 U.S.C. § 9611(a)(2). Respondent further waives all other statutory and common law claims against EPA, including, but not limited to, contribution and counterclaims, relating to or arising out of conduct of the RI/FS or this Consent Order.

86. Nothing in this Consent Order shall constitute or be construed as a release from any claim, cause of action, or demand in law or equity against any "person," as that term is defined in Section 101(21) of CERCLA, 42 U.S.C. § 9601(21), not a signatory to this Consent Order for any liability it may have arising out of or relating in any way to the generation, storage, treatment, handling,

transportation, release, or disposal of any hazardous substances, pollutants, or contaminants found at, taken to, or taken from the Site or to the ownership or operation of any part of the Site. Nothing herein shall constitute a finding that Respondent is the sole responsible party with respect to the release and threatened release of hazardous substances at or from the Site.

87. Respondent shall bear its own costs and attorneys fees.

XXIV. FINANCIAL ASSURANCE, INSURANCE, AND INDEMNIFICATION

88. Within thirty (30) days of the effective date of this Consent Order, Respondent shall establish and maintain financial security initially in the amount of one million dollars in one of the following forms:

(a) A surety bond guaranteeing performance of the work required of Respondent under this Consent Order;

(b) One or more irrevocable letters of credit equaling the total estimated cost of the work required of Respondent under this Consent Order;

(c) A trust fund;

(d) An unconditional written guarantee in favor of the United States to perform the work required of Respondent under this Consent Order, issued by one or more parent corporation or subsidiaries, or by one or more unrelated corporation that have a substantial business relationship with Respondent provided, that Respondent shall demonstrate that such corporation or subsidiary satisfies the general requirements of 40 C.F.R. §264.143(f).

89. If Respondent seeks to demonstrate the ability to complete the Work through a guarantee by a third party pursuant to the preceding paragraph of this Consent Order, Respondent shall demonstrate that the guarantor satisfies the requirements of 40 C.F.R. §264.143(f). If Respondent seeks to demonstrate its ability to complete the work required of Respondent under this Consent Order by means of the financial test or the corporate guarantee pursuant to the preceding paragraph, it shall resubmit sworn statements conveying the information required by 40 C.F.R. §264.143(f) annually on the anniversary of the effective date of this consent Order. In the event that EPA determines at any time that the financial assurance provided pursuant to this Section are inadequate, Respondent shall, within 30 days of receipt of notice of EPA's determination, obtain and present to EPA for approval additional financial assurances meeting the requirements of this Section. Respondent's inability to demonstrate financial ability to complete the work required of Respondent under this Consent Order shall not excuse performance of any activities required under this Consent Order.

90. (a) Prior to commencement of any work under this Consent Order, Respondent shall secure and maintain in force for the duration of this Consent Order and for two (2) years after the completion of all activities required by this Consent Order, Comprehensive General Liability

("CGL") and automobile insurance, with limits of $5,000,000 combined single limit, naming the United States as additional insured thereunder with the right to receive notice addressed to the first two addressees listed in paragraph 41 above in the event of cancellation or amendment. The CGL insurance shall include Contractual Liability Insurance in the amount of $2 million per occurrence, and Umbrella Liability Insurance in the amount of $10 million per occurrence.

(b) Respondent shall also secure and maintain in force for the duration of this Consent Order and for two (2) years after the completion of all activities required by this Consent Order the following:

i. Professional Errors and Omissions Insurance in the amount of $1,000,000 per occurrence.

ii. Pollution Liability Insurance in the amount of $1,000,000 per occurrence, covering as appropriate both general liability and professional liability arising from pollution conditions.

(c) For the duration of this Consent Order, Respondent shall satisfy, and shall ensure that its contractors or subcontractors satisfy, all applicable laws and regulations regarding the provision of employer's liability insurance and workmen's compensation insurance for all persons performing work on behalf of Respondent, in furtherance of this Consent Order.

(d) If Respondent demonstrates by evidence satisfactory to EPA that any contractor or subcontractor maintains insurance equivalent to that described above, or insurance covering the same risks but in a lesser amount, and, in either case, including the naming of the United States as an additional insured, then with respect to that contractor or subcontractor, Respondent needs only provide that portion of the insurance described above which is not maintained by the contractor or subcontractor.

(e) Prior to commencement of any work under this Consent Order, and annually thereafter on the anniversary of the effective date of this Consent Order, Respondent shall provide to EPA certificates of such insurance and a copy of each insurance policy.

91. At least seven (7) days prior to the commencement of any work by a contractor on behalf of Respondent under this Consent Order, Respondent shall certify to EPA that the required insurance has been obtained by that contractor.

92. Respondent agrees to indemnify and hold the United States Government, its agencies, departments, agents, and employees harmless from any and all claims or causes of action arising from or on account of acts or omissions of Respondent, its employees, agents, servants, receivers, successors, or assignees, or any other persons acting on behalf of Respondent, including, but not limited to, firms, corporations, parent, subsidiaries and contractors, in carrying out activities under this Consent Order. The United States Government or any agency or authorized representative thereof shall not be held as a party to any contract entered into by Respondent in carrying out activities under this Consent Order.

93. Neither the United States Government nor any agency thereof shall be liable for any injuries or damages to persons or property resulting from acts or omissions by Respondent or Respondent's

officers, directors, employees, agents, contractors, consultants, receivers, trustees, successors or assigns in carrying out any action or activity pursuant to this Consent Order.

XXV. EFFECTIVE DATE AND SUBSEQUENT MODIFICATION

94. This Consent Order shall be effective on the date it is signed by the Regional Administrator of the U.S. Environmental Protection Agency - Region II.

95. This Consent Order may be amended by mutual agreement of EPA and Respondent. Amendments shall be in writing and shall be effective when signed by EPA. EPA Project Coordinators do not have the authority to sign amendments to this Consent Order.

96. No informal advice, guidance, suggestions, or comments by EPA regarding reports, plans, specifications, schedules, and any other writing submitted by Respondent will be construed as relieving Respondent of their obligation to obtain such formal approval as may be required by this Consent Order. Any deliverables, plans, technical memoranda, reports (other than progress reports), specifications, schedules and other documents required to be submitted to EPA pursuant to this Consent Order shall, upon approval by EPA, be deemed to be incorporated in and an enforceable part of this Consent Order.

XXVI. TERMINATION AND SATISFACTION

97. When Respondent concludes that all of the work required by this Consent Order, including the performance of any additional work, payment of costs in accordance with Section XX of this Consent Order, and payment of any stipulated penalties demanded by EPA, has been fully and satisfactorily completed by Respondent, Respondent shall submit a report to EPA describing the basis for that belief and certifying in writing that Respondent has fully performed all of its obligations under the Consent Order. If EPA concludes that Respondent has fully performed all the work, paid all costs and penalties (if any), and completed all obligations required of Respondent by this Consent Order, EPA will so notify Respondent in a letter signed by the Chief, New York Remediation Branch, U.S. Environmental Protection Agency - Region II. This written notification shall release Respondent from any further obligation to perform any work under this Consent Order, other than Respondent's obligation to continue to preserve records pursuant to Section XV of this Consent Order.

98. The certification referred to in paragraph 97, above, shall be signed by a responsible official(s) representing each Respondent. Such representative shall make the following attestation:

> "I certify that the information contained in or accompanying this certification is true, accurate, and complete."

For purposes of this Consent Order, a responsible official is a corporate official who is in charge of a principal business function.

U.S. ENVIRONMENTAL PROTECTION AGENCY

_____ _____

Jeanne M. Fox Date
Regional Administrator
U.S. Environmental Protection Agency
Region II

CONSENT

Respondent identified below has had an opportunity to confer with EPA regarding this Consent Order. Respondent hereby consents to the issuance of this Consent Order and to its terms. The individual executing this Consent Order on behalf of Respondent certifies under penalty of perjury under the laws of the United States and of the State of Respondent's incorporation that he or she is fully and legally authorized to agree to the terms and conditions of this Consent Order and to bind Respondent thereto.

ISP Environmental Services Inc.
NAME OF RESPONDENT

5/13/99
Date

(signature)

Sunil K. Garg
(typed name of signatory)

Vice President, Environmental Services
(title of signatory)

Exhibit G

COPY

McCARTER & ENGLISH, LLP
ATTORNEYS AT LAW
FOUR GATEWAY CENTER
100 MULBERRY STREET
P.O. BOX 652
NEWARK, N.J. 07101-0652
(973) 622-4444

200343

RECEIVED

JUN 0 8 1998

June 3, 1998

VIA FEDERAL EXPRESS

Re: LCP Chemical Site, Linden, Union County, New Jersey
Request for Information

Mr. Richard Ho
Emergency and Remedial Response Division
U.S. Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007

Dear Mr. Ho:

Enclosed is the Hanlin Group, Inc.'s response to the EPA's request for information.

Very truly yours,

Eduardo J. Glas

EJG:cag
enclosure
cc: Mr. Muthu Sundram, Esq., Assistant Regional Counsel

RESPONSE OF THE HANLIN GROUP INC.
TO THE EPA'S REQUEST FOR INFORMATION
REGARDING THE LCP CHEMICAL SITE IN
LINDEN, NEW JERSEY

Hanlin Group Inc. ("Hanlin") submits this response to the Request for Information of the United States Environmental Protection Agency ("EPA") under Section 104(e) of CERCLA regarding the LCP Chemical Site in Linden, New Jersey (the "Site").

Several factors hamper Hanlin's ability to provide fully responsive answers to the EPA's request. First, Hanlin filed for bankruptcy in 1991 under Chapter 11 of the Bankruptcy Code. Although the company continued manufacturing operations in other states for some period of time, it sold its operating assets in April, 1994 and all manufacturing ceased at that time. Hanlin has been liquidating its remaining assets and fixing its liabilities since then. The estate is administratively insolvent, meaning that it does not have sufficient assets to pay its post petition creditors.

Second, the company has only one remaining employee in New Jersey, Alan Margulies, who is the treasurer/secretary of Hanlin. Mr. Margulies was not an officer, director or employee of Hanlin during the bankruptcy until after operations ceased (although he was previously Hanlin's outside accountant). In addition to Mr. Margulies, Hanlin retains the services of Karl DeVoe as a consultant to monitor the Site for security and environmental purposes. The company ceased manufacturing activities at the Site in 1985 long before the bankruptcy filing, and after some terminalling operations, all activities ceased in early 1993. All corporate officers and employees who were located in New Jersey pre- and post-petition left the company in 1994.

Third, the company's records are in complete disarray. Many of the company records were warehoused in Pennsylvania. After Hanlin received notice of a claim for storage costs, a motion was filed by Hanlin in Bankruptcy Court to abandon the records. The motion was duly served on the EPA at the time. An order was thereafter entered by the Honorable Stephen A. Stripp authorizing abandonment of the records in that warehouse.

With respect to records maintained at the Linden Site, we are informed that the cabinets and storing file drawers holding those documents were emptied and removed from the Site to be sold as used-furniture. The party to whom the cabinets were allegedly sold apparently just dumped the documents and took the cabinets. As a result, the documents contained in those cabinets were left in heaps and strewn throughout the floor of a building at the Site. Nevertheless, if the EPA desires to inspect the Site or any of these documents, Hanlin will make them available for inspection upon request. Given the current state of affairs, including Hanlin's lack of manpower and resources and the status of the records, we have not been able to review the documents at the Site, some of which could conceivably be responsive to some of the information sought by the EPA in its request. The invitation to inspect records, however, should not be deemed as a waiver of any privilege that may apply to any of the files at the Site.

In order to answer the EPA's requests, Hanlin has asked one of its remaining employees in West Virginia, Don DeNoon,[1] to provide any information that may be responsive to this request. In addition, Karl DeVoe, a former employee and currently a contractor paid to provide limited services at the Site, was also contacted to answer this

request. Given the limited knowledge of these two individuals , the state of the records of the company, and the lack of manpower available to Hanlin, the company cannot categorically vouch for the accuracy of its responses or state that it has not overlooked some piece of information that the EPA may consider responsive in whole or in part to its Request or may cause Hanlin upon discovery of such information to supplement, modify or revise any of its responses herein. Accordingly, Hanlin reserves the right to supplement, modify and revise any of its responses to the Request set forth below.

Question # 1

a. The legal name of the company is Hanlin Group Inc. ("Hanlin")

b. The Vice-Chairman of the Board is James Mathis, 2714 South Southern Oaks Drive, Houston, Texas 77068; and the secretary/treasurer is Alan Margulies, 15 Exchange Place, Jersey City, New Jersey 07302. The company has been in bankruptcy since 1991 and currently has no manufacturing operations at any of its plants. Since April 1994, when its operating assets were sold, it has maintained a few employees for purposes of complying with bankruptcy reporting requirements and environmental monitoring. With one or two exceptions, the salaries of such employees are paid by Allied Signal. Christian Hansen, Hanlin's Chairman of the Board at the time of the bankruptcy filing; he was voted out of office in 1993 and was never replaced.

c. The state of incorporation of the company is Delaware. Agent for service in Delaware was Corporation Trust Company, Corporate Trust Center, 1209 Orange

---

[1] Hamlin has several employees in West Virginia. The salaries of such employees, however, are all fully reimbursed by Allied Signal, which utilizes the employees to conduct cleanup operations at Hanlin's former Moundsville, West Virginia site.

Street, Wilmington, Delaware 19801. Agent for service in New Jersey is Alan Margulies [see address above], or McCarter & English, 100 Mulberry Street, Newark, New Jersey 07102-4096.

d. See attached copies of certificate of incorporation and amendments thereto.

e. As of the filing of the bankruptcy petition, there were three subsidiaries and no affiliates. LCP National Plastics, Inc. was reorganized pursuant to a Plan of Reorganization confirmed by the U.S. Bankruptcy Court in December 1993. The other two subsidiaries remain in bankruptcy: LCP Transportation, Inc. and Hanlin Chemicals West Virginia Inc. In addition, the company has operated under different legal names: Linden Chemicals and Plastics, LCP Chemicals. Ultimately, through a series of name changes, these were all consolidated into Hanlin Group Inc.

Question # 2

Hanlin has a RCRA, Hazardous and Solid Waste Amendments (HSWA) permit. Hanlin's EPA identification number is NJD079303020.

Question # 3

Hanlin owns the property. The property was purchased from General Aniline and Film Corporation (GAF) in 1972. See attached copy of the deed. All documentation related to the acquisition of the property in 1972 is in a bound volume which is available for review at McCarter & English's office in Newark.

Currently, Active Water Jet, Inc. is a month to month tenant at the site. There is no written lease.

Question # 4

Hanlin purchased a 26 acre chlorine production facility in Linden, New Jersey from General Aniline and Film corp. ("GAF") in 1972. GAF purchased the land from the U.S. Government in 1950, reclaimed the marshland and constructed the facility in the early 1950s.

In 1952, GAF began producing chlorine and sodium hydroxide using the mercury cell electrolytic process. Hanlin purchased the site in 1972, renovated the plant, and operated the mercury cell process until 1982. LCP produced chlorine, sodium hydroxide, hydrochloric acid and anhydrous HCL. In the early 1980s the plant was converted to produce potassium hydroxide and operated briefly before it permanently ceased production in August 1985.

The site then was used as a transfer terminal for products from other Hanlin facilities. The products included potassium hydroxide, sodium hydroxide, hydrochloric acid and methylene chloride which arrived in bulk by rail and truck and were transferred to above ground tanks and tank trucks.

From 1959 to 1990, a portion of the site west of Avenue D was leased to the Union Carbide Linde Division and was used for wholesale gas activities. In 1990, Ultra Pure Compressed Gasses, Inc. leased the site for the same operation. Building 231 was leased to Microcell Technologies in 1987. From 1974 to 1981, Kuehne Chemical manufactured sodium hypochlorite and chlorine in a leased area near Building 220. Caleb Bret Labs leased a portion of a laboratory and locker building north of Building 220 to store petroleum product samples, and a portion of the building was also leased to

Liquid Carbonic for office use. Land adjacent to the laboratory and locker building was leased to Liquid Carbonic for carbon dioxide transfer operations. Active Water Jet, a pipe cleaning company, is now the only company leasing space at the site, primarily for storage.

For several reasons, Hanlin is unable to provide additional information. As mentioned above, the company has been in bankruptcy since 1991 and retains none of the personnel who were at the Site while Hanlin conducted business operations. Hanlin has been liquidating its assets since 1994 and currently has few resources. It only retains a handful of employees (most of whom are paid by Allied), only one of whom works in New Jersey. In addition, its records are in total disarray. As the EPA may know from its visit to the plant, the cabinets that contained the company's records were removed from the site, leaving the documents behind exposed to the elements and completely unorganized.

Question # 5

See Answer to Question # 4 above.

The person in charge of operations at Linden was Christian Hansen, former CEO of the company.

Karl DeVoe was the manager at the Site when it was used as a transfer terminal, until early 1993. Currently, Mr. DeVoe is retained to monitor ground water stations in particular and the security of the plant in general. In this capacity, Mr. DeVoe goes to the site at least once per week. Other than Mr. DeVoe's monitoring, there are no longer any Hanlin activities at the site. Other than Mr. Margulies, Hanlin has no employees in New Jersey.

For information on how to contact Mr. Hansen and Mr. DeVoe see Question # 11.

Question # 6

Hanlin is not currently engaged in any business or any other "practice" at the Site. Hanlin was previously engaged in the manufacturing of chemicals and terminalling operations. Chemical products or materials purchased, used, and/or handled at the facility were regulated as hazardous substances by CERCLA.

a. As indicated, Hanlin generated, purchased, used, and/or handled chemicals from 1972 until 1985 while the plant was in production. From 1985 until early 1993, chemicals were handled while the facility was used as a transfer terminal.

b. Until 1985, chemicals were used to manufacture chlorine, sodium hydroxide, hydrochloric acid, anhydrous HCl and potassium hydroxide. After 1985 and until early 1993, chemicals products were handled at the Site while it was used as a transfer station. The products handled at the transfer station were methylene chloride, sodium hydroxide, potassium hydroxide and hydrochloric acid.

c. No information for the volume of chemicals used or generated is currently available. It is unclear whether any such information currently exists. The company files remaining are in total disarray at the Linden site. What records remain have been exposed to the elements and are completely disorganized.

Question # 7

See Question # 8 for some pre-1982 disposal methods. Prior to 1982, waste was also disposed off-site at approved facilities. After 1982, waste was stored in above

ground tanks and disposed off-site at EPA approved facilities. Currently, chemical samples are located on site on shelves in glass or plastic bottles or other small containers. Given the state of the records of the company, it is not possible to provide further information. Mr. Hansen may have more information in connection with this question.

Question # 8

Above ground tanks were used for storage. See attached information. Of the tanks listed in the attached inventory, the two tanks containing methylene chloride have been removed from the site. The tanks listed as having a capacity of 250,000 gals. each and containing potassium and sodium hydroxide respectively were emptied and cleaned. The tank listed as having a capacity of 500,000 gallons and containing sodium hydroxide is empty but still contains residues. The two stormwater tanks with a capacity of 50,000 gallons are still in use. The stormwater tank with a capacity of 60,000 gallons is out of service. The two wastewater treatments are out of service and empty. The emergency storage tank listed is still in use for storm waters.

There are no known underground tanks, except for septic systems.

There is a closed brine sludge lagoon. This lagoon received mercury-contaminated hazardous waste generated from the chlor-alkali operations. The lagoon was triangular in shape, contained about 30,000 cubic yards of waste, and covered 1.5 acres. The disposal of brine muds was terminated in March 1982. The plant's waste lines were flushed to the lagoon and closure began in 1984 after approval by the NJDEP. The contents of an adjacent lagoon, which contained wastes treated by experimental chemical fixation, were also transferred into the pond for closure. A closure of the pond with the waste material in-place was approved by NJDEP. The closure involved removal

of standing free liquids, regrading of dried lagoon materials, and compaction. No removal of wastes or lining of the lagoon walls or bottom was undertaken. The lagoon was graded and capped with two feet of clay and one foot of soil cover.

Question # 9.

As mentioned above, it is not possible to provide documents responsive to this question due to the status and abandonment of the company's files. The EPA has been on the site and has full access to any and all documents therein. Because the company has no employees in New Jersey other than Mr. Margulies, it is not able to review the documents that are strewn on the floor of the facility in no particular order.

Question # 10.

We are unaware of any releases at any time.

Question # 11

Given the fact that the company has no remaining employees in New Jersey other than Mr. Margulies and that its records are in total disarray, it is hard to identify persons that would have the knowledge of the facts required to answer the question. However, a person who probably has the required information is Christian Hansen, the former CEO of the company. Mr. Hansen can be contacted through his lawyer Vincent J. D'Elia, One Engle Street, Englewood, New Jersey 07631, telephone (201) 569-2613. Mr. Hansen remained with the company as CEO until April 1993. In addition to Mr. Hansen, another person who might have information relevant to this question is Karl DeVoe. Mr. DeVoe used to work at the Linden plant in a managerial capacity. As explained above, Mr. DeVoe is currently engaged to monitor the site. Mr. DeVoe's address is 41 South Robert

St., Sewaren, New Jersey 07077, and his phone number is (732) 636-4951. Mr. DeVoe did aid in responding to some of these questions.

Question # 12

As mentioned above, it is simply not possible to determine whether responsive documents still exist. Most files were abandoned and the remaining are in heaps at the Site. The company simply does not have the resources to determine whether any of the records strewn on the floor of one of the buildings of the Site are responsive. Any and all documents on Site are available for EPA inspection, subject to any applicable privilege.

Question # 13

When Hanlin purchased the property from GAF in 1972, it did so pursuant to a purchase/sale agreement, which contained language providing for indemnification for contamination under certain circumstances. A copy of the agreement is annexed hereto. The remaining closing documents are in a bound volume available for inspection at the offices of McCarter & English.

Question # 14

Hanlin had some general liability policies. The law firm of Dechert Price & Rhoads (Princeton office) had been retained to provide counseling regarding insurance coverage under Hanlin's policies for pollution. In 1994, Dechert Price had to cease its representation due to a conflict of interest that had arisen. Dechert Price asserts that it returned its files (including insurance policies) to the company. We have, however, been unable to locate the insurance policies returned by Dechert Price and, accordingly, Hanlin has been unable to locate any insurance policies that are responsive to this question.

Question # 15

a. Hanlin Group Inc., LCP Transportation, Inc., and Hanlin Chemical West Virginia, Inc. filed for bankruptcy in July 10, 1991.

b. The bankruptcy petition was filed under Chapter 11 of the Bankruptcy Code.

c. The petition was filed in U.S. Bankruptcy Court in Trenton, New Jersey.

d. No trustee has been appointed, largely because of the significant overlay of administrative cost that would necessarily be incurred. The debtor remains in possession but is administratively insolvent and unable to pay for current services (including legal). Robert J. Schneider, Esq. of the U.S. Trustee's Office, One Newark Center, Suite 2100, Newark, New Jersey 07102, is assigned to this case.

e. The case is still pending while the Debtor resolves the few remaining disputed claims and liquidates all its assets.

f. The Debtor is administratively insolvent. Hanlin has been liquidating its assets since 1994, when it sold its operating assets and ceased operations. Other than Alan Margulies, the former CPA, there are no employees working for the company in New Jersey. The EPA filed an administrative claim against the estate for the cleanup of the Linden site. The claim was settled by an Order entered on April 27, 1998. A copy of the Order is attached.

Question # 16

Hanlin Group Inc. has no further information on other possible sources who might have disposed of hazardous substances, wastes and/or CERCLA waste material at the

Linden Site. Christian Hansen, the former CEO of the company, may have information relevant to this question.

Question # 17

See Question # 4 above.

Question # 18

Alan Margulies, [for address see Question # 1]. Phone # (201) 333-0666. Mr. Margulies does not have personal knowledge of the answers provided.

Question # 19

Don DeNoon provided information for answers to Questions # 2; 4; 5; 6; 7 and 8. [address: Hanlin Chemicals-West Virginia, P.O. Box J, Moundsville, WV 26041; Phone # (304)843-1310]

Karl DeVoe provided information for answers to Question # 2; 4; 5; 6; 7; 8 and 10 [for address see Question #11].

CERTIFICATION OF ANSWERS TO REQUEST FOR INFORMATION

State of New Jersey

County of Hudson

I certify under penalty of law that I have personally examined and am familiar with the Information submitted in this document (response to EPA Request for Information) and all documents submitted herewith, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true and accurate, and complete given the limitations stated in the opening paragraphs of the Hanlin Group's response submitted herewith, and that all documents submitted herewith are complete and authentic unless otherwise indicated. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Alan C Margulies
NAME

Treasurer
TITLE

SIGNATURE

Sworn to before me this
1st day of June, 1998

Marie A. Fisher
Notary Public

NWK2: 414537.01

MARIE A. FISHER
NOTARY PUBLIC OF NEW JERSEY
Commission Expires 8/2/2002

Sent by: MC CARTER ENGLISH 973 624 7070; 06/01/98 1:41PM;JetFax #619;Page 14/14

Exhibit H

Remedial Investigation Report
LCP Chemicals, Inc. Superfund Site
Linden, New Jersey
Volume I of V
Report Text

Prepared for
ISP Environmental Services, Inc.
500 Hercules Road
Wilmington, Delaware 19808-1599

Revised October 2013
July 2013

Project Number: 137005

Brown AND Caldwell
2 Park Way, Suite 2A
Upper Saddle River, New Jersey 07458

693610

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Executive Summary

The LCP Chemicals, Inc. Superfund Site (LCP site) Remedial Investigation (RI) is reported herein. The RI field investigation has been performed in two phases under the regulatory and technical oversight of the USEPA, with a further adjunct investigation of two off-site ditches located adjacent to the site. This report includes a comprehensive characterization of the nature and extent of contamination on the site in addition to assessments of risk to human health and the environment.

This RI Report represents a revision of the version that was submitted in July 2013 and was subsequently approved by USEPA on August 12, 2013. The revisions made herein do not reflect any changes in content from the July 2013 and have been made solely to correct minor typographical errors and also updates to the document format.

Site History

The LCP site is a former chemical manufacturing plant located on an approximate 26 acre property. The site was developed in the early 1950s for the production of chlorine by the brine cell process (mercury cathode carbon anode) also known as the chlor-alkali process. Chlorine manufacturing operations commenced in 1955 and continued until the plant was shut down in 1985. Related operations, including a hydrogen gas processing plant and sodium hypochlorite manufacturing area were also located on the site. While the plant was initially developed and operated by GAF beginning in 1955, the facility was sold to LCP in 1972 and was expanded and operated by LCP until 1985. Activities continued on site (by LCP and others) until 2000.

Hanlin Group, Inc., d.b.a. LCP, filed a petition under Chapter 11 of the bankruptcy code in 1991 and liquidated all of its assets before April 1994 using the proceeds to pay creditors including the USEPA. The Linden, New Jersey property was abandoned by Hanlin Group pursuant to an order of the Bankruptcy court and ownership reverted back from the bankruptcy estate. Title to the property is currently listed as LCP-Chemicals New Jersey, a d.b.a. for Hanlin. Hanlin is a defunct corporate entity. The facility has remained abandoned since 2000.

The site was placed onto the National Priority List (NPL) in 1998. A voluntary Administrative Order was entered into by the USEPA and ISP-ESI in 1999 to perform a Remedial Investigation and Feasibility Study (RI/FS). ISP Environmental Services Inc. (ISP-ESI) is currently the only potentially responsible party, among several, that has cooperated with USEPA to address the site.

The LCP site has a complex history of industrial ownership. The north-central and eastern portions of the property were owned and developed by various companies preceding GAF dating back to the 1880s. Other portions of the property were previously owned by E.I. duPont de Nemours and Central Railroad of New Jersey (now Conrail).

The entire area of the LCP site and nearly all of the surrounding area was historically tidal wetlands. It was necessary to raise the elevation prior to the historic development of these areas for industrial and other uses through the placement of anthropogenic fill. The filling of the property occurred during the prior ownership of the property, before the development of the LCP site in 1955.

The site has been zoned for "heavy industrial use" and continues as such as do the surrounding properties. It is anticipated that the upland portion of the site could possibly be re developed into another industrial use, such as warehousing, transportation or electric power generation.

Contamination Sources

The RI results are summarized by the finding of the widespread presence of mercury in various environmental media as a result of manufacturing activities at the LCP site. Other contaminants potentially related to chlorine production are also found, including hexachlorobenzene (HCB), polychlorinated naphthalenes (PCNs), and polychlorinated dibenzo furans (PCDFs). Polychlorinated biphenyls (PCBs) are also a site-related constituent due their potential presence in electrical equipment on the site. Each of these other site-related constituents is present at levels much less than those of mercury. These other site-related contaminants are co-located with mercury; however the frequency and magnitude of exceedances of soil remediation standards is, respectively, less than that of mercury.

Contamination is also present as a result of the prior placement of anthropogenic fill materials. Contaminants that are ubiquitous in fill materials include metals/metalloids (e.g., lead, chromium, and arsenic), and polycyclic aromatic hydrocarbons (PAHs) as a result of the common practice of using combustion residues (e.g., coal ash and slag) as fill. Other contaminants in the anthropogenic fill are consistent with sources of industrial fill from neighboring properties (e.g., duPont, GAF) and include arsenic and chlorobenzenes. Other various chemicals, including dioxins, are also found from regional sources such as air deposition and sediment transport.

Contamination Conditions

The surficial fill at the LCP site is impacted primarily with mercury which is widely distributed throughout the site. This contamination includes some visual observations of elemental mercury in areas surrounding the main production buildings. However, the horizontal and vertical migration of mercury and other site-related constituents is relatively limited and the underlying soils contain concentrations that are lower than those in the overlying fill.

Groundwater contamination at the site results from the dissolution of the various contaminants from site soils (both LCP related and fill related). Groundwater contamination, however, shows minimal migration either horizontally or laterally and is not moving off site to any significant extent. In addition, groundwater at the site is non-potable as the result of naturally occurring saline conditions. Since the groundwater is saline, alternative groundwater quality criteria (AGWQC) are relevant at the site, and site-specific AGWQC have been developed.

Sediments and low marsh soils in South Branch Creek (an on-site, man-made tidal ditch) are contaminated with mercury and other constituents, especially in the "upstream" areas. The contamination decreases with distance from the manufacturing area of the site and is essentially at background levels where South Branch Creek meets the Arthur Kill. Similar contaminated sediment conditions are observed in the Northern Off-Site Ditch Sediments, albeit at lower concentrations than South Branch Creek. The sediment contamination in South Branch Creek and the Northern Off-Site Ditch do not appear to be due to ongoing sources. Biological specimens (fish and crabs) collected in South Branch Creek contain elevated concentrations of mercury and other constituents compared with those collected in a nearby area.

The Human Health Risk Assessment (HHRA) indicated that exposure to soil and soil vapor by future commercial/industrial workers, site-specific workers, and construction/utility workers may result in adverse non-cancer effects; exposure to soil by future commercial/industrial workers may also result in adverse cancer effects. Dermal contact with groundwater by construction/utility workers has the potential to result in adverse non-cancer effects. Potential non-cancer hazards in soil and soil vapor were driven by mercury; potential non-cancer hazards in groundwater were driven by furans and manganese. No unacceptable cancer or non-cancer risks were identified for current/future trespassers

exposed to sediment/bank soil in South Branch Creek. Hypothetical use of groundwater for potable purposes was also evaluated to support remedial decision-making and risk management; the HHRA indicated future potable use of groundwater by commercial/industrial workers may result in adverse cancer and non-cancer effects.

The Baseline Ecological Risk Assessment (BERA) indicated that contaminants in South Branch Creek sediment, primarily arsenic, barium, and mercury, have the potential to result in adverse ecological effects to benthic macroinvertebrates and sediment-probing birds. Potential ecological risks were also identified for terrestrial mammals (insectivores) and birds (invertivores and, to a lesser extent, carnivores) potentially exposed to contaminants in upland soil, driven primarily by mercury and hexachlorobenzene. However, the former facility offers limited ecological habitat for these receptors as the majority of the Site is paved or occupied by structures.

Section 1

Introduction

This report presents the findings of a multi-phased Remedial Investigation (RI) performed at the LCP Chemicals, Inc. Superfund Site located in Linden, New Jersey. The initial phase (Phase I) of the RI was performed in 2001-2002 and was reported in the document titled, "Site Characterization Summary Report, LCP Chemicals Superfund Site, Linden, New Jersey", (Brown and Caldwell, August 2002). The Phase II RI field investigation was performed during 2006-2007 and the data was reported in the document titled, "Phase II Site Characterization Summary Report, LCP Chemicals Superfund Site, Linden, New Jersey, (Brown and Caldwell, September 2007). In addition an adjunct investigation to the RI was performed in 2011 on the two off-site ditches, in response to EPA comments on the draft RI Report (Brown and Caldwell, September 2008). The RI Report, presented herein, provides a comprehensive presentation and analysis of the RI data.

This RI Report represents a revision of the version that was submitted in July 2013 and was subsequently approved by USEPA on August 12, 2013. The revisions made herein do not reflect any changes in content from the July 2013 and have been made solely to correct minor typographical errors and also updates to the document format.

1.1 Authority

The site was placed onto the National Priority List (NPL) in 1998. On May 13, 1999, Administrative Order No. II CERCLA 02 99 2015 (hereinafter referred to as the Order) was entered into voluntarily by the United States Environmental Protection Agency (USEPA) and ISP Environmental Services Inc. (ISP-ESI). ISP-ESI is currently the only potentially responsible party, among several, that has cooperated with USEPA to address the site. The stated purpose of the Order was to:

"(a)... conduct a remedial investigation ("RI") to determine the nature and extent of contamination and any threat to the public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants or contaminants at or from the Site; (b) to determine and evaluate alternatives, through the conduct of a feasibility study ("FS"), to remediate said release or threatened release of hazardous substances, pollutants, or contaminants; (c) to provide for the reimbursement to EPA of response and oversight costs incurred by EPA with respect to the Site; and (d) to provide for reimbursement to EPA of response costs incurred by EPA at the Site prior to the effective date of this Consent Order."

In accordance with the provisions of Section VII.25.H of the Order, the RI Report is hereby submitted. The RI report provides an analysis of the horizontal and vertical extent of mercury and other site constituents at the site in the various site media. The RI field investigation and reporting were performed by Brown and Caldwell from 2001 through 2008 under contract to and on behalf of ISP-ESI. The scope of the initial phase of the RI field investigation was performed in accordance with the USEPA-approved Work Plan documents described in Section 1.4.1. The technical objectives and scope of the Phase II RI field investigation was performed in accordance with the USEPA-approved Work Plan documents described in Section 1.4.2.

Baseline Human Health Risk Assessment (BHHRA) and Baseline Ecological Risk Assessment (BERA) have been performed in accordance with a pending amendment to the Administrative Order

Amendment. The BHHRA and BERA were performed by Geosyntec Consultants Inc. under contract to ISP-ESI and are summarized, herein. The full text of BHHRA and BERA reports are provided as Appendices P and Q, respectively.

1.2 Site Description

The LCP Chemicals, Inc. Superfund Site (hereinafter referred to as the LCP site) is located in the Tremley Point section of the City of Linden, Union County, New Jersey. The site is located along the western shore of the Arthur Kill and east of the New Jersey Turnpike as shown on Figures 1-1 and 1-2. It is accessed from the Road to Grasselli, which is reached from Linden via South Wood Avenue and Tremley Point Road. The coordinates of the approximate center of the site are Latitude 40.60832° and Longitude -74.21163°.

The site was formerly an industrial complex with chemical manufacturing operations. A mercury-cell, chlorine production (chlor-alkali) facility was operated at the site from 1955, until cessation of manufacturing operations in 1985, and included a mercury-cell chlorine process area, hydrogen gas processing plant, and sodium hypochlorite manufacturing area, as shown on Figure 1-3. The site was also used as a terminal for products produced at other facilities and various other industrial operations. In addition, a variety of tenants operated on site until the site was closed in August 1994.

The area surrounding the LCP site was historically developed for heavy industrial use, much of which is currently inactive and/or decommissioned. Primary current, active land use in the area is bulk storage and transport of petroleum products and aggregates.

Tidal wetlands are known to have existed historically in the area of the site. The placement of anthropogenic fill to raise the grade for industrial development is known to have occurred starting in the 1880s along the margins of the Arthur Kill.

1.3 Site History

1.3.1 Property Ownership

The real property parcels on which the LCP Chemicals, Inc. Superfund Site is located include City of Linden Block No. 587, Lots No. 3.01, 3.02, and 3.03. The land has a long and complex history of industrial use and property ownership. This ownership history has been researched by Keller & Kirkpatrick (2008) based on a detailed evaluation and reconstruction of the areas represented by various historic deeds that are available from public records from approximately 1909 to the present. Information regarding various property transfers and easements is presented on a series of maps by Keller & Kirkpatrick (Appendix A) and is summarized on Table 1-1. A description of the historic land ownership and easements is described on the basis of this research and on other available information.

1.3.1.1 Historic Land Ownership

The north central portion of the LCP site had a long history of industrial ownership starting in about 1880 with the Standard Chemical Works that was purchased by the Grasselli Chemical Company in 1889. Around 1924, the Grasselli Dyestuff Corporation, which is reported to have been a joint venture of Grasselli Chemical and Bayer AG, was incorporated under the laws of the State of Delaware.

The Grasselli Chemical Company transferred a number of large parcels to the Grasselli Dyestuff Company on October 20, 1928 which included, in part, the northern portion of what became the LCP property. Parallel property transfer records indicate duPont purchased the property in 1928. The

property transfer record indicates this same area was transferred by Grasselli Chemical Company to E.I. duPont de Nemours and Company (duPont) on November 30, 1928. In addition, a strip of property extending to the Arthur Kill east of the tracks was also transferred to Grasselli Dyestuff Company that would later be used for relocation of South Branch Creek.

Grasselli Dyestuff Corporation changed its name to General Aniline Works, Inc. on February 27, 1929. The company then changed its name to General Aniline & Film Corporation on October 30, 1939 and merged into American I.G. Chemical Corporation on October 31, 1939[1].

In 1942, the United States Justice Department seized American I.G. Chemical Corporation as a war asset. While under government control, the General Aniline & Film Corporation completed construction of a chlor-alkali (chlorine manufacturing) plant on the LCP site in 1955. In 1965 the U.S. Government sold the ownership of General Aniline & Film Corporation in a public stock offering. General Aniline & Film Corporation changed its name to GAF Corporation on April 24, 1968.

Other parcels in what became the LCP property were acquired separately. The central portion of the LCP property located west of the railroad tracks was owned by E.I. duPont de Nemours and Company prior to 1949 and transferred to General Aniline & Film Company in 1949. The southern portion of the LCP property located west of the railroad tracks was transferred from Central Railroad Company of New Jersey to General Aniline & Film Company in 1958. A narrow strip of land along what is now the current southern property line and extending to the extreme eastern tip was transferred from Central Railroad Company of New Jersey to General Aniline & Film Company in 1967.

GAF Corporation sold the LCP Site which included the chlor-alkali facility to Linden Chlorine Products, Inc. of Edison, New Jersey on August 24, 1972. LCP Chemicals and Plastics, Inc. conveyed its property to LCP Chemicals-New Jersey, Inc. on December 14, 1979. At some point, the company became known as LCP Chemicals, Inc., a division of the Hanlin Group, Inc.

1.3.1.2 Easements

Numerous easements have been established at the LCP site. These easements include various rights of way for physical access by road and rail to the LCP site, use of utility poles and other utilities, use of the flume and outfall ditch for wastewater drainage, easements for numerous underground and overhead utility lines not specifically related to the LCP site including a historic sanitary sewer trunk line; gas and petroleum transmission lines; water lines; electric lines, access to leaseholds within the LCP site property; and access to other neighboring properties. These easements are listed on Table 1-1.

1.3.1.3 Site Operation

GAF began the chlorine operation at the LCP site in 1955. By 1956, the core of the buildings required for the chlorine productions were present, including Buildings 220 and 230. GAF had stopped operation of the chlor-alkali manufacturing facility in 1971. Linden Chlorine Products, Inc., which was founded in 1972, purchased the site from GAF and subsequently resumed operation of the plant. Another mercury cell building (Building 240) and other site buildings were added by LCP in the early 1970s.

As of 1975, Linden Chlorine Products, Inc. reported that it owned no other manufacturing facilities and that only three products were produced – chlorine, sodium hydroxide, and hydrogen. By the early 1980's, the company had acquired additional chlor-alkali manufacturing facilities, including sites in Syracuse, New York, Moundsville, West Virginia, and Brunswick, Georgia.

[1] The merger into American I.G. Chemical Corporation in 1939 is reported in the deed research by Keller & Kirkpatrick. Other records suggest that ownership by American I.G. Chemical Corporation may have occurred in approximately 1928 or 1929.

Portions of the LCP site were leased to other companies for the operation of other related manufacturing operations at the site. In 1957, part of the property to the west, was leased to Union Carbide Corporation (UCC) to be used as a hydrogen plant utilizing the by-products of the chlorine plant and is known as the Linden Division hydrogen plant. UCC operated its plant through 1990. Kuehne Chemicals, Inc. leased the northern portion of the property in 1972 and opened a sodium hypochlorite manufacturing plant, which also distributed and sold chlorine.

The ownership of the Linden Chlorine Products, Inc. facility became LCP Chemicals-New Jersey, Inc., a subsidiary of Linden Chemicals & Plastics, Inc. The chlor-alkali manufacturing operations had ceased by 1985 and the facility was used as a terminal for products produced at other locations.

Hanlin Group, Inc., d.b.a. LCP, filed a petition under Chapter 11 of the bankruptcy code in 1991 and liquidated all of its assets before April 1994 using the proceeds to pay creditors including the USEPA. The Linden, New Jersey property was abandoned by Hanlin Group pursuant to an order of the Bankruptcy court and ownership reverted back from the bankruptcy estate. Title to the property is currently is listed as LCP-Chemicals New Jersey, a d.b.a. name for Hanlin. Hanlin was formerly incorporated in New Jersey but is now a defunct corporate entity.

In August 1994, the EPA conducted a site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional and that the site was vacated by LCP employees. Active Water Jet Inc., a pipe cleaning company, who was a tenant at the site since about the early 1990s, remained onsite until 2000. The facility has remained abandoned ever since.

1.3.2 Operations and Development

The text in this section has been adapted from the document titled "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000) and updated with information that has been obtained from other available sources. Much of the historic information presented, herein, is compiled from documents dating back to 1975 and earlier. Within these documents there are some contradictions concerning the past operations of the site. This problem is compounded by the fact that much of LCP Chemicals, Inc.'s records were lost or destroyed sometime in the 1980s (Eder, September 1993).

At the time of LCP Chemicals, Inc.'s mercury cell chlorine production, there were three main operating centers at the site; the mercury cell chlorine process area, the hydrogen gas processing plant, and the sodium hypochlorite manufacturing area. Materials needed for processing were shipped in by barge, rail, or by truck. Storage and distribution of chlorine and its related products (including methylene chloride and potassium hydroxide) occurred on this site throughout its history. The manufacturing operations were subject to periodic shutdowns due to changes in market demands for chlorine production. The processes by which the chlorine and its by-products were created are described in the section below.

1.3.2.1 Mercury Cell Chlorine Process Area

The mercury cell was an industrial system that split common salt molecules (NaCl) to produce chlorine gas. A typical mercury cell process used electrolysis to split the salt solution. An electric current was passed through the salt solution (brine) between a graphite anode and a mercury cathode (Figure 1-4) to produce chlorine gas and sodium. The sodium dissolved into the mercury and the sodium-mercury mixture was made to react with water to produce sodium hydroxide and hydrogen gas. All of the material from this process, including the spent brine, hydrogen gas and sodium hydroxide, contained residual amounts of mercury. The mercury was separated from the resulting chlorine and hydrogen gas and sodium hydroxide which were packaged for sale for additional processing and/or for distribution.

The raw materials used in the chlorine production process were salt, water, mercury, and electric power. Documentation of LCP Chemicals, Inc.'s procedure for the handling and storage of chemicals is not available. Rock salt or evaporated salt, which was utilized later, was transported to the site by rail. It was stored in salt silos located by Building 233 (Figure 1-3) and fed to the adjacent saturators to create brine. The brine was treated and filtered in a brine treatment tank in Building 233. To treat the brine, sodium hydroxide, sodium carbonate, and barium chloride were added to precipitate impurities in the solution, such as calcium carbonate, sulfates, and hydroxides. The residual material is known as brine purification mud or "brine sludge". In the mid 1960s, a surface impoundment, the brine sludge lagoon, was constructed and used to dispose the brine sludge and process wastewater. The sludge was mixed with brine and the resulting slurry was pumped to the brine sludge lagoon through overhead pipes. The supernatant, or liquid content of the brine sludge lagoon, was pumped back to the brine purification tank for recycling and for redistribution either to the mercury cells or for the slurry usage. Documentation of the disposal practices for the brine sludge before the construction of the sludge lagoon is not available.

After pre-treatment of the brine, it was piped to the mercury cells in Building 230 and Building 240 to produce gaseous chlorine and a mercury sodium mixture through electrolysis. Once the chlorine was cooled, dried (i.e., water vapor removal) with sulfuric acid, and liquefied in Building 233, it was stored in 100 ton vessels. The used brine was recycled to the treatment tank in Building 233 for re saturation and to repeat the process.

The mercury-sodium mixture was then piped to denuders, or strippers, where it was hydrolyzed to form elemental mercury, a sodium hydroxide solution and gaseous hydrogen. The recovered mercury was returned to the mercury cells. The sodium-hydroxide solution was filtered and stored in above ground storage tanks at the northeast corner of the facility. The hydrogen gas was also filtered by way of a commercial "Purasiv" unit south of Building 231. From there it was piped to the hydrogen facility where it was packaged and distributed by Union Carbide (Linde Division). Occasionally, the hydrogen gas was mixed with water and chlorine to form hydrochloric acid in both gaseous and liquid form. The hydrochloric acid was then stored in tanks near Building 231. In 1985, LCP Chemicals stopped the mercury cell process, thus brine sludge production was also stopped.

Between 1985 and 1994, the site was used as a transfer terminal for products made at other Hanlin Group Facilities. The Hanlin products were shipped to the site via rail or truck and stored in above ground storage tanks. From there they were repackaged and distributed. The products were potassium hydroxide, sodium hydroxide, hydrochloric acid and methylene chloride. Aerial photographs of the facility during full operation in 1966-67 (Building 240 not constructed yet) and shortly after shut down of the mercury cell process are shown on Figures 1-5 and 1-6, respectively.

1.3.2.2 Linde Division Hydrogen Plant

The hydrogen plant was operated by the Linde Division unit of Union Carbide Corporation (Linde) which occupied a 2.1-acre leasehold on the western portion of the site (Figure 1-3) interconnected to the mercury cell process area. The Linde Division hydrogen plant started operation in 1957 and ceased operation in 1990. Hydrogen was supplied from the mercury cells to the plant via overhead pipes. The gas was purified by UCC to remove additional residual mercury (reportedly, at least five pounds of mercury was removed from the gas stream by Linde daily), stored, compressed, and shipped by trailer. Union Carbide, in their 104(e) response claims that one disposal method for the Linde waste mercury was to give it to employees for resale. In 1980, the hydrogen plant stopped using the hydrogen from the chlorine plant, and began to package liquid cryogenic hydrogen that was shipped in from outside sources.

In 1988, in preparation for a new tenant, UCC had the building interior and the hydrogen compressors decontaminated for mercury (IT, April 22, 1988). IT reportedly recovered 30 pounds of free mercury from one compressor and its associated piping.

In May 1990, the Linde Division plant ceased operations after the UCC lease with LCP expired. This triggered the NJDEP's Environmental Cleanup Responsibility Act (ECRA, now known as ISRA). Due to several areas of concern unrelated to the chlorine manufacturing process (i.e., former underground storage tanks, sumps, septic tanks, etc.), ISRA required that a soil and groundwater investigation be conducted within the boundaries of the site. The required investigation and its cleanup took place in the early 1990s. The NJDEP granted a No Further Action (NFA) declaration for the hydrogen facility on June 20, 1995 for soils only. To our knowledge, Praxair (successor to UCC) has had engineering controls on the leasehold.

The Linde Division facility was last used in October 1994 by Liquid Carbonic Corporation. Liquid Carbonic Corporation was later purchased by Praxair, Inc. Liquid Carbonic rented the Linde Division site from LCP Chemicals, Inc., and used it for office space and as a parking area for truck trailers.

1.3.2.3 Hypochlorite Facility

Kuehne Chemical, Inc., leased Lot Nos. 3.02, 3.03 and the northern part of Lot 3.01 from LCP Chemicals, Inc. and started a sodium hypochlorite manufacturing process. The processing area was located to the north of Building 220 and between Avenue C and D and consisted of above ground storage tanks, loading areas and support buildings (Figure 1-3). The manufacturing plant received its raw materials, chlorine and sodium hydroxide, from the LCP chlorine plant via overhead pipes. The raw material were utilized by Kuehne to produce sodium hypochlorite (bleach). Chlorine, sodium hydroxide, hydrochloric acid, and sodium hypochlorite were also stored and distributed by Kuehne. Kuehne Chemical Inc. had vacated the site by February 1981. It is likely Kuehne mercury waste was disposed of along with the LCP mercury waste.

1.3.2.4 Other Operators

Conrail (successor to Central Railroad of New Jersey) constructed and operated a railroad line and railroad yard across the property as described in Section 2.1.1 and as shown on Figure 2-8.

Active Water Jet operated a pipe and tank washing operation on the property from 1990 until 2000. Active Water Jet cleaned, with water blasting, contaminated tanks, filters, pipes, condensers and similar items. Its offices were located in building 220.

Caleb Brett leased a portion of the property from 1988 to 1995; they are known to have stored petroleum crude oil, No. 6 fuel oil, kerosene, asphalt products, pot ash, caustic soda, alcohol, and ketones at the site.

Microcell Technologies leased building 231 from 1987 until 2000 and operated a pilot plant that produced small glass spheres.

1.4 RI Site Investigation

The work plan documents and the technical objectives for each of the RI field investigations are described below.

1.4.1 Phase I RI

Phase I RI Work Plan Documents

The Phase I RI was performed during 2001 and 2002 in accordance with the following USEPA-approved documents:

1. "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000).
2. "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001), hereinafter referred to as the FOP.

3. "Quality Assurance Project Plan, Field Operations Plan, Part II, Draft Sampling and Analysis Plan" (URS, February 12, 2001), hereinafter referred to as the QAPP.
4. "Addendum No. 1, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Cased Deep Borings," (Brown and Caldwell, October 12, 2001).
5. "Addendum No. 2, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Subsurface Utility Clearance," (Brown and Caldwell, November, 2001).
6. "Addendum No. 3, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Sampling Beneath Buildings 230 and 240" (Brown and Caldwell, March 2002).

Agency approval of these Phase I RI Work Plan documents was provided in letters from USEPA in 2001 and 2002.

Phase I RI Objectives

The objectives of the Phase I RI were stated in Section 2 of the "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001):

- Determine the nature and extent of contamination in the soil, groundwater, surface water, and sediment.
- Evaluate stratigraphy on a site-wide basis - confirm the distribution of the Tidal Marsh Deposit and evaluate its effectiveness as a confining layer.
- Define the hydrogeology on a site-wide basis - confirm groundwater gradients, flow directions, and aquifer properties (e.g., hydraulic conductivity, transmissivity, etc.) to predict the direction and flow rate of groundwater contaminant migration.
- Evaluate tidal effects on groundwater and groundwater flow direction.
- Evaluate the potential ecological resources of, and impacts to, South Branch Creek.
- Characterize-anthropogenic fill at the site.
- Develop a conceptual site model.
- Determine risks posed to human health and environment.

The results of the Phase I RI field investigation were presented in the document titled, "Site Characterization Summary Report (SCSR), LCP Chemicals Superfund Site, Linden, New Jersey", (Brown and Caldwell, August 2002).

1.4.2 Phase II RI

Phase II RI Work Plan Documents

The Phase II RI was performed from August 2006 through June 2007 in accordance with the following 14 USEPA-approved documents:

1. "Work Plan, Remedial Investigation and Feasibility Study" (URS, October 6, 2000).
2. "Final Sampling and Analysis Plan, Field Operations Plan, Part I, Draft Sampling and Analysis Plan" (URS, April 12, 2001), hereinafter referred to as the FOP.
3. "Quality Assurance Project Plan, Field Operations Plan, Part II, Draft Sampling and Analysis Plan" (URS, February 12, 2001), hereinafter referred to as the QAPP.
4. "Addendum No. 1 (Soil and Groundwater) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site", (Brown and Caldwell, July 2004, Revised April 2006, Revised October 2006).

5. "Addendum No. 2 (South Branch Creek & Ecological Issues) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site", (Brown and Caldwell, July 2004, Revised August 2006, Revised October 2006).
6. "Addendum No. 1, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Cased Deep Borings," (Brown and Caldwell, October 12, 2001).
7. "Addendum No. 2, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Subsurface Utility Clearance," (Brown and Caldwell, November, 2001).
8. "Addendum No. 3, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Sampling Beneath Buildings 230 and 240" (Brown and Caldwell, March 2002).
9. "Addendum No. 4, Field Operations Plan, LCP Chemicals, Inc. Superfund Site (Bedrock Monitoring Wells, Soil Vapor Testing, Groundwater Sampling)", (Brown and Caldwell, April 2006, Revised October 2006).
10. "Addendum No. 5, Field Operations Plan for the LCP Chemicals, Inc. Superfund Site, Ecological Sampling", (Brown and Caldwell, August 2006, Revised October 2006).
11. "QAPP Addendum for South Branch Creek Sampling," (Brown and Caldwell, August 2006, Revised October 2006).
12. "Supplemental Work Plan: Sediment Toxicity Testing (South Branch Creek), Phase II Remedial Investigation LCP Chemicals, Inc. Superfund Site," (Brown and Caldwell, September 2006, Revised October 2006).
13. "Interim Ecological Risk Assessment Problem Formulation," (Brown and Caldwell, Revised October 2006).
14. "Health and Safety Plan For Phase II Remedial Investigation at the LCP Chemicals, Inc. Superfund Site," (Brown and Caldwell, September 2006).

Agency approval of these Phase II RI Work Plan documents was provided in the following:

- Letter from Ms. Carole Petersen of USEPA dated September 13, 2006 referenced: "Conditional Approvals for Addendum No. 2 (South Branch Creek and Ecological Issues) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site (Revised July 2006); and Addendum No. 5 Field Operations Plan LCP Chemicals, Inc. Superfund Site (Ecological Sampling) (August 2006)."
- Letter from Ms. Carole Petersen of USEPA dated October 5, 2006 referenced: "Conditional Approvals for Addendum No. 1 (Soil and Groundwater) Work Plan: Phase II Remedial Investigation, LCP Chemicals, Inc. Superfund Site (April 2006) and Addendum No. 4 Field Operations Plan, LCP Chemicals Inc. Superfund Site (Bedrock Monitoring Wells, Soil Vapor Testing, Groundwater Sampling) (April 2006)."
- Submittal of revised Phase II Work Plan documents to USEPA by October 13, 2006 in accordance with the conditions set forth in the conditional approval letters.

Phase II RI Objectives

The Phase II RI Work Plan included an approach and methodology to address the following technical objectives:

- Additional delineation of surficial and shallow soils in the western area of the site through the installation and testing of soil from a number of borings.
- Characterization of deep soils through the installation and testing of a number of borings to determine the vertical extent of contamination identified in the shallow soils.
- Characterization of soil quality within the glacial till beneath Building Nos. 230 and 240.

- Determination of the presence of methyl mercury in soil from a number of shallow and deep soil samples obtained in various areas of the site.
- Determination of the specific form of mercury in a number of surficial soil samples including mercuric (Hg+2), mercurous (Hg2+2), and methyl (CH3Hg+).
- Characterization of surficial soil quality near storage tanks remaining at the site that may have had potential releases to the environment.
- Determination of groundwater quality in the bedrock water-bearing zone.
- Additional characterization of groundwater quality in the overburden water-bearing zone through the collection of a second complete round of monitoring well samples, including the use of "ultra-clean" sample collection and handling techniques for mercury.
- Determination of the groundwater flow characteristics in the bedrock water-bearing zone.
- Additional characterization of groundwater flow conditions in the overburden water-bearing zone.
- Determination of the in-place hydraulic conductivity of the unconsolidated and consolidated geologic material screened by the newly installed monitoring wells.
- Determination of the presence of methyl mercury in groundwater from a number of overburden and bedrock groundwater samples obtained in various areas of the site.
- Characterization of soil vapor to address the potential vapor intrusion pathway to future building structures at the site.
- Current wetland delineation and jurisdictional determination.
- Additional delineation of selected constituents in sediment and surface water in South Branch Creek as well as in the confluence area of South Branch Creek and Arthur Kill to address ecological concerns.
- Evaluation of the bioavailability of mercury in the surface water and sediment within South Branch Creek. This includes a determination of the ratio of methyl mercury to total mercury.
- Determination of the influence of mercury speciation and sediment chemistry on bioavailability to aquatic organisms.
- Utilization of a Reference Channel for the purpose of differentiating certain chemical constituents with respect to the background conditions when performing environmental characterization and analysis.2
- Estimation of biota sediment accumulation factors (BSAFs) from sediment to crabs and fish.
- Collection of site-specific information to support the Baseline Ecological Risk Assessment, including a biologic habitat assessment and the collection of tissue residue in selected aquatic biota in South Branch Creek and the confluence area of South Branch Creek and Arthur Kill.
- Evaluation of sediment toxicity.

1.4.3 Off-Site Ditch Investigation

Off-Site Ditch Work Plan Documents

The off-site ditch investigation phase of the RI was performed from July 22, 2011 to July 28, 2011 in accordance with the following two USEPA-approved documents:

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2 The Phase II RIWP documents, dated October 2006, included tasks for the selection and collection of samples from a reference stream. An e-mail message dated August 18, 2006 from Mr. Jon Gorin of USEPA to ISP-ESI that stated " . . . after consulting with BTAG, we've determined that there is no need for a reference stream right now." The approved documents included identification and sampling of a reference stream. This work was therefore conducted in accordance with the approved documents without oversight by USEPA.

- "Revised Scope of Work - Characterization of Off-Site Ditches, LCP, Chemicals Inc. Superfund Site", (Brown and Caldwell, May 14, 2010).
- "Quality Assurance Project Plan, LCP Chemicals, Inc. Superfund Site, Linden, New Jersey", (Brown and Caldwell, May 2010).

Off-Site Ditch Work Plan Objectives

The Off-Site Ditch Scope of Work included an approach and methodology to address the following technical objectives:

- To characterize the extent to which the Northern and Southern Off-Site ditches are tidally influenced.
- To characterize the extent to which the Northern and Southern Off-Site ditches may be impacted by site-related constituents.

1.5 Report Organization

The data presented in this RI Report includes the Phase I and II RI data and is intended to characterize current site conditions for each medium that was investigated. The environmental database (Appendix F) contains the complete laboratory analytical data from both the Phase I and Phase II RI field investigations.

The RI Report is organized as follows:

- Section 1 Introduction
- Section 2 Site Setting
- Section 3 RI Field Investigation Methods and Procedures
- Section 4 Data Management
- Section 5 Physical Characteristics
- Section 6 Nature and Extent of Contamination
- Section 7 Contaminant Fate-and-Transport
- Section 8 Baseline Risk Assessment Summary
- Section 9 Recommendations
- Section 10 References

Appendices to the RI Report are as follows:

- Appendix A Property Transfers
- Appendix B Field Operations Plan
- Appendix C Well Construction and Soil Boring Logs
- Appendix D Hydrogeologic Data
- Appendix E Wetland Delineation
- Appendix F Habitat Assessment Report
- Appendix G Representative Photographic Logs
- Appendix H Analytical Lab Deliverables (DVD)
- Appendix I Data Usability Reports
- Appendix J Tabular Summary of Analytical Data
- Appendix K Environmental Database (CD-ROM)
- Appendix L Sediment Toxicity Testing Report

- Appendix M Regional Studies
- Appendix N NJDEP Technical Regulations Checklist
- Appendix O Human Health Risk Assessment
- Appendix P Ecological Risk Assessment

Section 2

Site Setting

The LCP Chemicals Inc. Superfund Site (LCP site) is located in the Tremley Point section of the City of Linden, Union County, New Jersey as shown on Figure 1-1. The site is located along the western shore of the Arthur Kill and east of the New Jersey Turnpike. It is accessed from the Road to Grasselli which is reached from Linden via South Wood Avenue and Tremley Point Road. The coordinates of the center of the site are Latitude 40.60832° and Longitude -74.21163°.

The LCP site property includes Block 587, Lots 3.01, 3.02, and 3.03. The area of these three lots totals approximately 26 acres. The shape of the property is highly irregular with a maximum east-west dimension of approximately 2,500 feet and a maximum north-south dimension of 1,600 feet (Figure 1-3).

The site is bisected by an inactive railroad spur running north and south that is located on an easement and is operated by the Consolidated Rail Corporation (Conrail). The LCP chlor alkali manufacturing facility was formerly housed in a group of buildings located immediately west of the railroad tracks. The mercury cell buildings (No. 230 and 240) and the liquefaction building (No. 231) are shown on Figure 1-3.

The current alignment of a man-made ditch, known as South Branch Creek, is located east of the railroad tracks along a narrow portion of the property that connects to the Arthur Kill. Occupying most of the remaining portion of the property east of the railroad tracks is a closed RCRA unit, a cooling tower, and the pad for a former sludge roaster. The closed RCRA unit is currently maintained by ISP-ESI.

West of the railroad tracks there are numerous buildings and tanks associated with the LCP Chemicals Inc. facility and its tenants. Several of the buildings also exist on the property that were part of associated processes leased and operated by other companies, including the Linde hydrogen plant predominantly on the western portion of the property, and the Kuehne Chemicals sodium hypochlorite and chlorine packaging facility. Other notable site features on the western portion of the site include an electrical transformer and rectifier yards and an on-site railroad yard. Additionally, engineering and institutional controls consisting of a 0.7 acre asphalt cap and deed restriction were placed on the western portion of the property by former tenant Linde in 1994 pursuant to the New Jersey Environmental Responsibility Act (ECRA) Site No. 90367. This engineering control installed by Linde, the cap, has not been inspected or maintained by Linde or its successors, including Praxair to the knowledge of ISP-ESI, at any time after installation in 1994. The cap is currently in disrepair with major cracks and trees growing out of it. NJDEP, EPA and Praxair have been notified of this situation on several occasions.

The LCP site started chlor-alkali manufacturing operation in 1955 and the core of the manufacturing buildings were present by 1956. Cell Building 240 was added in 1972. Manufacturing of chlorine ceased at the facility by August 1985 and site operation by LCP ended by August 1994; several tenant operators remained until 2001. Additional information regarding the site history, including site operation and development is presented in Section 1.3.

The southern LCP property is adjacent to a pair of parallel railroad tracks operated by Conrail, and further south by two parallel drainage channels hereinafter referred to as the Northern and Southern Off-Site Ditches. The two ditches run parallel with the southern LCP property line, and are not apparently associated with development on the LCP site.

2.1 Land Use and Zoning

The area surrounding the LCP site historically was developed for heavy industrial use, much of which is currently inactive. A map depicting land use as of 2002 is presented in Figure 2-1. The map was developed based on GIS datalayers obtained from the New Jersey Department of Environmental Protection (NJDEP).

The current primary active land use in the area is bulk storage and transport of petroleum products and aggregates. The transport of these materials occurs by ship and barge using dockage along the Arthur Kill as well as by rail, truck, and pipeline. Other active facilities in the area include a municipal wastewater treatment plant, trucking and warehousing, and truck repair. An active, major rail freight line runs parallel to the eastern side of the New Jersey Turnpike, west of the site. A number of large chemical manufacturing facilities formerly operated within one mile of the site, most of which are currently inactive and in various stages of demolition and site remediation.

The industrial properties located immediately adjacent to the LCP site include:

- NuStar Energy Linden Terminal located north and south of South Branch Creek to the east of the inactive Conrail railroad spur.
- The former GAF site manufacturing facility to the north.
- Citgo Petroleum Corp, Linden Transload Terminal located to the south and southwest.
- Linden-Roselle Sewerage Authority (LRSA) sludge barge dock located southeast of the site along the Arthur Kill.

Various undeveloped areas are located within one mile of the site, many of which are either vacant former chemical manufacturing plants or tidal wetlands. The former manufacturing areas are depicted on the Land Use map (Figure 2-1) either as "Industrial", "Undeveloped/Barren/Field", and/or "Scrubland". Areas of tidal wetlands, some of which are partially filled, are located along the Rahway River to the south and Piles Creek to the north. Pralls Island is located northeast of the site and across the Arthur Kill in Richmond County, New York and is a wildlife sanctuary consisting of dredge spoil fill placed over former tidal wetlands. The City of New York, Department of Sanitation Fresh Kills Landfill, is located approximately three miles south of the site.

Most of the currently or formerly developed land in the vicinity is located on what has been mapped by the New Jersey Geologic Survey (2005) as "Historic Fill" in accordance with N.J.S.A. 58:10B-1 et seq. Additional information regarding anthropogenic fill is presented in Section 1.3.2.

The only area of residential development within one mile of the site is the Tremley section of Linden which is located west of the New Jersey Turnpike approximately 3,850 feet (¾ mile) from the nearest (western) edge of the LCP site.

2.1.1 Anthropogenic Fill

The entire area of the LCP site and most of the area surrounding the site formerly consisted of tidal wetlands, as depicted on historic topographic maps in Figures 2-2 through 2-4. It was necessary to raise the grade prior to the historic development of these areas for industrial and other uses. This was accomplished through the placement of non-indigenous materials, that is, materials not originally native to the tidal wetlands, including soil, ash, dredge spoil, demolition debris, and other materials. This material is referred in this report as "anthropogenic fill", namely, fill material that has been placed by humans. The placement of fill in the Tremley Point area allowed for the industrial development of the peninsula.

Historic Placement of Anthropogenic Fill

The presence of anthropogenic fill at the site has been verified by evaluation of soils encountered as part of the extensive soil boring program, which was completed as part of Phase I and II of the RI, as well as prior subsurface investigations conducted by others. This observation has been independently confirmed through an evaluation of the historic placement of anthropogenic fill identified on available historic maps and aerial photographs. Briefly, these sources (Figures 2-5 through 2-17) reveal that the entire area, formerly occupied by tidal marsh, was progressively filled. A chronologic description of the placement of anthropogenic fill is described below.

Historic topographic mapping from 1898 (Figure 2-2) reveals that the entire LCP site was formerly occupied by tidal wetlands that were contiguous with the Arthur Kill. In fact, the only nearby area that was not wetland is the slightly elevated land along Tremley Point Road.

Early industrial development occurred immediately along the margin of the Arthur Kill with the construction and operation of the Standard Chemical Works and later the Grasselli Chemical Company. This presence of the Grasselli Chemical Company is evident on the 1898 topographic map (Figure 2-2).

Aerial photography as of May 8, 1929 (Figures 2-5 and 2-6), reveal what appeared to be extensive filling in the Grasselli East Works area (east of railroad tracks). This land was owned immediately prior to this time by the Grasselli Chemical Company and was later acquired by duPont, with a narrow strip owned by Grasselli Dyestuff Company. The fill was also identified as far south as South Branch Creek, evident by the apparent steep banks on either side of the creek located north of the LCP property (Figure 2-5). The area west of the tracks had apparently not yet been filled.

Available aerial photography from April 28, 1940 reveals extensive areas of filling located on what was likely the duPont property at the time located east of tracks (Figure 2-8). These areas include north and south sides of South Branch Creek between the confluence with Arthur Kill and the eastern-most railroad track, a triangular area immediately south of South Branch Creek and immediately east of the western railroad tracks, and the large area located north of South Branch Creek. Other areas may be filled, including the entire area of the future LCP property east of the tracks, although this is not completely clear from the photograph.

By 1940 the south-western portion of the future LCP property between the railroad tracks was filled in preparation for the construction of a railroad yard (Figure 2-8). This railroad yard was on property that was owned at the time by the Central Railroad Company of New Jersey (Figure 2-11).

An irregular area is evident on the 1940 photograph (Figure 2-8) that appears to have been filled. This possible fill area was located on property owned by duPont that was located immediately north of railroad track, contiguous with South Branch Creek. The area immediately north of South Branch Creek is apparently not filled, as well as the far southeast corner of the future LCP property (west of the tracks).

By July 1947 (Figure 2-10), aerial photographs reveal that the northern portion of the property is covered with raw material piles on property owned by General Aniline & Film Corporation. These material piles and decommissioned process equipment storage yard are located in an area that has obviously been filled. South Branch Creek has now been re-routed to a position further south.

The old alignment of South Branch Creek is evident in the photographs from 1951 in which it and the area surrounding it are in the process of being filled (Figures 2-11 and 2-12). This is located on land that had been acquired by General Aniline & Film Corporation from duPont just shortly before in 1949. The northwestern most corner of the LCP property is partially filled along what appears to be a road leading to the western portion of the GAF facility. A strip of empty land immediately to the south is apparently not yet filled.

As of July 17, 1952, aerial photography indicates that the northern portion of the property remains covered with raw material piles and a process equipment storage yard in an area that has obviously been filled. South Branch Creek has now been re-routed to a position further south. The old alignment of South Branch Creek is still evident in the photograph in which it and the area surrounding it have been filled. The new (southern) alignment of South Branch Creek is evident. The entire western portion of the LCP property has now been filled. The most recent area of filling is partially covered with rows of equipment (Figure 2-12). In a photograph dated May 16, 1954 (Figure 2-13), the entire site east of the tracks appears to have been filled.

In summary, most filling of the LCP property was performed over a long time span likely starting around 1885. Much of the filling occurred by various owners prior to the development of the site for chlor alkali production. Most, but not all of the property, appears to have been filled by 1949.

2.1.2 Regional Industrial History

A brief description of some of the major industrial occupants of the Tremley Point area is presented below. Information contained herein was obtained from NJDEP files, the attached title search summary, or was provided by the property owner. ISP-ESI has not conducted an independent investigation of any of these properties or their operations. The historic regional land use circa 1940 is presented in Figure 2-3.

Former GAF Chemicals Manufacturing Facility

The former GAF Chemicals manufacturing facility, now referred as the GAF site, was first utilized for chemical manufacturing in approximately 1919. Under the various ownerships, chemical products were manufactured at the GAF site from approximately 1919 until closure of the plant in April 1991. Products manufactured at the GAF site primarily consisted of dyestuffs and surfactants, but also included ethylene oxide, tetrahydrofuran and herbicides. The plant ownership and various corporate entities are described in Section 1.3.1. The current owner of the site is Linden Property Holdings LLC.

The GAF site has been remediated. The site remediation conducted to-date has included demolition of site structures, capping, grading and drainage improvements, construction of a shallow groundwater barrier and groundwater collection system, installation of bedrock groundwater extraction wells, LNAPL collection and the construction and operation of a groundwater conveyance and treatment system. NFA letters have been received for site-wide soils and groundwater from the NJDEP. Remedial Action Permits for Groundwater (Permit ID RAP110002) and Soil (Permit ID RAP110001) became effective at the GAF Site on February 22, 2012.

The environmental conditions at the GAF site were documented in a comprehensive Remedial Investigation Report (Eckenfelder, 1991). Raw materials and associated bi-products from the former GAF operations are reported to have included arsenious acid catalysts, arsenic acid, arsenic mercuric sulfate, and mercury oxide catalysts among numerous other organic and inorganic constituents. The predominant organic constituents in soils and groundwater include various VOCs and SVOCs, including chlorobenzene, benzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, naphthalene, 4-chloroaniline, and phenol. The most prominent inorganics in soils and groundwater were mercury, chromium, and arsenic. These constituents are widely distributed across the entire Site with the highest levels observed in the "Old Landfill" and in the former production area. In fact, dissolved mercury concentrations range as high as 2,520 µg/L in the bedrock water-bearing zone.

A groundwater barrier wall formed of sealed-joint, steel sheet piling (Waterloo Barrier) was installed to provide hydraulic containment of shallow groundwater, and to limit the potential for contaminated soil particle migration from the site. The groundwater barrier wall spans a length of approximately

8,523 feet and surrounds an area of approximately 104 acres. Its alignment encompasses the former main plant site of the GAF site (Figure 2-18). The wall penetrates miscellaneous fill materials and is keyed into the underlying organic silt and clay aquitard and/or the glacial till formation.

A shallow groundwater collection system is installed just inside the barrier wall to intercept and control potentially contaminated shallow groundwater and percolations above the aquitard and direct these waters to the on-site wastewater treatment plant. This shallow groundwater collection system, in conjunction with the barrier wall, controls the interior shallow groundwater elevation, such that intragradient conditions (i.e., hydraulic head on the inside of the barrier wall is below that on the outside) prevail along the length of the barrier wall, thus containing shallow groundwater within the limits of the barrier wall and controlling the lateral migration of groundwater from the GAF site. This system consists of a collection drain situated essentially parallel to and a short distance inside the barrier wall alignment. The drain includes a 15-inch diameter high density polyethylene perforated pipe surrounded by drainage stone, which is wrapped in a geotextile blanket. A series of 26 precast concrete manholes serve as inspection and maintenance points along the length of the drain. Collected waters within this system are directed to two pumping stations, each consisting of an above-grade pump house situated over a precast concrete collection sump. Each pump station is equipped with a primary and backup pump, liquid level sensors and controls to operate the pumps and maintain groundwater at the desired elevation. Water discharged from each pump station is conveyed to the WWTP.

A bedrock groundwater extraction system provides areal hydraulic capture of the GAF site. Primary hydraulic capture of the majority of the site is provided by two wells located on the eastern edge of the site, DEW-2 and DEW-4A (Figure 2-18) with well screen intervals of 45 to 65 ft bgs and 45 to 55 ft bgs, respectively. Extraction wells DEW-2 and DEW-4A are operated in a continuous pumping mode at 18-20 gpm each, and have been operational on a nearly continuous basis since 2002. Additional, minor hydraulic capture of the northern edge of the GAF site has been achieved by two extraction wells, EW-2, and DEW-2, that became operational in early 2010, at pumping rates of approximately 1 to 2 gpm each. Water from the bedrock extraction system is conveyed to the on-site waste water treatment facility.

NOPCO

A NOPCO Chemical Company ("NOPCO") chemical manufacturing site was located immediately south of the LCP site on land now occupied by NuStar Energy. The NOPCO facility is observed on a 1966 aerial photograph (Figure 2-16). NOPCO constructed a toluene diisocyanate manufacturing plant on the site in the early 1960s with an initial design capacity of 10 million pounds per year. Raw materials used in the production of toluene diisocyanate include phosgene, chlorobenzene, and dichlorobenzenes, among others. Toluene diisocyanate is used as an intermediate in the production of polyurethane. The NOPCO Linden operation was related to its "Lockfoam" product line.

NOPCO acquired the land to construct the toluene diisocyanate plant from Sinclair Refining on December 28, 1960. The plant was constructed in the early 1960s and full operation was initiated by March and April of 1963. However, the plant operations were discontinued by September 1964 after a long series of design, construction, and operational difficulties. NOPCO sold the property to Allied Chemical Corp on April 5, 1965 (NOPCO Chemical Company, 1960, 1961, 1962, 1963, 1964, 1965). NOPCO Chemical merged into the Diamond Alkali Company who shortly thereafter merged with the Shamrock Oil Company to form the Diamond Shamrock Corporation in 1967.

E. I. duPont de Nemours and Company (duPont) Site

The duPont site is currently located northeast of the LCP site along the Arthur Kill. This former chemical manufacturing site has been decommissioned and is currently in the ISRA process.

The duPont plant manufactured inorganic salts and acids, organic pesticides (including DDT), sulfuric acid, ammonium thiosulfate, and a sodium bisulfate solution. duPont used areas of surrounding marsh

for discharge of aqueous manufacturing wastes from 1928 until the mid-1970s. The wastes disposed of were from the manufacture of inorganic compounds such as phosphate plaster (CaSO4 with 2-3% phosphate residual), hypo muds (diatomaceous earth, sulfur, carbon, and rust particles), silicate muds (sand, filter aid, and minor quantities of sodium silicate), and metal sulfides. The wastes also included coal, coal ash and waste residues. Various arsenic-containing materials are reported to have been manufactured including lead arsenate, iron arsenate, and arsenic acid, in addition to various pesticides that may have included arsenic.

The parcel has been used for chemical manufacturing from about 1880 until 1990 when duPont ceased operations.

Petroleum Product Terminals

Two bulk petroleum product terminal facilities are located on properties immediately adjacent to the LCP site. The NuStar Energy-Linden Terminal is located north and south of South Branch Creek to the east of the inactive Conrail railroad spur on the property previously occupied by NOPCO. This facility has been in existence under various ownerships since the 1970s. The Citgo Petroleum Corp, Linden Transload Terminal located to the south and southwest of the site has been in existence since before 1940. These facilities receive and ship various products including petroleum distillates, gasoline, jet fuel, ethanol, and other residual fuels. The mode of product receipt includes ship, barge, rail and pipeline. The mode of delivery includes ship, barge, pipeline, and truck.

Bayway Refinery

The Bayway Refinery is located west and northwest of the LCP site. The facility is approximately 1,300 acres with a refinery, two chemical plants, tank fields, and a marketing and distribution station. The refinery has been producing petroleum products in continuous operation since 1909. The eastern border of the property abuts the western headwaters of Piles Creek. Various ownership changes have occurred over the years. Standard Oil Company purchased the Bayway property in 1907. Successors included Standard Oil of New Jersey and Exxon. More recent ownership has included Tosco Corp and ConocoPhillips. The facility is currently under an Administrative Order and has triggered ISRA several times. It is our understanding that Exxon-Mobil retains the liability for the environmental cleanup of the site.

On the eastern side of the Bayway Refinery, the New Jersey Turnpike passes through the site, separating the main refinery and process areas from the waterfront area, which borders on the Arthur Kill. Two outlying tank fields (the Rahway River Tank Field and the 40-acre Tank Field) are located southwest of the main refinery and process areas.

The west side chemical plant produces additives for motor oils and high purity propylene. Tanks on site store sulfidic caustic, asphalt, butane, gasoline additives, heavy catalytic naptha, domestic oil, gasoline, petrolite, Celsius, water white, standard white, gas oil, treated naptha, crude naptha, and crude petroleum. The east side chemical plant produced methyl ethyl ketone, tertiary butyl alcohol, secondary butyl alcohol, methyl isobutyl ketone, isopropyl alcohol, acetone, propylene, isophorone, and fuel gas. Finished products stored on site include heating oil, heavy fuel oil, jet fuel, diesel fuel, kerosene, asphalt. There is a tetraethyl lead building. Processes include calatytic cracking, naptha reforming, alkylation, and disulfurization. Early products produced on site (1914-1919) included gasoline and kerosene.

Former American Cyanamid Warners Plant

The former American Cyanamid Warners Plant was located at the tip of the Tremley Point peninsula at the confluence of the Arthur Kill and the Rahway River. The 33-acre site was built in 1916-1917 and originally produced concentrated "ammo-phos" fertilizers. During WWI, the facility produced ammonia and nitric acid for military purposes. The plant also made aluminum sulfate for water treatment and a

range of organic chemicals including rubber, motor oil additives, accelerators, fumigants (hydrocyanic acid) and pesticides. A sulfuric acid production unit started operation in 1970. The facility discontinued operations in 1998.

The site has been decommissioned and an environmental remediation has been performed under RCRA. The property has been sold and is currently awaiting redevelopment.

PSE&G

The PSE&G Linden Generating Station is a 1,526 MW natural gas powered electric power plant located along the Arthur Kill immediately north of Piles Creek. This plant replaced a former oil-fired plant that was also operated by PSE&G.

2.1.3 Current Site Land Use

Manufacturing of chlorine ceased at the LCP facility in 1985 and site operation by LCP ended by August 1994. Several tenant operators, including Active Water Jet, Inc. remained until 2000. Today, the LCP site is unoccupied and unused.

2.1.4 Zoning

The area of the site located east of the New Jersey Turnpike (NJTP) is zoned for heavy industry. Allowable uses in this area include various types of manufacturing (except explosives, fertilizers, and the use of liquefied natural gas); assembly and packaging; warehousing; airports; offices, research facilities; service stations and automotive repair shops; public utility generating stations, truck terminals and tank farms. Residential, consumer retail, and recreational development in the area located east of the NJTP is specifically not allowed.

Some of the areas located along South Wood Avenue, west of the New Jersey Turnpike, are zoned for light industry. Allowable uses for these areas would include manufacturing that employs no chemical or raw material processing, assembly and packaging operations, warehousing, airports, offices and research facilities, and service stations and automotive repair shops.

2.1.5 Anticipated Future Land Use

The Tremley Point area of Linden, located east of the New Jersey Turnpike, is anticipated to undergo brownfields redevelopment on the sites of the former manufacturing facilities. A major transportation infrastructure has been in the planning stages to support this redevelopment. Specifically, New Jersey Department of Transportation (NJDOT, 2008) "Tremley Point Access Local Roadway Improvements", Project ID 9324A is anticipated to be funded as part of the FY 2009 Transportation Capital Program that will consist of a four-lane, 1.1 mile long roadway and bridge to connect Tremley Point with Exit 12 of the New Jersey Turnpike in Carteret. This project is specifically intended to address "the increase in truck traffic anticipated by the redevelopment of the Tremley Point brownfields into more than six million square feet of warehouse and distribution space" (NJDOT, 2008).

Potential future land uses of the LCP site may include power generation, petroleum terminals, warehousing and distribution, and transportation.

2.2 Demography

In the following sections, demographic information (including population, economic indicators, and labor information) is presented and discussed. Data are reported for areas in New Jersey within a one-mile radius of the site's boundaries. Much of the data reported are based on 2000 census data.

2.2.1 Population

Population distribution for cities and townships in the vicinity of the LCP site is summarized on Table 2-1. Included are population data for the Cities of Elizabeth, Linden, and Rahway (of Union County) and the City of Carteret (of Middlesex County). As shown, the City of Elizabeth is the most densely populated (9,865.5 persons per square mile) and also has the largest population (120,568 persons) of the jurisdictional areas evaluated.

Change in population from 1980 to 1988 is also shown in Table 2-1. Union County has experienced an increase in population of 5.8 percent for the period of 1990 to 2000. Elizabeth, Linden, and Rahway have significantly gained in population (9.5 percent, 7.2 percent, and 4.7 percent change in population, respectively). Middlesex County experienced a significant 11.6 percent gain in population over this time period. The population change for Carteret increased 8.9 percent during this time. These data indicate that, in general, the area in the region of the LCP site experienced a growing trend in population during the period of 1990 to 2000.

Only a slight increase in population was expected for Union County for the time period 2000 and 2006 (1.6 percent), while a more sizeable increase in population (4.9 percent) was anticipated for Middlesex County during the same time period.

In Table 2-2, population distribution by age group is presented. As shown, the highest percentage of the population for the jurisdictional areas evaluated is within the working age group of 18 to 64 years. The City of Linden has the greatest amount of residents aged 65 years to older (at 16.3 percent) while the City of Elizabeth has the smallest amount (at 10.0 percent). This is also reflected by median age reported with Linden having the highest median age (38.0 years) and Elizabeth having the lowest (32.6 years).

2.2.2 Economic Indicators

Per capita income for the jurisdictional areas evaluated is reported in Table 2-3. In 1999, per capita income for the cities of Elizabeth, Linden, and Rahway were substantially less than that for Union County, with the City of Elizabeth having the lowest ($15,114). Similarly, the 1987 to 1999 percent increase in income for the City of Elizabeth (42.5 percent) was lower than that for Linden (57.3 percent) or Rahway (60.3 percent). The City of Carteret had a lower per capita income than the rest of Middlesex County; however, the per capita income reported for Woodbridge Township ($25,087) was very close to the number reported for Middlesex County ($26,535). The 1987 to 1999 percentage increase in per capita income was significantly less for Carteret (47.7 percent) compared to Woodbridge Township (71.1 percent).

Household income data reported for 1999 and 2004 are shown in Table 2-4. Median household incomes were somewhat higher for Middlesex County ($60,987) compared to Union County ($55,247). The percent of persons living below the poverty level in the City of Elizabeth was a substantial portion of the population (17.8 percent) and was over twice the number for Union County (6.4 percent). A similar trend was reported for families living below the poverty level in 2000; the percentage reported for the City of Elizabeth was 15.6 percent versus 5.0 percent for the City of Linden.

2.2.3 Labor Information

Available data on the civilian labor force for cities and counties in the vicinity of the LCP site are shown in Table 2-5. In 1999, the City of Carteret had the largest percentage of unemployed (at 5.8 percent) followed by the City of Elizabeth (5.2 percent), the City of Rahway (4.3 percent), and the City of Linden (3.6 percent). Union and Middlesex Counties displayed similar percentages of unemployed residents—3.5 percent and 3.4 percent, respectively.

Employment data by industrial category (1999 data) for Union and Middlesex counties is presented in Table 2-6. Employment trends are slightly different from what they were during the last census. The manufacturing industry accounted for the highest percentage of jobs in Middlesex County at 18.6 percent while the education and healthcare industries accounted for 18.4 percent in Union County. The retail trade industry is also a major employer in both counties. The agricultural and mining industry employs only a minor portion of the employed populations in Middlesex and Union counties (0.1 percent in both counties).

2.2.4 Summary of Demographic Characteristics

In summary, the New Jersey jurisdictional areas within a one-mile radius of the property boundaries are experiencing a slight increase in population. Only a small increase in population was projected in Union County to the year 2006 (1.6 percent increase) and a somewhat greater increase was projected for Middlesex County (4.9 percent). The majority of the population living in the region of the LCP site is of working age (18 to 64 years old). Of the jurisdiction areas evaluated, the City of Linden has the highest percentage of residents over the age of 65 years and also the highest median age (38.0 years).

Per capita income in 1999 for the cities of Elizabeth, Linden, and Carteret is substantially less than their respective counties. The lowest per capita income ($15,114) was reported for the City of Elizabeth. The percentage of persons and families living below the poverty level was also highest for the City of Elizabeth and represents a substantial portion of the population (17.8 and 15.6 percent, respectively). The percentages of persons and families living below the poverty level for the remaining jurisdictional areas were 11.0 percent or less and 8.6 percent or less, respectively.

The percentage of the total civilian labor force that was unemployed ranged from 3.4 percent (Middlesex County) to 5.8 percent (City of Carteret) in 1999. The majority of the work force in Middlesex and Union counties was employed in the manufacturing, education and the health care industry, and retail trade industries as of 1999.

2.3 Climate and Meteorology

Climatological data are recorded at the NOAA measuring station located at Newark Airport in Newark, New Jersey. The LCP site is located approximately seven miles south of the recording station. The elevation and topographic setting of the LCP site are very similar to that of the NOAA station such that the NOAA data provide an accurate representation of the climatology of the site. The climatology for the area was obtained from Comparative Climatic Data for the United States (NOAA, 2000) and monthly summaries up through 1998 (NOAA). Mean temperature and precipitation data contained therein are based upon a thirty-year period of record from 1961 to 1990 referred to as "normals". Wind direction and speeds are based upon records since 1944.

2.3.1 Temperature

Average daily temperatures range from a normal daily maximum of 87.0°F in July to a normal daily minimum of 23.4°F in January. The normal monthly temperatures range from 77.8°F to 30.6°F (Table 2-7) and occur in the months of July and January, respectively. The average 30-year normal of the average monthly temperatures for the period of record is 54.8°F. The average normal daily maximum is 63.4°F and the average normal daily minimum is 46.1°F. Although the average normal monthly temperature varies greatly, with an average deviation of 14.3°F, these temperatures occur in a relatively normal distribution (Figure 2-19), with July being the warmest month and January and February comprising the colder months on either side of the temperature distribution. Occurrences of extreme temperatures have been recorded as high as 105°F in July of 1966 and as low as 8°F in January of 1985.

2.3.2 Precipitation

The 30 year normal of the annual precipitation is recorded as 43.97 inches (Table 2-7). The annual precipitation is fairly uniformly distributed throughout the year (Figure 2-20) with a mean deviation of 0.30 inches. Extreme monthly precipitation values have been reported as high as 13.22 inches in October 2005 and as low as 0.07 inch in June 1949. The mean maximum precipitation for a 24-hour period is reported as 7.84 inches in August 1971. Relative humidity for the region averages 73 percent at sunrise (0700 hours) and 53 percent at sundown (1900 hours). Although slightly higher relative humidity readings are reported for the months of August through January, mean monthly readings occur in a generally uniform distribution throughout the year.

2.3.3 Prevailing Wind Direction and Speed

The prevailing wind direction for the area is from the southwest during the months of May through December as determined by data compiled by NOAA, since 1944. However, during the months of February through April, the prevailing wind direction is from the northwest or west-northwest. The mean wind direction in January is from the northeast.

The mean prevailing wind speed is reported as 10.2 miles per hour (mph), and varies from 11.9 mph in March to 8.7 mph is August (Table 2-7). Higher mean wind velocities occur during the months of November through May, while lower velocities are observed in the months of June through October. The highest wind speed (fastest observed one min value) recorded at the Newark Weather Station is 82 mph in November 1950. The next highest wind speed is recorded at 58 mph in December 1984.

2.4 Surface Water Bodies

In the following sections, information (including surface water features and classifications) is presented and discussed. Information is provided for both the region and for areas within the LCP site's boundaries.

2.4.1 Regional Surface Water Features

Tidal marsh formerly covered the entire area in which the LCP site is now located. Nearly all developed land in the Tremley Point area, inclusive of the LCP site, constitutes man-emplaced fill material laid over the former tidal marsh. Therefore, the topography of the area is relatively flat, with an elevation of only a few feet above sea level. The primary exception is the naturally-occurring high ground southwest of the LCP site along which Tremley Point Road runs. Additional information regarding the placement and distribution of anthropogenic fill is presented in Section 2.1.1.

The LCP site is almost entirely surrounded by tidal water bodies. Most prominent among these is the Arthur Kill, which is a large tidal straight that connects Newark Bay and Kill van Kull to the north and Raritan Bay to the south. The Rahway River, with a drainage area of 41 mi^2 (Rahway River Association, 2008) joins the Arthur Kill just south of the site. Piles Creek is a small tidal creek that connects to the Arthur Kill immediately north of the adjacent GAF site. To the west of the LCP site is the tidal stream known as Marshes Creek, which is a tributary of the Rahway River. Relatively extensive areas of unfilled tidal marsh exist along the lower reaches of the Rahway River, Marshes Creek, and Piles Creek.

Other tidal streams located further from the LCP site include Morses Creek and the Elizabeth River which flow into the Arthur Kill north of the site; and Kings Creek, which is another small tributary of the Rahway River, located west of the site. A number of tidal creeks enter the Arthur Kill from Staten Island including, from north to south, Old Place Creek, Pralls Creek, Sawmill Creek, Neck Creek and Fresh Kills. The locations of each of the surface water bodies are depicted on Figure 2-21.

2.4.2 Surface Water Classifications

The major surface water bodies located near the LCP site, including the Arthur Kill and the Rahway River, have been classified under the NJDEP Surface Water Quality Standards, N.J.A.C. 7:9B-1.15.

The Elizabeth reach Arthur Kill, along which the site is located, is classified as SE3. The designated uses of SE3 waters include: secondary contact recreation; maintenance and migration of fish populations; migration of diadromous fish; maintenance of wildlife; and any other reasonable uses [N.J.A.C 7:26B-1.12(f)].

The lower tidal reach of the Rahway River is classified as SE2. The intended uses of SE2 waters include maintenance, migration and propagation of the natural and established biota; migration of diadromous fish; maintenance of wildlife; secondary contact recreation; and any other reasonable uses [N.J.A.C 7:26B-1.12(e)].

2.4.3 Flood Hazard

Flood insurance studies for Union County, New Jersey (FEMA, 2006) reveal that various areas of the City of Linden are subject to both tidal (coastal) and fluvial (riverine) flooding. The tidal wave velocities are dampened by the meanders of the stream channels such that the tidal influence is less severe than the fluvial flooding along more inland local waterways. The City of Linden is subject to fluvial flooding along Morses Creek, Peach Orchard Brook, and Kings Creek which is caused by rivers and streams overflowing their banks. The Arthur Kill and its tributaries account for tidal flooding in the area. Water levels in these waterways are controlled by tidal conditions.

As stated previously, the site is nearly completely surrounded by tidal water bodies, including the Arthur Kill and its tributaries. The Arthur Kill (and its tributaries) are subject to tidal and coastal flooding influence and are not subject to riverine flood hazards. In addition, the facility is located outside of the influence of fluvial flooding by Morses Creek, Peach Orchard Brook, and Kings Creek. Therefore, the LCP site is not subject to riverine flooding.

Coastal flooding is caused by long and short wave surges that affect the shores of the open ocean, bays, and tidally influenced rivers, streams, and straights (such as the Arthur Kill). The movement of coastal waters is influenced by the astronomic tide and meteorological forces such as northeasters and hurricanes. Flooding is primarily the result of storm surges, wave setup, and wave run-up which occur during hurricanes and northeasters.

The 100-year tidal flood elevation has been established by FEMA (2006) at 8.4 feet NGVD, a level that would flood most of the LCP site.

2.4.4 Navigational Dredging

The Arthur Kill is a large, highly industrialized navigational tidal straight. It is tidally influenced by the New York Harbor and the Atlantic Ocean. Given the depositional character of the water body, it is necessary to periodically dredge the navigation channels to maintain this important waterway for commercial shipping. The dredging responsibility lies with the United States Army Corps of Engineers (USACE).

Dredging in the Arthur Kill has been performed since the 1870s when the navigational channel was first dredged to the depth of 16 feet (New York Times, 1873). In the recent decades, the navigation channel has been maintained at the depth of 35 feet and a width of 600 feet. A massive harbor improvement project is currently underway in which the navigational channels in the Arthur Kill will be deepened by dredging to a depth of 41 feet. The longer term plan will be to further deepen the Arthur Kill navigational channel to 50 feet (Port Authority of New York and New Jersey, 2008). The ongoing and planned future dredging necessarily results in the removal of huge amounts of sediment.

2.5 LCP Structures

2.5.1 Buildings

The chlorine production facilities that comprise the majority of the site were first constructed between 1954 and 1956. Cell Building No. 240 and other structures were not constructed until LCP ownership in the early 1970s. A brief description of the usage and history of the structures involved in the chlorine production, as well as the hypochlorite and hydrogen production facilities still found on the site follows below (Figure 1-3).

Building 223 – Kuehne Chemical Inc., Hypochlorite Facility – This facility was leased in 1972 and produced sodium hypochlorite (Bleach) from chlorine and sodium hydroxide transferred to the structure from the Chlorine facilities via overhead pipes. Chlorine, sodium hydroxide, hydrochloric acid and sodium hypochlorite were also stored and distributed from this facility.

Buildings 230 and 240 - Building 230 was the original mercury cell room that was built with the rest of the plant in the mid 1950s and contained 42 mercury cells. Building 240, the "new" cell room, was constructed sometime around 1972 and it contained 40 mercury cells. Process wastewater, brine spills, and mercury cell wash water in the buildings drained to concrete floor trenches, collected in sumps in the northeast corner of each cell building, pumped to holding tanks, and eventually pumped to a wastewater treatment system. Mercury was reportedly recovered from separators in the sumps and returned to the cells. A new concrete floor was poured over the old one in January 1981 due to the observation of cracks in the old floor.

Building 230 is among the most dilapidated structures at the site. Portions of the concrete block walls and individual concrete roof panels have periodically collapsed. However, this steel-framed building has not shown evidence of catastrophic failure and associated collapse. While the condition of Building 240 appears to be relatively un-degraded, the condition of the members that support a large gantry crane is not known.

Building 231, Liquefaction Building, Purasiv Area – Building 231 originally housed compressors and other equipment for chlorine liquefaction. An HCl burner and a commercial hydrogen gas purification unit ("Purasiv") used for the removal of mercury were located south of the building. A former electric substation, diesel generator, and wastewater area were located immediately north of the building.

Building 233 – Brine Building – Brine was treated and filtered in the brine treatment tank within Building 233. This included adding sodium hydroxide, sodium carbonate, and barium chloride to precipitate impurities out of solution. The remaining precipitates were transferred to the Brine Sludge Lagoon. Prior to the construction of the Brine Sludge Lagoon in the 1960's, it is unknown where the sludge was disposed of. The concrete block walls of this steel-frame building are substantially degraded.

Building 250 - Warehouse – The mortar between the concrete block in the walls appears to be substantially degraded. Portions of the warehouse may be in jeopardy of collapsing. However, the warehouse is a relatively small structure and no hazardous materials are known to presently exist within it.

Linde Hydrogen Plant - This structure was leased from the Owners of the site and operated from 1957 1990. Hydrogen produced from the chlorine process in Buildings 230 and 240 was piped to this facility where it was purified and stripped of mercury. Prior to the occupation by a new tenant, the lessee UCC had the building and equipment decontaminated and sampled for mercury. In 1990 the expiration of the lease prompted an ECRA investigation. An environmental investigation and cleanup followed, with NJDEP approving "No Further Action" (NFA) in 1995. The property was later used by Liquid Carbonic Corporation for office space and truck parking.

Salt Unloading - Salt to be used in the preparation of brine for the chlorine process was unloaded at this location.

Former Brine Sludge Lagoon (now referred to as the "Closed RCRA Unit") - Precipitate sludge from Building 233 was mixed with brine to form slurry, which was pumped into this surface impoundment. The liquid component of the slurry was allowed to settle out then was pumped back to Building 233 to be purified and recycled. The lagoon was closed under a RCRA permit in 1984.

Chemfix Lagoon - The Chemfix Lagoon was constructed in 1976 north of the Brine Sludge Lagoon to conduct a test to determine whether the mercury in the brine sludge could be stabilized, thereby allowing the material to be managed as non-hazardous waste. The lagoon had the rough shape of a triangle with sides of about 60 ft by 80 ft by 80 ft. and was constructed with 8 foot high earthen berms. It was lined with two layers of 0.20 mil thick impermeable geosynthetic liners separated by a sand layer for an underdrain leachate collection system. Leachate collected by the system was pumped to the wastewater treatment system at Building 231. A demonstration run was conducted by Chemfix Technologies Inc. in 1976. Approximately 120,000 gallons of brine sludge (about 460 cubic yards) were treated and stored in the Chemfix lagoon over a four-day period. The process was never repeated and the lagoon was not used again.

In October 1981, LCP Chemicals, Inc., submitted a closure plan for the Chemfix lagoon to the NJDEP and reported that the treated material had the consistency of concrete. The closure strategy consisted of dewatering the lagoon, treating the wastewater in their waste treatment facility, and transferring the solid Chemfix contents, including liners and leachate collection system, to the Brine Sludge Lagoon.

The closure plan was approved by the NJDEP and the Chemfix lagoon materials were transferred to the brine sludge lagoon by September 1983. The Chemfix lagoon was backfilled, graded, seeded, and formally closed by the end of 1983 with NJDEP approval.

Former Sludge Roaster - A pilot sludge roaster unit was constructed south of the brine sludge lagoon in 1978, but the brine sludge material was processed through it only infrequently. By 1980, the final modifications to the sludge roaster were completed and the unit was brought back on line after LCP Chemicals, Inc., was issued a temporary air permit from the NJDEP. In 1985, the unit was dismantled and moved off Site, leaving only the concrete pad.

A number of additional structures are located on the LCP site, including:

- Building 220 – Shops and Service Building
- Building 221 – Lab and Locker Building
- Building 234 – Cooling Tower
- Building 250 – Warehouse
- Building 309 – Cooling Tower
- FRP Fabricating Shop

2.5.2 Tanks

A number of tanks are located on the site that were previously used to store mercury, chlorine, hydrochloric acid, brine, bleach, petroleum and other compounds. The onsite tanks were investigated as part of the Phase I and Phase II RI. The name, location, contents and condition of the tanks are detailed in Table 2-8.

2.6 LCP Waste Handling

2.6.1 Wastewater and Site Drainage

Industrial process water and stormwater flow from the LCP site during operations drained to the Arthur Kill. This drainage occurred historically via the former GAF site drainage system through hydraulic connections to South Branch Creek. After approximately 1976, the wastewater drainage was treated separately from the GAF site. The drainage in and around the LCP site was modified several times, and is described as follows:

Prior to 1947

Prior to 1947, before operations began at the LCP site, South Branch Creek was oriented in what was a relatively natural tidal stream channel that was relatively unimpacted by filling (Figures 2-2 through 2-4). The flow originated from the area located west and south of the GAF site production area and flowed eastward across the center of what would later become the LCP site to discharge to the Arthur Kill (Figure 2-22).

Surface water drainage in the wetlands located to the southwest of the LCP Site flowed into the Northern Off-Site Ditch, and followed a parallel alignment to the future LCP property line towards the southeast and onward to a series of mosquito ditches leading to the Arthur Kill. The remnants of ditches from the western side of the LCP Site and adjacent GAF property directed drainage into the Northern Off-Site Ditch. The Southern Off-Site Ditch runs parallel to the Northern Off-Site Ditch and collected drainage from the future Conoco bulk petroleum storage property, and discharges to the same series of Mosquito Ditches.

1947 to 1951

Starting in 1947, South Branch Creek was diverted to an alignment that looped around the southern area of the future LCP production area prior to discharging to the Arthur Kill. The realignment was associated with the filling of the portion of the creek in what would become the production area of the LCP site. That same year the original creek was filled in. A primary treatment facility was constructed along the southerly loop of South Branch Creek on the LCP site as observed on the April 20, 1951 aerial photo (Figure 2-11).

The Northern Off-Site Ditch has been redirected to a culvert on the downstream end which appears to have directed flows in a northeast direction across the present day alignment of South Branch Creek. The alignment of the Southern Off-Site Ditch remains the same. The Southern Off-Site Ditch was placed in a culvert at its downstream end to re-direct flows in a direct eastward direction towards the Arthur Kill.

1951 to 1966

The construction of the future LCP site began in approximately 1951. The chlorine operation began at the LCP site in 1955. By 1956, the core of the buildings required for the chlorine productions were present, including Buildings 220 and 230. The hydrogen processing facility started operation in 1959. The Brine Sludge Lagoon was reportedly constructed in 1962. Four years later, berms were present along the north and west side of the lagoon area.

The South Branch Creek channel continued to flow to the Arthur Kill from the southeastern portion of the GAF site, as described above, around the southern end of the LCP site, until 1966 (Figure 2-23). During this time, wastewater in South Branch Creek and site drainage from the LCP and GAF sites were treated in the primary wastewater plant area located at the southern end of the South Branch Creek loop on the LCP site as observed on Figures 2-13, 2-14, 2-15 and Figure 2-22.

The process wastewater from the mercury cell buildings drained to concrete floor trenches where it was collected in the northwest corner of each building. The process wastewater was reported to have been pumped to holding tanks and eventually pumped to the on-site wastewater treatment plant.

1966 to 1971

South Branch Creek was relocated by 1966 into a covered channel (or "flume") located along the northern border of the LCP site (Figure 2-24). The primary WWTP located along the southern loop of South Branch Creek was apparently replaced at this time with a treatment area on the GAF site located several hundred feet upstream of the covered channel. The portion of South Branch Creek that previously looped around the southern side of the LCP site was replaced by a continuous concrete drainage trench.

1971 to 2003

In 1971, GAF ceased chlorine manufacturing operations. A year later, in 1972, LCP Chemicals, Inc. purchased the site from GAF and restarted manufacturing operations. Around the same time, the South Branch Creek channel located east of the railroad tracks was relocated into a newly created, narrow, man-made channel that discharged to the Arthur Kill approximately 950 feet south of the former South Branch Creek channel (Figure 2-25). This is the present alignment of the South Branch Creek channel.

A shallow concrete trench surrounding the process area was constructed in the 1970s (Eder, 1992) and was utilized to collect storm water and excess runoff from LCP Buildings 230 and 240. The flows in the trench were routed to a concrete sump south of Building 231 before being pumped to holding tanks outside Building 233. The water was pH adjusted, filtered, polished with carbon, and stored pending discharge to South Branch Creek under a NJPDES permit.

Wastewater treatment was previously reported to have occurred in a pond located along South Branch Creek immediately east of the electrical switchyard on the LCP site (Eder, January 1992) and as noted in an aerial photography analysis by USEPA (1999). Through the review of additional historic information, it is now known that this area was not used for treatment. This area is now known to have represented a wide segment of the ditch that was crossed by a bridge, hereinafter referred as the "Ditch Bridge Area" (Figure 2-14). The treatment area has been correctly located as previously discussed. The Ditch Bridge Area was reportedly excavated, backfilled, and covered with asphalt. The Ditch Bridge Area was still present in mid 1972 (LCP, July 21, 1972) and possibly only backfilled in 1982 (NJDEP, February 1982).

Around 1975-76, GAF constructed a new wastewater treatment facility on the GAF site. With the commencement of that wastewater treatment plant, wastewater flows from the LCP and GAF sites became separate.

The exposed portion of South Branch Creek, located immediately west of the railroad bridge, was blocked off with timber cribbing. This blockage of the creek likely occurred sometime after 1976 when the LCP site drainage was separated from that of the GAF site.

The chlor-alkali operations ceased in 1985. As discussed previously, the site continued to be used as a transfer terminal for other Hanlin products until 1994.

After 2003

Stormwater drainage from a large portion of the LCP site previously drained overland to a ditch that was located on the GAF site located immediately north of the LCP property line. Remedial construction activities at the GAF site including the construction of the shallow groundwater barrier and the site regrading have created a large undrained area in the northern and central areas of the LCP site.

Stormwater drainage from the LCP site is currently poorly defined. Large areas of the site are currently undrained including the aforementioned area along the GAF property line. In addition, much of the former LCP production area is currently undrained given the cessation of stormwater collection and treatment on the LCP site. Remaining areas of the site do drain to South Branch Creek and the unnamed ditch located immediately south of the LCP site. However, drainage from these areas is not well established given a lack of drainage structures and the nearly flat grades on the site. Accordingly, surface water that does drain to South Branch Creek and the unnamed ditch is characterized by undefined pathways and a distinct lack of high velocity flow. Ponding occurs in several areas of the site for long durations depending on rainfall intensity and duration.

2.6.2 Solid and Hazardous Waste Generation

It was reported that mercury-contaminated sludge, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, mercury contaminated process wastewater, spill wash down fluids and stormwater runoff were all waste products generated onsite (Eder, January, 1992).

The main source of mercury waste was the brine purification mud (otherwise known as, brine sludge) and associated process wastewater. In 1981, brine purification mud from mercury cell processes was listed as a hazardous waste by the EPA, No. K071. Associated wastewater treatment sludge was also listed as a hazardous waste, No. K106. The driving chemical behind the new classification was mercury.

A "typical" brine sludge composition as reported by LCP in 1975, was NaCl (20%), $BaSO_4$ (50%), $CaCO_3$ (15%), $CaSO_4$ (15%), metal hydroxides (2%), dirt (2%), mercury (100-500 parts per million – 0.05%). Wastewater treatment sludge was also generated during chlorine production. In a 1975 LCP Preliminary Report on Brine Sludge, LCP estimated that 7.5 tons of sludge was generated everyday and that their current sludge stockpile was an estimated 11,000 cubic yards (Eder, 1992). Eder (1992) reported that up to 20 tons of sludge was generated per day.

Between 1980 and 1981, seven sludge samples were analyzed for selected inorganics (NJDEP, January 8, 1988). The samples showed that the sludge contained mercury concentrations ranging from 272 mg/kg to 4,574 mg/kg. Liquids filtered from the sludge contained mercury concentrations ranging from 40 µg/L to 2,520 µg/L.

A survey plan in a groundwater quality monitoring report by Geraghty & Miller (1982) shows that the brine sludge pile grew to a height of about 40 feet above the ground surface. An estimated 31,000 cubic yards of brine sludge was left in the lagoon at the time of its closure. The contents of the lagoon were dewatered, graded compacted and capped with clay and soil in 1984. This closure was permitted by NJDEP a New Jersey Pollution Discharge Elimination System (NJPDES) Discharge to Groundwater (DGW) Permit. The DGW permit is the New Jersey equivalent of a RCRA permit under USEPA's authorization of New Jersey's Hazardous Waste program.

Other potential sources of contamination included:

- Anthropogenic fill placement by duPont, GAF and Conrail.
- Kuehne Chemical Company, which operated at the site from 1972 to 1981, allegedly dumped bleaches and other caustic materials into South Branch Creek on a daily basis.
- The Linde Division Hydrogen Plant, which received mercury-contaminated hydrogen gas from about 1957 to 1980, processed mercury on a daily basis.
- Eder (September 1993) reported that small quantities of solvents used at the site for general cleaning and degreasing could have been released.
- Transformers were located behind Buildings 230, 240, and 231. (PCB contamination in the oil.)
- Storage tanks at the site used to store a number of different chemicals, including chlorine, sodium hypochlorite, sodium hydroxide, and methylene chloride (NJDEP, January 8, 1988).

- A 300 square-foot concrete drum storage pad with containment berms was located onsite. It was used to store motor oil, waste oil and other lubricants (Eder, 1993). During a NJDEP site inspection in December 1987, it was noted that there was stained soil in the area and vapors were detected.
- Active Water Jet discharged wash water from dirty tanks and pipes onto the site.

2.6.3 Environmental Compliance

2.6.3.1 Summary of Incidents and Enforcement Actions

In September of 1975, LCP was fined $10,000 for discharges of supernatant from the brine sludge lagoon into South Branch Creek in both 1971 and 1974, according to the NJDEP (July, 1991). On September 17, 1981 the NJDEP signed the Administrative Consent Order, which required LCP Chemicals, Inc. to cease use of the brine sludge lagoon by January 1, 1982, submit a closure plan for the sludge lagoon, submit a closure plan for the Chemfix lagoon, conduct air monitoring of the sludge pile and conduct groundwater, surface water, soil and sediment sampling sessions.

By late 1984 both sludge lagoons were closed. Air monitoring of the sludge pile took place on June 4, 1981 (RECON, 1981). Limited groundwater, surface water, soil, and sediment sampling were taken by Geraghty and Miller (1982).

The NJDEP issued an Order dated May 4, 1982 to cease the November 5, 1981 violation of N.J.A.C. 27-8.3(e)2 resulting from a ruptured muffler plate on the sludge roaster, which subsequently allowed mercury emissions to vent through for unpermitted roasting sessions. The sludge roaster was abandoned due to "bugs" in 1981. In a June 4, 1982 letter the NJDEP denied LCP's Hazardous Waste Facility Permit Application due to several deficiencies in the sludge roasting system. LCP responded with a letter promising to fix the issues with the brine stabilization process.

The EPA issued a Complaint/Compliance Order dated August 1982 for lack of freeboard in a surface impoundment (otherwise known as the brine sludge lagoon). LCP was also cited for lack of waste analysis plan, not maintaining a scheduled inspection period, and a lack of a contingency plan. The freeboard penalty held a $1,000 fine; however, the other violations were corrected, thus a fine was avoided.

One year later in 1983 the NJDEP issued two "Notice of Violations". One was for failure to submit a RCRA Treatment, Storage, or Disposal Facility Report. A report was submitted shortly after and so a penalty was avoided. The second was for failure to establish financial assurance for closure and post-closure monitoring of the brine sludge lagoon and to demonstrate financial responsibility for claims. LCP stated that the NJDEP Division of Waste Management now had copies of the necessary documents and that the matter was resolved.

The NJDEP issued an Administrative Order, dated February 11, 1985, requiring that LCP maintain documentation of the job title for each position at the facility related to hazardous management, the name of the employee that filled each job, security of roll-off containers with hazardous waste and to develop an evacuation procedure for employees. LCP corrected the problems and was issued a $900 fine.

2.6.3.2 Summary of Spills and Releases

The following spills/releases are documented by the EPA and NJDEP.

- In October 1972 and February 7, 1974, the NJDEP reportedly observed lagoon overflows into South Branch Creek, quantities and responses unknown. As for LCP, they acknowledged both discharges in September 1975 and were levied a fine by NJDEP of $5,000 for each occurrence (NJDEP, July 1991).

- June 25, 1975 – During a recycle pump failure, nine hours worth of discharge from the brine sludge lagoon spilled into South Branch Creek (LCP, July 27, 1975).
- August 15, 1979 – A salt blockage in a saturator caused an overflow of mercury contaminated brine (LCP, August 20, 1979). A sample of the overflow was taken by LCP and showed a concentration of 8.6 parts per million of TDS.
- In early 1981, a former employee who worked there from '72 to '80 stated he would sometimes analyze effluent water being discharged into South Branch Creek (NJDEP, October 7, 1981). It was noted that one specific time this former employee measured mercury concentrations of eight to ten times greater than the maximum allowances.
- October 7, 1981 – The NJDEP cited the Kuehne Chemical Company for discharging caustic material into the creek (NJDEP, October 7, 1981). Kuehne refused to accept charges and subpoenaed the NJDEP twenty days later for depositions. The outcome is unknown.
- The following spill documentation was noted in a RCRA Facility Assessment for LCP, NJDEP Site Inspection Reports regarding several spills near the 500,000 gallon brine tank (NJDEP January 8, 1988):
  - The first of the documented spills was in September 1980 when an unspecified amount of brine sludge was noted on the gravel near the tank. The second was also in 1980, one month later. While transferring brine sludge from the 500,000 gallon tank to the lagoon some was spilled. (Front end loader and dump trucks were used for this process). LCP stated that the sludge would be flushed to the sump next to the tank.
  - In January 1981, an overhead pipe appeared to have a leak, which dumped wash water from cells onto unpaved ground. Another pipe was observed to have had a leak in 1981. However, this pipe was filled with hydrochloric acid. The final spill located by the 500,000 gallon tank was noted in April 1982. It involved a spill of sodium sulfide crystals.
- Though that was the final spill documented by the tank, it was not the last documented spill on site. Other NJDEP Site Inspection reports cite brine sludge spills/ leaks (NJDEP, January 8, 1988). Three examples were found and are listed below, all in 1981.
  - In January 1981, a former employee who worked on site from 1972 to 1980 stated that brine sludge was removed from the lagoon and spread out on the ground between Building 231 and the railroad tracks (NJDEP January 25, 1981). It was noted that to the former employee's knowledge this only happened one time in either 1973 or 1974.
  - In October 1981, a 1 ft by 15 ft spill of brine sludge slurry leaked from overhead piping between the 500,000 gallon tank and the sludge lagoon. The exact location is not well documented, but noted on the NJDEP sketch maps (NJDEP November 19, 1981).
  - In November of 1981, an overhead line was leaking, resulting in a 30 ft by 125 ft spill along Avenue B railroad tracks.

The information on spills/releases at the LCP site was one factor used to develop the original RI work plan for the site (URS, 2001).

2.6.3.3 LCP Environmental Upgrades

LCP met with the NJDEP by 1975 to investigate waste disposal options for brine sludge, wastewater and the estimated 11,000 cubic yards of sludge material stockpiled in the brine sludge lagoon. LCP Chemicals, Inc. informed the NJDEP that off-site disposal options were too expensive and elected to begin pilot testing a more cost effective stabilization process developed by Chemfix Technologies, Inc.

As required for stabilization, an auxiliary surface impoundment was constructed onsite, the Chemfix lagoon. Its process treated about 120,000 gallons (or 460 cubic yards) of brine sludge over its 4 days existence in 1976. The results were apparently questionable, so the Chemfix process was never continued.

LCP Chemicals, Inc. also tested a sludge roasting process. This stabilization method would volatilize and capture mercury from steam dried brine sludge. LCP received favorable results during bench testing. A pilot sludge roaster unit was constructed south of the brine sludge lagoon in 1978. Throughout the lifespan of the sludge roaster, it was only used infrequently as it required constant "debugging, modification, and repair". Finally in 1980, the sludge roaster was up and running. LCP was issued a temporary air permit from the NJDEP, although a final permit was never issued. In December 1980, LCP Chemicals, Inc. and the NJDEP agreed that the brine sludge lagoon required closure and would formalize the process through an Administrative Consent Order.

In 1982, LCP ceased plant operations during the lagoon closure as a protective measure for plant workers' health and safety, reportedly at the orders of the NJDEP and EPA. A year later the Chemfix lagoon was closed (all materials were transferred to the brine sludge lagoon). The brine sludge lagoon was closed by November 1984 with NJDEP approval. In accordance with law, the lagoon was reportedly dewatered, compacted, covered with a two foot thick clay cap, and then covered again with soil and seeded as part of a RCRA permit for the Closed Brine Sludge Lagoon). This area is now called the closed RCRA Unit. In June 1984, LCP submitted a facility closure plan to the NJDEP. The EPA (1984) stated that LCP Chemicals, Inc. had planned to begin chlor-alkali manufacturing facility operations again in late 1984, but decided to cease all plant production instead. By August 1985, all plant productions were stopped. The facility was dismantled; the equipment was shipped to other LCP facilities along the east coast. The facility was still being used as a storage and transfer station for chlorine-related products, including, sodium hydroxide, potassium hydroxide, methylene chloride, and hydrochloric acid.

The Hanlin Group, Inc. filed for bankruptcy under the Chapter 11 of the U.S. bankruptcy code in July 1991. By April 1994, Hanlin sold all of its company assets and ceased all operations. After a site visit in August 1994, the EPA confirmed that the facility was no longer functional and that all employees were expected off the site by the end of August 1994. On November 10, 1998 the site property was formally abandoned by the bankruptcy trustee by order of the Federal Bankruptcy Court.

2.6.3.4 Environmental Permits

In 1975, a NJPDES - Discharge to Surface Water (DSW) permit was granted to LCP for discharge of treated wastewater.

In August 1974, Kuehne Chemical Company submitted a New Jersey Pollutant Discharge Elimination System (NJPDES) permit application (No. 0027707). It was not until August 1980 that Kuehne received a permit for discharge of cooling water only. One year later, the NJDEP alleged that Kuehne was illegally dumping caustic chemicals. A Notice of Civil Administrative Penalty Assessment was issued to Kuehne. The notice states that a pipe was observed during an NJDEP site visit on January 26, 1981 "connected to the outfall in such a manner as to allow for a physical conduit for the passage of pollutants to the waters of the State." The connection was removed the next day on a follow-up visit by the NJDEP. The notice also stated that the Kuehne operations had ceased and vacated the site on the next day.

A NJPDES-DGW permit (No. NJ0077038) renewal was issued to LCP Chemicals – New Jersey on June 11, 1993 with respect to the RCRA closure of the former brine sludge lagoon. This permit is the equivalent of a RCRA Post Closure permit under the USEPA authorization of New Jersey's Hazardous Waste program.

2.6.3.5 Interim Remedial Actions

Interim Remedial Measure of Former Mercury Cell Buildings

An Interim Removal Action (IRA) was performed by ISP-ESI in the former mercury cell buildings and elsewhere in the production areas on site in 2001 and 2002. The IRA included the removal and disposal of former process equipment, laboratory samples and chemicals, visible elemental mercury that was present at that time, loose asbestos, and miscellaneous debris. Further detail of the IRA is provided in the Interim Removal Action Final Report, prepared by URS dated April 16, 2001.

Proposed Interim Action for South Branch Creek

The conceptual design for an Interim Action (IA) was proposed by ISP-ESI on June 15, 2007, in response to the presence of elevated mercury and other contaminants in sediment and low marsh soils associated with South Branch Creek. The IA was intended to arrest the potential migration of the contaminated low marsh soils and sediments from the site. Implementation of the proposed IA was rejected in a letter from Ms. Carole Petersen of USEPA dated August 8, 2007.

2.7 Regional Geologic Conditions

The area of the site is located on the eastern edge of the Newark Basin, which is located in the Triassic lowlands subprovince of the Piedmont Plateau physiographic province of New Jersey. The Newark Basin contains approximately 15,000 to 20,000 feet of late Triassic and Early Jurassic (135 to 225 million years ago) continental derived sediments, including shales, siltstones, sandstones, and conglomerates. Interbedded among these sediments are three major extrusive basalt flows and one major diabase intrusive, representing volcanic episodes during the early Jurassic period (Olsen, 1980). A thin mantle of Pleistocene glacial and Recent deposits covers much of the Newark Basin rocks today. These units are described in additional detail in the following subsections.

2.7.1 Surficial Geology

Anthropogenic Fill

Anthropogenic filling of the region began in the 1600s as soon as European settlement occurred. Larger scale filling occurred in the late nineteenth and early twentieth century and was largely associated with industrial and transportation infrastructure development. Filling continued in the area to support the Newark Airport and the Port Newark and Port Elizabeth marine terminals until around 1970. A large percentage of the former tidal marshes in the area have now been filled. The emplaced fill materials include sand, gravel, silt, clay, and rock, as well as various man-made materials like cinders, ash, brick, concrete, wood, slag, glass, and trash (Stanford, 2002). The fill is most often less than 10 feet thick but may be thicker in road and rail beds.

Tidal Marsh Deposits

Recent sedimentation in the region includes alluvium (river), tidal marsh, and eolian (windblown) deposits. The alluvium includes floodplain, channel, and backswamp deposits, which include sands, silts and minor gravels and clays with sorting that varies from well to poor, depending on the specific depositional environment.

Tidal marsh material, underlying the anthropogenic fill, is present beneath much of lowland areas that comprise the eastern portion of Linden bordering the Arthur Kill and other coastal and tidal water bodies in New Jersey. Tidal marshes are flat, low lying coastal areas that become regularly inundated during high tide periods. Sediments that have formed in the marsh areas in the vicinity of the site include organic rich silts and clays, as well as peat. The peat typically consists of a horizontal layer of roots of salt tolerant plants in various stages of biological decomposition. The peat occurs in varying states of

weathering and consolidation. Peat typically weathers to organic silt and clay. Thus, it is not unusual to encounter the organic silt and clay beneath peat at the base of the tidal marsh deposits. Fine to coarse grained, well sorted sand sediment that formed as the result of eolian (e.g., wind-blown) deposition may be interbedded with the organic clay and peat (Stanford, 2002).

Glacial Till

The Linden area is situated near the glacial terminus and was covered with a relatively thin layer of glacial ice during the last (Wisconsin) ice advance. During this time, much of New Jersey to the west and northwest was covered with a thicker ice layer, estimated to have been at least one mile thick. As a result of a lighter overburden of ice, glacial deposits near the glacial terminus are considerably less dense and less compacted than those to the west and northwest. As the glacier melted, numerous glacial sediments (tills and moraines) were deposited over much of New Jersey. Ground moraine deposits are typically poorly sorted and not stratified. Much of the area north of the terminal moraine, including Linden, New Jersey, is covered by a sheet of ground moraine more commonly called till.

The Rahway Till found in and around the LCP site varies from silty sand to sandy clayey silt. The till contains some to many pebbles, cobbles and a few boulders. The till can be as thick as 90 feet but is usually less than 20 feet in thickness (Stanford, 2002).

2.7.2 Bedrock Geology

The unconsolidated deposits are underlain by Triassic-Jurassic aged sedimentary rock. The rocks formed following the close of the Paleozoic Era (225 million years ago), when compressive forces that formed the Appalachian Mountains relaxed, and extensional forces associated with the rifting and spreading of the Atlantic Ocean began. A series of isolated troughs called grabens formed east of the Appalachian Chain extending from Nova Scotia to North Carolina. As spreading of the ocean progressed, large blocks of crust down-faulted along extensional fault zones. Synchronous with the down faulting, large quantities of continental sediments produced from the erosion of the Appalachian Mountains were deposited in these troughs. The continued accumulation of sediments overloaded the troughs and contributed to their subsidence. This sinking effect allowed for the thick accumulation of Triassic sediments that exist in the Newark Basin. During the early Jurassic Period (180 million years ago), as rifting continued, faults in the area became progressively deeper and intersected the earth's mantle. Consequently, volcanism occurred in the form of extrusive basalt flows over parts of the basin, forming the Watchung Mountains of New Jersey. Three separate episodes of basalt flows occurred, interrupted by periods of continental sedimentation (Faust, 1975).

Nine formations comprising the Newark Supergroup resulted from the lithification of these basin sediments and volcanic flows (Olsen, 1980). The formations from oldest to youngest are as follows: the Stockton, the Lockatong, the Passaic, the Orange Mountain Basalt, the Feltsville, the Preakness Basalt, the Towaco, the Hook Mountain Basalt, and the Boonton. Contemporaneous with the basalt flow events, intrusive sills and feeder dikes formed the Palisades Diabase. The diabase unit is not classified as part of the Supergroup, despite its stratigraphic presence within the Newark Basin formations.

Three of the nine Newark Super group formations are present below the site, including the Stockton, the Lockatong, and the Passaic. The Stockton and the Lockatong formations were not encountered during the investigation, as they are present only at great depth; therefore, they will not be discussed further in this report. The Passaic formation was observed during the investigation and is discussed below in greater detail.

- **Passaic Formation (JTp):** According to Olsen (1980), the Passaic formation, representing flood bank and fluvial deposits, reaches a thickness of approximately 20,000 feet. This unit consists of reddish brown mudstone (a non fissile equivalent of shale), siltstone, and sandstone interbedded with conglomeratic sandstones along the basin margins.

- **Lockatong Formation (Tl):** The Lockatong Formation, which conformably underlies the Passaic Formation, is approximately 3,800 feet thick in west central New Jersey and thins laterally to the northeast and southwest. This formation was deposited as a large lacustrine lens composed of gray and black shales with argillite, flagstone and impure limestone layers (Wolff, 1977). Regionally, the lower members of the Lockatong Formation are intruded by the Palisades diabase as a sill.
- **Stockton Formation (Tl):** The Stockton formation consists primarily of lacustrine sediments similar to the overlying Lockatong formation. The lower Stockton represents mostly fluvial deposits. The Stockton Formation consists of sandstone, siltstone, arkose conglomerate and mudstone with color ranging from a light brown to dark brown-purple-red. The formation has a maximum thickness of 6,000 feet.

One of the nine Supergroup formations, the Passaic Formation (JTp), is present below the Site. In this area, the Passaic Formation is comprised of two facies: the sand and siltstone facies to the northwest and mudstone facies to the southeast of the area. The Linden area is underlain by the mudstone facies. Typically these sediments form cyclic sequences of cross-bedded units that grade upward from coarser to finer grain size. The dominant facies in the formation are siltstone (60%) and mudstone (40%) with the coarser sandstones and conglomerates comprising only a small fraction of the total percentage. Generally, the overall sequence of the Lower Passaic formation becomes finer from bottom to top with more mudstone and less siltstone going upward (Olsen, 1996). The Upper Passaic formation displays the reverse trend, with increasingly frequent silt and fine sand beds and less frequent gray and black mudstones progressively towards the top of the unit.

The upper shale (mudstone) of the Passaic formation is relatively soft and easily weathered. At surface exposures this rock is intensely and indiscriminately fractured on a small scale (1 to 5 mm) and obtains a hackly to chippy appearance. Unlike the siltstone layers of the Passaic formation, this rock lacks well-developed bedding planes and the regional joint pattern set (Houghton, 1986).

With increasing depth, the shale grades vertically into hard, massively bedded siltstones. The regional joint system is very prominent in these rocks and the bedding planes are very distinctive. The dominant strike of the Passaic Formation is reported to be N50°E with the beds dipping gently to the northwest between 9° and 12°. The shale also has a prominent set of vertical fractures (joints) striking N45°E and a less prominent second set of near vertical fractures striking N75°W. Regionally, this rock outcrops several miles west of the site where it exhibits more resistance to weathering and retains its characteristic features.

2.8 Regional Hydrogeologic Conditions

The Passaic and Lockatong Formations form the widespread Brunswick aquifer which conducts water in the region eastward to discharge to the Arthur Kill. Groundwater is found predominantly in the fracture planes within this rock and flow is directionally controlled by the fracture orientation. Permeability and storage are also controlled by fractures in the mudstone and siltstone facies though not necessarily to the same degree in the sandstone facies (Michalski, 1996). Hydraulic conductivities in the Brunswick Aquifer have been found to range from 6.9×10^{-7} cm/sec to 7.6×10^{-3} cm/sec (New Jersey Geological Survey, 2004; Michalski, *et al.*, 1992).

2.8.1 Groundwater Use

Due to the proximity of the Arthur Kill and other tidal waters to Linden, groundwater within this region, including the Passaic bedrock aquifer(s), is typically saline (Anderson, 1968). Since this water exceeds the New Jersey Safe Drinking Standards for naturally occurring salinity, the area is unsuitable for public water supply wells.

Regionally, brackish groundwater concentrations tend to diminish gradually with increasing distance from the source waters. Further inland from the Arthur Kill and within five miles of the site, the Passaic formation is extensively developed as the primary water supply source. The depths of these wells range from 75 to 570 feet and yield volumes of water between 100 and 400 gallons per minute (see Table 2-9). Locally occurring unconsolidated aquifers have also been tapped for water supply within this region. Relatively fewer in number, these aquifer(s) serve as the primary public water source for the Rahway area. Also, some shallow supply wells screened in the Quaternary sand and gravel, and yielding up to 300 gallons of water per minute, are used as a source of industrial waters.

Six (6) public community water supply wells (Figure 2-26), all upgradient of the site, are located within a four to five (4 to 5) mile radius of the site. As shown in Table 2-9, the depths of these wells typically range from 200 to 500 feet bgs. The pumping rates for these wells are not known but the capacity for wells range from 200 to 450 gallons per minute (gpm). Each of these wells is owned and operated by the New Jersey American Water and are located approximately four miles to the northwest and upgradient of the Arthur Kill. New Jersey American Water is the primary supplier of potable water to the Linden, New Jersey area. At the site, all potable water is provided by the New Jersey American Water.

2.8.2 Groundwater Classification

The "default" groundwater quality classification in New Jersey is Class II-A unless otherwise classified as Classes I, II-B or III. Per N.J.A.C. 7:9C-1.5(e)1, "The primary designated use for Class II-A ground water shall be potable water and conversion (through conventional water supply treatment, mixing or other similar technique) to potable water." Therefore, most groundwater in New Jersey is regulated for potential potable supply."

Notwithstanding the Class II-A classification, there are specific areas in the region and at the site in which groundwater is not suitable for potable uses. Some of these have been formally reclassified to Class III-B pursuant to N.J.A.C. 7:9C-1.5(f)4 in recognition of the naturally-occurring saline condition of the groundwater. Other areas that would not meet the Class III-B reclassification requirements nevertheless are unlikely to be developed for potable water supply given other regulatory constraints. These conditions are described as follows:

Overburden Water-Bearing Zone

While naturally-occurring saline conditions are observed in areas of the overburden water-bearing zone in very close proximity to tidal surface water bodies, the areal distribution of this condition is insufficient for the reclassification of the entire zone at the LCP site. However, at least two (2) separate New Jersey regulations would prevent the overburden water-bearing zone from ever being used at the site as a potable or non-potable water supply through the installation of Category 1 or 2 wells[3].

N.J.A.C. 7:9D (Well Construction and Maintenance; Sealing of Abandoned Wells) states that for potable water supplies installed in unconsolidated formations:

> "All well casing shall be no less than four inches in diameter and no less than 50 feet in depth" (N.J.A.C. 7:9D-2.3(a)3i.); and "All wells shall have a minimum length of 50 feet of grout seal extending from the top of the gravel pack or top of the well screen to grade." (N.J.A.C. 7:9D-2.3(a)3iii.)

[3] Per N.J.A.C. 7:9D-2.1, Category 1 Potable Water Supply Wells are defined as "domestic, non-public, public community supply, and public non-community wells" and Category 2 Non-Potable Water Supply Wells are defined as "fire protection, irrigation, test, industrial, livestock, open loop geothermal and injection or recharge wells."

By application of this regulatory restriction, a water supply well can never be installed within the overburden water-bearing zone at the site since it is required to be entirely sealed off by impermeable casing material. Geologic information presented in Section 5.1 reveals that the depth to the bedrock beneath the site typically ranges between 35 and 50 feet below ground surface. This depth is short of the minimum 50 foot casing and grout requirement specified in N.J.A.C. 7:9D such that it would be physically impossible to install a well in the overburden without violating the 50-foot casing requirement.

In addition to this well construction restriction, N.J.A.C. 7.7E (Coastal Zone Management) restricts groundwater use in areas where coastal resources could be negatively impacted by pumping. With regard to groundwater use, this particular regulation states:

> "Coastal development shall demonstrate, to the maximum extent practicable, that the anticipated groundwater withdrawal demand of the development, alone and in conjunction with other groundwater diversions proposed or existing in the region, will not cause salinity intrusions into the groundwaters of the zone, will not degrade groundwater quality, will not significantly lower the water table or piezometric surface, or significantly decrease the base flow of adjacent water sources." (N.J.A.C. 7.7E-8.6(b))

It is likely that groundwater withdrawals from the overburden water-bearing zone would cause substantial reduction of the water table surface that would potentially cause saltwater intrusion. Thus, approval for the use of overburden groundwater as a drinking water source would not be possible under N.J.A.C. 7.7E.

Nevertheless, despite the actual use or potential use of the resource, the regulatory standards for Class II-A are the applicable standards for the overburden water bearing zone

Bedrock Water-Bearing Zone

The bedrock water-bearing zone at the LCP Site has formally been reclassified as Class III-B as described in the document titled "Request for Class III-B Aquifer Designation, LCP Chemicals Inc. Superfund Site and ISP-ESI Linden Site, Linden, New Jersey" (Brown and Caldwell, April 2008) and as approved by a letter from Messrs. Frank Faranca and Ian R. Curtis of NJDEP dated February 27, 2009.

The groundwater quality within the bedrock water-bearing zone was characterized through the sampling of monitoring wells installed and located on both the LCP site and the adjacent GAF site. The water quality data include the results from chloride and total dissolved solids (TDS) analyses in addition to numerous other analytical parameters. Chloride and TDS are the two parameters specified in N.J.A.C. 7:9C as the parameters used to establish Class III-B classification. N.J.A.C. 7:9C states that:

> "Class III-B ground water consists of all geologic formations or units which contain ground water having natural concentrations or regional concentrations (through the action of salt-water intrusion) exceeding 3,000 mg/l Chloride or 5,000 mg/l Total Dissolved Solids, or where the natural quality of ground water is otherwise not suitable for conversion to potable uses."

The chloride and TDS results for the LCP and GAF sites exceeded the Class III-B criterion of 3,000 mg/L for chloride and the 5,000 mg/L criterion for TDS for all tested bedrock wells on the LCP site. These data demonstrated that the groundwater quality conditions in the bedrock water-bearing zone are impacted as a result of naturally-occurring, salt water intrusion from the nearby tidally influenced surface water bodies.

2.9 Ecologic Conditions

No endangered, threatened, or rare (ETR) species or significant ecological communities have been found within the LCP site's boundaries, nor are there any records at NJDEP of rare wildlife or plant species or ecological communities within the site (NJDEP has reported that foraging habitat for several threatened bird species lies within ¼ mile of the site [black- and yellow-crowned night herons and colonial water birds], but none of these species have actually been observed). Similarly, NYSDEC indicated that two endangered bird species are located within ¼ of the site (yellow-crowned night heron and pied-billed grebe). South Branch Creek represents low-grade habitat for these species and nesting on site is therefore not expected. There is also no suitable habitat in the site area for the two species listed for Union County on the Federal Comprehensive List of Endangered and Threatened species provided on the USFWS's website (one turtle, one bat).

Overall, the flora and fauna found on the site are species typically found in heavily industrialized areas within intertidal marsh ecosystems. Vegetative species found within the site are very common to highly disturbed areas and possess no Federal or New Jersey State protection. Six terrestrial mammals and two terrestrial reptile/amphibian species have been reported. No aquatic mammals have been reported.

South Branch Creek and the Arthur Kill are National Wetlands Inventory (NWI)-mapped wetlands. There are no State designated wetlands on site. A wetlands delineation was performed along South Branch Creek for which a Letter of Interpretation was obtained by NJDEP (Figure 5-18). The border of the nearest NJDEP-mapped wetland is located to the south of the site, approximately 500 feet from the outlet of South Branch Creek to the Arthur Kill.

Pralls Island, located in the Arthur Kill directly opposite to the LCP site off the shoreline of Staten Island, contains areas of New York State Department of Environmental Conservation-mapped Tidal Wetlands. Classified tidal wetlands include areas identified as Intertidal Marsh, High Marsh, and Formerly Connected. The locations of these wetlands are presented in Figure 2-27. Please refer to the Habitat Assessment report (Appendix F) for additional details.

2.10 Regional Studies

As stated previously, most of the region was highly industrial and consists of land that has been created through the filling of tidal wetlands. The Arthur Kill is a large navigable, tidal straight that is tidally influenced from the New York Harbor and the Atlantic Ocean. Likewise, the Rahway River to the south is a tidally influenced tributary of the Arthur Kill traveling through an industrial area. Background contaminant conditions and contributions to the sediments from many sources are widespread. There are numerous NJDEP-contaminated sites in the region, in addition to the LCP site, many of which have the highest remedial level designations of "C3" and "D," indicating high levels of multiple contaminants that may be impacting surface and groundwater. Additionally, there are a number of sites within the Newark Bay complex with extremely high mercury levels that may influence levels in Arthur Kill (NJDEP 2001). In addition, the New Jersey Turnpike, completed in 1954, crosses Piles Creek west of the GAF site. The Turnpike is a regional source of contaminants typical of road runoff, such as heavy metals (particularly lead), BOD/COD, nutrients, oil and grease, PAHs, pesticides, herbicides, and PCBs, as well as of contaminants released through spills and accidents on the roadways.

Numerous studies have addressed specific contaminants and their fate and transport in the New York/ New Jersey Harbor system. Many of these are catalogued and distributed by several regional organizations. Key data from these organization's databases are presented on Figures 2-28 through 2-30. Additional information regarding the regional studies is described below.

2.10.1 Contamination Assessment & Reduction Project (CARP)

Contamination Assessment & Reduction Project (CARP) is a coalition of harbor partners from federal, state and non-governmental branches, headed up by the New York State Department of Environmental Conservation (NYSDEC). The purpose of the project is to find solutions for the harbor's dredged materials. Its main objectives are identifying and quantifying the sources of contamination, establishing baseline levels of contaminants of concern in the water, sediment and fish tissue, and predicting future conditions (CARP, 2008).

CARP uses mathematical modeling to characterize the dioxins/ furans, PAHs, pesticides, and metals present in the harbor system. Their models include point and non-point source loading inputs, estuarine hydrodynamics and sediment transport, contaminant fate and transport, bioaccumulation and toxicity (CARP, 2008). The results used for these models are stored in a database. The database not only stores CARP data but also a range of other data sources, including the EPA's REMAP project.

The EPA's Regional Environmental Monitoring and Assessment Program, otherwise known as REMAP, is a regional study, which obtains information on the New York/ New Jersey Harbor. It was created to "answer ecological questions on a regional scale" (EPA, 2007). The project obtains sediment, water and benthic samples. These results can be found in the CARP database along with several other projects.

In Figures 2-28 and 2-29 CARP's results for mercury and dioxin in the estuary sediment have been plotted. Each figure shows a large number of samples collected in the Lower Passaic region due to its industrial nature, which is a useful comparison for the LCP region.

2.10.2 National Oceanic and Atmospheric Administration (NOAA)

National Status and Trends Program run by the National Oceanic and Atmospheric Administration (NOAA) also monitors the Hudson-Raritan Estuary. The concentrations of contaminants and the biological responses to said contaminants in this area have been compared to other sites around the United States. This study specifically targets point and non-point sources and characterizes the contaminants of concern for each.

The NOAA study was used to determine the current status of the NY/NJ Harbor estuary system. Their samples were taken north of the LCP site, mostly in the Newark Bay and in the lower Passaic River, Figure 2-28 through 2-30. These results were then compared with the CARP data and the LCP data.

2.10.3 Old Place Creek

Old Place Creek was selected to serve as a reference stream. Old Place Creek is a tidal creek consisting of salt marshes and an adjacent successional southern hardwood forest, and is located in Staten Island, New York, on the eastern side of the Arthur Kill (Figure 2-21). The area is located immediately north of the Goethals's Bridge and is surrounded by heavy industrial development. This creek is similar in many respects to SBC, including the width and depth, and provides a tool for evaluation of SBC and other regional data.

Samples of sediment, surface water, and biota were collected in Old Place Creek by BC on behalf of ISP-ESI contemporaneously with the Phase II RI in fall 2008. The purpose of this effort was to characterize regional background conditions. Samples were analyzed for TCL/TAL analytes as well as total and methyl mercury, and Dioxins/Furans. The results of the study of Old Place Creek are presented in Appendix M.

Section 6

Nature and Extent of Contamination

A comprehensive characterization of the nature and extent of contamination in site media was performed through the RI field investigation. The field investigation was performed in two phases from 2001 to 2008 with an additional investigation of the Off-Site Ditches conducted in August 2011.

The RI field investigation included the collection of samples from soil, soil vapor, groundwater, surface water sediment, and biota as described in Section 3.4. The collected samples were submitted for laboratory analysis as described in Section 3.7. This included analyses for the Target Compound List (TCL) organic constituents plus Tentatively Identified Compounds (TICs), Target Analyte List (TAL) inorganic constituents, and hexavalent chromium. Select samples and media were analyzed for additional parameters including PCDDs/PCDFs, methyl mercury, and mercury species, and total organic carbon. Certain media such as biota were subjected to special limited analyses, e.g., co-planar PCBs and speciated arsenic. The specific laboratory analyses are described in detail in Section 3.7.

The distribution and character of the chemical contamination is presented for each site medium in the subsections that follow. When describing specific concentration values, the text uses "ND" to indicate that the constituent was not detected. The descriptions are supported by various data tables and figures. The figures include numerous constituent distribution maps that were developed using the geographical information system (GIS) as described in Section 4.4. The concentration legends for each medium are referenced to various promulgated standards or other relevant criteria, as applicable. The data reported on the tables and maps are reported to three (3) significant figures.

For ease of reference, the discussions below have been addressed by medium and contaminant class. Section 6.9 provides a site-wide summary of the nature and extent of contamination. Further integration of the data into the Conceptual Site Model is provided in Section 7.4.

6.1 Soil

Soil samples were collected during Phases I and II through the full thickness of the overburden soils that underlie the site, including a large number of surficial (0-2 ft) soil samples. The soil samples were obtained as surficial grab samples, shallow direct-push borings, deep borings by hollow-stem auger and fluid rotary drilling and horizontal borings.

The New Jersey Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS) are used as benchmarks for the characterization and relative distribution of chemical constituents within surficial and subsurface soils. The NRDCSRS are promulgated remediation standards [N.J.A.C. 7:26D] that are based on theoretical exposures via accidental human ingestion, dermal contact, and/or inhalation of soils. The NRDCSRS represent concentrations below which NJDEP would not have concern about incidental human contact. The unsaturated zone soil data are also compared to default Impact to Ground Water Soil Screening Levels. These are not standards, but default guidance values intended to be used "where no site specific information is available." Since there are ample available groundwater quality data for the Site, these screening levels are simply presented for reference.

Soil quality maps include data from both Phase I and Phase II and are separated into the four (4) depth ranges that reflect the three (3) distinct lithologies found on the site: surficial soil (0 - 2 feet), deep anthropogenic fill (> 2 feet), tidal marsh deposits, and glacial till. In situations in which there are

multiple samples within a single lithology (e.g., deep fill) the sample with the highest constituent is displayed. The "low marsh" soils may, in part, represent the geologic surface exposure or "outcrop" of the tidal marsh deposits along South Branch Creek and are included on the constituent maps of the tidal marsh deposits. However, the low marsh soils are also separately described in Section 6.2.

The constituents, for which soil quality maps were prepared, were selected on the basis of the relative frequency of exceedances of their respective NRDCSRS and relevance as contaminants of concern as related to the site. Descriptive statistics for soil are presented in Tables 6-1a through 6-1d and the exceedances of the NRDCSRS are presented in Tables 6-2a through 6-2d, broken into the distinct layers as described above.

6.1.1 Mercury

Total Mercury

In the surficial fill soils, the total mercury concentrations ranged from non-detect to 7,870 mg/kg, with approximately 57 percent of these detections exceeding the NJ NRDCSRS of 65 mg/kg. The exceedances of the NJ NRDCSRS are presented in Table 6-2a and Figure 6-1a.

Aside from recent surficial sampling performed in May 2008, laboratory samples were not submitted for mercury analysis when samples contained visible elemental mercury. The elemental mercury was generally observed as a very fine spherical particles. Larger masses of elemental mercury have infrequently been observed on the ground surface in the vicinity of the production area in and horizontal borehole samples collected beneath the mercury cell buildings.

Elemental mercury was visually observed in 31 sample locations within the site, as presented in Table 6-3 and shown on Figures 6-1a through 6-1d. Six (6) of these sampling locations contained elemental mercury in the surficial fill only, including DC-SS19, 5K-B4, 5K-B5, 231-B5, SS-08-09, and SS-08-10. At four (4) of these sampling locations, including 5K-B3, 231-B4, 231-B6, and 231-B8, elemental mercury was present in both the surficial and deep fill, as depicted on Figures 6-1a and 6-1b. Surficial samples collected in May 2008 revealed that the highest relative concentration of elemental mercury compared to total mercury, 15%, can be found between Building 231 and immediately west of Building 240 in sample SS-08-07, as presented in Table 6-4. The visual occurrence of elemental mercury and the laboratory results for total mercury in borehole samples demonstrate decreasing mercury concentrations with depth. Moreover, mercury pooling at the ground surface has frequently been observed at the LCP site in apparent response to rainfall events, likely as a result of capillary action as soil pores become saturated with water (see Section 7.1.4). These observations suggest that downward migration of elemental mercury through the overburden material as a result of its density does not appear to be a primary transport mechanism at the LCP site. There is some deeper observed elemental mercury in the vicinity of the production buildings, as presented in Figures 6-1a through 6-1d, which may be attributed to downward migration along building pilings that penetrate the overburden strata.

Total mercury concentrations in the deep fill, ranged from 0.063 to 2,110 mg/kg. Approximately 27 percent of the mercury detections exceeded the NJ NRDCSRS at depths ranging up to 14 feet, as depicted on Figure 6-1b. Of particular note was the presence of visible, elemental mercury observed in samples collected from the horizontal borings within the deep fill located beneath Buildings No. 230 and 240.

Total mercury concentrations tended to be lower in the naturally occurring soil units that underlie the anthropogenic fill, including the tidal marsh deposits and the glacial till. In fact, only five out of 28 tested samples of the tidal marsh deposits exceeded the NJ NRDCSRS of 65 mg/kg. It should be noted,

however, that four (4) of the tidal marsh soils contained visible elemental mercury and were not analyzed (Table 6-3 and Figure 6-1c). These samples were collected from boring MW-25D, located along the probable alignment of the former South Branch Creek channel (see Section 2.6.1), and adjacent to Building No. 231 and the former 500K tank.

The tested borehole samples collected from the glacial till did not exceed the NJ NRDCSRS for total mercury, including the samples collected beneath the production buildings from the horizontal borings. Notable exceptions, however, included two of the glacial till samples collected from horizontal borings beneath Buildings No. 240 that contained visible, elemental mercury (Table 6-3 and Figure 6-1d). These findings would suggest that mercury is normally attenuated at depth within the glacial till but may be subject to sporadic downward vertical migration along features such as building piles or fractures in the till.

Mercury Speciation

Six surficial soil samples were selected for analysis by a selective sequential extraction method after Bloom, *et al.*, 2003. Additional information regarding mercury sequestial extraction is found in the Human Health Risk Assessment (Appendix O). This is a five-step sequence of extractions that was established to separate various groups of mercury compounds into "biogeochemically" distinct categories. Accordingly, the method provides direct information regarding the relative mobility of the various mercury species and is comprised of the following extracts:

- F1 - Water soluble Hg
- F2 – "Stomach acid" soluble
- F3 - organo-chelated Hg
- F4 - elemental Hg and other Hg species
- F5 - mercuric sulfide (cinnabar)

The results of the sequential mercury testing are presented on Table 6-5. The data revealed that mercury in the tested surficial soils was present primarily in insoluble forms including elemental (metallic) mercury and mercury sulfide (cinnabar). Mercury speciation testing revealed some variability in the speciation profile of mercury in fill. In five of the six samples tested (230-B-101-0-1, DSP-101-0-1, 231-102-0-1, LP-102-0-1, and BSL-101-0-1; see Table 6-5), more than half of the mercury extracted in the later fractions (F4 and F5), indicating low mobility potential. In one sample, however (231-101-0-1), just over half the mercury extracted in the F3 fraction (potassium hydroxide, targeted to elute organo-metallic complexes, which can be more mobile than the later-extracting forms). However, the groundwater data clearly support the conclusion that mercury is not mobile. There are wells near sample 231-101-01 that contain only traces of dissolved mercury in the overburden (less than 0.5 µg/L; MW-26S) and no detectable mercury in the bedrock groundwater (MW-25D). Thus while the exact form of mercury appears to vary somewhat by location, the data overall indicate that the mercury present in these samples is not migrating vertically or partitioning into the aqueous phase.

TCLP Mercury

An evaluation of the leachability of mercury from highly contaminated soils was performed as a supplemental study in May 2008. This assessment involved the collection of four (4) surficial soil samples that contained visible elemental mercury. Each sample was subjected to testing for both total mercury and TCLP mercury. TCLP testing involves the recirculation of water at a 20:1 liquid-to-solid ratio under specific, prescribed conditions (e.g., pH, temperature, time) and then measuring the resultant concentration in the leachate.

The results of the TCLP testing are presented in Table 6-6. The ratio of the TCLP mercury to the total mercury is also presented on the table. These data indicate that only a very small fraction of the available mercury in the tested samples was leached from the samples. The proportion of leached mercury ranged from 0.01 to 1.89 percent, with an average value of approximately 0.5 percent. Furthermore, only two of the four samples exceeded the TCLP criterion of 0.2 mg/l. This means that even some samples containing visible elemental mercury would not be characterized as hazardous waste on the basis of TCLP testing.

Summary of Mercury in Soil

Elevated levels of mercury were found in the anthropogenic fill soils throughout nearly the entire site. The highest concentrations are found around the former production area near Buildings No. 230 and 240, including below the buildings, around which visible elemental mercury was also observed. Substantial attenuation of mercury was observed in the underlying natural soils, including the tidal marsh deposits and the glacial till. With the exception of two samples beneath Building No. 240, none of the glacial till samples exceeded the applicable standards.

In addition to mercury detected in analytical samples, there have been observations of visible elemental mercury on the ground surface and in soil borings. Observations of visible elemental mercury on the ground surface appear to coincide with rainfall events, suggesting the movement of mercury through pore spaces in surficial soils is due to capillary action, or with mechanical disturbance (e.g., excavation) of surficial soil. Visible elemental mercury found in soil borings have been primarily found in the fill material; however, limited instances have been observed in the tidal marsh deposits and glacial till in areas where building pilings penetrate the fill material.

Mercury speciation testing revealed that most of the total mercury was present in relatively insoluble forms including mercury sulfide and elemental mercury. The insolubility of the mercury in soil indicates that it is relatively immobile in the subsurface.

Mechanisms that could affect mercury in soils and alter environmental mobility, such as volatilization, are discussed in Section 7.

6.1.2 Arsenic and Other Metals

Arsenic

Arsenic concentrations in the surficial fill ranged from ND to 335 mg/kg, with a NJ NRDCSRS exceedance frequency of approximately 19 percent. The arsenic concentrations in surficial fill are presented on Figure 6-2a. While arsenic exceedances are widely distributed across the site, relatively few exceedances are observed within the former LCP production area. The greatest density of arsenic exceedances and the highest arsenic concentrations in soil were found in the western portion of the site in the former Linde Division leasehold.

The deep fill revealed arsenic concentrations that ranged from ND to 775 mg/kg, with approximately 36 percent of these exceeding the NJ NRDCSRS of 19 mg/kg. The NJ NRDCSRS exceedances in the deep fill ranged up to 16 feet in depth and were widely distributed across the site, as shown on Figure 6-2b. As with the surficial soil, the highest arsenic concentrations were located in the former Linde Division leasehold which is, in fact, higher than the concentrations in the surficial soil. Furthermore, arsenic is not specifically related to the chlor-alkali process. The headwater of South Branch Creek (the "Transect A Area") has historically received drainage from other sources, as discussed in Section 2.6.1. This included comingled wastewater and stormwater from the LCP and GAF sites. In addition, ditches located parallel to both sides of the railroad track conveyed surface drainage from the

north that originated on the GAF and duPont sites. Both the GAF and duPont sites were known to have used arsenic. The arsenic present in South Branch Creek, which is heavily concentrated in the Transect A area, greatly exceeds the concentrations found in LCP site soils, further suggesting an off-site source(s).

As with the surficial soil, the highest arsenic concentrations in the deep fill were located in the former Linde Division leasehold where concentrations were higher than in the surficial soil. Furthermore, arsenic is not specifically related to the chlor-alkali process. There is no history of arsenic use at the Linde Division, although arsenic presence may be related to the placement of anthropogenic fill in preparation for the construction of a Central Railroad Company of New Jersey railroad yard prior to 1940 (see Section 2.1.1).

Arsenic was detected in all but one of the tidal marsh deposit samples at concentrations ranging from ND to 437 mg/kg. Approximately 35 percent of the samples exceeded the NJ NRDCSRS of 19 mg/kg (Figure 6-2c). The highest levels of arsenic in subsurface tidal marsh soils occur in the area of the former Linde Division leasehold.

Arsenic was ND in more than half of the tested glacial till samples. No exceedances of the NJ NRDCSRS for arsenic were observed in the glacial till (Figure 6-2d).

Other Metals

A relatively small number of exceedances of the NJ NRDCSRS were observed for other metals, including cadmium, cobalt, lead, and zinc as presented on Tables 6-2a through 6-2d. These higher concentrations were primarily observed in the anthropogenic fill. Many of the soil samples that exceeded the NJ NRDCSRS for lead were detected within a small well defined area of the Linde Division leasehold. Barium was used in the brine sludge process, where it entered the process as barium sulfate and was converted to barium chloride. Barium's presence is therefore site related. However, barium was not detected above the NRDCSRS in any of the 91 surficial soils samples analyzed and is therefore not a key site COC. Each metal was substantially attenuated at depth in all areas of the site. There were no exceedances of other metals in the underlying glacial till.

Arsenic and Other Metals Summary In Soil

The ubiquitous presence of arsenic and various other metals in areas with no production history, their distribution within the anthropogenic fill without a decreasing concentration gradient, and the absence of an association with the known sources of contamination lead to the conclusion that the occurrences of arsenic and other metals are not associated with site operations; rather they are associated with the presence of anthropogenic fill materials and off-site sources.

This point is made simply to illustrate the prevalence of these metals in anthropogenic fill not as a result of site-specific manufacturing processes. These exceedances were largely related to the elevated levels of arsenic and several other metals, including lead, that were observed in the anthropogenic fill predominantly in the former Linde Division leasehold area.

Concentrations of arsenic and other metals in the underlying natural soils were substantially attenuated with respect to the anthropogenic fill. In fact, relatively few metals exceedances were observed in the tidal marsh deposits. Furthermore, nearly all of the exceedances of arsenic and other metals in the tidal marsh deposits occur within the western portion of the site. This distribution differs from that of mercury, which was concentrated in the former chlor-alkali facility production areas.

No exceedances of arsenic or metals, including mercury, were observed within the glacial till.

6.1.3 PCBs

Polychlorinated biphenyls, or PCBs, are a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl. Theoretically, 209 separate PCB congeners can exist, although only about 130 congeners typically occur in commercial PCB mixtures. Commercial PCBs are referred by their trade name "Aroclor," mixtures that usually contain 50 or more PCB congeners. PCB Aroclors were analyzed for in each of the soil samples.

Aroclor 1254 was the predominant PCB mixture detected within site soils, with Aroclor 1260 occurring less frequently. No other PCB Aroclors were detected on the site. The spatial distribution of the sum of Aroclor 1254 and 1260 is depicted for each of the four (4) depth intervals on Figures 6-3a through 6-3d. Total PCB concentrations (sum of each of the seven individual Aroclors) were compared to the NJ NRDCSRS for total PCBs of 1 mg/kg. As shown on Figure 6-3a, numerous exceedances of the NJ criterion were observed in surficial soil, particularly around the former LCP production area. While 21 percent of the surficial soil samples exceeded the NJ NRDCSRS, the total PCB concentrations were relatively low compared with other regulatory limits. Only one sample in the surficial soil (230-B4), located east of Building 230 in the former rectifier area, exceeds the USEPA Toxic Substances Control Act (TSCA) criterion of 25 mg/kg for soil decontamination in restricted access (industrial) areas per the PCB Rule [40 CFR Part 761.125].

PCBs were undetected (ND) in ¾ of the tested deep fill samples. Total PCB concentrations in the deep fill ranged from ND to 43.2 mg/kg. In the deep fill interval, total PCB concentrations exceeded the 1 mg/kg NJ NRDCSRS in 9 percent of the samples. The 25 mg/kg USEPA criterion was only exceeded, however, in one sample (Aroclor 1254 in 231-B6, located at the southwest corner of Building 231). There were no exceedances of the 1 mg/kg NJ NRDCSRS criterion in samples collected from the tidal marsh deposits or the glacial till.

Aroclor 1254 and Aroclor 1260 were the primary commercial mixtures that were used in electrical equipment in the US around 1950 (Fiedler, 1997). PCBs are not directly related to the chlor-alkali process. It is likely, however, that electrical equipment used at the site was the source of these PCBs in soil given the distribution of PCBs in the surficial soils around the production area. The data suggest, however, that likely PCB spills from electrical equipment were relatively modest given the relatively low concentrations and the fact that they have not penetrated to any substantial degree in subsurface soils.

6.1.4 Polychlorinated Naphthalenes

Polychlorinated naphthalenes (PCNs) are a group of halogenated compounds that are considered to be "dioxin like". They consist of two fused benzene rings, or naphthalene, with one to ten chlorine atoms attached. Commercially available PCNs are mixtures of 75 chlorinated naphthalene congeners and byproducts.

It is possible that the detected PCNs at the site may be related to reactions between the chlorine and the graphite anodes. However, the PCNs present in site soils include only the mono, di-, and tri-chlorinated congeners as presented on Table 6-7. The more toxicologically significant higher chlorinated congeners (penta through hepta) that are of concern at other chlor-alkali sites are not detected at the LCP site. The higher chlorine group congeners would have been detected on the TIC scan if they were present. The analytical laboratory took specific steps to run the GC/MS for sufficient time to allow the higher-chlorine PCNs to elute. The total PCN concentrations ranged from 0.007 mg/kg to 76.8 mg/kg in the surficial fill and 0.012 mg/kg to 19.2 mg/kg in the deep fill. Although low levels of PCNs were also detected in several tidal marsh deposits and glacial till samples, the concentrations were considerably lower than detected in shallower soils.

6.1.5 Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a class of compounds comprised of fused aromatic rings in a variety of structural configurations. PAHs can be formed as products of the incomplete combustion of organic materials and are present in considerable quantities in fossil fuels, including coal, fuel oil, and diesel fuel. Sources of PAHs in soil include emissions from power plants and domestic heating systems that burn oil, coal or wood, gasoline and diesel engine emissions, emissions from waste incineration facilities, and various industrial activities. Accordingly, fill containing combustion residues often contains considerable levels of PAHs. Table 6-8a through -8d and Figures 6-5a through 6-5d presents the sum of the 18 TCL PAHs analyzed in site soils.

PAHs are hydrophobic compounds, and their persistence in the environment is due in large part to their low water solubilities and resistance to biodegradation. Higher-molecular weight PAHs exhibit a greater environmental persistence than lower-molecular weight PAHs due to an increase in hydrophobicity and an increasing resistance to biodegradation as the molecular size of the PAHs increases (up to four or five fused benzene rings). The higher-molecular weight PAHs are more commonly associated with coal or coal by products, including bottom and fly ash, whereas the lower-molecular weight PAHs are more closely associated with petroleum products (see table below).

Low-molecular weight PAHs (2- and 3-ring structures)	High-molecular weight PAHs (4-, 5-, and 6-rings)
Acenaphthene	Benz[a]anthracene
Acenaphthylene	Benzo[a]pyrene
Anthracene	Benzo[b]fluoranthene
Fluorene	Benzo[ghi]perylene
Naphthalene	Benzo[k]fluoranthene
2-Methylnaphthalene	Chrysene
2-Chloronaphthalene	Dibenz[a,h]anthracene
Phenanthrene	Fluoranthene
	Indeno[1,2,3-cd]pyrene
	Pyrene

The high-molecular weight PAHs were frequently detected in the soils and occur across the entire site, including areas with no production history. The frequency of detection in the deep fill (> 2ft) for these constituents ranged from 7 percent (dibenzo(a,h)anthracene) to 74 percent (fluoranthene). The NJ NRDCSRS were infrequently exceeded by the high-molecular weight compounds.

The low-molecular weight PAHs were also detected frequently and occur across the entire site, including areas with no production history. The range for this group of PAHs in the deep fill (> 2 ft) was from a low of 6 percent detections (acenaphthylene) to a high of 68 percent (phenanthrene). The NJ NRDCSRS for the low-molecular weight PAHs were not exceeded.

These observations lead to the conclusion that the PAHs are primarily associated with anthropogenic fill materials and are not the result of site operations.

Carcinogenic PAHs

Eight (8) specific, high-molecular weight PAHs are designated by USEPA as possible human carcinogens. Benzo(a)pyrene (B(a)P) is the most completely studied of the possibly carcinogenic PAHs (cPAHs) and exhibits the highest relative toxicity. Toxic Equivalency Factors (TEFs) are assigned to these cPAHs relative to the carcinogenic potency factor of B(a)P by USEPA (1993) based on the risk of oral exposure,

as presented in Table 6-9. The TEFs are used to develop a Toxicity Equivalency Quotient (TEQ) which is the sum of the quantity of individual cPAHs respective TEF. TEQs allow the comparison of the relative risk of exposure in areas of contamination that vary widely in the composition and level of cPAHs.

A summary of the resultant TEQ values is presented in Tables 6-10a through 6-10d and shown in Figures 6-6a through -6d and Figures 6-7a through -7d. Map pairs of cPAHs are presented for each depth interval. The first map in each pair presents a graphical representation of the relative concentration of each cPAH and lists the total cPAH concentration in the sample. The second map in each pair presents a graphical representation of the relative cPAH TEQ. As with the PCDDs and PCDFs described below, the TEQs are used here to describe the geo-spatial distribution of these compounds and not to represent risk.

The figures reveal that most of the cPAHs were found in the anthropogenic fill layers. This is not surprising, given the likely presence of PAHs at the site as a result of anthropogenic fill placement. cPAHs were infrequently detected in the tidal marsh deposits, except where they were exposed as "low marsh" soils along South Branch Creek. The cPAHs were not detected in the underlying glacial till except beneath the production buildings in which they may have migrated downward along the numerous timber building piles.

The cPAH data revealed that most samples contained relatively even proportions of each of the eight (8) cPAHs, with only a few exceptions in which a single cPAH predominates (e.g., benzo(a)anthracene in the surficial sample at TLS-11).

The cPAH TEQs ranged from non-detectable to a high of 102 mg/kg. The cPAH TEQs are widely distributed across the entire site with no apparent pattern of distribution. The cPAH TEQ values are no higher in the former LCP production area than in any other area of the site. This distribution provides additional evidence of the presence of PAHs as a result of anthropogenic fill.

6.1.6 PCDDs/PCDFs

Polychlorinated dibenzo-p-furans (PCDFs) and polychlorinated dibenzo-p-dioxins (PCDDs) are groups of halogenated organic compounds. There are 210 possible structural congeners of PCDF and PCDD. Of these, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has been shown to be the most toxic. In addition, PCDF and PCDD congeners, in which the lateral 2, 3, 7, and 8 positions are occupied with chlorines (2,3,7,8-substituted congeners), are acknowledged to have a higher relative toxicity than the other congeners (i.e., non-2,3,7,8-substituted congeners).

PCDDs and PCDFs can be formed as by-products in the manufacture of organochlorides, during the incineration of chlorine-containing materials, in the bleaching of paper, and from natural sources such as volcanoes and forest fires (Beychok, 1987). The major current and historical sources of PCDDs and PCDFs include coal fired utilities, municipal waste incinerators, metal smelting, diesel trucks, land application of sewage sludge, burning treated wood, and backyard trash burn barrels (USEPA, 2005).

PCDFs and PCDDs in soils were tested as a part of this investigation in approximately 10 percent of the samples during Phase I and II.

Seventeen (17) specific PCDDs/PCDFs have been assigned Toxic Equivalency Factor (TEFs) by the World Health Organization (WHO, 2005) and these have been adopted by USEPA. The TEFs are based on the chemical's toxicity relative to 2,3,7,8-TCDD, with the toxicity of 2,3,7,8-TCDD being equal to 1.0. The TEFs are used to develop a Toxicity Equivalency Quotient (TEQ) which is defined as "the sum of the quantity of individual PCDD/PCDF congeners multiplied by the respective TEF." TEQs allow the comparison of the relative risk of exposure in areas of contamination that vary widely in the composition

and level of PCDDs/PCDFs. The TEQs are used here to develop a single concentration expression for each sample for the purpose of evaluating the nature and extent of the PCDD/PCDF distribution. These TEQ sums are not intended to represent risk from contact with soils. A summary of the resultant TEQ values is presented in Table 6-11 and shown in Figures 6-4a through 6-4d.

Very low levels of PCDDs and PCDFs were detected in each of the samples analyzed, as presented in Table 6-11. Each of the TEQs were less than 1.0 µg/kg (ppb), ranging from 0.00002 to 0.885 µg/kg. The highest TEQs, which were largely driven by the PCDFs, were observed in the surficial soils, particularly in two samples collected immediately east of Building No. 231 (Samples No. LP-10 and LP-16). Substantial attenuation of TEQ concentrations was observed with increasing depth (Figures 6-4a through 6-4d).

There is some evidence as reported in the literature that PCDDs and particularly PCDFs may be present in the mercury sludge at chlor-alkali sites as a result of the reactions between the chlorine and the graphite anodes, as may be the case in Samples No. LP-10 and LP-16. This is revealed by the higher levels of total CDFs in these samples and the higher relative proportion of the tetra-CDFs and penta-CDFs and lower relative proportion of the octa-CDFs compared to the other site samples.

The PCDDs are not likely to have resulted from site sources. The distribution of PCDD concentrations in the other surficial soils is very heterogeneous, based both on specific concentrations of the various congeners and on the TEQs (Figure 6-4a). This heterogenacity and widespread distribution across the site is not apparently related to the former production area and is likely attributed to regional background conditions. While some of the PCDFs in the soil appear attributable to site operations, much of the PCDFs on the site are due to background conditions, particularly in the areas distant from the production area. The background sources likely include atmospheric deposition on the ground surface as a result of the formation of PCDDs and PCDFs from the various potential sources described above.

6.1.7 Hexachlorobenzene

Hexachlorobenzene (HCB) is a chlorinated hydrocarbon that was formerly used as a fungicide and is frequently produced as an unintended byproduct from various manufacturing processes. HCB is documented to have been produced as a byproduct in chlor-alkali plants through the reaction of the chlorine with the graphite anodes (Environment Canada, 1993).

HCB at the site was generally detected only in the anthropogenic fill with the highest levels being found in the surficial fill in the area of the former production area. Accordingly, the presence and distribution of HCB in soils appears to be related to the chlor-alkali manufacturing process at the LCP site.

HCB concentrations in the surficial fill ranged from ND to 1,440 mg/kg, with 16 percent of these samples exceeding the NJ NRDCSRS of 1 mg/kg for HCB. The exceedances occurred near Building 250, east of the tank car reconditioning shed, west of Building 240 along the former alignment of South Branch Creek, west of the sodium hydroxide tanks, near the bullet tanks, around Building 231, near the closed RCRA unit, and in the western area of the site away from the process areas. The distribution of HCB in surficial fill is presented on Figure 6-8a.

In the deep fill, HCB concentrations ranged from ND to 44 mg/kg. The NJ NRDCSRS exceedance frequency for hexachlorobenzene was 4 percent, with exceedances occurring near the "Ditch Bridge Area" along former South Branch Creek area located east of the electrical switchyard and by Building 231, as presented on Figure 6-8b.

HCB exceedances of the NJ NRDCSCC were not observed in either the tidal marsh deposits or the glacial till (Figures 6-8c and 6-8d).

6.1.8 Other Organic Compounds

A number of other organic compounds revealed infrequent exceedances of their respective NJ NRDCSRS. Only benzene (presented in Figures 6-9a through 6-9c), hexachlorobenzene, methylene chloride and hexachlorobutadiene exceeded the criteria in greater than 1 percent of samples in any depth interval.

Chlorobenzene

Chlorobenzene is a VOC that is not generally related to chlor-alkali manufacturing but was detected within the soils, albeit at concentrations less than the NJ NRDCSRS of 7,400 mg/kg. Chlorobenzene was used in manufacturing operations at the adjacent GAF and NOPCO chemical manufacturing sites. However, chlorobenzene in soils is not at sufficiently elevated concentrations to explain its presence in overburden groundwater. While not widely distributed across the site, chlorobenzene was detected in the deep fill in MW-24S at the Ditch Bridge Area along the former alignment of South Branch Creek and immediately south of Building 231 (Figures 6-10a and 6-10b). These locations are along the historic alignment of drainage from the GAF site, as discussed in Section 2.6.1. Furthermore, chlorobenzene was detected in the subsurface tidal marsh deposits south of Building 231 and in the surficial low marsh soils along South Branch Creek including near well MW-6S (Figure 6-10c).

BTEX

The presence of benzene in the soil appears to be related in many cases to "BTEX" constituents that include benzene, toluene, ethylbenzene, and xylenes, as summarized on Table 6-12a through 6-12d The toluene, ethylbenzene, and xylenes, however, do not exceed the respective NJ NRDCSCC values. The BTEX is present primarily in anthropogenic fill soils and is likely due to spills of fuel or oil on the ground or was present in the fill prior to placement.

Miscellaneous Organic Compounds

Several other organic compounds exceeded their respective NJ NRDCSCC primarily in the anthropogenic fill. These exceedances were primarily observed south of Building 231 and include benzene (Figures 6-9a to Figure 6-9c), hexachlorobutadiene, and tetrachloroethene. Methylene chloride had four exceedances of its criterion, including three near the "Ditch Bridge Area" along the former adjacent South Branch Creek and one north of Building 231. These other organic compounds are not known to be related to manufacturing operations at the site. Some of these other organic compounds were widely used in manufacturing processes at the adjacent GAF site which may be the source within the anthropogenic fill.

Residual Organic Saturation

Visual identification of possible residual saturation of unidentified organic liquids were made in a number of soil samples, as listed on Table 6-13, as were generally characterized by the presence of oily material smudge. This material is not widely distributed across the site. The soil laboratory analysis data yields no additional information regarding this material. In addition, no free phase liquids were observed in monitoring wells.

6.1.9 Tank Contents Sample

As part of the tank assessment, a single sample of the contents of the 150,000 gallon brine tank was taken as part of the Phase II field investigation. The results of this sample are presented in Table 6-14.

6.2 Low Marsh Soil

The "low marsh" soil represents narrow bands of soil located along the margins of South Branch Creek that is generally fine-grained and with a high organic content. This material likely represents sediment that has been deposited along the bank. The low marsh soils may also represent, in part, the geologic surface exposure, or "outcrop," of the tidal marsh deposits. Accordingly, the low marsh soils were also presented on the aforementioned constituent distribution maps for the tidal marsh deposits.

Ninety chemical constituents were detected in the surficial (0-0.5-foot) low marsh soil samples collected along South Branch Creek and 70 chemical constituents were detected in the low marsh soil samples collected along the Arthur Kill at the confluence with South Branch Creek. Table 6-15 summarizes the descriptive statistics of detected constituents in low marsh soil samples, and Tables 6-16a through 6-16c present the data compared to NJ NRDCSRS, the Effects Range – Low (ER-L), and Effects Range – Median (ER-M) screening values (Long, *et al.*, 1995), respectively.

The horizontal and vertical delineation of site-related constituents for low marsh soil is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of low marsh soil may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.2.1 Mercury

Figure 6-11 shows the spatial distribution of mercury in low marsh soil. Mercury was detected in each of the 20 low marsh soil samples collected along South Branch Creek; up to 3,050 mg/kg (Table 6-15, Figure 6-11) at Transect C, near the midpoint of South Branch Creek. The NJ NRDCSRS of 65 mg/kg for mercury was exceeded in 80 percent of the samples; the ER-L and ER-M sediment screening criteria were exceeded in all of the samples. In the four low marsh soil samples collected along the Arthur Kill, all observations were below the NRDCSRS and above the sediment screening criteria, with a maximum concentration of 25.8 mg/kg. The presence of mercury in the low marsh soil is consistent with and generally related to its presence in sediments, as discussed further in Section 6.6.

Methyl Mercury

Methyl mercury was detected in each of the 20 low marsh soil samples collected from South Branch Creek and in all four of the low marsh soil samples from along the Arthur Kill (Table 6-17). The maximum concentrations were 0.1 mg/kg in the South Branch Creek samples and 0.0259 mg/kg in the samples collected from the Arthur Kill area. However, the percentage of methyl mercury as a function of total concentration was low in all of these samples: the maximum proportion of methylated was 0.13 percent in South Branch Creek and 0.1 percent in the Arthur Kill.

6.2.2 Other Metals and Arsenic

Other than mercury, 18 other metals and arsenic were detected in the low marsh soil samples collected in South Branch Creek (Table 6-15). Arsenic, cadmium and lead concentrations exceeded NRDCSRS and all elements exceeded respective ER-Ls and ER-Ms (Tables 6-16a through 6-16c). The frequency of concentrations exceeding the NRDCSRS in South Branch Creek low marsh soil samples ranged from 5 to 75 percent.

Arsenic levels were particularly elevated in the low marsh soil samples collected at the head end of South Branch Creek (Figure 6-12) consistent with the sediment results (Section 6.6.2). In addition to receiving historic discharge from the LCP site, this area receives stormwater drainage from a swale running parallel to the railroad track from the north. Historically, this swale would have carried stormwater that originated, in part, from the duPont and GAF sites located northeast of the LCP site.

These detections do not likely result from LCP site sources as they were considerably higher than arsenic levels observed in site soils within the former LCP production area. Arsenic is not related to chlor-alkali manufacturing facilities.

Arsenic, which is not related to chlor-alkali manufacturing operations, is present in upland surficial fill at an average concentration of 16 mg/kg (maximum 335 mg/kg). Arsenic is relatively heterogeneously distributed in the fill (see Figures 6-2a and b) and shows no "hot spots" or other areas with elevated arsenic (with the exception of a few locations in the Linde area on the western portion of the site, which is not close to South Branch Creek). The low marsh and sediment soils, however, exhibit much higher arsenic concentrations: up to 5,460 in low marsh soils and up to 4,250 mg/kg in sediments. These concentrations cannot be explained by the presence of low-level arsenic throughout the upland fill areas of the site.

In low marsh soil along the Arthur Kill, 18 elements other than mercury were detected, 11 of which have NRDCSRS. Only arsenic concentrations exceeded the NJ NRDCSRS (in 25 percent of the samples). Almost all elements were present at higher concentrations in the low marsh soil samples from South Branch Creek than from the Arthur Kill. Arsenic concentrations were a 100-fold higher; cadmium, barium, lead and zinc had 10-fold higher concentrations.

6.2.3 Organics

6.2.3.1 PCBs

The total Aroclors found in low marsh samples are presented in Figure 6-13. Only one PCB mixture (Aroclor 1260) was detected in one of the Low Marsh Samples in South Branch Creek, at a concentration of 0.356 mg/kg Table 6-15). Aroclor 1260 was also detected in two of the low marsh samples collected from the Arthur Kill in the same concentration range. No other PCB Aroclors were reported. Individual Aroclors do not have NJ NRDCSRS established for them, but there is a NJ NRDCSRS for total PCBs of 1.0 mg/kg, which was not exceeded in any of the samples. The detection of Aroclor 1260 exceeded the NJ NRDCSRS for total PCBs. This sample was the only one in South Branch Creek that exceeded the ER-L and ER-M of 0.023 and 0.18 mg/kg, respectively.

6.2.3.2 PAHs

Of the 18 SVOC TCL chemical constituents analyzed and classified as PAHs, 15 were detected in low marsh soil samples of South Branch Creek. In Arthur Kill low marsh soil samples, 14 PAHs were detected (Table 6-15). The frequency of detection of PAHs in South Branch Creek samples ranged from 5 to 100 percent. In the Arthur Kill samples, 25 to 100 percent contained detectable PAHs. NJ NRDCSRS have been established for 10 PAHs, and ER-Ls/ER-Ms for 16. Six of the South Branch Creek and two Arthur Kill low marsh soil samples exceeded the NRDCSRS for B(a)P (Table 6-16a). ER-Ls for all compounds were exceeded (various locations in both South Branch Creek and the Arthur Kill) (Table 6-16b), but ER-Ms were only exceeded for phenanthrene and pyrene (Table 6-16c), and only in one location (Transect D).

Table 6-18 and Figure 6-14 present the sum of the 18 analyzed PAHs in South Branch Creek and the Arthur Kill. In both there was considerable inter-sample variability, but South Branch Creek and the Arthur Kill had similar average total PAH concentrations, in the range of 2-3.26 mg/kg. Figure 6-15 shows the compound-specific distribution of the carcinogenic PAHs. The array of compounds is similar in all samples areas, with a predominance of fluoranthene and pyrene. In addition, benzo(g,h,i)perylene was also predominant in the Arthur Kill and benzo(k)fluoranthene in South Branch Creek. Figure 6-16 presents the B(a)P equivalents for Low Marsh soil. Only two samples, both at Transect D, had total PAH concentrations above the ER-L of 4 mg/kg; none exceeded the total PAH ER-M of 45 mg/kg. PAHs were detected at concentrations within the same order of magnitude for both South Branch Creek and the Arthur Kill.

As described previously in Section 6.1.6, the ubiquitous presence of PAHs in soil samples collected on site is a result of their presence in the anthropogenic fill. Furthermore, the presence of PAHs is common within sediments of industrialized waterways, such as the Arthur Kill. Accordingly, PAHs in the low marsh soils are attributable to sources other than the LCP site.

6.2.3.3 Other Organic Compounds

PCDDs/PCDFs

The low marsh soil samples were analyzed for 17 PCDDs/PCDFs, 21 pesticides and herbicides, 51 non-PAH SVOCs, and 46 VOCs. Each of the low marsh soil samples collected from South Branch Creek and the Arthur Kill contained detectable dioxins and furans (all analyzed compounds) (Table 6-15). While there is a high total TEQ found in Transect C, the remaining samples collected along South Branch Creek revealed a significantly lower total TEQ than the sample taken along the Arthur Kill (223 pg/g). Table 6-19 shows a summary of individual sample results for PCDDs/PCDFs and TEQs in low marsh soil. The PCDD/PCDF TEQ results are presented in Figure 6-17. As discussed previously in Section 6.1.8, PCDFs are attributed in part to site operations, as reflected in the predominance of PCDFs in the TEQ in landward low marsh soils. Low marsh soils near the Arthur Kill reflect a greater TEQ contribution of PCDDs from regional sources. This pattern of regional contamination, attributable to regional influences, is similar to that observed in sediment (see Section 6.6.3.3).

Pesticides/Herbicides

Four pesticide and herbicide compounds were detected in the South Branch Creek low marsh soils (Table 6-15), with a detection frequency ranging from 15 to 95 percent. In the Arthur Kill, six pesticide and herbicide compounds were detected, ranging from 25 to 100 percent detection frequency. All concentrations were the same order of magnitude. NJ NRDCSRS have been established for 16 pesticide and herbicide compounds, but none of the low marsh soil samples exceeded respective values. ER-Ls/ER-Ms (available for nine pesticide compounds) were also not exceeded.

PCNs

PCNs were not detected in the low marsh soil samples.

Other Organic Compounds

Of the non-PAH SVOCs analyzed, 10 were detected in the low marsh soil samples from South Branch Creek and two in the Arthur Kill samples. Seven VOC compounds were detected in the South Branch Creek low marsh soils and two in the samples collected from the Arthur Kill low marsh soils. As with sediments, VOCs were generally trace: with the exception of chlorobenzene (maximum detected 120 mg/kg, vs. the NRDCSRS of 7400 mg/kg), all other observations were below 3 mg/kg.

Ten non-PAH SVOC compounds were detected in South Branch Creek low marsh soil samples. The detection frequency for these ranged from 5 to 80 percent (Table 6-15). Two SVOCs (bis(2-ethylhexyl phthalate and carbazole) were detected in the Arthur Kill, with a detection frequency of 25 and 75 percent. NRDCSRS have been established for 29 of the analyzed non-PAH SVOC compounds, but none of the low marsh soil samples exceeded respective values. All detected SVOCs had concentrations in the same order of magnitude.

Hexachlorobenzene was detected at low concentrations in only two of the tested samples. The concentrations of 0.047 and 0.175 mg/kg and did not exceed the NJ NRDCSRS of 1 mg/kg. The NJ lowest sediment screening value (used as ER-L by the NJDEP) of 0.020 was exceeded in both samples, but the higher NJ screening value of 24 mg/kg (used as the ER-M) was not.

6.3 Soil Vapor

Soil vapor samples were collected from shallow soil vapor probes as shown on Figure 3-2. Samples from ten (10 probes) were tested for VOCs. Samples from four (4) probes were tested for mercury vapors. The statistical summary of the data are summarized on Table 6-20.

The delineation of site-related constituents for soil vapor is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of soil vapor may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.3.1 Mercury

Mercury vapors were detected in each of the four (4) samples that were tested. The concentrations ranged from 0.2 to 2.5 $\mu g/m^3$. There are no NJDEP Soil Gas Screening Levels for elemental mercury (NJDEP, March 2013). However, none of these values exceed the Draft Vapor Intrusion Guidance value of 3 $\mu g/m^3$ (USEPA, November 2002) that correspond to a hazard of 1. There are no detections of mercury in the samples above this screening level.

6.3.2 Volatile Organic Compounds

The VOCs detected in the soil vapor are similar to those that were detected in the soil. The VOCs in soil vapor include chlorobenzene, BTEX compounds, hexachlorobutadiene, chloroform and TCE. A comparison to New Jersey Soil Gas Screening Levels-Non-Residential (NJSGSLNR, NJDEP, March 2013) reveals a total of 11 exceedances (Table 6-21) of five separate constituents (Hexachlorobutadiene, TCE, PCE, Carbon Tetrachloride, and Chloroform). The exceedances were from various soil vapor probes located along the railroad tracks and the western portion of the site, as well as the central portion west of Building Nos. 230 and 240.

6.4 Groundwater

Two (2) rounds of groundwater quality samples were collected from monitoring wells at the site. These included one (1) round each of the complete group of wells that were available during each phase of the investigation. The Phase I round included the collection of samples from a total of 15 overburden wells in December 2001. The Phase II groundwater data comprised the sampling from 19 overburden and 10 bedrock monitoring wells between January and March 2007.

The horizontal and vertical delineation of site-related constituents for groundwater is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of groundwater may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.4.1 Groundwater Quality Criteria

As discussed in section 2.8.2, the New Jersey Class IIA groundwater quality standards (GWQS) [N.J.A.C. 7:9C] are used as benchmarks for the characterization of overburden groundwater. Comparisons of site-specific overburden groundwater quality data to the Class IIA GWQS are provided in Tables 6-23a and 6-24a and in the following text sections.

While the bedrock groundwater has been granted III-B reclassification based upon concentrations of chloride and total dissolved solids (Table 6-22), no specific procedure that is acceptable to NJDEP currently exists to develop alternate groundwater quality criteria for Class III-B aquifers. In order to be protective of surface water in the Arthur Kill, to which the bedrock groundwater discharges, the New Jersey Surface Water Quality Standards (SWQS) [N.J.A.C. 7:9B] for saline environments are used as benchmarks for the characterization of bedrock groundwater. Comparisons of site-specific bedrock

groundwater quality data to the SWQS are provided in Tables 6-23b and 6-24b and in the text sections that follow including separate comparisons to the Acute and Chronic Aquatic criteria and the Human Health criteria.

6.4.2 Mercury, Other Metals, and Arsenic

Despite the best efforts to minimize suspended solids in groundwater samples using the low-stress (low-flow) sampling technique, it was not possible to completely eliminate solids, particularly in the overburden wells. Given that metals tend to sorb to soil particles, suspended solids in the groundwater sample that originate from the soil in which the wells are screened may cause the over-estimation of metals concentrations in a unfiltered (total metals) sample because of the fact that soil particles are not mobile in groundwater. An exception, however, is that mobile colloidal-size particles containing metals may be present which generally are mobile in groundwater. For the purpose of this investigation, samples for metals analysis were collected in duplicate: one was field filtered through an in-line 0.45 µm filter, and the other was submitted unfiltered. Notwithstanding the issue of colloids and the official agency position regarding this matter, the filtered (dissolved metals) samples are considered to best represent the mobile concentrations of metals in groundwater.

6.4.2.1 Total Mercury

Total mercury in overburden groundwater samples was detected in 40 percent of the filtered (dissolved) samples and 65 percent of the unfiltered samples (Table 6-23a). However, mercury concentrations in overburden groundwater samples exceeded the Class IIA groundwater quality standard of 2 µg/L in ten percent of the filtered samples and 30 percent of the unfiltered samples. The highest mercury readings were in well MW-24S located near the "Ditch Bridge Area" along the former alignment of South Branch Creek at 164 µg/L and 233 µg/L in filtered and unfiltered samples, respectively. The only other well in which a dissolved exceedance of the overburden GWQS was observed was MW-23S which is located west of mercury cell Building No. 230as depicted on Figure 6-18b. Of particular note, however, is the fact that filtered mercury (Figure 6-18a) was ND in most of the samples located between the production area and South Branch Creek, including each of the wells located east of the railroad tracks.

Mercury concentrations in the bedrock water-bearing zone were substantially lower than in the overburden. In fact, none of the bedrock wells in the vicinity of or downgradient of the LCP production area contained detectable levels of mercury. The only mercury in the bedrock was observed in the four upgradient wells (under non-pumping conditions including MW-16D, MW-17D, MW-18D, and MW-20D (Figures 6-18c and 6-18d). The highest concentrations were observed in MW-18D at 10.9 and 11.1 µg/L in filtered and unfiltered samples. Exceedances of the Saline Human Health SWQS of 0.051 µg/L were noted for each well with mercury detections. Exceedances of the ecological CCC and CMC values were noted for wells MW-17D, MW-18D, and MW-20D. Of note is the fact that the filtered and unfiltered sample pairs from bedrock wells were very similar to one another, which is not surprising given the greater ease of collecting low-turbidity samples by the low-stress method in the bedrock relative to that in the overburden wells.

Mercury concentrations in overburden groundwater are relatively low considering the elevated levels of mercury that are present in the soils. Mercury in groundwater is generally restricted to areas of the site in which very high levels of mercury are observed in the soils. These data provide additional confirmation that the mercury in the LCP site soil is present in primarily insoluble forms. Detectable mercury in groundwater is relatively immobile and does not create groundwater plumes that extend laterally from the likely source areas.

Mercury in groundwater was largely undetected around the perimeter of the closed RCRA unit (former brine storage lagoon), demonstrating that that unit is not a source of mercury in groundwater. Exceptions include two low-level detections in unfiltered samples at levels that do not exceed the overburden NJGWQS of 24 µg/L or the NJGWQS of 2 µg/L.

The only bedrock wells that contain detectable levels of dissolved mercury are located northwest of the LCP production area (MW-17D, MW-18D, and MW-20D) and contain mercury concentrations ranging up to10.9 µg/L. Under pumping conditions, groundwater has been demonstrated to originate from the adjacent GAF site, sweeping through the western portion of the LCP site in which these wells are located, and then back to the GAF site to be captured by extraction well DEW-4A (Section 5.2.3.3). Relatively high dissolved mercury concentrations have been observed in nearby wells on the adjacent GAF site, which are the likely source of the mercury in the three LCP bedrock wells. These data demonstrate that the only dissolved mercury detected in bedrock at the LCP site originates from the GAF site.

Evidence of the mercury mobility in bedrock groundwater is provided by the apparent relative mercury solubility differences between the LCP and GAF sites. The mercury sources in soil at the LCP site have been demonstrated to consist primarily of insoluble forms (Section 6.1.1), which is consistent with the generally low levels of dissolved mercury detected in overburden groundwater at the LCP site. Contrasted with this is that dissolved mercury at the GAF site has been observed at concentrations that are orders of magnitude higher than at the LCP site, ranging up to 2,520 µg/L, suggesting the presence of much more soluble forms of mercury at the GAF site. Furthermore, none of the LCP bedrock wells containing detectable mercury were located in overburden groundwater. Only bedrock wells in the northwest portion of the Site had detectable mercury. In summary, the soluble mercury from the GAF site is the likely source of mercury in the LCP bedrock wells and this mercury is being captured by the GAF groundwater extraction system.

6.4.2.2 Methyl Mercury

Methyl mercury was analyzed in six selected wells, three (3) of which were in the overburden and three (3) in the bedrock. Table 6-25 presents the total mercury results (filtered and unfiltered) in comparison to the total methyl mercury results in each respective sample.

The methyl mercury results in the tested overburden groundwater samples ranged from 0.635 µg/L to 168 µg/L, corresponding to 0.32 percent to 102 percent[5] of the total mercury (Figure 6-19a). The highest methyl mercury concentration was detected in monitoring well MW-24S, in which a very high proportion of the total mercury was in the methyl form. This result is in contrast to methyl mercury results in other site groundwater, soil, and sediment samples in which methyl mercury made up a very minor proportion of the total mercury, generally far less than 1 percent. As stated previously, MW-24S is screened in the Ditch Bridge Area along the former alignment of South Branch Creek in which methylation could have occurred in sediments prior to filling of this area after 1972 (Section 2.6.1).

In the tested bedrock groundwater samples, methyl mercury was analyzed in three wells, with results ranging from 0.0192 µg/L to 0.188 µg/L (Figure 6-19b). The proportion of methyl mercury ranged from 0.01 percent to 0.09 percent (Table 6-28), which is similar to methyl mercury proportions in other media at the site.

6.4.2.3 Arsenic

Arsenic in overburden wells was detected in 70 percent of the unfiltered and filtered samples. Overburden groundwater arsenic concentrations ranged up to 588 µg/L (MW-12S) for dissolved (filtered) samples and 275 µg/L (MW-26S) for unfiltered samples. Each detection of arsenic was above the

[5] The calculated percentage of methyl mercury greater than 100 percent of total mercury reflects the variability in the analysis, which was well within acceptable QC criteria established by USEPA.

GWQS of 3 µg/L. The distribution of arsenic in overburden groundwater is depicted on Figures 6-20a and 6-20b. In general, total and dissolved sample concentrations were comparable, indicating that arsenic occurs in groundwater in a soluble form. Anomalous results are observed in well MW-12S in which the filtered result was substantially higher at 588 µg/L compared to 192 µg/L in the corresponding unfiltered sample.

Arsenic in overburden groundwater was widely distributed across the site and appears to be spatially unrelated to the LCP manufacturing area. In fact some of the lower arsenic concentrations in overburden groundwater were observed in the area immediately surrounding the LCP production buildings. In addition, arsenic was undetected in the wells located downgradient of the closed RCRA unit further supporting that arsenic in groundwater is unrelated to LCP operations. Due to the distributed pattern of concentrations in the overburden groundwater, the source of arsenic is most likely from the anthropogenic fill.

Arsenic in bedrock wells was detected in 30 percent of the unfiltered and filtered samples and at concentrations that are substantially lower than in the overburden groundwater. Bedrock groundwater arsenic concentrations ranged to 27.7 µg/L for dissolved samples and 25.2 µg/L for unfiltered samples collected from MW-11D. Exceedances of the Saline Human Health SWQC of 0.061 µg/L were noted in wells MW-11D, MW-16D, MW-23D, and MW-25D. The distribution of arsenic in bedrock groundwater is depicted on Figures 6-20c and 6-20d.

6.4.2.4 Other Metals and Inorganics

Cadmium in overburden groundwater was detected in just 5 percent and 15 percent, respectively of the filtered and unfiltered overburden groundwater samples. Each of these detections exceeded the overburden GWQS of 4 µg/L, in which the maximum concentrations ranged up to 10.5 and 22.9 µg/L in filtered and unfiltered samples, respectively. Concentrations in the filtered and unfiltered samples were generally comparable, with the exception of MW-7S, which showed a concentration of 22.9 µg/L in the unfiltered sample, with no cadmium detected in the filtered sample. Cadmium was not detected in bedrock groundwater.

Barium in overburden groundwater was detected in just 5 percent of both the filtered and unfiltered overburden groundwater samples. One well, MW-21S, revealed exceedances the overburden GWQS of 6000 µg/L, in which the maximum concentrations were 15,300 and 14,200 µg/L in filtered and unfiltered samples, respectively. Barium was detected in 30 percent of both the filtered and unfiltered bedrock groundwater samples, with a maximum detection of 288 µg/L. There are no saline SWQSs for Barium for comparison to bedrock groundwater quality data.

Chromium was detected in 25 percent and 30 percent, respectively, of the filtered and unfiltered overburden and bedrock groundwater samples. One well, MW-18S, revealed exceedances the overburden GWQS of 70 µg/L, in which the concentration was 211 and 233 µg/L in filtered and unfiltered samples, respectively. Chromium was detected in 1 unfiltered bedrock groundwater sample, with at 10.3 µg/L. The result did not exceed the Saline Human Health SWQC of 750 µg/L.

Cyanide in overburden groundwater was detected in 16 percent of groundwater samples. There were three detections of cyanide ranging from 20 to 77 µg/L, each exceeding the overburden GWQS of 0.1 µg/L. The wells with cyanide detection included MW-17S, MW-12S, and MW-18S. Cyanide in two unfiltered bedrock groundwater samples at concentrations of 11 and 12 µg/L. Each of these samples exceeded the USEPA Saline Ecological Criteria Continuous Concentration (CCC) and the USEPA Saltwater Criteria Maximum Concentration (CMC) criteria of 1.0 µg/L.

It is likely that the presence of cadmium, chromium, and cyanide in overburden groundwater are related to the presence of anthropogenic fill.

Lead was detected in 5 percent and 20 percent, respectively, of the filtered and unfiltered overburden groundwater samples and in 80 percent of the filtered and unfiltered bedrock groundwater samples. Dissolved and total concentrations were generally comparable. Two of the unfiltered overburden lead results exceeded the overburden GWQS of 5 µg/L (MW-23S and MW-18S) No exceedances of the lead GWQS were found in dissolved samples from the overburden. Exceedances of the CCC criterion of 8.1 µg/L were noted in 7 dissolved samples and 5 unfiltered samples.

Iron was detected in 90 percent and 100 percent, respectively, of the filtered and unfiltered overburden and bedrock groundwater samples. Eighty-five (85) percent of the unfiltered and filtered samples in the overburden exceeded the GWQS of 300 µg/L. There are no saline SWQC for Iron.

Manganese was detected in 95 percent of both the filtered and unfiltered overburden groundwater samples and in 100 percent of both the filtered and unfiltered bedrock groundwater samples. Dissolved and total concentrations were generally comparable. 85 percent and 90 percent, respectively, of the unfiltered and dissolved overburden manganese results exceeded the GWQS of 50 µg/L. 90 percent and 100 percent, respectively, of the unfiltered and dissolved bedrock results exceeded the Saline Human Health SWQC of 0.061 µg/L.

Lead, iron, and manganese are major constituent in natural soils and rock; hence elevated groundwater levels are not unexpected.

6.4.3 Organics

Several volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) were observed in both overburden and bedrock groundwater at the site. Aside from known and suspected storage of petroleum and heating oil in the vicinity of the Linde Hydrogen Plant, organic compounds are not known to have been used in production at the LCP site. The highest VOC/SVOC detections are attributed to off-site sources including the adjacent NOPCO site and the former GAF site. However, many of these same compounds are also found in the soils at the site and wide distribution within the overburden groundwater may be attributed, in part, to dissolution from the anthropogenic fill. The bulk petroleum product terminal facilities have been located in close proximity to the LCP site for more than 50 years and have likely contributed to regional contamination by VOCs and other fuel-related compounds.

Benzene, various chlorobenzene compounds, and 4-chloroanaline were observed in the overburden groundwater at concentrations that exceed the respective overburden GWQS. The specific exceedances are listed on Table 6-24a. The spatial distributions of benzene and chlorobenzene in overburden groundwater are depicted on Figures 6-22a and 6-23a, respectively. The exceedances of the overburden GWQS were observed in 13 overburden wells.

Substantially elevated levels of benzene, chlorobenzene and 1,2-dichlorobenzene that exceed the overburden GWQS were observed in wells MW-6S, MW-21S, and other overburden wells to the northwest of those wells. These exceedances likely result from residual subsurface materials from the former NOPCO site which was located immediately adjacent to wells MW-6S and MW-21S. Given these observations and the fact that chlorobenzene is not related to chlor-alkali facilities, their presence in these overburden wells is likely due to the former NOPCO site. VOCs in well MW-6S present a potential risk to surface water quality given its proximity to South Branch Creek.

Well MW-24S, located in the former "Ditch Bridge" area was impacted by exceedances of the overburden GWQS for benzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, pentachlorophenol, hexachlorobenzene, methylene chloride, and tetrachloroethene. The presence of these compounds likely results from historic wastewater transport across the LCP site from the adjacent GAF site.

Several VOCs/SVOCs including benzene, toluene, and 1,2,4-trichlorobenzene exceeding the Saline Human Health SWQC, were observed in the three bedrock wells located in the northwestern portion of the site, upgradient of the manufacturing area, including wells MW-17D, MW-18D, and MW-20D, exceeding the Saline . Much lower levels of these compounds were also detected in several other wells around the site. The specific bedrock exceedances are listed on Table 6-24b. The aerial distributions of benzene and chlorobenzene in bedrock groundwater are depicted on Figures 6-22b and 6-23b, respectively.

Benzene and chlorobenzenes were not used in production at the LCP site but are documented to be present in groundwater at the adjacent GAF site. The northwestern bedrock wells in which benzene and chlorobenzenes were detected are within the zone in which the GAF groundwater extraction system has been shown to induce bedrock groundwater flow from the neighboring GAF site. Accordingly, benzene and chlorobenzenes in bedrock is present as a result of the GAF site in the same manner as is mercury. The benzene and chlorobenzene in the northwestern bedrock wells is captured and subsequently treated by the GAF remediation system.

One sample groundwater samples from each zone was analyzed for PCDD/PCDF (Table 6-26, Figures 6-21a and 6-21b). Very low levels of both PCDDs and PCDFs were detected in each sample with TEQs of 0.181 ng/L (0.000181 µg/L) and 0.00882 ng/L (0.00000822 µg/L in the overburden and bedrock, respectively. Given the extremely low solubilities of PCDDs and PCDFs in water, these detections are likely associated with solids in the sample rather than representing dissolved phase constituents. The turbidity of the overburden sample was 16.2 NTU while the bedrock sample was 271 NTU. The overburden TEQ is dominated by the PCDFs in a similar pattern as the fill soils in this unfiltered that further supports site soil impacts on this groundwater sample. The exceedingly low TEQ was in the bedrock groundwater sample may be due to a very small level of cross-contamination that may have occurred either during well installation or during sampling that is observable due to low detection limits for PCDD/PCDF analysis.

No free phase liquids were observed in the groundwater column in either overburden or bedrock monitoring wells.

6.5 Surface Water

Surface water samples were collected from five locations in South Branch Creek and two locations in the Arthur Kill (see Figures 3-1 and 3-2). As discussed in Section 3.3.4, these stations correspond to the transects along which the sediment samples were collected. Additional surface water samples were collected from the Off-Site Ditches from two locations in each ditch.

The complete analytical results of detected constituents in surface water are presented in Appendix J. A total of 13 TCL and 13 TAL chemical constituents were detected in the unfiltered surface water samples collected from South Branch Creek. In unfiltered surface water samples from the Arthur Kill, 1 TCL and 9 TAL chemical constituents were detected. There were 11 TCL and 15 TCL chemical constituents found in surface water samples from the Northern Off-Site ditch, while 8 TCL and 12 TAL constituents were detected in the Southern Off-Site Ditch. Table 6-27 presents a summary of descriptive statistics for surface water chemicals collected in South Branch Creek and the Arthur Kill, and the Off-Site Ditches.

Both chronic and acute toxicity criteria are available for surface water for various constituents including mercury. The chronic value is referred to as Criteria Continuous Concentration (CCC), which is an estimate of the highest contaminant concentration to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The acute value, Criterion Maximum Concentration (CMC), is an estimate of the highest contaminant concentration to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. Applicable water quality criteria have not been developed for any of the detected chemicals on an unfiltered basis. USEPA

National Recommended Water Quality Criteria (NRWQC) for saltwater exist for dissolved arsenic, cadmium, copper, lead, mercury, selenium and zinc; however, filtered inorganics were not analyzed during the Phase I and II investigation with the exception of the tidal evaluation for mercury, described below and the Off-Site Ditch investigation. In addition, due to the tidal influences and the inherently mobile nature of surface water, the surface water data provide limited information on nature and extent of contamination in the water bodies compared with sediment.

The horizontal and vertical delineation of site-related constituents for surface water is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of surface water may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.5.1 Mercury

The unfiltered surface water data indicate higher overall inorganic concentrations in South Branch Creek and the Northern Off-Site than in the Arthur Kill. This observation is likely related to the greater presence of suspended particulates in stations closer to the site.

The maximum mercury concentration observed in South Branch Creek in Phase II was at Transect A (5.8 µg/L). In Phase II, surface water mercury concentrations declined approaching the Arthur Kill, with the lowest concentrations observed at Transects F and G, and concentrations in South Branch Creek approximately 10-fold higher than in the Arthur Kill (Appendix J). However, in Phase I, the maximum observed overall mercury concentration (18.1 µg/L) was at SW-5, in the general vicinity of Transect D. The concentration of unfiltered metals found in surface water is dependent on when in the tidal cycle the sample is collected (as discussed further below). Therefore, it is not possible to directly compare Phase I and Phase II surface water data.

To address the influence of tidal conditions, an additional separate sampling effort was performed to determine whether mercury from South Branch Creek is being transported to the Arthur Kill in either the dissolved or particle-bound phase. Particle-bound mercury, dissolved mercury, and suspended solids were sampled during two-hour intervals throughout an entire tidal cycle in February 2007. The samples were collected from the petroleum terminal bridge spanning South Branch Creek between Transects C and D. The data are summarized on Figure 6-24. Based on filtered surface water results, dissolved mercury was undetected in each of the samples. Therefore, mercury detected in surface water is associated with the suspended solid phase. Mercury was observed in each of the unfiltered surface water samples collected from South Branch Creek at concentrations ranging up to 5.8 µg/L, with a mean concentration of 3.2 µg/L.

Mercury was detected in both unfiltered and dissolved samples in the Northern Off-Site Ditch with a maximum concentration of 13.1 µg/L for unfiltered samples and 0.0173 µg/L for dissolved samples. The difference in mercury concentrations between total and dissolved samples indicated the mercury found in the Northern Off-Site Ditch is primarily associated with suspended particles.

Mercury was also detected in both the unfiltered and dissolved samples in the Southern Off-Site Ditch, however at much lower concentrations. A maximum concentration of 0.022 µg/L for unfiltered samples and 0.001 µg/L for dissolved samples was found in samples from the Southern Off-Site Ditch.

The CCC and CMC values for dissolved mercury are 0.94 and 1.8 µg/L, respectively. The highest unfiltered mercury concentrations in South Branch Creek were measured during ebb tide and the flood when water velocity is highest, which creates the maximum potential for mercury-containing solids to be suspended. The lowest mercury concentrations were measured during periods of high and low slack tide, when water velocity is low. Figure 6-24 shows that the values for total suspended solids and

turbidity follow the same tidal pattern. The pattern of mercury presence in surface water is clearly dependent on the tidal condition. The CCC and CMC values for mercury were not exceeded in dissolved samples from either the Northern or Southern Off-Site Ditches.

6.5.1.1 Methyl Mercury

Methyl mercury was also detected in each of the five unfiltered surface water samples collected at South Branch Creek in the Phase II RI, with a maximum concentration of 19.5 ng/L (0.0195 µg/L). In the two unfiltered surface water samples collected from the Arthur Kill, the maximum concentration of methyl mercury was 0.738 ng/L (Table 6-28). No Saltwater CCC and CMC values have been established for methyl mercury. The percentage methyl mercury of the total mercury concentration was low in all of those samples, with a maximum of 0.34 percent in South Branch Creek, and 0.31 percent in the Arthur Kill surface water samples.

Methyl mercury was also detected in the surface water collected during the regional study within Old Place Creek, where the maximum concentration was 0.091 ng/L (0.00091 µg/L; Appendix M Table N-2). This concentration is more than two order of magnitude below the highest level observed in the surface water in South Branch Creek, which would be expected based on the lower overall surface water mercury concentrations. However, the percentage methyl mercury of the total mercury concentration was 0.07 percent in the samples from the regional study, also lower than in either South Branch Creek or the Arthur Kill. These results indicate a lower rate of methylation.

As discussed further in Section 7.1.6, various factors affect the observed methylmercury presence in each medium. However, the net methylation rate (which accounts for both formation and removal mechanisms) in Old Place Creek surface water is, empirically, several times higher than that in South Branch Creek. In South Branch Creek and the Arthur Kill, methyl mercury represented between 0.05 and 0.16 percent of total mercury; in Old Place Creek, the percentage of mercury in the methylated form ranged from 0.35 to 0.51 percent. A similar pattern is observed in sediment, with South Branch Creek/Arthur Kill samples typically exhibiting less than 0.05 percent methylmercury, while Old Place Creek samples (except W 1 and W 2) contained 0.1 to 0.39 percent methylmercury. These data do not necessarily reflect the initial rate of methylation, but do suggest that overall the South Branch Creek system is producing a lower net rate of mercury methylation.

6.5.2 Other Metals and Arsenic

Of the 22 elements analyzed other than mercury, 12 metals and arsenic were detected in the surface water samples of South Branch Creek, eight in the Arthur Kill, 15 in the Northern Off-Site Ditch and 11 in the Southern Off-Site Ditch (Table 6-27, Appendix J). The frequency of detection for the South Branch Creek samples ranged from 20 to 100 percent. In the Arthur Kill samples, the detection frequency ranged from 50 to 100 percent. In Phase I, arsenic was observed between 59 µg/L and 114 µg/L in the near-facility portions of South Branch Creek (SW-1 through -3), declining to the 40 µg/L range further toward the Arthur Kill (SW-4 and -5) and to ND by the Arthur Kill (SW-6). Several metals (barium, lead, cadmium, iron, and zinc) showed the highest concentrations in the mid-South Branch Creek areas (SW-3 through SW-5) and lower concentrations closer to the former facility and in the Arthur Kill. In Phase II, however, the highest arsenic and metal concentrations were typically in the Transect A and B stations. As indicated above, the tidal influence prevents direct comparison of the results from the two sampling events, and concentrations are related to the presence of suspended material.

Various inorganic constituents were found in unfiltered samples exceeding the Saltwater CCCs and CMCs in the Off-Site Ditches, including arsenic, cadmium, copper, lead, nickel, and zinc, however only arsenic was found to exceed the criteria in dissolved samples. Dissolved arsenic was detected in the

Northern Off-Site Ditch at concentrations up to 152 µg/L, while the highest concentration found in the Southern Off-Site Ditch was 42 µg/L. Additionally manganese was found to exceed saltwater Human Health criteria in dissolved samples in both ditches, with a maximum concentration of 624 µg/L in the Northern Off-Site Ditch and 598 µg/L in the Southern Off-Site Ditch.

6.5.3 Organics

Traces of several PAHs (fluoranthene, fluorene, naphthalene, and phenanthrene, all less than 1 µg/L) were reported in the Phase II surface water samples at Transect A; a fraction of a µg/L of naphthalene was also reported in the Arthur Kill sample at Transect G. PAHs may be present as part of the suspended solids due to erosion of fill material.

Pesticide and PCB compounds, PCNs, and hexachlorobenzene were not detected in surface water.

Benzene and chlorinated benzenes (1,2- and 1,4-dichorobenzene and 1,2,4-trichlorobenzene) were detected in several surface water samples collected in South Branch Creek in both Phase I and II. No aquatic life-basis CCC or CMC values are available for these compounds. However, based on a literature review, aquatic life protection benchmarks were developed for benzene, chlorobenzene, 1,2- and 1,4-dichlorobenzene (Table 6-27). While occurrence was scattered, most of the higher reported concentrations were clustered in the Transects A, C, and D areas. These constituents were detected in groundwater and soil throughout the site. They were also present at substantially elevated concentrations in MW-6, a shallow well about 50 feet from South Branch Creek from which groundwater would be expected to discharge to the creek somewhere between Transects B and C. The chlorinated benzenes in surface water may be due at least in part to shallow groundwater infiltration. However, their widespread occurrence in surface water and sediments (see below) suggests a migration mechanism similar to that of other adsorbed site contaminants including historic wastewater and storm water discharge from the LCP and GAF sites..

Scattered detections of other VOCs (tert-butyl methyl ether and Freons) were reported in South Branch Creek surface water samples. The frequency of detection ranged from 20 to 40 percent. These constituents were not present in shallow groundwater near the stream and do not appear to be related to the site. VOCs were not detected in the surface water samples collected from the Arthur Kill.

6.6 Sediment

Phase II sediment samples were collected along five (5) transects located in South Branch Creek and two transects in the Arthur Kill near the mouth of South Branch Creek. Nine additional 0-0.5-foot samples were collected in the Phase I RI. The samples were collected following methods described in Section 3.3.5.

Phase II sediment samples were sampled to "human refusal", which occurred at depths ranging from 0.5 to 2.5 feet. Sample refusal, the depth at which the manually operated sampler could no longer penetrate, is assumed to correspond to the bottom of the sediment which is believed to be considerably softer than the underlying soils.

As described in Section 3, an extensive list of chemical constituents was analyzed in sediment as described in Section 3.7. The complete analytical results of detected constituents in sediment are presented in Appendix J. Of these, 23 TAL and 63 TCL analytes were detected in South Branch Creek (Transects A through E), and 20 TAL and 45 TCL analytes were detected in the Arthur Kill (Transects F and G). Table 6-29 presents a summary of descriptive statistics for the sediment samples for South Branch Creek and the Arthur Kill. Figures 6-25a through 6-27d show the spatial distribution of mercury, arsenic, and the total PCBs, Aroclor 1254 and Aroclor 1260, in the sediments from South Branch Creek and the Arthur Kill.

A regional study was performed in Old Place Creek in Staten Island, New York, a tributary of the Arthur Kill following the same methods and procedures as used during the LCP Phase II RI in which 86 analytes were detected. A summary of descriptive statistics for sediment samples collected during the regional study can be found in Appendix M, Table N-4.

There are no promulgated regulatory standards for sediment quality. However, the ER-L and ER-M screening values (Long, *et al.*, 1995) are used to provide a context for assessing the sediment data. These screening levels were selected from among several sets of frequently cited benchmarks because they are preferred by the NJDEP (NJDEP, 1998). The ER-Ls and ER-Ms represent the 10th and 50th percentile concentrations, respectively, associated with observed biological effects from systems with multiple contaminants. Correlation between effects and concentrations for many constituents, including mercury, was described by the Long, *et al.* (1995) as "weak." The ER-Ls are used as a threshold below which biological effects are not expected. The ER-Ms are indicators of when effects might be expected. The ER-Ms do not indicate biological hazard, only that additional risk evaluation may be warranted. Tables 6-30a and 6-30b list the ER-L and ER-M values for various constituents, along with exceedances of these screening values for South Branch Creek.

The ER-L value was exceeded for 23 constituents in at least one sample from South Branch Creek, and for 22 in the Arthur Kill. Twenty-two chemicals exceeded respective ER-Ms in South Branch Creek, 17 in the Arthur Kill. This pattern suggests a comparable level of criterion exceedance in both sampled areas.

In the descriptive text that follows, the South Branch Creek samples refer to those collected along Transects A through E, and the Arthur Kill samples refer to Transect F and G which are near the mouth of South Branch Creek. The transect locations are depicted on Figures 3-1 and 3-2, as well as contaminant-specific figures discussed below.

The horizontal and vertical delineation of site-related constituents for sediment is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of sediment may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.6.1 Mercury

Total Mercury

Total mercury was detected in 98 percent of the sediment samples in South Branch Creek, and in 100 percent of the sediment samples in the Arthur Kill (Table 6-29, Figure 6-25a, through 6-25d), and 100 percent of the sediment samples from both Off-Site Ditches (Figure 6-25e). The ER-L and ER-M concentrations for mercury are 0.15 and 0.71 mg/kg, respectively. Mercury concentrations exceeded both the ER-L and ER-M threshold in 48 of the 49 South Branch Creek sediment samples and also in all six of the sediment samples from the Arthur Kill. Although mercury was found in both areas, concentrations of mercury were higher in South Branch Creek than in the Arthur Kill. Mercury concentrations exceeded the ER-L threshold in each of the Off-Site Ditch samples. The ER-M threshold was exceeded in each of the samples from the Northern Off-Site Ditch, and 67% of the Southern Off-Site Ditch. The overall concentrations of mercury in the Northern Off-Site Ditch were elevated, averaging 90.2 mg/kg, although they were generally lower than those found in South Branch Creek. Concentrations of mercury in the Southern Off-Site Ditch were significantly lower, averaging 1.29 mg/kg.

As indicated on Figures 6-25a, there is a pattern of generally declining mercury concentrations in surficial sediment along South Branch toward the Arthur Kill. Maximum mercury concentrations (in the 300-400 mg/kg range) were reported in stations SED-A-1, SED-A-2, and SED-2, each of which was located at the headwaters of South Branch Creek. In the Transect B/SED-3 area, approximately 350 feet closer to the Arthur Kill, concentrations are substantially lower (all below 200 mg/kg). Slight increases are observed in the SED-C area, which is likely related to the depositional nature of this "back-bay" area and possibly to the presence of additional drainage inputs from the large concrete outfall that

is a historic remnant of the City of Linden trunk sewer line. Further toward the Arthur Kill, concentrations continue to decline, with concentrations between 24.5 and 128 mg/kg observed in the first Arthur Kill transect (Transect F). At Transect G, furthest out in the Arthur Kill, mercury ranged from 0.86 to 12.5 mg/kg. These concentrations are similar to those observed throughout the Arthur Kill in both published agency databases and in samples collected in Old Place Creek (Appendix M). Extensive regional information published by various agencies (Figure 2-28) indicates that mercury in the Arthur Kill is generally in the single digit mg/kg range. Samples collected form Old Place Creek to supplement the regional information revealed an average mercury concentration of around 7 mg/kg (Table N-4). Thus the concentrations of mercury in Transect G, which average 5.5 mg/kg, indicates that mercury attenuates to background in the area of the Arthur Kill just beyond the mouth of South Branch Creek.

Similar attenuation is observed for the deeper sediments (Figures 6-25b through 6-25d):, there is more of a distinct increase in mercury accumulation in the Transect C and D areas relative to more near-facility locations than is observed in the 0-0.5-depth interval, but the concentrations in sample SED-6 at Transect F (8.7 mg/kg at 0.5-1.0 feet and 4.8 mg/kg at 1.0-1.5 feet) are well within the range of background.

The pattern of mercury concentrations in surficial sediment in the Northern Off-Site Ditch do not show a decreasing gradient from upstream to downstream, however that is to be expected due to the parallel run of the ditch adjacent to former operations areas of the LCP Site. The concentrations of mercury in the Southern Off-Site Ditch are lower than those found in the Arthur Kill during the Phase II RI. The mercury results of the two off-site ditches indicates the Northern Off-Site Ditch has been impacted by runoff with contaminated sediment from the LCP Site, while the Southern Off-Site Ditch has not.

Table 6-31 and Figure 6-28 present the mercury sediment results in South Branch Creek by depth for each station (along with selected other elements). For clarity of display, the graphical patterns are presented separately for each transect. The pattern of mercury presence by depth is highly variable. In certain locations (such as SED-5 and SED-6) there is a marked gradient with depth such that mercury declines to background levels by the 1.0 to 1.5-foot depth interval. At other stations, there is no apparent decrease with depth, and the location where the deepest sediment was available for collection (SED-D-2) showed essentially no change in concentration down to 2.5 feet. Several stations (notably SED-3) exhibited a maximum observed concentration in the second shallowest depth interval (0.5-1.0 feet). Overall, there appears to be no correlation between the location along the channel and the vertical mercury gradients. This heterogeneity probably reflects the tidal flushing and related processes of deposition and re-suspension that vary by location and have resulted in variable degrees of sediment mixing over time.

Sequential Extraction

Seven samples from three transects were submitted for analysis by a selective sequential extraction method after Bloom, *et al.*, (2003). This five-step sequence of extractions groups mercury compounds into "biogeochemically" distinct categories. These data are presented in Table 6-32.

The majority of the mercury present was associated with fraction F4. F4 comprised between 65 and 88 percent of total mercury, and the proportion was not related to the total mercury detected or the location within the areas evaluated (Transects A through C). The next most common forms of mercury present extracted with the F5 fraction, indicating highly insoluble mercury sulfide. Higher total mercury concentrations appear to be associated with a higher proportion of F5 and a lower proportion of acid soluble (F2) but the correlations are weak and there are an insufficient number of data points to draw any firmer conclusions. There is essentially no soluble mercury in sediments. These results were very similar to the on-site surficial soils in which elemental mercury and mercury sulfides were predominant.

The developers of the sequential extraction procedure indicate in their paper (Bloom, *et al.*, 2003) that the presence of methyl mercury cannot always be definitively linked with one of the sequential extraction fractions, as mercury methylation is variable based on specific conditions (See Section 7 for additional discussion of factors affecting methylation). However, case studies indicate that the methyl fraction may be associated with F3 (organo-chelated forms). The percentage of mercury present in the F3 fraction is South Branch Creek sediments ranged from 0.16 to 4.8 percent of total mercury. Methyl mercury analyses were not performed on these specific samples; however, based on the extremely low presence of methyl mercury as a percentage of total mercury (Table 6-33), it is certainly feasible that the very low concentrations of methyl mercury could be a portion of the F3 fraction.

There are limited data on methyl mercury in the Arthur Kill basin overall. The agency databases report only total mercury results. In the regional study sediment samples collected in Old Place Creek, methyl mercury was detected in all 10 samples (Appendix M, Table N-4). The highest percentage of methyl mercury was 0.39 percent, slightly higher than observed in South Branch Creek or the Arthur Kill.

Methyl Mercury

Methyl mercury was detected in 29 of the 32 sediment samples collected from South Branch Creek and in all six of the sediment samples from the Arthur Kill (Table 6-33). The percentage methyl mercury of the total mercury concentration was low (fractions of a percent) in all of the samples. In general, samples with higher total mercury concentration exhibited lower percentage methyl mercury. Sample SED-C-2-0.5-1.0 from South Branch Creek sediment showed the highest maximum total mercury concentration (901 mg/kg) and the lowest percentage methyl mercury (0.0015 percent). Arthur Kill results for maximum total mercury (30 mg/kg) and percentage methyl mercury were lower than the results from South Branch Creek.

6.6.2 Other Metals and Arsenic

Besides mercury, 22 metals and the metalloid arsenic were detected in sediment (Table 6-29). Of these, ER-L and ER-M values have been established for arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc. ER-L and ER-M exceedance frequency (Tables 6-30a and 6-30b, respectively) for these elements in South Branch Creek sediment samples was 35 to 98 percent, and 2 to 98 percent, respectively. In the Arthur Kill, ER-L values were exceeded in 17 to 100 percent of the samples and ER-M values were exceeded for three of those eight elements with an exceedances frequency of 17 percent. In the Northern Off-Site Ditch, ER-L values were exceeded in 50 to 100 percent of the samples and ER-M values were exceeded for four of those eight elements(arsenic, lead, nickel, and zinc) with an exceedances frequency of 17 to 100 percent. In the Southern Off-Site Ditch, ER-L values were exceeded in 33 to 50 percent of the samples and ER-M values were not exceeded.

Nine metals had the highest concentrations in South Branch Creek and the lowest concentrations in the Arthur Kill. Arsenic concentrations were ten-fold higher overall in South Branch Creek than in the Arthur Kill, with a clear gradient from the Site (as discussed further below). Zinc and lead concentrations in South Branch Creek were approximately five times higher than in the Arthur Kill. Other metals had comparable concentrations in both sampled areas. Barium and cadmium had the highest concentrations in South Branch Creek, approximately ten-fold higher than in the Arthur Kill sediments.

Arsenic concentrations in the Northern Off-Site ditch were approximately 6 times higher than in the Arthur Kill. While the highest concentration of lead in the Northern Off-Site Ditch (242 mg/kg) was higher than the highest found in the Arthur Kill (161 mg/kg), the average concentrations of lead were comparable. Concentrations of other metals in the Southern Off-Site Ditch were comparable or lower than the Arthur Kill.

Arsenic

The distribution of arsenic in sediments at various depths appears on Figures 6-26a through 6-26d, and the depth distribution appears in Table 6-31. Figure 6-28 shows the variation by station and depth. There is an area of marked arsenic elevation in the headwater section of South Branch Creek, with surficial sediments containing up to 4,250 mg/kg arsenic (SED-2). Similar elevated levels of arsenic were similarly detected in this area in the low marsh soils (Section 6.2.2). Arsenic in other surficial sediment samples in the Transect A area ranged from 118 to 2,640 mg/kg.

Moving toward the Arthur Kill, arsenic concentrations decrease dramatically; by Transect F, arsenic ranged from 13 to 47 mg/kg, and by Transect G, the concentrations were between 14 and 16 mg/kg. These levels are comparable to the regional arsenic concentrations in agency databases, which reported arsenic in surficial sediments between 10 and 100 mg/kg, most frequently in the range of 20 mg/kg (Section 2.10). Arsenic concentrations in sediments collected in the regional study from Old Place Creek averaged 35 mg/kg (Appendix M Table N-4). Therefore, the arsenic impact, as with mercury, attenuates to background by the mouth of South Branch Creek.

The elevated arsenic concentration observed in SED-2 appears to be a surficial condition, since the 0.5-1.0-foot and 1.0-1.5-foot samples at that location only contained around 100 mg/kg. A decrease with depth was also observed in SED-6 and SED-E-2, and to a lesser extent in SED-4 and SED-5. Other locations showed no decrement with depth.

The headwater area of South Branch Creek is clearly impacted by elevated arsenic. However, the arsenic enrichment appears to be a relatively isolated condition, as concentrations drop off rapidly with distance from the headwater. This apparent arsenic hot-spot does not likely result from on-site sources. Arsenic is not associated with chlor-alkali facilities and the sediment concentrations are considerably higher than arsenic levels observed in site soils within the former LCP production area. These data suggest that the source of arsenic in this area may have originated from another off-site source, possibly as a result of overland flow in the swale along the railroad tracks from the duPont and GAF sites. The elevated nature of the arsenic concentrations in this area relative to in upland on-site areas has already been described in Section 6.2.2 as part of the low marsh soils discussion. The fish tissue data collected at Transect A (see Section 6.7.2) further indicate that there is an unusual form of arsenic present in this area

Arsenic concentrations found in the Northern Off-Site Ditch, presented in Figure 6-26e, do not appear to follow a clear pattern, with the highest concentration found in the middle B-transect, and comparable concentrations at the A and C transects. As discussed above, the concentrations are significantly elevated over the Arthur Kill, indicating a discharge of Arsenic into the Northern Off-Site Ditch. The highest concentrations of Arsenic in surficial soils on the LCP Site were found in the vicinity of the former Linde Hydrogen Plant, located north of the ditch, indicating runoff from this area of the Site may have impacted the Northern Off-Site Ditch.

Concentrations of Arsenic in the Southern Off-Site Ditch are comparable or lower than those found in the Arthur Kill indicating arsenic is not a concern beyond regional conditions.

Other Metals

Sediment results for other key metals (cadmium, copper, lead, nickel, and zinc) appear in Appendix J and Figures 6-29 through 6-32. In general, as illustrated in the figure, the concentrations of multiple inorganic elements show a high degree of correlation. Key pattern similarities include a decline in concentration with depth at SED-1, SED-C-2, SED-5, and SED-E-2 a concentration elevation at SED-B-1 with relatively consistent concentrations across the rest of Transect B; similar concentrations in all samples at SED-D-2 (all depths) and SED-D-3; and overall declining levels at the mouth of South Branch

Creek and into the Arthur Kill. Mercury generally correlates with the other elements, but shows a more marked decline along South Branch Creek and into the Arthur Kill. The relative immobility may be due to binding of mercury with sulfides to form insoluble cinnabar.

The high correlation among multiple elements suggests that the distribution is related to sediment characteristics (e.g., grain size) and not to specific sources. Visual descriptions of the relative grain size of the sediment are presented in Appendix C.

Acid Volatile Sulfide/Simultaneously Extractable Metals (AVS/SEM)

AVS/SEM measurements are used as a general indicator of bioavailability of divalent metals (cadmium, copper, nickel, lead, mercury and zinc) in sediment. The major component of AVS; iron sulfide (FeS), reacts with those metals to form metal sulfides. The solubility of these metal sulfides is very low, and they are therefore not considered bioavailable. In sediments that contained a high level of reactive sulfide, the partitioning of divalent metals (Cd, Cu, Ni, Pb, Hg, and Zn) into the aqueous fraction (pore water), which represents the contact medium for aquatic life, will be minimized. Conversely, sediments with SEM greater than AVS are of potential concern with regard to bioavailability from sediment. Specifically, where the AVS/SEM ratio is less than one, there is a potential for the presence of soluble (bioavailable) metals.

Four samples from South Branch Creek had AVS/SEM ratios below one (Table 6-34): two from Transect D and two from Transect E. Similarly, all three samples from Transect G in the Arthur Kill had AVS/SEM levels below one. These results suggest the potential for bioavailability of divalent metals in these sediments, possibly due to the low levels of sulfides associated with coarser-grained substrate. In general, the AVS/SEM ratios do not appear to correlate with the total SEM concentrations. However, as discussed above, bulk concentrations of metals overall are elevated in the portion of ditch closest to the former production facility. The total bulk concentration of metals is not useful in predicting the potential for bioavailability since concentrations of sulfides, which control bioavailability, vary. In fact, the sample with the highest total SEM (SED-B-1-0-0.5 in South Branch Creek, 0.27 µmoles/g) is predicted to have minimal bioavailability due to high AVS, and, conversely, the samples in the Arthur Kill with low total SEM have low proportional AVS and therefore higher predicted bioavailability. The AVS/SEM calculation is based on the total of divalent metals and therefore accounts for competition among individual metals for binding sites. In addition, other variables such as total organic carbon may bind metals. For these reasons, therefore, it appears as if the total concentration of metals is of limited use in predicting bioavailability and ecological risk in this system. Rather, the presence of sulfides and other ligands, likely associated with fine-grained, depositional sediments, may be the controlling factor.

6.6.3 Organics

PCBs

Sediments collected from South Branch Creek had PCBs detected in 16 samples. Those PCBs were identified as Aroclor 1254 and Aroclor 1260 (Table 6-35, Figure 6-27a through 6-27d) which are the same as those observed in the on-site soils. The ER-L and ER-M concentrations for Aroclor 1254 are 0.023 mg/kg and 0.18 mg/kg, respectively. Of the samples with detectable PCBs, 18 percent exceeded the ER-L and 16 of the ER-M threshold.

None of the Arthur Kill sediment samples had detectable PCB concentrations. In the Transect A area, Aroclor 1254 was present, while in the locations closer to the Arthur Kill, PCBs were identified as Aroclor 1260. The maximum observed concentrations was 2.73 mg/kg and 1.12 mg/kg in the surficial samples at station SED-8 and SED-2, respectively. Other PCB results in South Branch Creek were well below 1 mg/kg, and the deeper samples contained less than the shallower (0-5-foot) samples. Overall, the Transect A area contains slightly higher PCBs than the remainder of South Branch Creek. This pattern, and the presence of AR 1254 (found upland), suggests that there could be a contribution from

Site sources, although, as discussed in Section 2.6.1, other sources have historically discharged to this area as well. Additionally, regional studies of the Newark Bay estuary, as discussed in Section 2.10, have shown PCBs to be ubiquitous at concentrations similar to those found in South Branch Creek. These results indicate that there is the possibility of PCB contributions to South Branch Creek in the furthest upland transects.

PCBs were not in the Off-Site Ditch samples with a single minor exception. One sample from the Southern Off-Site Ditch contained total PCBs at 0.0985 mg/kg. These results suggest that PCB contamination is not an issue in the Off-Site Ditches.

PAHs

All eighteen analyzed SVOCs that are classified as polycyclic aromatic hydrocarbons (PAHs) were detected in sediment samples collected from South Branch Creek. The frequency of detection for these 18 chemicals in South Branch Creek samples ranged from 16 to 78 percent (Table 6-30a through 6-30b). ER-L/ER-M values have been established for 12 of these PAHs. The frequency of ER-L exceedances ranged from 4 to 39 percent. The ER-Ms were exceeded for 10 of these constituents, in 2 to 10 percent of the samples. The average total PAH concentration in South Branch Creek sediments was 8.3 mg/kg (Table 6-36 and Figures 6-33a through 6-33d). However, there was considerable variability: a relatively high value (27.6 mg/kg at SED-B-1-0-0.5) and the minimum (0.26 mg/kg at SED-B-2-0.5-1.0) were observed in the same transect.

In sediment samples collected from the Arthur Kill, 17 of the 18 PAHs were detected (2-chloronaphthalene was not detected). The frequency of detected chemicals ranged from 50 to 100 percent, with between 33 and 67 percent of samples exceeding ER-Ls and 17 to 50 percent exceeding ER-Ms. The average total PAH concentration in the Arthur Kill sediment samples (50.2 mg/kg)(Table 6-36) was nearly an order of magnitude higher than in South Branch Creek (8.3 mg/kg). The maximum observed total PAH concentration was in the shallowest sample at station F-3 (225 mg/kg), followed by 49.9 mg/kg and 19.9 mg/kg in SED-F1 and SED-F2, respectively. However, as with South Branch Creek, there was over two orders of magnitude variability within the Arthur Kill sample set.

In sediment samples collected from the Northern Ditch, 16 of the 18 PAHs were detected. The frequency of detected chemicals ranged from 67 to 100 percent. Of those detected, acenaphthene, anthracene, benzo(a)anthracene, chrysene, phenanthrene, dibenzo(a,h)anthracene, fluoranthene, and pyrene were detected above the ER-Ls. Only one sample for anthracene was detected above the ER-Ms. In sediment samples collected from the Southern Off-Site Ditch, 12 of the 18 PAHs were detected. The frequency of detected chemicals ranged from 17 to 100 percent. Of those detected only dibenzo(a,h)anthracene was detected above the ER-Ls. No samples for PAHs were detected above the ER-Ms.

The average total PAH concentrations for the Northern Off-Site Ditch (3.2 mg/kg) and Southern Off-Site Ditch (0.75 mg/kg) were lower than found in the Arthur Kill (50.2), indicating there is not an elevated concern for PAHs in sediment in the Off-Site Ditches compared to the Arthur Kill.

The profile of PAH compounds (Figures 6-34a through 6-34d) is similar at most stations and depths in both South Branch Creek and the Arthur Kill, with a relatively even distribution of various compounds. Total carcinogenic PAHs (cPAHs) in sediments and cPAHs normalized to B(a)P) are shown on Figures 6-35a through 6-35d. This pattern is similar to what was observed in site fill (Section 6.1.6). The exception was the portion of South Branch Creek nearest to the Site (Transect A area), where chrysene and benzo(a)anthracene (B(a)A) represented a higher proportion of PAH species. The samples with the different profile were also ones in which higher total B(a)P equivalents were observed; otherwise, cPAH concentrations were generally comparable throughout South Branch Creek and the

Arthur Kill, or higher in the Arthur Kill. It appears as if the cPAH presence in the Transect A area is from a source other than site fill or regional contribution. As discussed previously, this area has historically received flow from various non-site industrial sources, which appear to account for other contamination observed (notably arsenic).

PAHs are ubiquitous and the low-ppm concentrations observed in South Branch Creek are typical of industrialized waterways (ATSDR, 1995). Comparable concentrations were detected in the regional study samples collected in old Place Creek (which averaged around 5 mg/kg total PAHs; Table N-10). Furthermore, the elevated concentrations in the Arthur Kill sediments (Transect F) compared with South Branch Creek suggest a source unrelated to the Site. The PAHs detected in sediments (as well as low marsh soils) appear to be derived from regional sources, with the exception of some sediment in the Transect A area, which was derived in part from overland flow from neighboring properties.

PCDDs/PCDFs

Sediment samples were analyzed for 17 polychlorinated dibenzo-p-dioxins and -furans (PCDDs/PCDFs), 21 pesticides and herbicides, 51 non-PAH SVOCs and 46 volatile organic compounds (VOCs).

The full suite of analyzed PCDD and PCDF congeners was detected in nearly every sediment sample collected from South Branch Creek and the Arthur Kill. These data were expressed by normalizing to the WHO (2005) TEFs to obtain TEQ. The TEQs have been calculated individually for PCDDs and PCDFs and are presented in Table 6-37 and Figures 6-36a through 6-36c. Discussion of TEFs in assessing risk also appears in the Human Health and Ecological Risk Assessments (Appendices P and Q).

The spatial distribution of TEQ values is presented in Figures 6-36a though 6-36c. The lowest TEQ observed in South Branch Creek was at SED-A-2-1.0-1.5 (2 ng/kg), and the highest at SED-C-3-0-0.5 (170 ng/kg) These differences may be related to variations in depositional conditions; for example, the Arthur Kill has been repeatedly dredged over the years. Furthermore, the PCDDs/PCDFs in each of the study areas are within the range of urban sediment background for Arthur Kill and are substantially lower than the levels in Newark Bay. These data support the conclusion that South Branch Creek is a receiving area for PCDD/PCDF deposition from regional sources in addition to the apparent contributions of PCDFs from the site.

The proportions of PCDFs in the South Branch Creek samples are dominated by PCDFs, particularly in the landward samples (Figures 6-36a through 6-36b). The mid-channel South Branch Creek samples reveal decreasing proportions of PCDFs while the sample collected within the Arthur Kill (Transect G) are comprised nearly entirely of PCDDs. These data suggest that a site related contribution of PCDFs in the South Branch Creek sediments that becomes more progressively dominated by the PCDDs of regional origin in the samples approaching Arthur Kill.

Pesticides/Herbicides

A variety of pesticide and herbicide compounds were reported in sediments: a total of 12 compounds were detected in the South Branch Creek sediments, with a detection frequency ranging from 2 to 49 percent. In the Arthur Kill, six pesticide and herbicide compounds were detected, ranging from 17 to 83 percent detection frequency (Table 6-29).

The highest concentration observed was dieldrin at 15 mg/kg in the 1.0-1.5 foot depth sample at station SED-B-2. This observation appears to be an anomaly, as other dieldrin observations were all below 0.012 mg/kg. The principal pesticides present in sediments are DDT and its daughter products, which were distributed throughout South Branch Creek and the Arthur Kill. There does not appear to be any consistent pattern or relationship to the Site, with highest concentrations in SED-B-2 (1.0-1.5 feet) followed by SED-E-2 (0.5-1 feet), SED-B-2 (1.0-1.5 feet), SED-F-3 (0-0.5 feet), and SED-G-2 (0-0.5 feet).

The total DDT compound average concentrations were slightly higher in the Arthur Kill (1.2 mg/kg, Table 6-31) than in South Branch Creek (0.481 mg/kg), and the lack of an overall pattern indicates that the Site is not a source.

DDT and its daughter products DDE and DDD were also detected in both the Northern and Southern Off-Site Ditches, however their respective concentrations were lower than those found in either South Branch Creek or the Arthur Kill. The maximum detections of DDTin the Northern Off-Site Ditch was 0.244 mg/kg, and 0.0067 in the Southern off Site Ditch.

Chlorinated Benzenes

As in surface water, a variety of chlorinated benzene compounds (chlorobenzene, 1,2- and 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene) were reported in sediments. The maximal chlorinated benzene impact overall was in the Transect A area (up to 0.64 mg/kg chlorobenzene, 7.12 mg/kg 1,2-dichlorobenzene, 15.1 mg 1,4-dichorobenzene, and 11.8 mg/kg 1,2,4trichlorobenzene), although the maximum individual chlorobenzene concentrations were at Transect C (1.1 and 2.3 mg/kg, both at deeper locations at station SED-C-2). A somewhat lower chlorobenzene concentration (0.33 mg/kg) was observed in the 0-0.5-foot depth interval at this location. This pattern of increasing concentration with depth (which was not observed with other site-related constituents) suggests impacts from historic wastewater discharge and/or groundwater discharge that may be responsible for what was observed in sediments in this immediate area. Well MW-6S, which contained 16,200 mg/L of chlorobenzene, is within a couple hundred feet of the Transect C area of South Branch Creek. Similarly, benzene concentrations were highest in sediments at Transect C. Both chlorobenzene and benzene are more soluble than the di- and tri-chlorinated benzenes with lower k_{oc}s and would be expected to be more mobile at the groundwater/surface interface, but then to have lower residence times in surface water. These properties could account for benzene and chlorobenzene having a more pronounced presence in the area of the presumed groundwater intrusion but lower persistence in sediments overall when introduced via run-off/suspended solids.

Chlorinated benzenes were detected in the Northern Off-Site Ditch at concentrations generally between those found in South Branch Creek and the Arthur Kill, with one notable exception. 1,4-Dichlorbenzene was detected on average at 2.5 mg/kg, compared to the average of 0.3 mg/kg South Branch Creek. Chlorinated benzenes were not detected in sediments in the Southern Off-Site Ditch.

Other Organics

Sixteen non-PAH SVOC compounds were detected in South Branch Creek, with a detection frequency ranging from 2 to 57 percent (Table 6-29). Fifteen SVOCs have been detected in the Arthur Kill. The detection frequency for these 15 SVOCs ranged from 17 to 50 percent. Chlorobenzene was detected at concentrations 2 to 3 orders of magnitude higher in South Branch Creek than the Arthur Kill.

Notwithstanding low levels of benzene and chlorobenzene, as discussed above, VOCs were not generally prevalent in sediments. Seventeen VOCs were detected in the South Branch Creek sediments, with a detection frequency between 3 and 84 percent (Table 6-29). In the Arthur Kill sediments, eight VOCs were detected, ranging from 17 to 67 percent. Sixteen (16) VOCs were detected in the Northern Off-Site Ditch, with a detection frequency between 17 and 100 percent. Three VOCs were detected in the Southern Off-Site Ditch, with a detection frequency between 17 and 67 percent. All detected VOCs had concentrations within the same order of magnitude. With the exception of chlorobenzene, acetone, and toluene, VOC concentrations were in the low ug/kg range and are considered trace.

None of the organic compounds other than those discussed in Section 6.6.3.1 through 6.6.3.3 have ER-L and ER-M values established for them.

6.6.4 Sediment Toxicity

Four sediment samples were collected for concurrent sediment toxicity and bulk chemistry analysis. The samples were collected from Stations A-3, C-1, and E-1 in South Branch Creek (Figure 2-1). and Station W-2 in the tributary to Old Place Creek during the regional study (Appendix M, Figure N-1). The sediment toxicity report prepared by American Aquatic Testing of Allentown, Pennsylvania, appears in Appendix H.

Upon receipt and handling, the sediment toxicity testing laboratory, American Aquatic, reported that samples E-1 and C-1 produced mercury vapors (0.3 mg/m^3 and 0.09 mg/m^3, respectively) that could not be managed safely in the laboratory environment. Following extensive discussions with American Aquatic, several additional sediment toxicity testing facilities, and EPA/NJDEP, EPA authorized the elimination of these samples from the program on October 26, 2006. On October 27, 2006, American Aquatic transported these samples to the site where they were combined with the Investigational Derived Waste (IDW) for proper disposal.

Sediment toxicity testing using a 10-day testing protocol proceeded on sample A-3 and a regional control sample (W-2), as required by the method. Percent survival (56%) for the South Branch Creek sample was significantly lower than the laboratory control survival (95%). The site sample is considered acutely toxic because of the reduced survival in the acute testing conditions. Therefore, additional chronic testing was not performed.

Table 6-38 summarizes the 10-day survival rates for the marine amphipod (*Leptocheirus plumulosus*), along with sediment contaminant results, in the South Branch Creek and laboratory control samples. Table 6-38 excludes trace metals that were ND in both samples, common earth elements (aluminum, calcium, magnesium, potassium, and sodium), and PCDDs/PCDFs. The PCDD/PCDF TEQ for sample A-3 is 27 ng/kg (within the range throughout South Branch Creek and the Arthur Kill).

The overall pattern of organic compounds in the two samples is similar and does not suggest that organic contamination accounts for the difference in amphipod survival between the two stations. The differences in observed sediment toxicity are more likely related to differences in mercury concentrations.

6.7 Biota

Fish (mummichog) and crab (fiddler crab) samples were collected in South Branch Creek, and the Arthur Kill in September 2006. Fish samples were collected at the approximate midpoint of each transect, at high tide, and crab samples were collected from each bank of the channel at each transect, at low tide (Figure 3-2 and Appendix M, Figure N-1). Fish and crab samples were rinsed, but not depurated and analyzed on a whole body basis for the list of COPECs (see Section 3.3.6). Detected analytes in tissue samples are presented in Tables 6-39a and 6-39b and Appendix J.

Specimens were inspected for obvious deformities. None were noted in the crabs. An anatomical abnormality was noted in only one individual fish, from sample MC-E. This specimen presented with a bulbous growth under the gill at the ventral side of the fish. The growth was a clear bladder, approximately twice the size of the fish's eye. There was some red visible inside, possibly blood. This particular fish measured 67 mm and weighted approximately 3.5 grams (a just above average size for this sample).

During exploratory seining as part of pilot studies, some mini krill and shrimp were observed. However, this method was not used for the specimen collection. Crabs observed were almost entirely *uca pugnax* (Atlantic marsh fiddler), with an occasional *uca minax* (red-jointed fiddler crab, estimated at 1-5% of the

specimens encountered). Other species noted were blue crab (one notation, several observations, with larger specimens observed towards the mouth of South Branch Creek), black fingered mud crab (one observation of an apparent juvenile, 1 to 1 ½ inches long), and the occasional small unidentified crab.

No incidental observations of fish other than mummichog were noted. However, the fish collection efforts involved the use of minnow traps designed to capture small fish and were not intended to serve as a fish population survey tool.

Fish and crab whole body tissue was analyzed for 10 metals, methyl mercury, arsenic speciation compounds (arsenobetaine, arsenite, arsenate, monomethylarsonate, and dimethylarsinate), percent lipids, percent solids, and 156 PCB Congeners. Tables 6-39a and 6-39b present a summary of descriptive statistics for the fish and crab tissue samples, respectively; Figures 6-37a through 6-38b show the spatial distribution of mercury and arsenic in these samples.

Mummichog and fiddler crab samples were collected in the tributary to Old Place Creek during the regional study in September 2006. A summary of descriptive statistics for fish and crab tissue samples collected during the regional study can be found in Appendix M, Table N-12a , N-12b Figures N-9a through N-10b in Appendix M show the spatial distribution of mercury and arsenic in fish and crab tissue in samples from the regional study

The horizontal and vertical delineation of site-related constituents for biota is adequate to perform the analysis and selection of remedial alternatives as part of the Feasibility Study (FS). Additional delineation of biota may be performed, as necessary, as part of a Pre-Design Investigation (PDI).

6.7.1 Mercury

The distribution of mercury concentrations in fish (Figure 6-37a) paralleled those observed in sediment, with the maximum concentration (7.68 mg/kg) reported in sample MC-C (Transect C), somewhat lower concentrations in Transect A (2.59 mg/kg in MC-A), a somewhat lower concentration in Transect B, and diminishing concentrations approaching the Arthur Kill. The one fish sample collected from the Arthur Kill (MC-F) contained 0.535 mg/kg mercury, comparable to the levels in fish collected from Transects D and E. The comparability of the patterns of mercury in fish tissue and sediment reflects the low mobility of this fish species and is consistent with bioaccumulation from the sediment in the immediate habitat area. However, since aquatic animals are consumed whole, for risk estimation purposes, whole body measurements are the most representative. The DERA estimates food chain exposures based on the whole body data.

Typically, the majority of mercury in fish tissue would be present in the methylated form, as was the case in the samples where total mercury was relatively low. However, where fish tissue mercury was highest, the majority of mercury is not methyl mercury (Table 6-40a). Possibly the quantity of mercury in sediments in these areas has resulted in uptake of elemental or inorganic forms via a less typical mechanism. The higher levels of total mercury may result from incidental sediment in the gut.

The distribution of mercury in crab samples differed slightly from that in fish (Table 6-40b, Figure 6-37b). The maximum concentration (70.2 mg/kg) was detected in FC-C-1 (Transect C), but Transect B showed the next highest concentrations, followed by Transects A and D. The total mercury concentration detected in one of the two samples from the Arthur Kill (FC-F-2; 3.74 mg/kg) was comparable to that observed in samples from Transect A.

Tissue samples collected during the regional study (Old Place Creek) contained far lower mercury concentrations than those collected from South Branch Creek, with a maximum concentration of 0.15 mg/kg in fish and 0.19 mg/kg in crab (Appendix M, Tables N-13a and N-13b, Figures N-9a and N-9b).

Crab sample mercury reflected a lower percentage of methyl mercury, ranging from 0.77 to 78 percent in South Branch Creek (Table 6-40b and Appendix M Table N-13b). The crab samples revealed a clear negative relationship between total mercury and percentage methyl mercury. Overall the percentage methyl mercury in biota tissue was higher where the total mercury concentration was lower, although this pattern was more consistent in crabs than in fish.

Crabs and fish contained comparable levels of lipids, approximately 1 percent of body weight.

6.7.2 Arsenic

As with sediment, arsenic concentrations in both fish and crab tissue (presented on Figures 6-38a and 6-38b, respectively) exhibited a notable elevation in the MC-A and FC-A samples (Transect A). Concentrations elsewhere in South Branch Creek and in the Arthur Kill stations were relatively consistent (in the 3 to 6 mg/kg range for fish and the 7-10 mg/kg range for crabs). The regional study arsenic concentrations in fish tissue averaged 2.4 mg/kg (Table N-12a, Appendix M), somewhat lower. However, the regional study total arsenic crab data (average 9.9 mg/kg; Table N-12b) were comparable to those from South Branch Creek and Arthur Kill These data suggest that other than in the area of extremely elevated sediment, arsenic concentrations in crab tissue are not especially sensitive to the immediate sediment quality and may be homeostatically regulated.

Speciation data for arsenic in fish tissue appear in Table 6-41. As predicted based on arsenic's known tendency to predominate in fish tissue in an organic form (ATSDR, 2007) a very small proportion of arsenic was inorganic (typically in the range of 1 percent or less), with the majority present as arsenobetaine (a nontoxic organic form). The exception was in the area of highly elevated arsenic sediment concentrations, MC-A (Transect A), which showed 2-3 percent organic arsenic. In addition, the arsenic species that were analyzed (trivalent inorganic, pentavalent inorganic, arsenobetaine, dimethylarsinate, and monomethylarsonate) accounted for the approximate total arsenic present in most samples. At Transect A, however, the total arsenic concentration did not reflect the sum of these forms, with only 20 to 38 percent of the total arsenic accounted for (Table 6-41). These results suggest that the fish in Transect A have accumulated an unusual form of arsenic that is not typical in the environment, perhaps a complex organic form. This unusual arsenic contamination appears to have no relationship to the former chlor-alkali operations or anthropogenic fill and provides additional evidence of a separate, off-site source of arsenic into the head end of South Branch Creek.

The arsenic tissue data were carefully reviewed and the appropriate moisture corrections were applied. Certainly there are precision issues with comparing the sum of speciated forms with the total for the analyzed element. This imprecision is exacerbated by the fact that the speciation analyses and the bulk analyses were performed by different laboratories. Nonetheless, each of the crab tissue samples in South Branch Creek and the Arthur Kill with the exception of the FC-A samples showed sums of arsenic species that accounted for between 70 and 120 percent of the total arsenic concentration, which is relatively good correlation given the inter-laboratory situation and the matrix effects. The arsenic forms in the FC-A samples, on the other hand, only accounted for 20 to 38 percent of total arsenic. Thus a majority of arsenic in those samples is not inorganic or in the most common organic forms, methylated and betaine, which typically accounts for the majority of arsenic in fish issue (Ackley, *et al.*, 1999). In summary, the arsenic therefore appears to be in some other organic form that is not commonly observed.

The nature and source of the unidentified arsenic species is unknown. However, as detailed in earlier sections of this report (see Section 2.6.1), the headwaters area of South Branch Creek has historically received drainage from the duPont and GAF sites, which are known to have used and potentially discharged arsenicals. It is therefore entirely plausible that the arsenic present in the fish in this area of markedly elevated arsenic concentrations in sediment have accumulated an arsenical that is not commonly found.

6.7.3 Other Metals

Table 6-39a presents the descriptive statistics for fish tissue data for the other inorganic COPECs (barium, chromium, copper, iron, lead, manganese, vanadium, zinc). These eight metals were also detected in the fish tissue sample from the Arthur Kill. In the crab samples from South Branch Creek, these eight metals and arsenic were also detected in all 10 samples collected; as well in both crab tissue samples from the Arthur Kill (Table 6-39b).

Figures 6-39 through 6-41 illustrate the distribution of fish tissue inorganic results. Barium concentrations in fish tissue samples were highest in South Branch Creek samples, approximately 10-fold higher than the Arthur Kill. Fish tissue concentrations for iron, lead, manganese, vanadium, chromium and copper were the lowest in the samples collected from South Branch Creek. All metals but barium were detected in the same order of magnitude in both sample areas. Figures 6-42 through 6-44 show the distribution of inorganics in crab tissue. Barium, zinc, and lead concentrations in crab tissue samples were highest in South Branch Creek samples. Barium concentrations in crab tissue samples collected from South Branch Creek were 10-fold higher than the Arthur Kill. Crab tissue concentrations for iron, manganese, vanadium, and copper were the lowest in the samples collected from South Branch Creek. All other elements were present at comparable concentrations.

Overall, no pattern of elevated fish tissue concentrations is observed with these other metals (Figures 6-40 through 6-41). In crab tissue, barium, iron, lead, and zinc are present at higher concentration in South Branch Creek biota samples than in the Arthur Kill. As with mercury, this observation may reflect retention of impacted sediment in the gut rather than accumulation in tissue.

Further discussion of the biota-sediment accumulation factors appears in Section 6.8.

6.7.4 PCBs

Co-planar PCBs were analyzed in tissue. Of the 156 PCB congeners analyzed, 131 were detected in the fish tissue samples collected from South Branch Creek (Table 6-39a, Figure 6-45). The PCB conger detection frequency ranged from 20 to 100 percent. In the sample collected from the Arthur Kill, 99 PCB congeners were detected. The total concentration of PCBs (sum of the average congener concentrations) was only slightly higher in South Branch Creek (344 ug/kg) than in the Arthur Kill (209 ug/kg), and comparable to the concentration of 278 ug/kg detected in samples from the regional study (Appendix M, Table N-12a). These concentrations are above the fish flesh criterion of 100 ug/kg that has been developed for the most sensitive receptors (mink), but below that estimated for less sensitive receptors such as rabbit (660 ug/kg; Newell, *et al.*, 1987).

The comparability of the PCB data in fish tissue from various locations indicates that PCB bioaccumulation from the South Branch Creek area is comparable with regional conditions.

In crab tissue, total PCBs in South Branch Creek specimens averaged 211 ug/kg, with 86 ug/kg in Arthur Kill samples (Table 6-39b, Figure 6-46), the same total PCB concentrations as observed in the regional study crab samples (Table N-12b, Appendix M). The greater elevation in South Branch Creek crab but not fish tissue concentrations probably reflects the tendency of undepurated crabs to retain sediment in their guts, thereby more closely reflecting the immediate sediment quality.

6.8 Measures of Biological Accumulation

6.8.1 Bioconcentration Factors (BCFs)

Bioconcentration factors (BCFs) reflect the accumulation of contaminant in tissue from water. They are estimated as follows:

$$BCF\left(\frac{l\,water}{kg\,tissue}\right)=\frac{mg/kg\,tissue}{mg/l\,water}$$

Based on the average total mercury concentration in fish and surface water from Transects A through E (2.6 mg/kg and 3.9x 10^{-3} mg/l, respectively; see Tables 6-39a and 6-27 for the data), the bioconcentration factor (BCF) from water to fish is approximately 700 (Table 6-42). Using methyl mercury results (0.68 mg/kg in fish and 5.5 x 10^{-6} µg/L in fish and water, respectively), the approximate BCF for methyl mercury is 1 x 10^{5}. Using the samples from Transect F to represent the Arthur Kill (no fish were obtained at Transect G), the total and methyl mercury BCFs are estimated at 400 and 4 x 10^{5}, respectively. These BCFs are comparable with those that have been reported in the literature (see Section 7.2) and indicate that bioaccumulation is occurring despite the tiny proportion of total mercury present in surface water that is methylated.

6.8.2 Biota-Sediment Accumulation Factors (BSAFs)

Tissue accumulation is not typically a concern for metals. However, the USEPA previously expressed concern about the potential for tissue accumulation and specifically requested tissue analyses for 10 metals. To address the resulting data, Biota-Sediment Accumulation Factors (BSAFs) were calculated for these metals. The BSAFs provide an estimate of the uptake of chemical constituents from sediment to biological tissue by taking the lipid-normalized concentration in organisms divided by the organic carbon-normalized concentration in sediments. The BSAFs for metals are reported as:

$$BSAF\left(\frac{kg\,sediment}{kg\,tissue}\right)=\frac{mg/kg\,tissue}{mg/kg\,sediment}$$

And the BSAFs for total PCB Congeners are reported as:

$$BSAF\left(\frac{kg\,OC}{kg\,lipid}\right)=\frac{mg/kg\,lipid}{mg/kg\,OC}$$

These BSAFs are based on the undepurated data, meaning that the total tissue concentrations reflect sediment retained in the gut. The BSAFs therefore may not provide an accurate representation of contaminants accumulated in tissue. However, mummichog and crab are prey species consumed whole. Therefore, the BSAFs estimated based on the undepurated results reflect the food chain impacts.

The BSAFs for fish and crab tissue are presented in Tables 6-43a and 6-43b, respectively. They are highly variable but all well below 1, indicating that the tissue contains lower concentrations than sediments in the corresponding areas. Thus biomagnification into tissue is not occurring from sediment.

The squares of the regression coefficients (R^2) values are also shown in the tables. These values show the statistical strength of association between the sediment concentration and the tissue concentration; they do not indicate the magnitude of the BSAF (the slope of the relationship, or extent to which tissue will change in response to sediment concentrations). Specifically, the R^2 value (0-1) represents the proportion of change in one variable that can be predicted by the other variable. Note that R^2 values

only give a guide to the "goodness-of-fit" and do not indicate whether an association between the variables is large or statistically significant. R^2 values below 0.69 are considered not to be strong enough to conclude that there is any substantial association.

The analytes with R^2 values above 0.69 for fish in South Branch Creek were total PCBs, barium, and lead. The analytes with the R^2 values above 0.69 for crab in South Branch Creek were arsenic and total PCBs. These results suggest that the tissue concentrations of these analytes are associated to some extent with sediments, although none of the relationships are strong.

6.8.3 Mercury

The highest fish BSAF for mercury in South Branch Creek is 0.023 in Transect B. In the Arthur Kill, the fish BSAF for mercury is 0.0089 (Table 6-43a). In South Branch Creek, the R^2 value is 0.68, below a level indicating a meaningful relationship. These BSAFs indicate minimal dependence of fish tissue concentrations on sediment concentrations within small geographic zones. However, the concentrations of mercury in fish do indicate an overall impact from mercury presence in sediments, since the levels are well above those that have been reported in various New York Harbor estuary samples (USEPA, 1997), which were typically in the 0.2 mg/kg range. The concentrations reported by the USEPA are similar to those observed in the regional study conducted in Old Place Creek, where concentrations in fish ranged up to 0.15 mg/kg, thus indicating that Old Place Creek is representative of regional conditions.

The highest crab BSAF for mercury is 0.31 at station B-2 in South Branch Creek (Table 6-43b). In the Arthur Kill, the highest crab BSAF for mercury is 0.13. The highest crab BSAF for mercury in the regional study is 0.1 at station W-2. Crab BSAFs decrease as mercury sediment concentrations increase, suggesting a saturation of the bioaccumulation mechanism. In cases where exposures impact population dynamics, the appearance of decreases in accumulation with increasing concentrations can be indicative of lethality in the higher-exposed individuals. This phenomenon does not appear to be the case in South Branch Creek. The populations of both fish and crabs in South Branch Creek were observed to be robust and healthy. There were no observed die-offs or apparent deformities associated with the higher-mercury concentrations zones, nor evidence of fewer individuals. Therefore, lethality with increasing concentrations is not a likely explanation for decreasing BSAFs with concentration. Note the uptake functions for mercury (and other metals) in invertebrates have been shown to be logarithmic and generally follow the algorithm $\log(y) = a' + b \log(x)$, where y and x represent the tissue and sediment concentrations, respectively, and the BSAF is estimated as y/x (see Bechtel Jacobs, 1998[6]). Thus mercury BSAFs show a declining relationship with concentration.

No correlation between the crab BSAFs and the sediment mercury concentration was observed in South Branch Creek. As with fish, however, crab mercury tissue burdens in South Branch Creek, which ranged up to 70 mg/kg, were well above mercury invertebrate concentrations that have been reported regionally (0.1 to 0.3 mg/kg; USEPA, 1997), indicating that even if individual sample concentrations cannot be predicted based on localized sediment levels, there is bioaccumulation overall from South Branch Creek sediments.

6.8.4 Other Metals

As mentioned above, metals other than mercury with the high R^2 values for fish in South Branch Creek were barium (0.89) and lead (0.78). The highest fish BSAF for metals other than mercury in South Branch Creek is 0.56 for barium in Transect C (Table 6-43a). The R^2 value for this BSAF barium is 0.89,

[6] Bechtel Jacobs, 1998. Biota Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation. Oak Ridge National Laboratory, Oak Ridge, TN. BJC/OR-112.

indicating a strong relationship between the sediment concentration and tissue concentration. As mentioned above, the other metals with the high R^2 values for fish in South Branch Creek were barium (0.89) and lead (0.78).

However, the fish BSAFs for barium (as well as for manganese, vanadium, zinc, and copper) decrease as concentrations for those metals in South Branch Creek sediments increase. These observations suggest a saturation mechanism where the proportion of uptake decreases as the concentrations increase. As stated above, failure to thrive among higher-exposed individuals is an unlikely explanation for the negative relationship between BSAFs and sediment concentration. In addition, barium is not a bioaccumulative constituent. It is not identified by EPA as a Persistent Bioaccumulative and Toxic (PBT) chemical. A mean bioaccumulation factor (BAF) for earthworms of 0.088 has been reported[7] ; BAFs for small mammals range from 0.014 to 0.019[8]. These low BAFs indicate no propensity for barium to bioaccumulate.

The highest crab BSAF for metals other than mercury in South Branch Creek is 5.6 for barium in Transect A (Table 6-43b). This is also the highest observed crab BSAF for metals. In the Arthur Kill, the highest crab BSAF is 2 for copper. The highest crab BSAF for metals in the regional study is 5.0 at Transect X, also for arsenic. The R^2 value for arsenic is 0.96, indicating a strong relationship between the sediment concentration and tissue concentration and therefore a high confidence in the calculated BSAF. As mentioned above, the other constituent with a high R^2 value for crab in South Branch Creek is total PCBs. In the regional study none of the analytes had R^2 values for crab above 0.69, indicting no meaningful association between tissue and sediment.

6.8.5 Total PCB Congeners

PCB sediment data were analyzed as Aroclors, while tissue data were analyzed as PCB congeners. These data sets are not directly comparable, and therefore BSAFs were not estimated using the measured tissue data. The Baseline Ecological Risk Assessment (BERA: Appendix P) estimated total Aroclor 1254 and 1260 concentrations in tissue using literature-derived BSAFs (1.99 for crab and 2.14 for fish). Please refer to the BERA for additional discussion and application of these BSAFs.

6.9 Summary of Overall Nature of Contamination

6.9.1 Soil Summary

Contaminants derived from manufacturing activities at the LCP site have directly impacted soil quality as a result of site operations. Contaminated soil provides a historic and potential ongoing source of contamination of other media. The soil impacts are primarily observed in the shallow anthropogenic fill soils given the fact that the discharges likely occurred on the ground surface. The underlying natural soils, including the tidal marsh deposits and glacial till, are impacted to a much lesser degree than are the anthropogenic fill soils.

Overall, the only soil constituents that clearly appear to have originated from historic chlor-alkali site operations are mercury, PCNs, and HCB and, to a limited extent, PCDFs. PCBs are also a site-related constituent due their potential presence in electrical equipment on the site. Other constituents that are present in the anthropogenic fill and/or represent regional background conditions include arsenic and other metals, PCDDs, PAHs, BTEX, chlorobenzene, and several other miscellaneous organics.

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[7] Sample, B.E. et al, 1998. Development and Validation of Bioaccumulation Models for Earthworms. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM-220.

[8] Sample, B.E. et al, 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-219.

Site related contaminants in soil have been horizontally delineated to the north and west where the LCP property abuts the LPH Site, which itself has been investigated and has received an NFA designation for soil contaminants (Section 2.1.2). Soil contaminants are bounded to the east by South Branch Creek. Contamination in fill material has not been delineated in the area located south of the Linde Hydrogen Plant, however, given the findings of the Off-Site Ditch Investigation have shown site related contaminants in the Northern Off-Site Ditch. It is reasonable to conclude shallow soil contamination in the vicinity of the Linde Hydrogen Plant is bounded to the south by the Northern Off-Site Ditch, particularly given the unimpacted condition of the Southern Off-Site Ditch. Site-related contaminants have been vertically delineated as evidenced by data from the underlying Tidal Marsh Deposits and Glacial Till soils.

Site Operations Constituents

Mercury is the primary site-related contaminant and is present in soil as a result of the chlor-alkali manufacturing process at the LCP site. Elevated levels of mercury, including visible elemental mercury, were found in the anthropogenic fill soils throughout nearly the entire site. The highest mercury concentrations were observed in and around the former production area near Buildings No. 230, 231, and 240, including beneath the buildings. Substantial attenuation of mercury concentrations was observed in the underlying natural soils. No exceedances of NJ NRDCSRS were observed in the glacial till except beneath Building No. 240. The mercury in soil is relatively immobile given the fact that it is primarily present in relatively insoluble forms including mercury sulfide and elemental mercury.

PCBs (Aroclors 1254 and 1260), PCN, and HCB are widely distributed across the site within the anthropogenic fill. Some occurrence of PCDFs may be related to the site. PCBs are associated with the electrical equipment that was formerly used on the site. PCNs, HCB, and sometimes PCDFs formation are formed as byproducts in chlor-alkali plants through the reaction of the chlorine with the graphite anodes. The decreasing vertical distribution of PCBs, PCNs, HCB in the fill suggests on-site surface sources of these other constituents. The site-related occurrences of PCBs, PCNs, HCBs, and PCDFs are generally co-located with samples containing elevated levels of mercury, as shown on Figure 6-47.

Anthropogenic Fill and Regional Constituents

Other constituents that are not related to manufacturing activities at the site are frequently detected in the site soils, particularly in the anthropogenic fill. These include arsenic and other metals, PCDDs, PAHs and other organics, including chlorobenzenes. The ubiquitous presence of arsenic, other metals and PAHs in areas with no production history, the presence of anthropogenic fill, the absence of a decreasing concentration gradient within the fill, and the absence of an association with the known sources of contamination lead to the conclusion that the occurrences are not associated with LCP site operations; rather they are associated with the presence of anthropogenic fill materials and/or neighboring operations as shown on Figure 6-48. Arsenic concentrations found in soil in the vicinity of the former Linde Hydrogen Plant, as well as the upstream areas of South Branch Creek, are elevated beyond the concentrations found typically throughout the site-wide anthropogenic fill material. Arsenic is not a site-related process chemical; however locations where arsenic concentrations are elevated beyond those found in anthropogenic fill are sufficiently co-located with process related contaminants and therefore would be subject to remediation.

Sporadic elevated concentrations of chlorobenzenes and other VOCs are observed in anthropogenic soils. Substantially higher concentrations of chlorobenzenes are observed in the deep fill as compared to the shallow fill which suggests the absence of an on-site source. Chlorobenzenes (mono, di, and tri) were extensively used in the manufacture of organic dyestuffs and pigments at the GAF site, as

described in the GAF RI Report, (Eckenfelder, 1991). As a result, chlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene are among the most commonly detected organic constituents in soil and groundwater at the GAF site. Chlorobenzenes were generally not detected in the underlying tidal marsh deposits.

6.9.2 Low Marsh Soil Summary

Low marsh soils represent native tidal marsh material that has likely been overlain by deposition of aquatic sediments during tidal surges. Samples collected were shallow (0-0.5- feet deep) and therefore likely reflect the sediment deposition component.

In general, the low marsh sample contamination indicates higher association with sediment than with marsh deposit soils in the upland portion of the site. Mercury was highest in the low marsh samples near Transect C, not along the portion of South Branch Creek closest to the site. Furthermore, the total mercury present in low marsh soils was higher overall than in the tidal marsh deposits upland on the site (Figure 6-1c).

Other site-related constituents were not prevalent in the low marsh material. Hexachlorobenzene, and PCBs, which were present throughout surficial site soils, were minimally detected in low marsh soils. Conversely, arsenic concentrations were higher in low marsh soils than anywhere on site. PCDDs and PCDFs were higher in locations approaching the Arthur Kill than closer to the Site.

The contaminant distribution is similar to that observed in sediments, reflecting only mercury as a principal contaminant of site origin. Additional discussion of the low marsh soils in the context of overall site contamination appears as part of the sediment evaluation (Section 6.6.4).

6.9.3 Groundwater Quality Summary

Surface Water Quality Standards (SWQS) are utilized herein for comparison to bedrock groundwater quality as the bedrock water-bearing zone was formally reclassified as Class III-B due to its natural saline conditions. The SWQS are utilized, in the absence of a NJDEP-approved method for the development of alternate groundwater quality criteria, to be protective of surface water quality in South Branch Creek and the Arthur Kill as a result of discharging bedrock groundwater. The overburden groundwater quality data are compared to the Groundwater Quality Standards (GWQS) given that its classification remains as Class IIA.

The source of groundwater contamination within the overburden water-bearing zone is the dissolution of various constituents from the site soils. Accordingly, mercury is the only site-related contaminant that is generally found in groundwater, albeit at relatively low concentrations. The other site-related constituents, including PCBs, PCNs, HCB and PCDFs, are relatively insoluble and are not detected in groundwater.

Other detected groundwater constituents including arsenic and other metals and several VOCs and SVOCs are not site related. The highest VOC/SVOC detections are attributed to historic off-site sources including the adjacent NOPCO site and the historic wastewater conveyance from the former GAF site. However, many of these same compounds may occur from their dissolution from the anthropogenic fill. Mercury levels in overburden groundwater is either detected at relatively low concentrations or is not detected, and is generally limited to areas of the site in which very high levels of mercury are observed in the soils. These findings provide additional evidence that mercury in soil is present in primarily insoluble forms. Moreover, mercury in groundwater was largely undetected around the perimeter of the closed RCRA unit, demonstrating that that unit is not a source of mercury in groundwater.

Most groundwater constituents in bedrock are undetectable except in the northwest area of the site, upgradient of the LCP production area. Mercury, benzene, and chlorobenzenes are detected within the zone in which the GAF groundwater extraction system has been shown to induce bedrock groundwater

flow from the neighboring GAF site. However, bedrock groundwater is captured and treated by the adjacent GAF groundwater remediation system. None of the detected groundwater constituents form laterally continuous plumes across the site, regardless of whether or not they are related to the site production areas. These sporadic patterns reflect the relatively sporadic distribution of various source materials in the soils (e.g., VOCs).

No free phase organic liquids were observed in the groundwater column in either overburden or bedrock monitoring wells.

Site-related contaminants and arsenic in groundwater have been vertically and horizontally delineated in both the overburden and bedrock water bearing zones. Delineation of non-site related contaminants benzene and chlorobenzene in the overburden groundwater is not complete in the southeast direction, towards the NOPCO facility. No further delineation is necessary of site related contamination in groundwater.

6.9.4 Sediment and Surface Water Quality Summary

South Branch Creek and the Northern Off-Site Ditch exists within the regionally contaminated Arthur Kill system and has also been impacted by numerous localized historical inputs in addition to the LCP site. Thus contamination observed is attributable to impacts from four general sources: site operations; contamination on site due to contaminated soil/fill; discharges from non-site sources; and regional contamination.

Mercury, present throughout sediment and surface water in South Branch Creek and the Northern Off-Site Ditch, is site related. Shallow groundwater in the vicinity contains little or no mercury, so sources are historically related to direct discharges and surface run-off. There is no substantial ongoing drainage from the site to South Branch Creek. It is not specifically known to what degree runoff from the LCP site drains into the Northern Off-Site Ditch although this appears to be a likely transport pathway. Mercury appears in suspended particulates in surface water as well as low marsh soil, which has likely been impacted by upland sediment deposition. Mercury concentrations are highest in the areas of historical inputs, namely Transect A, which has received drainage from multiple sources over the years, and the former City of Linden sewer pipe at Transect C. Mercury concentrations attenuate with distance from the site and are comparable to regional Arthur Kill background by the confluence with the Arthur Kill. Other site-related constituents reported in sediments are low-level PCBs, PCDFs, and chlorinated benzenes, all of which show a similar gradient leading to background or undetected concentrations in the Arthur Kill. Site-related sources of mercury within the South Branch Creek sediment and surface water are primarily related to historic stormwater discharges from the LCP site. Shallow groundwater that discharges to South Branch Creek contains little or no mercury, such that groundwater is not an ongoing mercury migration pathway to South Branch Creek. Furthermore, stormwater discharges from the site to South Branch Creek have been poorly defined since about 1976. Given the estimated stormwater discharge velocities and volumes, ongoing mercury migration via this pathway has been and likely continues to be minimal. The concentration gradient of Mercury found in the Northern Off-Site Ditch is less defined due to the parallel configuration of the Ditch alongside the operations areas of the Site.

As described in Section 2.6.1, no defined stormwater drainage system currently exists at the LCP site. Large areas of the site are currently undrained given the remedial action on the adjacent GAF site in 2003 and the cessation of stormwater collection and treatment on the LCP site upon cessation of operations. The concrete drainage channels on site are now filled and the connection to South Branch Creek was obstructed at some point in the past. Areas that do drain to South Branch Creek and the unnamed ditch likely do so relatively slowly given the lack of drainage structures and the nearly flat grades on the site. Ponding occurs in several areas of the site for long durations depending on rainfall intensity and duration.

Arsenic concentrations in South Branch Creek sediment, low marsh soil, and surface water are markedly elevated in the Transect A area, but the elevated levels relative to those detected on site indicate that arsenic is present due to non-site sources (historic drainage along the railroad tracks from other sites). Arsenic impacts also attenuate with distance along South Branch Creek, reflecting the generally low sediment mobility in the ditch. Arsenic concentrations in the Northern Off-Site Ditch, while lower than found in South Branch Creek, are elevated beyond those found in the Arthur Kill, indicated historic discharge to the Ditch from the LCP site. Other contaminants (metals, PAHs, and CDDs) show minimal relationship to the site and appear to be of regional origin.

Site related contaminants in South Branch Creek have been delineated to levels consistent with regional sediment contaminant conditions in the Arthur Kill. Given the fact that the sediment investigation included the full extent of South Branch Creek, no further delineation of sediment contamination is necessary.

The investigation of sediments in the Northern Off-Site Ditch has not yielded complete delineation of Site Related contaminants in the upstream direction. It is recommended that further delineation sampling, as necessary, would be conducted as a part of a remedial pre-design investigation (PDI). The downstream end of the Northern Off-Site Ditch is believed to be connected via a culvert to South Branch Creek. Further delineation in the downstream direction, toward South Branch Creek, is not necessary.

The concentrations of contaminants in the Southern Off-Site Ditch are significantly lower than those found in the Northern Off-Site Ditch or South Branch Creek, and are more similar to regional conditions found in the Arthur Kill. Based upon the analytical results, the Southern Off-Site Ditch does not appear to have been impacted by contaminants relating to the LCP Site.

Investigation of both South Branch Creek and the Northern and Southern Off-Site Ditches has shown that the presence of contaminants in Surface Water is driven primarily by suspended particles in the water column. Due to the dynamic nature of the medium and the tidal fluctuations, meaningful delineation of contaminants in surface water is not possible.

206230

Remedial Investigation Report
LCP Chemicals, Inc. Superfund Site
Linden, New Jersey
Volume II of V
Appendices A through G

Prepared for
ISP Environmental Services, Inc.
500 Hercules Road
Wilmington, Delaware 19808-1599

July 2013

Project Number: 137005

Brown AND Caldwell
2 Park Way, Suite 2A
Upper Saddle River, New Jersey 07458

Appendix A: Property Transfers

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
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41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
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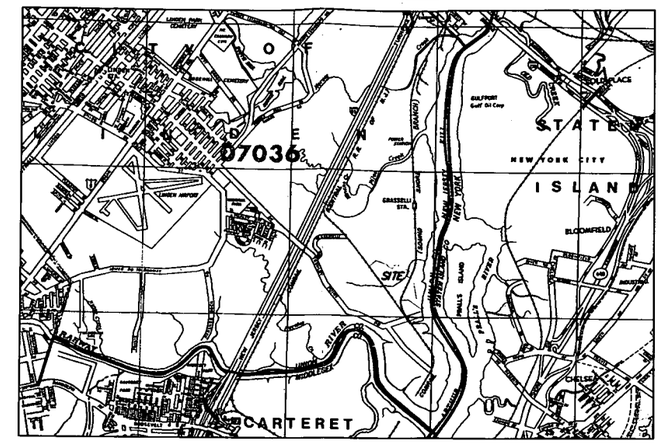
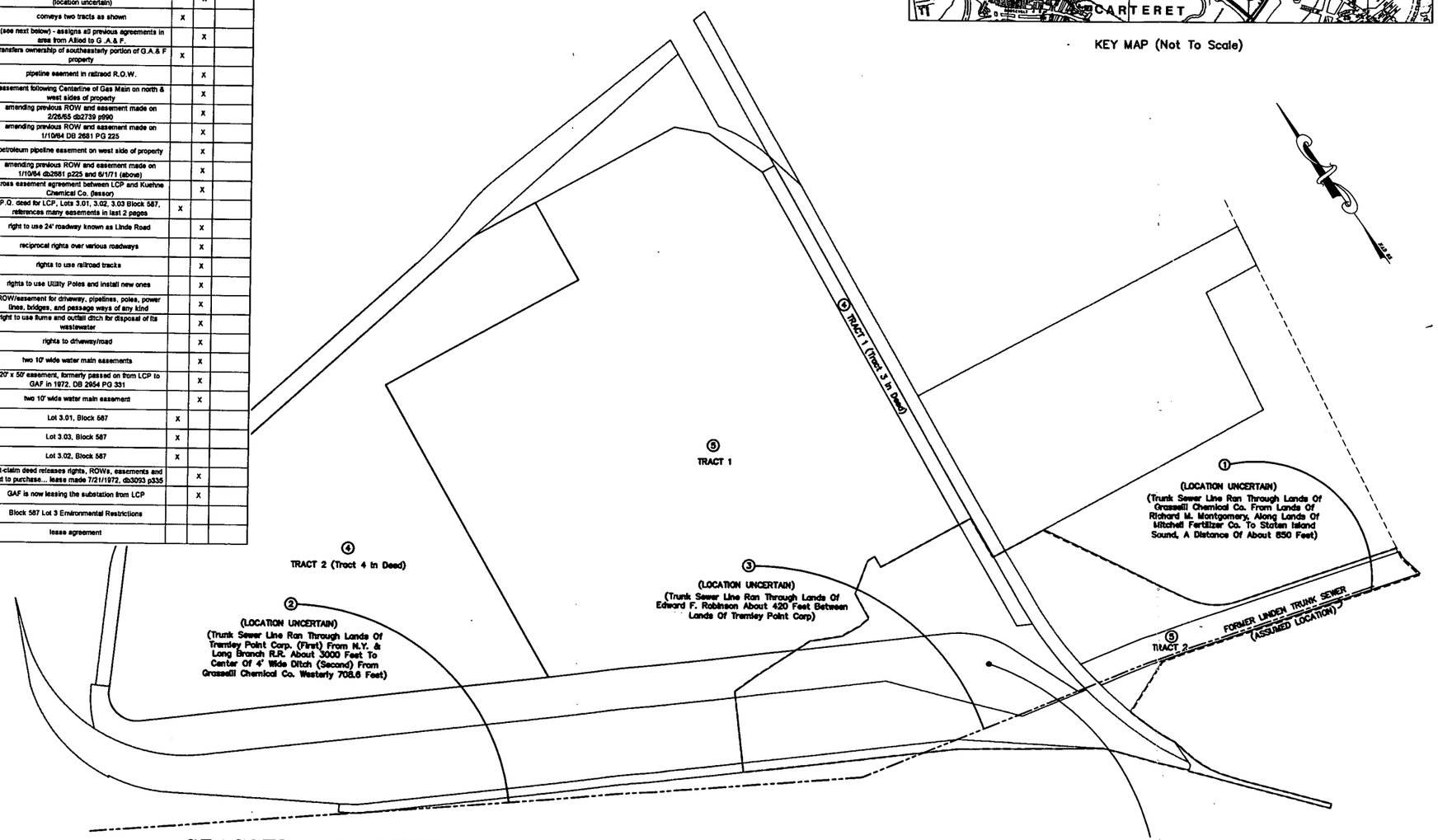


KEY MAP (Not To Scale)



GRASSELLI DYESTUFF CORPORATION - PRIOR TO 1939

LCP SITE

REVISIONS	
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DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
PROJ.: 2001202 CHKD.: PAGE:

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE F. JAMES, Professional Engineer, Lic. 23313

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 1 OF 6

R2-0003605

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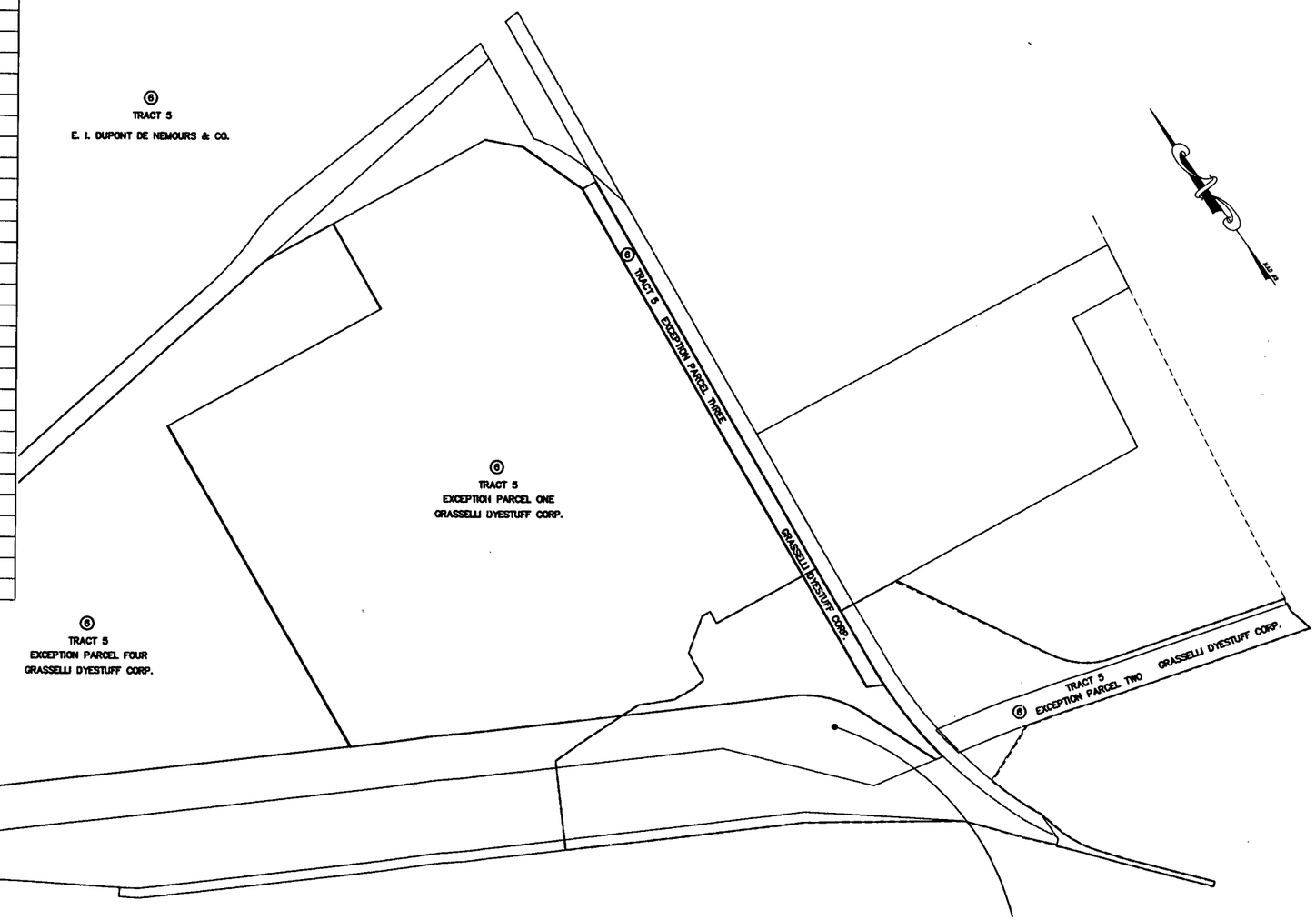

E.I. DUPONT DE NEMOURS & COMPANY - 1928

LCP SITE

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CONSULTING ENGINEERS
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CHRONOLOGICAL DEED PLOTTING
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LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 2 OF 6

R2-0003606

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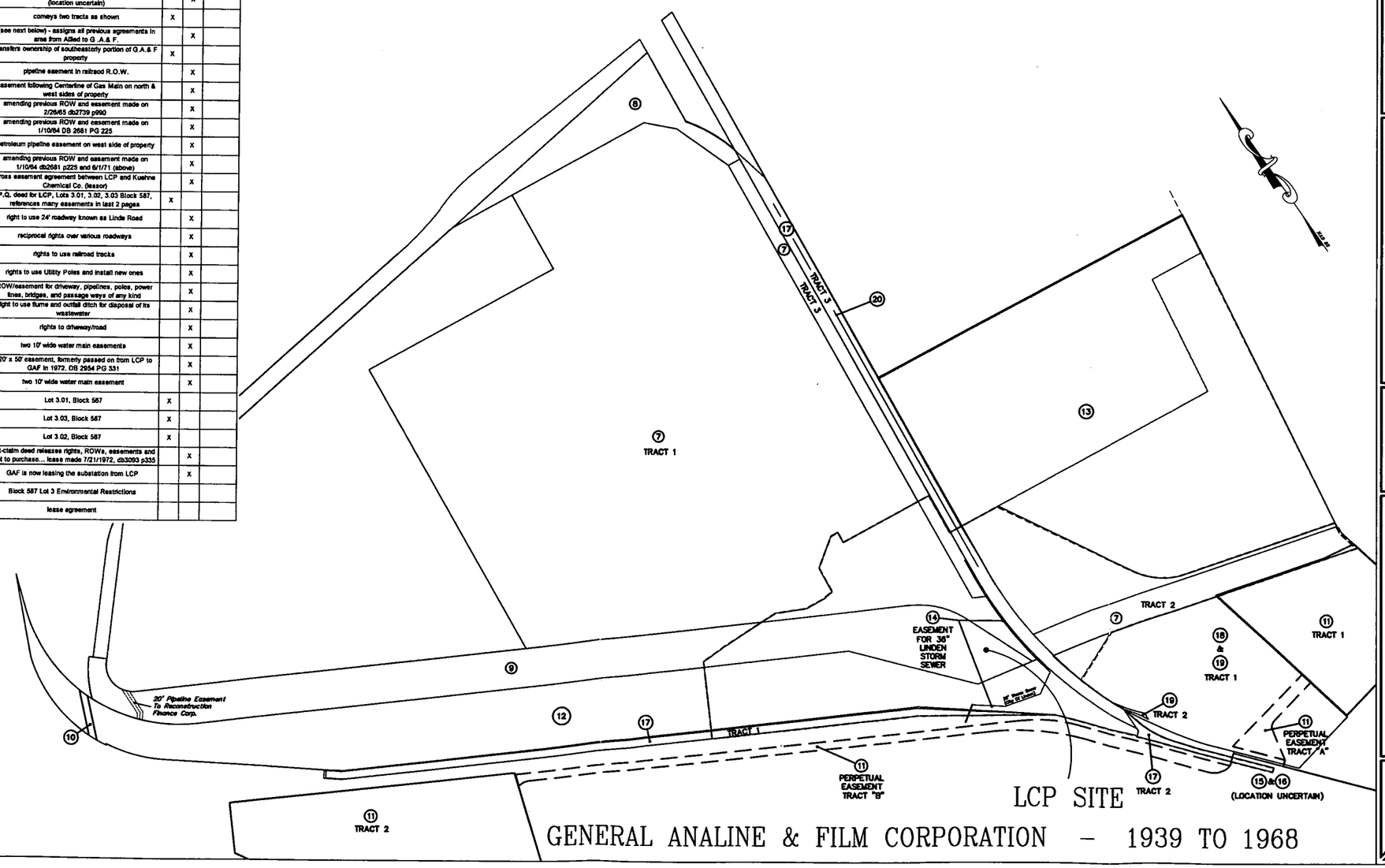

GENERAL ANALINE & FILM CORPORATION – 1939 TO 1968

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REVISIONS

DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
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501 Gibraltar Drive, Suite 2J, Morris Plains, NJ. 07950 973-377-5500
CONSULTING ENGINEERS
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CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 3 OF 6

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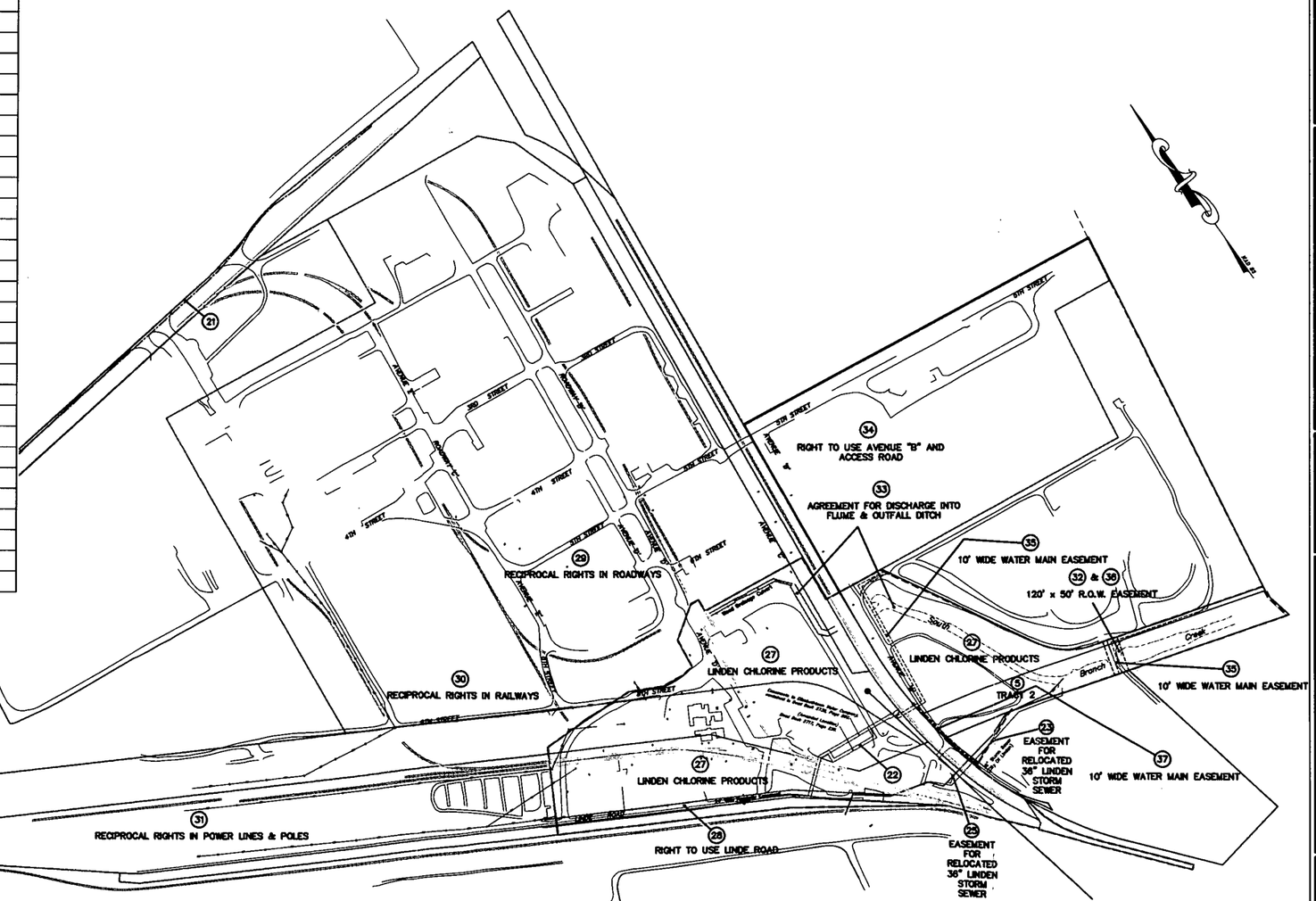
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X	
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X	
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X	
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X	
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included. believed to convey the railroad property highlighted	X	
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X	
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X
15	11/19/1965	2771	856	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X	
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X	
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X	
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X
35	5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X
38	12/14/1979	3207	82	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X	
39	12/14/1979	3207	93	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X	
40	12/14/1979	3207	97	LCP Chemicals-New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X	
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions		
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement		



GAF CORPORATION - 1968-1978

LCP SITE

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 17301
EDWIN F. JAMES, Professional Engineer, Lic. 23941

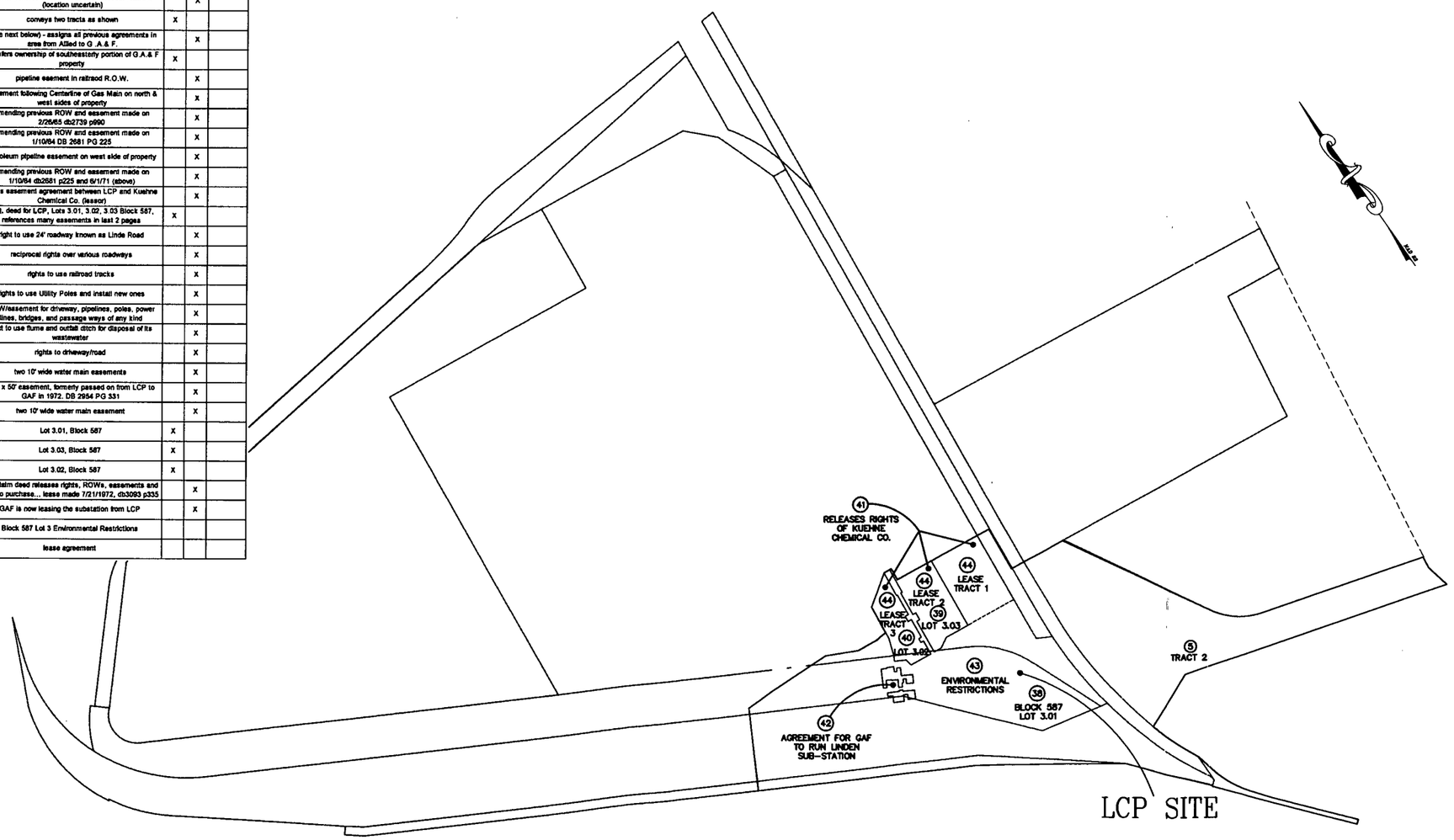
CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 4 OF 6

R2-0003608

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dyestuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	228	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A & F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X	
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	228	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2926	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	298	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2985	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/9/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
39	12/14/1979	3207	93	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X		
40	12/14/1979	3207	97	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



LCP CHEMICALS - NEW JERSEY, INC - 1979 TO 1994 & KUEHNE LEASE - 1972

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Keller & Kirkpatrick Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE F. JAKEL, Professional Engineer, Lic. 22534

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 5 OF 6

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X
4	10/20/1928	1185	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X	
5	10/20/1928	1185	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X	
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X	
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X	
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X	
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X
11	4/16/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X	
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included, believed to convey the railroad property highlighted	X	
13	7/9/1963	2548	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X	
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)		X
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X	
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X
19	5/15/1967	2802	538	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	X	
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.		X
21	8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X
25	4/17/1972	2948	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X	
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X
35	5/6/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X
38	12/14/1979	3207	82	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X	
39	12/14/1979	3207	93	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X	
40	12/14/1979	3207	97	LCP Chemicals–New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X	
41	6/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions		
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement		

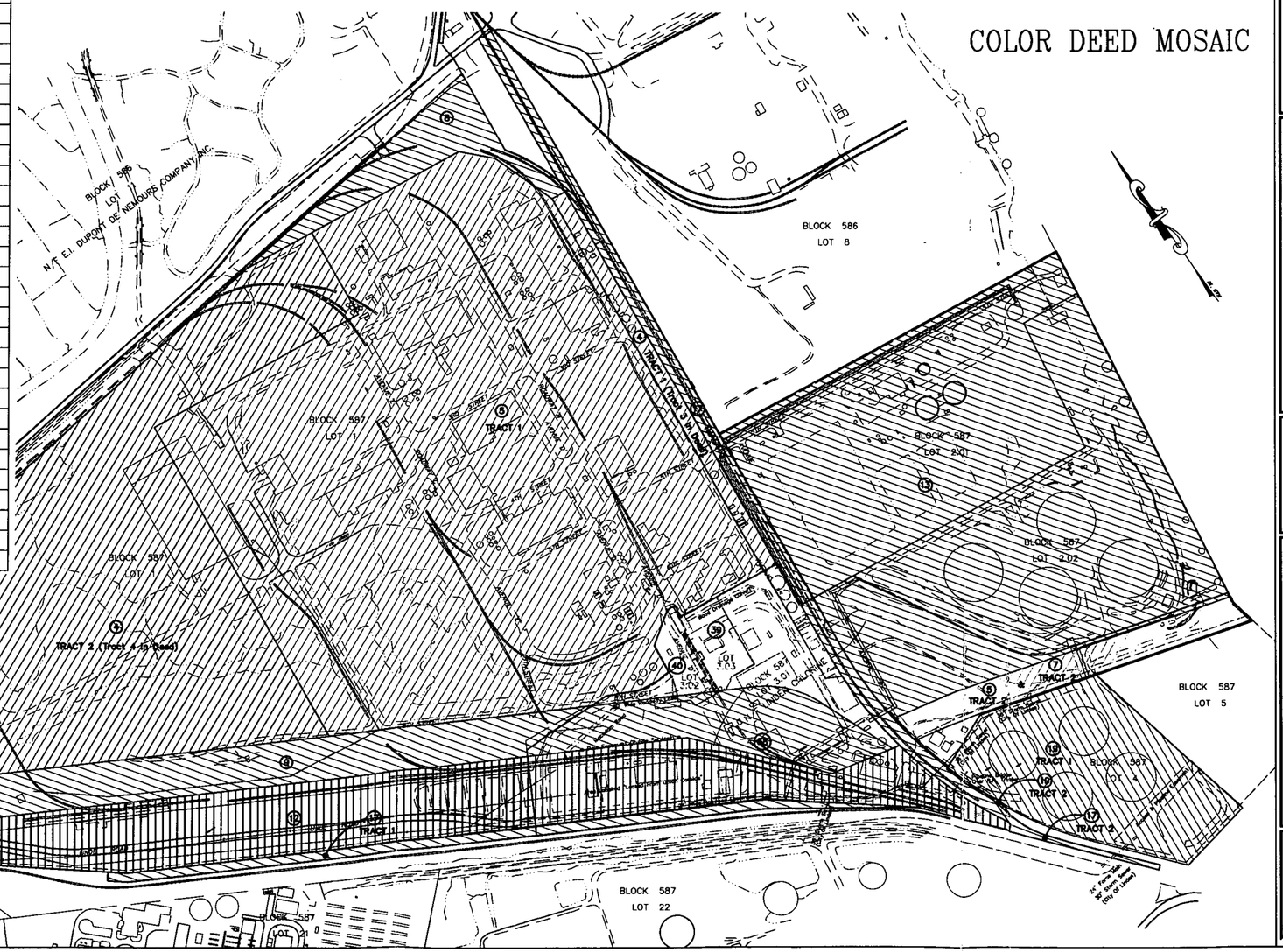
COLOR CHART

- GRASSELLI CHEMICAL COMPANY TO GRASSELLI DYESTUFF CORPORATION – PRIOR TO 1928 (4) & (5)
- TRANSFERRED FROM E.I. DUPONT DE NEMOURS & CO. TO GENERAL ANILINE & FILM CORPORATION – 1940–1963 (8) (9) & (13)
- TRANSFERRED FROM CENTRAL RILROAD CO. OF N.J. TO GENERAL ANILINE & FILM COROPORATION – 1958 (12)
- TRANSFERRED FROM ALLIED CHEMICAL CORP. TO G A F CORPORATION – 1967 (19)
- CONVEYED BY GAF CORPORATION TO LINDEN CHLORINE PRODUCTS – 1972 (27) & CONVEYED BY LINDEN CHLORINE PRODUCTS TO L C P CHEMICALS–NEW JERSEY, INC. – 1979 (38) (39) & (40)

CORPORATE NAME CHANGES

GRASSELLI DYESTUFF CORPORATION WAS INCORPORATED UNDER THE LAWS OF THE STATE OF DELAWARE. ON FEBRUARY 27, 1929, IT CHANGED ITS NAME TO GENERAL ANILINE WORKS, INC. ON OCTOBER 30, 1939, IT BECAME KNOWN AS GENERAL ANILINE & FILM CORPORATION. ON OCTOBER 31, 1939, IT MERGED INTO AMERICAN I.G. CHEMICAL CORPORATION. ON APRIL 24, 1968, IT CHANGED ITS NAME TO GAF CORPORATION. ON AUGUST 24, 1972, GAF CONVEYED PROPERTY TO LINDEN CHLORINE PRODUCTS, INC. ON DECEMBER 14, 1979, LCP CHEMICALS & PLASTICS, INC. CONVEYED ITS PROPERTY TO LCP CHEMICALS–NEW JERSEY, INC.

NOTE: NOTE: SITE INTERIOR DETAILS SHOWN HEREON REPRESENT SITE CONDITIONS AS OF THE AERIAL SURVEY PERFORMED ON 4/05/02 AND DO NOT REFLECT PRESENT SITE CONDITIONS.



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DATE: 4/23/08 SCALE: 1"=200' FLD. BK.:
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Keller & Kirkpatrick
Certificate of Authorization #24GA28037400
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
CONSULTING ENGINEERS
LAND SURVEYORS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE P. JAKEL, Professional Engineer, Lic. 22534

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 6 OF 6

R2-0003610

Tables

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
Property Transfers							
10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	1, 4	4
10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	1, 4	5
11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dyestuff Corp. (exceptions to Tract 5)	2	6
10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	3, 6	7
5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	3, 6	8
9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	3, 6	9
4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	3, 6	11
1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included. believed to convey the railroad property highlighted	3, 6	12
7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	3, 6	13
1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	3, 6	17
5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A.& F property	3	19
8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	4	27
12/14/1979	3207	82	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	5	38
12/14/1979	3207	93	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	5	39
12/14/1979	3207	97	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	5	40

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
Easements							
7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound	1	1
9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property	1	2
2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property	1	3
7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property	3	10
1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer	3	14
11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)	3	15
11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use roadway crossing railroad (location uncertain)	3	16
5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.	3	18
11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline easement in railroad R.O.W.	3	20
8/20/1970	2909	697	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property	4	21
2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990	4	22
6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225	4	23
8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property	4	24
4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)	4	25
7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)	4	26
8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road	4	28
8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways	4	29
8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks	4	30
8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones	4	31
8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind	4	32
8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater	4	33
1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road	4	34
5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements	4	35

TABLE 1-1
DEED HISTORY FOR THE LCP PROPERTIES (Note 1.)
LCP Chemicals, Inc. Superfund Site, Linden, New Jersey

Date	Book	Page	Grantee	Grantor	Description	(Note 2.) K&K Sheet	(Note 2.) Map ID
5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331	4	36
3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement	4	37
8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335	5	41
9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP	5	42
Deed Restriction							
9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions	5	43
Lease Agreement							
7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement	5	44

Notes:
1. Deed history for Block No. 587, Lots No. 3.01, 3.02, and 3.03 as researched by Keller & Kirkpatrick, Morris Plains, NJ, July 2008
2. Drawings depicting the locations of the various deeds are presented in Appendix XX.

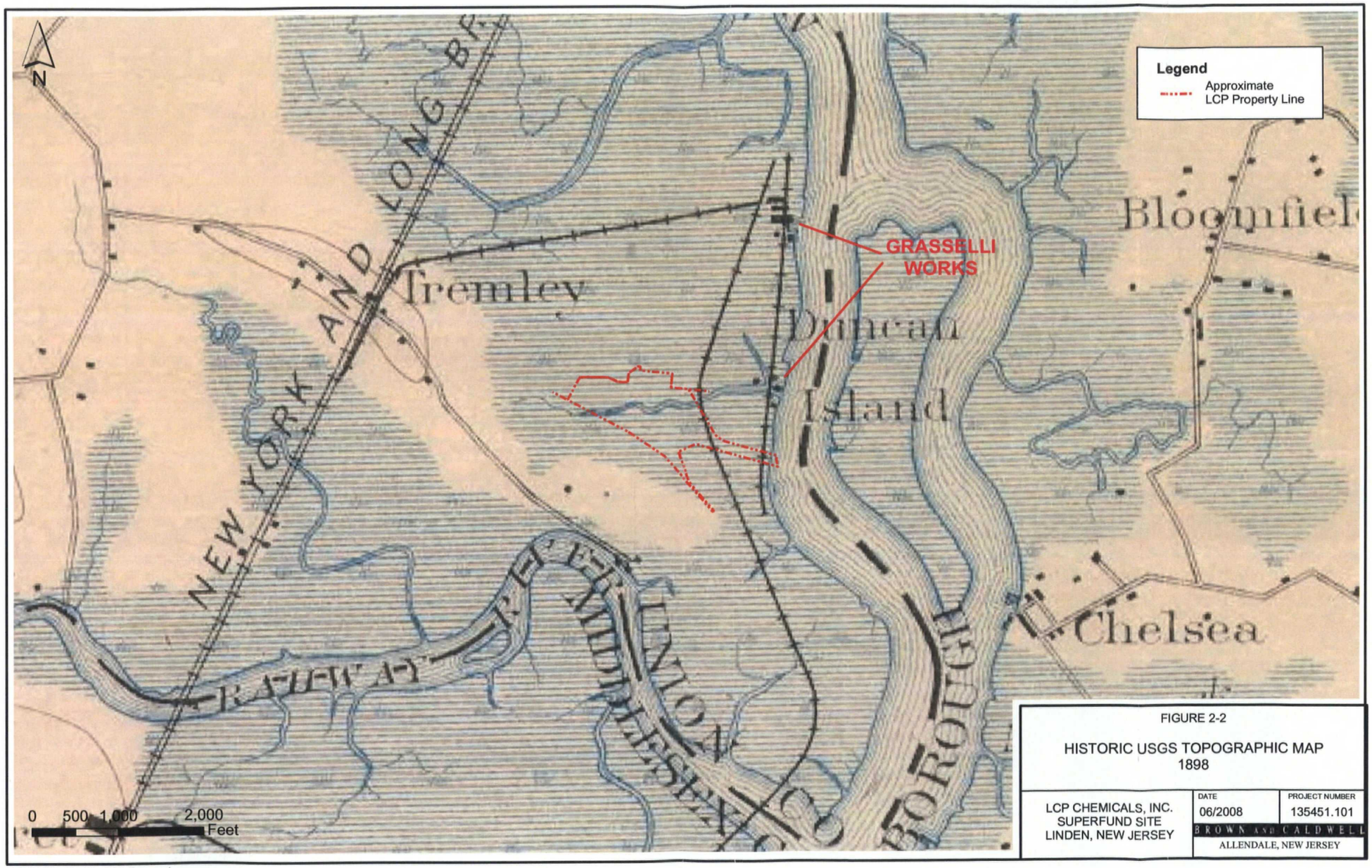


FIGURE 2-2

HISTORIC USGS TOPOGRAPHIC MAP
1898

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1898_Topo.mxd

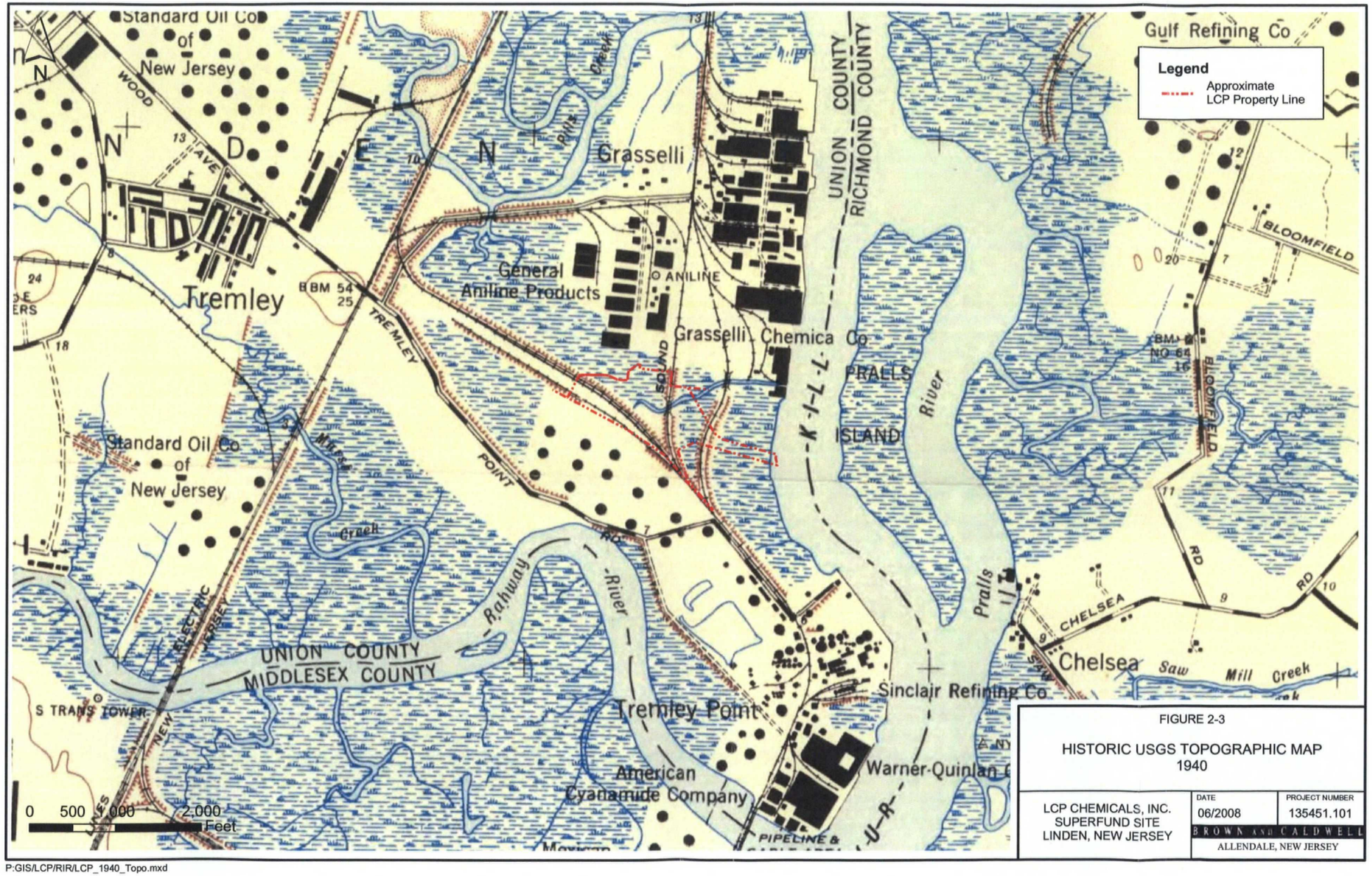


FIGURE 2-3

HISTORIC USGS TOPOGRAPHIC MAP
1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1940_Topo.mxd

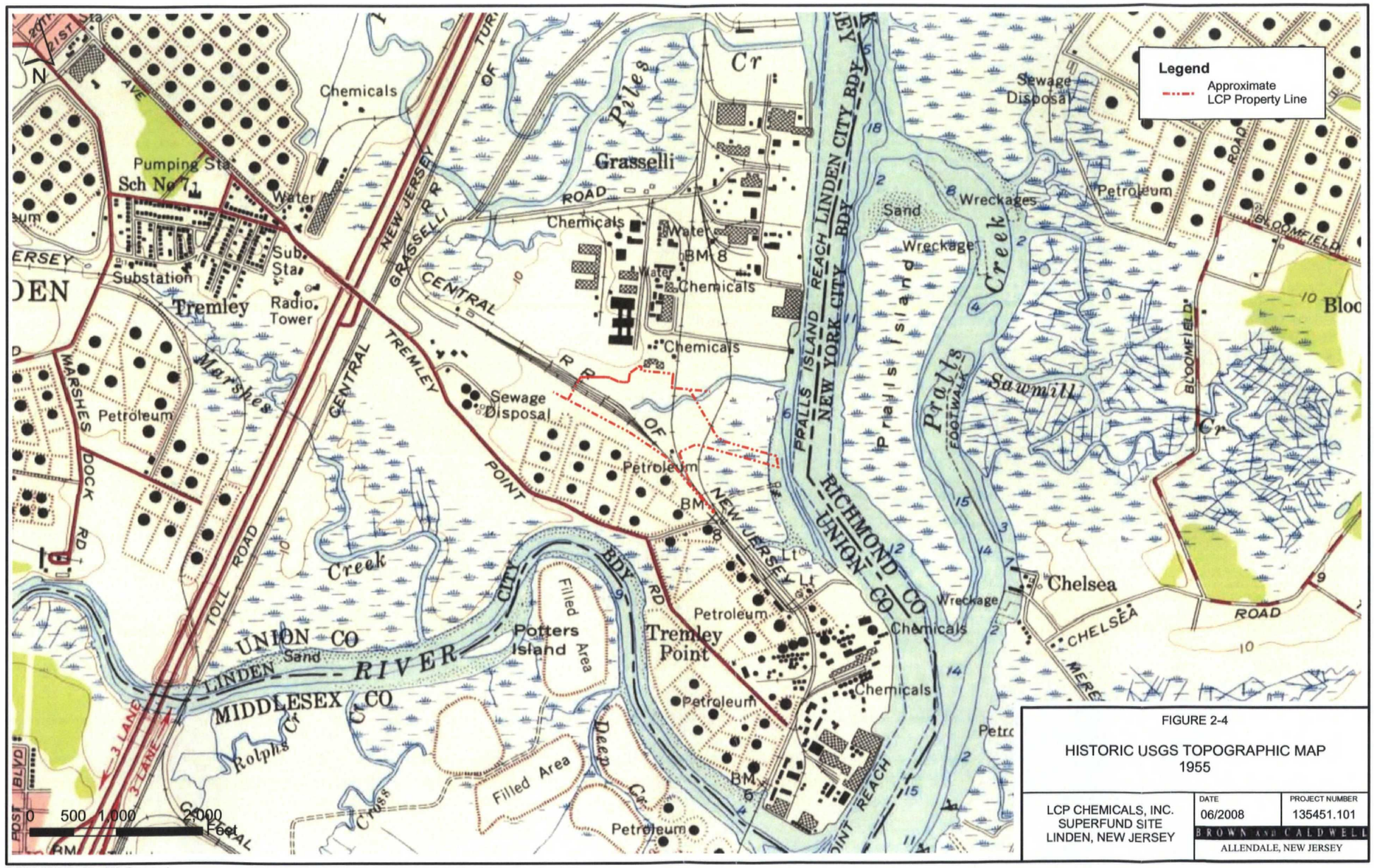


FIGURE 2-4

HISTORIC USGS TOPOGRAPHIC MAP
1955

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/RIR/LCP_1955_Topo.mxd

R2-0003439

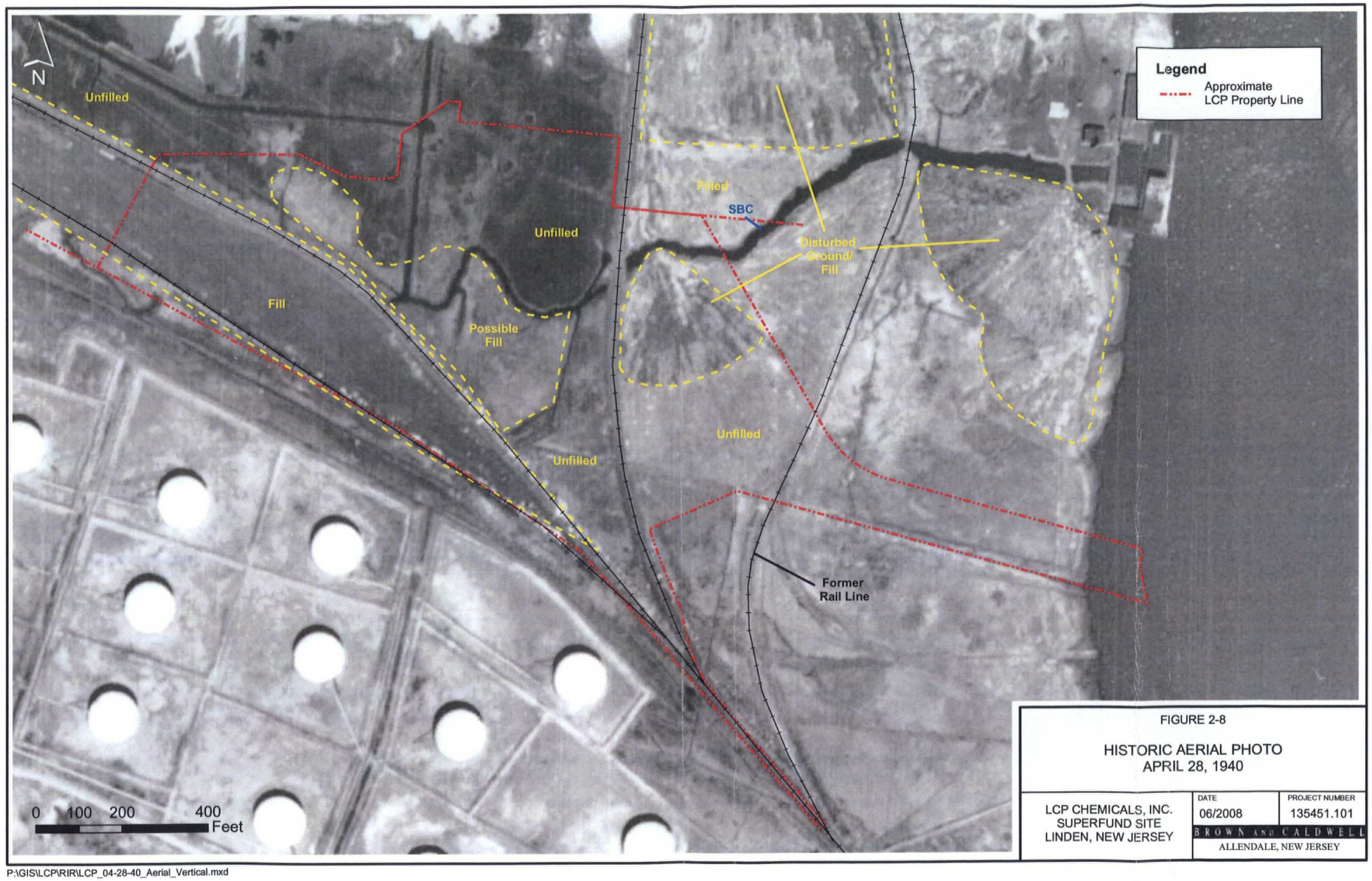


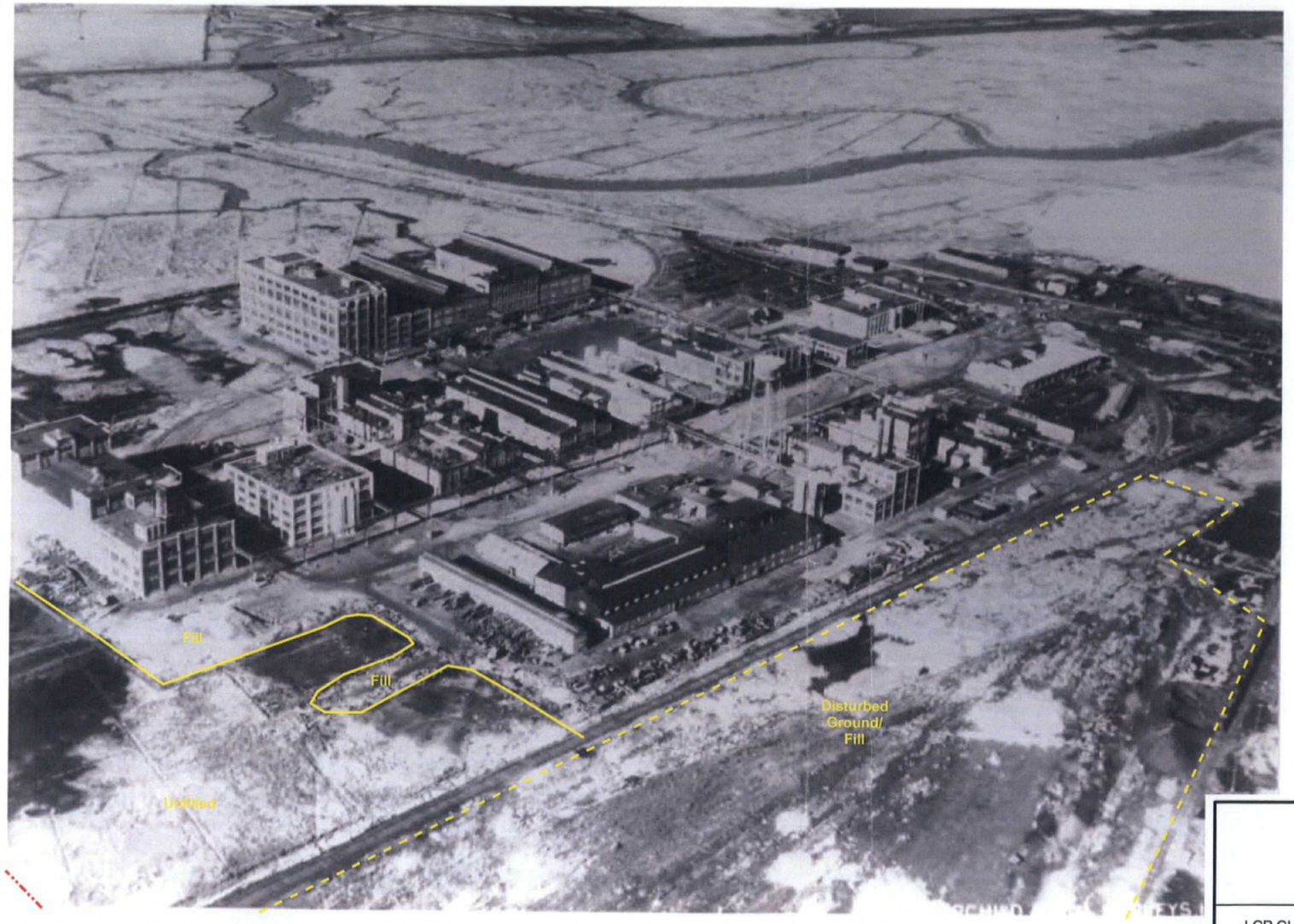
FIGURE 2-8

HISTORIC AERIAL PHOTO
APRIL 28, 1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:\GIS\LCP\RIR\LCP_04-28-40_Aerial_Vertical.mxd

R2-0003443



Legend

Approximate LCP Property Line

N

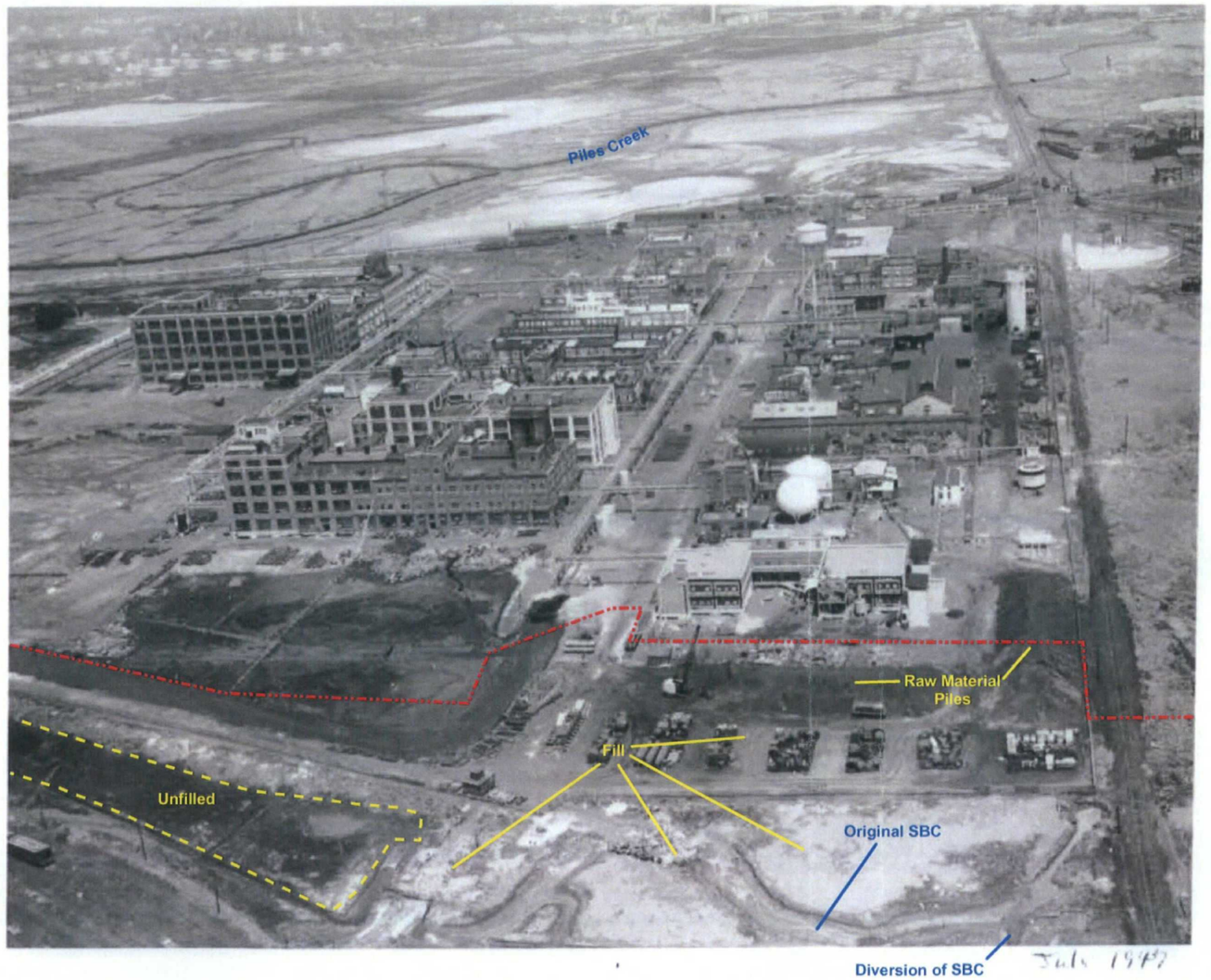
FIGURE 2-9

HISTORIC AERIAL PHOTO
1940

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 06/2008	PROJECT NUMBER 135451.101
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:\GIS\LCP\RIR\LCP_1940_Aerial_Oblique.mxd

R2-0003444



Legend

LCP Property Line

Note:
Property Line is estimated.

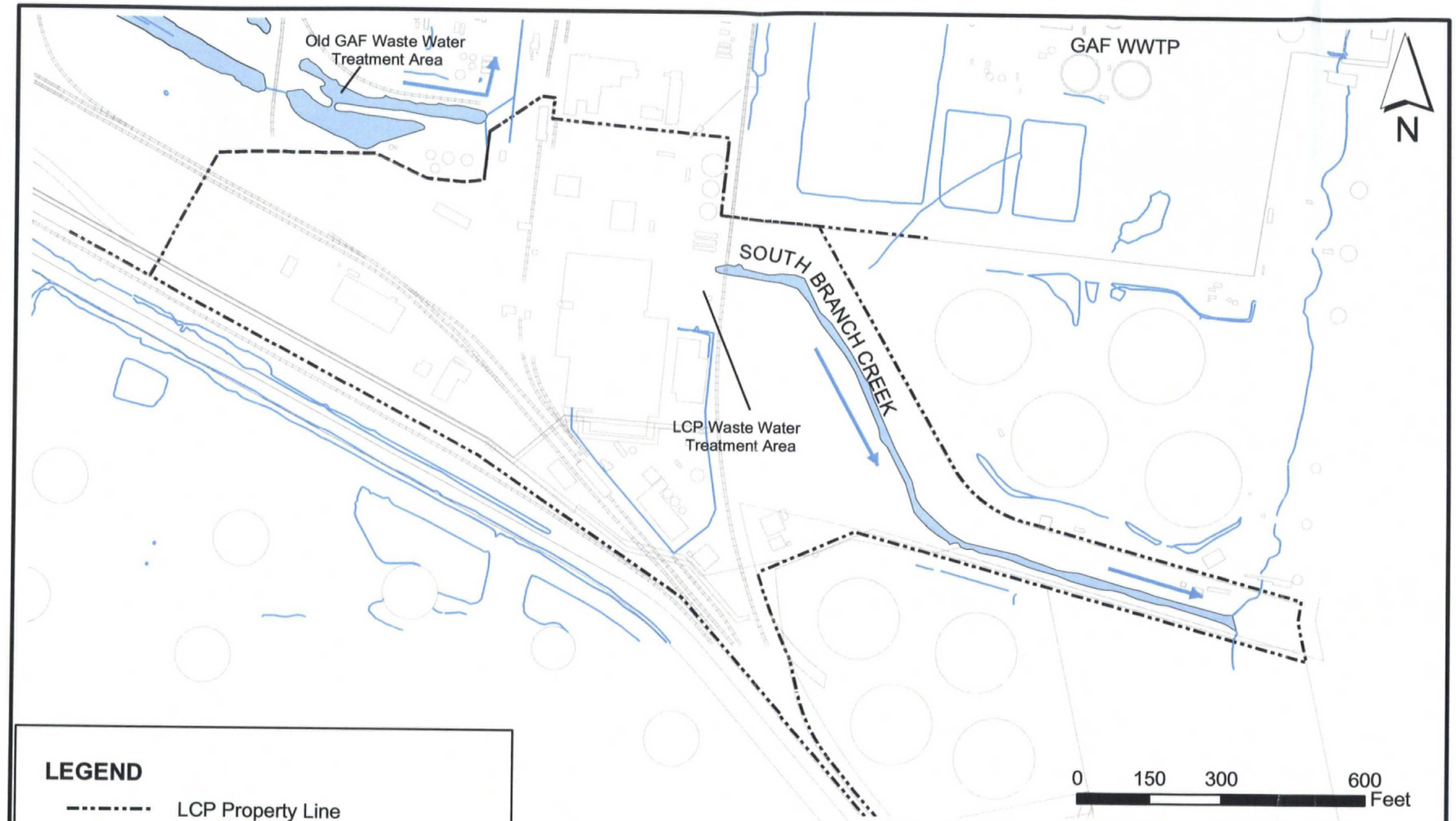
N

FIGURE 2-10
HISTORIC AERIAL PHOTO
JULY 1947

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 04/2007	PROJECT NUMBER 131369.104
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:GIS/LCP/Fill_History/07-47_Oblique.mxd

R2-0003445



LEGEND

- LCP Property Line
- Site Drainage Channels
- Direction of Flow

NOTES:
1. Site map and existing site features as of 4/05/02 obtained from drawing titled "ALTA/ACSM LAND TITLE SURVEY, ISP ENVIRONMENTAL SERVICES INC., BLOCK 587, LOTS 1 & 2. 10", prepared by Keller & Kirkpatrick, (PROJ NO. 2020408. 10, 8/26/03).

FIGURE 2-25

HISTORIC DRAINAGE PATTERN MAP (1977-PRESENT)

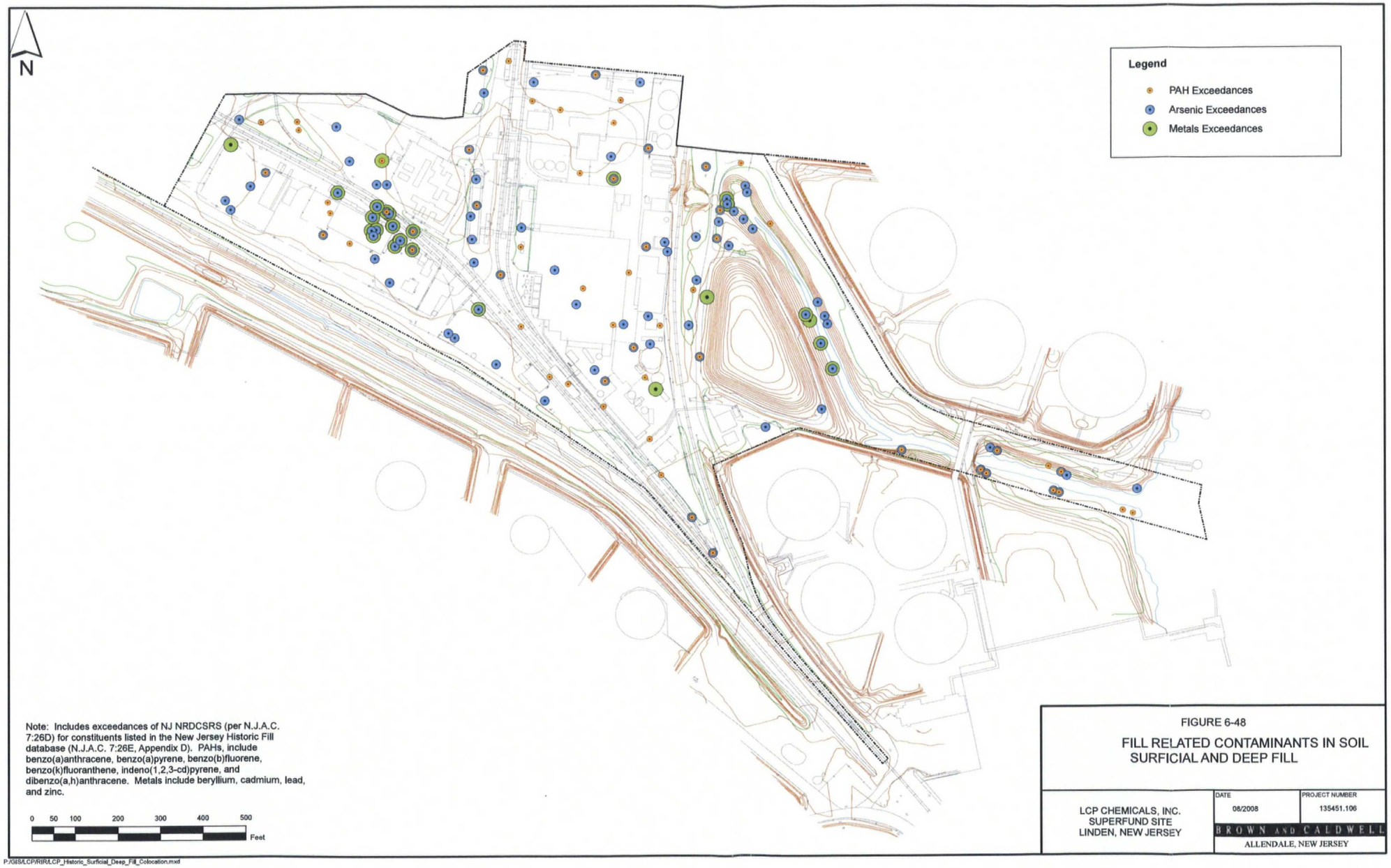
LCP CHEMICALS, INC.
SUPERFUND SITE
LINDEN, NEW JERSEY

DATE	PROJECT NUMBER
06/2008	135451.102

BROWN AND CALDWELL

ALLENDALE, NEW JERSEY

P:/GIS/LCP/RIR/LCP_Drainage_1977-Present.mxd



Note: Includes exceedances of NJ NRDCSRS (per N.J.A.C. 7:26D) for constituents listed in the New Jersey Historic Fill database (N.J.A.C. 7:26E, Appendix D). PAHs, include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluorene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene. Metals include beryllium, cadmium, lead, and zinc.

FIGURE 6-48

FILL RELATED CONTAMINANTS IN SOIL
SURFICIAL AND DEEP FILL

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY	DATE 08/2008	PROJECT NUMBER 135451.106
	BROWN AND CALDWELL ALLENDALE, NEW JERSEY	

P:/GIS/LCP/RIR/LCP_Historic_Surficial_Deep_Fill_Colocation.mxd

R2-0003602

Exhibit I

SDMS Document
113613

FINAL
WORK PLAN

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

F O R T H E

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY

Prepared for:

ISP Environmental Services Inc.
1361 Alps Road
Wayne, New Jersey

Version
April 12, 2001

300759

FINAL
WORK PLAN

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

F O R T H E

LCP CHEMICALS, INC. SUPERFUND SITE LINDEN, NEW JERSEY

Prepared by:

URS Corporation
201 Willowbrook Boulevard
Wayne, New Jersey 07474

Version
April 12, 2001

300760

WORK PLAN
REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

LCP CHEMICALS, INC.
LINDEN, NEW JERSEY

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Appendix C Malcolm Pirnie 1995 Wetland Report
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This document is a Work Plan to conduct a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation and Feasibility Study at the LCP Chemicals, Inc. Superfund Site, in Linden, New Jersey. This Work Plan describes the history and physical characteristics of LCP Chemicals, Inc., the rationale for field investigation activities, the objectives of the activities, and the methods that will be used to conduct the Remedial Investigation (RI) and Feasibility Study (FS). This document is submitted on behalf of ISP Environmental Services Inc., in accordance with the requirements of the U.S. Environmental Protection Agency's (EPA) Administrative Order on Consent ("Consent Order"), Index No. II-CERCLA-02-99-2015, dated May 31, 1999.

1.1 SITE LOCATION

The LCP Chemicals, Inc. Superfund Site (the "site") is located in an industrial area at the foot of South Wood Avenue in Linden, Union County, New Jersey. The general site vicinity is known as Tremley Point. The site is centered at 40 degrees 36 minutes 29 seconds latitude and 74 degrees 12 minutes 41 seconds longitude on the United States Geological Survey Arthur Kill, N.Y./N.J. quadrangle map (Figure 1-1). The site encompasses about 26 acres and consists of the City of Linden Tax Block 587, Lot 3.01, Lot 3.02, and Lot 3.03.

The site is bounded to the north by ISP Environmental Services Inc. (inactive since 1991), to the northeast by Northville Industries' bulk petroleum storage area, to the southeast by the Mobil Gas bulk petroleum storage area, and to the south by the British Petroleum bulk petroleum storage area. A small, rechanneled tidal creek, South Branch Creek, flows eastward from the site and drains into the Arthur Kill.

As shown in Figure 1-1, the main Conrail line (Central Railroad of New Jersey) parallels the New Jersey Turnpike. A Conrail Spur (Sound Shore Branch) parallels the shoreline of Arthur Kill and crosses the site along Avenue B. A set of Conrail spurs, roughly parallel to Tremley Point Road, borders the southern part of the site. The Tremley Point Road spurs and the Sound Shore spur join at the southeast end of the site.

1.2 PROJECT OVERVIEW

The site consists of a former chlorine production plant and ancillary terminalling, packaging, and distribution areas. Between 1955 and 1982, the plant manufactured gaseous chlorine using a technology known as the mercury cell electrolysis process. A by-product of this process was wastewater and sludge that contained residual elemental mercury (a detailed discussion of site operations is presented in Section 1.4.2). Beginning in the early 1980s, both the EPA and the New Jersey Department of Environmental Protection (NJDEP) conducted numerous inspections

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and limited investigations at the site because of environmental concerns associated with the mercury cell process. The results of their investigations indicated that there were mercury releases at the site and to South Branch Creek, although the magnitude and extent of contamination were not determined. In 1985, LCP Chemicals, Inc. stopped their production activities and began to dismantle the facility. In 1995, a Resource Conservation and Recovery Act (RCRA) Facility Investigation Work Plan was prepared for the site (Eder, 1993) to evaluate potential contamination in areas of concern. The Work Plan was approved by the EPA on January 3, 1995 but it was not implemented because the owner of the site did not have the financial resources for remediation work. In 1996, the EPA evaluated the site for a Superfund Removal Action, but determined that there were no acute threats to human health and environment and that consequently, a short-term, emergency cleanup was not warranted. The EPA added the LCP Chemicals, Inc. site, a Division of Hanlin Group, Inc., to the National Priority List (NPL) on July 27, 1998 (which required that a CERCLA RI/FS be conducted for the site). In September 1998, the EPA identified GAF Chemicals Corporation as one of six potentially responsible parties (PRPs) for the site. The other five PRPs identified by the EPA were Caleb Brett (USA), Inc., Kuehne Chemical Company, Inc., Praxair, Inc., Union Carbide Corporation, and LCP Chemicals, Inc. (a division of the Hanlin Group, Inc.).

ISP Environmental Services Inc., which has assumed the liabilities of GAF Chemicals Corporation, executed the Consent Order with the EPA on May 31, 1999. This Remedial Investigation and Feasibility Study Work Plan describes the activities that will be conducted in accordance with the Consent Order. The proposed field investigation, however, is based on assumed site conditions, and a specific site activity, as described in Chapter 5.0, may not be appropriate once the actual conditions become known. Therefore, ISP reserves the right to modify the sampling or testing regime based on preliminary results or actual conditions encountered in the field. If major modifications to the RI/FS work scope described in this document become necessary, they will be submitted to the EPA in the form of a Technical Memorandum or other form of communication and the proposed modifications will not be implemented in the field without EPA approval. This Work Plan also acknowledges that the project objectives discussed below may not be completely fulfilled upon completion of the specific activities described in this document and that additional site investigations may be required before a remedy can be selected.

1.3 PROJECT OBJECTIVES

The environmental concern at the site is the potential for contamination resulting from mercury-bearing wastes that were generated, stored, or disposed of at the site for a period of about 25 years. Other sources of contamination, such as electric transformers that contained oils with polychlorinated biphenyls (PCBs) and former drum storage areas may also have contributed to site contamination.

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The overall objective of the remedial investigation is to identify the nature and extent of contamination that may pose risks to human health and environment and to evaluate proposed remedies for the site. The objective of the feasibility study is to methodically select the most appropriate remedy, on the basis of several factors such as land use, effectiveness, and cost, that will be protective of human health and environment.

1.4 SITE BACKGROUND

This section presents the background history of the site.

1.4.1 Site Ownership

The Grasselli Chemical Company began industrial operations in the vicinity of the site around 1885. Before then, the area was undeveloped marshland. In 1924, the company became the Grasselli Dyestuff Company. It was incorporated in 1929 as American I.G. Chemical Corporation, which was owned by the German company I.G. Farbenindustrie, A.G. In 1939, the company changed its name to General Aniline & Film Corporation. In 1942, 98 percent of the company stock was seized by the United States Justice Department as a war asset and the company was operated by the U. S. Government acting as Alien Property Custodian. The chlorine plant was constructed at the site sometime around 1955; the site was generally undeveloped marshland up until that time. In 1965, the U.S. Government sold the stock in a public offering and in 1968, General Aniline & Film Corporation changed its name to GAF Corporation. In 1971, GAF Corporation shut down the chlorine production plant (the site).

In 1972, GAF Corporation (GAF) sold the plant to Linden Chlorine Products, Inc. of Edison, New Jersey. The company was founded by former GAF employees and formed solely for the reopening and operation of the Linden chlorine plant. In 1975, Linden Chlorine Products, Inc. reported that they owned no other facilities and that they produced only three products - chlorine, sodium hydroxide, and hydrogen.

By the early 1980s, as the company acquired additional chlorine production facilities along the U.S. east coast, Linden Chlorine Products, Inc. became LCP Chemicals-New Jersey, Inc., a subsidiary of Linden Chemicals & Plastics, Inc. Between 1987 and 1989, the company name was changed to LCP Chemicals-New Jersey, a division of Hanlin Group, Inc. On July 10, 1991, Hanlin Group, Inc. filed for bankruptcy under Chapter 11 of the United States Bankruptcy Code and sold all of its operating assets before April 1994. In August 1994, the EPA conducted a site visit and confirmed that the chlorine process buildings were decommissioned, the facility was no longer functional, and that the site was vacated by LCP employees. Active Water Jet, Inc., a pipe cleaning company, who was a tenant at the site since about the early 1990s, remains as the only current tenant at the site. Other former site tenants are described later in this chapter.

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1.4.2 Site Operations

At the time of LCP Chemicals, Inc.'s mercury cell chlorine production, there were three main operating centers at the site - the mercury cell chlorine process area, the hydrogen gas processing plant, and the sodium hypochlorite manufacturing area. Process materials were transported to and from the site by tank truck, tank railroad car, or by barge. The storage and distribution of chlorine and related products (including methylene chloride and potassium hydroxide) generally occurred throughout the site's history. The chlorine production operations, however, were subject to periodic shutdowns brought on by changing market demand. The chlorine and related operating centers are described below, following a general description of the mercury cell electrolysis process.

1.4.2.1 Mercury Cell Electrolysis Process

The mercury cell was an industrial system that split common salt to produce chlorine. In a typical mercury cell process, salt solution (brine) passes between a graphite anode and a mercury cathode to produce chlorine and sodium through electrolysis. The chlorine is packaged in gaseous or liquid form for additional processing or distribution. The sodium dissolves in the mercury and the sodium-mercury mixture is made to react with water to produce sodium hydroxide and hydrogen. The products generated from this process, including the spent brine, contain residual amounts of mercury.

1.4.2.2 Chlorine Process Area

At the former chlorine plant, salt, water, mercury, and electricity were the principal raw materials used in the chlorine production process. LCP Chemicals, Inc.'s procedure for mercury handling and storage is not documented. Rock salt (or later evaporated salt) was transported to the site by rail, stored in the salt silos by Building 233 (Figure 1-2), and fed to the adjacent saturators to create brine. The brine was treated and filtered in a brine treatment tank in Building 233. The treatment consisted of adding chemicals such as sodium hydroxide, sodium carbonate, and barium chloride to precipitate impurities like calcium carbonate, sulfates, and hydroxides. This residual material is known as brine purification mud or brine "sludge". In the mid 1960s, a surface impoundment, the brine sludge lagoon, was constructed and used to dispose of the brine sludge and process wastewater. The sludge was mixed with brine and the resulting slurry was pumped to the brine sludge lagoon through overhead pipes. The supernatant, or the liquid content of the brine sludge lagoon, was pumped back to the brine purification tank for recycling and for redistribution either to the mercury cells or for slurry usage. Disposal practices for the brine sludge before the brine sludge lagoon was constructed are not documented.

After treatment, the purified brine was piped to the mercury cells in Building 230 and Building 240 to produce gaseous chlorine and a mercury-sodium mixture. The chlorine was cooled, dried (i.e., water vapor removed) with sulfuric acid, liquefied in Building 233, and stored in 100 ton

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vessels. The spent brine was recycled to the brine treatment tank in Building 233 for resaturation and to repeat the process.

The mercury-sodium mixture was piped to denuders, or strippers, where it was hydrolyzed to form elemental mercury, a sodium hydroxide solution, and gaseous hydrogen. The mercury was recovered and returned to the mercury cells. The sodium hydroxide solution was filtered and stored in above ground storage tanks at the northeast corner of the facility. Hydrogen gas was filtered in a commercial "Purasiv" unit south of Building 231 and piped to the hydrogen plant at the west end of the facility for packaging and distribution. On various occasions, the hydrogen gas was mixed with water and chlorine to form hydrochloric acid in both gaseous and liquid form. The hydrochloric acid was stored in tanks near Building 221. In March 1982, LCP Chemicals stopped the mercury cell process and brine sludge was no longer generated.

Between 1985 and 1994, the site was used as a transfer terminal for products made at other Hanlin Group Facilities. Products including potassium hydroxide, sodium hydroxide, hydrochloric acid, and methylene chloride were shipped to the site by rail or by truck, stored in above ground tanks, repackaged, and distributed. The Hanlin Group sold all of its operating assets by April 1994.

1.4.2.3 Linde Hydrogen Plant

The hydrogen plant, formerly known as Linde Gasses, occupied about 2.1 acres at the west end of the site (Figure 1-2). In 1957, Union Carbide Corporation (UCC) leased the hydrogen plant from GAF and operated it through 1990. Hydrogen was distributed from the mercury cells to the plant through overhead pipes. The gas was purified by UCC to remove entrained mercury (reportedly, up to five pounds of mercury was removed from the gas stream daily), stored, compressed, and shipped for distribution by trailer. This process continued through LCP Chemicals, Inc.'s 1972 purchase of the site from GAF. The hydrogen plant stopped utilizing the hydrogen generated by chlorine plant in 1980 and began packaging liquid cryogenic hydrogen that was brought to the plant from outside sources.

In 1988, in preparation of a new tenant, UCC had the building interior and hydrogen compressors decontaminated for mercury and collected wipe samples to confirm that the cleanup was effective (IT, April 22, 1988). IT reportedly recovered about 30 pounds of free mercury from one compressor and its associated piping.

In May 1990, the Linde plant ceased operations after the UCC lease with LCP expired, which triggered the NJDEP's Environmental Cleanup Responsibility Act (ECRA). Because several areas of environmental concern unrelated to the chlorine manufacturing process were noted at the plant (former underground storage tanks, sumps, septic tanks, etc.), ECRA required that a soil and groundwater investigation be conducted within the general boundaries of the 2.1 acre site.

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An environmental investigation and cleanup took place in the early 1990s and the NJDEP approved no further action for the hydrogen facility on June 20, 1995.

The Linde Gas Facility was apparently last used in October 1994 by Liquid Carbonic Corporation, which was later purchased by Praxair, Inc. Liquid Carbonic rented the Linde Gas site from LCP Chemicals, Inc. and used it for office space and as a parking area for truck trailers. Liquid Carbonic Corporation ended its lease with LCP Chemicals, Inc. in March 1996.

1.4.2.4 Hypochlorite Facility

In 1972, Kuehne Chemical, Inc. participated in the formation of LCP Chemicals, Inc. Kuehne leased Lot 3.02, Lot 3.03, and the northern part of Lot 3.01 from LCP Chemicals, Inc. and started a sodium hydroxide manufacturing process. The processing area, located north of Building 220 and between Avenue C and Avenue D, consisted of above ground storage tanks, loading areas, and support buildings (Figure 1-2). Kuehne obtained the raw materials - chlorine and sodium hydroxide, by overhead pipes from the chlorine plant and blended the chemicals to make sodium hypochlorite (bleach). Chlorine, sodium hydroxide, hydrochloric acid, and sodium hypochlorite were also stored and distributed by Kuehne. Kuehne vacated the site in February 1981.

1.4.3 Site History

Much of the historic information presented in this report is compiled from numerous documents dating back to 1975 and earlier. Within these documents are numerous contradictions concerning the past operations of the site. This problem is compounded by the fact that much of LCP Chemicals, Inc.'s records were lost or destroyed sometime in the early 1980s (Eder, September 1993). Every attempt was made to reconcile these differences through evaluations of supporting evidence such as historic maps, deed records, and aerial photographs. Appendix A presents a timeline that summarizes some of the key milestones that occurred at the site, lists the supporting references, and provides a qualitative assessment of the reliability of data. The historic information presented in this document is based on this timeline, which will likely require updates if, and when, additional sources of information becomes available.

In 1870, all of Tremley Point was undeveloped marshland. By 1903, the tracks of the Sound Shore railroad were present, indicating that backfilling of low areas at the site had begun by that time. In 1923, the Grasselli Chemical Company was operating a large facility on the east side of the tracks north of South Branch Creek. The property on the west side of the tracks was vacant. By May 1929, the core buildings of the GAF Facility were present, but the LCP Chemicals, Inc., site was not developed. The property south of GAF's Building 1 (about 550 feet north of the northern LCP site boundary) was undeveloped and dissected with man-made drainage channels.

In 1940, the northern portion of the LCP Chemicals, Inc. site was still undeveloped marshland, with the exception of the presence of the Sound Shore Railroad tracks and the Central Railroad

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tracks along Tremley Point Road. The British Petroleum tank farm was present (15 tanks). By July 1947, the GAF Facility had expanded southward to South Branch Creek. GAF's Building 204 (Figure 1-2) was present at the northern edge of the site and northern part of the LCP site (just north of Building 220) was used as a laydown area for coal piles, tanks, and drums. Part of South Branch Creek was already filled in.

GAF began the chlorine operation at the LCP site in 1955 and by 1956, the core buildings of the chlorine facility were present, including Building 220 and Building 230. The hydrogen processing facility was constructed by 1959 and GAF leased 2.1 acres of the site to Union Carbide for hydrogen processing. The Brine Sludge Lagoon was reportedly constructed in 1962 and by 1966, berms were present along the north and west side of the lagoon area. The chlorine process waste was reportedly treated in a former wastewater treatment unit before this time. The former wastewater treatment unit system is described in Section 1.6. By 1966, South Branch Creek was filled west of Avenue B and the site drainage was provided by a flume and storm ditch system.

In 1971, GAF ceased chlorine operations and in 1972, LCP Chemicals, Inc. purchased the site from GAF and restarted operations. Between 1968 and 1972, the portion of South Branch Creek east of Avenue B was rechanneled to a location about 750 feet to the south and mercury cell Building No. 240 was constructed.

In 1972, LCP Chemicals, Inc. leased the northern part of the site to Kuehne Chemical Company to operate the sodium hypochlorite facility. In October 1972 and February 1974, the NJDEP reportedly observed lagoon overflows to South Branch Creek, but the quantities and responses are not known. LCP Chemicals, Inc. acknowledged both discharges in September 1975 and was levied a fine by NJDEP of $5,000 for each occurrence (NJDEP, July 1991).

By 1975, LCP Chemicals, Inc. was cooperating with the NJDEP and held meetings to investigate waste disposal options for brine sludge, wastewater, and the estimated 11,000 cubic yards of sludge material stockpiled in the brine sludge lagoon. LCP Chemicals, Inc. informed the NJDEP that off-site disposal options were too expensive and elected to begin pilot testing of a more cost-effective stabilization process developed by Chemfix Technologies, Inc.

LCP Chemicals, Inc. constructed an auxiliary surface impoundment, the Chemfix lagoon, and treated about 120,000 gallons (or about 460 cubic yards) of brine sludge using the Chemfix process. The Chemfix lagoon was used for a period of 4 days in 1976; the effectiveness of the operation was apparently questionable and LCP Chemicals, Inc. never continued with the Chemfix process.

LCP Chemicals, Inc. turned to using a proprietary sludge roasting process which would volatilize and capture mercury from steam dried brine sludge; they received favorable results during laboratory bench testing. A pilot sludge roaster unit was constructed south of the brine sludge

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lagoon in 1978 but the brine sludge material was processed through it only infrequently as the unit required constant "debugging", modification, and repair. By 1980, the final modifications to the sludge roaster were completed and the unit was brought back on line after LCP Chemicals, Inc. was issued a temporary air permit from the NJDEP. In December 1980, LCP Chemicals, Inc. and the NJDEP agreed that the brine sludge lagoon required closure and agreed to formalize the process through an Administrative Consent Order.

In March 1980, the Linde hydrogen plant stopped accepting hydrogen from LCP Chemicals, Inc. because of excess mercury contamination in the gas. In early 1981, Kuehne Chemical was cited by the NJDEP for caustic discharges, allegedly deliberate, into South Branch Creek, and Kuehne vacated the site shortly thereafter. The NJDEP entered into the Consent Order with LCP Chemicals, Inc. in September 1981 which required that, among other items, no more waste be placed in the brine sludge lagoon, a closure plan be developed and submitted for NJDEP approval, and a groundwater investigation be conducted. In November 1981, LCP Chemicals, Inc., abandoned the sludge roaster process because of equipment problems and stopped the generation of brine sludge in March 1982.

In 1982, LCP Chemicals, Inc. ceased plant operations, reportedly at the orders of the NJDEP and EPA, during the lagoon closure work to be protective of plant worker health and safety. The Chemfix lagoon was closed in 1983 (the Chemfix material was transferred to the brine sludge lagoon), and the brine sludge lagoon was closed by November 1984 with NJDEP approval. The lagoon closure consisted of dewatering, compaction, the addition of a two-ft thick clay cap, the addition of soil cover, and seeding. In June 1984, LCP submitted a facility closure plan to the NJDEP to close the production areas because of economic reasons. The EPA (1984) stated that LCP Chemicals, Inc. had planned to return to full chlorine-manufacturing operations in mid July 1984, but they instead ceased all plant production operations by August 1985. The facility began to be dismantled and the equipment was shipped to other LCP facilities along the east coast. Beginning in 1985, the facility was used only as a storage and transfer station for chlorine-related products produced by other LCP facilities, such as sodium hydroxide, potassium hydroxide, methylene chloride, and hydrochloric acid.

In July 1991, the Hanlin Group, Inc. filed under chapter 11 of the U.S. bankruptcy code and by April 1994, Hanlin sold all of its nation wide operating assets and all its chlorine manufacturing ceased. The EPA conducted a site visit in August 1994 and confirmed that the facility was no longer functional and that the employees were expected off the site by the end of August 1994. On November 10, 1998, the site property was formally abandoned by the New Jersey Bankruptcy Court.

1.4.4 Site Layout

The site is in a rough shape of a rectangle with two long, narrow arms extending to the southeast (Figure 1-2). The northern arm borders the course of South Branch Creek to Arthur Kill and the

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southern arm borders the railroad spurs of the Central Railroad of New Jersey for a distance of about 800 feet south.

Avenue B, Avenue C, and Avenue D extend roughly north to south across the site (Figure 1-2). South Branch Creek, the former Chemfix lagoon, the former brine sludge roasting unit, and the closed brine sludge lagoon are east of Avenue B.

The channel to South Branch Creek extends from Arthur Kill westward and ends at the railroad tracks between Avenue B and Avenue C (the original channel was relocated between 1968 and 1972). A wooden flume formerly connected to the creek at this point, extended northward along Avenue C, then extended westward along the northern boundary of the site across Avenue D and connected into the ditch system of the GAF site. The flume system is currently backfilled.

Above ground storage tanks (currently empty) used for sodium hydroxide, chlorine, and brine are located between Avenue B and Avenue C. The chlorine liquefaction and compressor building (Building 231), the former hydrogen filtering unit (Purasiv unit), and the wastewater metering sump are also here. An effluent treatment building was also located just south of the surface water flume to South Branch Creek.

The chlorine and hypochlorite processing areas and the brine treatment area were located between Avenue C and Avenue D in the central part of the site. The north central area consisted of the former hypochlorite processing area, which included a chlorine truck-loading area, a laboratory and locker building (Building 221), and Building 223 (usage unknown). The mid-central area contains the cell buildings (Building 230 and Building 240), the shop and service building (Building 220), and the chlorine cooling and drying building (southern part of Building 240). The south central portion contains the former salt storage tanks, the saturators, the brine storage tanks and the brine processing building (Building 223).

The site is mostly vacant west of Avenue D. This area contains the area of the former hydrogen plant and an existing electrical switchyard. Much of the area was used for employee parking.

1.5 SOLID AND HAZARDOUS WASTE GENERATION

The wastes generated at the site included mercury contaminated sludge, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, mercury contaminated process wastewater, spill wash down fluids, and stormwater runoff (Eder, January 1992).

Brine purification mud (brine sludge) and associated process wastewater were the principal wastes generated at the site. In 1981, the EPA listed brine purification mud from the mercury cell process as hazardous waste No. K071 and associated wastewater treatment sludge as hazardous waste No. K106. The mercury content of these materials is the basis for listing the material as hazardous.

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A "typical" brine sludge composition was reported by LCP Chemicals, Inc. (1975) as NaCl (20%), BaSO4 (50%), CaCO3 (15%), CaSO4 (15%), metal hydroxides (2%), dirt (2%), mercury (100-500 parts per million - 0.05%). Wastewater treatment sludge was also generated during chlorine production. In their 1975 Preliminary Report on Brine Sludge, LCP Chemicals, Inc. reported that an estimated 7.5 tons of sludge was generated every day and that their current stockpile of sludge was an estimated 11,000 cubic yards. Eder (1992) reported that up to 20 tons of sludge were generated per day.

Seven sludge samples were analyzed for selected inorganic constituents between 1980 and 1981 (NJDEP, January 8, 1988). The analyses showed that the sludge contained mercury with concentrations ranging between 272 mg/kg and 4,576 mg/kg. Liquids filtered from the sludge contained mercury at concentrations ranging between 40 ug/l and 2,520 ug/l.

Waste disposal practices for the chlorine plant before construction of the brine sludge lagoon are poorly documented. GAF reportedly used a small pond as a wastewater treatment unit for disposal. The wastewater was pH neutralized, filtered though a carbon unit at the north end of the site, and discharged into South Branch Creek. The location of the discharge point into South Branch Creek is not documented.

A survey plan in a report by Geraghty & Miller (1982) shows that the brine sludge pile grew to a height of about 40 above the ground surface. An estimated 31,000 cubic yards of brine sludge was left in the lagoon at the time of closure. The material in the lagoon was dewatered, graded, compacted, and capped with a clay cover in 1984.

Other sources of potential sources of contamination included:

- Kuehne Chemical Company, which operated at the site from 1972 to 1981, allegedly dumped bleaches and other caustic material into South Branch Creek on a daily basis.
- The Linde Hydrogen Plant, which received mercury-contaminated hydrogen gas from about 1957 to 1980, processed mercury on a daily basis.
- Eder (September 1993) reported that small quantities of solvents used at the site for general cleaning and degreasing could also potentially have been released to the environment.
- Transformers were located behind Building 230 and Building 240, and on the north side of Building 231. The transformers may have contained oil with PCBs.
- Storage tanks at the site were used to store chlorine, sodium hypochlorite, sodium hydroxide, and methylene chloride (NJDEP, January 8, 1988).

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- A 300 square-foot concrete drum storage pad with containment berms was located at the south central edge of the site. The pad was used to store drums of motor oil, waste oil, and other lubricants (Eder, 1993). During their December 22, 1987 inspection, the NJDEP noted stained soils and detected organic vapors around the pad.

1.6 WASTEWATER AND SURFACE WATER HANDLING

Before 1972, wastewater generated by cell washdown and cell maintenance was reportedly processed in a former pond, located east of the electrical switchyard (Eder, January 1992). The pond was originally part of the channel of South Branch Creek (Eckenfelder, September 1989). The wastewater was pH neutralized, filtered though a carbon unit at the north end of the site, and discharged to South Branch Creek. Eder (January 1992) stated that in the mid 1970s, the former wastewater treatment unit was reportedly excavated, backfilled, and covered with asphalt. The treatment unit was still present in mid 1972 (LCP, July 21, 1972) and possibly only backfilled in 1982 (NJDEP, February 1982).

Plant wastewater and sludge were collected in a 500,000 gallon (500K) agitating collection tank and the slurry was piped to Silo No. 4. The supernatant was directed to the effluent treatment system and the settled solids were directed to the brine sludge lagoon, or later, to a 4,500 gallon surge tank at the sludge roaster unit (NJDEP, January 8, 1988).

Storm water runoff at the site collected in a continuous concrete drainage swale/trench that surrounded the process area and was routed to a concrete sump south of Building 231. The runoff was pumped to holding tanks outside Brine Building 233, pH adjusted, filtered, polished with carbon, and stored pending annual or semiannual discharge to South Branch Creek in accordance with their New Jersey Pollutant Discharge Elimination System (NJPDES) permit. The system in Brine Building 233 was operational since the early 1980s.

Process wastewater in the mercury cell buildings drained to concrete floor trenches, collected in sumps in the northeast corner of each cell building, pumped to holding tanks, and eventually pumped to the wastewater treatment system.

1.7 PERMITS

A summary of the permits that were issued to LCP Chemicals, Inc. is presented in Table 1-1. The first reference to Permit No. NJ0003778, the discharge to surface water permit, was made in June 1975, when the facility reported to the EPA that an accidental release of brine sludge to South Branch Creek occurred for an estimated nine-hour period. The conditions of that permit were not described.

The NJDEP reissued the Permit in 1987 and required that LCP Chemicals, Inc. install four new monitoring wells to evaluate the groundwater quality in the water table aquifer.

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Kuehne Chemical Company submitted a National Pollutant Discharge Elimination System (NPDES) permit application, Application No. 0027707, on August 27, 1974. In August 1980, the EPA issued the NPDES permit for the discharge of uncontaminated cooling water only from the sodium hypochlorite process. In 1981, the NJDEP alleged that Kuehne Chemical Company was dumping caustic material into the outfall and issued a Notice of Civil Administrative Penalty Assessment against the company on October 7, 1981. The notice states that a pipe was observed during an NJDEP site visit on January 26, 1981 "connected to the outfall in such a manner as to allow for a physical conduit for the passage of pollutants to the waters of the State". This connection was removed at the time of a follow up visit by the NJDEP on the next day. The notice also states that Kuehne Chemical Company ceased operations and vacated the site that same day.

1.8 REGULATORY VIOLATIONS, ACTIONS, AND INVESTIGATIONS

The section summarizes the regulatory history of the LCP Chemicals, Inc. site.

1.8.1 Summary of Incidents and Enforcement Actions

The NJDEP (July 1991) states that in September 1975, LCP Chemicals, Inc. was fined $10,000 for discharges of supernatant from the brine sludge lagoon to South Branch Creek in October 1971 and February 1974. Details of the discharges are not known.

On September 17, 1981 the NJDEP signed an Administrative Consent Order, dated September 17, 1981 requiring that LCP Chemicals, Inc. perform the following tasks:

- Cease use of the Brine Sludge Lagoon by January 1, 1982;
- Submit a closure plan for the Brine Sludge Lagoon;
- Submit a closure plan for the Chemfix Lagoon;
- Conduct air monitoring of the brine sludge pile; and
- Conduct a soil, sediment, surface water, and groundwater sampling program.

LCP Chemicals, Inc. responded to the requirements of the order and both lagoons were formally closed by November 1984, air monitoring of the sludge pile took place on June 4, 1981 (RECON, 1981), and a limited soil, sediment, surface water, and groundwater investigation was performed by Geraghty and Miller (1982). The results of the investigation are briefly summarized in Section 1.10.4.

The NJDEP issued an Order dated May 4, 1982 to cease the November 5, 1981 violation of N.J.A.C. 27-8.3(e)2 resulting from a ruptured muffler plate on the brine sludge roaster allowing mercury emissions to vent directly to the atmosphere from the operation of four unpermitted propane burners on the unit (Eder, January 1992). LCP Chemicals, Inc., however, abandoned the

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sludge roaster experiment because of equipment problems and had stopped roaster operations in November 1981.

In a letter dated June 4, 1982, the NJDEP denied LCP Chemicals, Inc.'s Hazardous Waste Facility Permit Application because of the severe deficiencies of the sludge roasting system and the inability to process the waste on site. LCP Chemicals, Inc. (June 29, 1982) responded in a letter to the NJDEP that they planned to modify the roaster design to correct these deficiencies. LCP Chemicals, Inc. continued with the lagoon closures and began to dispose of its waste off site.

The EPA issued a Complaint/Compliance Order dated August 25, 1982 for lack of freeboard in a surface impoundment (brine sludge lagoon). LCP Chemicals, Inc. was also cited for lack of a waste analysis plan, not maintaining a schedule of inspections, and lack of a contingency plan. LCP Chemicals, Inc. (August 10, 1984) reported that they were fined $1,000 for the freeboard violation and corrected the other violations with no penalty assessment.

The NJDEP issued a Notice of Violation dated January 7, 1983 for failure to submit a RCRA Treatment, Storage, or Disposal Facility annual report. An annual report was submitted to the NJDEP shortly thereafter on January 17, 1983 and no penalty was assessed.

The NJDEP issued a Notice of Violation dated November 16, 1983 for failure to establish financial assurance for closure and post-closure monitoring of the brine sludge lagoon and to demonstrate financial responsibility for claims. LCP Chemicals, Inc. responded (August 10, 1984) that it was their understanding that the NJDEP Division of Waste Management now had copies of the necessary documents and that the matter was now resolved.

The NJDEP issued an Administrative Order, dated February 11, 1985, requiring that LCP Chemicals, Inc. maintain documentation of the job title for each position at the facility related to hazardous waste management, the name of the employee filling each job, keep a roll-off container with hazardous waste material secure, provide immediate access to telephones and alarm systems within hazardous waste areas of the facility, and to develop an evacuation procedure for employees. LCP Chemicals, Inc. corrected the deficiencies and was assessed a penalty of $900.

1.8.2 Summary of Spills and Releases

Several spills and releases at the site were documented by the NJDEP and the EPA. These incidents are briefly described below.

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1.8.2.1 South Branch Creek

October 30, 1972 - A release occurred from the brine sludge lagoon - location and quantities unknown (NJDEP, July 1991).

February 7, 1974 - A release occurred from the brine sludge lagoon - location and quantities unknown (NJDEP, July 1991). LCP Chemicals, Inc. acknowledged both releases on September 25, 1975 and was fined a total of $10,000.

June 25, 1975 - A nine hour discharge of the contents of the brine sludge lagoon into South Branch Creek occurred when a recycling pump failed (LCP, July 27, 1975).

August 15, 1979 - An estimated 10,000 to 20,000 gallons of mercury-contaminated brine overflowed a saturator for an 8-hour period when it became blocked with salt. The brine discharged into South Branch Creek (LCP, August 20, 1979). A sample from the spill was analyzed by LCP Chemicals, Inc. for mercury and showed a concentration of 8.6 parts per million.

In January 1981, a former employee who worked at the site between 1972 and 1980 stated that he sometimes performed laboratory analyses on the effluent water that was being discharged into South Branch Creek (NJDEP, January 25, 1981). On one occasion, he detected mercury concentrations eight to ten times greater that the maximum allowed (the concentrations were not specified). The employee alleged that his supervisor told him to destroy the results, which he did.

October 7, 1981- Kuehne Chemical Company was cited by the NJDEP for discharging caustic material into South Branch Creek (NJDEP, October 7, 1981). Kuehne Chemical Company contested the NJDEP's action and subpoenaed the NJDEP on October 27, 1981 for depositions. The outcome of this dispute is unknown.

1.8.2.2 500,000 Gallon (500K) Tank

Several releases were documented by the NJDEP near the 500,000 gallon (500K) brine tank. The NJDEP Site Inspection Reports can be found in the RCRA Facility Assessment for LCP Chemicals - New Jersey (NJDEP, January 8, 1988).

On September 17, 1980, an unspecified amount of brine sludge was noted on the gravel near the 500K tank.

On October 9, 1980, brine sludge was transferred from the 500K tank to the brine sludge lagoon by front end loader and dump truck. During the transfer process, some sludge had fallen to the

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ground. LCP told the NJDEP that the spilled sludge would be flushed into the sump next to the 500K tank.

On January 22, 1981, a leak was observed in an overhead pipe north of the 500K tank. Wash water from the cell rooms spilled onto the unpaved ground. The NJDEP was informed that repairs would be made.

On October 22, 1981, a 10 ft by 4 ft hydrochloric acid spill resulting from a leaking overhead pipe was observed about 15 ft northwest of the 500K tank.

On April 13, 1982, a spill of sodium sulfide crystals was observed just north of the 500K tank.

1.8.2.3 Releases Near the Brine Sludge Lagoon

NJDEP Site Inspection reports document releases of brine sludge from leaks from the overhead pipes leading from Building 233 to the brine sludge lagoon. The NJDEP Site Inspection Reports can be found in the RCRA Facility Assessment for LCP Chemicals - New Jersey (NJDEP, January 8, 1988).

On October 22, 1981, a 1 ft by 15 ft spill of brine sludge slurry resulted from a leaking overhead transfer line between the 500K tank and the brine sludge lagoon. The spill occurred on Avenue B, between the railroad tracks and the brine sludge lagoon. The exact location of the overhead line is not well documented, but NJDEP sketch maps (e.g., NJDEP, November 19, 1981) indicate that it extended from the 500K Tank/Building 233 area to the southwest corner of the brine sludge lagoon.

On November 19, 1981, the overhead line was again leaking, which resulted in a 30 ft by 125 ft spill along the Avenue B railroad tracks.

In January 1981, a former employee who worked at the site between 1972 and 1980 stated that sometime in 1973 or 1974, brine sludge was removed from the brine sludge lagoon and the material was spread out on the ground between Building 231 and the railroad tracks (NJDEP, January 25, 1981). To his knowledge, this occurred on only one occasion.

1.9 PHYSICAL SETTING

The general physical setting of the LCP Chemicals, Inc. site is presented in this section.

1.9.1 Topography and Drainage

The site is relatively flat, with the exception of the former brine sludge lagoon, at an elevation of about 8 feet above mean sea level (Figure 1-1). The former brine sludge lagoon has a footprint

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of about 150 ft by 250 ft and it reaches a height of about 15 ft above grade. The mound is vegetated, although several shallow erosion gullies are present along the flanks.

The 100-year flood elevation for the Linden, New Jersey area is estimated to be about 9 ft mean sea level (Eckenfelder, 1991) and therefore, most of the site is located within a 100-year flood zone. A map showing the site in relation to the 100 year and 500 year flood plain is shown in Appendix B.

Storm water runoff at the site collects in drainage swales that surrounded the process area and routes to a concrete sump south of Building 231. The runoff is reportedly periodically pumped into holding tanks outside Building 233, pH adjusted, filtered, polished with carbon, and stored pending annual or semiannual discharge to South Branch.

1.9.2 Geology

The geology across the site is defined only in a few locations. Subsurface data east of Avenue B were collected from borings that were advanced to bedrock immediately around the brine sludge lagoon (Geraghty & Miller, February 1982). The following four stratigraphic units are identified in the area around the former brine sludge lagoon (Figure 1-3):

- Fill Unit - industrial fill and imported sands (5-10 ft thick)
- Tidal Marsh Deposits - dark gray organic clay (10 ft thick)
- Till Unit - red brown silt and clay , +/- red-brown weathered shale (20-30 ft thick)
- Bedrock - siltstone and shale of the Passaic Formation.

Fill Unit - the Fill Unit is a heterogeneous mixture of silt to gravel-sized particles containing industrial material including slag, crushed stone, and brick. On the basis of its geographic location (i.e., in lowlands), date of deposition (beginning in the late 1920s), and composition, this material likely meets the definition of "Historic Fill", as defined by the NJDEP in N.J.A.C. 7:26E-1.8.

Tidal Marsh Deposits - This unit consists of dark gray clay with organic matter and tidal grasses, with occasional layers of peat and silt. A subunit of organic silty sand with shells was also identified.

Till Unit - This unit consists of reddish brown clay, silt, sandy silt, and gravel. Some of this material, at depths close to bedrock, is derived from the weathering of bedrock.

Bedrock - Bedrock consists of the reddish brown shale and siltstone of the Passaic Formation of the Newark Supergroup.

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This same stratigraphic package was also identified immediately north of the site at the GAF Chemicals Corporation facility (hereafter called the ISP Environmental Services Inc. site) by Eckenfelder (1991).

The subsurface geology west of Avenue B was never investigated in detail. During the ECRA investigation of the Linde Hydrogen Plant, eight borings were advanced, but only to depths of about 15 feet (IT, 1991). IT identified the material underlying the 2.1 acre site, from top to bottom, as 8 feet of fill, consisting of black cinders, black sand, and pieces of rock and gravel, and an undetermined thickness of gray clay, peat, and red and gray silt (Tidal Marsh Deposit). The Tidal Marsh Deposit was apparently not completely penetrated at the former hydrogen plant.

1.9.3 Hydrogeology

The groundwater characteristics of the site are not well defined. On a regional scale, the groundwater flow direction is inferred to be predominately eastward toward Arthur Kill. Data from previous investigations indicate that the water table is between 3 and 6 feet below the ground surface with an elevation of approximately 5 to 6 feet above mean sea level.

Geraghty & Miller (1982) installed six monitoring wells (MW-1, MW-1A, and MW-2 through MW-5) around the former brine sludge lagoon. The length of the well screens varied from 5 ft to 30 ft (Table 1-2) and the screens were set at different depths and within different stratigraphic units (Figure 1-3). As such, these wells are considered suspect for any evaluation of contamination and the groundwater elevation data from these wells are not useful to identify groundwater gradients and flow directions. Permeability tests and the evaluation of tidal influences on these wells were apparently never conducted.

Eder installed four shallow groundwater wells in 1990 (MW-6 through MW-9) with screens set across the water table (Figure 1-2), but did not report groundwater elevations, flow directions, or possible tidal influences on groundwater (Eder, January 1992; September, 1993).

In the west portion of the site, IT Corporation installed 8 shallow monitoring wells between 1991 and 1992 (MW-1 through MW-8; herein called IT-MW-1 through IT-MW-8) around the Linde hydrogen plant (Figure 1-2) as part of an ECRA investigation (IT, May 1992). On the basis of data collected during two rounds of water level measurements, IT reported that the groundwater flow direction was south to southwest toward the Rahway River (Figure 1-1). Groundwater data can no longer be collected from these wells because they were sealed, with NJDEP approval, on October 13, 1993 in response to the NJDEP's no further action decision for the hydrogen plant (IT, June 1994).

Eckenfelder (1991) reports that the shallow groundwater flow direction in the northwestern portion of the site is to the north based on work conducted on the neighboring ISP Environmental Services Inc. Site.

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An evaluation of the available historic boring and monitoring well data (Table 1-2) allows several inferences to be made about groundwater at the site. Data from monitoring well pair MW-1 and MW-1A (Figure 1-3) suggests that a potential downward vertical gradient exists between the upper and deeper water-bearing zones, although the transient effects of tides on site groundwater have not been investigated in detail. The water table appears to occur within the fill unit (see Eder and IT data in Table 1-2) just above the Tidal Marsh Deposit. The Tidal Marsh deposit may be locally acting as a confining layer to infiltrating precipitation which could cause the local groundwater to exist under perched conditions. A substantial saturated thickness is not present above the TMD. The historic data shown in Table 1-2 suggest that only an average of 2 to 3 ft of water is present above the TMD. This conceptual geologic and hydrogeologic model of the site will be further evaluated during this RI.

1.9.4 Wetlands

Malcolm Pirnie (1995), as an EPA Contractor, conducted a wetland delineation survey in 1995 along South Branch Creek using 1989 U.S. Federal wetland determination criteria (EPA and others, January 1989). Malcolm Pirnie reported that a narrow corridor of wetlands existed along both banks of South Branch Creek for its entire length. Malcolm Pirnie estimated that about 2,300 lineal feet (0.43 miles) of wetlands frontage existed along South Creek basin and within the boundaries of the site, although the total acreage was not reported. The wetlands were classified as estuarine emergent wetlands. Malcolm Pirnie (1995) also reported that there are no terrestrial sensitive areas on or within 200 feet of the site property. Malcolm Pirnie's report of the wetland delineation survey is presented in Appendix C. Malcolm Pirnie's wetland delineation map is also included in Appendix C, although the delineation lines apparently were not reproducible from the original because the extent of wetlands in not visible on the map.

1.9.5 Surface Water

The center of the site is located within 1,500 feet of the Arthur Kill. Arthur Kill is a tidal channel that joins Newark Bay and Raritan Bay. Pralls Island is in the center of the Arthur Kill opposite the site.

South Branch Creek, a local tidal tributary of Arthur Kill, drains the site and discharges to the Arthur Kill. Originally, South Branch Creek flowed across the center of the site, roughly beneath the area where Building 230 now stands, and extended to the area now occupied by the former hydrogen plant. By 1947, the creek was beginning to be filled and diverted from its original channel west of Avenue B.

The course of South Branch Creek between Avenue B and Arthur Kill was altered sometime between 1968 and 1972. The original discharge point of the Creek was about 750 feet north of the current discharge point. By 1966, South Branch Creek was no longer present west of

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Avenue B (Eckenfelder, 1989) and a system of wooden flumes and concrete trenches were installed to provide drainage west of Avenue B.

Arthur Kill is classified by the NJDEP as saline estuarine waters - SE3 (N.J.A.C. 7:9B) with designated usages of secondary contact recreation (i.e., boating, fishing, minimal ingestion), maintenance of wildlife, and maintenance and migration of the natural and established biota. The Rahway River is located about 1,500 south of the site. The Rahway River is classified as SE2 (N.J.A.C. 7:9B) which has similar uses as SE3 waters.

1.9.6 Tidal Data

Tidal influences on groundwater or South Branch Creek are not well defined. NUS (1984) states that there are 2 foot tides in South Branch Creek. High tide and low tide differences measured at the Rahway River Station (about 1 mile southwest of the site) average about 5 ft per cycle (Tide Tables, 1996). Tidal influences on Eder's shallow monitoring wells MW-6 through MW-9 have not been reported.

1.9.7 Land Use

The site is located between the Arthur Kill to the east, the New Jersey Turnpike to the west, and the Rahway River to the south. The area is mostly industrial. The only residential area within a mile radius is in the Tremley section of Linden, about 0.75 miles west of the site. The area immediately surrounding the site is zoned by the City of Linden as H-1, Heavy Industrial District. The permitted uses of this zone include manufacturing (with no chemical or raw material processing), research and laboratory offices, service stations, truck terminals, and tank farms. The zoning regulations do not currently allow residential development east of the New Jersey Turnpike (Eckenfelder, 1991).

Current land use is within an approximate 1-mile radius of the site is primarily industrial, with pockets of wooded wetlands, saline marshes, and surface water bodies (NJDEP, 1996). A map showing land use in the site vicinity is presented in Appendix B. The New Jersey Turnpike forms a major geographic boundary separating Tremley Point from the rest of the City of Linden, New Jersey.

1.9.8 Well Search

Potable water supplies in the vicinity of the site have been researched by Malcolm Pirnie (July 1995). Groundwater is not used as a source of drinking water within four miles of the site. Although the Passaic Formation is a state aquifer, there are no potable wells within four miles of the site. There are no designated or proposed Wellhead Protection Areas within four miles of the site. A preliminary compilation of Public-Community Water-Supply (PCWS) Wells conducted for New Jersey by the NJ Geological Survey (July, 1997) indicates that there are no PCWS wells

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within 3.5 miles of the site. A decision to update the well search for the site vicinity will be conducted after an evaluation of the hydrogeologic and groundwater quality data generated during the RI field investigation.

1.9.9 Ecological Resources

A Greenway project was initiated for the Arthur Kill as part of a response to a 1990 Bayway Refinery oil spill. Numerous salt marsh habitats were identified inside the Arthur Kill watershed area close to the site. The Peregrine Falcon, the northern harrier, the great blue heron, the yellow crowned night heron, and the little blue heron are reported to either breed or hunt in the surrounding marshes. A habitat restoration project was ongoing at Pralls Island as of 1996 to protect these NJ state-listed species. An ecological evaluation of South Branch Creek was apparently never performed. There are no terrestrial sensitive environments within 200 feet of the site (U.S. EPA, 1996).

1.9.10 Climate

The National Oceanic and Atmospheric Administration/Cooperative Institute for Research in Environmental Sciences Climate Diagnostics Center (April 2000) report the following climate data for the site area (Newark, NJ). From 1961 through 1990, the average monthly maximum temperatures range from 85.7 degrees Fahrenheit in July to 37.7 degrees Fahrenheit in January. Temperature extremes range from a high of 105 degrees Fahrenheit in July 1966 to a low of -8 degrees Fahrenheit in January 1985.

The 30-year normal annual precipitation (1961 through 1990) is 43.9 inches with its distribution relatively uniform throughout the year. The mean annual snowfall is 26.6 inches. Eckenfelder (1991) report that in the site area, the prevailing wind direction is from the southwest, west, and northwest. Relative humidity for the area averages about 73 percent in the morning to about 61 percent in the evening.

1.9.11 Aerial Photographs

A set of aerial photographs was compiled by Eckenfelder (1989) for the ISP Environmental Services Inc. site which borders the site to the north. An evaluation of the photographs, which include the LCP site, is presented in Appendix D. Reproductions of the aerial photographs from the years 1929, 1947, 1952, 1956, and 1967 are also included in Appendix D. The EPA (1999) also compiled an evaluation of aerial photographs of the site. The EPA evaluation was used to identify historic potential areas of concern such as areas of stained soil and areas of standing water (Section 1.11.15). Data from the EPA aerial photograph interpretation were used in the selection of proposed sampling locations, which is detailed in Section 5.0.

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1.10 OVERVIEW OF PREVIOUS INSPECTIONS AND INVESTIGATIONS

Table 1-3 presents a summary of the regulatory site inspections and investigations conducted at the site. A brief discussion of those investigations which generated analytical data is presented below. This summary is not intended to provide detailed information on the nature and extent of site contamination because much of the analytical data generated to date is old, unsupported, and consequently suspect and unusable for site decisions. Some of the analytical results (such as data from filtered groundwater samples) are not plotted or tabulated in this report because the data has no regulatory value. The intent of this section is to present a broad overview of the previous investigations to provide a general historic perspective of the site.

To provide a point of reference for the discussion of the historical results, the current NJDEP cleanup criteria (May, 1999) for mercury, the primary constituent of concern, is presented. The NJDEP Residential Direct Contact Soil Cleanup Criterion for mercury is 14 mg/kg, the NJDEP Non Residential Direct Contact Soil Cleanup Criterion for mercury is 270 mg/kg, and the NJDEP groundwater criterion for mercury is 2 ug/l. New analytical data collected during this RI/FS will be compared against the current Applicable or Relevant and Appropriate Requirements, as required by CERCLA.

1.10.1 1978 NJ Department of Health Sampling

An aqueous sample was collected from the "leachating drainage ditch tributary to Arthur Kill" on May 31, 1978 (Table 1-4). The collector is unknown. The pH of the sample was 12, which represents caustic conditions. The exact location of the sample is not known.

1.10.2 1980 NJ Department of Health Sampling

A total of seven sediment samples (C05786, C05784, C05782, C05851, C05793, C05790, and C05788) were collected from South Branch Creek on August 12, 1980 for unspecified reasons. The collector is unknown and the locations of some samples can only be inferred because maps were not provided. The mercury concentrations of the samples ranged between 7.8 mg/kg to 87.7 mg/kg (Table 1-5). The current NJDEP sediment guidance screening value for mercury is 0.71 mg/kg (medium effect range for estuarine sediments). Figure 1-4 provides the inferred sediment sample locations and the analyte concentrations.

1.10.3 RECON Systems 1981 Sludge Pile Air Sampling

On June 4, 1981, RECON Systems, Inc. conducted real-time mercury air monitoring of the waste pile in the brine sludge lagoon. They estimated that the pile emitted an average 113 grams/day of mercury. They cautioned, however, that because of numerous atmospheric variables used to calculate the emission rate (e.g., temperature, wind speed, etc.), the results were valid for that day

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only. Mercury emissions at active chlorine production facilities currently cannot exceed 2,300 grams/day (EPA, 40 CFR Part 61).

1.10.4 1981 Geraghty & Miller Groundwater Investigation

The first formal investigation at the site occurred in 1981 with the installation of six monitoring wells around the brine sludge lagoon in September and October 1981 to comply with the NJDEP September 1981 Consent Order and with RCRA groundwater monitoring requirements. Geraghty & Miller (1982) installed one water table monitoring well (MW-1A) and five wells (MW-1 through MW-5) that were screened either below or across the Tidal Marsh Deposit (Figure 1-3). As previously stated, these wells are suspect for any data previously collected and will not be used in any future investigations.

Soil samples collected from the upper 10 feet (Fill Unit) of the monitoring well borings had mercury concentrations that ranged from 1.0 mg/kg to 772 mg/kg (Table 1-6). The concentration of mercury in soil decreased with depth, and generally decreased distinctly at the base of the fill layer (Figure 1-5). The soil data indicates that the screens for the Geraghty & Miller monitoring wells MW-1, MW-2, MW-3 and MW-4 were set below the depth of significant mercury contamination in soil.

The monitoring well network (MW-1, MW-1A, and MW-2 through MW-5) established by Geraghty & Miller (1982) is not effective in monitoring shallow groundwater quality around the brine sludge lagoon. The screens for these monitoring wells were set within different geologic horizons (described in Section 1.9.3 and shown in Figure 1-3) and, as described above, below the depth of mercury contamination in saturated soil. The groundwater data from these wells, according to the NJDEP, were not useful to support further action or no further action decisions for the site. In 1987, the NJDEP (January 1987) downgraded the status of these wells to piezometers and required that LCP Chemicals, Inc. install four new water table monitoring wells. The new wells were installed by Eder in 1990 (Figure 1-2).

Geraghty & Miller submitted two rounds of dissolved (filtered) groundwater samples to the site laboratory for mercury analysis in October 1981 and one round of groundwater samples to an independent laboratory in November 1981. The analytical results showed mercury concentrations of less than 1 ug/l.

Four surface soil samples (S-1 through S-4) and one sediment sample (GM-Sed) were collected by Geraghty & Miller and analyzed by the site laboratory. Mercury concentrations in the soil samples (Table 1-6 and Figure 1-6) ranged between 27 mg/kg and 1,580 mg/kg and the mercury concentration in the sediment sample was 46 mg/kg (Table 1-5 and Figure 1-4).

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1.10.5 March 1982 Groundwater Samples to ETC laboratory

Filtered groundwater samples (MW-1, MW-2, MW-3, and MW-4) were collected on March 15, 1982 by LCP Chemicals, Inc. and submitted to ETC Laboratories for the analysis of selected metals, selected pesticides, one herbicide (silvex), radiological parameters, bacteria, and water quality parameters. Arsenic (10 ug/l) and cadmium (10 ug/l) exceeded the current NJDEP Groundwater Criteria of 8 ug/l and 4 ug/l, respectively.

1.10.6 1984 NUS Corporation Investigation

On September 27, 1984, NUS, as contractors for the EPA, collected three groundwater samples (GW-1 through GW-3), two surface soil samples (S-1 and S-2), and two sets of surface water/sediment samples (SW-1/SD-1 and SW-2/SD-2) from areas around the brine sludge lagoon. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals.

The three groundwater samples, designated by NUS as 3348-GW-1, 3348-GW-2, and 3348-GW-3, were collected from MW-2, MW-4, and MW-5, respectively. The samples contained concentrations of arsenic, chromium, and lead, that exceeded the current NJDEP groundwater standard of 8 ug/l, 100 ug/l, and 10 ug/l, respectively (Table 1-7). Mercury concentrations in MW-4 (253 ug/l) and MW-5 (116 ug/l) exceeded the current NJDEP mercury groundwater standard of 2.0 ug/l.

The two surface soil samples collected from east of the brine sludge lagoon (3348-S-1) and from the surface of the excavated Chemfix lagoon (3348-S-2) exceeded the NJDEP arsenic cleanup criterion of 20 mg/kg with concentrations of 26 mg/kg and 50 mg/kg, respectively (Table 1-6 and Figure 1-6). The mercury concentrations were 2.6 mg/kg and 53 mg/kg, respectively.

Surface water sample 3348-SW-1 was collected from the drainage flume and sample 3348-SW-2 was collected east of the brine sludge lagoon (Figure 1-7). Samples 3348-SW-1 and 3348-SW-2 contained mercury at concentrations of 20 ug/l and 212 ug/l, respectively (Table 1-4). Sediment collection points were collocated with the surface water samples (1-4). Sediment sample 3348-SD-1 contained arsenic at a concentration of 44 mg/kg and mercury at a concentration of 784 mg/kg. Sediment sample 3348-SD-2 contained arsenic at a concentration of 54 mg/kg (Table 1-5).

1.10.7 LCP 1987 Quarterly Groundwater Results

Four rounds of groundwater samples were collected from monitoring wells MW-1 through MW-4 by LCP in 1987. The concentrations of dissolved mercury were generally undetected in the samples.

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1.10.8 1988 Blasland, Bouck & Lee Soil Investigation

In August 1988, Blasland, Bouck & Lee conducted a soil investigation around Building 231 for the proposed expansion of that building. Soil samples were collected from areas both south and north of the building, including the proposed southern expansion area (Figure 1-8). Selected samples were submitted for the analysis of VOCs, base neutral compounds, pesticides/PCBs, and inorganic constituents (Table 1-6). Nineteen samples were collected from fourteen locations. The constituents that exceeded the current NJDEP Non-Residential or Impact to Groundwater soil cleanup criteria were chlorobenzene (1.6 mg/kg), chloroform (1.1 mg/kg), hexachlorobenzene (20 mg/kg), arsenic (43 mg/kg), and mercury (up to 41,400 mg/kg). The laboratory reported that the sample with the maximum mercury concentration (S231-2A) contained visible beads of mercury.

1.10.9 Geraghty & Miller 1988 Groundwater Sampling Round

In 1988, in an attempt to demonstrate the adequacy of the monitoring well network around the brine sludge lagoon, Geraghty & Miller (1989) conducted a pressure packer study. The packer test was used to isolate the upper five feet of monitoring well screen from the rest of the boring. The packer test was conducted on monitoring wells MW-2 through MW-5. The test was not conducted on either monitoring well MW-1A, because the screen was too short (5 ft) for a packer or monitoring well MW-1, because the well was discovered to be silted up. The purpose of the packer test was to demonstrate that measurements and analytical results of groundwater quality were not dependent on the length of screen. Groundwater samples were collected from each well without a packer installed and with a packer installed and the samples were submitted for laboratory analyses. Geraghty & Miller concluded on the basis of the similarity of the analytical results of the no-packer/packer samples that the installation of additional monitoring wells was not required around the brine sludge lagoon.

1.10.10 1990-1992 Eder Shallow Groundwater Investigation

In March 1990, Eder installed four additional monitoring wells, MW-6, MW-7, MW-8, and MW-9 (Figure 1-2), to resolve the issues surrounding the effectiveness of the MW-1 through MW-5 monitoring well network. Detailed boring logs or well construction logs are not available but it appears that the base of the well screens were generally installed in the Tidal Marsh Deposit (Table 1-2).

Eder conducted eight quarterly sampling rounds between 1990 and 1992. The groundwater samples were collected from monitoring wells MW-6 through MW-9 and submitted for the analysis of six metals and water quality parameters. Groundwater sampling logs are not available so it is not known whether the samples were filtered or not.

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The analyses of individual inorganic constituents in samples collected from any given well were not performed on a consistent basis. Samples collected from monitoring wells MW-6 through MW-8 generally did not contain detectable concentrations of mercury (Table 1-7). Samples from MW-9 were never analyzed for mercury. In general, the concentrations of metals in groundwater samples only exceeded NJDEP groundwater criteria for arsenic (up to 210 ug/l in MW-9) and cadmium (up to 67 ug/l in MW-7).

1.10.11 1990-1995 Linde Gases ECRA Cleanup

As described in Section 1.4.2.3, a NJDEP ECRA investigation and cleanup was conducted at the former 2.1 acre hydrogen facility in the late 1980s and early 1990s and the NJDEP approved no further action for the facility on June 20, 1995. A deed notice was required for the site because of the presence of historic fill and the presence of associated organic and inorganic constituents in groundwater and soil. The investigation showed that benzene (up to 43 ug/l), arsenic (up to 590 ug/l), lead (up to 46 ug/l) and mercury (up to 32 ug/l) impacted shallow groundwater at the Linde site. IT (1994), however, reported "Any elevated levels of contaminants in the shallow groundwater of this area are documented in the NJDEPE files as the result of off-site sources. No remediation was conducted for this area of concern".

A macadam "cap" was the remedial action for the site. With the exception of possible investigation of the distribution of historic fill across the site, additional investigations were not required by the NJDEP at this facility. It is not known whether a biennial certification for the maintenance of the engineering control (i.e., cap) is provided to the NJDEP, in accordance with current deed notice requirements.

1.10.12 1995 Malcolm Pirnie Site Inspection Sampling Event

On January 11, 1995, Malcolm Pirnie, an EPA contractor, conducted a site inspection and sampling event at the LCP site. Three surface soil samples (SL1 to SL3), ten surface water samples (SW-1 to SW-10), and eight sediment samples (SED1, SED3-SED7, SED9, and SED10) were collected for inorganic analysis. The surface soil analytical results were generally good, with detected mercury concentrations below the current NJDEP soil cleanup criterion (Non-Residential) of 270 mg/kg (Figure 1-6). In surface water, the maximum mercury concentration of 93 ug/l was detected in sample SW3 (Figure 1-7) and in sediment, the maximum mercury concentration of 1,060 mg/kg was detected in sample SED3 (Figure 1-4). These samples were collected about 40 feet downstream of the LCP and GAF outfalls. Other constituents including arsenic, cadmium, and lead also exceeded NJDEP cleanup criteria in both sediments and surface water. Malcolm Pirnie (1995) concluded that the analytical results of the surface water and sediment samples documented that a release of mercury had occurred from the site to the surface water pathway.

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1.10.13 1994 Through 1998 NJPDES Permit Groundwater Sampling

Between 1994 and 1998, groundwater samples were collected from monitoring wells MW-6, MW-7, MW-8, and MW-9 on an annual basis and analyzed for selected metals. The analyses were performed to satisfy the LCP Chemicals, Inc. stormwater discharge monitoring requirements for NJPDES Permit No. 0077038. The collection of groundwater samples and analyses stopped after 1998 when the Hanlin Group, Inc officially abandoned the site.

The analytical data, provided by the EPA (March 14, 2000), are summarized in Table 1-8. The inorganic constituents of concern, as shown by these historic data, are arsenic, cadmium, lead, and mercury, although the quality of the analytical data are suspect. For example, the July 1998 analytical data for monitoring well MW-9 shows high concentrations of several constituents (up to 169 ug/l mercury), but the next round of data shown for October 1998 shows concentrations of the same constituents that are far less than their respective regulatory criteria. Neither the method of sampling (i.e., low-flow versus conventional bailer techniques) nor the analytical methods were described.

1.11 POTENTIAL SOURCES AND AREAS OF CONCERN

On the basis of the information collected during the NJDEP's and EPA's Site Inspections (NUS, 1984; NJDEP, 1988; NJDEP 1991, Malcolm Pirnie, 1995) and information compiled in this chapter, several potential sources and areas of concern were identified (Figure 1-2) and are described below. The areas of proposed investigation and the rationale for the proposed work are described in Chapter 5.0 - Scope of Work.

1.11.1 Brine Sludge Lagoon

The Brine Sludge Lagoon was an earthen surface impoundment (reported to be both unlined and lined with a spray of hot tar) in which the mercury cell process wastes were disposed. The lagoon was probably constructed in the mid 1960s. The lagoon had a trapezoid shape with an approximate footprint of 275 ft by 200 ft by 220 ft by 80 ft. Earthen dikes, about seven feet high, surrounded the impoundment. The final total volume of waste material in the lagoon was estimated to be about 31,000 cubic yards and the sludge pile grew to a height of up to 40 feet.

The normal disposal procedure was to pump brine sludge and wastewater in the lagoon. The supernatant was pumped back to the wastewater treatment system for salt resaturation and treatment from a sump located in a pump house at the southeast corner of the lagoon. The solid waste was stored in the center of the impoundment. A crane was used (at least once in 1981) to shape the solid sludge pile and to improve the supernatant flow to the pump house.

In March 1982, the chlorine production stopped at the site because of poor market conditions. In July 1982, when the sludge roaster permit was rejected by the NJDEP, LCP Chemicals was

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Exhibit J

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: AUG 1 2 1996

SUBJECT: Removal Site Evaluation for LCP Chemicals, Inc., Division of Hanlin Group, Linden, Union County, New Jersey

FROM: Nick Magriples, CHMM, On-Scene Coordinator N. Magriples
Removal Action Branch

TO: File

Site I.D. No.: ZZ
REMOVAL ASSESSMENT RANKING: not eligible

I. INTRODUCTION

The Removal Action Branch received a verbal request from the Pre-remedial Section in January, 1996 to evaluate LCP Chemicals, Inc. for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Removal Action consideration. The request was focused on the former lagoon area.

There has been a release of CERCLA designated Hazardous Substances at LCP Chemicals, Inc. Elevated levels of mercury are present in the soil, sediment, and nearby surface waters due to past disposal practices at the Site. However, based on the available information, LCP Chemicals, Inc. is not eligible for a CERCLA Removal Action at this time. According to the New Jersey Department of Health and the Agency for Toxic Substances and Disease Registry, there are no completed or anticipated human exposure pathways associated with the Site under present conditions. Furthermore, there are no defined acute ecological threats which warrant a CERCLA Removal Action at this time.

The Site is currently undergoing further study under the pre-remedial site assessment program for potential National Priorities List (NPL) consideration.

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

1. Physical location

LCP Chemicals, Inc. (Site) is situated off of South Wood Avenue on the Tremley Point peninsula, in Linden, Union County, New Jersey (see Figure 1). The Site, which occupies 26 acres on filled marshland and is located in an industrial area, is bordered by the South Branch Creek to the east; GAF Corporation to the north; and Northville Industries, BP Corporation, and Mobil to the northeast, south, and west, respectively.

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It is estimated that 38 persons reside within one-half mile of the Site, with the nearest residential home being approximately one-half mile west on South Wood Avenue. The distance from the entrance to the Site from South Wood Avenue via paved roadway is estimated to be at least one mile.

The South Branch Creek, a tributary to the Arthur Kill, appears to arise onsite and flows approximately 1,000 feet along the eastern border of the Site before discharging into the Arthur Kill. The Arthur Kill is classified as "Saline Estuarine Waters: SE2" and is reportedly used for recreational boating. The Arthur Kill, which is tidally influenced, flows south for approximately 10 miles where it discharges into the Raritan Bay. The Site is located within the 100-year floodplain. River and coastal tidal water wetlands exist in the immediate vicinity of the Site.

The Peregrine Falcon, northern harrier, great blue heron, yellow-crowned night heron, and little blue heron, all state-listed species, are reported to either breed or hunt in the salt marshes near the Site. Prall's Island, located approximately 1,000 feet east of the mouth of the South Branch Creek, is a breeding area and rookery for some of these birds. Currently, a habitat restoration project is ongoing at Prall's Island and other nearby salt marshes as part of the mitigation for the 1990 Bayway Refinery oil spill. No terrestrial sensitive environments have been identified on or within 200 feet of the Site.

It is reported that ground water is not utilized as a source of potable water with four miles of the Site. Surface water is the primary source for potable water usage within four miles of the Site. The surface water sources for this area are not located in the Site's surface water pathway nor are they impacted by the Site.

2. Site characteristics

The LCP Chemicals Linden facility (see Figure 2) was used from 1972 to 1985 to produce chlorine using a mercury cell electrolysis process. The facility is owned by Hanlin Group, Inc. of Edison, New Jersey. Prior to 1972, GAF had produced chlorine and sodium hydroxide at this location since 1952. GAF had purchased the land from the U.S government in 1950, filled an area of marshland and lowland, and developed it.

When LCP Chemicals purchased the site they continued using the same chlorine processing method already being used with a few minor modifications. During operations, LCP Chemicals manufactured 500 tons of chlorine per day. The company also produced sodium hydroxide, hydrochloric acid and anhydrous hydrochloric acid. In the early 1980s the plant was converted to produce potassium hydroxide and operated briefly before it permanently ceased production operations at the plant in 1985.

In the period prior to 1994, when the Linden facility was vacated, the Site was used as a transfer terminal for products from other Hanlin Group facilities. Products including potassium hydroxide, sodium hydroxide and hydrochloric acid arrived in bulk by rail and truck and were transferred to aboveground tanks and tank trucks. The plant was dismantled during the period between 1985 to 1994.

The mercury cell electrolytic process involved the electrolysis of a sodium chloride (brine) solution in the presence of metallic mercury. Metallic mercury was partially recovered and recycled in a brine purification process. The remaining mercury-contaminated sludge was placed into an on-site lagoon (Brine Sludge Lagoon) located in an area between the fenced-in operations portion of the LCP facility and the adjacent Northville facility. The supernatant from the lagoon was collected and piped to the site wastewater treatment plant for treatment prior to being discharged to the South Branch Creek via the company's New Jersey Pollutant Discharge System (NJPDES) permit. The sludge, which contained amongst other constituents, barium and mercury, was left in the lagoon. It is reported that the sludge accumulated for more than 20 years prior to the lagoon's closure under the Resource Conservation and Recovery Act (RCRA) in 1984.

The former Brine Sludge Lagoon, now a landfill, is approximately 200 feet long by 150 feet wide by 20 to 25 feet high. The total volume of sludge stored in the lagoon is estimated to be nearly 31,000 cubic yards. As part of the closure of the lagoon, it was reportedly dewatered; compacted; capped with a two-foot layer of clay, six inches of drainage media, six inches of soil; and vegetated. The cover is reportedly inspected and maintained as part of the closure plan.

3. Site assessment activities/observations

The following EPA personnel were directly involved in the Removal Assessment conducted for LCP Chemicals, Inc.: Nick Magriples and Robert Montgomery of the Removal Action Branch (RAB).

A site visit conducted on August 18, 1994 for a previous Removal Site Evaluation (September 9, 1994) revealed that the company was preparing to leave the Site. According to company officials at that time, LCP was in Chapter 11 bankruptcy and had sold all of its operating assets. At the time of the site visit, all employees were reportedly expected to be off the facility by the end of August, 1994. Two small businesses lease a portion of the buildings near the entrance. Union Carbide reportedly leased a portion of the Site from the time period when GAF owned the property till 1990.

Site visits on March 26, 1996 and May 2, 1996 revealed that

access to the LCP Chemicals property was readily available. A tank cleaning company currently leases several structures from the owners of the property and operate near the entrance to the Site. Indications of vandalism are evident in portions of the vacant facility. Except for a Northville Industries oil tank farm, there does not appear to be any occupied structures present around the Site for at least one-quarter mile.

A fence and rail line separate the main portion of the former operations from the location of the impoundment on one side. The gate on this fence has been discovered open on both visits and apparently is not locked. The gates on the fences separating the impoundment area from the adjoining petroleum tank farms on the northern and southern ends appear to be kept unlocked for an access road for the tank farms. This unpaved road passes directly adjacent to the berm of the lagoon. The impoundment, which itself is encircled by a smaller unpaved path branching off of the access road, rises approximately 30 feet in elevation above this roadway. The sides of the impoundment are vegetated with grass and weeds. Some erosion of the impoundment's berms was observed on all sides.

4. Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

Through the years there have been several documented significant releases of brine from the impoundment onto the ground surface and into the South Branch Creek. In 1979, a sodium chloride solution contaminated with inorganic mercury overflowed from the process and the wastewater system resulting in a release of an estimated 10,000 to 20,000 gallons of this material into the South Branch Creek.

During installation of monitoring wells in 1982, mercury was discovered in the soil at 0-2 feet in depth at concentrations ranging from 36 mg/kg to 772 mg/kg. Surface soils (actual depth unknown) collected from the perimeter of the lagoon at that time indicated mercury levels ranging from 27 mg/kg to 1,580 mg/kg.

On January 11, 1995, an EPA pre-remedial contractor collected three surface soil samples (0-6 inches), ten surface water samples, and eight sediment samples. The highest level of mercury noted in the surface soils was 110 mg/kg. The average concentration of mercury in the downstream sediments of the South Branch Creek was 500 mg/kg. The highest concentration was 1,060 mg/kg. Mercury was detected in the surface water at 93 ug/l near the facility's outfall. Arsenic was also present in most of the samples. The arsenic concentration in the surface water and sediment was 336 ug/l and 318 mg/kg, respectively. The highest level in the soil was 17 mg/kg. Zinc, copper, lead, and cadmium were also noted in these samples.

The materials listed above are CERCLA designated Hazardous Substances, as listed in 40 CFR Table 302.4. The above data is only a summary of the more pertinent analytical information. It is not meant to be inclusive of all of the analytes or compounds detected.

The mechanism for past releases to the environment is based upon the discharge of wastewaters and sludges into the impoundment and the subsequent releases from the impoundment to the ground surface and South Branch Creek. Limited construction information is available for the former impoundment.

Currently, the contaminated soil and sediment remains unmitigated. Leaching of contaminants into South Branch Creek is ongoing. The flow of contaminants into the Arthur Kill is not defined at this time. Prall's Island, a breeding area and rookery located approximately 1,000 feet from the South Branch Creek discharge into the Arthur Kill, could be impacted. Ground water may be impacted from leakage of contaminants into the subsurface.

5. NPL status

The Site is currently not an NPL site. A Site Inspection (SI) has been completed. Further pre-remedial activities are expected. The Site was evaluated by NJDOH/ATSDR on June 24, 1996.

B. Other Actions to Date

1. Previous actions

There have been no other previous Federal or private party actions taken at the Site.

2. Current actions

Currently, there are no Federal actions taking place at the Site.

C. State and Local Authorities' Role

1. State and local actions to date

There have been no State or local actions taken at the Site.

2. Potential for continued State/local response

At this time it is not known whether there will be any future State or local actions taken at the Site.

III. THREAT TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

A. Threats to Public Health or Welfare

Elevated levels of mercury, a CERCLA designated hazardous substance, are present in the soils, sediments, and surface waters in and around the Site. Migration appears to be occurring into the South Branch Creek, and potentially to the Arthur Kill and nearby wetlands. Although it is possible, it is not likely that the public will come into contact with the contaminated soil. According to the New Jersey Department of Health (NJDOH) and Agency for Toxic Substances and Disease Registry (ATSDR), there are no completed or anticipated human exposure pathways associated with the Site under present conditions (see Attachment A).

B. Threats to the Environment

A screening-level ecological risk assessment was completed (July 3, 1996) by personnel from the U.S. EPA Environmental Services Division (see Attachment B). A comparison of surface water inorganic contaminant levels to available screening values indicates that there is a potential for acute effects to aquatic biota for the length of South Branch Creek, depending on the influence of tides and flow rates at any given time. A comparison of sediment inorganic contaminant levels to available screening values indicates that there is a potential for significant impact throughout the creek system. Mercury is a mutagen, teratogen, and carcinogen, and causes embryocidal, cytochemical, and histopathological effects.

If marine species are present in South Branch Creek, then they could introduce contamination into the food chain through at least two pathways: accumulation of contaminants by young marine species that may be carried into the food chain, and accumulation by any aquatic or benthic species that may be consumed by avian piscivores. As noted in Section II.A.1. of this report, there are several important avian habitats located near the site.

It should be noted that the potential for realization of these potentially acute effects is based on, but not limited to, the assumptions that South Branch Creek is a tidal tributary and wetland with ecological value, and that it is used by estuarine aquatic species for all life stages, as well as by marine species for spawning and nursery habitat. The actual use of the creek by these species would depend on the specific characteristics of the creek channel and wetlands, even if contamination is not considered.

IV. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

This section is not applicable at this time.

V. CONCLUSIONS

LCP Chemicals, Inc. is not eligible for a CERCLA Removal Action at this time since there are no completed or anticipated human exposure pathways associated with the Site under present conditions and due to the currently indeterminate nature of the threat to the environment in an area that has been historically impacted from numerous industrial and municipal activities.

Attachment A

LCP CHEMICALS -- NEW JERSEY, INC.
HANLIN GROUP, INC.
EDISON, NJ

DESCRIPTION OF CURRENT CONDITIONS
RCRA FACILITY INVESTIGATION TASK I
LCP CHEMICAL - NEW JERSEY, INC.
LINDEN, NJ

PROJECT #625-3
JANUARY 1992

EDER ASSOCIATES
CONSULTING ENGINEERS, P.C.
Locust Valley, New York
Madison, Wisconsin
Ann Arbor, Michigan
Augusta, Georgia

eder associates
consulting engineers, p. c.

February 19, 1992
File #625-3

Mr. Samuel I. Ezekwo
United States Environmental
Protection Agency
Region II
Hazardous Waste Facilities Branch
26 Federal Plaza
New York, New York 10278

Re: LCP Chemicals - New Jersey, Inc.
NJD079303020

Dear Mr. Ezekwo:

On behalf of LCP Chemicals - New Jersey, Inc., a Division of Hanlin Group, Inc., enclosed are three copies of the Description of Current Conditions for the Linden, New Jersey facility (EPA ID. No. NJD079303020) representing Task I of the Scope of Work for the RFI, as required by the facility's HSWA permit. We revised the draft version of this report to include the RFA and a pre-RFI site investigation report as requested. Also, more detailed descriptions of SWMUs, Areas of Concern, and permit and enforcement actions have been added, as requested.

Task II Evaluation of Corrective Measure Technologies and the Task III Work Plan will be submitted in accord with the permit deadlines of February 23 and March 25.

Please call me if you have any questions.

Very truly yours,

EDER ASSOCIATES CONSULTING ENGINEERS, P.C.

Kenneth J. Pasterak
Hydrogeologist

KJP/eml
enc.

cc: J. Merle
B. Marcolina

LLV2035

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APPENDIX C - BUILDING 231 INVESTIGATION REPORT

I. PURPOSE

This document describes past and current conditions and activities, identifies solid waste management units (SWMUs) and areas of concern (AOCs), and presents a preliminary assessment of potential impacts caused by prior activities. The document has been prepared as Task I of the RCRA Facility Investigation for the Hanlin Group, Inc., LCP Chemicals - New Jersey (LCP) Division Linden facility, in accord with Module III, Section E.1 of the LCP 1984 HSWA (NJD079303020) effective November 25, 1991.

II. BACKGROUND INFORMATION

Site History

LCP Chemicals purchased a 26 acre chlorine production facility in Linden, New Jersey from General Aniline and Film Corporation (GAF) in 1972 (Figure 1). GAF purchased the land from the U.S. government in 1950, filled an area of marshland and lowland, and developed it for chlorine production. The facility is situated on the Tremley Point peninsula adjacent to the Arthur Kill. South Branch Creek, a tributary of Arthur Kill, runs through a portion of the site and flows through engineered conveyance structures on the north side of the property.

GAF produced chlorine and sodium hydroxide by the mercury cell electrolytic process beginning in 1952. LCP purchased the site in 1972, renovated the plant, and operated the mercury cell process until 1982. LCP Chemical produced chlorine, sodium hydroxide, hydrochloric acid, and anhydrous HCL. In the early 1980's the plant was converted to produce potassium hydroxide and operated briefly before it permanently ceased production in August 1985.

The site is now used as a transfer terminal for products from other Hanlin Group facilities. Dismantling activities have been ongoing since 1985. Presently, products including potassium hydroxide, sodium hydroxide, and hydrochloric acid arrive in bulk by rail and truck and are transferred to aboveground tanks and tank trucks. Administrative tasks and product storage and transfer are the only activities currently conducted at the site.

A portion of the site west of Avenue D was leased to the Union Carbide Linde Division from 1959 to 1990 and was used in its wholesale gas activities. Beginning in 1990, Ultra Pure Compressed

Gasses, Inc. leased the site for the same operation. Building 231 has been leased to Microcell Technologies since 1987. From 1974 to 1981 Kuehne Chemical manufactured sodium hypochlorite and chlorine in a leased area near Building 220. Caleb Brett Labs leased a portion of a laboratory and locker building north of Building 220 to store petroleum product samples and a portion of the building was also leased to Liquid Carbonic for office use. Land adjacent to the lab and locker building was leased to Liquid Carbonic for carbon dioxide transfer operations.

Surrounding Land Use

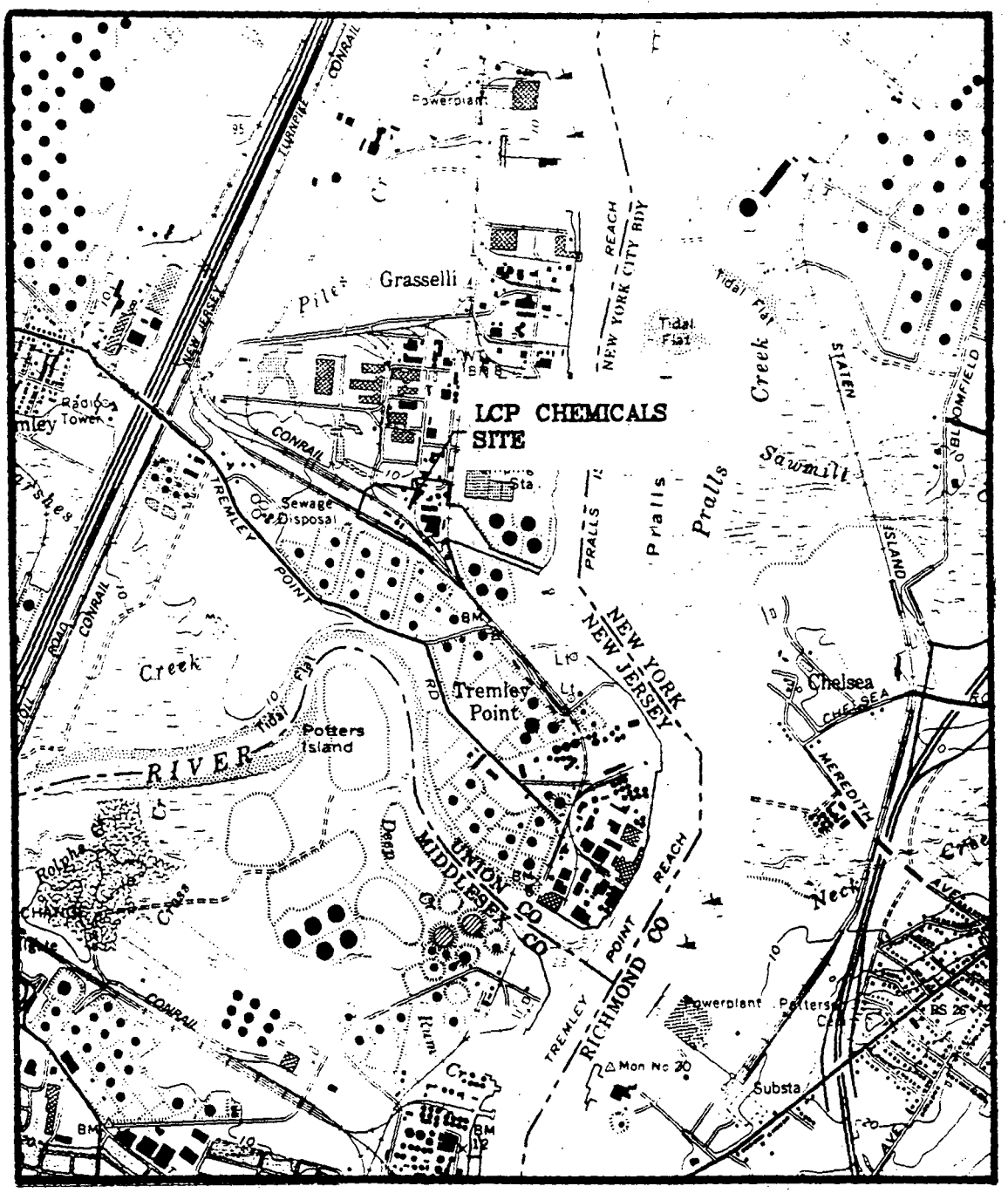
The facility is owned by Hanlin Group, Inc., Edison, NJ. Property boundaries and adjacent property owners are identified on Drawing 1. All surrounding land use is heavy industrial and the nearest residence is approximately 0.75 miles to the west. The City of Linden is a densely populated urban area of about 60,000 people and is about three miles west of the site.

GAF occupies land immediately north of LCP and produced surfactants and pharmaceutical specialty products. The GAF Corporation site became inactive in April 1991. Bulk petroleum storage terminals owned by Northville, BP, and Mobil occupy land to the northeast, south and west.

Surface Drainage

Roads (Avenues A, B, C, D and E depicted on Drawing 2), electrical substations, and secondary containment areas around tanks are paved. The remainder of the site is essentially unpaved. Stormwater runoff from former process areas collects in a concrete drainage swale drawn in Drawing 2 or infiltrates the soil in unpaved areas. The swale (date of construction unknown) conveys runoff to a concrete sump south of Building 231 where it is pumped to a holding tank for treatment.

LCP CHEMICALS–NEW JERSEY, INC.
A DIVISION OF HANLIN GROUP, INC.
LINDEN, NEW JERSEY



SCALE 1"=2000'

LOCATION MAP

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Land outside the process area is generally unpaved, except for roadways (identified on Drawing 2) and tank containment areas, and precipitation percolates through soil to the shallow water table, eventually discharging to South Branch Creek and the Arthur Kill.

According to LCP, no topographic contour maps exist for the plant site. A topographic map will be prepared as part of the RFI to fulfill LCP's HSWA permit map requirement.

Principal Activity Conducted at the Site

Salt and water were the principal raw materials used by LCP in its production processes. Rock salt (and, in 1982, evaporated salt) was transported to the facility by rail car, placed in salt silos by building 233, and fed to saturators to generate brine. The brine was treated and filtered in building 233 to remove calcium carbonate, calcium sulfate, magnesium hydroxide and other impurities. Purified brine was fed to electrolytic mercury cells in buildings 230 and 240 to produce chlorine and a mercury-sodium amalgam. Chlorine was cooled, dried with sulfuric acid, liquified in building 233 and stored in 100 ton vessels. Spent brine was returned to building 233 for neutralization, re-saturation, filtration and return to the cells. The mercury-sodium amalgam flowed from electrolyzers to denuders where it was reacted with water to produce elemental mercury, sodium hydroxide solution and hydrogen gas. Hydrogen gas was purified south of building 231 and elemental mercury was returned to the electrolyzers, completing the process.

Sodium hydroxide was filtered and stored in tanks at the north end of the facility and some was reacted with water and chlorine to produce sodium hypochlorite. Hydrogen was burned for energy recovery or with a stream of chlorine and water to produce hydrochloric acid which was stored in tanks near building 221.

Hydrogen chloride was desiccated with sulfuric acid to produce anhydrous hydrochloric acid. All product was shipped off-site by rail or truck.

Solid and Hazardous Waste Generation

Brine purification mud ("brine sludge") was the principal solid waste generated at this site during production, and mercury is the basis for listing the sludge as Hazardous Waste No. K071. In 1971, brine sludge was pumped from building 233 to an on-site lined settling lagoon and LCP continued this practice. Sludge was pumped to the lagoon via aboveground line and through a hose inside pipe underneath the railroad right of way as depicted in Drawing 3. On one occasion, a small amount of sludge was pumped from the brine sludge lagoon to a lined experimental chemical fixation lagoon for treatment and monitoring. LCP investigated sludge treatment to render the K071 waste non-hazardous and retorted the sludge in a roasting unit on a pilot scale basis for several years. All waste management units are described in Report Sections IV and V.

Wastewater treatment sludge was also generated during chlorine production and is a RCRA listed hazardous waste (No. K106) on the basis of mercury content. This waste was placed in the on-site lagoon during LCP's ownership of the facility.

Small quantities of solvent such as carbon tetrachloride were probably used for general cleaning and degreasing, and small quantities of methyl ethyl ketone were used in the fiberglass shop.

LCP is registered as a RCRA hazardous waste generator (No. NJD079303020) and currently generates demolition debris from the plant closure some of which is contaminated by mercury. Filter cake from the wastewater treatment system is also generated and is disposed of off-site as mercury contaminated waste. Both wastes are listed as D009 and are generated on an irregular basis, with an

estimated volume of 60 tons/year. Waste oil from diesel locomotive servicing could also potentially be generated.

Wastewater Handling

Storm water runoff collects in drainage swales (shown in Drawing 2) surrounding the former process area and is routed to a concrete sump south of building 231. Runoff is piped to holding tanks outside building 233 and is pH adjusted, filtered, polished with activated carbon and stored pending discharge once or twice a year in accord with LCP's NJPDES permit. The collected stormwater is occasionally used to wash down structures and equipment in the former process area. The wastewater treatment system at building 233 has been operational since the early 1980's.

Prior to LCP's ownership of the site, process wastewater was conveyed to a pond (the GAFRAC unit) along Avenue D east of the main switch yard, was pH neutralized, and was filtered through carbon in the northwest corner of the facility and discharged to South Branch Creek. In the mid 1970's the GAFRAC pond was reportedly excavated, filled with soil, and covered with asphalt. The pond will not be investigated as part of the RFI. It is not known when the GAFRAC pond and wastewater treatment system were constructed.

When the cells were operational, wastewater generated by cell washdown and cell maintenance drained to a floor trench which emptied to a concrete floor sump in buildings 230 and 240 where it was pumped through overhead piping to the GAFRAC pond. During LCP's operation of the plant, this wastewater was pumped form the cell room sumps to a holding tank, and to the wastewater treatment system.

Underground Tanks and Piping

There are no known underground tanks at the facility except for septic systems (Drawing 3).

Known underground piping includes fresh and river water (now inactive) mains and service lines, a 36 inch storm sewer that was plugged around 1974 (see discussion in Surface Water section), cooling tower water feed and return lines, septic leach fields, a section of pipe through which a flexible hose was run to pump brine sludge from building 233 to the brine sludge lagoon (about 30 lineal feet) and a nitrogen line. The approximate location of known piping is depicted on drawing 3.

Concrete trenches in building 230 and 240 cell rooms collected washdown water and any release of mercury which might have occurred during cell maintenance and rebuilding activities. The trenches drained to a concrete sump in the northwest corner of each cell room and the sump contents was pumped to the effluent treatment system. The concrete floors in the cell rooms were re-paved with epoxy and concrete at least once in the 1970's to cover spalled areas and improve drainage to the trenches and sump.

Location of Production, Injection, and Monitoring Wells

Six monitoring wells were installed in 1981 around the brine sludge lagoon and MW1, MW2, MW3, MW4, MW5 are monitored semi-annually to determine the impact of the lagoon on alluvium groundwater. Four additional monitoring wells, MW-6, MW-7, MW-8 and MW-9 were installed in 1990 to comply with an NJDEP request. Boring logs and well construction details are in Appendix A.

Shallow groundwater in the area is not used as a potable water source due to salt water intrusion. There are two public water supply well fields within a four mile radius of the facility

reportedly screened in the Brunswick Formation. The Elizabethtown Water Company field is about 3.5 miles northwest of LCP and the City of Rahway field is about 3.5 miles west of LCP. The facility's water supply source is Elizabethtown Water Company mains.

Hydrogeology

Site hydrogeology is described in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. The site is located on a thin layer of glacial and alluvial deposits which overlie the Brunswick Formation of Triassic age. The upper 5 to 15 feet of unconsolidated deposits consist of artificial fill comprised of silt, sand, gravel, cinders, crushed stone and brick, underlain by up to five feet of organic clay and silt. Beneath the organic clay and silt is 4 to 18 feet of poorly sorted gravelly sand and 14 to 29 feet of silty clay with a layer of pebbles and cobbles at the base. The depth to bedrock is 40 to 50 feet below grade based on data collected during drilling at monitoring well locations and building foundation borings. The water table is 5 to 10 feet below grade and the groundwater is brackish due to tidal influence from surrounding surface water bodies.

Groundwater beneath the site evidently discharges to South Branch Creek and/or Arthur Kill and there are no water supply wells between the facility and these surface waters. Downstream surface water in Arthur Kill is not used as a potable source.

Permit Issuance and Enforcement Action History

The following is a summary of permitting and enforcement actions based on information from LCP, NJDEP and USEPA Region II files:

The plant at this site was operated in accord with certain housekeeping and operational requirements established by USEPA NESHAP in the mid 1970's to ensure mercury releases to air during operation were below 1300 g/d.

LCP was fined by NJDEP for supernatant overflows from the brine sludge lagoon in 1972 and 1974. The overflow location(s), quantity released, and response measures employed are unknown.

A sodium chloride blockage in LCP's east saturator caused the release of 10,000 to 20,000 gallons of brine to South Branch Creek in August 1979 resulting in enforcement action. A brine sample was analyzed at the time of the spill and was found to contain 8.6 ppm mercury.

Kuehne Chemical was issued a NPDES permit in August 1980 for cooling water discharge to Arthur Kill. NJDEP cited and fined Kuehne Chemical in 1981 for an NPDES violation of pH and free chlorine, apparently relating to discharge of unknown quantities of acid and caustic.

In September 1981, NJDEP issued an Administrative Consent Order to LCP requiring the closure of its brine sludge lagoon and implementation of air, soil and groundwater monitoring. Initial data collected during the investigation was summarized in a February 1982 Geraghty & Miller, Inc. report Waste Lagoon Groundwater Monitoring. The brine sludge lagoon was closed in 1984 and 1985.

In 1980, LCP filed a RCRA Part A permit application for hazardous waste storage in tanks and a surface impoundment. Hazardous waste was never stored in tanks, however, and LCP's filing was reportedly incorrect.

In March 1980, NJDEP granted LCP a permit to construct and temporary certificate to operate a brine sludge roaster and dryer. In November 1981, NJDEP issued CLP a Motion of Violation for a ruptured muffler plate and operation of unpermitted propane burners for the sludge roaster system. In 1982 USEPA requested that the brine sludge lagoon be closed and the plant shut down as a safety precaution during lagoon closure.

A site inspection and hazardous ranking system determination was conducted by USEPA in 1984. LCP was cited in 1988 by NJDEP for groundwater exceedances at the brine sludge lagoon and failure to report groundwater monitoring data. The groundwater exceedances were reportedly associated with salt water intrusion at downgradient monitoring wells and were not indicative of a release. The failure to report was apparently the result of an oversight by LCP.

In 1990, NJDEP found gaps in LCP's groundwater monitoring data submittals during a compliance evaluation inspection and LCP addressed these in a response.

LCP currently holds a surface water discharge permit (NJ0003778) for discharge of treated wastewater and also a RCRA permit (HSWA portion only).

Copies of permits and enforcement related correspondence are in Appendix B.

III. NATURE AND EXTENT OF CONTAMINATION

History of Spills and Releases

The following releases and spills at the facility were documented by NJDEP:

Supernatant overflows from the brine sludge lagoon to South Branch Creek were observed by NJDEP on October 30, 1972 and February 7, 1974. The overflow locations, quantities, and nature of LCP's response are unknown. In June 1975, a brine recycle pump failed and a breach in the brine sludge lagoon occurred. An undetermined quantity of brine entered South Branch Creek for an estimated nine hour period. The location of the release was likely near the southeast corner of the lagoon but the exact location is unknown. It is not known what, if any, remedial measures were performed other than mechanical repair of the pump.

A release of 10,000 to 20,000 gallons of brine to South Branch Creek occurred August 20, 1979 due to sodium chloride blockage in the saturator. A brine sample was collected and analyzed at the time of the release and was found to contain 8.3 ppm mercury. The breach was remediated. It is unknown what, if any, other remedial measures were implemented.

Releases from piping near the 500,000 (500 K) gallon tank were observed on September 17, 1980, June 21, 1981, October 22, 1981 and August 13, 1982. Releases occurred along the side of the tank and along and east of the railroad tracks. The volume and nature of released liquid is unknown. It is unknown what, if any, remedial measures were implemented.

A brine sludge slurry spill was observed on pavement below salt silo #4 on October 9, 1980, according to an NJDEP inspection report. This slurry flowed into the adjacent drainage swale according to LCP.

Kuehne Chemical was cited in 1981 for discharging acids and caustics to Arthur Kill. The quantity of material discharged is unknown. It is unknown what remedial measures, if any, were implemented.

Sludge or brine was observed in the bullet tank farm containment area on September 17,1980, October 9, 1980. May 19, 1981, June 22, 1981, September 29, 1981 and August 13,1982. The nature and source of this sludge are unknown. According to LCP, the sludge (or sediment) was flushed out with water to the adjacent drainage swale which led to a collection sump as described in the Surface Runoff section of this report.

Union Carbide reported a release of 60,000 cubic feet of hydrogen gas in September 1988 and a series of waste oil releases which were remediated by excavation of contaminated soil in May 1988. A small amount of mercury contaminated soil was found and removed from the vicinity of a hydrogen tank in 1988 on land leased by Union Carbide. The quantity of soil excavated and the spill location are unknown.

In the early 1980's, NJDEP found a hole in a muffler plate on the sludge roaster which allowed mercury vapor to discharge. The volume of mercury released is unknown and the roaster was shut down as requested by NJDEP.

Copies of inspection and spill reports are in Appendix D.

Past Investigations

On July 31, 1981, NJDEP issued an Administrative Consent Order to LCP requiring implementation of air, soil and groundwater monitoring for the brine sludge lagoon. Data collected during the investigation was summarized in a February 1982 Geraghty & Miller, Inc. report Waste Lagoon Ground-water Monitoring.

Groundwater monitoring data associated with the brine sludge lagoon has been generated and reported to NJDEP since the unit was closed in 1984. Monitoring well construction data is contained in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. There has been no indication of an on-going release to groundwater from this unit although barium was detected at concentrations exceeding the 1 ppm NJDEP Action Level. Manganese, iron, sulfate, and total dissolved solids were detected in upgradient and downgradient monitoring wells at concentrations exceeding the permit levels, but high ambient levels would not be unusual in local groundwater due to the geochemistry of the Brunswick Formation (sulfate mineralization) and the brackish nature of local groundwater due to tidal influence. Mercury was detected at concentrations exceeding the drinking water standard on one occasion in 1982 but the data quality is suspect.

According to the 1982 Waste Lagoon Ground-water Monitoring Report, mercury concentrations up to 1,580 parts per million (ppm) were found in surface soil samples collected near the sludge roaster and near Building 231. Soil samples collected during monitoring well drilling were analyzed for mercury and were found to contain concentrations at ground surface up to 772 ppm, dropping to less than 10 ppm below 10-17 feet below grade. One sample of bottom sediment, from South Bend Creek contained 46.62 ppm mercury.

A site inspection and hazard ranking system scoring was conducted in 1984 by NUS Corporation for USEPA. NUS reported the

potential for soil and groundwater contamination impact to Arthur Kill flora and fauna. No potential impacts to potable water supplies were identified.

Unidentified organic vapors were reportedly detected by NJDEP in the headspace of several of the monitoring wells during site inspections conducted in 1987 and 1989.

Analytical data from soil samples collected in 1988 around building 231 as part of a site evaluation for expansion of the building indicated the presence of mercury and volatile organic constituents in soil and all of this data was submitted to NJDEP. This area will be investigated further during the RFI, as described in Section V.

Areas of Potential Contamination

Mercury is the most likely potential soil contaminant at this site. Solvents used for general parts cleaning (such as carbon tetrachloride, acetone, and methyl ethyl ketone) and their decomposition products could also be present if solvent was ever spilled or released. Section V identifies and describes potential source areas.

Potential Migration Pathways

Site hydrogeology was described in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. Groundwater beneath the site likely discharges to South Branch Creek and/or Arthur Kill and there are no water supply wells between the facility and these surface water features. The prevailing wind direction is from the west and northwest. Potential migration pathways include surface water runoff, groundwater migration, air releases from contaminated soil and

wind-blown soil. There is no data indicating contaminants are migrating from the site at this time.

IV. HAZARDOUS WASTE GENERATION, TREATMENT, STORAGE AND DISPOSAL AREAS

Areas known to have been used for treatment, storage, and disposal of hazardous waste, and areas where hazardous waste was reportedly generated, are described below.

Brine Sludge Lagoon

Up to 20 tons/day of brine sludge were generated and discharged along with wastewater treatment sludge to an earthen lagoon east of building 231 (Drawing 1). The lagoon was constructed around 1970 by GAF Corp. and the interior was reportedly sprayed with hot tar as a lining. Sludge was piped to the lagoon until chlorine production was discontinued in the mid 1980's. During the operating life of the lagoon supernatant was collected at a sump in the southeast corner of the lagoon and was piped to the wastewater treatment system. There is no information indicating that any wastes other than brine filtration sludge and wastewater treatment sludge were deposited in the lagoon.

Brine sludge in the lagoon is likely comprised of calcium carbonate, cellulose fiber, water, magnesium and ferric hydroxides, and mercuric sulfide.

At the time the lagoon was closed in 1983-84, it contained an estimated 30,900 cubic yards of sludge and occupied about 3,000 square feet. The lagoon was capped with two feet of compacted clay overlain by six inches of drainage media and six inches of soil capable of supporting vegetative cover in accord with the RCRA closure regulations (40 CFR 265.110) and the Closure and Post Closure Plan for Brine Sludge Lagoon approved by the NJDEP Division

of Waste Management in 1983. The fate of brine sludges generated by GAF Corp. prior to this lagoon is unknown however.

Groundwater monitoring around the closed lagoon continues and monitoring data are submitted to NJDEP after each sampling event. The database does not indicate that the brine sludge lagoon is releasing mercury to groundwater. The lagoon cover is inspected and maintained in accord with NJDEP post-closure requirements. The closed unit is not subject to the investigation and corrective action requirements of LCP's HSWA permit.

Building 233

Building 233 was used for brine filtration until the early 1980's when it was converted for wastewater treatment. Wastewater treatment sludge is currently generated here and is managed as hazardous waste. An October 1980 NJDEP inspection documented brine caked on the floor near the filters. The brine was washed to the runoff collection sump and treated. There is no evidence of releases from this building and it will not be investigated in the RFI.

Brine Sludge Roaster

Around 1980 a brine sludge roasting kiln and a packed scrubber were constructed on a concrete pad south of the brine sludge lagoon to recover mercury. Mercury-bearing Brine sludge waste from LCP's process was roasted to remove mercury and treated sludge was placed in the brine sludge lagoon. The unit was operated on a trial basis under a temporary NJDEP permit to construct and operate an air emission source. A permit for full scale operation was never obtained due to unresolved air emission issues and the unit was shut down. It was dismantled in 1985.

The roaster was built on a one foot thick, 16 by 40 foot concrete pad surround by a cinder block curb with drain channels connecting to the effluent treatment plant. This location will not be investigated in the RFI since it is unlikely that hazardous constituents were released to soil or groundwater in this area. The RFI-VSI conducted December 22, 1987 included an inspection of this unit and no release was evident. It will not be investigated in the RFI.

Chem-Fix Lagoon

A lined lagon was used to study the effectiveness of treating LCP's brine sludge waste. This unit will be included in the RFI and is described in the following section.

GAF Wastewater Treatment Area

During GAF's ownership of the site in the 1950's to 1970's, process wastewater and wastewater from the cell room trench sumps was reportedly routed to and stored in a pond east of the main switch yard prior to treatment. The pond was excavated and paved to support a transformer substation in the early 1970's. This area will not be investigated as part of the RFI.

V. SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN

The solid waste management units and areas of concern that will be investigated as part of the RFI are identified and described below.

Chem-Fix Lagoon

The Chem-fix lagoon was constructed as a pilot scale test in 1976 to determine if mercury in the brine sludge could be rendered immobile, thereby allowing the treated sludge to be managed as non-hazardous waste. The lagoon was triangular, approximately 70 feet per side, and was located north of the brine sludge lagoon (Drawing 2). The lagoon was lined with two impermeable geosynthetic liners and contained a granular media leachate collection base sloped to a sump to allow leachate to be collected and pumped to the adjacent brine sludge lagoon.

In 1976, approximately 120,000 gallons of brine sludge were pumped to the Chem-Fix Lagoon and treated. The lagoon sump was monitored and sampled until 1980, and samples were analyzed for mercury. The lagoon was closed in 1983 and 1984 in accord with the Closure and Post-Closure Plan for Brine-Sludge Lagoon approved by NJDEP. In 1983 an estimated 460 cubic yards of brine sludge were removed from the Chem-fix Lagoon and placed in the brine sludge lagoon along with the synthetic liner and leachate collection material.

Based on company records and information from employees there is no indication that the lagoon leaked or that brine sludge or leachate were released to soil or groundwater. Groundwater monitoring data from monitoring wells downgradient of the unit do not indicate that a release not indicate that a release to

groundwater has occurred. Nonetheless, the USEPA RFI protocol requires that soil samples be collected in the area of the former lagoon to determine if a release occurred.

Salt Silo #4

Salt silo #4 was one of four salt storage silos adjacent to Building 233 and is believed to have been constructed in the 1950's or 1960's. In 1980 and 1981, silo #4 was used to mix water with brine sludge and the resultant slurry was pumped to the sludge roaster. NJDEP reportedly observed brine sludge on the ground around the silo during an October 1980 inspection. The area beneath and around the silo was reportedly paved in the early 1970's and sludge released from this unit would have likely entered the adjacent drainage swale. The drainage swale empties to a concrete sump where wastewater is collected and pumped to the treatment system. The silos were dismantled in the mid 1980's.

Soil samples will be collected to determine if mercury is present in soil around the pad and, if the pad is cracked, soil beneath the pad will also be sampled.

Process Areas in Buildings 230 and 240

The floors in the cell rooms were paved and contained concrete trenches leading to a sump for conveyance and collection of washwater and potential spills. Aboveground piping conveyed wastewater from the sumps to the treatment system. The concrete floor spalled over time and was paved over on several occasions to improve flow to the trenches and reduce pooling of water. A former LCP employee told NJDEP in 1981 that LCP resurfaced significantly cracked floors in the cell rooms but LCP employees and plant records do not indicate that significant cracks in the cell room were ever covered over. In 1976 OSHA inspected the buildings and reported cracks in the floor and walls but there was no indication

of mercury contamination of soil. Soil beneath and around the two buildings will be investigated to determine if a release of mercury or mercury contaminated brine has occurred through joints or cracks in the floors of Buildings 230 and 240.

500 K Tank

A 500,000 gallon tank was constructed in the 1950's or 1960's south of Building 231 for brine storage prior to pumpage to the cells. Sodium hydroxide produced in Buildings 230 and 240 was on occasion also stored in this tank. The tank (referred to as the 500 K tank) was, in the 1970's and early 1980's, used to store wastewater prior to treatment. The tank was dismantled in the late 1980's and the concrete pad remains.

Releases near this tank occurred in the 1970's and 1980's. NJDEP observed brine sludge near the tank in September 1980 and liquid was observed leaking from a pipe near the tank in January 1981. Brine sludge slurry was present on the ground on one occasion in 1980 along the sludge and return pipes leading to the brine sludge lagoon and leakage from one of these pipes was observed by NJDEP between the lagoon and the railroad tracks in 1981. Sodium sulfide crystals were observed on the gravel surface in the pump pit area in 1980. The exact locations of these releases are unknown. A hydrochloric acid spill was observed 15 ft. northwest of the tank by NJDEP during an October 22, 1981 inspection. Releases will be investigated in these areas by soil sampling and, if warranted, groundwater sampling.

Bullet Tanks

The tanks referred to as bullet tanks were constructed as pressurized storage vessels for chlorine in the 1950's or 1960's. They were later used for storing treated and untreated wastewater and for product storage. The aboveground tanks were equipped with

secondary containment prior to conversion to wastewater storage and there is no information to suggest that a release ever occurred. In the 1980's, standing water occasionally approached the capacity of the containment area. The "continual problems with brine containment" in 1980 and 1981 mentioned in LCP's HSWA permit evidently refers to the standing water problem, however, precipitation - not brine or wastewater - was likely in the containment area according to LCP personnel.

"Brine residues" were reportedly observed in the containment area during NJDEP inspections between September 1980 and April 1982 according to the LCP RFA. Sludge or sediment in the containment area was occasionally flushed out to the adjacent drainage swale. It is not likely that this material was brine sludge according to LCP personnel.

Soil and, if warranted, groundwater will be investigated, however, to determine if a release occurred from these tanks.

Area South of Building 231

A Purasiv® hydrogen purification unit was located immediately south of building 231 during production at the facility, and releases of mercury could have occurred in this area. Soil sampling and analysis was conducted in 1988 (see Appendix C). Mercury and volatile organic contamination of soil was found in samples collected on the north, south, and west side of the building, and all analytical data were provided to the NJDEP in a November 8, 1988 letter report. A former LCP employee told NJDEP in 1981 that brine sludge was placed on the ground between Building 231 and the railroad tracks.

Soil and, if necessary, groundwater in the vicinity of building 231 will be investigated as part of the RFI.

Drum Storage Area

A drum storage area was located in the southwest perimeter of the facility (Drawing 2). Motor oil, gear oil, waste oil and possibly Freon (used in chlorine liquifiers) were stored in drum quantities (55 gallons or less) on a 300 square foot concrete pad with secondary containment. The concrete base is one foot thick with a six inch secondary containment curb. Waste solvents could have been stored here but LCP employees do not recall this.

In December 1987 NJDEP reportedly found oily residue on the gravel outside the pad and in April 1989 NJDEP found stained soils and organic vapors near the pad. There are visible cracks in the containment wall and petroleum residue is evident on the ground in one small area outside the pad. The nature and extent of contamination around and beneath the pad will be investigated by soil sampling and, if necessary, soil vapor and groundwater sampling.

Lined Trenches

Swales consisting of open concrete trenches surround most of the production area and collect surface water runoff and conveys it to a sump where water is pumped to the wastewater treatment system holding tank. These surface water collection swales, shown in Drawing 2, were constructed in the 1970's (exact date unknown) and will be investigated to determine if they contain mercury-contaminated sediment. Soil beneath and around the swales may also be investigated if there is evidence of past overflow or seepage through expansion joints, in which case mercury could be present in the subsurface.

Transformers

Stained soil has been reported at the former location of transformers and rectifiers west of buildings 230 and 240 and at the northeast corner of Building 231. Soil will be investigated for releases of petroleum hydrocarbons and polychlorinated biphenyls.

Process Sewers

Concrete trenches and a sump in buildings 230 and 240 were used to collect brine and residual mercury when the cell room was washed down. Wastewater from the sumps was pumped to the wastewater treatment system. Mercury was collected in a second closed sump and was recovered for reuse. Soil in the vicinity of the wastewater piping will be investigated to determine if a release of mercury occurred during production.

South Branch Creek

Supernatant overflows from the brine sludge lagoon to South Branch Creek were observed by NJDEP on October 30, 1972 and February 7, 1974, and reported to USEPA in June 1975. The exact locations and quantities of these releases is not known.

The proximity of the site and, in particular, the brine sludge disposal area, to South Branch Creek suggests that the Creek could have also received contaminated surface water runoff or groundwater discharge from a spill or release during the operating history of the production activities at this site. Mercury is the only waste constituent which would be expected to be present since the use of solvents was reportedly restricted to small quantities during LCP's ownership. Volatilization and hydrolysis would be expected to significantly reduce any concentrations in soil if there was a small quantity release during production activities.

VI. IMPLEMENTATION OF INTERIM MEASURES

Post-closure monitoring of the brine sludge lagoon continues in accord with the approved post-closure plan (see Section IV, Brine Sludge Lagoon). LCP also continues to recover and treat production area surface runoff (see Section V, Lined Trenches).

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APPENDIX A

100630

LCP CHEMICALS - NEW JERSEY
FOOT OF SOUTH WOOD AVENUE
LINDEN CITY, UNION COUNTY, NEW JERSEY
EPA ID# NJD079303020

LCP owns a twenty-six (26) acre chemical manufacturing facility in Linden which is currently used exclusively for the storage and transfer of methylene chloride and caustic soda. GAF Corporation aquired the property in 1950 from the U.S. Government, filled an area of coastal wetlands on site, and developed it for production of liquid chlorine by the mercury cell process. LCP purchased the facility in 1972 from GAF and with a few minor modifications of the process continued chlorine manufacturing, until September 1985. Other property within 1.5 miles is zoned for heavy industry (B.P. Oil, E.I. DuPont, GAF, Northville Industries) and transportation (New Jersey Turnpike). Also, Union Carbide operates the Linde Hydrogen Plant (LHP) as a tenant organization at the LCP Linden facility. Site security is adequately maintained by a perimeter chain link fence, a twenty-four (24) hour/day guard staff, and closed circuit TV cameras. Finished products are transported in bulk quantities via tank truck or rail car, and stored on site in three (3) aboveground tanks with a total combined volume of 1.02 million gallons.

The City of Linden is a densely populated urban area, such that, within three miles of the LCP facility an estimated 62,500 people were in residence as of December 1984. Linden is supplied with potable water by surface resevoirs located in Clinton, NJ approximately thirty miles to the west. The Arthur Kill, located almost 1100' off-site to the east is used for recreational boating and an endangered species, the Peregrine Falcon, is known to hunt in the salt marshes nearby.

LCP's Tremley Point Plant is situated directly upon a hetrogeneous fill material composed of sand, gravel, brick, and slag up to 10 or 15 feet thick. Bedrock occurs at 30 to 40 feet below grade and consists of a red sandy shale overlain by 10 to 15 feet of glacial deposits and 20 feet of organic silt, clay and peat. This portion of the New Brunswick Formation is not used as a potable aquifer within several miles of the facility due to the salt intrusion from the nearby coastal waters. LCP was provided all of its' potable and industrial water requirements (430,000 gallons/day when at full production in 1979) from the Elizabethtown Water Company. LCP does maintain five (5), NJPDES Discharge to Ground Water (DGW) permitted, monitoring wells which are screened in sand lenses of the glacial till and organic sediments. Within these wells the depth to water and salt concentrations vary according to the ebb and flow of the tides.

The "mercury cell process" yields chlorine gas through the electrolysis of a sodium chloride (brine) solution in the presence of metalic mercury. An amalgum of mercury and sodium is removed from the cell and used to hydrolize water forming sodium hydroxide and hygrogen gas (which are also comerically valuable). Metalic mercury was recovered and recycled in a brine purification process, but incompletely yielding a sludge residue.

LCP wastes included: mercury contaminated sludges, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, process wastewater, spill wash down, and stormwater runoff. LCP's tenant LHP purportedly does not generate any hazardous wastes. Mercury sludges were landfilled on-site in the Brine Sludge Lagoon for at least twenty (20) years, until 1982 when LCP began storing this waste in 55 gallon drums prior to shippment off-site. Mercury vapor emissions were discharged to the atmosphere from process equipment and an on-site sludge roaster under permits from the NJDEP DEQ Air Pollution Control Program. Spent lubracating oils, transformer oils, and degreasing solvents were stored in 55 gallon drums before shippment off-site for recovery. Process wastewater, stormwater runoff and spill wash-down from process equipment, the parking lot, and transfer areas was treated then discharged to the South Branch Creek, a tributary of the Arthur Kill (classified "Saline Estuarine waters, SE-2" by the Division of Water Resources).

Plant wastewater and sludges were collected in a 500,000 gallon agitated tank. The dilute slurry was pumped to a 140,000 gallon settling silo No. 4. The supernatant was directed to the effluent treatment system and the settled solids to the 4,500 gallon surge tank at the sludge roaster site. The brine sludge composition was reported by LCP on June 9, 1975 to be: 15 to 20 percent sodium chloride, 40 to 50 percent barium sulfate, 20 to 30 percent calcium carbonate and/or sulfate, 2 percent metal hydroxides, 2 percent dirt, and 100 to 500 ppm mercury. Settling silo No. 4, and the surge tank are no longer maintained at the Linden facility. The collection tank is in service only for emergency purposes as a holding tank for excessive volumes of stormwater.

Effluent treatment consists of pH neutralization, contact with activated carbon, and filtration. Prior to construction of the cooling towers (in 1980) NJPDES Discharge to Surface Water (DSW) permits limitations for temperature were exceeded regularly. Other infractions included occasionally alkaline pH and one major incident on August 20, 1979 when ten to twenty thousand gallons of mercury tainted brine was discharged to the South Branch Creek. An analysis of sediment samples from the creek (below LCP's discharge outfall), as reported by Geragthy and Miller Inc. February 1982, indicates that mercury is present at 46 ppm. LCP began recycling its process wastewater in 1982 and amended the DSW permit to reflect this change. Currently only stormwater runoff and spill wash down after treatment, are discharged.

AREAS OF CONCERN:

Enforcement personnel with the Division of Hazardous Waste Management reported evidence of numerous small releases observed during inspections in 1980, 81, 82, and 83.

9/17/80 Brine sludge was observed on the gravel near the 500,000 gallon "collection tank."

10/9/80 Brine sludge was observed on the gravel in the vicinity of "Settling Silo #4."

1/21/81 During the inspection a liquid was observed spewing from a cracked PVC pipe near the 500,000 gallon collection tank and the pump pit.

3/19/81 An acid spill (9' x 4') was noted on the soil near Building #220 and Avenue C.

10/22/81 A brine sludge slurry release from a transfer line was evidenced by a 1' x 15' spill area located on Avenue B between the pump pit and the Brine sludge Lagoon. Also, a 10' x 4' hydrochloric acid spill area was noted approximately 15' northwest of the 500,000 gallon collection tank.

11/19/81 The brine sludge slurry spill area noted on the previous inspection has expanded to cover a 125' x 30' area along the railraod tracks.

4/13/82 Sodium sulfide crystals were evident on the gravel surface in the pump pit area. Also noted was a salt spill at the railroad siding area.

8/5/82 Yellow crystals (probably sodium sulfide) was observed to cover a 10' x 15' area of broken asphalt near building #240.

2/28/83 Approximately two cubic yards of rubber liner from the caustic tank were deposited within the brine sludge lagoon in violation of the DEQ ACO.

Late in 1982, LCP paved the railroad siding and adjacent areas, the area under the salt silos, and sections of Avenue C.

In addition to the areas noted by DEP personnel a former employee of LCP has alleged several other sites of possible contamination.

1. The soil surface between the compressor building #231 and the railroad tracks received mercury contaminated sludge which was excavated from the Brine Sludge Lagoon.

2. Prior to OSHA requiring the repair of the cracked and broken concrete floor within the mercury cell Buildings #230 and #240, numerous spills were transmitted to the underlying soils.

3. The willful destruction of unfavorable laboratory analytical results from effluent sampling of the outfall to South Branch Creek may have obscured LCP's impact to the sediments and surface waters downstream of the facility.

The former owner (GAF Corporation) operated a Waste Water Treatment Plant (WWTP) at this facility, principally for pH neutralization, through the 1950's, 60's, and early 70's. Purportedly the site of this treatment system was paved over and is currently used to maintain an extensive electrical power transformer substation.

UNIT ANALYSIS:
There are four (4) Solid Waste Management Units (SWMU's) at the LCP facility in Linden. The "Brine" Sludge Lagoon" is the only RCRA regulated unit. The "Chem-Fix" Lagoon, the "Sludge Roaster", and the "Container Storage Area" (CSA) comprize the remaining three units. A RCRA part A permit application was submitted by LCP on August 13, 1980. Since the only TSD activity on-site (the Brine Sludge Lagoon) was certified closed in September 1985 the part B application was considered unnecessary in lieu of a post closure permit.

1. The Brine Sludge Lagoon was an unlined surface impoundment in which mercury contaminated sludges were disposed of for twenty (20) years or more. The lagoon was roughly a trapezium, approximately 275' x 200' x 220' x 80', and the accumulated waste volume estimated at 30,900 cubic yards. Analysis of the sludge in the lagoon was performed by the Princeton Testing Laboratories June 15, 1981 which indicated that mercury was present at 340 ppm.

   In order to preclude worker exposure to mercury vapors eminating from the disturbed surface of the Brine sludge and Chem-Fix lagoons during closure operations, the USEPA and NJDEP required LCP to suspend manufacturing and restrict access to the site from 1982 until 1984. Closure operations (concluded September 1985) included a clay cap, soil cover, grading, and seeding.

   Five (5) shallow NJPDES permitted wells monitor leachate releases to the phreatic surface. Quaterly reports of analysis from these wells indicate that concentrations of the metals: lead, chromium, cadmium, mercury, selenium, silver, and radium have exceeded permitted parameters on several occasions between 1982 and 1987. Elevated mercury levels detected in the soils from the monitor well borings (up to 500 ppm) and from the land surface (up to 1,500 ppm) are, according to a Geraghty and Miller Inc. report dated February 1982, "the result of present or prior land use" and "represent low solubility compounds of sulfides, phosphates, or carbonates."

   In a recently issued NJPDES DGW permit, four (4) additional wells are mandated in order to fully characterize the local water table and adequately monitor leachate from this unit. During the December 22, 1987 RCRA walk through site inspection conducted by personnel of the Bureau of Planning and Assessment, the HNu meter detected organic vapors eminating from the headspace of existing monitor wells P-1 and P-2. The NJPDES 30 year post closure monitoring program should be expanded to include an initial scan for priority pollutants and volatile organic compounds. Further investigation of this unit is unwarranted at this time.

2. The Chem-Fix Lagoon was a surface impoundment, used briefly in 1976 for experiments in stabilizing the mercury constituents of the brine sludge. This lagoon was roughly triangular, 60 to 80 feet on each side, with a total surface area of approximately 3,000 square feet. The lagoon dikes were constructed to a height of 8 feet with an earthern core and crushed stone cover. Two (2) 0.20 mil thick visquene plastic liners were installed in the lagoon which was also

equipped with perforated under drain system for leachate collection. The lagoon contents, 460 cubic yards of treated brine sludge, was transfered to the Brine Sludge Lagoon in 1983. The Chem-Fix lagoon was subsequently excavated, filled, graded, and seeded. The proximity of the Chem-Fix Lagoon site to the Brine Sludge Lagoon site enables the NJPDES DGW permitted wells to monitor any leachate releases to the ground water from either unit. A further investigation of the Chem-Fix Lagoon is not warranted at this time.

3. The Sludge Roaster was designed and built in 1978 to vaporize mercury from steam dryed brine sludge, and thereby decontaminate the waste sufficiently to allow for final disposal at an off-site sanitary landfill. The roaster system was situated on a 16' x 40' concrete pad, one (1) foot thick, equipped with surface drainage channels (connected to the Waste Water Treatment Plant) and a cinder block curb. An Administrative Consent Order (ACO) issued September 1, 1981 required LCP to submit an application for a Hazardous Waste Facility (HWF) permit to operate the roaster unit. On June 30, 1982 the Bureau of Hazardous Waste Engineering (BHWE) denied the permit and LCP subsequently abandoned the process.

   A November 5, 1981 inspection by enforcement personnel of the Division of Environmental Quality, Air Pollution Control Program discovered a ruptured muffler plate on the sludge roaster that allowed excessive quantities of mercury vapors to be released to the atmosphere. Starting in 1985, this unit was dismantled and most of the components shipped to other LCP facilities around the country. No further investigation of the sludge roaster is warranted at this time.

4. The Container Storage Area (CSA) is a 300 square foot concrete pad, 1 foot thick with a 4 to 8 inch curb. Approximately 40 (55 gallon) drums or 2,000 gallons of waste: lubracating oils, transformer oils, disgreasing solvents, and dewatered brine sludges could have been stored on this unit at any one time. These wastes were shipped off-site for proper disposal within 90 days. During the recent RCRA walk through inspection (December 22, 1987) no containerized wastes were present at this unit, however the surface of the pad was covered with an absorbant material (speedy-dry) and some oily residues were noted on the gravel in the surrounding area. A limited investigation in the vicinity of the container storage area should be performed to determine the extent of contamination which may have occurred.

PERMITS:

NJPDES Discharge to Surface Water (DSW) permit #NJ0003778 grants LCP permission to discharge stormwater runoff and spill wash-down, after treatment, through one outfall to South Branch Creek (classified SE-3). This DSW permit was issued August 10, 1987 and is effective until April 30, 1991.

NJPDES Discharge to Ground Water (DGW) permit #NJ0003778 grants LCP permission to continue post-closure ground water monitoring of the wells surrounding the closed lagoons and to implement the modified Post-Closure Plan. "The potential discharge is leachate from the lagoon to the ground

waters of the State, to the organic (marsh) deposits of recent geologic age, the Raritan-Magothy formation of the Cretaceous age, and the New Brunswick formation of the Jurassic age." The DGW permit was issued October 30, 1987 and is effective until November 29, 1992.

Air Pollution Control permit #044133 was issued on March 3, 1980 granting LCP permission to operate the Sludge Roaster System. This permit expired on October 5, 1982 well after LCP suspended operation of the roaster November 7, 1981.

Other Air Permits included:

PERMIT #	UNIT	EXPIRATION DATE
067418	Boiler Stack	2/17/89
020928	Pura-SIV stack	11/9/85
037033	Mercury Cell Destruct Tower	3/26/89
040435	Mercury Cell Destruct Tower	3/26/88
076056	Mercury Cell Destruct Tower	5/15/87
036994	HCL Scrubber	6/11/88
036993	HCL Scrubber	11/20/88
035067	HCL Scrubber	3/28/88

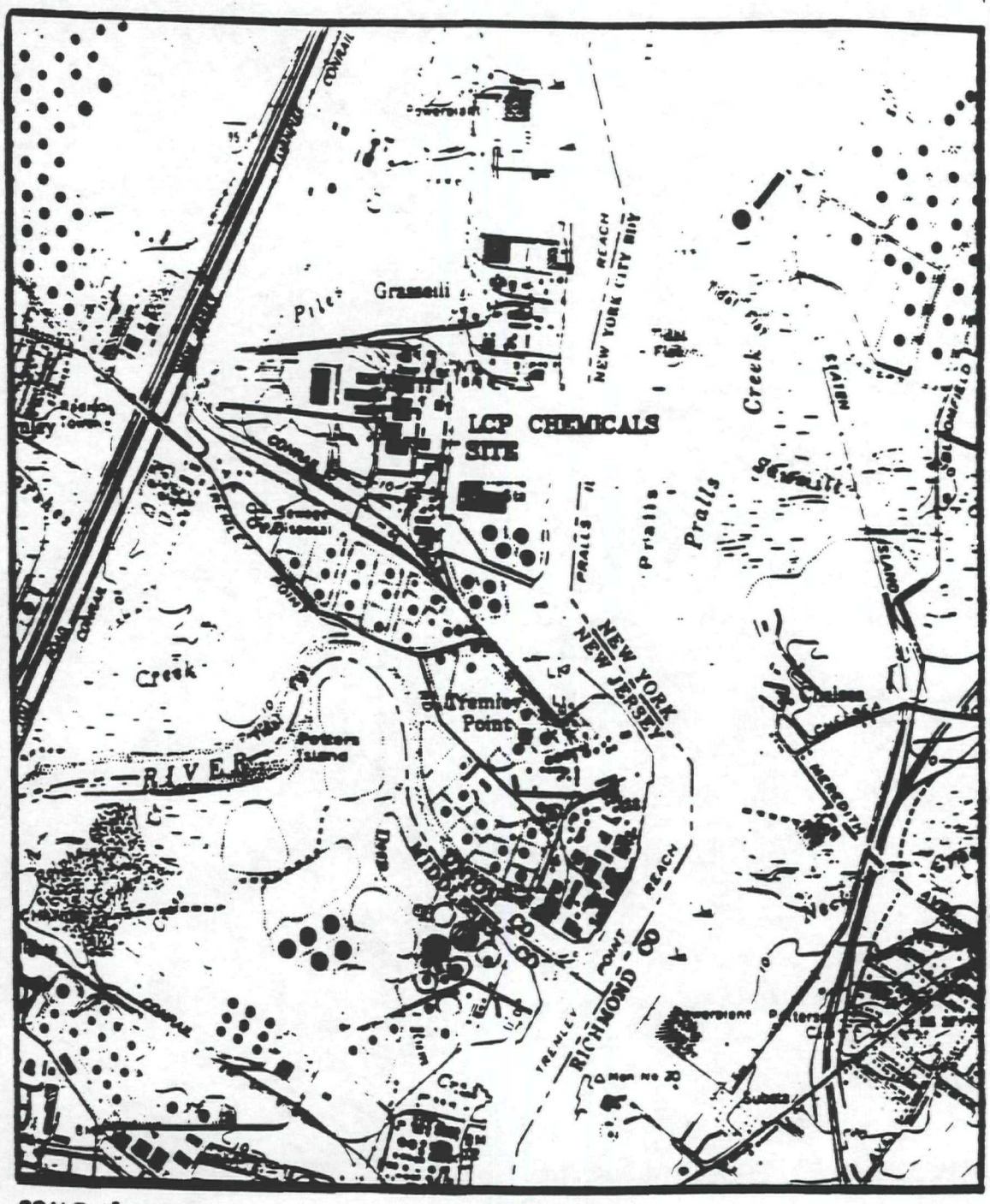
REGULATORY ACTIONS:
An Administrative Consent Order (ACO), was issued September 1, 1981 by the NJDEP Division of Environment Quality. The ACO required LCP to apply for a permit to operate the Sludge Roaster as a hazardous waste treatment facility, to submit bi-weekly progress reports of activities at the brine sludge lagoon, to submit applications for closure of the Chem-Fix Lagoon and the Brine Sludge Lagoon, and to fully evaluate all potential avenues of release to the ambient environment (ie. air monitoring, groundwater monitoring, soil boring, and surface water monitoring).

A Civil Administrative Penality of $17,500.00 was assessed against a former tenant at LCP, the Kuhne Chemical Company (KCC) in November 1981. KCC was issued a NJPDES permit #0027707 on September 9, 1974 to discharge uncontaminated, non-contact cooling water to the South Branch Creek. Analysis of effluent sampling from KCC's outfall, conducted January 1981, revealed extremely elevated concentrations of caustics and free chlorine (up to 124,430 ppm) and a correspondingly excessive alkaline pH. Aside from the obvious violation of permit parameters the DWR alleged KCC's discharge of waste materials was deliberate.

RECOMMENDATIONS:
Of the four SWMU's at LCP Chemicals in Linden only one unit, the CSA requires corrective action under the RCRA post closure permit program. A limited investigation to include soil sampling in the vicinity of the CSA is necessary to determine the nature and extent of contamination which may have resulted from past spill events.

The previously cited "Areas of Concern" which remain accessible, also require soil sampling to verify that adequate remediation was accomplished at the numerous, documented sites of small spills and past releases.

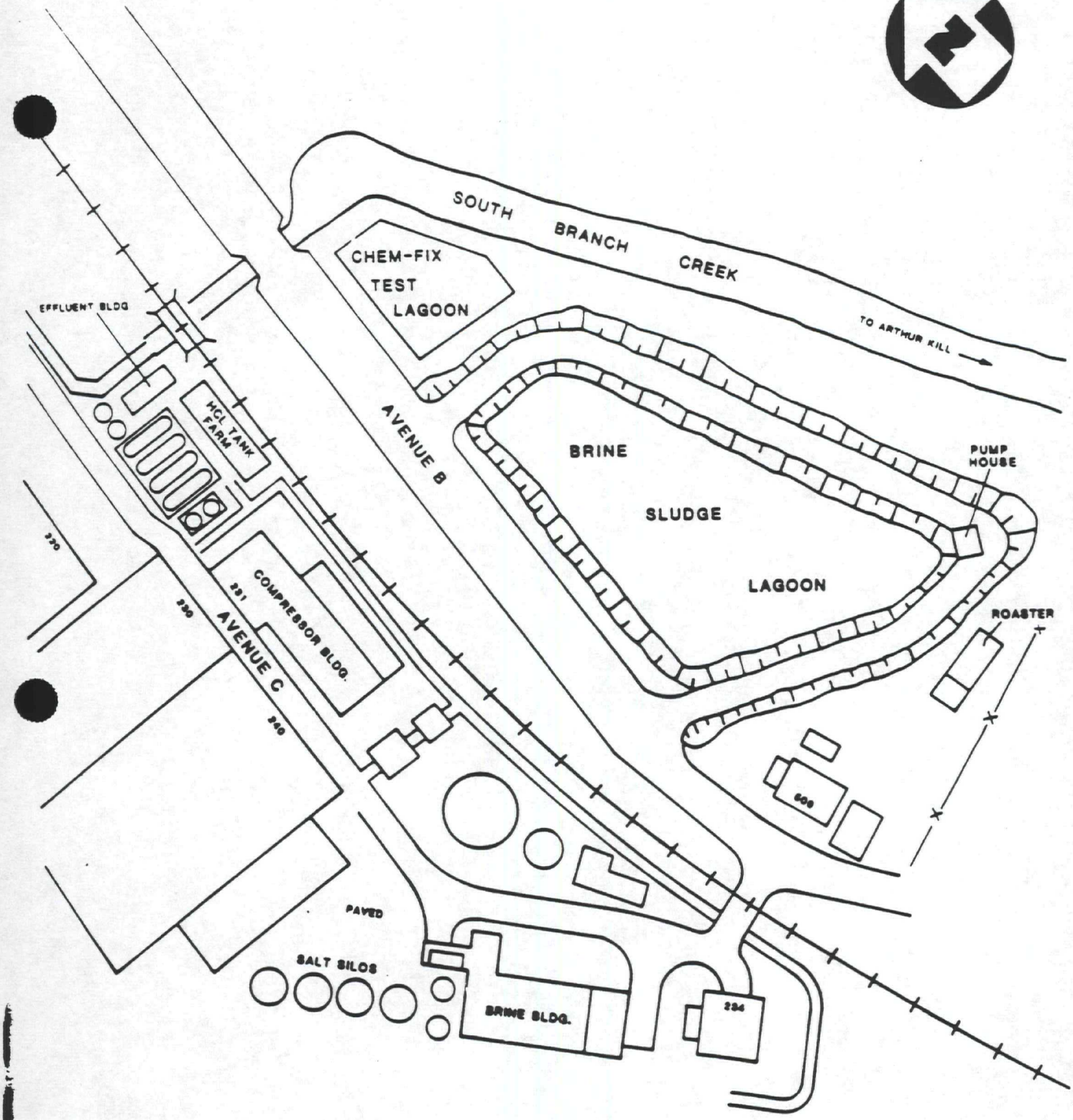
LCP CHEMICALS–NEW JERSEY, INC.
A DIVISION OF HANLIN GROUP, INC.
LINDEN, NEW JERSEY



SCALE 1"=2000'

FIGURE 1: SITE LOCATION MAP

Note: This Figure was adapted from the 1992 RCRA Facility Inspection Report prepared for the LCP Chemical site by Eder Associates Consulting Engineers, P.C. (Ref. No. 15).



SITE MAP

LCP CHEMICALS SITE, LINDEN, N.J.

SCALE: 1" = APPROX. 100'

FIGURE A-2

NUS CORPORATION

A Halliburton Company

24 of 102

100012

State of New Jersey
DEPARTMENT OF HEALTH
CN 360
TRENTON, N.J. 08625-0360

CHRISTINE TODD WHITMAN
GOVERNOR

LEN FISHMAN
COMMISSIONER OF HEALTH

TO: David Hutchins; ATSDR, Technical Project Officer

FROM: James Pasqualo; NJDOH, ATSDR Project Manager

DATE: June 24, 1996

SUBJECT: Site Visit Report; LCP Chemical Site

Attached is a site visit report package regarding the *LCP Chemical* site. Included in this package are:

1) A site summary checklist.
2) Site narrative.
3) A site location map (coordinates 40' 36.43" N, 74'12.62" W)

The NJDOH performed a site visit at the LCP Chemical site on May 2, 1996. This was in response to a request from the United States Environmental Protection Agency to ascertain the nature and extent of potential human exposure pathways at the site.

It is our evaluation that although metals (mercury, and to a lessor extent arsenic) are present in concentrations exceeding ATSDR comparison values, there are no completed or anticipated human exposure pathways associated with the site under present conditions.

The site is an inactive industrial facility. Although physical hazards exist on the site, it is not an area where trespassing is likely. Off-site contact by adults or children with site related contaminants is unlikely under present conditions.

Level D protection is adequate for visiting the site under present conditions. Additional activity by the ATSDR or the NJDOH is not indicated at this time. The NJDOH recommends revisiting the site subsequent to commencement of remedial activity by the USEPA.

c. with attachments

File

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Attachment B

REGION II

DATE: JUL 0 3 1996

SUBJECT: Screening-level Ecological Risk Assessment for LCP

FROM: Christopher A. Stitt, Environmental Scientist
Surveillance and Monitoring Branch (ESD-SMB)

TO: Nicholas Magriples, On-Scene Coordinator
Removal Action Branch (ERRD-RAB)

As you requested, we have reviewed the existing data for the LCP Chemicals, Incorporated site, located in Linden, Union County, New Jersey. We provide the following screening-level ecological risk assessment for this site.

The LCP site is currently being addressed through the initial stages of the removal process, so extensive knowledge of the magnitude and extent of contamination is not available. Activities at the site revolved around the production of chlorine using a mercury cell electrolysis process. Wastewater from this process, in the form of a sludge lagoon supernatant containing mercury, was discharged to an on-site creek after passing through a treatment plant or directly from the lagoon during several overflow and breaching events. Mercury related operations were stopped in the early 1980s, including closure and clay capping of the sludge lagoon. Investigation of the site has indicated that the soil on the site and the sediment and surface water of the creek are contaminated with mercury, with concentrations in creek sediment as high as 1,060 mg/Kg. Analytical data contained in the "Final Draft Site Inspection" (SI), prepared by Malcolm Pirnie, Incorporated, and last updated July 24, 1995, were used as the basis for this assessment.

The on-site creek is a small tributary of the Arthur Kill, known as South Branch Creek. It appears to arise on the site from various culverts and/or discharge pipes, before passing along the edge of the former lagoon area. South Branch Creek is tidally-influenced and appears to flow for approximately 1,000 feet before entering the Arthur Kill. Based on review of reference material (i.e., no site visit was conducted), habitat associated with the site appears to include the developed terrestrial portion of the site proper, the channel of the creek adjacent to and downstream of the site, and the wetlands and tidal fringe along the creek and at its mouth at the confluence with the Arthur Kill. As South Branch Creek appears to be a tidal creek with estuarine wetlands, the potential exists for the creek to be used by a number of estuarine aquatic species (e.g., mummichog, fiddler crab) for all life stages, as well as by marine species (e.g., blue crab, weakfish, summer flounder) for spawning and nursery habitat. The actual use of the creek by these species would depend on the specific characteristics of the creek channel and wetlands even if contamination is not considered. However, if these species are present, then they could introduce contamination into the food chain through at least two pathways: accumulation of contaminants by young marine species that may be carried into the marine food chain (e.g., weakfish entering the bay or ocean as an adult and being consumed by a predatory fish), and accumulation by any aquatic or benthic species that may be consumed by avian piscivores.

In the vicinity of the site, there are several important avian breeding areas and rookeries, foraging areas, and wintering habitats. These areas are primarily attractive to wading birds (e.g., herons, bitterns, rails, ibises, sandpipers), but also attract many other birds associated with estuaries, such as gulls, terns, ducks, and raptors. Species recorded as recently breeding in the vicinity of the site include state-listed special animals (e.g., great blue heron, yellow-crowned night heron, little blue heron). Additionally, many state-listed species are recorded as using the area as foraging or wintering habitat (e.g., northern harrier, peregrine falcon). The breeding areas and rookeries include Pralls Island (approximately 2,000 feet east of the site and 1,000 feet east of the mouth of South Branch Creek), Island of Meadows (approximately 2 miles to the south), and Shooters Island (approximately 3.5 miles to the northeast), as well as local watersheds. Within 4 miles of the site, which is an arbitrary radius selected to include the ranges of most of the raptors and the larger birds associated with the rookeries, there appears to be considerable foraging habitat provided by the marshes and mud flats associated with the Arthur Kill and its tributaries. These include, from north to south, the lower Elizabeth River watershed, Old Place Creek, Morses Creek watershed, Piles Creek, Sawmill Creek, Neck Creek, lower Rahway River watershed, Rum Creek, Fresh Kills watershed, Noes Creek, Smith Creek, and Woodbridge Creek watershed. Although the Arthur Kill has been heavily developed and altered, it still has some remnants of high quality salt marsh and tidal wetland that are actively used as critical habitat by many species. It has also been the site of ongoing habitat restoration projects for some of these species. These projects include the salt marsh restoration on Pralls Island, across the Arthur Kill from the site, as part of the mitigation for the 1990 Bayway oil spill, as well as salt marsh restorations on Saw Mill Creek, east of Pralls Island, and on Old Place Creek, north of the site.

Consideration of the potential for ecological risk at the site was divided into two components: the terrestrial risk associated with the developed portion of the site, and the aquatic risk associated with the creek system. While contaminants appear to be significantly elevated on the developed portion of the site, effort was not expended to assess the terrestrial risk because it appears that the terrestrial areas on the site proper offer relatively limited habitat value. However, it should be noted that there is still concern that these areas will continue to act as a source of contamination to areas likely to contain ecological receptors (e.g., the creek). The aquatic system is addressed by assessing the ecological risk based on the sediment and surface water data. As no delineation of the habitat associated with the site is available, it is assumed that South Branch Creek, and all of the area adjacent to South Branch Creek, is a tidal tributary and wetland with ecological value. The available sediment and surface water data from the creek are assumed to be representative of these wetland and tidal fringe habitats; therefore, the results of this assessment of the creek sediment surface water data are viewed as representative of these sensitive environments.

The initial step in this screening-level ecological risk assessment is the comparison of the analytical results from the available sampling to appropriate ecological screening values for the creek media (Tables 1, 2, and 3). Surface water sample locations are numbered from upstream to downstream as SW1 through SW10. The SI notes that the samples are from the creek, as well as outfall pipes or culverts entering the creek. Nevertheless, all of the samples are assumed to be representative of the surface water of the creek for the purposes of this assessment because data regarding flow rates and percent contribution to the surface water volume are unavailable. For

the purposes of this assessment, location SW1 is considered to be upstream, and is not included. Locations SW6 and SW7 are duplicate samples from one location; the data are averaged for use in this assessment. Any non-detects are included in this assessment at one-half of the detection limit (e.g., the mercury result for SW4 of 0.20U ug/L is included in the surface water data as 0.10 ug/L).

For surface waters, the USEPA's Ambient Water Quality Criteria (AWQC) were used as screening values (Federal Register/Vol. 57, No. 246/Tuesday, Dec. 22, 1992/Rules and Regulations, p. 60911; and as revised for specific metals by Federal Register/Vol. 60, No. 86/Thursday, May 4, 1995/Rules and Regulations, p. 22228). It is typically recommended that a screening-level ecological risk assessment use the most conservative value available for comparison, which would be the Criterion Continuous Concentration (CCC), or chronic effects value. However, the initial review of the surface water data indicates that inorganic contaminant concentrations exceeding acute effects levels are widespread in the creek. Therefore, the less conservative acute AWQC value, or the Criterion Maximum Concentration (CMC), is selected for comparison. In accordance with the USEPA's Section 304(a) Criteria for Priority Toxic Pollutants (40 CFR 131.36(b)(1), July 1, 1995), the CMC (acute value) is defined as a water quality criterion to protect against acute effects in aquatic life and is the highest instream concentration of a priority toxic pollutant consisting of a one-hour average not to be exceeded more than once every three years on the average. All of the AWQC values used in this assessment are based on dissolved metal concentration and an assumed Water Effect Ratio (WER) of 1.0. Actual criteria for South Branch Creek would have to be calculated based on a specific creek WER, which is not currently available.

The CMC for mercury is 1.8 ug/L. Of the eight surface water sample locations (SW2, 3, 4, 5, 6/7, 8, 9, 10), all but two have concentrations of mercury exceeding the acute value. Mercury concentrations ranged from undetected, at 0.2 ug/L, to 93 ug/L. It is recommended that the maximum concentration be used for comparison in a screening-level risk assessment to remain conservative. Since the surface water is assumed to be flowing, and may potentially be varying in concentration due to tidal influence, the less conservative mean concentration is considered for this assessment. A mean value for the mercury concentration in the surface water of the creek is 29.7 ug/L. This concentration is still an order of magnitude greater than the CMC. Additionally, the mean concentrations of the inorganic contaminants arsenic, copper, and zinc exceed their respective acute values, while lead and silver each exceed their acute value for at least one location. The results of this screening of the surface water concentrations appears to indicate that acute effects to aquatic biota are possible for the length of South Branch Creek, depending on the influence of tides and flow rates at any given time.

Sediment samples are from the same locations as the surface water locations, and are numbered in the same manner. SED1 is again considered to be upstream of the site for the purposes of this assessment and is not included. Sediment samples are not available for locations 2 and 8. SED6 and 7 are duplicates and the results are averaged. Creek sediments are screened against the Long 1995 values, as they provide a relevant database for estuarine systems (E. Long, et al. 1995. "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine

and Estuarine Sediments." Environmental Management Vol. 19, No. 1, pp. 81-97.). Again, it is recommended that conservative screening values be used in a screening-level ecological risk assessment. For estuarine sediments, these would be the Effects Range-Low (ER-L), which are the lower 10th percentile that are associated with adverse effects. Exceeding the ER-L indicates that the sample concentrations are in a " ... range within which effects would occasionally occur." However, initial review of the sediment data from the six locations (SED3, 4, 5, 6/7, 9, 10) indicates that concentrations of certain inorganics appear to be sufficiently elevated to raise concerns for significant impacts throughout the creek system. As an attempt to estimate the magnitude of this potential, less conservative screening values were again selected. The less conservative values used are the Effects Range - Median (ER-M), which are the median, or 50th percentile, of the effects data and are defined as concentrations " ... that are frequently associated with adverse effects ... " when exceeded. Not only does the maximum detected mercury concentration exceed the ER-M, but all six of the locations contain mercury at least two orders of magnitude greater than the ER-M. Mercury concentrations ranged from 56.9 mg/Kg to 1,060 mg/Kg; the ER-M for mercury is 0.71 mg/Kg. In addition to these apparently significant mercury elevations, arsenic, cadmium, copper, lead, and zinc all have mean concentrations in the creek samples exceeding the ER-M, while nickel and silver each exceed their respective ER-M in at least one location.

The initial review of the available data appears to indicate that there is the potential for ecological risk from mercury and several other inorganics contained in stream sediments and surface waters. The widespread elevation of these inorganic contaminants in the creek surface water and sediment suggests that there is a significant impact to the aquatic and benthic community in the creek. If a significant effect is present throughout the creek, it would likely disrupt the local food chain. Such a disruption of the food chain would probably prevent a complete exposure pathway to upper trophic level receptors in South Branch Creek (e.g., wading birds, raptors). Therefore, modeling of exposure of higher trophic level receptors to contaminants through the food chain is not included because the apparent severity of the potential impacts from surface water and sediment inorganic contamination based on screening values indicates that prey items are not likely to survive in the creek. A complete exposure pathway through the food chain is not believed to exist due to contamination. However, the continuing elevation of these contaminants, specifically mercury, in the surface water even after the cessation of operations and the efforts to contain the lagoon raises concern that the sediment and/or other on-site areas are acting as a continuing source to the environment. There also are no data regarding contamination in the sediment and surface water beyond the most downstream sample in South Branch Creek (SW10). The historical and ongoing contribution of potentially adverse concentrations of contaminants to the Arthur Kill by South Branch Creek has not been addressed. Additionally, while the predicted impacts may be limited to the aquatic and benthic community of South Branch Creek, there remains the concern that there is a zone of mixing in the Arthur Kill in which concentrations are not directly toxic to the aquatic and benthic organisms but do accumulate in their tissue. This may result in an undefined area in which adverse impacts to higher trophic level ecological receptors, such as the wading birds and raptors, may be occurring through the food chain. This is of particular concern for two primary reasons: the bioaccumulative property of mercury, and its impacts to reproductive activities.

A cursory review of the "Mercury Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review" (R. Eisler. April 1987. Biological Report 85(1.10). Contaminant Hazard Reviews Report No. 10. U.S. Fish and Wildlife Service) reveals that there is no known biological function for mercury. While some forms may have relatively low toxicity or bioavailability (e.g., inorganic mercury), other forms easily enter the food chain through strong bioaccumulative properties (e.g., organomercury compounds). Biological activities can transform the less toxic forms of mercury into the more toxic and bioavailable forms, such as the methylation of mercury in anaerobic sediments. Finally, mercury is known to be a mutagen, teratogen, and carcinogen, and to cause embryocidal, cytochemical, and histopathological effects. The potential for mercury to enter the food chain in the vicinity of the South Branch Creek and to impact the breeding populations of wading birds and raptors in the area, including state-listed endangered and threatened species, remains a concern of undefined potential. It is recommended that additional activities be conducted to address the potential ecological risk associated with contamination of South Branch Creek to protect the environment.

The nature of a screening-level ecological risk assessment and the limited data available for this site precludes definitive conclusions regarding the significance of any effects that may actually be occurring in the field. However, the uncertainties can be clarified so that any risk management decisions that must be made can be as informed as possible. The following are, first, factors which may decrease the uncertainty or increase the potential that significant ecological effects may be occurring in the field and, second, factors which are common to screening-level ecological risk assessments that may increase the uncertainty.

South Branch Creek represents an ongoing source of mercury into the environment. The area surrounding the creek is used for breeding, foraging, and wintering of numerous species. Breeding is typically a time of increased susceptibility to environmental factors, such as contamination. Additionally, mercury is known to cause adverse impacts in the development of young and the reproductive cycle in birds. The presence of mercury in this area may therefore present an even greater risk than this assessment indicates. While mercury appears to be the primary contaminant of concern for this site, several other inorganic contaminants have significantly elevated concentrations in South Branch Creek. Additionally, concentrations of PAHs and PCBs were detected in the sediment samples. These contaminants were not considered in this assessment because it was assumed that the inorganic contaminants generate the greatest risk. However, the organic contaminants may contribute additional risk to benthic and aquatic receptors, while contaminants such as the PCBs may also enter the food chain. Therefore, while there may be uncertainty that any one contaminant is actually causing impacts in the field, a qualitative assessment of the number of contaminants present at elevated concentrations, the relative number of locations with concentrations exceeding screening values, the total number of separate inorganic constituents exceeding screening values at each of these locations, and the magnitude by which the screening values are exceeded would appear to reduce the uncertainty. It should also be noted that terrestrial ecological risk was not assessed. While terrestrial risk was assumed not to be significant for this assessment due an apparently limited potential for exposure, any effects to the biota from the contaminants in this habitat may add to any impacts from the aquatic media. Finally, it is typically recommended that the screening values for an assessment

such as this be based on the most conservative values available. Therefore, the CCC, or chronic effect level, for surface water and the ER-L for sediment should be used to be appropriately conservative to support the dismissal of the potential for risk if these values are not exceeded. As this screening-level ecological risk assessment was being prepared as part of a removal investigation and because of the high concentrations of the contaminants being assessed, the less conservative CMC, or acute effects level, for surface water and ER-M for sediments were used. This indicates that if potential ecological risk is found in the assessment, then there may be a higher probability that effects are actually occurring in the field. It may also mean a higher probability that any effects that are occurring in the field may be significant adverse effects. The use of the less conservative screening values is intended to reduce the uncertainty of the risk assessment. This was done to facilitate supporting risk management decisions associated with potential removal actions; decisions that often must be made even if conducting field investigations and/or confirmatory studies is not feasible.

The AWQC for surface water can be influenced by site-specific parameters. The pH and salinity are examples of parameters that can influence the bioavailability and/or toxicity of contaminants in estuarine surface water. These parameters were not available for use in this assessment, so the comparison to the AWQC may actually include more or fewer exceeded values. Grain size distribution, total organic carbon content, reduction-oxidation potential, pH, aerobic state (aerobic/anaerobic), and other factors can influence the bioavailability and/or toxicity of contaminants in the sediment. Without these parameters, the actual availability and toxicity of the sediment contaminants to biological receptors is unknown, regardless of the indications of screening values. An assessment of the food chain is not included because of the assumption that a complete exposure pathway to higher level trophic receptors does not exist due to the apparent toxicity of the creek. However, there would appear to be a high potential that contaminants are being transported out of South Branch Creek and into the Arthur Kill, where the potential for food chain uptake is undefined. All of these factors contribute to the uncertainty of this assessment of ecological risk; however, it should be noted that these uncertainties can actually influence the results in both directions (i.e., more and less conservative).

Based on the results of this screening-level ecological risk assessment, it is our recommendation that additional activities be conducted to address the contamination in the creek system. If additional ecological investigations cannot be performed, then due to apparent toxicity of the creek to aquatic and benthic species and the potential for highly toxic and/or bioaccumulative contaminants to be transported off of the site at highly elevated concentrations and effect piscivorous or other predatory species, it may be appropriate for the areas of highest stream sediment contamination (hot spots) to be removed and ongoing sources to the creek from the site to be eliminated. Any such action may serve to reduce the potential ecological risk and serve to protect the environment.

We hope these comments have been helpful. The BTAG and/or ESD is interested in reviewing any future documents pertaining to this site. If you have any questions, comments, or require further information, please contact me at (908) 321-6676.

Attachments

TABLE 1. LCP CHEMICALS, INC.

Surface water inorganic data.

Location	As	Cu	Hg	Zn
SW 2	97.4	38.6	30.5	52.9
SW 3	54.9	106.0	**93.0**	329.0
SW 4	73.5	0.6	0.1	137.0
SW 5	127.0	29.4	44.6	303.0
SW 6/7	**231.0**	**331.5**	62.8	**878.0**
SW 8	65.1	4.2	1.0	33.7
SW 9	62.9	5.6	2.0	47.6
SW10	23.8	27.1	3.7	74.4
Mean	92.0	67.9	29.7	232.0

(All analytical data from the "Final Draft Site Inspection LCP Chemicals, Inc.," Reference No. 17.)

(All surface water concentrations are in ug/L.)

(Bold data indicate maximum detected contaminant concentration.)

(Undetected results ("U") calculated as 1/2 detection limit; Duplicate samples averaged.)

TABLE 2. LCP CHEMICALS, INC.

Sediment inorganic data.

Location	As	Cd	Cu	Pb	Hg	Zn
SED 3	115.0	16.5	383.0	**358.0**	**1,060.0**	1,030.0
SED 4	**318.0**	3.2	65.6	82.3	429.0	777.0
SED 5	80.3	**132.0**	201.0	182.0	187.0	**9,040.0**
SED 6/7	156.5	6.4	271.5	262.0	410.0	469.0
SED 9	90.0	7.6	**389.0**	268.0	433.0	526.0
SED10	75.4	4.5	327.0	312.0	56.9	502.0
Mean	139.2	28.4	272.9	244.1	429.3	2,057.3

(All analytical data from the "Final Draft Site Inspection LCP Chemicals, Inc.," Reference No. 17.)

(Bold data indicate maximum detected contaminant concentrations.

(All sediment concentrations in mg/Kg.)

(Undetected results ("U") calculated as 1/2 detection limit; Duplicate samples averaged)

TABLE 3. LCP CHEMICALS, INC.

Surface water and sediment inorganic maximum and mean concentrations compared to screening values.

	Media concentration		Screening value	
Surface water	Maximum	Mean	acute	chronic
As	231.0	92.0	69.0	36.0
Cu	331.5	67.9	2.4	2.4
Hg	93.0	29.7	1.8	0.025
Zn	878.0	232.0	90.0	81.0

(Additionally, Pb and Ag have at least 1 location with concentrations exceeding the acute screening value.)

Sediment	Maximum	Mean	ER-M	ER-L
As	318.0	139.2	70.0	8.2
Cd	132.0	28.4	9.6	1.2
Cu	389.0	272.9	270.0	34.0
Pb	358.0	244.1	218.0	46.7
Hg	1,060.0	429.3	0.71	0.15
Zn	9,040.0	2,057.3	410.0	150.0

(Additionally, Ni and Ag have at least one location with concentrations exceeding the ER-M screening value.)

(Surface water acute value is the unadjusted AWQC saltwater CMC; surface water chronic value is the unadjusted AWQC saltwater CCC.)

(Sediment ER-M and ER-L values from Long, et al. 1995.)

(All surface water concentrations in ug/L; all sediment concentrations in mg/Kg.)

Exhibit K

LCP CHEMICALS -- NEW JERSEY, INC.
HANLIN GROUP, INC.
EDISON, NJ

DESCRIPTION OF CURRENT CONDITIONS
RCRA FACILITY INVESTIGATION TASK I
LCP CHEMICAL - NEW JERSEY, INC.
LINDEN, NJ

PROJECT #625-3
JANUARY 1992

EDER ASSOCIATES
CONSULTING ENGINEERS, P.C.
Locust Valley, New York
Madison, Wisconsin
Ann Arbor, Michigan
Augusta, Georgia

eder associates
consulting engineers, p. c.

February 19, 1992
File #625-3

Mr. Samuel I. Ezekwo
United States Environmental
Protection Agency
Region II
Hazardous Waste Facilities Branch
26 Federal Plaza
New York, New York 10278

Re: LCP Chemicals - New Jersey, Inc.
NJD079303020

Dear Mr. Ezekwo:

On behalf of LCP Chemicals - New Jersey, Inc., a Division of Hanlin Group, Inc., enclosed are three copies of the Description of Current Conditions for the Linden, New Jersey facility (EPA ID. No. NJD079303020) representing Task I of the Scope of Work for the RFI, as required by the facility's HSWA permit. We revised the draft version of this report to include the RFA and a pre-RFI site investigation report as requested. Also, more detailed descriptions of SWMUs, Areas of Concern, and permit and enforcement actions have been added, as requested.

Task II Evaluation of Corrective Measure Technologies and the Task III Work Plan will be submitted in accord with the permit deadlines of February 23 and March 25.

Please call me if you have any questions.

Very truly yours,

EDER ASSOCIATES CONSULTING ENGINEERS, P.C.

Kenneth J. Pasterak
Hydrogeologist

KJP/eml
enc.

cc: J. Merle
B. Marcolina

LLV2035

100599

2 of 390

480 FOREST AVENUE, LOCUST VALLEY, NEW YORK 11560 • (516) 671-8440 • FAX (516) 671-3349

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APPENDIX A - BORING LOGS AND MONITORING WELL CONSTRUCTION DATA
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I. PURPOSE

This document describes past and current conditions and activities, identifies solid waste management units (SWMUs) and areas of concern (AOCs), and presents a preliminary assessment of potential impacts caused by prior activities. The document has been prepared as Task I of the RCRA Facility Investigation for the Hanlin Group, Inc., LCP Chemicals - New Jersey (LCP) Division Linden facility, in accord with Module III, Section E.1 of the LCP 1984 HSWA (NJD079303020) effective November 25, 1991.

II. BACKGROUND INFORMATION

Site History

LCP Chemicals purchased a 26 acre chlorine production facility in Linden, New Jersey from General Aniline and Film Corporation (GAF) in 1972 (Figure 1). GAF purchased the land from the U.S. government in 1950, filled an area of marshland and lowland, and developed it for chlorine production. The facility is situated on the Tremley Point peninsula adjacent to the Arthur Kill. South Branch Creek, a tributary of Arthur Kill, runs through a portion of the site and flows through engineered conveyance structures on the north side of the property.

GAF produced chlorine and sodium hydroxide by the mercury cell electrolytic process beginning in 1952. LCP purchased the site in 1972, renovated the plant, and operated the mercury cell process until 1982. LCP Chemical produced chlorine, sodium hydroxide, hydrochloric acid, and anhydrous HCL. In the early 1980's the plant was converted to produce potassium hydroxide and operated briefly before it permanently ceased production in August 1985.

The site is now used as a transfer terminal for products from other Hanlin Group facilities. Dismantling activities have been ongoing since 1985. Presently, products including potassium hydroxide, sodium hydroxide, and hydrochloric acid arrive in bulk by rail and truck and are transferred to aboveground tanks and tank trucks. Administrative tasks and product storage and transfer are the only activities currently conducted at the site.

A portion of the site west of Avenue D was leased to the Union Carbide Linde Division from 1959 to 1990 and was used in its wholesale gas activities. Beginning in 1990, Ultra Pure Compressed

Gasses, Inc. leased the site for the same operation. Building 231 has been leased to Microcell Technologies since 1987. From 1974 to 1981 Kuehne Chemical manufactured sodium hypochlorite and chlorine in a leased area near Building 220. Caleb Brett Labs leased a portion of a laboratory and locker building north of Building 220 to store petroleum product samples and a portion of the building was also leased to Liquid Carbonic for office use. Land adjacent to the lab and locker building was leased to Liquid Carbonic for carbon dioxide transfer operations.

Surrounding Land Use

The facility is owned by Hanlin Group, Inc., Edison, NJ. Property boundaries and adjacent property owners are identified on Drawing 1. All surrounding land use is heavy industrial and the nearest residence is approximately 0.75 miles to the west. The City of Linden is a densely populated urban area of about 60,000 people and is about three miles west of the site.

GAF occupies land immediately north of LCP and produced surfactants and pharmaceutical specialty products. The GAF Corporation site became inactive in April 1991. Bulk petroleum storage terminals owned by Northville, BP, and Mobil occupy land to the northeast, south and west.

Surface Drainage

Roads (Avenues A, B, C, D and E depicted on Drawing 2), electrical substations, and secondary containment areas around tanks are paved. The remainder of the site is essentially unpaved. Stormwater runoff from former process areas collects in a concrete drainage swale drawn in Drawing 2 or infiltrates the soil in unpaved areas. The swale (date of construction unknown) conveys runoff to a concrete sump south of Building 231 where it is pumped to a holding tank for treatment.

LCP CHEMICALS–NEW JERSEY, INC.
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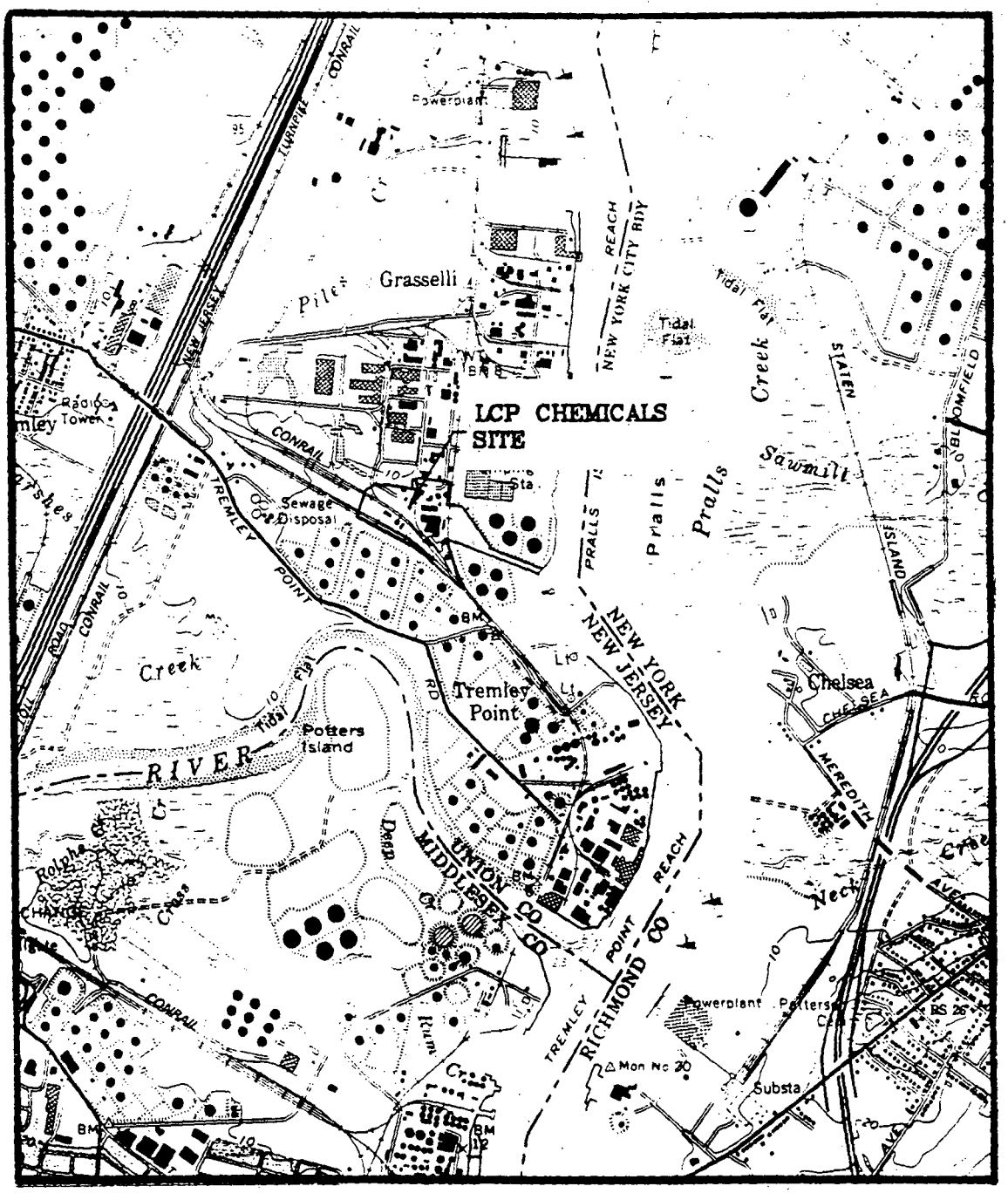
LINDEN, NEW JERSEY



SCALE 1"=2000'

LOCATION MAP

100605

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Land outside the process area is generally unpaved, except for roadways (identified on Drawing 2) and tank containment areas, and precipitation percolates through soil to the shallow water table, eventually discharging to South Branch Creek and the Arthur Kill.

According to LCP, no topographic contour maps exist for the plant site. A topographic map will be prepared as part of the RFI to fulfill LCP's HSWA permit map requirement.

Principal Activity Conducted at the Site

Salt and water were the principal raw materials used by LCP in its production processes. Rock salt (and, in 1982, evaporated salt) was transported to the facility by rail car, placed in salt silos by building 233, and fed to saturators to generate brine. The brine was treated and filtered in building 233 to remove calcium carbonate, calcium sulfate, magnesium hydroxide and other impurities. Purified brine was fed to electrolytic mercury cells in buildings 230 and 240 to produce chlorine and a mercury-sodium amalgam. Chlorine was cooled, dried with sulfuric acid, liquified in building 233 and stored in 100 ton vessels. Spent brine was returned to building 233 for neutralization, re-saturation, filtration and return to the cells. The mercury-sodium amalgam flowed from electrolyzers to denuders where it was reacted with water to produce elemental mercury, sodium hydroxide solution and hydrogen gas. Hydrogen gas was purified south of building 231 and elemental mercury was returned to the electrolyzers, completing the process.

Sodium hydroxide was filtered and stored in tanks at the north end of the facility and some was reacted with water and chlorine to produce sodium hypochlorite. Hydrogen was burned for energy recovery or with a stream of chlorine and water to produce hydrochloric acid which was stored in tanks near building 221.

Hydrogen chloride was desiccated with sulfuric acid to produce anhydrous hydrochloric acid. All product was shipped off-site by rail or truck.

Solid and Hazardous Waste Generation

Brine purification mud ("brine sludge") was the principal solid waste generated at this site during production, and mercury is the basis for listing the sludge as Hazardous Waste No. K071. In 1971, brine sludge was pumped from building 233 to an on-site lined settling lagoon and LCP continued this practice. Sludge was pumped to the lagoon via aboveground line and through a hose inside pipe underneath the railroad right of way as depicted in Drawing 3. On one occasion, a small amount of sludge was pumped from the brine sludge lagoon to a lined experimental chemical fixation lagoon for treatment and monitoring. LCP investigated sludge treatment to render the K071 waste non-hazardous and retorted the sludge in a roasting unit on a pilot scale basis for several years. All waste management units are described in Report Sections IV and V.

Wastewater treatment sludge was also generated during chlorine production and is a RCRA listed hazardous waste (No. K106) on the basis of mercury content. This waste was placed in the on-site lagoon during LCP's ownership of the facility.

Small quantities of solvent such as carbon tetrachloride were probably used for general cleaning and degreasing, and small quantities of methyl ethyl ketone were used in the fiberglass shop.

LCP is registered as a RCRA hazardous waste generator (No. NJD079303020) and currently generates demolition debris from the plant closure some of which is contaminated by mercury. Filter cake from the wastewater treatment system is also generated and is disposed of off-site as mercury contaminated waste. Both wastes are listed as D009 and are generated on an irregular basis, with an

estimated volume of 60 tons/year. Waste oil from diesel locomotive servicing could also potentially be generated.

Wastewater Handling

Storm water runoff collects in drainage swales (shown in Drawing 2) surrounding the former process area and is routed to a concrete sump south of building 231. Runoff is piped to holding tanks outside building 233 and is pH adjusted, filtered, polished with activated carbon and stored pending discharge once or twice a year in accord with LCP's NJPDES permit. The collected stormwater is occasionally used to wash down structures and equipment in the former process area. The wastewater treatment system at building 233 has been operational since the early 1980's.

Prior to LCP's ownership of the site, process wastewater was conveyed to a pond (the GAFRAC unit) along Avenue D east of the main switch yard, was pH neutralized, and was filtered through carbon in the northwest corner of the facility and discharged to South Branch Creek. In the mid 1970's the GAFRAC pond was reportedly excavated, filled with soil, and covered with asphalt. The pond will not be investigated as part of the RFI. It is not known when the GAFRAC pond and wastewater treatment system were constructed.

When the cells were operational, wastewater generated by cell washdown and cell maintenance drained to a floor trench which emptied to a concrete floor sump in buildings 230 and 240 where it was pumped through overhead piping to the GAFRAC pond. During LCP's operation of the plant, this wastewater was pumped form the cell room sumps to a holding tank, and to the wastewater treatment system.

Underground Tanks and Piping

There are no known underground tanks at the facility except for septic systems (Drawing 3).

Known underground piping includes fresh and river water (now inactive) mains and service lines, a 36 inch storm sewer that was plugged around 1974 (see discussion in Surface Water section), cooling tower water feed and return lines, septic leach fields, a section of pipe through which a flexible hose was run to pump brine sludge from building 233 to the brine sludge lagoon (about 30 lineal feet) and a nitrogen line. The approximate location of known piping is depicted on drawing 3.

Concrete trenches in building 230 and 240 cell rooms collected washdown water and any release of mercury which might have occurred during cell maintenance and rebuilding activities. The trenches drained to a concrete sump in the northwest corner of each cell room and the sump contents was pumped to the effluent treatment system. The concrete floors in the cell rooms were re-paved with epoxy and concrete at least once in the 1970's to cover spalled areas and improve drainage to the trenches and sump.

Location of Production, Injection, and Monitoring Wells

Six monitoring wells were installed in 1981 around the brine sludge lagoon and MW1, MW2, MW3, MW4, MW5 are monitored semi-annually to determine the impact of the lagoon on alluvium groundwater. Four additional monitoring wells, MW-6, MW-7, MW-8 and MW-9 were installed in 1990 to comply with an NJDEP request. Boring logs and well construction details are in Appendix A.

Shallow groundwater in the area is not used as a potable water source due to salt water intrusion. There are two public water supply well fields within a four mile radius of the facility

reportedly screened in the Brunswick Formation. The Elizabethtown Water Company field is about 3.5 miles northwest of LCP and the City of Rahway field is about 3.5 miles west of LCP. The facility's water supply source is Elizabethtown Water Company mains.

Hydrogeology

Site hydrogeology is described in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. The site is located on a thin layer of glacial and alluvial deposits which overlie the Brunswick Formation of Triassic age. The upper 5 to 15 feet of unconsolidated deposits consist of artificial fill comprised of silt, sand, gravel, cinders, crushed stone and brick, underlain by up to five feet of organic clay and silt. Beneath the organic clay and silt is 4 to 18 feet of poorly sorted gravelly sand and 14 to 29 feet of silty clay with a layer of pebbles and cobbles at the base. The depth to bedrock is 40 to 50 feet below grade based on data collected during drilling at monitoring well locations and building foundation borings. The water table is 5 to 10 feet below grade and the groundwater is brackish due to tidal influence from surrounding surface water bodies.

Groundwater beneath the site evidently discharges to South Branch Creek and/or Arthur Kill and there are no water supply wells between the facility and these surface waters. Downstream surface water in Arthur Kill is not used as a potable source.

Permit Issuance and Enforcement Action History

The following is a summary of permitting and enforcement actions based on information from LCP, NJDEP and USEPA Region II files:

The plant at this site was operated in accord with certain housekeeping and operational requirements established by USEPA NESHAP in the mid 1970's to ensure mercury releases to air during operation were below 1300 g/d.

LCP was fined by NJDEP for supernatant overflows from the brine sludge lagoon in 1972 and 1974. The overflow location(s), quantity released, and response measures employed are unknown.

A sodium chloride blockage in LCP's east saturator caused the release of 10,000 to 20,000 gallons of brine to South Branch Creek in August 1979 resulting in enforcement action. A brine sample was analyzed at the time of the spill and was found to contain 8.6 ppm mercury.

Kuehne Chemical was issued a NPDES permit in August 1980 for cooling water discharge to Arthur Kill. NJDEP cited and fined Kuehne Chemical in 1981 for an NPDES violation of pH and free chlorine, apparently relating to discharge of unknown quantities of acid and caustic.

In September 1981, NJDEP issued an Administrative Consent Order to LCP requiring the closure of its brine sludge lagoon and implementation of air, soil and groundwater monitoring. Initial data collected during the investigation was summarized in a February 1982 Geraghty & Miller, Inc. report Waste Lagoon Groundwater Monitoring. The brine sludge lagoon was closed in 1984 and 1985.

In 1980, LCP filed a RCRA Part A permit application for hazardous waste storage in tanks and a surface impoundment. Hazardous waste was never stored in tanks, however, and LCP's filing was reportedly incorrect.

In March 1980, NJDEP granted LCP a permit to construct and temporary certificate to operate a brine sludge roaster and dryer. In November 1981, NJDEP issued CLP a Motion of Violation for a ruptured muffler plate and operation of unpermitted propane burners for the sludge roaster system. In 1982 USEPA requested that the brine sludge lagoon be closed and the plant shut down as a safety precaution during lagoon closure.

A site inspection and hazardous ranking system determination was conducted by USEPA in 1984. LCP was cited in 1988 by NJDEP for groundwater exceedances at the brine sludge lagoon and failure to report groundwater monitoring data. The groundwater exceedances were reportedly associated with salt water intrusion at downgradient monitoring wells and were not indicative of a release. The failure to report was apparently the result of an oversight by LCP.

In 1990, NJDEP found gaps in LCP's groundwater monitoring data submittals during a compliance evaluation inspection and LCP addressed these in a response.

LCP currently holds a surface water discharge permit (NJ0003778) for discharge of treated wastewater and also a RCRA permit (HSWA portion only).

Copies of permits and enforcement related correspondence are in Appendix B.

III. NATURE AND EXTENT OF CONTAMINATION

History of Spills and Releases

The following releases and spills at the facility were documented by NJDEP:

Supernatant overflows from the brine sludge lagoon to South Branch Creek were observed by NJDEP on October 30, 1972 and February 7, 1974. The overflow locations, quantities, and nature of LCP's response are unknown. In June 1975, a brine recycle pump failed and a breach in the brine sludge lagoon occurred. An undetermined quantity of brine entered South Branch Creek for an estimated nine hour period. The location of the release was likely near the southeast corner of the lagoon but the exact location is unknown. It is not known what, if any, remedial measures were performed other than mechanical repair of the pump.

A release of 10,000 to 20,000 gallons of brine to South Branch Creek occurred August 20, 1979 due to sodium chloride blockage in the saturator. A brine sample was collected and analyzed at the time of the release and was found to contain 8.3 ppm mercury. The breach was remediated. It is unknown what, if any, other remedial measures were implemented.

Releases from piping near the 500,000 (500 K) gallon tank were observed on September 17, 1980, June 21, 1981, October 22, 1981 and August 13, 1982. Releases occurred along the side of the tank and along and east of the railroad tracks. The volume and nature of released liquid is unknown. It is unknown what, if any, remedial measures were implemented.

A brine sludge slurry spill was observed on pavement below salt silo #4 on October 9, 1980, according to an NJDEP inspection report. This slurry flowed into the adjacent drainage swale according to LCP.

Kuehne Chemical was cited in 1981 for discharging acids and caustics to Arthur Kill. The quantity of material discharged is unknown. It is unknown what remedial measures, if any, were implemented.

Sludge or brine was observed in the bullet tank farm containment area on September 17,1980, October 9, 1980. May 19, 1981, June 22, 1981, September 29, 1981 and August 13,1982. The nature and source of this sludge are unknown. According to LCP, the sludge (or sediment) was flushed out with water to the adjacent drainage swale which led to a collection sump as described in the Surface Runoff section of this report.

Union Carbide reported a release of 60,000 cubic feet of hydrogen gas in September 1988 and a series of waste oil releases which were remediated by excavation of contaminated soil in May 1988. A small amount of mercury contaminated soil was found and removed from the vicinity of a hydrogen tank in 1988 on land leased by Union Carbide. The quantity of soil excavated and the spill location are unknown.

In the early 1980's, NJDEP found a hole in a muffler plate on the sludge roaster which allowed mercury vapor to discharge. The volume of mercury released is unknown and the roaster was shut down as requested by NJDEP.

Copies of inspection and spill reports are in Appendix D.

Past Investigations

On July 31, 1981, NJDEP issued an Administrative Consent Order to LCP requiring implementation of air, soil and groundwater monitoring for the brine sludge lagoon. Data collected during the investigation was summarized in a February 1982 Geraghty & Miller, Inc. report Waste Lagoon Ground-water Monitoring.

Groundwater monitoring data associated with the brine sludge lagoon has been generated and reported to NJDEP since the unit was closed in 1984. Monitoring well construction data is contained in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. There has been no indication of an on-going release to groundwater from this unit although barium was detected at concentrations exceeding the 1 ppm NJDEP Action Level. Manganese, iron, sulfate, and total dissolved solids were detected in upgradient and downgradient monitoring wells at concentrations exceeding the permit levels, but high ambient levels would not be unusual in local groundwater due to the geochemistry of the Brunswick Formation (sulfate mineralization) and the brackish nature of local groundwater due to tidal influence. Mercury was detected at concentrations exceeding the drinking water standard on one occasion in 1982 but the data quality is suspect.

According to the 1982 Waste Lagoon Ground-water Monitoring Report, mercury concentrations up to 1,580 parts per million (ppm) were found in surface soil samples collected near the sludge roaster and near Building 231. Soil samples collected during monitoring well drilling were analyzed for mercury and were found to contain concentrations at ground surface up to 772 ppm, dropping to less than 10 ppm below 10-17 feet below grade. One sample of bottom sediment, from South Bend Creek contained 46.62 ppm mercury.

A site inspection and hazard ranking system scoring was conducted in 1984 by NUS Corporation for USEPA. NUS reported the

potential for soil and groundwater contamination impact to Arthur Kill flora and fauna. No potential impacts to potable water supplies were identified.

Unidentified organic vapors were reportedly detected by NJDEP in the headspace of several of the monitoring wells during site inspections conducted in 1987 and 1989.

Analytical data from soil samples collected in 1988 around building 231 as part of a site evaluation for expansion of the building indicated the presence of mercury and volatile organic constituents in soil and all of this data was submitted to NJDEP. This area will be investigated further during the RFI, as described in Section V.

Areas of Potential Contamination

Mercury is the most likely potential soil contaminant at this site. Solvents used for general parts cleaning (such as carbon tetrachloride, acetone, and methyl ethyl ketone) and their decomposition products could also be present if solvent was ever spilled or released. Section V identifies and describes potential source areas.

Potential Migration Pathways

Site hydrogeology was described in the February 1982 Geraghty & Miller, Inc. report, Waste Lagoon Ground-water Monitoring. Groundwater beneath the site likely discharges to South Branch Creek and/or Arthur Kill and there are no water supply wells between the facility and these surface water features. The prevailing wind direction is from the west and northwest. Potential migration pathways include surface water runoff, groundwater migration, air releases from contaminated soil and

wind-blown soil. There is no data indicating contaminants are migrating from the site at this time.

IV. HAZARDOUS WASTE GENERATION, TREATMENT, STORAGE AND DISPOSAL AREAS

Areas known to have been used for treatment, storage, and disposal of hazardous waste, and areas where hazardous waste was reportedly generated, are described below.

Brine Sludge Lagoon

Up to 20 tons/day of brine sludge were generated and discharged along with wastewater treatment sludge to an earthen lagoon east of building 231 (Drawing 1). The lagoon was constructed around 1970 by GAF Corp. and the interior was reportedly sprayed with hot tar as a lining. Sludge was piped to the lagoon until chlorine production was discontinued in the mid 1980's. During the operating life of the lagoon supernatant was collected at a sump in the southeast corner of the lagoon and was piped to the wastewater treatment system. There is no information indicating that any wastes other than brine filtration sludge and wastewater treatment sludge were deposited in the lagoon.

Brine sludge in the lagoon is likely comprised of calcium carbonate, cellulose fiber, water, magnesium and ferric hydroxides, and mercuric sulfide.

At the time the lagoon was closed in 1983-84, it contained an estimated 30,900 cubic yards of sludge and occupied about 3,000 square feet. The lagoon was capped with two feet of compacted clay overlain by six inches of drainage media and six inches of soil capable of supporting vegetative cover in accord with the RCRA closure regulations (40 CFR 265.110) and the Closure and Post Closure Plan for Brine Sludge Lagoon approved by the NJDEP Division

of Waste Management in 1983. The fate of brine sludges generated by GAF Corp. prior to this lagoon is unknown however.

Groundwater monitoring around the closed lagoon continues and monitoring data are submitted to NJDEP after each sampling event. The database does not indicate that the brine sludge lagoon is releasing mercury to groundwater. The lagoon cover is inspected and maintained in accord with NJDEP post-closure requirements. The closed unit is not subject to the investigation and corrective action requirements of LCP's HSWA permit.

Building 233

Building 233 was used for brine filtration until the early 1980's when it was converted for wastewater treatment. Wastewater treatment sludge is currently generated here and is managed as hazardous waste. An October 1980 NJDEP inspection documented brine caked on the floor near the filters. The brine was washed to the runoff collection sump and treated. There is no evidence of releases from this building and it will not be investigated in the RFI.

Brine Sludge Roaster

Around 1980 a brine sludge roasting kiln and a packed scrubber were constructed on a concrete pad south of the brine sludge lagoon to recover mercury. Mercury-bearing Brine sludge waste from LCP's process was roasted to remove mercury and treated sludge was placed in the brine sludge lagoon. The unit was operated on a trial basis under a temporary NJDEP permit to construct and operate an air emission source. A permit for full scale operation was never obtained due to unresolved air emission issues and the unit was shut down. It was dismantled in 1985.

The roaster was built on a one foot thick, 16 by 40 foot concrete pad surround by a cinder block curb with drain channels connecting to the effluent treatment plant. This location will not be investigated in the RFI since it is unlikely that hazardous constituents were released to soil or groundwater in this area. The RFI-VSI conducted December 22, 1987 included an inspection of this unit and no release was evident. It will not be investigated in the RFI.

Chem-Fix Lagoon

A lined lagon was used to study the effectiveness of treating LCP's brine sludge waste. This unit will be included in the RFI and is described in the following section.

GAF Wastewater Treatment Area

During GAF's ownership of the site in the 1950's to 1970's, process wastewater and wastewater from the cell room trench sumps was reportedly routed to and stored in a pond east of the main switch yard prior to treatment. The pond was excavated and paved to support a transformer substation in the early 1970's. This area will not be investigated as part of the RFI.

V. SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN

The solid waste management units and areas of concern that will be investigated as part of the RFI are identified and described below.

Chem-Fix Lagoon

The Chem-fix lagoon was constructed as a pilot scale test in 1976 to determine if mercury in the brine sludge could be rendered immobile, thereby allowing the treated sludge to be managed as non-hazardous waste. The lagoon was triangular, approximately 70 feet per side, and was located north of the brine sludge lagoon (Drawing 2). The lagoon was lined with two impermeable geosynthetic liners and contained a granular media leachate collection base sloped to a sump to allow leachate to be collected and pumped to the adjacent brine sludge lagoon.

In 1976, approximately 120,000 gallons of brine sludge were pumped to the Chem-Fix Lagoon and treated. The lagoon sump was monitored and sampled until 1980, and samples were analyzed for mercury. The lagoon was closed in 1983 and 1984 in accord with the Closure and Post-Closure Plan for Brine-Sludge Lagoon approved by NJDEP. In 1983 an estimated 460 cubic yards of brine sludge were removed from the Chem-fix Lagoon and placed in the brine sludge lagoon along with the synthetic liner and leachate collection material.

Based on company records and information from employees there is no indication that the lagoon leaked or that brine sludge or leachate were released to soil or groundwater. Groundwater monitoring data from monitoring wells downgradient of the unit do not indicate that a release not indicate that a release to

groundwater has occurred. Nonetheless, the USEPA RFI protocol requires that soil samples be collected in the area of the former lagoon to determine if a release occurred.

Salt Silo #4

Salt silo #4 was one of four salt storage silos adjacent to Building 233 and is believed to have been constructed in the 1950's or 1960's. In 1980 and 1981, silo #4 was used to mix water with brine sludge and the resultant slurry was pumped to the sludge roaster. NJDEP reportedly observed brine sludge on the ground around the silo during an October 1980 inspection. The area beneath and around the silo was reportedly paved in the early 1970's and sludge released from this unit would have likely entered the adjacent drainage swale. The drainage swale empties to a concrete sump where wastewater is collected and pumped to the treatment system. The silos were dismantled in the mid 1980's.

Soil samples will be collected to determine if mercury is present in soil around the pad and, if the pad is cracked, soil beneath the pad will also be sampled.

Process Areas in Buildings 230 and 240

The floors in the cell rooms were paved and contained concrete trenches leading to a sump for conveyance and collection of washwater and potential spills. Aboveground piping conveyed wastewater from the sumps to the treatment system. The concrete floor spalled over time and was paved over on several occasions to improve flow to the trenches and reduce pooling of water. A former LCP employee told NJDEP in 1981 that LCP resurfaced significantly cracked floors in the cell rooms but LCP employees and plant records do not indicate that significant cracks in the cell room were ever covered over. In 1976 OSHA inspected the buildings and reported cracks in the floor and walls but there was no indication

of mercury contamination of soil. Soil beneath and around the two buildings will be investigated to determine if a release of mercury or mercury contaminated brine has occurred through joints or cracks in the floors of Buildings 230 and 240.

500 K Tank

A 500,000 gallon tank was constructed in the 1950's or 1960's south of Building 231 for brine storage prior to pumpage to the cells. Sodium hydroxide produced in Buildings 230 and 240 was on occasion also stored in this tank. The tank (referred to as the 500 K tank) was, in the 1970's and early 1980's, used to store wastewater prior to treatment. The tank was dismantled in the late 1980's and the concrete pad remains.

Releases near this tank occurred in the 1970's and 1980's. NJDEP observed brine sludge near the tank in September 1980 and liquid was observed leaking from a pipe near the tank in January 1981. Brine sludge slurry was present on the ground on one occasion in 1980 along the sludge and return pipes leading to the brine sludge lagoon and leakage from one of these pipes was observed by NJDEP between the lagoon and the railroad tracks in 1981. Sodium sulfide crystals were observed on the gravel surface in the pump pit area in 1980. The exact locations of these releases are unknown. A hydrochloric acid spill was observed 15 ft. northwest of the tank by NJDEP during an October 22, 1981 inspection. Releases will be investigated in these areas by soil sampling and, if warranted, groundwater sampling.

Bullet Tanks

The tanks referred to as bullet tanks were constructed as pressurized storage vessels for chlorine in the 1950's or 1960's. They were later used for storing treated and untreated wastewater and for product storage. The aboveground tanks were equipped with

secondary containment prior to conversion to wastewater storage and there is no information to suggest that a release ever occurred. In the 1980's, standing water occasionally approached the capacity of the containment area. The "continual problems with brine containment" in 1980 and 1981 mentioned in LCP's HSWA permit evidently refers to the standing water problem, however, precipitation - not brine or wastewater - was likely in the containment area according to LCP personnel.

"Brine residues" were reportedly observed in the containment area during NJDEP inspections between September 1980 and April 1982 according to the LCP RFA. Sludge or sediment in the containment area was occasionally flushed out to the adjacent drainage swale. It is not likely that this material was brine sludge according to LCP personnel.

Soil and, if warranted, groundwater will be investigated, however, to determine if a release occurred from these tanks.

Area South of Building 231

A Purasiv® hydrogen purification unit was located immediately south of building 231 during production at the facility, and releases of mercury could have occurred in this area. Soil sampling and analysis was conducted in 1988 (see Appendix C). Mercury and volatile organic contamination of soil was found in samples collected on the north, south, and west side of the building, and all analytical data were provided to the NJDEP in a November 8, 1988 letter report. A former LCP employee told NJDEP in 1981 that brine sludge was placed on the ground between Building 231 and the railroad tracks.

Soil and, if necessary, groundwater in the vicinity of building 231 will be investigated as part of the RFI.

Drum Storage Area

A drum storage area was located in the southwest perimeter of the facility (Drawing 2). Motor oil, gear oil, waste oil and possibly Freon (used in chlorine liquifiers) were stored in drum quantities (55 gallons or less) on a 300 square foot concrete pad with secondary containment. The concrete base is one foot thick with a six inch secondary containment curb. Waste solvents could have been stored here but LCP employees do not recall this.

In December 1987 NJDEP reportedly found oily residue on the gravel outside the pad and in April 1989 NJDEP found stained soils and organic vapors near the pad. There are visible cracks in the containment wall and petroleum residue is evident on the ground in one small area outside the pad. The nature and extent of contamination around and beneath the pad will be investigated by soil sampling and, if necessary, soil vapor and groundwater sampling.

Lined Trenches

Swales consisting of open concrete trenches surround most of the production area and collect surface water runoff and conveys it to a sump where water is pumped to the wastewater treatment system holding tank. These surface water collection swales, shown in Drawing 2, were constructed in the 1970's (exact date unknown) and will be investigated to determine if they contain mercury-contaminated sediment. Soil beneath and around the swales may also be investigated if there is evidence of past overflow or seepage through expansion joints, in which case mercury could be present in the subsurface.

Transformers

Stained soil has been reported at the former location of transformers and rectifiers west of buildings 230 and 240 and at the northeast corner of Building 231. Soil will be investigated for releases of petroleum hydrocarbons and polychlorinated biphenyls.

Process Sewers

Concrete trenches and a sump in buildings 230 and 240 were used to collect brine and residual mercury when the cell room was washed down. Wastewater from the sumps was pumped to the wastewater treatment system. Mercury was collected in a second closed sump and was recovered for reuse. Soil in the vicinity of the wastewater piping will be investigated to determine if a release of mercury occurred during production.

South Branch Creek

Supernatant overflows from the brine sludge lagoon to South Branch Creek were observed by NJDEP on October 30, 1972 and February 7, 1974, and reported to USEPA in June 1975. The exact locations and quantities of these releases is not known.

The proximity of the site and, in particular, the brine sludge disposal area, to South Branch Creek suggests that the Creek could have also received contaminated surface water runoff or groundwater discharge from a spill or release during the operating history of the production activities at this site. Mercury is the only waste constituent which would be expected to be present since the use of solvents was reportedly restricted to small quantities during LCP's ownership. Volatilization and hydrolysis would be expected to significantly reduce any concentrations in soil if there was a small quantity release during production activities.

VI. IMPLEMENTATION OF INTERIM MEASURES

Post-closure monitoring of the brine sludge lagoon continues in accord with the approved post-closure plan (see Section IV, Brine Sludge Lagoon). LCP also continues to recover and treat production area surface runoff (see Section V, Lined Trenches).

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New Jersey Department of Environmental Protection. Administrative Consent Order (Chem-Fix and Brine Sludge Lagoon Closure). March 20, 1981.

New Jersey Department of Environmental Protection. RCRA Facility Assessment. August 1989.

APPENDIX A

100630

LCP CHEMICALS - NEW JERSEY
FOOT OF SOUTH WOOD AVENUE
LINDEN CITY, UNION COUNTY, NEW JERSEY
EPA ID# NJD079303020

LCP owns a twenty-six (26) acre chemical manufacturing facility in Linden which is currently used exclusively for the storage and transfer of methylene chloride and caustic soda. GAF Corporation aquired the property in 1950 from the U.S. Government, filled an area of coastal wetlands on site, and developed it for production of liquid chlorine by the mercury cell process. LCP purchased the facility in 1972 from GAF and with a few minor modifications of the process continued chlorine manufacturing, until September 1985. Other property within 1.5 miles is zoned for heavy industry (B.P. Oil, E.I. DuPont, GAF, Northville Industries) and transportation (New Jersey Turnpike). Also, Union Carbide operates the Linde Hydrogen Plant (LHP) as a tenant organization at the LCP Linden facility. Site security is adequately maintained by a perimeter chain link fence, a twenty-four (24) hour/day guard staff, and closed circuit TV cameras. Finished products are transported in bulk quantities via tank truck or rail car, and stored on site in three (3) aboveground tanks with a total combined volume of 1.02 million gallons.

The City of Linden is a densely populated urban area, such that, within three miles of the LCP facility an estimated 62,500 people were in residence as of December 1984. Linden is supplied with potable water by surface resevoirs located in Clinton, NJ approximately thirty miles to the west. The Arthur Kill, located almost 1100' off-site to the east is used for recreational boating and an endangered species, the Peregrine Falcon, is known to hunt in the salt marshes nearby.

LCP's Tremley Point Plant is situated directly upon a hetrogeneous fill material composed of sand, gravel, brick, and slag up to 10 or 15 feet thick. Bedrock occurs at 30 to 40 feet below grade and consists of a red sandy shale overlain by 10 to 15 feet of glacial deposits and 20 feet of organic silt, clay and peat. This portion of the New Brunswick Formation is not used as a potable aquifer within several miles of the facility due to the salt intrusion from the nearby coastal waters. LCP was provided all of its' potable and industrial water requirements (430,000 gallons/day when at full production in 1979) from the Elizabethtown Water Company. LCP does maintain five (5), NJPDES Discharge to Ground Water (DGW) permitted, monitoring wells which are screened in sand lenses of the glacial till and organic sediments. Within these wells the depth to water and salt concentrations vary according to the ebb and flow of the tides.

The "mercury cell process" yields chlorine gas through the electrolysis of a sodium chloride (brine) solution in the presence of metalic mercury. An amalgum of mercury and sodium is removed from the cell and used to hydrolize water forming sodium hydroxide and hygrogen gas (which are also comerically valuable). Metalic mercury was recovered and recycled in a brine purification process, but incompletely yielding a sludge residue.

LCP wastes included: mercury contaminated sludges, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, process wastewater, spill wash down, and stormwater runoff. LCP's tenant LHP purportedly does not generate any hazardous wastes. Mercury sludges were landfilled on-site in the Brine Sludge Lagoon for at least twenty (20) years, until 1982 when LCP began storing this waste in 55 gallon drums prior to shippment off-site. Mercury vapor emissions were discharged to the atmosphere from process equipment and an on-site sludge roaster under permits from the NJDEP DEQ Air Pollution Control Program. Spent lubracating oils, transformer oils, and degreasing solvents were stored in 55 gallon drums before shippment off-site for recovery. Process wastewater, stormwater runoff and spill wash-down from process equipment, the parking lot, and transfer areas was treated then discharged to the South Branch Creek, a tributary of the Arthur Kill (classified "Saline Estuarine waters, SE-2" by the Division of Water Resources).

Plant wastewater and sludges were collected in a 500,000 gallon agitated tank. The dilute slurry was pumped to a 140,000 gallon settling silo No. 4. The supernatant was directed to the effluent treatment system and the settled solids to the 4,500 gallon surge tank at the sludge roaster site. The brine sludge composition was reported by LCP on June 9, 1975 to be: 15 to 20 percent sodium chloride, 40 to 50 percent barium sulfate, 20 to 30 percent calcium carbonate and/or sulfate, 2 percent metal hydroxides, 2 percent dirt, and 100 to 500 ppm mercury. Settling silo No. 4, and the surge tank are no longer maintained at the Linden facility. The collection tank is in service only for emergency purposes as a holding tank for excessive volumes of stormwater.

Effluent treatment consists of pH neutralization, contact with activated carbon, and filtration. Prior to construction of the cooling towers (in 1980) NJPDES Discharge to Surface Water (DSW) permits limitations for temperature were exceeded regularly. Other infractions included occasionally alkaline pH and one major incident on August 20, 1979 when ten to twenty thousand gallons of mercury tainted brine was discharged to the South Branch Creek. An analysis of sediment samples from the creek (below LCP's discharge outfall), as reported by Geragthy and Miller Inc. February 1982, indicates that mercury is present at 46 ppm. LCP began recycling its process wastewater in 1982 and amended the DSW permit to reflect this change. Currently only stormwater runoff and spill wash down after treatment, are discharged.

AREAS OF CONCERN:

Enforcement personnel with the Division of Hazardous Waste Management reported evidence of numerous small releases observed during inspections in 1980, 81, 82, and 83.

9/17/80 Brine sludge was observed on the gravel near the 500,000 gallon "collection tank."

10/9/80 Brine sludge was observed on the gravel in the vicinity of "Settling Silo #4."

1/21/81 During the inspection a liquid was observed spewing from a cracked PVC pipe near the 500,000 gallon collection tank and the pump pit.

3/19/81 An acid spill (9' x 4') was noted on the soil near Building #220 and Avenue C.

10/22/81 A brine sludge slurry release from a transfer line was evidenced by a 1' x 15' spill area located on Avenue B between the pump pit and the Brine sludge Lagoon. Also, a 10' x 4' hydrochloric acid spill area was noted approximately 15' northwest of the 500,000 gallon collection tank.

11/19/81 The brine sludge slurry spill area noted on the previous inspection has expanded to cover a 125' x 30' area along the railraod tracks.

4/13/82 Sodium sulfide crystals were evident on the gravel surface in the pump pit area. Also noted was a salt spill at the railroad siding area.

8/5/82 Yellow crystals (probably sodium sulfide) was observed to cover a 10' x 15' area of broken asphalt near building #240.

2/28/83 Approximately two cubic yards of rubber liner from the caustic tank were deposited within the brine sludge lagoon in violation of the DEQ ACO.

Late in 1982, LCP paved the railroad siding and adjacent areas, the area under the salt silos, and sections of Avenue C.

In addition to the areas noted by DEP personnel a former employee of LCP has alleged several other sites of possible contamination.

1. The soil surface between the compressor building #231 and the railroad tracks received mercury contaminated sludge which was excavated from the Brine Sludge Lagoon.

2. Prior to OSHA requiring the repair of the cracked and broken concrete floor within the mercury cell Buildings #230 and #240, numerous spills were transmitted to the underlying soils.

3. The willful destruction of unfavorable laboratory analytical results from effluent sampling of the outfall to South Branch Creek may have obscured LCP's impact to the sediments and surface waters downstream of the facility.

The former owner (GAF Corporation) operated a Waste Water Treatment Plant (WWTP) at this facility, principally for pH neutralization, through the 1950's, 60's, and early 70's. Purportedly the site of this treatment system was paved over and is currently used to maintain an extensive electrical power transformer substation.

UNIT ANALYSIS:
There are four (4) Solid Waste Management Units (SWMU's) at the LCP facility in Linden. The "Brine" Sludge Lagoon" is the only RCRA regulated unit. The "Chem-Fix" Lagoon, the "Sludge Roaster", and the "Container Storage Area" (CSA) comprize the remaining three units. A RCRA part A permit application was submitted by LCP on August 13, 1980. Since the only TSD activity on-site (the Brine Sludge Lagoon) was certified closed in September 1985 the part B application was considered unnecessary in lieu of a post closure permit.

1. The Brine Sludge Lagoon was an unlined surface impoundment in which mercury contaminated sludges were disposed of for twenty (20) years or more. The lagoon was roughly a trapezium, approximately 275' x 200' x 220' x 80', and the accumulated waste volume estimated at 30,900 cubic yards. Analysis of the sludge in the lagoon was performed by the Princeton Testing Laboratories June 15, 1981 which indicated that mercury was present at 340 ppm.

   In order to preclude worker exposure to mercury vapors eminating from the disturbed surface of the Brine sludge and Chem-Fix lagoons during closure operations, the USEPA and NJDEP required LCP to suspend manufacturing and restrict access to the site from 1982 until 1984. Closure operations (concluded September 1985) included a clay cap, soil cover, grading, and seeding.

   Five (5) shallow NJPDES permitted wells monitor leachate releases to the phreatic surface. Quaterly reports of analysis from these wells indicate that concentrations of the metals: lead, chromium, cadmium, mercury, selenium, silver, and radium have exceeded permitted parameters on several occasions between 1982 and 1987. Elevated mercury levels detected in the soils from the monitor well borings (up to 500 ppm) and from the land surface (up to 1,500 ppm) are, according to a Geraghty and Miller Inc. report dated February 1982, "the result of present or prior land use" and "represent low solubility compounds of sulfides, phosphates, or carbonates."

   In a recently issued NJPDES DGW permit, four (4) additional wells are mandated in order to fully characterize the local water table and adequately monitor leachate from this unit. During the December 22, 1987 RCRA walk through site inspection conducted by personnel of the Bureau of Planning and Assessment, the HNu meter detected organic vapors eminating from the headspace of existing monitor wells P-1 and P-2. The NJPDES 30 year post closure monitoring program should be expanded to include an initial scan for priority pollutants and volatile organic compounds. Further investigation of this unit is unwarranted at this time.

2. The Chem-Fix Lagoon was a surface impoundment, used briefly in 1976 for experiments in stabilizing the mercury constituents of the brine sludge. This lagoon was roughly triangular, 60 to 80 feet on each side, with a total surface area of approximately 3,000 square feet. The lagoon dikes were constructed to a height of 8 feet with an earthern core and crushed stone cover. Two (2) 0.20 mil thick visquene plastic liners were installed in the lagoon which was also

equipped with perforated under drain system for leachate collection. The lagoon contents, 460 cubic yards of treated brine sludge, was transfered to the Brine Sludge Lagoon in 1983. The Chem-Fix lagoon was subsequently excavated, filled, graded, and seeded. The proximity of the Chem-Fix Lagoon site to the Brine Sludge Lagoon site enables the NJPDES DGW permitted wells to monitor any leachate releases to the ground water from either unit. A further investigation of the Chem-Fix Lagoon is not warranted at this time.

3. The Sludge Roaster was designed and built in 1978 to vaporize mercury from steam dryed brine sludge, and thereby decontaminate the waste sufficiently to allow for final disposal at an off-site sanitary landfill. The roaster system was situated on a 16' x 40' concrete pad, one (1) foot thick, equipped with surface drainage channels (connected to the Waste Water Treatment Plant) and a cinder block curb. An Administrative Consent Order (ACO) issued September 1, 1981 required LCP to submit an application for a Hazardous Waste Facility (HWF) permit to operate the roaster unit. On June 30, 1982 the Bureau of Hazardous Waste Engineering (BHWE) denied the permit and LCP subsequently abandoned the process.

   A November 5, 1981 inspection by enforcement personnel of the Division of Environmental Quality, Air Pollution Control Program discovered a ruptured muffler plate on the sludge roaster that allowed excessive quantities of mercury vapors to be released to the atmosphere. Starting in 1985, this unit was dismantled and most of the components shipped to other LCP facilities around the country. No further investigation of the sludge roaster is warranted at this time.

4. The Container Storage Area (CSA) is a 300 square foot concrete pad, 1 foot thick with a 4 to 8 inch curb. Approximately 40 (55 gallon) drums or 2,000 gallons of waste: lubracating oils, transformer oils, disgreasing solvents, and dewatered brine sludges could have been stored on this unit at any one time. These wastes were shipped off-site for proper disposal within 90 days. During the recent RCRA walk through inspection (December 22, 1987) no containerized wastes were present at this unit, however the surface of the pad was covered with an absorbant material (speedy-dry) and some oily residues were noted on the gravel in the surrounding area. A limited investigation in the vicinity of the container storage area should be performed to determine the extent of contamination which may have occurred.

PERMITS:

NJPDES Discharge to Surface Water (DSW) permit #NJ0003778 grants LCP permission to discharge stormwater runoff and spill wash-down, after treatment, through one outfall to South Branch Creek (classified SE-3). This DSW permit was issued August 10, 1987 and is effective until April 30, 1991.

NJPDES Discharge to Ground Water (DGW) permit #NJ0003778 grants LCP permission to continue post-closure ground water monitoring of the wells surrounding the closed lagoons and to implement the modified Post-Closure Plan. "The potential discharge is leachate from the lagoon to the ground

waters of the State, to the organic (marsh) deposits of recent geologic age, the Raritan-Magothy formation of the Cretaceous age, and the New Brunswick formation of the Jurassic age." The DGW permit was issued October 30, 1987 and is effective until November 29, 1992.

Air Pollution Control permit #044133 was issued on March 3, 1980 granting LCP permission to operate the Sludge Roaster System. This permit expired on October 5, 1982 well after LCP suspended operation of the roaster November 7, 1981.

Other Air Permits included:

PERMIT #	UNIT	EXPIRATION DATE
067418	Boiler Stack	2/17/89
020928	Pura-SIV stack	11/9/85
037033	Mercury Cell Destruct Tower	3/26/89
040435	Mercury Cell Destruct Tower	3/26/88
076056	Mercury Cell Destruct Tower	5/15/87
036994	HCL Scrubber	6/11/88
036993	HCL Scrubber	11/20/88
035067	HCL Scrubber	3/28/88

REGULATORY ACTIONS:
An Administrative Consent Order (ACO), was issued September 1, 1981 by the NJDEP Division of Environment Quality. The ACO required LCP to apply for a permit to operate the Sludge Roaster as a hazardous waste treatment facility, to submit bi-weekly progress reports of activities at the brine sludge lagoon, to submit applications for closure of the Chem-Fix Lagoon and the Brine Sludge Lagoon, and to fully evaluate all potential avenues of release to the ambient environment (ie. air monitoring, groundwater monitoring, soil boring, and surface water monitoring).

A Civil Administrative Penality of $17,500.00 was assessed against a former tenant at LCP, the Kuhne Chemical Company (KCC) in November 1981. KCC was issued a NJPDES permit #0027707 on September 9, 1974 to discharge uncontaminated, non-contact cooling water to the South Branch Creek. Analysis of effluent sampling from KCC's outfall, conducted January 1981, revealed extremely elevated concentrations of caustics and free chlorine (up to 124,430 ppm) and a correspondingly excessive alkaline pH. Aside from the obvious violation of permit parameters the DWR alleged KCC's discharge of waste materials was deliberate.

RECOMMENDATIONS:
Of the four SWMU's at LCP Chemicals in Linden only one unit, the CSA requires corrective action under the RCRA post closure permit program. A limited investigation to include soil sampling in the vicinity of the CSA is necessary to determine the nature and extent of contamination which may have resulted from past spill events.

The previously cited "Areas of Concern" which remain accessible, also require soil sampling to verify that adequate remediation was accomplished at the numerous, documented sites of small spills and past releases.

Steve Cornwell

Mr. Burkett + Champion will be at L + I Bldg on THE. June 17th to answer any questions we may have concerning this proposal for disposal. Harvey has set aside the date for you if you are interested.

LINDEN CHLORINE PRODUCTS, INC.

PRELIMINARY REPORT ON BRINE SLUDGE

Presented To:

New Jersey Department Of
Environmental Protection
Bureau of Solid-Waste Management

June 9, 1975

Prepared By:

R. J. Burkett, Technical Superintendent

100704

Attachment - Hazardous 1070-390

I. INTRODUCTION

Linden Chlorine Products, Inc. is developing a program for brine sludge disposal. The contamination of the sludge with mercury dictates that such disposal be accomplished. Although it is standard practice in the chloroalkali industry to impound brine sludges in earthen basins[1], we recognize that this is environmentally unsound and unacceptable. It is the policy of LCP to accomplish this disposal as quickly as possible with the advise and consent of the Bureau of Solid-Waste Management.

This report was prepared to provide the Bureau with details concerning LCP and our brine sludge problem. It includes the results of the investigation conducted since our first meeting on March 18, 1975.

II. COMPANY HISTORY

LCP was formed in 1972 for the sole purpose of starting up and operating the divested GAF Corporation Chlorine/Caustic manufacturing plant in Linden, New Jersey. The plant is located next to the GAF complex and was operated by GAF for a total of ten years before shutdown in 1971. LCP has no other facilities and produces only three products: chlorine, sodium hydroxide, and hydrogen.

The plant employs 175 people.

III. PROCESS

The plant utilizes mercury cell technology. Many technological innovations were introduced when LCP took over operation. A major change was the conversion from graphite to DSA anodes.

A process flowsheet of the brine saturation area is included. It is a closed loop process with the addition of rock salt and the removal of impurities, i.e. sludge. The mercury contamination occurs in the cells. The circulating brine dissolves and entrains a small amount of mercury of which a portion (100-500 ppm) is purged with the sludge.

The sludge is pumped to the brine sludge pond where the solids settle out. The water is recycled to the sludge receiver and brine filters

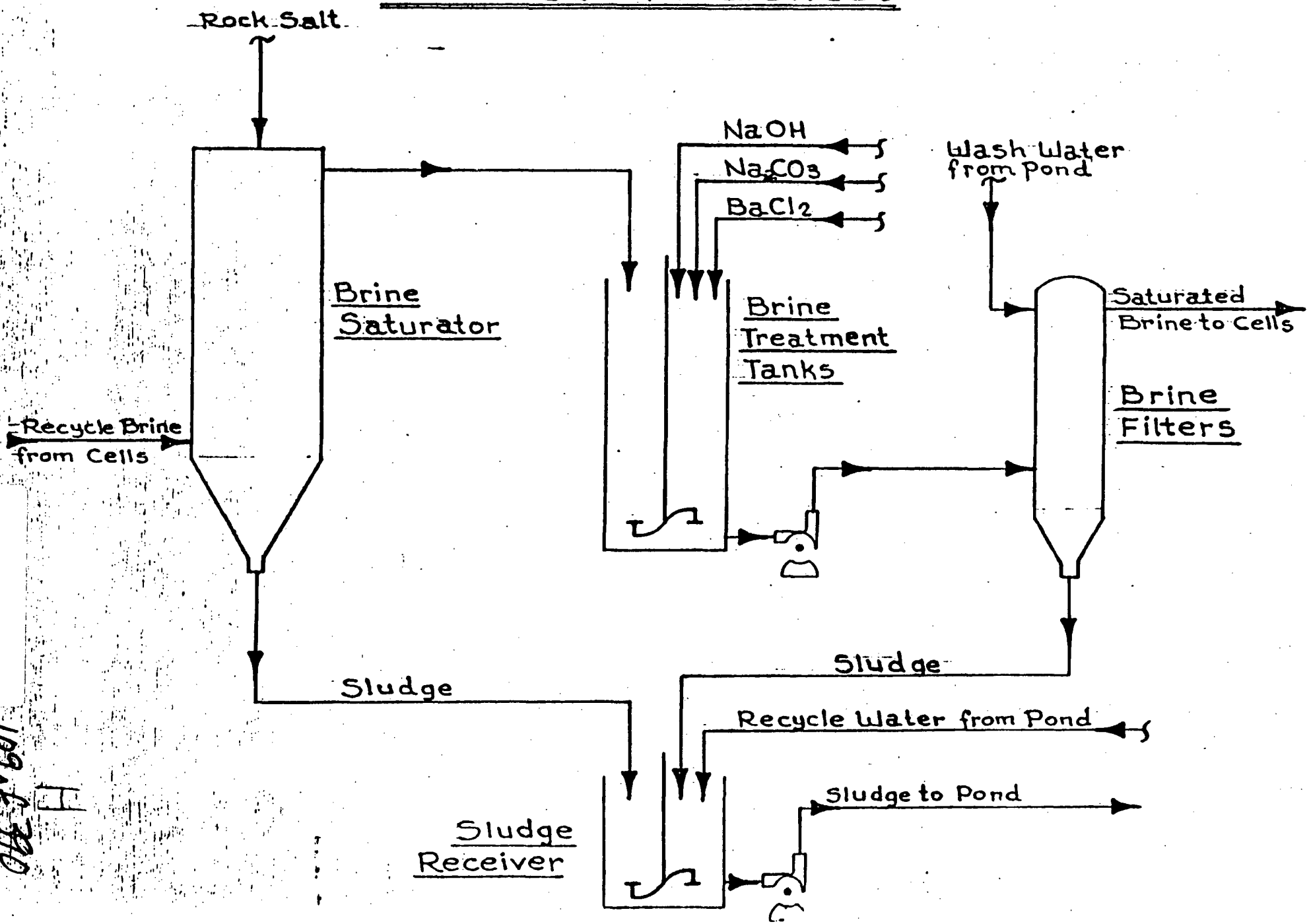
IV. CHEMISTRY

Rock Salt: Contains 1 to 1½% inerts $CaSO_4$, $MgCl_2$, Metals, Dirt

$$CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3 \downarrow + Na_2SO_4$$
$$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 \downarrow + 2NaCl$$

100705

Process Flowsheet



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IV. CHEMISTRY (continued)

$MgCl_2 + 2NaOH \longrightarrow Mg(OH)_2 \downarrow + 2NaCl$

Metals + NaOH $\longrightarrow$ Fe, Cr, V, Hydroxides

Sludge Composition:

NaCl	15 - 20%
$BaSO_4$	40 - 50%
$CaCO_3$	10 - 15%
$CaSO_4$	10 - 15%
Metal Hydroxides	2%
Dirt	2%
Hg	100 - 500 ppm

Material Balance

Theoretical: $1.65 \frac{T\ NaCl}{T\ Cl_2}$

Actual: $2.0 \frac{T\ NaCl}{T\ Cl_2}$

Sludge Production:

$$2.0 \frac{T\ NaCl}{T\ Cl_2} \left| \frac{.015\ LB\ Inerts}{LB\ NaCl} \right| \frac{250\ T\ Cl_2}{Day} = 7.5 \frac{T\ Sludge}{Day}$$ (750 gall

Estimated Sludge Inventory: 300,000 ft^3

V. SLUDGE DISPOSAL

During the operation of a chlorine cell using graphite anodes, the graphite is consumed. The graphite dissappears as CO_2 gas and is eroded in fine particles. The small particles are picked up by the brine and eventually find their way into the brine sludge.

LCP has two sludges. The first is the contents of the existing pond which represents ten years of operation and contains significant amounts of graphite. The second is current and future sludges which contain no graphite. Due to the different mercury extraction characteristics of the sludge from the DSA process[2], LCP is proposing two sludge disposal processes. Each is discussed below.

Existing Sludge Pond

On March 18, 1975 I met with Mr. Saltzman and Mr. Hui, NJDEP, concerning LCP's brine sludge pond. The purpose of the meeting was to discuss the compliance status of LCP and the various disposal processes acceptable to the NJDEP.

V. SLUDGE DISPOSAL (continued)

Existing Sludge Pond

We discussed the history of the plant, the process and the factors causing the sludge generation. We explored various disposal techniques currently available. At the conclusion of the meeting I was given a list of "waste processing facilities" and asked to contact the appropriate vendors. I was to report back on my findings. These are the results of my investigations:

March 19: I contacted by telephone the following companies:

1. Chem-Trol - Model City, New York
2. Chemfix - Pittsburgh, Pennsylvania
3. Frontier Chemical - Niagara Falls, New York
4. Rollins Environmental - Bridgeport, New Jersey
5. Browning Ferris Ind. - Pedricktown, New Jersey

March 24 to April 2: All five companies visited the plant and took samples.

April 17 to May 19: Received bids from Chem-Trol and Chemfix.

May 19 to Present: Contacted other companies but as yet no response.

Both Chem-Trol and Chemfix bid on the same basis which was disposal of the entire contents of the sludge pond.

Company	Method	Cost
Chem-Trol	Hauling to secured landfill	$1,038,400
Chemfix	Fixation of heavy metals and landfill	$ 110,000

The Chem-Trol proposal requires no further statement as to environmental impact. It is a recognized waste treatment company of the highest quality. It's secured landfill operation stands on it's record. However, fully one-half of the costs in their proposal is accounted for by freight charges. This is a financial burden which LCP cannot bear. Their proposal is unacceptable.

The Chemfix process offers a solution which could be economically absorbed by LCP. However, the question of leachate remains. Chemfix has run a sample of our sludge through their laboratories. The sample is now and will continue to be tested for mercury containmination of the leachate.

V. SLUDGE DISPOSAL (continued)

Existing Sludge Pond

LCP is prepared to accept the Chemfix proposal. However, both we and Chemfix feel it prudent to run a preliminary test to verify the laboratory findings.

The test could be conducted this summer with a follow-up report on the leachate results. Total pond treatment could then be accomplished with the consent and approval of NJDEP.

Current Sludge Production

As of April, 1975 LCP had converted completely to Dimensionally Stable Anodes (DSA) from graphite anodes. (A DSA is a titanium metal anode which is thinly coated with platinum metal.) A recently published EPA report[2] and our own laboratory investigations show that in the absence of graphite, mercury can be successfully leached from brine sludges using sodium hypochlorite.

LCP feels that such a treatment process offers the opportunity to economically recover the brine sludge which we consider a valuable resource. Although all of the details have not been worked out, we are currently researching the process.

We propose to develop and install such an extraction process to treat current and future sludges. This would be a continuous process which would eliminate the accumulation of sludge.

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1. "Assessment of Industrial Hazardous Waste Pract
Chemical Industry", EPA Contract No. 68-01-2246
Versar, Inc., October 21, 1974

2. "Mercury Recovery from Contaminated Waste Water
EPA Project 12040 HDU, Program 1BB037,
Richard Perry, Georgia-Pacific Corporation, Aug

Exhibit L

CLOSURE AND POST-CLOSURE PLAN

FOR BRINE-SLUDGE LAGOON

LCP CHEMICALS - N.J., INC., LINDEN, N.J.

ENGINEERING

JULY 16, 198:

100435

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CLOSURE AND POST-CLOSURE PLAN
FOR BRINE-SLUDGE LAGOON
LCP CHEMICALS - N.J., INC., LINDEN, N.J.

INTRODUCTION

LCP Chemicals - N.J., Inc. intends to close a Brine Sludge Lagoon RCRA Facility No. NJD 079303020) on its property at Linden, N.J., in cc'.d with this plan which complies with 40 CFR 265.110 and minimizes he post closure escape of hazardous constituents to the environment.

FACILITY DESCRIPTION

he LCP Brine Sludge Lagoon "the facility" received mercury contaminated aste generated in the electrolysis of sodium chloride to make chlorine.

he facility is located near the northeast corner of the LCP plant site Lot 3; Block 587) adjacent to the tidal South Branch Creek. The lagoon as constructed prior to LCP Chemical's purchase of the site in 1972. he facility is triangular in shape with a total surface area of approxmately 33,500 square feet. LCP has modified its process stream to elimnate this hazardous component and to reduce the volume of process waste to ermit the offsite removal of drummed waste. The generation of brine muds K-071) was terminated in March 1982. LCP has completed the process of shing the plant's waste lines to the facility. The waste inventory as f March 1982 is 22,000 cubic yards. The contents of an experimental chemix lagoon will be excavated and placed into the Brine-Sludge lagoon prior o closure (Chem fix Lagoon closure plan submitted October 30, 1981.)

he facility is surrounded by earth dikes that are approximately 10 feet igher than the average plant ground elevation and approximately 15 feet igher than the creek high tide level. The dikes show no evidence of leakge, erosion, or slumping. The dike tops are graded so that rainwater runs nto a trench on the inner dike margin and flows into the facility. A pumpng station located at the eastern corner of the facility was used to return ater to the plant after the solids settled out.

JUSTIFICATION FOR IN-PLACE CLOSURE

his facility has been operated for approximately 15 years. Down-gradient onitoring wells located in the immediate vicinity of the facility have ot intercepted contamination migrating from the facility (see Appendix A - onitoring Well Water Analyses.) The waste material is of a dense and low ermeable nature. The absence of ground-water contamination in the saturatec one surrounding the facility provides sufficient evidence to indicate hat the 40 CFR 265.111 closure standard can be satisfied with the waste aterial remaining in place after closure.

Summary of Results

Independent Well Results

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indicated in Appendix A, contamination of ground water is not evi-
nt. To ensure the indefinite integrity of this waste site, review
s made of potential disturbance that could effect the site and more
ecifically, disturbance resulting from:

. Erosion resultant from waste settling due to inadequate dewatering
d compaction. The specific details outlined under Physical Closure:
tivities and Specifications have been designed to: 1) eliminate the
tential of erosion from settling, and 2) minimize the cost of main-
nance.

. Purposefull modification. From a view point of realistic economics
nsidering the area occupied by the site, the inaccessibility of the site
three sides due to permanent structures and natural barriers, it is
likely that economic justification would ever be proposed to modify
e site for other purposes.

. Vandalism/Sabotage. The existing site location is inaccessible ex-
pt through facilities of LCP Chemicals and Northville Terminal Industries.
th facilities are protected by a chain link fence to impede any potential
truder. Both facilities are manned on an round-the-clock basis with per-
nnel cognizant of and responsible for elimination of a potential in-
ruder.

RCRA SUBPART G CLOSURE PLAN (40 CFR 265.110)

eneral Nature of Facility Closure

CP will close the facility with the waste material in place. The facility
s inactive and will be closed as a unit (no partial closure.)

RCRA ground-water monitoring system is in place at the facility with wells
ocated at three downgradient locations close to the hazardous waste
acility boundary. These wells are screened in unconsolidated material to
etect hazardous constituents migrating from the facility in the ground
ater. The monitoring data from these wells indicate that the facility
as not leaked. The absence of mercury and mercury-related contaminants
n ground water at the downgradient facility boundary demonstrates that
he facility has not contaminated the ground water and there is a suffi-
iently low potential for migration to justify closure in place.

ANTICIPATED CLOSURE SCHEDULE

CP cannot know the precise date that the Regional Administrator will ap-
rove this plant before the fact. This closure schedule identifies pro-
ect milestones and estimated time using target dates from the anticipated
ate that the Regional Administrator approves the closure plan.

tivity (Milestone)	Target Dates
A Approval	October 1982
location of Chem-fix sludge in Brine-Sludge Lagoon	January 1983
watering completed	5/83 - 9/83
contouring equipment decontaminated	September 1983
ste compaction	9/83 - 4/84
acement of final cover initiated	April 1984
acement of final cover completed	August 1984
nal cover graded and planted	September 1984
ysical equipment decontamination	September 1984
gineer's certification	September 1984

TE: Should the RA require changes in this closure plant pursuant to the EPA's review (40 CFR 265.112(c)), LCP may have to amend the estimated schedule.

DECOMMISSIONING AND DECONTAMINATION OF EQUIPMENT AND STRUCTURES

e following equipment and structures are associated with the facility:

- 600 feet of 4 inch steel pipe
- Two Durco 4x3 stainless steel centrifugal pumps
- Plywood pumphouse on concrete slab

CP plans the following decommissioning and decontamination activities:

- All pipe will be excavated as necessary, manually disassembled or cut with a torch. Decontaminated pipe will be sold as scrap.

- Pumps will be decontaminated and reused by LCP.

- The plywood pumphouse will be dismantled and placed in the facility prior to cover.

- The concrete slab will be decontaminated, washed, and left in place.

econtamination will be accomplished by high pressure washing with water nd HCl or water and HGX (a compound that binds mercury.) Pipe, pumps, nd earth moving equipment used in the physical closure will be decon-aminated in the LCP plant. Wash water will be sent to the plant's waste-ater treatment plant (A NPDES permitted facility.) LCP personnel will arry out decontamination activities and will be supervised by the LCP lant Engineer.

The target dates for closure milestones take into account the seasonal factors of temperature and precipitation that are critical to the proper execution of each closure operation in regard to performance standards. Hence changes in the RA approval date might require substantial revision of the closure schedule.

GAS & LEACHATE COLLECTION SYSTEMS

e are required since the waste will not generate gasses or leachate.

PROTECTION AGAINST FLOODING

facility is located in an area classified as "flood prone" by the . Geological Survey (Arthur Kill quadrangle, 1973.) The area where ndation is predicted during a "100-year" flood coincides with the foot elevation contour with respect to mean sea level. The grade vation near the facility is approximately 8 feet, and the facility es extend another 10 to 12 feet above grade. The facility would not inundated even if the "100-year" flood elevation were exceeded by 50 cent. As part of this closure, LCP will protect the dike on all three es by covering it with clay to a minimum thickness of 1 foot, followed an additional 18" of rip rap. These costs are reflected in the closure t estimate.

POST CLOSURE MAINTENANCE AND INSPECTION

st closure maintenance will consist of the care and renovation of both e soil and vegetative cover as necessary to prevent erosion. The site l be inspected by LCP personnel on a weekly basis and repairs to the ver, surface draingage system and/or the dikes will be made on an as-eded basis.

P does not anticipate using the closed area. As the closed facility l not be used, the integrity of the cap and cover is not jeopardized.

e facility is located at an industrial site that is fenced for security rposes. The site is not accessible to the public or to livestock or mestic animals. Contact with the closed facility will not pose a risk persons or animals.

pendent upon the type of vegetative cover utilized, and the care require-nts of same, LCP estimates the total cost of inspection, vegetative care, d necessary maintenance not to exceed $10,000 annually.

POST CLOSURE MONITORING PLAN

ound-water monitoring wells are in place as required by 40 CFR 265.91 d 265.117. Monitoring for the following constituents will be performed ring the first post closure year:

	Times Per Year	Replicates	Total Analyses
rium	4	1	4
dmium	4	1	4
ad	4	1	4
rcury	4	1	4
lver	4	1	4
loride	4	1	4
dium	4	1	4
lphate	4	1	4
	4	1	4
ecific Conductance	4	1	4

nitoring for the following constituents will be implemented after e first monitoring year

loride	2	1	2
rcury	2	1	2
dium	2	1	2
	2	1	2
ecific Conductance	2	1	2

is monitoring program does not preclude LCP's petition for relief rsuant to 40 CFR 265.117(d).

PHYSICAL CLOSURE: ACTIVITIES AND SPECIFICATIONS

e physical closure of the facility will entail the following steps:

- The facility will be dewatered by pumping standing liquid to the LCP waste treatment plant (a NPDES facility.) Estimated volume is 50,000 to 70,000 gallons. Nature of the materials in the lower areas of the lagoon are such that the top 12-18 inches of material typicall retain moisture for a significant period of time. To eliminate the potential of any further settling as a result of this phenomenon, material in these lower areas will be systematically spread over the higher areas of the lagoon in thin layers to maximize dewatering. These lower areas will then be filled with dry dewatered material from the higher areas, mechanically compacted, and sloped to ensure rain water runoff. This procedure is expected to take 4 months, after which near final contouring will take shape and final mechanical compaction. Several months of natural settling, followed by a final mechanical compaction will ~~occur prior to~~ capping.

Collection of rain water runoff during this dewatering, compaction and contouring phase will be via the perimeter collection system presently in existence.

Elimination of any collected runoff will be through the LCP Waste Treatment plant (an NPDES Permitted facility.)

- Two feet of clay (with maximum permeability rate of 1 x 10-7 cm/sec) will be placed in maximum lifts of 6 inches and compacted to 90% minimum per ASTM D-1557 Method C.

- A 1-foot thick layer of soil will cover the clay cap, the top 6 inches of soil will be capable of supporting vegetation. The bottom 6 inches will be designed to provide adequate drainage. Total estimated volume of soil is 2,500 cubic yards.

- A vegetative cover approved by the NJDEP will be seeded as soon as seasonal conditions permit.

Final grading shall facilitate drainage with a maximum final top grade of at least 5%. Where this grade cannot be achieved, the final grade will be suitably terraced.

The clay cap and soil cover shall comply with general closure requirements (NJAC 7:26-9.8).

ESTIMATED CLOSURE COST (1982 DOLLARS)

estimates the cost of physical closure as follows:

Dewatering	$21,000
Reinforce north, east, and south banks using approximately 900 cubic yards of off-site clay (permeability of 10-7 cm/sec)	14,000
Recontour sludge prior to capping	20,000
Supply and install 2-foot thick clay cap	65,000
Supply and install 3-foot thick soil cover, fertilize, seed, and mulch	45,000
Decommission and decontaminate pipe, pump & pumphouse	2,000
Decontaminate equipment used in closure program	1,000
Plus 15 percent contingency override	25,200
Estimated Closure Cost	$193,200

WEEKLY INSPECTION REPORT
WASTE ENTOMBMENT

TE _____ TIME _____ TEMP. _____ TIDE LEVEL _____

EMBANKMENT

	ERROSION Yes	ERROSION No	DISPLACED RIP RAP Yes	DISPLACED RIP RAP No	COMMENT
E. Side	☐	☐	☐	☐	_____
S. Side	☐	☐	☐	☐	_____
W. Side	☐	☐	☐	☐	_____

SIDE SLOPES

	ERROSION Yes	ERROSION No	Bare Spots Yes	Bare Spots No	COMMENT
E. Side	☐	☐	☐	☐	_____
S. Side	☐	☐	☐	☐	_____
W. Side	☐	☐	☐	☐	_____

	VEGETATION	SECURITY
E. Side	_____ " Height	Fence Condition _____
S. Side	_____ " Height	Fence Condition _____
W. Side	_____ " Height	Fence Condition _____

RIMETER ROADWAY CONDITION _____

TION TAKEN	YES	NO
pair Order Written	☐	☐
pair Order Number _____	☐	☐
rkman Assigned		
rk Duration _____ (hours)	☐	☐
ntractor Notified		
ntractor P.O. # _____		
pair Work Scheduled / /		

pected by: _____
proved by: _____
(Manager, Operations)

STRUCTION: Comments must be specific.
- Errosion to be defined by depth, width, and length in inches.
- Bare spots, displaced rip rap, and roadway deterioration to be defined in sq. ft.

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DISSOLVED Hg CONCENTRATIONS IN GROUND WATER

SAMPLES (CONCENTRATIONS IN MG/L OR PPM)

Done By Sample Date	LCP 10-6-81	LCP 10-15-81	LCP 2-6-82	ETC 3-15-82	LCP 6-14-82
Well #					
1	< 0.0002	0.0006	0.0006	0.0006	0.0006
1A	< 0.0002	0.0009	0.0009		0.0005
2	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
3	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
4	< 0.0002	< 0.0002	< 0.0002		< 0.0002
5	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002

Drinking Water Standard = 0.002

Equipment Limit .0002

Equipment Specification
Perkin Elmer
Mod 50A
Cold Vapor Method

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Exhibit M

State of New Jersey

JOHN A. GASTON, JR., P.E.
DIRECTOR

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
CN 029
TRENTON, NEW JERSEY 08625

DERK C. HOFMAN, P.E.
DEPUTY DIRECTOR

CERTIFIED MAIL
RETURNED RECEIPT REQUESTED

LCP Chemicals & Plastics, Inc. - N.J.
Raritan Plaza II, Raritan Center
Edison, N.J. 08837

DEC 27 1983

Re: NJPDES Permit No. NJ0003778
Effective Date: 2-1-84

Dear Sir:

Enclosed is the final NJPDES/Ground Water Discharge Permit and Notice of Authorization to discharge pollutants to the ground water, issued in accordance with the New Jersey Pollutant Discharge Elimination System Regulations, N.J.A.C. 7:14A-1 et seq. Violation of any condition of this permit may subject you to significant penalties.

Within 30 calendar days following your receipt of this permit, under N.J.A.C. 7:14A-8.6 you may submit a request to the Administrator for an adjudicatory hearing to reconsider or contest the conditions of this permit. Regulations regarding the format and requirements for requesting an adjudicatory hearing may be found in N.J.A.C. 7:14A-8.9 through 8.13. The request should be made to:

Administrator
Water Quality Management Element
Division of Water Resources
CN-029
Trenton, New Jersey 08625

Application for renewal of this permit must be submitted at least 180 days prior to expiration of this permit pursuant to N.J.A.C. 7:14A-2.1(f)5.

If you have any questions on this action, please contact Robert Berg, Supervisor, Land Application of Wastewater at (609) 292-0424.

Very truly yours,

John J. Trela, Chief
Ground Water Discharge Permits Bureau
Water Quality Management

New Jersey Is An Equal Opportunity Employer

Table [illegible] Ground Water Monitoring Requirements and Limitations for Initial Interim NJPDES Permits for Industrial Waste Management Facilities and Hazardous Waste Interim Status Facilities

The permittee shall install and sample a total of 5 ground water monitoring wells according to the schedule below. All ground water elevations must be determined prior to pumping and sampling the ground water monitoring wells. Sampling of the ground water monitoring wells be performed according to the methodology specified in Section 6.12 of the NJPDES regulati and the Department's Field Procedures Manual for Water Data Acquisition. The permittee sha sample for all parameters for which there is an "X" to the left of the parameter name. Sampling shall be performed during the months which are specified for that parameter.

	PARAMETER	LIMITATION	SAMPLING MONTH	SAMPLE TYPE	REPORTING MONTH
___	Aldrin/Dieldrin	0.003 ppb	JanAprJulOct	Grab	FebMayAugNov
___	Ammonia-Nitrogen	0.5 ppm	JanAprJulOct	Grab	FebMayAugNov
X	Arsenic and Compounds	0.05 ppm	JanAprJulOct	Grab	FebMayAugNov
X	Barium	1.0 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Benzidine	0.1 ppb	JanAprJulOct	Grab	FebMayAugNov
___	Biochemical Oxygen Demand (BOD_5)	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Cadmium	0.01 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Calcium	ppm	JanAprJulOct	Grab	FebMayAugNov
___	Chemical Oxygen Demand (COD)	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Chloride	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Chromium (Hexavalent) and Compounds	0.05 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Coliform Bacteria	(1)	JanAprJulOct	Grab	FebMayAugNov
___	Color	None Noticeable	JanAprJulOct	Grab	FebMayAugNov
___	Copper	1.0 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Cyanide	0.2 ppm	JanAprJulOct	Grab	FebMayAugNov
___	DDT and Metabolites	0.001 ppb	JanAprJulOct	Grab	FebMayAugNov
___	Endrin	0.004 ppb	JanAprJulOct	Grab	FebMayAugNov
___	Fecal Coliform, MPN per 100 ml	( )	JanAprJulOct	Grab	FebMayAugNov
___	Fluoride	2.0 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Foaming Agents	0.5 ppm	JanAprJulOct	Grab	FebMayAugNov
___	Gross Alpha		JanAprJulOct	Grab	FebMayAugNov
___	Gross Beta		JanAprJulOct	Grab	FebMayAugNov
___	Hardness	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Iron	0.3 ppm	JanAprJulOct	Grab	FebMayAugNov

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GROUND WATER MONITORING REQUIREMENTS AND LIMITATIONS - Page 2

	PARAMETER	LIMITATION		SAMPLING MONTH	SAMPLE TYPE	REPORTING MONTH
___	Kjeldahl Nitrogen		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Lead and Compounds	0.05	ppm	JanAprJulOct	Grab	FebMayAu
___	Lindane		ppb	JanAprJulOct	Grab	FebMayAu
___	Magnesium		ppm	JanAprJulOct	Grab	FebMayAu
X	Manganese	0.05	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Mercury and Compounds	0.002	ppm	JanAprJulOct	Grab	FebMayAugNov
___	Methoxychlor		ppb	JanAprJulOct	Grab	FebMayAugNov
___	Nitrate-Nitrogen (NO_3-N)		ppm	JanAprJulOct	Grab	FebMayAugNov
___	Odor and Taste	None Noticeable		JanAprJulOct	Grab	FebMayAugNov
___	Oil and Grease	10.0	ppm	JanAprJulOct	Grab	FebMayAugNov
X	pH		S.U.	JanAprJulOct	Grab	FebMayAugNov
X	Phenols		ppb	JanAprJulOct	Grab	FebMayAugNov
___	Phosphate, Total		ppm	JanAprJulOct	Grab	FebMayAugNov
___	Polychlorinated Biphenyls (PCBs)	0.001	ppb	JanAprJulOct	Grab	FebMayAugNov
___	Radionuclides	(2)		JanAprJulOct	Grab	FebMayAugNov
___	Radium			JanAprJulOct	Grab	FebMayAugNov
X	Selenium and Compounds		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Silver and Compounds	0.05	ppm	JanAprJulOct	Grab	FebMayAugNov
X	Sodium		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Specific Conductance (mmho·cm)			JanAprJulOct	Grab	FebMayAugNov
X	Sulfate		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Total Dissolved Solids (TDS)		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Total Organic Carbon (TOC)		ppm	JanAprJulOct	Grab	FebMayAugNov
X	Total Organic Halogen (TOH or TOX)		ppm	JanAprJulOct	Grab	FebMayAugNov
___	Total Volatile Organics by GC/MS Scan (3)	50	ppb	JanAprJulOct	Grab	FebMayAugNov
___	Toxaphene	0.005	ppb	JanAprJulOct	Grab	FebMayAugNov
___	Turbidity		ppm	JanAprJulOct	Grab	FebMayAugNov
___	Zinc and Compounds	5.0	ppm	JanAprJulOct	Grab	FebMayAugNov
___	2,4 D		ppb	JanAprJulOct	Grab	FebMayAugNov
___	2,4,5-TP Silvex		ppb	JanAprJulOct	Grab	FebMayAugNov

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GROUND WATER MONITORING REQUIREMENTS AND LIMITATIONS - Page 3

	PARAMETER	LIMITATION	SAMPLING MONTH	REPORTING MONTH
X	Elevation of Top of Monitor Well Casing (To be determined once, but reported as indicated)		JanAprJulOct	FebMayAugNov
X	Depth of Water Table from Top of Casing Prior to Sampling		JanAprJulOct	FebMayAugNov
X	Depth to Water Table from Original Ground Level Prior to Sampling		JanAprJulOct	FebMayAugNov

Notes: (1) A. By membrane filtration, not to exceed four per 100 ml in more than one sample when less than 20 are examined per month, or B. by fermentation tube, with a standard 10 ml portion, not to be present in three or more portions in more than one sample when less than 20 are examined per month, or C. prevailing criteria adopted pursuant to The Federal Safe Drinking Water Act (PL 93-523).

(2) Prevailing regulations adopted by USEPA pursuant to Sections 1412, 1415, and 1450 of The Public Health Services Act as amended by The Safe Drinking Water Act (PL 93-523).

(3) The minimum detection level shall be at least 10 ppb for all volatile organic chemicals. The concentration limit for specific volatile organic chemicals shall be that specified in Appendix F of the NJPDES regulations for the 10^{-5} Cancer Risk, but in no case shall the total concentration for all volatile organic chemicals exceed 50 ppb.

The Permittee shall complete the forms required on the "Monitoring Report - Transmittal Sheet" (Form T-VWX-014) which is included as a part of this Permit. Failure to submit sampling data on the forms required on the "Monitoring Report - Transmittal Sheet" shall be considered by the Department to be a violation of the Permit sampling requirements and may place the Permittee subject to civil and administrative penalties pursuant to N.J.S.A. 58:10A-10.

It shall be the Permittee's sole responsibility to maintain an adequate supply of the required report forms.

FACT SHEET
FOR NJPDES PERMIT TO DISCHARGE
INTO THE GROUND WATERS OF THE STATE

Name and Address of Applicant:

LCP Chemicals & Plastics, Inc. - N.J.
Raritan Plaza II, Raritan Center
Edison, N.J. 08818

Name and Address of Facility Where Discharge Occurs:

LCP Chemicals & Plastics - N.J.
Foot of S. Wood Avenue
P.O. Box 484
Lot 3.01, Block 587
Linden City, Union County N.J. 07036

Recieving Water:

The potential discharge is to the ground waters of the State; in particular, to the organic (marsh) deposits of Recent geologic age, the Raritan-Magothy formation of Cretaceous age and the Brunswick formation of Jurassic age.

Description of Facility:

Up until 1985 LCP Chemicals & Plastics, Inc. produced chlorine through the electrolysis of sodium chloride. Past practices included the use of brine mixed with mercury in this process. The brine sludge waste was disposed of in two surface impoundments (the Chem fix Pond and the Brine Sludge Lagoon). In 1982 LCP modified its process stream to reduce the volume of process waste so that it could be containerized and shipped off-site to an approved landfill. In 1984 the facility certified closure of the lagoon containing the mercury contaminated brine sludge. In 1985 LCP ceased all production and the facility now operates only as a product terminal.

Description of Discharge:

The potential discharge to the ground water of the state is from the closed Brine Sludge Lagoon located at the LCP facility, Lot 3.01, Block 587, Linden City, Union County.

Description of Permit:

The New Jersey Department of Environmental Protection (NJDEP) intends to reissue a New Jersey Pollutant Discharge Elimination System (NJPDES) Permit to continue post-closure ground water monitoring of the wells surrounding the closed lagoon and to

implement the modified Post-Closure Plan pursuant to the conditions of the permit.

This notice is being given to inform the public that NJDEP has prepared a draft NEW JERSEY POLLUTANT DISCHARGE ELIMINATION SYSTEM (NJPDES) permit in accordance with the provisions of the New Jersey "Water Pollution Control Act" (N.JS.A. 58:10A-1 et seq.) and its implementing regulations (N.J.A.C. 7:14A-1 et seq.).

LCP is an existing facility and implementation of the New Jersey Pollutant Discharge Elimination System requirements is the enforcement mechanism by which new and existing pollutant discharges are brought into conformance and compliance with laws, regulations and standards. The pollution control requirements are those conditions necessary to restrict the discharge of pollutants and protect the public health and the environment.

Permit Conditions:

According to the attached General and Specific Conditions.

DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

100717

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TABLE I.

GROUND WATER MONITORING REQUIREMENTS AND PROTECTION STANDARDS

All ground water elevations must be determined prior to pumping and sampling of the wells. Sampling of the wells shall be performed according to the methodology specified in Section 6.12 of the NJPDES regulations and the Department's Field Procedures Manual for Water Data Acquisition. The permittee shall sample for all parameters listed below. Sampling shall be performed and reported during the months which are specified for that parameter.

PARAMETER	GROUND WATER PROTECTION STANDARDS		SAMPLING MONTH	SAMPLE TYPE	REPORTING MONTH
Elevation of top of monitor well casing (to be determined once but reported as indicated)			JanAprJulOct	N/A	FebMayAugNov
Depth to Water Table from top of casing prior to sampling			JanAprJulOct	N/A	
Depth to Water Table from original ground level prior to sampling			JanAprJulOct	N/A	
Antimony		ppm	July	grab	August
Arsenic and Cmpds	0.05	ppm	July	grab	August
Barium	1.0	ppm	JanAprJulOct	grab	FebMayAugNov
Beryllium		ppm	July	grab	August
Cadmium	0.01	ppm	July	grab	August
Chromium (Hex.) and Compounds	0.05	ppm	July	grab	August
Copper	1.0	ppm	July	grab	August
Iron	0.3	ppm	July	grab	August
Lead and Cmpds	0.05	ppm	July	grab	August
Manganese	0.05	ppm	July	grab	August
Mercury and Cmpds	0.002	ppm	JanAprJulOct	grab	FebMayAugNov
Nickel		ppm	July	grab	August
pH	5-9	SU	JanAprJulOct	grab	FebMayAugNov
Selenium and Cmpds		ppm	July	grab	August
Silver and Cmpds	0.05	ppm	July	grab	August
Sulfates	250	ppm	JanAprJulOct	grab	FebMayAugNov
Thallium		ppm	July	grab	August
Total Dissolved Solids (TDS)	500	ppm	JanAprJulOct	grab	FebMayAugNov
Total Organic Carbon (TOC)		ppm	JanAprJulOct	grab	FebMayAugNov
Zinc and Cmpds	5	ppm	July	grab	August

NOTES:

(1) These standards represent State Ground Water Quality Standards and may not represent background ground water quality values for this site. These limitations and/or representative background ground water quality data for all constituents in this table will be used to determine the need for additional assessment and/or corrective action.

The permittee shall complete the forms required on the "Monitoring Report - Transmittal Sheet" (Form T-VWX-014) which is included as a part of this permit. Failure to submit sampling data on the forms required on the "Monitoring Report - Transmittal Sheet" shall be considered by the Department to be a violation of the permit sampling requirements and may place the permittee subject to civil and administrative penalties pursuant to N.J.S.A. 58:10A-10.

It shall be the permittee's sole responsibility to maintain an adequate supply of the required report forms.

Satisfactory ground water wells are defined in Section 6.13 of the NJPDES regulations and shall be subject to Departmental approval. If ground water monitoring wells do not meet these standards, they must be replaced with new wells meeting Departmental standards.

A Ground Water Monitoring Well Certification (Forms A and B) shall be completed for each existing and proposed ground water monitoring well. Information for each well must be shown on a separate form. For an existing well, if information required on the Ground Water Monitoring Certification (Forms A and B) cannot be determined or the ground water monitoring well is not adequately constructed to meet the requirements of this permit, the Department reserves the right to require a replacement well. Criteria to be used by the Department in judging the adequacy of a well will be related to the ability of the well to provide a representative ground water sample at any time of the year as specified by the permit. Any replacement well must be installed within a 10 foot radius of the existing well. Inadequate or damaged existing wells must be properly sealed pursuant to N.J.A.C. 58:4A-4.1. Instructions regarding sealing may be obtained by contacting the Water Allocation Office at (609) 984-6831.

Special Conditions for Post Closure Monitoring at
Closed Sludge Lagoon - LCP Chemicals, Linden

1. LCP shall be required to to adequately maintain and inspect the clay cap and final cover over the former waste impoundment in accordance with the requirements of N.J.A.C. 7:26-9.9 et seq., the facility's existing approved closure and post closure plan, and the following minimum requirements:

   (a) The final cover must consist of 1) a suitable clay cap, 2) one foot of soil over the clay cap, 3) a healthy vegetative cover which must be capable of preventing soil erosion. The top six inches of the soil layer must be capable of establishing and supporting a healthy vegetative cover with a minimum amount of maintenance. The bottom six inches of the soil cover must be capable of providing adequate drainage.

   (b) The fertility of the soil must be tested and maintained to support the healthy vegetative cover. The permittee is required to, at a minimum, test the pH, plant available phosphorus and potassium of the top six inches of the soil layer on an annual basis. The permittee shall make all appropriate additions of lime, nitrogen, phosphorus, and potassium fertilizers in accordance with the recommendations of the New Jersey State Land Grant Agricultural College in order to maintain the vegetative cover.

2. The final soil cover and clay cap shall be inspected on a monthly basis to insure its integrity.

3. Reports of the monthly inspections must be maintained at the facility and submitted to the Department upon demand. The monthly inspection reports shall summarize the existing condition of the cap including its integrity, soil erosion and the condition of the vegetative cover as well as any cap repair and maintenance conducted.

4. The permittee shall be required to comply with all of the Security Requirements of N.J.A.C. 7:26-9.4(h).

5. The facility is required to resubmit to the Department the engineering plans indicating the location and dimensions of the disposal area with respect to permanently surveyed benchmarks in accordance with N.J.A.C. 7:26-9.9(m). In particular, the plans must indicate the lowest bottom elevation of the surface impoundment and whether the bottom

of the impoundment had been excavated at any time below grade. The plans must be prepared and certified by a professional land surveyor.

6. The permittee is required to resubmit to the Department the Deed Restrictions for the facility in accordance with N.J.A.C. 7:26-9.9(n).

7. The permittee is required to comply with all conditions of Financial Assurance in accordance with N.J.A.C. 7:26-9.11. The facility must submit updates of its Financial Assurance statement to the Department annually.

8. The permittee is required to present the following information to the Department in a professional report format:

   (a) At precisely what time did LCP become a transfer station; what chemical compounds/products, quantity of each product, and area of storage prior to distribution are currently handled at the facility. A diagram should be included.

   (b) A complete description of the wastewater treatment plant's collection and treatment system. A diagram showing (1) all wastewater sources, (2) aerial extent of surface runoff (in acres) which is collected , (3) the components of the wastewater treatment plant including their function and storage capacity, and (4) the modifications which converted this to a "recycling" system.

9. Current site conditions require modifications to be implemented in the ground water monitoring system. The five existing monitoring wells shall not be used to monitor ground water quality at the site. The existing monitoring devices shall be downgraded from monitoring wells to piezometers and may be used for the collection of water levels only.

10. In the event that the permittee decides not to retain the piezometers as water level indicators, or at any time the Department determines that they are not viable monitoring devices, the permittee must seal them according to N.J.A.C. 58:4A-4.1 by a licensed New Jersey Well driller certified to seal wells. Conditions for the proper sealing of abandoned wells and piezometers can be found on pages attached to this permit. Additional instructions regarding sealing may be obtained by contacting the Water Allocation Office at (609) 984-6831.

11. The Permittee shall be required to replace any sealed monitoring device with a new one constructed to the specifications outlined below if the Department deems new monitoring devices necessary for the proper monitoring of the site.

12. The permittee must submit construction specifications of the "box" cover around piezometer 5. If the cover does not sufficiently seal the piezometer from any surface infiltration, then the permittee shall be required to seal piezometer 5 according to the conditions outlined above.

13. The new monitoring network shall consist of three downgradient and one upgradient well. The permittee shall install the four new ground water monitoring wells within 45 days of the effective date of this modification. The wells must be installed by a licensed New Jersey well driller, pursuant to N.J.S.A. 58:4A-6 and constructed according to the conditions stated below and the attached Department specifications. A valid New Jersey permit, issued pursuant to N.J.S.A. 58:4A-14, to drill a well must be obtained from the Water Allocation Office, (609) 292-0580 of the Division of Water Resources prior to the installation of any ground water monitoring wells.

14. The monitoring wells shall be installed according to the following construction specifications:

    (a) PVC schedule 40 casing and screen (10 or 20 mil slot size)

    (b) MW - 3 shall have 10 to 15 feet of screen and must be screened in the same sand unit found at P - 3. This may require the top of the screen to be somewhat below the average phreatic surface.

    (c) MW - 1,2 and 4 are to be screened one foot below first water encountered or expected to be encountered at peak low tide. Screen length is to be a maximum of 15 feet and a minimum of 10 feet in length.

    (d) Dedicated sampling equipment shall be installed in the upgradient well, MW-4. The permittee may also install dedicated sampling equipment in the three downgradient wells. Dedicated sampling equipment in all wells would essentially eliminate any possible cross contamination problem experienced during sampling.

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15. Satisfactory ground water wells are defined in Section 6.13 of the NJPDES regulations and shall be subject to Departmental approval. If any ground water monitoring wells do not meet these standards, they must be replaced with new wells meeting Departmental standards. Each ground water monitoring well must have the elevation of the top of the casing and the well permit number permanently marked on the well casing.

16. The locations of all the ground water monitoring wells and piezometers to be monitored are shown on Figure 1. The permit writer, Ms. Jill Monroe will supervise the staking of well locations. The permittee shall provide the permit writer and the Ground Water Quality Control Section a minimum of two weeks notification prior to the installation of any ground water monitoring devices required by this permit.

17. All new wells shall be logged using the U.S.D.A. Soil Texture Classification System. For sites where inadequate geological information is available to properly design the well specifications, a Department geologist will finalize the well specifications prior to drilling. Failure to obtain Departmental approval may result in disapproval of the wells as constructed and may require new wells to be installed.

18. The permittee shall submit to the Department "Ground Water Monitoring Well Certifications - Forms A and B" for each ground water monitoring well which is required to be sampled by this permit. The Ground Water Monitoring Well Certifications shall be submitted to:

    Ms. Jill Monroe
    NJDEP-Division of Water Resources
    Ground Water Quality Control Section
    CN-029
    Trenton, NJ 08625

    within 60 days of the Effective Date of the permit.

19. Within 60 days following the installation of the monitoring wells, the permittee shall show the location of all ground water monitoring wells, piezometers and supply wells on a plot plan drawn to a scale suitable to the Department. Adjacent to each monitoring well/piezometer located on the plot plan shall be the owner's well/piezometer number, the New Jersey well permit number, the latitude and longitude, and the elevation of the top of the well casing. This plot plan shall be signed and sealed by a licensed New Jersey Professional Engineer or a licensed New Jersey land surveyor.

20. A ground water monitoring well as required by this permit is a monitoring device under N.J.S.A. 58:10A-10 and as such the permittee is required to maintain the well(s) in proper working order at all times. The permittee is further required to take any and all reasonable steps necessary to limit public access by constructing fences, barricades, or any other structures or means necessary to restrict access to the ground water monitoring well(s). Said structures shall be maintained to restrict access.

21. The owner or operator shall inspect each ground water monitoring well on a weekly basis for structural integrity and/or damage. The permittee shall maintain a complete inspection record indicating dates of inspection, inspector's name, and conditions observed. These records shall be made available to the Department upon request. Failure to maintain or submit records upon request shall be a violation of the conditions of this permit.

22. If the monitoring wells are damaged or are otherwise rendered inadequate for their intended purpose, the Administrator, Water Quality Management Element, shall be notified within five (5) days in writing indicating:

    (a) Which wells were damaged or rendered inadequate for their intended use;

    (b) The cause and extent of damage or the reason for the inadequacy;

    (c) If the sampling schedule as required in this permit will be violated or if the results of the sampling may reasonably become misleading;

    (d) The date that the well will again be operational. Damaged wells must be replaced or repaired within thirty (30) days after the damage has occurred. The wells must be sampled within five (5) days after they have been installed. A replacement well must meet the construction requirements established by the Department. A valid New Jersey well permit is required prior to the installation of the replacement well;

    (e) The next date that the well will be sampled;

    Failure to follow these procedures is a violation of this permit and may subject the permittee to the provisions of N.J.S.A. 58:10A-10.

23. The permittee must obtain and analyze samples from the ground water monitoring system as required by this permit pursuant to the NJDEP Field Procedures Manual for Water Data Acquisition and as delineated in N.J.A.C. 7:14A-6.12. A chain of custody record for each sample shall be maintained at the facility and may be requested and/or examined by the Department. The permittee or his/her agent shall evacuate the ground water monitoring well(s) according to the procedures identified in Section 6.12 of the NJPDES regulations no more than four (4) hours prior to sample collection.

24. The permittee is required to use a bailer or a teflon bladder pump for sampling wells MW-1, MW-2 and MW-3 if dedicated sampling equipment is not installed in these wells. Complete decontamination procedures, as delineated in the Field Procedures Manual must be performed between each well. The upgradient well, MW-4 shall be sampled by using its dedicated sampling equipment.

25. The permittee shall comply with the QA/QC requirements of the attached Appendix A for each sampling event. In addition to the requirements of Appendix A, the permittee is required to obtain and analyze one field blank and one trip blank per sampling event. The field blank must be taken by trained sampling personnel at the time of ground water monitoring at a location adjacent to one of the monitoring wells so that it could detect any contamination from the sampling equipment and/or the environment. The certified lab must be informed by the permittee to acquire analyte free water and sampling containers for field blanks.

26. The data acquired by performing Appendix A and the requirements above shall be recorded on the attached Division of Water Resources Quality Assurance / Quality Control Package. The completed package shall be submitted to the Department along with the sampling results outlined below. The permittee is responsible for maintaining an adequate amount of QA/QC Package reporting forms.

27. All samples shall be analyzed by a New Jersey Certified Laboratory. Sampling results shall be reported on forms provided by the Division of Water Resources and attached as Part III of this permit. Information not reported on the above specified forms shall not be deemed to fulfill the reporting requirements of this permit. It shall be the permittee's responsibility to maintain an adequate supply of forms to report ground water monitoring data to the Department.

28. The permittee shall sample a total of four ground water monitoring wells (MW - 1, MW - 2, MW - 3, and MW - 4) according to the schedule listed in Table 1, Part III-DGW of this permit. All ground water elevations must be determined prior to evacuation and sampling of the wells.

29. The permittee shall sample the ground water monitoring wells in the following order:

    1. MW - 1 2. MW - 2 3. MW - 3 4. MW - 4

    Sampling and collection of ground water elevations of the wells shall commence approximately one half hour before the peak of low tide. MW - 4, the upgradient well and last to be sampled, shall be sampled no later than two hours after low tide. The entire sampling routine shall be performed as quickly as possible around the peak of low tide and shall not exceed three hours in length in an effort to circumvent tidal interference.

30. In the event that some or all of the wells recover too slowly such that the entire sampling process cannot be performed in the three hours surrounding the peak low tide, the following modifications to the sampling requirements may be implemented:

    (a) one to two well volumes, instead of the recommended three to five volumes may be evacuated during purging;

    (b) The wells may be evacuated as much as five hours ahead of time, during the onset of low tide and allowed to recover before sampling. If the wells recover so slowly that this step must be implemented, then the water level readings shall be taken immediately prior to collecting the ground water sample.

    The permittee is required to inform the Department of any well recovery problem. The permittee must secure the approval of one of the above listed sampling modifications or other proposed modification from the Department before the modification may be implemented.

31. In addition to the sampling results collected from the wells, the permittee is required to prepare and submit a ground water contour map based on water level readings collected from the wells and any retained piezometers for that sampling round. The map should show direction of flow, and estimate flow rate.

32. The point of compliance for the post closure monitoring actions at the LCP facility shall be a vertical plane immediately downgradient during the peak low tide condition of the LCP sludge lagoon. This plane shall be defined by monitoring wells MW - 1, MW - 2, and MW - 3 which are located on Figure 1 of Part IV - DGW of this permit.

33. The compliance period during which LCP is responsible for post closure monitoring shall be no less than thirty years unless pursuant to N.J.A.C. 7:26-9.9(c)1 it can be reduced.

34. The permittee shall conduct post closure ground water monitoring according to the schedule indicated and for the parameters shown in Table 1, Part III - DGW of this permit. The hazardous constituents contained in those monitoring requirements are:

Antimony	Lead
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Cadmium	Silver
Chromium (Hex)	Thallium

Ground water protection standards for these and all permit parameters can also be found on Table 1, Part III-DGW of this permit.

35. LCP shall perform the statistical requirements of N.J.A.C. 7:14A-6.15 using the following parameters: Mercury, Barium, TOC, TDS, and Sulfates.

36. The Department reserves the right to require LCP to utilize alternative statistical interpretation of the monitoring data in the event that the control chart method does not indicate accurately statistically significant variations.

37. LCP shall submit, within 30 days of the effective date of this permit modification to the Department, documentation as to their financial assurances regarding their post closure ground water monitoring program, as required under N.J.A.C. 7:26-9.11.

38. Compliance Monitoring:

(a) In the event that ground water monitoring requirements and limitations are exceeded, within three (3) days after detection of the excedence the permittee shall notify the Department of the excedence.

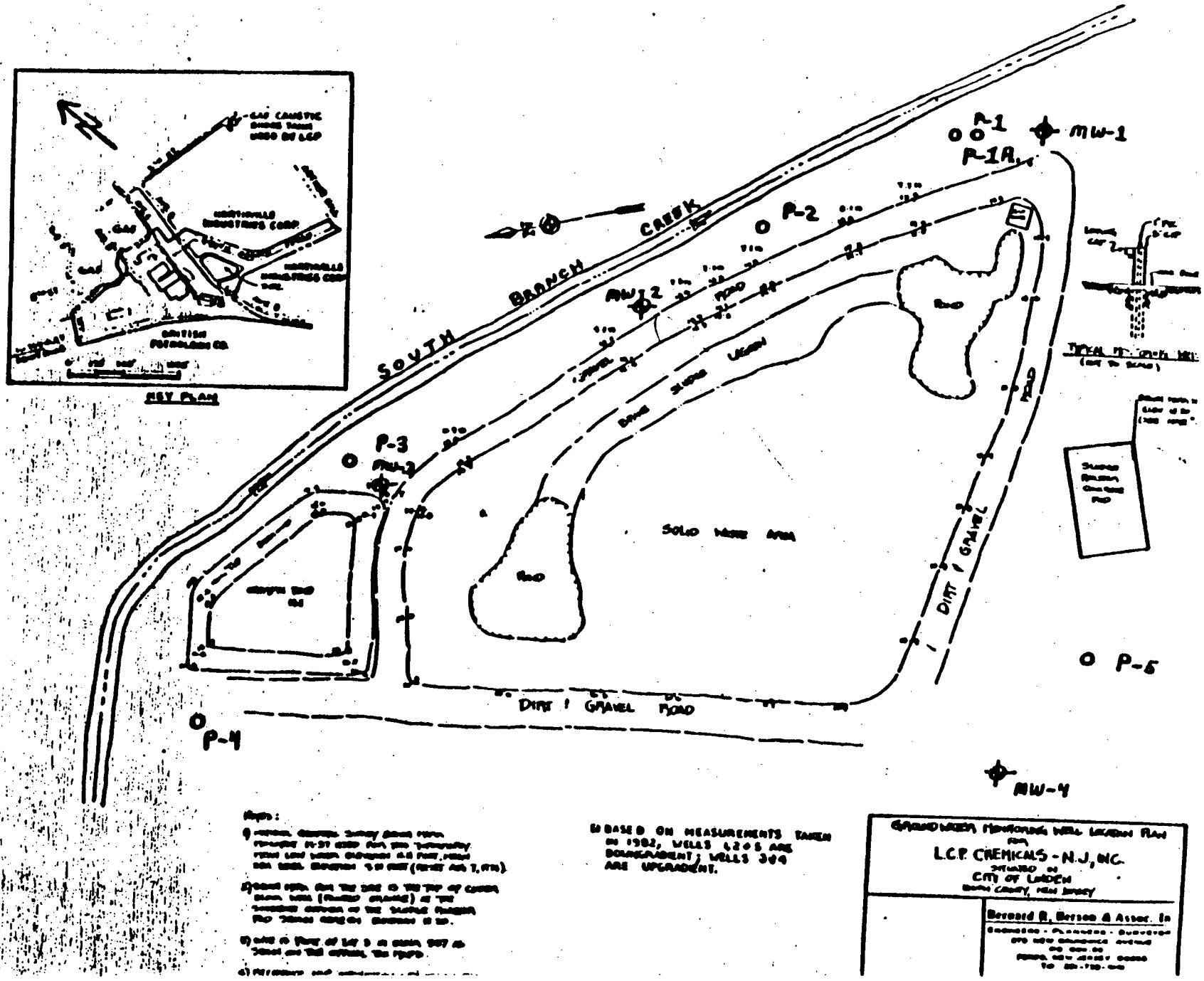
(b) The permittee shall submit to the Department a compliance monitoring program within thirty (30) days of written notification by the Department that the submission of the compliance monitoring program is required. The plan shall be in accordance with N.J.A.C. 7:14a-6.15 (j) and shall include an implementation schedule for further study to define the sources of contamination, the specific constituents of concern, and the vertical and horizontal extent of the plumes.

(c) Within thirty days of written Departmental approval of the ground water monitoring program required above, the permittee shall begin the approved study.

(d) The approved ground water study shall be completed within 180 days of the Department's written approval of the program.

(e) Within thirty (30) days of the completion of the ground water study identified above, the results of the study and recommendations concerning a corrective action program shall be submitted to the Department in writing. Pursuant to N.J.A.C. 7:14-6.15 (j) 10, in the event that the permittee can demonstrate to the satisfaction of the Department that the permittee is not a responsible party for the permit excedences investigated as a result of this Special Condition, the permittee shall not be responsible for the implementation of a corrective action plan as delineated herein.

FIGURE 1.



Attachment I
Page 32 of 370

100729

Exhibit N

file Linden Environmental

LCP CHEMICALS-NEW JERSEY, INC.
A Division of LCP Chemicals & Plastics, Inc. • P.O. Box 484 • Linden, NJ 07036 • (201) 862-1666

Certified Mail
Return Receipt Requested

November 23, 1988

David Beeman
Division of Hazardous Waste Management
Metropolitan Field Office
New Jersey Department of Environmental Protection
2 Bobtock Place
West Orange, NJ 07052

Dear Mr. Beeman:

This letter follows up the release reports provided to you by LCP Chemicals Inc. on September 29, 1988 and October 18, 1988 (National Response Center Reports 13601 and 14234). The enclosed report describes soil conditions found during a preliminary soil boring program as part of a building expansion plan.

The reported data indicate limited soil contamination by heavy metals, primarily mercury, and various chlorinated and non-chlorinated organics. The LCP Linden facility was operated as a mercury cell chlor-alkali plant. A Purasiv Hydrogen Purification unit in the area (see report Figure 1) could have been the source of the mercury contamination. LCP discontinued all mercury related processing on this site in August, 1985 and no longer uses the Linden site as a manufacturing facility. We believe that organics found in the soil may characterize soil conditions which are typical in the artificially filled areas and industrial sites along the Arthur Kill.

The report indicates that the area of concern is located close to Building No. 231 and is well within LCP property lines. The area is not accessible to the public and soils in this area are not disturbed during facility operations. The building expansion program is temporarily on hold.

A series of active groundwater monitoring wells surrounding a previously closed landfill are also hydraulically downgradient of Building 231 and quarterly data from these wells have been submitted to the Division of Water Resources quarterly since 1983. This database shows no mercury contamination and area background for the organics identified in the Building 23 soil sampling. The closest monitoring wells are about 135 feet downgradient from the soil sampling area near Building 231 and water-quality data from these wells show no evidence of contaminant migration. I would be pleased to provide this database for your information. Given its location and limited areal extent, we must conclude that the soil contamination near Building 231 does not constitute a threat to human health or to the environment.

Continued....

LCP is currently preparing to confirm the results of the preliminary soil sampling near Building 231, and develop a remedial plan. We will forward this plan to you promptly.

Please call me at (201) 862-1666 if you have any questions or need any further information.

Very truly yours,

Ronald Burkett

Ronald J. Burkett

RJB/lp

bcc: T.S. Farmer
P.D. Moore
Richard Levao
K. DeVoe
D.P.DeNoon
Michael J. McEachern

Exhibit O

REMEDIAL SITE ASSESSMENT DECISION - EPA REGION II

Site Name: LCP Chemicals Inc. **EPA ID#:** NJD079303020 **State ID#:**

Alias Site Names: Linden Chlorine Products, Linden Chemicals and Plastics, LCP Chemicals and Plastics

City: Linden **County or Parish:** Union **State:** NJ

Refer to Report Dated: 6/16/95 **Report type:** SI

Report developed by: PIRNIE

DECISION:

| | **1. Further Remedial Site Assessment under CERCLA (Superfund) is not required because:**

| | 1a. Site does not qualify for further remedial site assessment under CERCLA (No Further Remedial Action Planned - NFRAP)

| | 1b. Site may qualify for further action, but is deferred to:

|X| **2. Further Assessment Needed Under CERCLA:**

2a. Priority: |X| Higher | | Lower

2b. Other: (recommended action)

DISCUSSION/RATIONALE: The LCP Chemicals site is located in an industrial portion of Linden, Union County, New Jersey, adjacent to the Arthur Kill. The site is bordered to the east by South Branch Creek, and to the north, south, and west by industrial facilities. Chlorine production using a mercury cell hydrolysis process began at the site in 1961. Sludge containing mercury was disposed of in an on-site lagoon (the Sludge Brine Lagoon), located adjacent to South Branch Creek. Overflows of liquid from the lagoon to South Branch Creek were observed in 1972 and 1974. In 1979, approximately 10,000 to 20,000 gallons of mercury tainted brine solution was released do South Branch Creek as the result of an equipment failure. Sampling conducted at the site has indicated that elevated levels of mercury are present in site soils, as well as in the surface water and sediments of South Branch Creek. Groundwater is not utilized as a source of drinking water within four miles of the site, and there are no surface water intakes located within the site's surface water pathway. Fisheries exist in the Arthur Kill and Raritan bay. Sensitive environments associated with the site's surface water pathway include approximately 11.29 miles of wetland frontage, a state designated area for the protection of aquatic life, and habitat for one federally-listed endangered species. There are no schools, residents, daycare centers, or terrestrial sensitive environments present within 200 feet of the site, and there are no on-site workers. There are approximately 14 residents within 0.25 miles of the site, and a total of approximately 150,000 residents living within four miles of the site. This site is recommended for Higher Priority for Further Action (HPFA).

Site Decision
Made by: Jennifer Snow-Ashbrook Signature: Jennifer Snow-Ashbrook Date: 7/25/95

EPA Form # 9100-3

Exhibit P

Linden Chlorine Products, Inc.
PO Box 484 · Linden, NJ 07036 · 201-862-1663

June 27, 1975

Mr. James Reidy
ENVIRONMENTAL PROTECTION AGENCY
26 Federal Plaza
New York, New York 10007

Re: NJ0003778 Noncompliance Report

Dear Mr. Reidy:

On Wednesday, June 25, 1975, Linden Chlorine Products had mechanical failure that caused nine hours of noncompliance. This letter confirms my telephone call to your office reporting the noncompliance as stipulated in the permit.

1. The cause of noncompliance started with scheduled maintenance of the filter of the waste water treatment system. Shortly after work was initiated on the filter and water was being impounded, a critical water recycle pump failed. This caused a very high level of water in the impoundment system and, thereby, caused a failure in the impoundment system at the place of an old sewer that had been plugged. The breakthrough was not readily apparent until a milky precipitate formed in the outfall ditch.

2. The discharge water was high in pH and was tested in the outfall ditch at 10.3 pH. There were no apparent suspended solids in the discharge water. Any other contaminants will have to await time consuming and complicated analysis.

3. The condition existed for approximately nine hours and was corrected when the scheduled maintenance was finished on the waste water treatment filter, and the pump was repaired so the high level of water in the impoundment basin could be lowered and pumped to the treatment system.

4. Work is progressing on obtaining a spare filter for the waste water treatment system. The critical pump that failed will have a complete spare pump and motor. The spare motor has arrived and delivery of a complete spare pump is now promised by the manufacturer for late July.

197 of 340

Attachment 1

100793

5. The breakthrough of the impoundment system has apparently been located and will be permanently plugged so a repeat of the high level will not cause an unpermitted discharge.

Any questions concerning this report can be answered by Mr. Burkett or myself at any time.

Sincerely,

LINDEN CHLORINE PRODUCTS, INC.

Luther L. Dunn

Luther L. Dunn
Vice President of Manufacturing

LLD:dl
cc: Director, Division of Water Resources, NJDEP

Exhibit Q

20-14

BUREAU OF HAZARDOUS WASTE
FACILITY INSPECTION FORM

Facility Name: Linden Chlorine Products I.D. # Date: 10/9/80 Thurs. Time: 10:00 a

Facility Type: Chemical Processing

Street: South Wood Avenue Lot: 3 Block: 587

Town: Linden ~~Township~~ ~~Phone:~~ (201) ~~862-1666~~

County: Union County Person Contacted: Russ Del Tufo
Position: Process Project Engineer

Inspector: Steve Carfora/ Bob Chinery

Weather Conditions: Clear /X/ Rain /_/ Snow /_/

Wind Direction: Temp: 75° Speed 0-5 MPH

Security Measures: Fence /X/ Yes /_/ No

Guard /X/ Yes /_/ No 24 hours

Other _____

Safety Features:

Firefighting /X/ Yes /_/ No

Type:

Extinguisher /X/ Guns /_/ Other /_/ CO_2

Protective Clothing: /X/ Yes /_/ No
(Issued to Employees)

Written Emergency Procedures Posted /_/ Yes /X/ No

Inspection Observations:

Odors: On Site /_/ Yes /X/ No Off Site /_/ Yes /X/ No

Source: _____

Leaks, Spills: On Site /X/ Yes /_/ No Off Site /_/ Yes /X/ No

Source: See comment (2).

Overall Housekeeping: Poor /_/ Fair /X/ Good /_/ Excellent /_/

Drum Storage:

Total No. Approx. 38 Size 55 gallon Type Steel

Stacked Height: /X/ ~~1 Drum~~ /_/ ~~2 Drums~~ /_/ ~~3 Drums~~ /_/ ~~4 or more~~

Palletized: /X/ Yes /_/ No

100889

2926-390

Categorized: /X/ Yes /_/ No Labeled: /_/ Yes /X/ No

Manifested: /_/ Yes /X/ No Will be disposed of on-site.

Condition:

Leaking: /_/ Yes /X/ No Number of Leakers _____

General Condition: /_/ Poor /_/ Fair /X/ Good /_/ Excellent

Vehicles: Registered /_/ Yes /_/ No N/A

Numbers Displayed /_/ Yes /_/ No

Manifest Check:

Properly completed /_/ Yes /_/ No No waste being hauled off-site.

Explain:

Monitoring System: Air /X/ Yes /_/ No

Water /X/ Yes /_/ No

Does T.O.A. reflect capability: (Treatment/Processes) /_/ Yes /_/ No

We are waiting for submittal of Registration application and Engineering Des

Explain:

Samples Gathered: /_/ yes /X/ no Number _____

Photos: /_/ Yes /X/ No No. _____ Location: _____

1. _____

2. _____

3. _____

4. _____

5. _____

Observations and/or Other Comments

1. Bullet tank farm. The diked containment area for this tank farm was almost totally filled with sludge and slurry - the freeboard left was less than 1" in some areas and about 6" in other areas. Mr. Del Tufo said that the diked area was last pumped out about 1½ weeks ago. We recommended that he start to empty out the diked area as soon as possible so there will be no overflow and spillage. The sludge will either be removed with a backhoe or will be flushed out of the tank farm with a water hose and be drained into the trench system.

293 of 390

Inspector's Signature

Facility Operator's Signature

100890

LCP
10/ 9/80

Observations and/or Other Comments

2. #4 silo. This silo has been down since Sunday, 10/5, in order to remove the sludge that has settled in the silo. The sludge is dripped out of the bottom of the silo, collected by a front loader, transferred to a dump truc and disposed of in the lagoon. So far 50,000 gallons of sludge has been removed. The silo should be back up next week some time.

LCP is still able to treat its waste water even though the silo is dow The sludges that collected in the 500K tank and are normally pumped to the #4 silo are now being diverted to the lagoon. The liquid that collects in the lagoon is pumped to the pH tanks, bullet tanks, etc. The sludge that settles is left in the lagoon.

During the course of cleaning the silo sludge has fallen on the ground in the area. This sludge will be flushed across the road into the sump next to the 500K tank.

We also saw sludge caked on the floor in the brine building near where the brine filters are. Mr. Del Tufo explained that this sludge is flushed into the trench system which leads to the 500K tank.

3. Approximately 35 drums of Hg contaminated graphite are stored on pallets south of the 150K brine tank. Many of the drums had plastic tops. The ones that did not should be covered.

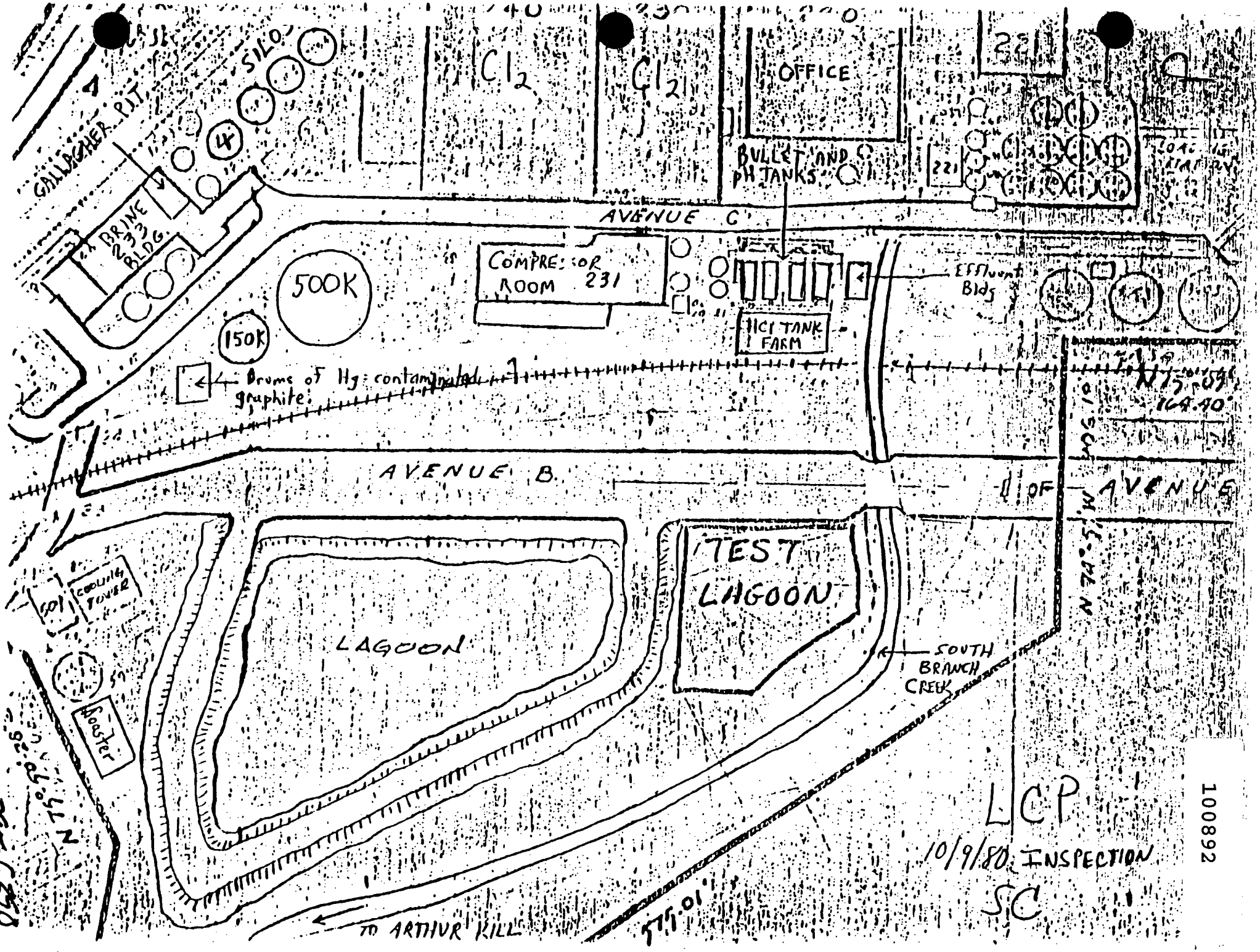
4. Three (3) drums of roaster sludge (Hg removed) are stored on the pad next to the roaster. The sludge will be disposed of at the lagoon. The roaster was down today for two reasons: 1) to strain rocks out of the sludge that is to be pumped through the roaster; and 2) maintenance work for the vacuum filter.

5. Work is continuing on the HCl tank farm next to the bullet tank farm. The three (3) concrete platforms for the tanks have been constructed.

Inspector's Signature: Stephen Collins

Facility Operator's Signature: 294 of 390

100891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SILO
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Cl_2
OFFICE
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BULLET AND PH TANKS
221
AVENUE C
BRINE 233 BLDG.
COMPRESSOR ROOM 231
500K
150K
Effluent Bldg
HCl TANK FARM
Drums of Hg contaminated graphite
AVENUE B
TEST LAGOON
LAGOON
COOLING TOWER
Booster
SOUTH BRANCH CREEK
TO ARTHUR KILL
N 75°.01
N 75°.09
164.40
N 74°.50
N 74°.28
LCP
10/9/80 INSPECTION
SC

100892

BUREAU OF HAZARDOUS WASTE
FACILITY INSPECTION FORM

Facility Name: Linden Chlorine I.D. # Date: Thurs. 1/22/81 Time: 9:00 am

Facility Type: Chemcial Processing

Street: South Wood Ave. Lot: 3 Block: 587

Town: Linden Phone: 201-862-1666

County: Union Person Contacted: Russ Del Tufo
Position: Process Project Engineer

Inspector: Stephen Carfora

Weather Conditions: Clear /X/ Rain /_/ Snow /_/

Wind Direction: Temp: 30 Speed 10-15 MPH

Security Measures: Fence /X/ Yes /_/ No

Guard /X/ Yes /_/ No

Other _____

Safety Features:

Firefighting /X/ Yes /_/ No

Type:

Extinguisher /X/ Guns /_/ Other /_/

Protective Clothing: /X/ Yes /_/ No
(Issued to Employees)

Written Emergency Procedures Posted /_/ Yes /X/ No

Inspection Observations:

Odors: On Site /X/ Yes /_/ No Off Site /_/ Yes /X/ No

Source: Sulfide odor around bullet tanks. From effluent treatment.

Leaks, Spills: On Site /X/ Yes /_/ No Off Site /_/ Yes /X/ No

Source: Leaking pipe. See comment 4

Overall Housekeeping: Poor /_/ Fair /X/ Good /_/ Excellent /_/

Drum Storage:

Total No. 9 Size 55 gal Type steel

Stacked Height: /X/ 1 Drum /_/ 2 Drums /_/ 3 Drums /_/ 4 or more

Palletized: /X/ Yes /_/ No

296 of 390

100893

Categorized: /X/ Yes /_/ No Labeled: /_/ Yes /X/ No

Manifested: /_/ Yes /X/ No

Condition:

Leaking: /_/ Yes /X/ No Number of Leakers _____

General Condition: /_/ Poor /_/ Fair /X/ Good /_/ Excellent

Vehicles: Registered /_/ Yes /_/ No

Numbers Displayed /_/ Yes /_/ No

N/A

Manifest Check:

Properly completed /_/ Yes /_/ No

Explain:

LCP has not had to use manifests because it does not ship any hazardous waste off site.

Monitoring System: Air /X/ Yes /_/ No

Water /X/ Yes /_/ No

LCP does not have any groundwater monitoring wells. LCP discharges effluent into the South Branch Creek, NPDES permit NJ0003778.

Does T.O.A. reflect capability: (Treatment/Processes) /_/ Yes /_/ No

Explain: LCP has never submitted a registration application form or engineering design for its lagoon (landfill) or roaster. LCP plans to meet with SWA officals or February 17 to discuss this matter.

Samples Gathered: /_/ yes /X/ no Number _____

Photos: /_/ Yes /X/ No No. _____ Location: _____

1. _____

2. _____

3. _____

4. _____

5. _____

Observations and/or Other Comments

1. Bullet tanks. As has been the case in previous inspections the containment area for the bullet tanks was filled nearly to the top (less than 6 inches freeboard) with sludg and liquid.

2. LCP corrected the problem that caused the back-up the effluent waters in the trench collection system. LCP resumed treating the effluent at the time of my last inspection on 1/7/81, and liquid levels in the trench system are now back to normal.

3. Roaster. LCP has not had time to install the recently delivered reworked screw because it is devoting much of its manpower to construct a bleach plant and scale house. LCP has set a March 1, 1981 target date for getting the roaster operating again.

297 of 390

Operator's Signature

Facility Operator's Signature

100894

Observations and/or Other Comments

LCP
1/22/81

4. Near the 500K tank I observed liquid which was leaking out of a cracked PVC pipe near an elbow joint. The liquid was falling on an unpaved area (soil covered by grave Mr. Del Tufo said that the piping carrys wash down water from the cell room sumps in buildings 230 and 240 to the 500K tank. Mr. Del Tufo filled out a work order request have the leaking elbow repaired. I would classify this as a minor leak and spill and I recommended that he take care of it as soon as possible.

5. Drum storage. LCP did not yet process the drums of mercury contaminated graphite or roasted sludge.

6. LCP had a crane onsite to dig out the lagoon to improve the flow of effluent to the pump house in the southern corner.

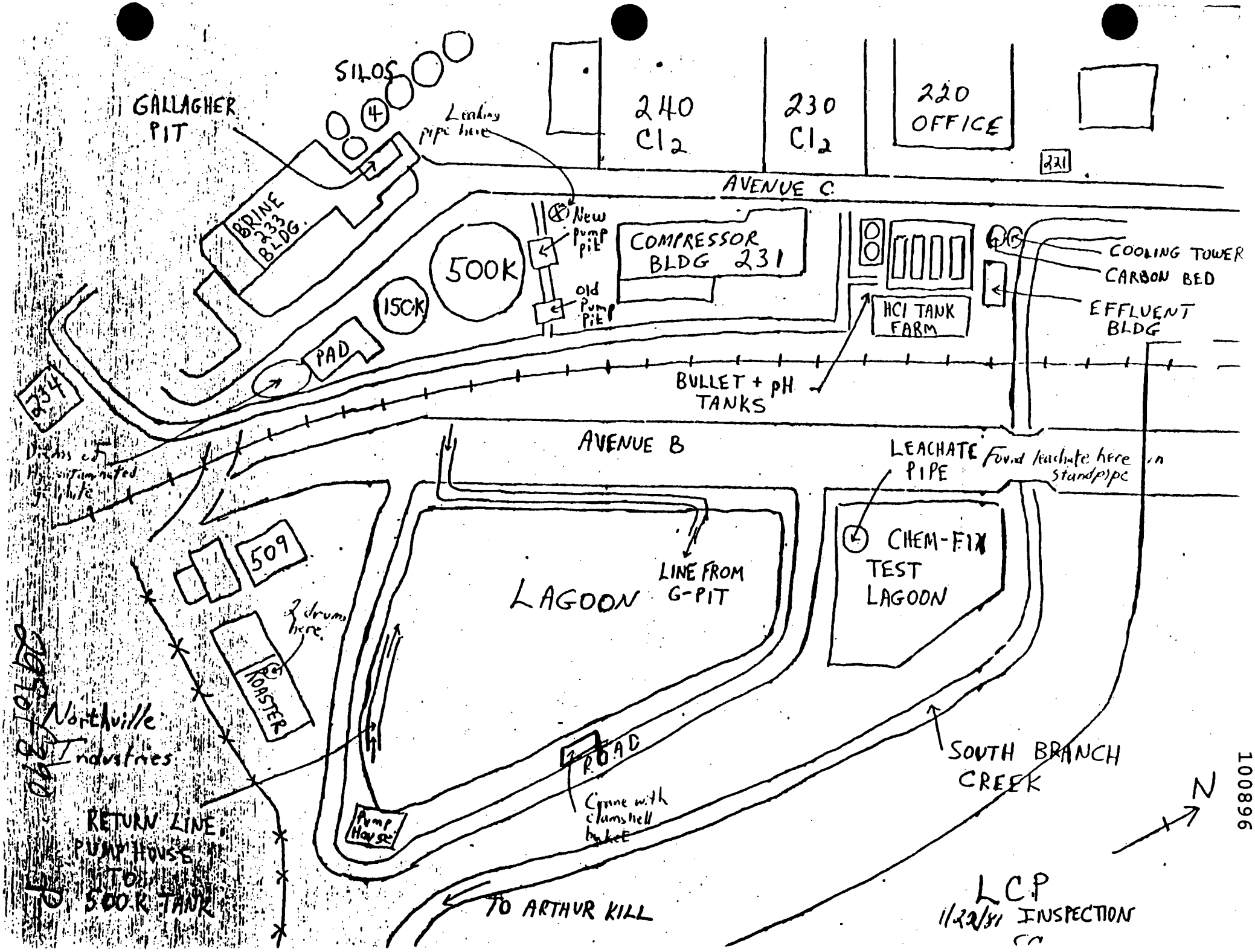
7. Chem fix lagoon. A layer of ice was on top of the lagoon. We checked the level of leachate in the standpipe with a long stick. There was at least 5 feet of liquid (measured on the slant). Mr. Del Tufo said he would have it pumped out to the adjacent lagoon. Also he will test it for mercury and solids. After the inspection we checked the engineering drawings for the lagoon. We found that the leachate pipe collects leachate from above the top liner. There is no way to detect whether leachate seeped between the liners or through both liners.

Inspector's Signature

Stephen C. Lathrop

Facility Operator's Signature

100895


SILOS
GALLAGHER PIT
Leaking pipe here
240 Cl2
230 Cl2
220 OFFICE
231
AVENUE C
BRINE 233 BLDG.
New pump pit
COMPRESSOR BLDG 231
500K
150K
old pump pit
COOLING TOWER
CARBON BED
EFFLUENT BLDG
HCl TANK FARM
PAD
234
BULLET + pH TANKS
AVENUE B
LEACHATE PIPE
Found leachate here in standpipe
LINE FROM G-PIT
LAGOON
CHEM-FIX TEST LAGOON
509
drums here
ROASTER
ROAD
Crane with clamshell bucket
Pump House
SOUTH BRANCH CREEK
N
Northville Industries
RETURN LINE PUMP HOUSE TO 500K TANK
TO ARTHUR KILL
LCP 11/22/91 INSPECTION
100896

20-14

BUREAU OF HAZARDOUS WASTE
FACILITY INSPECTION FORM

Facility Name: Linden Chlorine Products I.D. # Date: 3/19/81 Time: 9:15

Facility Type: Chemical Processing

Street: South Wood Ave. Lot: 3 Block: 587

Town: Linden Phone: 862-1666

County: Union Person Contacted: Rus Del Tufo
Position: Project Engineer

Inspector: Tom Downey

Weather Conditions: Clear /X/ Rain /_/ Snow /_/

Wind Direction: S Temp: 35 Speed 5 MPH

Security Measures: Fence /X/ Yes /_/ No

Guard /X/ Yes /_/ No

Other _____

Safety Features:

Firefighting /X/ Yes /_/ No

Type:

Extinguisher /X/ Guns /_/ Other /_/

Protective Clothing: /X/ Yes /_/ No
(Issued to Employees)

Written Emergency Procedures Posted /_/ Yes /X/ No

Inspection Observations:

Odors: On Site /_/ Yes /X/ No Off Site /_/ Yes /X/ No

Source: _____

Leaks, Spills: On Site /X/ Yes /_/ No Off Site /_/ Yes /X/ No

Source: see comment #7

Overall Housekeeping: Poor /_/ Fair /X/ Good /_/ Excellent /_/

Drum Storage:

Total No. 22 Size 55 gal Type steel

drums contain mercury contaminated graphite

Stacked Height: /X/ 1 Drum /_/ 2 Drums /_/ 3 Drums /_/ 4 or more

Palletized: /X/ Yes /_/ No

3000-390

100897

Categorized: /_/ Yes /_/ Labeled: /_/ Yes /_/ No
NA drums not sent out material reused

Manifested: /_/ Yes /_/ No

Condition:

Leaking: /_/ Yes /X/ No Number of Leakers _____

General Condition: /_/ Poor /X/ Fair /_/ Good /_/ Excellent

Vehicles: Registered /_/ Yes /_/ No

NA

Numbers Displayed /_/ Yes /_/ No

Manifest Check:

Properly completed /_/ Yes /_/ No no material sent off-site

Explain:

Monitoring System: Air /X/ Yes /_/ No

Water /X/ Yes /_/ No

Does T.O.A. reflect capability: (Treatment/Processes) /_/ Yes /_/ No

Explain: NO TOA in effect

Samples Gathered: /_/ yes /X/ no Number _____

Photos: /_/ Yes /X/ No No._____ Location: _____

1._____

2._____

3._____

4._____

5._____

Observations and/or Other Comments

1. Agitator on 500 K tank is down. Gear box is broken. Agitator has been down since 12/1/80. According to Mr. Del Tufo it should be back in service by next month.

2. Roaster is not yet operational, it stillneeds a few more weeks for completion of repair. Roaster was last used November 7, 1980.

3. Since agitator is down in 500k tank, sludge from galagher pit is pumped directly to sludge lagoon.

4. I discussed with Mr. Del Tufo a recent consent order between LCP and our office. LCP will be sending in permit application and engineering design on or around May 1, 1981.

301 of 390

Inspector's Signature _____ Facility Operator's Signature _____

100898

BUREAU OF HAZARDOUS WASTE
FACILITY INSPECTION FORM

Facility Name: Linden Chlorine Products I.D. #: Date: 10/22/91 Time: 1330

Facility Type: Chemical processing

Street: South Wood Ave Lot: 3 Block: 587

Town: Linden ~~Phone:~~ 201-862-1666

County: Union Person Contacted: Joe Willem

Inspector: Tom Downey Position: Senior Engineer

Weather Conditions: Clear [X] Rain [ ] Snow [ ]

Wind Direction: SE Temp: 60 Speed 5-10 MPH

Security Measures: Fence [X] Yes [ ] No

Guard [X] Yes [ ] No

Other _____

Safety Features:

Firefighting [X] Yes [ ] No

Type:

Extinguisher [X] Guns [ ] Other [ ]

Protective Clothing: [X] Yes [ ] No
(Issued to Employees)

Written Emergency Procedures Posted [ ] Yes [X] No

Inspection Observations:

Odors: On Site [ ] Yes [X] No Off Site [ ] Yes [X] No

Source: _____

Leaks Spills On Site [X] Yes [ ] No Off Site [ ] Yes [ ] No

Source: See comment # 4-6

Overall Housekeeping: Poor [ ] Fair [X] Good [ ] Excellent [ ]

Drum Storage:

Total No. 50 Size Various sizes Type Steel

Stacked Batches: [ ] 1 Drum [X] 2 Drums [ ] 3 Drums [ ] 4 or more

Palletized: [X] Yes [ ] No

302 of 390

100899

100900

Manifested: ☐ Yes ☒ No Labeled: ☐ Yes ☒ No

Manifested: ☐ Yes ☒ No

Condition:

Leaking: ☐ Yes ☒ No Number of Leakers _____

General Condition: ☐ Poor ☒ Fair ☐ Good ☐ Excellent

Placards: Registered ☐ Yes ☒ No

Numbers Displayed ☐ Yes ☒ No

Manifest Check:

Properly completed ☐ Yes ☐ No No waste is sent off site

Explain:

Monitoring System: Air ☐ Yes ☒ No

Water ☒ Yes ☐ No 6 wells

Does T.O.A. reflect capability: (Treatment/Processes) ☐ Yes ☐ No

Explain: No TOA in effect

Samples Gathered: ☐ yes ☒ no Number _____

Photos: ☐ Yes ☒ No No. _____ Location: _____

1. _____

2. _____

3. _____

4. _____

5. _____

Observations and/or Other Comments

① Bullet tank farm is in the process of being dug out. So far about 1/4 of the area (a section 2'x 8'x 50) has been dug out. The amount of material dug out was estimated at 30 cubic yards.

② Mineral jig is operating when man power is available. So far about one half of a 16 cubic yard dumpster has been emptied

③ New screens have been installed in screen. A test run is scheduled for next Thursday and Friday.

303 of 390

Inspector's Signature: Thomas Dare

Facility Operator's Signature: D. Miller

Observations and/or Other Comments

(4) A hydrochloric acid spill was noted on ground 15 ft NW of soak tank. Spill 15'x15' probably resulted from line drainage. Material drained down into surface sump. This spill should be cleaned up immediately along with contaminated

5) Sludge pile cover remains the same as noted in inspection three weeks ago. Cover has separated near base of pile. Liquid level at base of pile appears to be about one foot lower by visible line along side walls. According to Joe Wilson liquid from lagoon is pumped through effluent treatment system.

6) A leak was noted in the inlet line leading from gasoline pit to brine lagoon. Leak resulted in a spill 1'x15'.

7) Six water monitoring wells have been dug on site. (see map)

8) Chem fix lagoon remains the same as noted in last inspection. Leachate level is gage is even with ground.

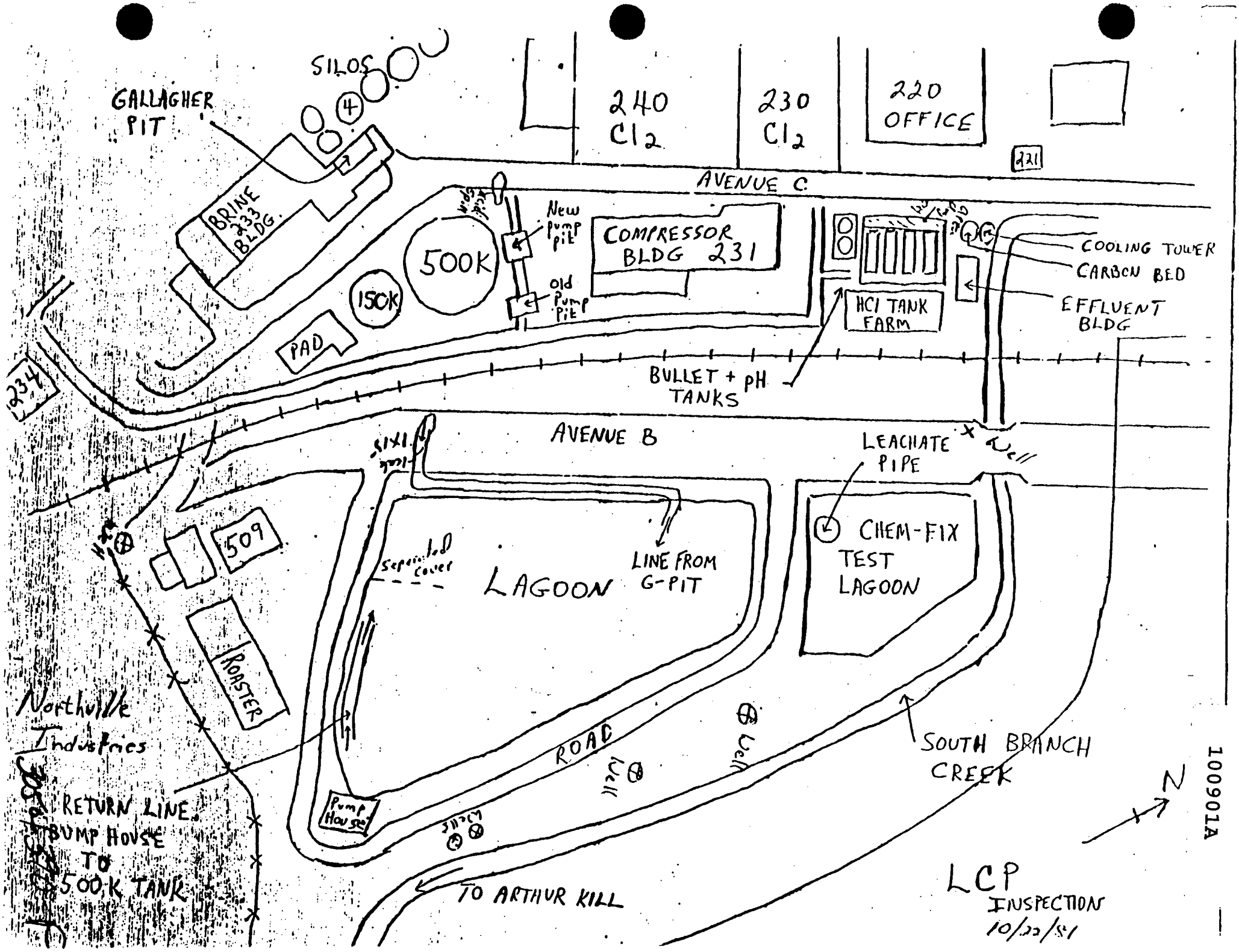
304 of 390

Inspector's Signature

Thomas Dunn

Facility Operator's Signature

100901


SILOS
GALLAGHER PIT
BRINE 233 BLDG.
PAD
150K
500K
New pump pit
Old Pump Pit
COMPRESSOR BLDG 231
240 Cl2
230 Cl2
220 OFFICE
221
AVENUE C
COOLING TOWER
CARBON BED
EFFLUENT BLDG
HCl TANK FARM
BULLET + pH TANKS
234
AVENUE B
LEACHATE PIPE
CHEM-FIX TEST LAGOON
509
LAGOON
LINE FROM G-PIT
ROASTER
ROAD
Pump House
SOUTH BRANCH CREEK
TO ARTHUR KILL
N
Northville Industries
RETURN LINE. PUMP HOUSE TO 500K TANK
LCP INSPECTION 10/22/81
100901A

20-14

BUREAU OF HAZARDOUS WASTE
FACILITY INSPECTION FORM

Facility Name: LCP Chemicals, N.J. I.D. #: Date: 11/13/81 Time: 1015

Facility Type: Chemical Processing

Street: North Wood Ave Lot: 3 Block: 587

Town: Linden Phone: 201-862-1666

County: Union Person Contacted: John Doane
Position: Plant Engineer

Inspector: Tom Downey

Weather Conditions: Clear [X] Rain [ ] Snow [ ]

Wind Direction: S Temp: 50 Speed 5 MPH

Security Measures: Fence [X] Yes [ ] No

Guard [X] Yes [ ] No

Other _____

Safety Features:

Firefighting [X] Yes [ ] No

Type:

Extinguisher [X] Guns [ ] Other [ ]

Protective Clothing: [X] Yes [ ] No
(Issued to Employees)

Written Emergency Procedures Posted [ ] Yes [X] No

Inspection Observations:

Odors: On Site [ ] Yes [X] No Off Site [ ] Yes [X] No

Source: _____

Leaks, Spills: On Site [X] Yes [ ] No Off Site [ ] Yes [ ] No

Source: See Comment #7

Overall Housekeeping: Poor [ ] Fair [X] Good [ ] Excellent [ ]

Drum Storage:

Total No. 81 Size 55 gal Type Steel

Include 6 drums of waste acid

Stacked Height: [ ] 1 Drum [X] 2 Drums [ ] 3 Drums [ ] 4 or more

Palletized: [X] Yes [ ] No Some

3 of 390

100902

Labeled: ☐ Yes ☒ No

Segregated: ☒ Yes ☐ No

Infested: ☐ Yes ☒ No

Condition:

Leaking: ☐ Yes ☒ No Number of Leakers _____

General Condition: ☐ Poor ☒ Fair ☐ Good ☐ Excellent

Vehicles: Registered ☐ Yes ☐ No N/A

Numbers Displayed ☐ Yes ☐ No

Manifest Check: No waste sent out

Properly completed ☐ Yes ☐ No

Explain:

Monitoring System: Air ☐ Yes ☒ No

Water ☒ Yes ☐ No monitoring wells

~~Does F.O.A.~~ Consent Order reflect capability: (Treatment/Processes) ☐ Yes ☐ No

Explain:

Samples Gathered: ☐ yes ☒ no Number _____

Location: _____

Photos: ☐ Yes ☒ No No. _____

1. _____
2. _____
3. _____
4. _____
5. _____

Observations and/or Other Comments

① Remainder of sludge from Bullet tank from dike has been dug out and placed in sludge lagoon.

② Minimal pigging operating during inspection. So far about 3/4 of the leaching dumpsite has been emptied. Reacting sludge from operation goes to the lagoon.

③ Reactor is non operational. It was run for 2-3 weeks and then stack failed. LCP is waiting for results of the stack test. Reactor cannot be run until approval is received from the Bureau of Air Pollution and Bureau of Haz. Waste.

Inspector's Signature _____ Facility Operator's Signature _____

LCP 10/19/81 100904

Observations and/or Other Comments

During the 2-3 weeks waste was operating, waste liquid was discharged into Brim Lagoon. During attack testing, waste generated about one 55 gallon drum of sludge per hour.

4) LCP is generally located to a highly permeable silt in this previously cut down on the amount of waste generated. This change will begin immediately.

5) No change noted in Chem-fix lagoon with the exception of 2-3 inches of rainwater on surface.

6) Cover on south side of Brim sludge pit remains partly separated, as in the last two inspections of the facility. John Dower closed the separation today and agreed to make a more permanent repair. Separation about 4" x 3'.

7) As noted in last inspection report 10/22/81 a PVC coupling was again leaking from gallagher pit to Brim sludge lagoon. Liquid was spraying out of a 2-3 inch line. The smelting spill ran down from Brim sludge lagoon & R/R tracks. See map for dimensions. Liquid spraying from pipe was probably mercury contaminated liquid. According to John Dower this area will be cleaned up immediately. Liquid will be pumped from R/R area back to lagoon. Contaminated soil will be cleaned up.

8) I discussed with John Dower the consent agreement between LCP & [illegible]

a) Biweekly reports are submitted to DEP by Plant Manager

b) Closure plan for Brim lagoon is being prepared

c) A final closure plan for Chem-fix lagoon submitted 10/23/81

d) Continued air monitoring submitted in June 1981

e) Ground water monitoring wells installed 10/2/81

f) Soil boring samples taken across the site, waiting results

Inspector's Signature

Section Chief's Signature

308 P 310 P

LCP 11/15/81

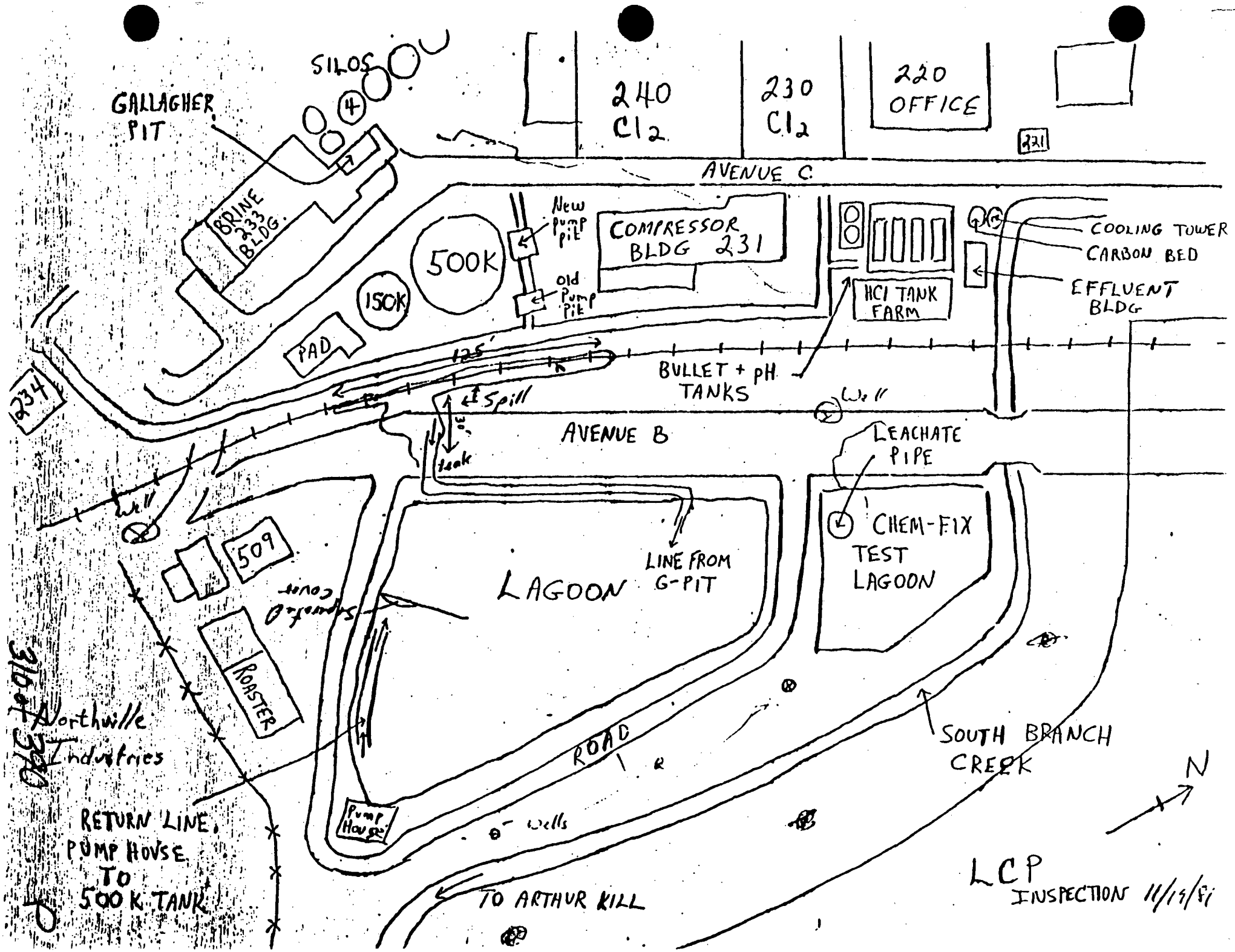
(3)

Observations and/or Other Comments

(g) Stream sediment sample taken 10/15/81 - still being analyzed
(h) Water sample taken from well 10/5 and 10/15.
When all results of sampling are in, data will be submitted to D

from comment #7) Leak appeared to be in same area as noted in last inspection report. According to John Dorse the leak noted in last report had been repaired. This was a new leak which had not been noted in 08/81 inspection earlier today. Leak was about 1 gallon per minute. Mr. Dorse shut pump which in turn stopped flow through line and leak ceased.

Reported to Mag. Management 11/23/81 to Charles Cartolano


SILOS
GALLAGHER PIT
BRINE 233 BLDG.
PAD
150K
500K
New Pump Pit
Old Pump Pit
COMPRESSOR BLDG 231
240 Cl2
230 Cl2
220 OFFICE
231
AVENUE C
HCl TANK FARM
COOLING TOWER
CARBON BED
EFFLUENT BLDG
BULLET + pH TANKS
125'
Spill
Leak
Well
AVENUE B
LEACHATE PIPE
CHEM-FIX TEST LAGOON
LINE FROM G-PIT
LAGOON
Sludge Cover
509
ROASTER
234
ROAD
Pump House
Wells
SOUTH BRANCH CREEK
N
TO ARTHUR KILL
RETURN LINE, PUMP HOUSE TO 500K TANK
Northville Industries
LCP INSPECTION 11/19/81

100906

100907

Chem-25
Sept. 75

"E ERSEY STATE DEPARTMENT OF HE T
TREAM OR WASTEWATER ANALYSI

Time & Date Received By Labs _____
Lab. No. _____

FIELD INFORMATION

PLEASE TYPE OR PRINT WITH BALLPOINT PEN

Date of Collection 5-31-78 19
Hour 11:00 A.M. P.M.
Composite Period Grab Interval
Collected by R Nicholson & E Steve
Residual Chlorine:
Immediate na
Developed na
Flow Rate Unknown
Temperature

Sample No. 19771
Municipality Linden
Plant New Linden Chlorine
Stream Trib to Cutten Kill
Location Behind LCP
Description and Remarks Unauthorized drainage ditch trib to Cutten Kill

ITEMS CIRCLED BELOW ARE UNSATISFACTORY

Dilutions Requested (Bacteriological)	10	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}

LABORATORY RESULTS
BACTERIOLOGICAL

Coliform MPN/100 ml. _____ (Confirmed Test); Fecal Coliform MPN/100 ml. _____
Fecal Streptococci:MPN/100 ml. _____ Other _____

RECEIVED
JUN 16 1978
State of New Jersey
Dept. Environmental Protection
Natural Resources

CHEMICAL AND PHYSICAL ANALYSES (mgs./liter, unless otherwise noted)

	Color (units)		Chloride		Sulfate		Other Determinations
	Odor (cold)		Suspended Solids		Grease & Oil		
	Turbidity (units)		Ash		Cyanide		
	pH* 12		Total Solids		Chromium Total		
	Acidity to pH 4		Ash		Chromium Hex.		
	Alkalinity to pH 4		Total PO_4		Ortho - PO_4		
	Nitrite N		MBAS		Copper		JUN 13 1978
	Nitrate N		Phenols		Lead		
	Ammonia N	X	COD 1257		Arsenic		DIV. OF LABORATORIES & EPID.
	Total Kjel. N		Iron		Zinc		

* FIELD MEASUREMENT

BIOCHEMICAL OXYGEN DEMAND (mgs./liter)

Field D.O.		Lab. D.O.			Seed Required:			Yes		No		
Sample Conc. %	PLEASE CIRCLE	0.1	0.2	0.5	1.0	2.0	5.0	10	25	50	75	100
BOD_5												

PART 1-CHEMISTRY COPY

3 of 3 Attachment Q

Exhibit R

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF THE COMMISSIONER
P. O. BOX 1390
TRENTON, N. J. 08625
609-292-2885

September 18, 1981

Ronald J. Burkett
Vice President, Technical
Linden Chemicals & Plastics, Inc.
Raritan Plaza II
Raritan Center
Edison, New Jersey 08837

Dear Mr. Burkett:

Enclosed please find an original and one copy of the executed Administrative Consent Order concerning the hazardous waste treatment and disposal practices of LCP Chemicals - N.J., Inc.

As always, your courtesies in arriving at an amicable solution of this matter have been appreciated.

The Department's solid waste and waste pollution personnel will continue to work closely with your staff on the expeditious implementation of this Order.

Very truly yours,

Keith A. Onsdorff
Chief, Office of Enforcement

KAO:jb
Enclosure

cc: Jack Stanton
Lee Pereira
Ralph Pasceri
Frank Coolick
Ron Corcory
Michael Diamond
Kathy McBride

CERTIFIED MAIL NO. P18 4219752
RETURN RECEIPT REQUESTED

100% RECYCLED

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
STEVEN J. PICCO, ASSISTANT COMMISSIONER
REGULATORY & GOVERNMENTAL AFFAIRS
P.O. BOX 1390
TRENTON, N.J. 08625
609 - 292 - 9289

(IN THE MATTER OF)
(LINDEN CHEMICALS & PLASTICS, INC.)

ADMINISTRATIVE CONSENT ORDER

The following ADMINISTRATIVE CONSENT ORDER is issued pursuant to the authority vested in the Commissioner of the New Jersey Department of Environmental Protection (hereinafter "the Department") and duly delegated to the Director, Division of Environmental Quality, pursuant to his authority under the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq.

FINDINGS

1) Linden Chemicals & Plastics, Inc. (hereinafter "LCP" or "the company") located in the City of Linden, County of Union, and State of New Jersey has been and is continuing to operate a Hazardous Waste Facility (hereinafter "brine sludge lagoon") by lagooning mercury contaminated brine sludge at the LCP Linden Plant, being more specifically described as Lot 3 of Block 587 on the Tax Map of the City of Linden.

2) LCP also has another lagoon containing mercury contaminated sludge located on the above specified premises, known as the Chem-fix lagoon, which was used for test purposes for four days in 1976 and has not since been operated.

3) LCP has constructed and operated from time to time a mercury brine sludge roaster designed to recapture and recycle the useful portion of this waste.

ORDER

NOW, THEREFORE, by mutual agreement of the parties hereto, Linden Chemicals & Plastics, Inc., is HEREBY ORDERED to undertake the following remedial measures with respect to its Linden Plant's hazardous waste disposal practices:

New Jersey Is An Equal Opportunity Employer

(1) LCP has submitted a complete application, engineering report and design plans for its hazardous waste (roaster) treatment facility. The Department shall endeavor to fully complete the required administrative procedures and render its final decision on this brine sludge roaster application by September 15, 1981.

(2) During the period of time that said application is pending final decision by the SWA, LCP may continue to deposit its brine sludge waste generated at this Linden plant into the above referenced on-site brine sludge lagoon so long as compliance with all the terms and conditions of this Administrative Consent Order are maintained by the company. LCP shall submit written bi-weekly progress reports detailing all actions taken in furtherance of its obligations pursuant to this agreement over the reporting period, said reporting obligations to commence August 5, 1981.

(3) Upon the Department's issuance of its final decision regarding LCP's application for approval of the brine sludge roaster, the company shall forthwith cease depositing these wastes into the on-site brine sludge lagoon. If said decision is affirmative, LCP may commence utilization of its roaster to treat these wastes; but if same should be negative, then the company shall have 10 working days from receipt of this denial or until Jan.1, 19 whichever later, to arrange for off-site disposal of this hazardous waste material at a State or federally approved treatment and/or disposal facility. LCP reserves the right, however, to appeal from any negative decision by the DEP regarding the licensing of the roaster. Furthermore, LCP may petition the Department for an extension of the aforesaid 10 day deadline should off-site disposal require additional time to be implemented. In the event that the Department approves operation of LCP's brine sludge roaster, the company may continue to deposit these wastes into the existing on-site brine sludge lagoon whenever the roaster is removed from operations to be serviced, until the Department completes its review of the brine sludge lagoon closure plan to be submitted by LCP in accordance with the terms of paragraph #4. This authorization for continued use of the existing on-site brine sludge lagoon is expressly contingent upon the environmental evaluation, to be conducted by the company, conclusively showing that the operation and maintenance of the brine sludge lagoon will not cause a violation of any applicable air or water emission and/or ambient quality standard.

(4) Whether the decision is affirmative or negative, LCP, upon receipt of the Department's final decision on said roaster application, shall by no later than 45 days thereafter submit to the SWA an application for the proper, final closure of the existing brine sludge lagoon. Said closure plan, signed and sealed by a licensed New Jersey Professional Engineer, shall provide for the final disposition of all wastes previously deposited into this on-site brine lagoon either by entombment or by complete excavation for ultimate disposal in a manner approved by the Department. Should LCP propose closure of this brine sludge lagoon via entombment, the company must provide sufficient revenues placed into an escrow account or surety bond, to allow for a monitoring system for the RCRA

legally required period of time to be used to verify the continuous integrity of said full containment system. The closure plan shall be reviewed and evaluated in accordance with the requirements of all applicable federal and State regulations governing such facilities.

(5) By no later than 45 days from the date of execution of this agreement, the company shall submit to the SWA an application for the proper, final closure of the Chem-fix lagoon, which closure plan shall be prepared in accordance with all the requirements as specified hereinabove in paragraph four.

(6) In order to fully evaluate all potential avenues of mercury and other metals release into the ambient environment from the operation and maintenance of the aforesaid on-site brine sludge lagoon, LCP shall undertake forthwith the following monitoring program, which shall include but not necessarily be limited to below listed tasks:

a. ambient air monitoring of the on-site brine lagoon to measure for mercury emissions from said waste stockpile. The mobile air monitoring device shall be approved in advance by the DEP and be calibrated to record mercury levels in nanograms per cubic meter of air;

b. installation of a sufficient number of groundwater monitoring wells as required to fully delineate the impacts, if any, of the brine sludge lagoon upon the soils and waters situated in the vicinity of the brine sludge lagoon, in addition to evaluating any impacts upon the tributary flowing into the South Branch Creek and the Creek itself. Twin or cluster well installations shall be drilled if necessary to obtain screen access to all different water bearing zones in the aquifer.

c. a soils boring protocol and water sampling routine as required to obtain a determination of whether the brine sludge lagoon and/or the chem-fix lagoon has or is presently contaminating the ground or surface waters of the State of New Jersey by release of any of the pollutants presently contained therein. Said protocol and routine shall encompass preparation of a water chemistry map and soils permeability calculations -- taken at a minimum of every five foot depth and at every change in the lithology utilizing split spoon sampling techniques.

Should the aforesaid evaluation determine that such contamination has or is occurring, then the company shall prepare a groundwater contour map as part of its program to delineate the full extent of the contamination of these soils and waters and the direction if its migration, if any;

d. all stream sediment samples shall be obtained at several depths beginning at the surface and continuing until the sampling instrument meets substantial resistance. At least one composite soil sample shall be obtained from a minimum of six separate locations in the vicinity of the roaster. All soil samples shall be analyzed by the company for mercury content by dry weight total mercury content;

e. all surface water samples shall be obtained at low tide and both surface and groundwater samples shall be obtained as split samples and analyzed by the company for total mercury content by wet weight. The duplicate sample shall be retained by the company for subsequent analysis by a certified private laboratory at its sole cost should confirmation be deemed warranted in the discretion of the Department. All wells shall also be sampled at least once for the presence of calcium carbonate, barium sulfate, iron hydroxide, calcium sulfate conductivity and pH, in accordance with the aforesaid analytical protocol where applicable;

f. the purging and bailing procedures for all monitoring wells shall be approved by the Department in advance and a representative of the DEP shall be on-site for the commencement of the soils boring program and thereafter at his discretion;

g. the elevations to sea level of the tops of all the monitoring wells shall be determined by a New Jersey licensed surveyor;

h. no later than 30 days after completion of the aforesaid evaluation, all findings and data generated thereby shall be provided to the Department in writing, along with recommendations for all further monitoring as deemed necessary to complete the requirements as set forth in paragraph d.

RESERVATION OF RIGHTS

(7) It is expressly understood and AGREED by the parties hereto that the execution of this Administrative Consent Order does not waive any rights or obligations of either of them to protect the environment from pollution emanating from the industrial activites of LCP as required by all applicable State, federal and local laws, rules and regulations pertaining to these activities conducted at its Linden facility, with the sole exception of the SWA's registration requirements which shall be complied with as set forth hereinabove.

(8) LCP and the DEP hereby consent and agree to comply with all the terms and provisions of this Administrative Consent Order, which shall be fully enforceable in the Superior Court of New Jersey and also may be enforced in the same fashion as an Administrative Order issued pursuant to N.J.S.A. 13:1E-1 et seq.

(9) LCP hereby waives its right to an administrative hearing on the subject matter of this Order.

C.A. Hansen - Sept 1, 1981

C.A. Hansen, Jr.
President
Linden Chemicals & Plastics, Inc.

Date: 9/17/81

John J. Stanton, Director
Division of Environmental Quality
Department of Environmental Protection

Exhibit S

NUS CORPORATION
A Halliburton Company

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
EXECUTIVE SUMMARY

LCP Chemicals	D079303020
Site Name	EPA Site ID Number
Linden, New Jersey	02-8403-54A
Address	TDD Number

SITE DESCRIPTION

LCP Chemicals, a division of LCP Chemicals and Plastics, Inc., operates a chlorine gas production facility at the foot of S. Wood Avenue in Linden, New Jersey. Chlorine gas is produced by the electrolysis of a sodium chloride brine. The process involved the use of a mercury cell for a period of several years during the 1970's. Sodium hydroxide (caustic soda) sludge, a biproduct of this process, was subsequently contaminated with mercury. The sludge was stored in a lagoon which was located between the production plant and S. Branch Creek to the east. LCP attempted to recover some of the mercury in an experimental chem-fix lagoon which was constructed at the edge of the main lagoon. The project was abandoned, and LCP changed their production procedures to eliminate the hazardous mercury component from the process.

In 1982 the US EPA ordered the LCP plant closed until the lagoon was secured and the hazard to plant workers was eliminated. LCP proposed to excavate the experimental lagoon and place the excavated material along with all mercury contaminated waste into the brine-sludge lagoon. The lagoon would subsequently be capped with an impermeable layer of clay. The proposal was accepted and closure procedures were completed during the fall of 1984.

The landfill covers an area of 62,500 square feet and rises to a point approximately 15 feet above S. Branch Creek, a tributary to the Arthur Kill River. LCP has installed five groundwater monitoring wells around the landfill. LCP samples these wells semi-annually and analyzes the samples for a list of 14 substances.

HAZARD RANKING SCORE: S_M - 13.1 S_{FE} - 18.89 S_{DC} - 20.83

Prepared by: J. S. Cattafe of NUS Corporation Date: 5/21/85

Exhibit T

LCP CHEMICALS - NEW JERSEY
FOOT OF SOUTH WOOD AVENUE
LINDEN CITY, UNION COUNTY, NEW JERSEY
EPA ID# NJD079303020

LCP owns a twenty-six (26) acre chemical manufacturing facility in Linden which is currently used exclusively for the storage and transfer of methylene chloride and caustic soda. GAF Corporation aquired the property in 1950 from the U.S. Government, filled an area of coastal wetlands on site, and developed it for production of liquid chlorine by the mercury cell process. LCP purchased the facility in 1972 from GAF and with a few minor modifications of the process continued chlorine manufacturing, until September 1985. Other property within 1.5 miles is zoned for heavy industry (B.P. Oil, E.I. DuPont, GAF, Northville Industries) and transportation (New Jersey Turnpike). Also, Union Carbide operates the Linde Hydrogen Plant (LHP) as a tenant organization at the LCP Linden facility. Site security is adequately maintained by a perimeter chain link fence, a twenty-four (24) hour/day guard staff, and closed circuit TV cameras. Finished products are transported in bulk quantities via tank truck or rail car, and stored on site in three (3) aboveground tanks with a total combined volume of 1.02 million gallons.

The City of Linden is a densely populated urban area, such that, within three miles of the LCP facility an estimated 62,500 people were in residence as of December 1984. Linden is supplied with potable water by surface resevoirs located in Clinton, NJ approximately thirty miles to the west. The Arthur Kill, located almost 1100' off-site to the east is used for recreational boating and an endangered species, the Peregrine Falcon, is known to hunt in the salt marshes nearby.

LCP's Tremley Point Plant is situated directly upon a hetrogeneous fill material composed of sand, gravel, brick, and slag up to 10 or 15 feet thick. Bedrock occurs at 30 to 40 feet below grade and consists of a red sandy shale overlain by 10 to 15 feet of glacial deposits and 20 feet of organic silt, clay and peat. This portion of the New Brunswick Formation is not used as a potable aquifer within several miles of the facility due to the salt intrusion from the nearby coastal waters. LCP was provided all of its' potable and industrial water requirements (430,000 gallons/day when at full production in 1979) from the Elizabethtown Water Company. LCP does maintain five (5), NJPDES Discharge to Ground Water (DGW) permitted, monitoring wells which are screened in sand lenses of the glacial till and organic sediments. Within these wells the depth to water and salt concentrations vary according to the ebb and flow of the tides.

The "mercury cell process" yields chlorine gas through the electrolysis of a sodium chloride (brine) solution in the presence of metalic mercury. An amalgum of mercury and sodium is removed from the cell and used to hydrolize water forming sodium hydroxide and hygrogen gas (which are also comerically valuable). Metalic mercury was recovered and recycled in a brine purification process, but incompletely yielding a sludge residue.

LCP wastes included: mercury contaminated sludges, mercury vapors, spent lubricating oils, transformer oils, degreasing solvents, process wastewater, spill wash down, and stormwater runoff. LCP's tenant LHP purportedly does not generate any hazardous wastes. Mercury sludges were landfilled on-site in the Brine Sludge Lagoon for at least twenty (20) years, until 1982 when LCP began storing this waste in 55 gallon drums prior to shippment off-site. Mercury vapor emissions were discharged to the atmosphere from process equipment and an on-site sludge roaster under permits from the NJDEP DEQ Air Pollution Control Program. Spent lubracating oils, transformer oils, and degreasing solvents were stored in 55 gallon drums before shippment off-site for recovery. Process wastewater, stormwater runoff and spill wash-down from process equipment, the parking lot, and transfer areas was treated then discharged to the South Branch Creek, a tributary of the Arthur Kill (classified "Saline Estuarine waters, SE-2" by the Division of Water Resources).

Plant wastewater and sludges were collected in a 500,000 gallon agitated tank. The dilute slurry was pumped to a 140,000 gallon settling silo No. 4. The supernatant was directed to the effluent treatment system and the settled solids to the 4,500 gallon surge tank at the sludge roaster site. The brine sludge composition was reported by LCP on June 9, 1975 to be: 15 to 20 percent sodium chloride, 40 to 50 percent barium sulfate, 20 to 30 percent calcium carbonate and/or sulfate, 2 percent metal hydroxides, 2 percent dirt, and 100 to 500 ppm mercury. Settling silo No. 4, and the surge tank are no longer maintained at the Linden facility. The collection tank is in service only for emergency purposes as a holding tank for excessive volumes of stormwater.

Effluent treatment consists of pH neutralization, contact with activated carbon, and filtration. Prior to construction of the cooling towers (in 1980) NJPDES Discharge to Surface Water (DSW) permits limitations for temperature were exceeded regularly. Other infractions included occasionally alkaline pH and one major incident on August 20, 1979 when ten to twenty thousand gallons of mercury tainted brine was discharged to the South Branch Creek. An analysis of sediment samples from the creek (below LCP's discharge outfall), as reported by Geragthy and Miller Inc. February 1982, indicates that mercury is present at 46 ppm. LCP began recycling its process wastewater in 1982 and amended the DSW permit to reflect this change. Currently only stormwater runoff and spill wash down after treatment, are discharged.

AREAS OF CONCERN:

Enforcement personnel with the Division of Hazardous Waste Management reported evidence of numerous small releases observed during inspections in 1980, 81, 82, and 83.

9/17/80 Brine sludge was observed on the gravel near the 500,000 gallon "collection tank."

10/9/80 Brine sludge was observed on the gravel in the vicinity of "Settling Silo #4."

1/21/81 During the inspection a liquid was observed spewing from a cracked PVC pipe near the 500,000 gallon collection tank and the pump pit.

3/19/81 An acid spill (9' x 4') was noted on the soil near Building #220 and Avenue C.

10/22/81 A brine sludge slurry release from a transfer line was evidenced by a 1' x 15' spill area located on Avenue B between the pump pit and the Brine sludge Lagoon. Also, a 10' x 4' hydrochloric acid spill area was noted approximately 15' northwest of the 500,000 gallon collection tank.

11/19/81 The brine sludge slurry spill area noted on the previous inspection has expanded to cover a 125' x 30' area along the railraod tracks.

4/13/82 Sodium sulfide crystals were evident on the gravel surface in the pump pit area. Also noted was a salt spill at the railroad siding area.

8/5/82 Yellow crystals (probably sodium sulfide) was observed to cover a 10' x 15' area of broken asphalt near building #240.

2/28/83 Approximately two cubic yards of rubber liner from the caustic tank were deposited within the brine sludge lagoon in violation of the DEQ ACO.

Late in 1982, LCP paved the railroad siding and adjacent areas, the area under the salt silos, and sections of Avenue C.

In addition to the areas noted by DEP personnel a former employee of LCP has alleged several other sites of possible contamination.

1. The soil surface between the compressor building #231 and the railroad tracks received mercury contaminated sludge which was excavated from the Brine Sludge Lagoon.

2. Prior to OSHA requiring the repair of the cracked and broken concrete floor within the mercury cell Buildings #230 and #240, numerous spills were transmitted to the underlying soils.

3. The willful destruction of unfavorable laboratory analytical results from effluent sampling of the outfall to South Branch Creek may have obscured LCP's impact to the sediments and surface waters downstream of the facility.

The former owner (GAF Corporation) operated a Waste Water Treatment Plant (WWTP) at this facility, principally for pH neutralization, through the 1950's, 60's, and early 70's. Purportedly the site of this treatment system was paved over and is currently used to maintain an extensive electrical power transformer substation.

UNIT ANALYSIS:
There are four (4) Solid Waste Management Units (SWMU's) at the LCP facility in Linden. The "Brine" Sludge Lagoon" is the only RCRA regulated unit. The "Chem-Fix" Lagoon, the "Sludge Roaster", and the "Container Storage Area" (CSA) comprize the remaining three units. A RCRA part A permit application was submitted by LCP on August 13, 1980. Since the only TSD activity on-site (the Brine Sludge Lagoon) was certified closed in September 1985 the part B application was considered unnecessary in lieu of a post closure permit.

1. The Brine Sludge Lagoon was an unlined surface impoundment in which mercury contaminated sludges were disposed of for twenty (20) years or more. The lagoon was roughly a trapezium, approximately 275' x 200' x 220' x 80', and the accumulated waste volume estimated at 30,900 cubic yards. Analysis of the sludge in the lagoon was performed by the Princeton Testing Laboratories June 15, 1981 which indicated that mercury was present at 340 ppm.

   In order to preclude worker exposure to mercury vapors eminating from the disturbed surface of the Brine sludge and Chem-Fix lagoons during closure operations, the USEPA and NJDEP required LCP to suspend manufacturing and restrict access to the site from 1982 until 1984. Closure operations (concluded September 1985) included a clay cap, soil cover, grading, and seeding.

   Five (5) shallow NJPDES permitted wells monitor leachate releases to the phreatic surface. Quaterly reports of analysis from these wells indicate that concentrations of the metals: lead, chromium, cadmium, mercury, selenium, silver, and radium have exceeded permitted parameters on several occasions between 1982 and 1987. Elevated mercury levels detected in the soils from the monitor well borings (up to 500 ppm) and from the land surface (up to 1,500 ppm) are, according to a Geraghty and Miller Inc. report dated February 1982, "the result of present or prior land use" and "represent low solubility compounds of sulfides, phosphates, or carbonates."

   In a recently issued NJPDES DGW permit, four (4) additional wells are mandated in order to fully characterize the local water table and adequately monitor leachate from this unit. During the December 22, 1987 RCRA walk through site inspection conducted by personnel of the Bureau of Planning and Assessment, the HNu meter detected organic vapors eminating from the headspace of existing monitor wells P-1 and P-2. The NJPDES 30 year post closure monitoring program should be expanded to include an initial scan for priority pollutants and volatile organic compounds. Further investigation of this unit is unwarranted at this time.

2. The Chem-Fix Lagoon was a surface impoundment, used briefly in 1976 for experiments in stabilizing the mercury constituents of the brine sludge. This lagoon was roughly triangular, 60 to 80 feet on each side, with a total surface area of approximately 3,000 square feet. The lagoon dikes were constructed to a height of 8 feet with an earthern core and crushed stone cover. Two (2) 0.20 mil thick visquene plastic liners were installed in the lagoon which was also

equipped with perforated under drain system for leachate collection. The lagoon contents, 460 cubic yards of treated brine sludge, was transfered to the Brine Sludge Lagoon in 1983. The Chem-Fix lagoon was subsequently excavated, filled, graded, and seeded. The proximity of the Chem-Fix Lagoon site to the Brine Sludge Lagoon site enables the NJPDES DGW permitted wells to monitor any leachate releases to the ground water from either unit. A further investigation of the Chem-Fix Lagoon is not warranted at this time.

3. The Sludge Roaster was designed and built in 1978 to vaporize mercury from steam dryed brine sludge, and thereby decontaminate the waste sufficiently to allow for final disposal at an off-site sanitary landfill. The roaster system was situated on a 16' x 40' concrete pad, one (1) foot thick, equipped with surface drainage channels (connected to the Waste Water Treatment Plant) and a cinder block curb. An Administrative Consent Order (ACO) issued September 1, 1981 required LCP to submit an application for a Hazardous Waste Facility (HWF) permit to operate the roaster unit. On June 30, 1982 the Bureau of Hazardous Waste Engineering (BHWE) denied the permit and LCP subsequently abandoned the process.

   A November 5, 1981 inspection by enforcement personnel of the Division of Environmental Quality, Air Pollution Control Program discovered a ruptured muffler plate on the sludge roaster that allowed excessive quantities of mercury vapors to be released to the atmosphere. Starting in 1985, this unit was dismantled and most of the components shipped to other LCP facilities around the country. No further investigation of the sludge roaster is warranted at this time.

4. The Container Storage Area (CSA) is a 300 square foot concrete pad, 1 foot thick with a 4 to 8 inch curb. Approximately 40 (55 gallon) drums or 2,000 gallons of waste: lubracating oils, transformer oils, disgreasing solvents, and dewatered brine sludges could have been stored on this unit at any one time. These wastes were shipped off-site for proper disposal within 90 days. During the recent RCRA walk through inspection (December 22, 1987) no containerized wastes were present at this unit, however the surface of the pad was covered with an absorbant material (speedy-dry) and some oily residues were noted on the gravel in the surrounding area. A limited investigation in the vicinity of the container storage area should be performed to determine the extent of contamination which may have occurred.

PERMITS:

NJPDES Discharge to Surface Water (DSW) permit #NJ0003778 grants LCP permission to discharge stormwater runoff and spill wash-down, after treatment, through one outfall to South Branch Creek (classified SE-3). This DSW permit was issued August 10, 1987 and is effective until April 30, 1991.

NJPDES Discharge to Ground Water (DGW) permit #NJ0003778 grants LCP permission to continue post-closure ground water monitoring of the wells surrounding the closed lagoons and to implement the modified Post-Closure Plan. "The potential discharge is leachate from the lagoon to the ground

waters of the State, to the organic (marsh) deposits of recent geologic age, the Raritan-Magothy formation of the Cretaceous age, and the New Brunswick formation of the Jurassic age." The DGW permit was issued October 30, 1987 and is effective until November 29, 1992.

Air Pollution Control permit #044133 was issued on March 3, 1980 granting LCP permission to operate the Sludge Roaster System. This permit expired on October 5, 1982 well after LCP suspended operation of the roaster November 7, 1981.

Other Air Permits included:

PERMIT #	UNIT	EXPIRATION DATE
067418	Boiler Stack	2/17/89
020928	Pura-SIV stack	11/9/85
037033	Mercury Cell Destruct Tower	3/26/89
040435	Mercury Cell Destruct Tower	3/26/88
076056	Mercury Cell Destruct Tower	5/15/87
036994	HCL Scrubber	6/11/88
036993	HCL Scrubber	11/20/88
035067	HCL Scrubber	3/28/88

REGULATORY ACTIONS:
An Administrative Consent Order (ACO), was issued September 1, 1981 by the NJDEP Division of Environment Quality. The ACO required LCP to apply for a permit to operate the Sludge Roaster as a hazardous waste treatment facility, to submit bi-weekly progress reports of activities at the brine sludge lagoon, to submit applications for closure of the Chem-Fix Lagoon and the Brine Sludge Lagoon, and to fully evaluate all potential avenues of release to the ambient environment (ie. air monitoring, groundwater monitoring, soil boring, and surface water monitoring).

A Civil Administrative Penality of $17,500.00 was assessed against a former tenant at LCP, the Kuhne Chemical Company (KCC) in November 1981. KCC was issued a NJPDES permit #0027707 on September 9, 1974 to discharge uncontaminated, non-contact cooling water to the South Branch Creek. Analysis of effluent sampling from KCC's outfall, conducted January 1981, revealed extremely elevated concentrations of caustics and free chlorine (up to 124,430 ppm) and a correspondingly excessive alkaline pH. Aside from the obvious violation of permit parameters the DWR alleged KCC's discharge of waste materials was deliberate.

RECOMMENDATIONS:
Of the four SWMU's at LCP Chemicals in Linden only one unit, the CSA requires corrective action under the RCRA post closure permit program. A limited investigation to include soil sampling in the vicinity of the CSA is necessary to determine the nature and extent of contamination which may have resulted from past spill events.

The previously cited "Areas of Concern" which remain accessible, also require soil sampling to verify that adequate remediation was accomplished at the numerous, documented sites of small spills and past releases.

Currently an investigation of the Brine Sludge Lagoon and the Chem-Fix Lagoon is under the auspices of a NJDLP DWR thirty year, post closure ground water monitoring program. Considering of the longevity of the Brine Sludge Lagoon and the detected presence of VOC's in the well heads during the RFA-VSI, the NJPDES DGW permit should be modified to require an initial scan for priority pollutants and volatile organic compounds. Further investigation and/or corrective action under RCRA may be necessary at some future date pending results of the present survey.

The Sludge Roaster System concrete pad was intact and the nearby soils appeared unstained on December 22, 1987 during the RFA-VSI. A further investigation of this unit is unwarranted at this time.

All actions taken at this facility by the USEPA should be integrated with previous activities and closely coordinated with the NJDEP.

Submitted by:

Kenneth Conrow

Kenneth Conrow, HSMS IV
NJDEP, DHWM - BPA

I. DOCUMENTS REVIEWED

	DOCUMENT NAME	DATE	AUTHOR	LOCATION	NO. PAGES
1.	Waste Lagoon GW Monitoring	2/82	G&M Inc.	BGWQ	50
2.	Closure & Post Closure Plans	10/21/86	BHWE	BHWE	30
3.	GW, SW, & Sediment Sampling	1980-87	LCP INc.	BGWQ	200
4.	Review & Evaluation GW Monitoring	6/84	G&M Inc.	BGWQ	20
5.	Evaluation and Site Inspection	5/82	EPA Edison, NJ	EPA Edison, NJ	20
6.	Closure & Post Closure Plans	10/16/86	LCP	BHWE	50
7.	Closure & Post Closure Plans	8/84	BGWQ	BGWQ	80
8.	Closure Plan Chem-Fix Lagoon	10/81	LCP	BHWE	30
9.	Closure Approval	11/7/83	BHWE	BHWE	20
10.	Preliminary Report on Brine Sludge	6/9/75	Chem Fix Inc.	BHWE	20
11.	Sludge Roaster Plans & Sludge Analysis	1981/1982	LCP Inc.	BHWE	50
12.	Health & Inspect Statement	1981	LCP Inc.	BHWE	[illegible]
13.	Site Inspections	1980-83	DHWM Enforcement	Metro	200
14.	NJPDES Permits	10/87	BGWQ	BGWQ	100
15.	Report of telephone call	6/25/80	DHWM Enforcement	Metro	1
16.	Report of telephone call	1/25/81	DHWM Enforcement	Metro	1
17.	Report of telephone call	12/2/80	DHWM Enforcement	Metro	1
18.	Compliance Monitoring Report	5/78	DWR Enforcement	Metro	20

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I. DOCUMENTS REVIEWED

	DOCUMENT NAME	DATE	AUTHOR	LOCATION	NO. PAGES
19.	Compliance Monitoring Report	2/79	DWR Enforcement	Metro	25
20.	ACO	9/1/81	DEQ Enforcement	Metro	20
21.	Record of Violation	7/19/85	DEQ Enforcement	Metro	2
22.	Discharge Report	2/7/79	DEQ Enforcement	Metro	1
23.	Order	11/4/81	DEQ Enforcement	Metro	1
24.	Investigation Summary	1/24/74	DEQ Enforcement	Metro	1
25.	Complaint Form	1/27/81	DEQ Enforcement	Metro	1
26.	Letter from LCP to EPA	3/20/87	LCP	Metro	1
27.	Letter from LCP to DWR	4/24/87	LCP	Metro	1
28.	Inspection Report, HRS	12/31/84	NUS Corp.	BPA	150
29.	Georlogy and GW Resources, Union County	4/19/82	USGS	BPA	10
30.	Letter from DFGW to NUS Corp.	11/15/84	DFGW	BPA	1
31.	Air Permits	3/3/80	DEQ-BAPC	Metro	20
32.	EPA Internal Memo	2/24/81	EPA-Region II	DWR, Metro	1
33.	Administrative Penalty	10/7/81	DWR	DWR, Metro	30
34.	NJPDES Permit	8/30/80	DWR	DWR, Metro	15

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II. OFFICES CONTACTED

	OFFICE	CONTACT	TELEPHONE #	CONTACT DATE
1.	BHWE	S. Wilson	(609) 292-9880	12/1/87
2.	BGWQM	J. Monroe	(609) 292-0424	12/3/87
3.	DHWM Metro Enforcement		(201) 669-3960	12/7/87
4.	DWR Metro Enforcement	T. Harrington	(201) 669-3900	12/8/87
5.	DEQ Air Program Enforcement		(201) 669-3935	12/8/87
6.	Linden Board of Health	H. Gaven	(201) 474-8409	12/11/87
7.	DCJ	P. Hayes	(609) 984-3900	12/11/87
8.	Flood Plain Management	P. Inverso	(609) 296-2373	12/14/87
9.	ORS		(609) 292-5697	12/14/87
10.	OEA	M. Ryon	(609) 292-8206	12/22/87
11.	USEPA		(201-321-6658	12/22/87
12.	DWR, Industrial Permits		(609) 292-0407	12/28/87

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Exhibit U

LCP CHEMICALS
FOOT OF SOUTH WOOD AVENUE
LINDEN, UNION COUNTY, NJ
EPA ID# NJD079303020

I. FACILITY OWNERSHIP/BACKGROUND INFORMATION

OWNERSHIP:
LCP Chemicals purchased the 26 acre chlorine production facility in 1972 from General Aniline and Film Corp. (GAF) who owned the facility since 1942. E.I. Dupont owned the land, which according to aerial photographs was coastal marshland, prior to GAF.

LCP leases two sections of their property. The Western section near the guard house, is leased by Union Carbide. They have been leasing the building and property since 1959 when the property was owned by GAF. The other leased section is Building 231. This building is leased by Microcell Technologies, Inc. They have leased the building since 1987. LCP also leased to Kuehne Chemical from 1974 to 1981, who operated in the area that is adjacent to Building 220 (presently a parking lot).

FACILITY OPERATIONS:
GAF began producing chlorine in 1961 by utilizing a "mercury cell electrolysis process". The process involved the electrolysis of a sodium chloride (brine) solution in the presence of metalic mercury. The residual mercury-sodium solution is then used to hydrolize water, forming sodium hydroxide and hydrogen gas. The metalic mercury was partially recovered and recycled in a brine purification process. The remaining mercury tainted sludge was placed into the Brine Sludge Lagoon. When LCP purchased the property they continued to process chlorine using the same process method with a few minor modifications. In 1975, LCP modified the electrolysis process by switching from a graphite anode to a dimensionally stable anode. The components of this anode would allow the leaching of the mercury so that the brine sludge could be recycled. Other products produced at LCP are caustic soda, hydrogen chloride and bleach. (Preliminary Report on Brine Sludge Lagoon).

In 1976, LCP investigated ways to clean the Brine Sludge Lagoon and remove mercury from the wastes that were being produced. They contracted Chem-fix of Pittsburgh to set up a temporary lab and to construct the Chem-fix Lagoon to receive non-contaminated wastes. They operated the lagoon for six days and determined that this was not a practicle means of clean-up and the lagoon was abandoned. LCP investigated the possibility of mercury recovery from the brine sludge via a roasting system in 1978. The roaster was designed and built to vaporize mercury from steam dried sludge. This would allow the solid waste to be shipped off site to a sanitary landfill. An Administrative Consent Order (ACO), issued September 1, 1981, required LCP to submit an application for a hazardous waste facility permit to operate the roaster unit. On June 30, 1982 the Bureau of Hazardous Waste Engineering denied the permit and LCP subsequently abandoned the process. Since the permit was not approved, LCP was also required to close the Brine Sludge Lagoon under the September 1, 1981 ACO.

Closure Plans for the two lagoons were submitted by February 1983 and approved on November 7, 1983. During the Closure of the lagoons, LCP closed down the production facilities in order to eliminate employee exposure to mercury. The closure of the lagoons was completed in 1984.

In June of 1984, LCP submitted a facility closure plan to NJDEP. This included the complete closure of all production areas due to economic reasons. The closure was completed in 1985. Since the closure of the production areas, LCP has operated as a storage and transfer station for methylene chloride, potassium hydroxide, sodium hydroxide and hydrochloric acid that is produced by other LCP facilities. The caustics and methylene chloride are stored in above ground tanks (five tanks, maximum volume 122,800 gallons). Hydrochloric Acid is pumped directly from tank cars to tank trucks.

Operations conducted by Union Carbide include the bottling, storing and transferring of hydrogen. They compress liquid hydrogen to hydrogen gas, bottle it and ship it to their clients. Occasionally they produce gas mixtures of hydrogen with either argon or nitrogen.

Union Carbide has had two environmental releases. One was an air release, which occurred on September 15, 1988 when a safety valve blew off a truck causing a release of hydrogen gas (60,000 cubic feet). The other was a series of oil releases that occurred over a period of several years. The soil contamination was reported by Union Carbide on October 14, 1987 to NJDEP's Division of Hazardous Waste, Metro Bureau of Enforcement. Union Carbide was issued a Notice of Violation (NOV) on December 1, 1987 for the discharge of a hazardous substance. They responded to the violation by contracting IT Corp to excavate the oil contaminated soil near their past waste oil storage area. The soil was excavated and backfilled to conform to the sites topography in May 1988.

Also in 1988, Union Carbide underwent a plant upgrading that was overseen by IT Corp. This included the dismantling of a hydrogen tank, cleaning and replacing of compressor parts and pipelines. A small amount of mercury was recovered from the area of the hydrogen tank by IT Corp.

Microcell Technologies Inc. is a pilot plant that produces small, hollow glass spheres that are used as a strengthener in steel. Microcell does not store, treat or process any hazardous substances. They have a completely closed cooling system so there is no requirement for a discharge permit. There is no evidence of environmental releases at this site.

Kuehne Chemical Company was contracted by LCP to handle the loading of LCP's products. Kuehne also manufactured sodium hypochlorite and chlorine gas. On January 8, 1981 an NJDEP inspector visited Kuehne and had noted a violation in their NPDES #NJ0027707 discharge to surface water permit. Kuehne's discharge had both high and low pH levels and elevated levels of free chlorine. On October 7, 1981 NJDEP Division of Water Resources issued an Administrative Penalty Assessment against Kuehne for $17,500.00. Kuehne ceased operations at the site on January 27, 1981.

LOCAL DEMOGRAPHICS:
LCP is located on 26 acres of filled marshland in the city of Linden, Union County, New Jersey. The property is located in an industrial area along the Arthur Kill. The site is bordered by the Kill (to the east), GAF Corp. (to the west and north) and Linden Roselle Sewage Authority and Northville Industries Corp. (to the south). Densely populated residential areas are located approximately 1.5 miles to the west with the nearest residential home being approximately 0.5 miles west on S. Wood Avenue. The estimated populations living within a one mile and a three mile radius of the site are 7 and 62,000 people, respectively.

TOPOGRAPHY/HYDROGEOLOGY:
According to aerial photographs there are three major topographic changes at the LCP site. Originally S. Branch Creek flowed through the LCP property to the Arthur Kill. Between 1974 and 1977 the creek was damned on both sides of the production area. This resulted in two small ponds on GAF's property. The creek presently flows from LCP's storage tanks to the Kill. The other two changes regard the Chem-fix Lagoon and the Brine Sludge Lagoon.

The Chem-fix Lagoon was constructed and operated in 1976. The Brine Sludge Lagoon was constructed by erecting earthen dikes to contain the sludge in the early 1960's. In 1984, the Chem-fix Lagoon was dewatered, excavated and back filled to conform with the site's topography and the Brine Sludge Lagoon was dewatered and capped closed. The 20 plus years of filling has caused the Brine Sludge Lagoon to be elevated approximately 40 feet above sea level.

LCP is underlain by the Brunswick Formation which consists mostly of organic clays, silt, sand, gravel and a shale bedrock. The first 10 to 15 feet below the surface of LCP is unconsolidated fill composed of silts, sands, gravel, crushed stone and brick. Beneath the fill is a dark gray organic clay layer that extends to the bedrock. Throughout the clay layer there are lenses of sand and gravel. Also between the fill and clay layers there are occasionally peat mats. The red-brown shale bedrock is encountered between 40 and 50 feet below the surface.

The groundwater in this area is not used as a potable water source due to the salt intrusion from nearby coastal waters. There are two public supply well fields within a four mile radius of LCP. One belongs to the Elizabethtown Water Company and is located approximately 3.5 miles northwest of LCP. The other well field is owned by the City of Rahway and located approximately 3.5 miles west of LCP. The wells range from 50 to 350 feet in depth and are all screened in the Brunswick Formation.

LCP monitors its groundwater under NJPDES permit (NJ0003778). The six monitoring wells currently maintained by LCP were installed along the perimeter of the Brine Sludge Lagoon in 1981. The following table lists the well numbers, total depth and screened interval.

WELL NO.	TOTAL DEPTH (feet)	SCREENED INTERVAL (feet)
MW1	38.50	18.00-38.50
MW1A	10.00	5.00-10.00
MW2	39.48	18.00-28.00
MW3	31.77	15.00-30.00
MW4	39.18	18.00-38.00
MW5	38.00	8.00-38.00

LCP currently monitors five of the six wells (not MW1A) to determine the impact of the Brine Sludge Lagoon on the groundwater. Past monitoring reports have indicated that groundwater quality criteria had been exceeded for iron, manganese, total organic halogens (TOX), arsenic, cadmium, chromium, lead, mercury, selenium, silver and radium. During RCRA Facility Assessment visual site inspections (VSI) conducted by NJDEP Bureau of Planning and Assessment on December 20, 1987 and April 13, 1989, the presence of volatile organic (VO) vapors were detected in headspace of Monitoring Wells 1, 2, 3, and 4. The wells are sampled quarterly for total organic carbon (TOC), TOX, phenols, dissolved metals and a few other inorganics.

LCP was required to install four new monitoring wells under their final NJPDES permit issued on October 30, 1987. LCP wished to contest the well installation and requested an adjudicator hearing on February 25, 1988. On March 28, 1988, Donald DeNoon and Karl DeVoe of LCP, Michael McEachern of Geraghty and Miller, LCP's hydrogeologic consultant, and representatives of the Division of Water Resources (DWR) met to discuss the installation of new wells and the adequacy of the present monitoring system.

The DWR had three concerns with the present monitoring system. They were:

- The well screens are not all the same length and the wells are not all the same depth.

- A release from the facility might be diluted to a concentration below the detection limits.

- A leak from the lagoon might be moving above the main groundwater system as "perched water" because of the natural glacial deposits beneath the lagoon are low in permeability (G & M proposal 5/10/88).

To address these concerns Geraghty and Miller proposed that the wells be monitored with the use of a temporary "packer" or plug that would isolate the top five feet of screen that is below the water table. The DWR agreed that the study should be conducted.

In July and August 1988 Geraghty and Miller collected groundwater samples and analyzed them for antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium and pH. The samples collected on July 27, and August 30 were conduted with the use of a temporary packer and the August 29 sampling was conducted without the use of the temporary packer. MW1 and MW1A did

not utilize a packer during the July 27 and August 30 sampling. This is because MW1A is a shallow well and MW1 was filled with sediment isolating only the top four feet of screen below the water level. The analysis indicated that MW1A exceeded the New Jersey Groundwater Quality Standard of 50 ppb, for arsenic, with levels of 73 ppb, 76 ppb, and 96 ppb. All other parameters monitored were below New Jersey Groundwater Quality Standards (NJGWQS) for all samples from all wells.

A comparison of the analytical results for wells sampled with a packer (July 27) and without a packer (August 29 & 30) revealed no significant differences, except in MW2, which exhibited an increase in barium when the packer was utilized. The concentration without the packer was 390 ppb while the concentrations with the packer were 750 ppb and 670 ppb. All concentrations were below the NJGWQS limit of 1,000 ppb. Mercury was detected only in MW1A. The concentrations for all three sampling dates were nearly identical; 0.58 ppb, 0.57 ppb, and 0.58 ppb. Again all of the concentrations were below the NJGWQS limit of 2 ppb. Also, a trace amount (8 ppb) of lead was detected in MW3 on the July 27 sampling round. Lead was not detected in any of the other wells or during either of the August sampling episodes. The lead concentration was below the NJGWQS limit of 50 ppb.

These analyses lead Geraghty and Miller to conclude that since there was no significant differences, except for barium in MW2, that there is no dilution occurring in the deep wells. Also, based on data provided by LCP, it has been determined that LCP has never used arsenic, therefore, the presence of arsenic is due to an outside source of contamination. The relatively invariant contaminant concentrations and the proximity of the well to the Arthur Kill suggest that the mercury and arsenic detected in the well represent background conditions in the Arthur Kill rather than contamination resulting from the LCP facility. (G & M January 89 Sam Report).

As of April 1989, the DWR had not yet reached a decision as to whether LCP would be required to install the additional monitoring wells. They also are considering amending the permit to include an analysis of volatile organics based on the findings of the December 22, 1987 VSI.

SURFACE WATER:

The surface waters of concern are the Arthur Kill, which borders the site on the east, and South Branch Creek, which flows through a section of the site and is a tributary to the Arthur Kill. The Arthur Kill is classified as "Saline Estuarine Waters: SE2" by the DWR and is used for recreational boating. The Peregrine Falcon, an endangered species, is known to hunt in the salt marshes near the Kill.

LCP operates a waste water treatment plant. When the plant was in full operation the waste waters from the electrolysis and sludge roaster as well as the plant's surface water run-off were treated and discharge to South Branch Creek under NJPDES permit NJ0003778. However, since the shut down of the plant's processing units, only surface run-off is treated. After treatment, the water is stored in an above ground tank. Due to the small amount of treated water, LCP discharges about two times a year.

From May 23 to May 26, 1988, Cosper Environmental Services Inc. performed a bioassay on LCP's effluent. The effluent samples collected were clear with no noticeable odor. There was a small amount of sediment present. The test organism for the bioassay was the sheeps-head minnow. There was no detection of the disease in the brood stock. For this bioassay, there was a 5.0% mortality at 100% effluent. The results were satisfactory with a LC50 of >100% effluent.

II. PERMITS:

1. NJPDES: LCP was issued a surface water discharge permit NJ0003778 on August 10, 1987, which expires April 30, 1991. The permit allows LCP to discharge treated surface run-off and spill wash-down to South Branch Creek (classified SE-3).

   LCP was issued a groundwater discharge permit NJ0003778 on October 30, 1987, which expires November 29, 1992. The permit requires LCP to continue to monitor the wells surrounding the closed Brine Sludge Lagoon in order to determine the impact of the lagoon on the groundwater.

2. Air: Currently LCP has a grandfathered air pollution control permit #076565, which is for the vents on their methylene chloride storage tanks. Previously LCP had eight air permits for hydrogen chloride tanks and several chlorine process apparatus. Due to the closure of the production areas at LCP, these permits have been deleted.

3. LCP submitted their Part A RCRA application on August 13, 1980. Since the only RCRA regulated unit was certified closed in September 1985, a Part B application was considered unnecessary in lieu of a post closure permit.

III. SOLID WASTE MANAGEMENT UNITS:

Twelve solid waste management units were identified at the LCP facility. The units are: The Brine Sludge Lagoon, the Chem-fix Lagoon, the 500K Tank, the Waste Oil Drum Storage Area, Area Between Building 231 and Railroad Tracks, South Branch Creek, the Bullet Tanks, Sludge Roaster, Salt Silo 4, past GAF Waste Water Treatment Area, the cracks in Building 230 and 240, and the Effluent Treatment Building. The only RCRA regulated unit is the Brine Sludge Lagoon.

UNITS SUMMARY:

1. Brine Sludge Lagoon: The lagoon is an unlined earthen surface impoundment, which is surrounded by earth dikes that extend about seven feet higher than the facility's average ground level. The lagoon is trapezium in shape, approximately 275 feet by 200 feet by 220 feet by 80 feet. The total waste volume is estimated to be 30,900 cubic yards, which was accumulated for over 20 years before the lagoon was closed in 1984.

   Under an Administrative Consent Order dated September 1, 1981, LCP agreed to submit a closure plan to the NJDEP for the lagoon. LCP submitted the plan on July 16, 1982. The plan was amended on February 28, 1983 and approved by the NJDEP on November 7, 1983. The lagoon

received the excavated waste from the Chem-fix Lagoon, which was dewatered, compressed and covered with a two foot clay cap. The cap was then covered with a foot of soil and seeded. The closure was completed in November 1984. During the closure of the lagoon, NJDEP and USEPA required LCP to suspend chlorine productions to eliminate worker exposure to mercury.

In 1981, LCP installed six monitoring wells to determine if there was any impact on the groundwater from the lagoon. These wells are sampled quarterly for TOC, TOX, phenols, dissolved metals and a few other inorganics. On several occasions between 1982 and 1987 quarterly reports indicate that concentrations of lead, chromium, cadmium, mercury, selenium and silver have exceeded the NJPDES permitted level.

Under the July 31, 1981 NJDEP Administrative Consent Order, LCP was required to implement a monitoring program to evaluate the release of mercury and other metals to the ambient environment. The program includes air, groundwater and soils obtained from land borings and creek sediments. Geraghty and Miller were retained to conduct all sampling except air. Recon Systems was contracted to perform air sampling. (Attachment B).

Recon collected two sets of sampling data on June 4, 1981. The first set of samples was collected three feet above the surface of the waste pile. Concentrations of mercury ranged from 1000 to 5000 nanogram/cubic meter (ng/m^3) to 12,600 ng/m^3 of mercury with an average concentration of 6400 ng/m^3. Based on the mercury contamination levels, crosswind speed and the lagoons dimensions an approximately 113 g/day of mercury is emitted by the lagoon.

Groundwater samples were taken on October 6, 1981 and October 15, 1981 and analyzed by LCP's lab for dissolved mercury. All samples were below the USEPA Primary Interim Drinking Water Standard of 0.002 ppm. The water samples were also sent to Princeton Testing Labs to be analyzed for calcium, barium, iron and mercury. Again all wells had levels below 0.002 ppm for mercury. However, the levels of barium ranged from 2.0 ppm to 7.0 ppm which exceed the NJDEP Action/Cleanup Level of 1 ppm.

Soil samples were taken from the monitoring well borings for MW1, MW2, MW3, MW4, MW5. The samples were analyzed by LCP for desorbable mercury with samples taken every 6 inches from the surface to the total depth of each well. Levels of mercury ranged from 0.26 ppm to 772 ppm, with the concentrations decreasing with depth. Surface soil samples were also taken near the sludge roaster and across Avenue B near the railroad tracks. The samples were analyzed in the same manner as the previous samples and had recorded levels of mercury ranging from 27.45 ppm to 1,580 ppm. Also, one creek-bed sediment sample was taken and analyzed by LCP for mercury. The sample contained 46.42 ppm of mercury. All of the surface samples exceeded the NJDEP Action/Cleanup Level of 1 ppm for mercury.

On April 13, 1989 the Bureau of Planning and Assessment (BPA) conducted a RCRA Visual Site Inspection (VSI) of the LCP facility. The closed lagoon appeared secure. During the investigation of the

monitoring wells, volatile organics were detected in the headspace of the wells by both the OVA and Hnu meter with readings ranging from 2 ppm to 350 ppm. Also, on a previous VSI conducted by the BPA on December 22, 1987, organic vapors were detected in MW1 and MW2 with the Hnu meter. Due to the presence of organic vapors in the headspace of the wells, it is recommended that the NJPDES 30 year post closure monitoring program be expanded to include an initial scan for priority pollutants and volatile organics. Due to the presence of mercury contamination, a RFI is recommended for this unit to determine the extent of the contamination. The RFI should consist of soil sampling around the perimeter of the lagoon to determine if any hazardous materials have leached from the lagoon. The sample analysis should include, but not be limited to, total mercury, total barium, volatile organics and priority pollutants. If this sampling indicates significant levels of contamination exist, a more detailed RFI is recommended.

2. The Chem-fix Lagoon: The Chem-fix Lagoon was an earthen surface impoundment which was in operation for a few months in 1976. The lagoon dikes were constructed to a height of eight feet with an earthen core and crushed stone cover. Two 0.20 mil thick visquene plastic liners were installed in the lagoon which was also equipped with a perforated under drain system for leachate collection. Any leachate collected was pumped to the effluent treatment plant. The lagoon received approximately 460 cubic yards of treated brine sludge.

   The Chem-fix Lagoon was closed in 1983. The contents of lagoon were excavated and placed into the Brine Sludge Lagoon. It was then back filled, graded and seeded. The proximity of the Chem-fix Lagoon to the Brine Sludge Lagoon allows the NJPDES permitted wells to monitor any leachate releases to the groundwater from either lagoon. During the VSI an April 13, 1989, the lagoon appeared secure and there is no evidence of releases. Due to the proximity of this lagoon to the Brine Sludge Lagoon and the potential to have received mercury waste; a limited RFI is recommended. The RFI should consist of soil sampling to determine if hazardous wastes have leached from the lagoon. The sample analysis should be identical to the analysis of the Brine Sludge Lagoon.

3. The Waste Oil Drum Storage Area: The Container Storage Area is a 300 square foot concrete pad, one foot thick, with a six inch curb. During full plant operations up to 40 (55 gallon) drums of waste lubricating oils, transformer oils, degreasing solvents, and dewatered brine sludges could be stored there. These wastes were shipped off-site for proper disposal within 90 days.

   During the December 22, 1987 VSI, there were no drummed waste being stored, however the pad was covered with an absorbant material and oily residues were noted on the gravel in the surrounding area. During the April 13, 1989 VSI, stained soils were also noted. Using air monitoring equipment (Hnu and OVA), organic vapors were detected in the soil (10 ppm on the OVA and 6 ppm on the Hnu). It is recommended that a RFI be conducted on this unit to determine the extent of the release. The RFI should consist of soil sampling and the analysis should include, but not be limited to, petroleum hydrocarbons, volatile organics, total mercury and priority

pollutants. Based on the results of the soil sampling it may be required that the groundwater be monitored.

4. Area Between Building 231 and Railroad Track: In August 1980, NJDEP was contacted by a LCP employee. The employee stated that one day in 1973 or 1974, LCP used a steam shovel to take some of the brine sludge from the lagoon and spread it on the ground behind the compressor building (#231). In 1981, during the Geraghty and Miller sampling episode, two surface soil samples (S-3, S-4) were taken near this area. The samples were analyzed for desorbed mercury. The results were: S-3, 1070 ppm and S-4, 1580 ppm of mercury. These levels of mercury are the highest detected in any sampling conducted on the LCP site. These concentrations are 300 ppm greater than the soil samples near the Brine Sludge Lagoon. Due to the presence of mercury contamination, a RFI is recommended for this unit to determine the extent of the contamination. The RFI should consist of soil sampling which includes, but not be limited to, total mercury and priority pollutants. If the results of the soil sampling indicate significant contamination, further investigation will be necessary to determine the extent.

5. 500K Tank and Surrounding Areas: The 500,000 gallon tank is located between Avenue C and Avenue B. The tank has served two purposes. Originally the tank was used to store sodium hydroxide and later became incorporated with the effluent treatment system and was used as a storage tank for wastewater. Presently the tank is not used. The area surrounding the tank was paved in 1982.

   From 1980 to 1982, a series of NJDEP Hazardous Waste Enforcement inspections revealed several releases in the area of the 500K Tank. The releases in this area are:

9/17/80	Brine Sludge was observed on the gravel near the 500K "collection tank."
1/21/81	During the inspection a liquid was observed spewing from a cracked PVC pipe near the 500K Tank and pump pit.
10/22/81	A brine sludge slurry release from a transfer line was evidenced by a 1 by 15 foot spill area located on Avenue B between the pump pit and the Brine Sludge Lagoon. There was also a hydrochloric acid spill approximately 15 feet northwest of the 500K Tank.
4/13/82	Sodium sulfide crystals were evident on the gravel surface in the pump pit area.

   Due to documented releases, a limited RFI is recommended for this unit. The RFI should consist of soil sampling and the analysis should include, but not be limited to, total mercury, hydrochloric acid, sodium hydroxide, sodium sulfide, and priority pollutants. A more in-depth RFA may be required based on the results of the soil sampling.

6. South Branch Creek: South Branch Creek is a tidal arm of the Arthur Kill that flows along the eastern border of the LCP property. Since

1974, LCP has had three discharges to the creek. On or about October 30, 1972 and February 7, 1974, there was an overflow of supernatant in contact with brine muds from LCP's Brine Sludge Lagoon into South Branch Creek. LCP pled guilty to violation 3 USC 1311 (a) for both occurrences on September 25, 1975. A fine of $5,000 was levied for each occurrence. The third incident occurred on August 15, 1979. Due to a sodium chloride block in LCP's east saturator an excess of mercury tainted brine overflowed the saturator. The surge of flow exceeded the surge capacity of the wastewater system. This caused an estimate of 10,000 to 20,000 gallons of brine to flow into South Branch Creek. LCP notified NJDEP and the EPA samples taken by the Coast Guard revealed the mercury contamination of the spill was 8.6 ppm.

In 1981, a sediment sample was taken from the creek. The sample was analyzed by LCP's Labs for mercury. The mercury concentration was 46 ppm, which exceeds NJDEP action/clean-up level of 1 ppm. Due to past releases to the South Branch Creek a limited RFI is recommended for this unit. The RFI should consist of sediment sampling and surface water sampling both upstream and downstream of LCP's discharge (DSN 001). The sample analysis should include, but not be limited to, total mercury, barium and priority pollutants.

7. Bullet Tanks: These tanks have been abandoned since about 1983. The Bullet Tanks were used to store brine sludge. A series of NJDEP Hazardous Waste Enforcement inspections have revealed that there were continual problems with brine containment in the area under the tanks. From September 17, 1980 until April 13, 1982 the inspections stated that the containment area had brine residues. On October 9, 1980 and January 22, 1981 the area was full with the potential to overflow.

   Due to the potential for a release to exposed soils a limited RFI is recommended for this unit. The RFI should consist of soil samples around the bermed area of the abandoned Bullet Tanks. The sample analysis should include, but not be limited to, total mercury, acid-base extractables and priority pollutants. Based on the results of the soil sampling it may be required that an additional investigation be conducted.

8. The Sludge Roaster: The Sludge Roaster was constructed in 1978 to vaporize mercury from steam dried brine sludge. The roaster was built on a 16 x 40 foot concrete pad, one foot thick, with drain channnels, that connect to the effluent treatment plant, and a cinder block curb around the pad.

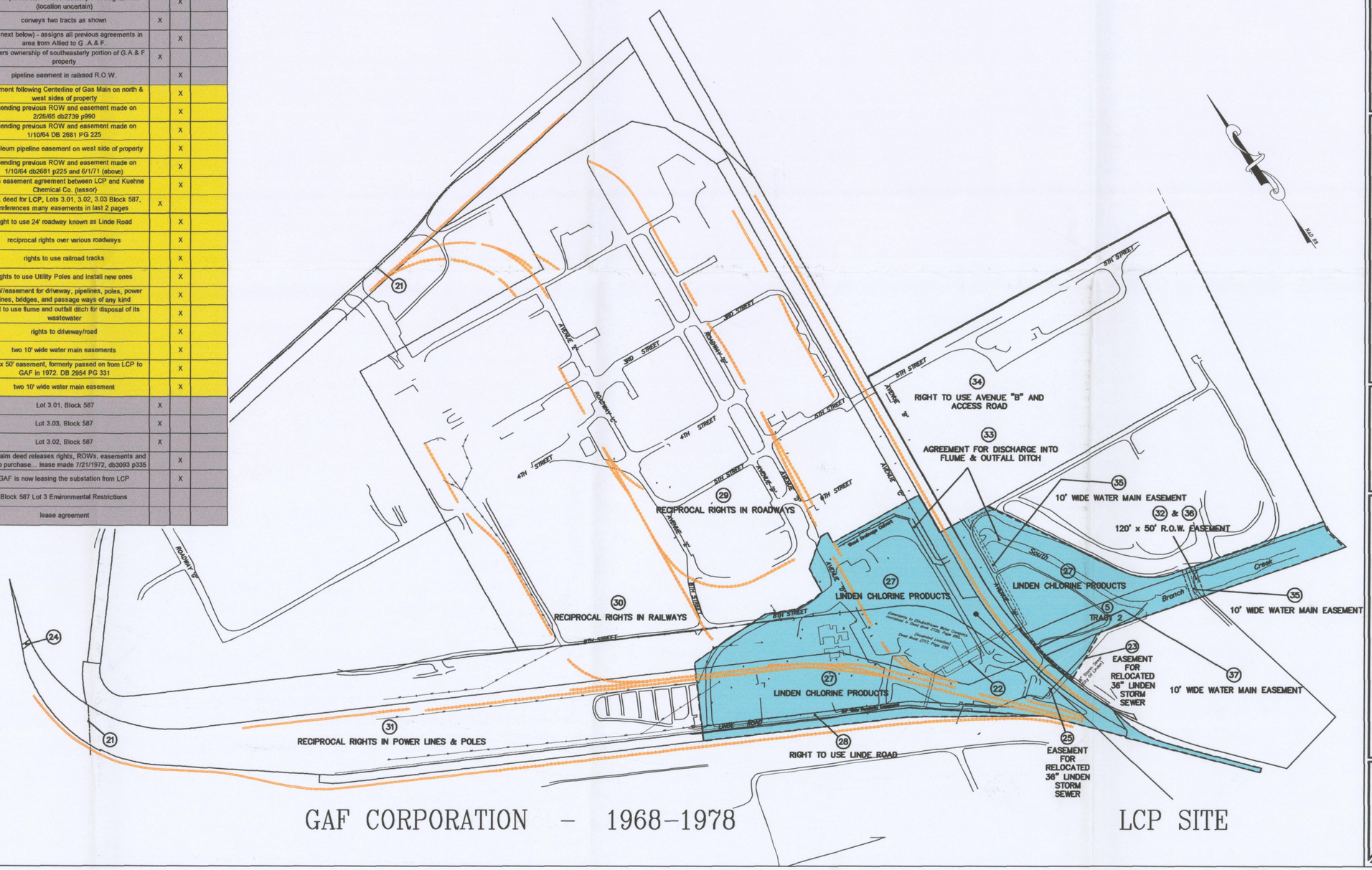
   Under an Administrative Order issued on September 1, 1981, LCP was required to submit an application for a Hazardous Waste Facility permit to operate the roaster unit. The permit was denied on June 30, 1982 by the Bureau of Hazardous Waste Engineering (BHWE) and LCP subsequently abandoned the process.

   An enforcement inspection by the Division of Environmental Quality, Air Pollution Control Program on November 5, 1981 disclosed a hole in a muffler plate on the sludge roaster. This allowed an excessive quantity of mercury vapors to be released to the atmosphere.

MAP

TABLE OF DOCUMENTS SUPPLIED

No.	Date	Book	Page	Grantee	Grantor	Description	Property	Easement	
1	7/27/1909	533	233	Borough of Linden	Grasselli Chemical Company	trunk sewer line through property to Staten Island Sound		X	
2	9/27/1909	533	589	Borough of Linden	Tremley Point Corporation	Trunk Sewer line through property		X	
3	2/28/1912	588	499	Borough of Linden	Edward F. Robinson	Trunk Sewer line through property		X	
4	10/20/1928	1165	576	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
5	10/20/1928	1165	582	Grasselli Dyestuff Corporation	The Grasselli Chemical Company	conveys two tracts as shown	X		
6	11/30/1928	1162	250	E.I. duPont de Nemours and Company	The Grasselli Chemical Company	conveys lands not previously conveyed to Grasselli Dystuff Corp. (exceptions to Tract 5)	X		
7	10/31/1939	1391	302	General Aniline & Film Corporation	General Aniline & Film Corporation	consolidates and renames General Aniline Works And American I.G. Chemicals into General Aniline & Film	X		
8	5/5/1942	1458	210	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
9	9/15/1949	1776	7	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	additional acquisition from DuPont	X		
10	7/7/1950	1847	79	duPont de Nemours	Central Railroad Company of New Jersey	irrevocable license to keep, maintain and use a private access road across railroad property		X	
11	4/18/1951	1898	168	Linden Roselle Sewerage Authority	Sinclair Refining Company	Block 587, Lots 5 & 21	X		
12	1/27/1958	2356	634	General Aniline & Film Corporation	Central Railroad Company of New Jersey	copy not included. believed to convey the railroad property highlighted	X		
13	7/9/1963	2648	319	General Aniline & Film Corporation	E.I. duPont de Nemours and Company	Block 587, Lots 2.01, 2.02	X		
14	1/10/1964	2681	229	City of Linden	General Aniline & Film Corporation	easement for 36" Linden storm sewer		X	
15	11/19/1965	2771	858	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to maintain and use pipeline bridge and pipelines crossing railroad (location uncertain)		X	
16	11/19/1965	2771	862	Allied Chemical Corporation	Central Railroad Company of New Jersey	grants permission to use raodway crossing railroad (location uncertain)		X	
17	1/19/1967	2794	745	General Aniline & Film Corporation	The Central Railroad Company of New Jersey	conveys two tracts as shown	X		
18	5/15/1967	2802	839	General Aniline & Film Corporation	Allied Chemical Corporation	(see next below) - assigns all previous agreements in area from Allied to G .A.& F.		X	
19	5/15/1967	2802	536	General Aniline & Film Corporation	Allied Chemical Corporation	transfers ownership of southeasterly portion of G.A & F property	X		
20	11/3/1967	2821	929	Union Carbide Corporation	General Aniline & Film Corporation	pipeline eaement in railraod R.O.W.		X	
21	8/20/1970	2909	897	Elizabethtown Gas Company	GAF Corporation	easement following Centerline of Gas Main on north & west sides of property		X	
22	2/24/1971	2917	226	Elizabethtown Water Company	GAF Corporation	amending previous ROW and easement made on 2/26/65 db2739 p990		X	
23	6/1/1971	2924	209	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 DB 2681 PG 225		X	
24	8/12/1971	2928	677	Buckeye Pipe Line Company	GAF Corporation	petroleum pipeline easement on west side of property		X	
25	4/17/1972	2946	162	City of Linden	GAF Corporation	amending previous ROW and easement made on 1/10/64 db2681 p225 and 6/1/71 (above)		X	
26	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products, Inc.	cross easement agreement between LCP and Kuehne Chemical Co. (lessor)		X	
27	8/24/1972	2954	273	Linden Chlorine Products	GAF Corporation	P.Q. deed for LCP, Lots 3.01, 3.02, 3.03 Block 587, references many easements in last 2 pages	X		
28	8/24/1972	2954	284	Linden Chlorine Products	GAF Corporation	right to use 24' roadway known as Linde Road		X	
29	8/24/1972	2954	296	Linden Chlorine Products	GAF Corporation	reciprocal rights over various roadways		X	
30	8/24/1972	2954	312	Linden Chlorine Products	GAF Corporation	rights to use railroad tracks		X	
31	8/24/1972	2954	323	Linden Chlorine Products	GAF Corporation	rights to use Utility Poles and install new ones		X	
32	8/24/1972	2954	331	GAF Corporation	Linden Chlorine Products	ROW/easement for driveway, pipelines, poles, power lines, bridges, and passage ways of any kind		X	
33	8/24/1972	2954	340	GAF Corporation	Linden Chlorine Products	right to use flume and outfall ditch for disposal of its wastewater		X	
34	1/17/1974	2995	280	Northville Linden Terminal Corp.	GAF Corporation	rights to driveway/road		X	
35	5/8/1975	3033	986	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easements		X	
36	5/22/1975	3034	974	Northville Linden Terminal Corp.	GAF Corporation	120' x 50' easement, formerly passed on from LCP to GAF in 1972. DB 2954 PG 331		X	
37	3/5/1976	3061	4	Elizabethtown Water Company	Linden Chlorine Products	two 10' wide water main easement		X	
38	12/14/1979	3207	82	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.01, Block 587	X		
39	12/14/1979	3207	93	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.03, Block 587	X		
40	12/14/1979	3207	97	LCP Chemicals--New Jersey, Inc.	LCP Chemicals & Plastics, Inc	Lot 3.02, Block 587	X		
41	8/11/1983	3331	219	Linden Chlorine Products	Kuehne Chemical Company	quit-claim deed releases rights, ROWs, easements and right to purchase... lease made 7/21/1972, db3093 p335		X	
42	9/17/1986	3499	97	GAF Corporation	Linden Chlorine Products	GAF is now leasing the substation from LCP		X	
43	9/23/1994	4228	125		Linden Chlorine Products	Block 587 Lot 3 Environmental Restrictions			
44	7/21/1972	3093	335	Kuehne Chemical Company, Inc.	Linden Chlorine Products	lease agreement			



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Keller & Kirkpatrick
301 Gibraltar Drive, Suite 2A, Morris Plains, NJ. 07950 973-377-8500
Certificate of Authorization #24GA28537400
CONSULTING ENGINEERS
LAND SURVEYORS
LANDSCAPE ARCHITECTS
PLANNERS
WERNER A. MALL, Professional Land Surveyor, Lic. 37201
GEORGE P. JAMES, Professional Engineer, Lic. 22834

CHRONOLOGICAL DEED PLOTTING
FOR
LCP Chemicals & Plastics, Inc.
TAX BLOCK 587
CITY OF LINDEN, UNION COUNTY, NEW JERSEY

SHEET No. 4 OF 6

R2-0003608