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LANDAU ASSOCIATES, INC.

USEPA SF
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Final Investigation Report
Blair Waterway Property
Tacoma, Washington

February 24, 1992
(Amended April 14, 1992)

Prepared for

Port of Tacoma
Tacoma, WA

Prepared by

Landau Associates, Inc.
P.O. Box 1029
Edmonds, WA 98020-9129

PORT of TACOMA U.S.A.

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JUN 17 1994
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June 16, 1994

Ms. Karen Keeley
U. S. Environmental Protection Agency
1200 Sixth Avenue
Seattle WA 98101

Subject: Correction to Reported Elevations
Blair Waterway Property Transfer
Port of Tacoma, Tacoma WA
Work Order No. E1192

This letter describes a correction to the elevations previously referenced in the following documents concerning the Blair Waterway Property transfer investigation and cleanup:

- Preliminary Investigation Report, Blair Waterway Property, Tacoma, Washington, April 13, 1990 (Amended April 23, 1990)
- Final Investigation Report, Blair Waterway Property, Tacoma, Washington, February 24, 1992 (Amended April 14, 1992)
- Supplemental Investigation, Blair Waterway Property, Tacoma, Washington, April 22, 1992
- Analysis of Alternatives, Blair Waterway Property, Tacoma, Washington, August 14, 1992 (Amended November 18, 1992)
- Cleanup Plan, Blair Waterway Property, Tacoma, Washington, February 19, 1993
- Blair Waterway Property Completion Report (including the Lincoln Avenue Ditch Addendum), Port of Tacoma, Tacoma, Washington, March 30, 1994.

Elevations reported in these documents were referenced to a benchmark (surface brassie) at the intersection of Lincoln and Alexander Avenues which, based on a 1991 control survey of the Port of Tacoma area conducted by HCE, Inc., had an elevation of 18.04 ft. on the Port of Tacoma/Corps of Engineers datum. However, a second control of the original benchmark elevation of

P.O. Box 1837 • Tacoma, Washington 98401-1837 • Telephone (206) 383-5841 • Telex 32-7473
Commissioners: Robert G. Earley • Jack [illegible] • Philip M. [illegible] • Paul J. O'Malley • Ned Shore
Executive Director: John J. Terpstra

18.04 ft. was revised and a new elevation was 17.02 ft. (David Evans and Associates, Inc., Port of Tacoma Survey Control Map, March, 1993) has been established. Therefore, 1.02 ft should be subtracted from the elevations in the above-referenced reports to determine the actual elevation on the Port of Tacoma/Corps of Engineers' datum.

Please contact me if you have any questions or comments.

Very truly yours,

Curtis L. Ratcliffe, P.E.
Chief Engineer

cc: Bill Sullivan, Puyallup Tribe of Indians
Jerry Ninteman, Landau Associates, Inc.

LANDAU
ASSOCIATES,
INC.
Geoenvironmental Engineering and Technologies

February 24, 1992

Port of Tacoma
P.O. Box 1837
Tacoma, Washington 98401-1837

Attention: Ms. Leslie Sacha
Director of Environmental Affairs

**RE: FINAL INVESTIGATION REPORT
BLAIR WATERWAY PROPERTY**

Attached is the Final Investigation Report for the Blair Waterway Property. We prepared this report for the Port of Tacoma, as authorized by Work Order E1192.

This report responds to requirements identified in the March 21, 1990 Memorandum of Agreement among the Puyallup Tribe of Indians, the Port of Tacoma, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency regarding the conveyance of six parcels of property to the Puyallup Tribe pursuant to the Puyallup Tribe of Indians Settlement Act of 1989. This report presents the results of investigations conducted in December 1989 through February 1990, July to September 1990, and July 1991; a comparison of laboratory analyses results to numerical environmental criteria; and identifies relevant cleanup objectives.

We appreciate the opportunity to continue providing engineering and environmental consulting services to the Port of Tacoma.

LANDAU ASSOCIATES, INC.

By:

Robert G. Fulton, P.E.
Vice President

and

Brian F. Butler
Senior Project Geologist

RGF/BFB/njb
No. 118-03.43
TACOMA\BLAIR\BLAR0223.LET

EXECUTIVE SUMMARY

LOCATION AND DESCRIPTION

The Blair Waterway Property (Property) is located along the north shore of the Blair Waterway in an area known as the Commencement Bay "Tideflats." The Property, which is 43.4 acres in area, is bounded by Alexander Avenue and railroad tracks to the northeast, the Blair Waterway to the southwest, the Weyerhaeuser Wood Chip Facility to the southeast, and the Domtar Gypsum Facility to the northwest. The area of the Property within 200 ft of the ordinary high water mark of Commencement Bay and the Blair Waterway is included in the Port Industrial S-10 Shoreline District designation, and the area landward of this area is included in the M-2 Heavy Industrial designation.

Property features of note include approximately 3,000 ft of shoreline along the Blair Waterway; a skid dock and a Graving Dock in the southeastern half of the Property; an impoundment (Mud Lake) for 37,000 cy of sediments dredged from the Blair Waterway in the northwestern portion of the Property; the Lincoln Avenue Ditch in the central portion of the Property; and two boundary ditches along the southeast (Weyerhaeuser Boundary Ditch) and northwest (Domtar Boundary Ditch) Property lines.

The history of the site indicates that fill was placed above the Tideflat surface beginning in the 1950s, during the episodic construction of the Blair Waterway. Former site activities included a wood chipping operation (1979-1981), construction of floating bridge pontoons using the Graving Dock and related facilities (1981-1985), and storage of dredged sediments, unsuitable for open-water disposal, in the lined Mud Lake Impoundment (1983-present).

INVESTIGATION PROCESS

This Blair Waterway Property Final Investigation Report (Report) is completed in accordance with the March 21, 1990 Memorandum of Agreement (MOA) between the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), the Puyallup Tribe of Indians (Tribe), and the Port of Tacoma (Port). The MOA guides the environmental investigation and necessary cleanup of six parcels of property to be conveyed to the Tribe pursuant to the Puyallup Tribe of Indians Settlement Act of 1989 and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Blair Waterway Property is one of those six parcels. The MOA requires that evaluation of property conditions be accomplished to demonstrate that "properties comply with appropriate Federal or

State contamination law" and can be used for commercial and industrial purposes. Chemical analysis results are evaluated using both commercial and industrial criteria.

Investigation of Blair Waterway Property conditions was accomplished by Landau Associates, Inc. (Landau Associates) in three phases, as outlined in the MOA and described below. The three phases are: 1) the environmental audit, which was summarized in the Phase I Environmental Investigation Report; 2) the preliminary site investigation and sampling, which were summarized in the Preliminary Investigation Report and the Draft Final Investigation Report; and 3) this Final Investigation Report, which summarizes the results of the previous phases and includes additional investigation results, final evaluations, and consideration of Tribe, EPA, and Ecology comments to the previous reports. This Final Report identifies areas where analysis of cleanup alternatives is needed.

During the environmental audit, relevant data and reports were collected and reviewed, historic site use was investigated and compiled, and a reconnaissance of the Property was conducted. The results of the audit, as summarized in the Phase I Environmental Investigation Report, were used to guide following investigations.

Investigations to address the Phase I Environmental Investigation Report recommendations were specified in the Phase II Environmental Investigation Work Plan. The Work Plan was approved by the Tribe, EPA, and Ecology. Site investigations and samplings were accomplished during the periods of December 1989 through February 1990, July and August 1990, and July 1991. Chemical analysis of the samples was accomplished to allow a screening evaluation for the possible presence of contaminants resulting from past Property use, from fill or construction materials brought to the Property or migrating from off-site sources. Environmental conditions at the Property were evaluated using samples of soil and ditch sediment, samples of marine sediment, groundwater samples from new monitoring wells, evaluation of data from Reichhold Chemicals, Inc. (RCI) monitoring wells southeast of the Graving Dock, and data from earlier property investigations. Most samples were analyzed for a range of constituents, including metals, volatile and semivolatile organics, pesticides and polychlorinated biphenyls (PCBs); some samples were tested only for a limited set of constituents. Sampling during the investigation included potential areas of known or suspected contamination, as well as portions of the Property where no contamination was expected; thus, the evaluation is considered to be conservative.

EVALUATION

Data Evaluation Process

The results of the chemical analyses were evaluated relative to screening criteria and local reference conditions in an effort to identify areas and constituents of potential concern. Screening criteria include Federal drinking water criteria, ambient water quality criteria, cleanup standards set by the Washington State Model Toxics Control Act (MTCA) Cleanup Regulations, and Federal Commencement Bay, PSDDA, and State marine sediment criteria. Chemical test data were validated, and the validation report was approved by EPA. Data obtained indicate that previous "release" of hazardous materials has occurred at some portions of the Property and/or offsite, with the term "release" including such conditions as groundwater contamination and the presence of ASARCO slag. Under certain exposure conditions, the presence of these materials may represent a potential threat to human health and the environment. The results of this evaluation and resulting recommendations for further action are summarized below.

The Property location and use meet the MTCA requirements for application of industrial criteria. To expedite the property transfer process, the Tribe resolved to restrict the use of the Blair Waterway Property to be consistent with industrial use zones M-2 and M-3 of the City of Tacoma zoning code. Accordingly, MTCA industrial use criteria are considered appropriate to evaluate the need for analysis of cleanup alternatives at the Blair Waterway Property.

Shallow Aquifer

Arsenic is present in shallow groundwater in the central portion of the Property at concentrations greater than MTCA residential (drinking water) levels but less than Federal Drinking Water Standards and the RCI RCRA groundwater protection standard. The principal source of the arsenic is believed to be near-surface slag deposits and, as such, will be addressed by source-related remedial activities for the slag. No analysis of cleanup alternatives is recommended for the shallow aquifer. This aquifer is not currently used as a drinking water source and is unlikely to be used as a source in the future because of its quantity limitations. It is recommended that shallow groundwater not be used as a drinking water source.

Intermediate Aquifer

Arsenic and organic chemical contamination is present in some portions of the intermediate aquifer. Chemical contamination of groundwater had been previously reported in the southeastern portion of the Property by RCI.

This investigation detected constituents including pentachlorophenol (PCP), formaldehyde, and vinyl chloride in intermediate depth wells in the central Property area. These constituents are among those for which groundwater protection standards are identified in the RCI RCRA permit. Vinyl chloride was detected in this study in the intermediate aquifer near the north corner of the Graving Dock at concentrations greater than the RCI Permit Protection Standard, the Federal Drinking Water Standard, and the MTCA Method A groundwater cleanup level. Formaldehyde was detected in several groundwater samples, but the analytical method used resulted in questions concerning the precision of the formaldehyde data. Therefore, although laboratory reported formaldehyde concentrations exceed MTCA Method B criteria for groundwater, no conclusions for additional action based on formaldehyde are presented.

Arsenic, at concentrations exceeding RCI's protection standard and the MTCA criteria is reported in one RCI intermediate aquifer monitoring well located adjacent to the southeast side of the Graving Dock. Arsenic concentrations, when detected in other wells, are generally less than the protection standard and MTCA criteria. This arsenic in groundwater may be associated with slag on the sides of the Graving Dock or from other sources. Additional evaluation of arsenic in intermediate groundwater is recommended in conjunction with the next phase of study.

Groundwater data reported by RCI was reviewed during this investigation, and comparison of concentrations detected to screening criteria confirm the need for RCI's planned groundwater remediation at the Blair Waterway Property.

It is recommended that RCI accomplish groundwater corrective action specified in the RCRA permit. Activities in preparation for groundwater cleanup of a portion of the intermediate aquifer at the Blair Waterway Property have been initiated by RCI in accordance with the RCRA permit, although pumping and treatment of groundwater from the Blair Waterway Property has not commenced. Additionally, RCI and EPA should be notified that vinyl chloride and PCP were detected in some wells at the Property, so that any necessary steps to expand the RCI groundwater remedial program can be initiated.

Periodic groundwater sampling is recommended to monitor progress of groundwater remedial action and identify any changes in existing distribution of organic and metal contaminants. Near-surface groundwater, such as that from the intermediate aquifer, should not be used for drinking water purposes.

Slag

Metals, including arsenic, are associated with slag on the Property. Slag, probably from the ASARCO smelter, is present at the surface and at shallow depth in the central portion of the Property and along the sides of the Graving Dock. Exploration of the base of the Graving Dock has not identified slag to be present at its bottom. Two slag samples were analyzed using the toxicity characteristics leaching procedure (TCLP), and the testing results for one of these samples exceeded MTCA TCLP criteria for arsenic. This investigation shows that shallow groundwater, subsurface soil, and ditch sediment quality are influenced by the presence of arsenic in the slag. Analysis of cleanup alternatives for the slag is appropriate to evaluate methods to minimize human exposure and migration of contaminants in surface water and groundwater to the marine environment.

Domtar and Weyerhaeuser Boundary Ditches

There were no exceedances of numerical screening criteria in the boundary ditch sediment samples near the Domtar Gypsum facility. No further evaluation of this area is warranted.

Arsenic exceeds MTCA industrial soil criteria and arsenic, copper, and zinc exceed Commencement Bay Nearshore/Tideflats Record of Decision (CBN/T ROD) Sediment Quality Objectives (SQOs) criteria in some samples from boundary ditch sediment near the Weyerhaeuser facility. The source of arsenic in these samples is believed to be onsite or nearby ASARCO slag deposits. Analysis of cleanup alternatives is needed to evaluate appropriate action for Weyerhaeuser Boundary Ditch sediments.

Lincoln Avenue Ditch and Former Lincoln Avenue Ditch

Sample results from the Lincoln Avenue Ditch indicate that arsenic concentrations in some samples exceed MTCA industrial soil criteria; and that other metal and organic contaminants are present at concentrations less than MTCA industrial soil criteria and, in most cases, are less than MTCA commercial soil criteria. An investigation by EPA and Ecology of contaminant sources in the drainage area upstream of the Property has commenced. RCI investigations also report arsenic, and other contaminants, in sediments of ditches that discharge to the Lincoln Avenue Ditch system. Analysis of cleanup alternatives associated with arsenic is appropriate for sediments in the Lincoln Avenue Ditch. Such analysis should consider the installation of the storm water sewer planned by the City of Tacoma.

A thin sediment horizon in a former section of the Lincoln Avenue Ditch is buried at a depth of 12-13 ft. The concentration of dioxin in one of two samples tested slightly exceeds MTCA Method C commercial criteria but was below MTCA industrial criteria. Arsenic and PCB concentrations exceeded MTCA industrial soil criteria in one of three samples. Because of the depth and limited amount of this buried sediment in the former ditch and the relative immobility of the dioxins and PCBs in groundwater, no analysis of cleanup alternatives is recommended. A conditional point of compliance may be necessary for the buried ditch sediments, with institutional controls implemented as required by MTCA. The conditional point of compliance will be defined during the next phase of study.

The Lincoln Avenue Ditch is tidally influenced. Since ditch sediments are not marine sediments, they are compared to marine criteria only in terms of their source potential for marine sediment contamination due to ditch water outfall. Results from several Lincoln Avenue Ditch sediment samples, when compared to marine sediment criteria, exceed CBN/T ROD SQOs for PCBs and arsenic. Sediments in the Lincoln Avenue Ditch are a potential, but minor, source of contaminants to the Blair Waterway. Source control efforts by EPA and Ecology in the drainage area outside of the Blair Waterway Property will be required to minimize continued contaminant discharge to the marine environment.

Mud Lake

Mud Lake is a lined impoundment on the Property which contains sediment dredged from the Blair Waterway, and which was not suitable for uncontrolled open water disposal. Previous sampling indicates that contaminants are present in Mud Lake sediments. The Port plans to remove Mud Lake sediments as part of the Sitcum Waterway Cleanup Action, which includes dredging of the Blair Waterway and placement of sediments in the Milwaukee Waterway as fill. Following removal of Mud Lake sediments, sampling to document residual soil quality is recommended. Any additional action will be based on test results of residual soils.

There were no exceedances of soil screening criteria in samples from the outfall and spillway areas. No additional evaluation is warranted.

Marine Sediment

CBN/T SQOs are exceeded for PCBs in one Blair Waterway Property surface sediment sample. Dredging of the marine sediments in conjunction with the Milwaukee Waterway

Fill/Blair Waterway Dredging Project will remove the shallow sediments from the Property. No additional sampling or analysis of sediment is recommended.

REMEDIAL ACTIVITIES AT ADJACENT PROPERTIES AND PLANNED SITE DEVELOPMENT

Remedial activities under way at adjacent and nearby facilities influence environmental conditions at the Blair Waterway Property. Filling of the Milwaukee Waterway and dredging of the Blair Waterway to increase the navigational depth are planned in conjunction with the Sitcum Waterway Remediation Project. Dredging of the Blair Waterway will remove contaminated sediment from the Blair Waterway Property in the area between the pierhead line and the current top of bank. Contaminated sediments in the lined Mud Lake Impoundment will also be removed in conjunction with the Sitcum Waterway Remediation Project and placed as fill in the Milwaukee Waterway.

Corrective action at the RCI facility to address soil, ditch sediment, and groundwater contamination has commenced under the RCI RCRA Permit. RCI is also required to accomplish remediation of groundwater at the Blair Waterway Property to address intermediate aquifer contamination associated with former RCI activities. RCI has installed two extraction wells but has not commenced groundwater pumping and treatment at the Property. Requirements to evaluate environmental contaminant source issues which effect conditions in the Lincoln Avenue Ditch are addressed in ongoing EPA evaluation of the "TSD Alley" portion of the Lincoln Avenue drainage system.

Other activities are planned at the Property, pursuant to the Puyallup Settlement Agreement. These activities include the City of Tacoma's Lincoln Avenue utility relocation, the Port of Tacoma's filling of the Graving Dock, and the Tribe's proposed dredging and excavation for berth expansion. Subsequent Property development also may include berth construction, raising the existing grade with additional fill, and paving the site for future activities.

ACTION SUMMARY

The areas/issues at the Blair Waterway Property which warrant analysis of cleanup alternatives are:

- Arsenic contamination of groundwater in the intermediate aquifer to the southeast of the Graving Dock

- ASARCO slag lining Graving Dock sides and in the central area of the Property
- Arsenic contamination of sediments in the Weyerhaeuser Boundary Ditch
- Arsenic and organic contaminants in the Lincoln Avenue Ditch.

Additionally, it is recommended that:

- RCI accomplish corrective action for groundwater contamination at the Blair Waterway Property, as required by the RCI RCRA permit.
- RCI and EPA evaluate intermediate aquifer detections of vinyl chloride in Monitoring Well BW-9i for possible expansion of the RCI extraction system.
- The Port accomplish periodic sampling of groundwater at the site to monitor RCI cleanup and to identify any changes in groundwater conditions.
- Groundwater movement be re-evaluated after the Graving Dock is filled.
- Groundwater in the shallow and intermediate aquifers not be used for drinking water.
- Residual soils be tested following excavation of Mud Lake, and that any additional action be based on evaluation of test data.
- EPA and Ecology take action to address source control issues in the upstream portion of the Lincoln Avenue Ditch drainage.

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BLAIR WATERWAY PROPERTY

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Herrera Environmental Consultants, Inc.
February 13, 1990

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BLAIR WATERWAY PROPERTY

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Reichhold Chemicals, Inc., Tacoma Facility
January 1991

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Applied Geotechnology, Inc.
January 15, 1986

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In Mud Lake Sediment
Applied Geotechnology, Inc.
January 15, 1986

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(Applicable to Upper Hylebos Property,
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1.0 INTRODUCTION

1.1 PURPOSE

This Final Investigation Report (Report) for the Blair Waterway Property (Property) is prepared for the Port of Tacoma (Port) by Landau Associates, Inc. (Landau Associates), and is completed in accordance with the March 21, 1990 Memorandum of Agreement (MOA) (Tacoma, Port 1990) between the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), the Puyallup Tribe of Indians (Tribe), and the Port. The MOA guides the environmental investigation and necessary cleanup of six parcels of property to be conveyed to the Tribe pursuant to the Puyallup Tribe of Indians Settlement Act of 1989 (U.S. Congress 1989) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; EPA 1980). The Blair Waterway Property is one of these six parcels. This Final Investigation Report is provided to the Port, Tribe, EPA, and Ecology as specified in the MOA, Section IIIA7.

The results of an initial environmental audit of the Property accomplished during spring 1989 are summarized in a report (Landau Associates 1989a). The Preliminary Investigation Report (Landau Associates 1990a) presented the results of investigations conducted in December 1989 through February 1990. The Draft Final Investigation Report Blair Waterway Property (Landau Associates 1991a) describes the results of all investigations accomplished until May 1991. This Final Investigation Report incorporates appropriate response to EPA, Ecology, and Tribe comments on the Blair Waterway Property Draft Final Investigation Report, includes all data provided in the Preliminary and Draft Final Investigation Reports, and includes results from investigations conducted since the Draft Final Investigation Report. This Report presents the sampling data gathered in accordance with the Phase II Environmental Investigation Work Plan (Landau Associates 1989b) and Sampling Plans (Landau Associates 1990b,c), provides an evaluation of site conditions compared to numerical environmental criteria [including chemical-specific applicable or relevant and appropriate requirements (ARARs) and factors to be considered (TBCs)], and presents relevant cleanup objectives.

In Section 1.0, the approach for the Blair Waterway Property investigation is described, a brief summary of the site location and physical description is presented, zoning of the Property is discussed, and a summary of the conclusions and recommendations from the Blair Waterway Property Environmental Audit (Landau Associates 1989a) is presented. In Section 2.0, sampling activities from December 1989 to February 1990, July to August 1990, and July

1991 site investigations are briefly summarized. A detailed description of the explorations and sampling efforts are in Appendices A and B. The investigation results are presented in Section 3.0, followed by a presentation of potentially applicable numerical environmental criteria in Section 4.0. Comparison of site data to identified numerical environmental criteria is presented in Section 5.0. Cleanup objectives and recommendations for analysis of cleanup alternatives are discussed in Section 6.0. Analytical data are presented in Appendices C and D. A summary of findings and recommendations are presented in Section 7.0.

1.2 APPROACH TO INVESTIGATION

A history of site activities, adjacent site development, and a summary of previous investigations at, and in the vicinity of, the Blair Waterway Property was presented in the Phase I Environmental Investigation Report (Landau Associates 1989a). This information, in conjunction with an inspection of present site conditions, was used during the Phase II property investigation process to focus exploration and sampling in areas where previous use indicated potential for degradation of environmental conditions. Sampling was also accomplished in areas of the Property with no identified history or surface indication of environmental degradation. Marine sediment and Lincoln Avenue Ditch sediment sampling was intended to provide a general indication of conditions and for comparison with other available information. Thus, the approach, as approved by EPA, Ecology, and Tribe representatives and presented in the Phase II Environmental Investigation Work Plan (Landau Associates 1989b), was designed to focus the investigation towards areas where environmental contamination, if present, would be expected. As specified in the MOA, evaluation includes consideration of Property conditions with respect to compatibility with future commercial and industrial use.

1.3 PROPERTY LOCATION AND DESCRIPTION

The Blair Waterway Property is located on the north side of the Blair Waterway (Figure 1), an industrial waterway extending southeasterly from Commencement Bay near Tacoma, Washington, in an area known as the Commencement Bay Tideflats (Tideflats). The Tideflats originally referred to an area of intertidal mudflats and marshlands at the mouth of the Puyallup River, but now refers to the extensive area of industrial lands and waterways developed since the late 1800s.

The Tideflats area is underlain by sediments deposited following the end of the Vashon stade of the Fraser Glaciation when deltaic deposits formed as the Puyallup River discharged

into Commencement Bay. The Tideflats have undergone extensive alteration during urbanization of the Tacoma area. Dredging and filling of the Tideflats have resulted in channelization of the Puyallup River, and the creation of a series of waterways. Materials dredged from the waterways or excavated from the nearby hillsides were placed on the Tideflats to fill the land between the waterways for industrial and commercial development, including the Blair Waterway Property.

The Blair Waterway Property is located within the boundary of the Commencement Bay Nearshore/Tideflats (CBN/T) Superfund Site. The Blair Waterway, adjacent to the property, is not designated as a "problem area" within the CBN/T site.

The Blair Waterway Property is a 43.4-acre parcel of land located between Alexander Avenue and the Blair Waterway near the center of the Tideflats industrial area (Figure 1). The Property is generally level, is divided approximately in half by the former extension of Lincoln Avenue, and includes about 3,000 ft of shoreline. Approximately 8 acres of the Property is intertidal and subtidal, extending from the shoreline to pierhead line of the Blair Waterway. The Property is bounded by Alexander Avenue to the northeast, the Weyerhaeuser Wood Chip facility to the southeast, the Domtar Gypsum facility to the northwest, and the Blair Waterway to the southwest (Figure 2). The Reichhold Chemicals, Inc. (RCI) facility is located across Alexander Avenue, northeast of the Property.

Property features of note include: a skid dock and a graving dock on the southeastern half of the Property; an impoundment for 37,000 cubic yards of sediments dredged from the Blair Waterway (Mud Lake) in the northwestern portion of the Property; the Lincoln Avenue Ditch in the central portion of the Property; and two boundary ditches along the southeast (Weyerhaeuser Boundary Ditch) and northwest (Domtar Boundary Ditch) Property lines.

The history of the site (summarized in Landau Associates 1989a) indicates that fill was placed above the Tideflat surface beginning in the 1950s, during the episodic construction of the Blair Waterway. [Former site activities included a wood chipping operation (1979-1981), construction of floating bridge pontoons using the Graving Dock and related facilities (1981-1985), and storage of dredged sediments unsuitable for open-water disposal in the lined Mud Lake Impoundment (1983-present).] Activities at the nearby RCI facility have resulted in groundwater contamination beneath the Property. Corrective action associated with RCI includes the installation of groundwater monitoring and recovery wells in the southeastern portion of the Blair Waterway Property under the Resource Conservation and Recovery Act (RCRA) Corrective Action Plan (RCI 1988a). Activities at other industrial and commercial areas

nearby, with surface water drainage to Lincoln Avenue Ditch, have also contributed to the contamination of sediments in the Lincoln Avenue Ditch on the Property (SAIC 1990).

The approximate locations of buried utilities crossing on, and in the vicinity of, the Blair Waterway Property are shown on Figure 3. Of principal interest are the 13- to 15-ft deep utility corridor along Alexander Avenue and the multiple utility corridor paralleling the Lincoln Avenue Ditch, including the 9-ft deep sanitary sewer line crossing the Property. The Alexander Avenue utility corridor is a potential hydrogeologic conduit for groundwater flow in the shallow aquifer. Construction of a buried storm drain to replace the open Lincoln Avenue Ditch and realignment of the sanitary sewer in the Lincoln Avenue corridor is planned by the City of Tacoma.

1.4 PROPERTY ZONING

Review of the Land Use Regulatory Code (Tacoma, City 1990), including the Shoreline Management Plan, indicates that the portion of the Property within 200 ft of the ordinary high water mark of Commencement Bay is included in the Port Industrial S-10 Shoreline District designation. The S-10 designation permits a variety of uses and development activities, subject to the issuance of a Substantial Development Permit. The only permitted commercial, port, terminal, and industrial uses, however, are those that are either water-dependent or water-related. The area landward of the 200-ft wide S-10 designation is included in the M-2 Heavy Industrial designation. The M-2 designation allows most commercial or heavy industrial uses. An M-3 designation allows commercial and light industrial uses. Residential dwellings are not allowed. The 1988 Puyallup Settlement Agreement also references only commercial/industrial use of the Property (Tribe 1988) once transfer of the Property to the Tribe is completed. A Puyallup Tribal Council Resolution (Tribe 1991) defines that Property use will be consistent with City of Tacoma industrial zones, M-2 and M-3.

1.5 SUMMARY OF PHASE I ENVIRONMENTAL AUDIT

The Phase I environmental audit at the Blair Waterway Property consisted of collection and review of relevant data and reports, compilation of historic site uses, and a Property reconnaissance. Evaluation of this information was used to develop recommendations for additional investigations to be conducted as part of the Phase II environmental investigation.

The primary conclusions and recommendations presented in the Phase I report (Landau Associates 1989a) are summarized below.

1. Lincoln Avenue Ditch: Review of previous studies [Applied Geotechnology (AGI) 1986; RCI 1989] indicates the presence of contamination including metals, polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), and dioxins in sediments of the Lincoln Avenue Ditch both on the Property and upstream of the Property. Sediments collected from various ditch segments upstream of the Blair Waterway Property, as part of RCI investigations (RCI 1989), show similar constituents with generally higher concentrations than detected at the Blair Waterway Property. Because of the potential discharge of contaminants to the Blair Waterway, additional sampling of the onsite portion of the Lincoln Avenue Ditch was identified as appropriate.
2. Boundary Ditches: Little or no sampling of the boundary ditches was previously accomplished for this Property. Therefore, additional sampling of the boundary ditches for general characterization was identified as appropriate.
3. Mud Lake: Mud Lake sediments have been analyzed on several occasions; reported concentrations of PAH, phthalates, and metals have varied between samples. Thus, additional sampling of the sediments was considered to be appropriate. However, since the Port plans to remove the Mud Lake sediments as part of the Sitcum Waterway Cleanup and the Milwaukee Waterway Fill projects, additional sampling was subsequently determined to be unnecessary.
4. Groundwater: Upgradient groundwater, principally at the RCI facility, is contaminated with solvents, phthalates, formaldehyde, metals, pentachlorophenol (PCP) and other phenols, PCBs, and PAH. Planned corrective action at the RCI facility involves monitoring and extracting contaminated groundwater in the intermediate and deep aquifers at the RCI facility and at adjacent properties, including the Blair Waterway Property southeast of the Graving Dock. It does not address either monitoring or remediation of groundwater in any other portion of the Blair Waterway Property and does not address these actions in the shallow aquifer. Accordingly, installation of groundwater monitoring wells at several locations in the central and northwestern portions of the Property was considered to be appropriate.
5. Marine Sediments: Offshore sediments, while not considered to be sufficiently contaminated to warrant remediation under the Commencement Bay Nearshore/ Tideflats Record of Decision (CBN/T ROD; EPA 1989a) activities, contain metals, semivolatile organics, and PCBs. Accordingly, collection of marine sediment samples

to provide data representative of sediment conditions for the nearshore portions of the Property was considered appropriate.

6. Outlet Fill Area: Previous investigations at the previous outlet area of the Lincoln Avenue Ditch (Figure 2), which was filled later than the rest of the Property, reported elevated concentrations of metals. Additional sampling in this area was appropriate.
7. Drum Storage Area: Surface soil under the drum storage area used during the operation of the Graving Dock was previously analyzed only for volatile organics. Since the identities of chemicals stored in the drums are not known, the previous analysis did not sufficiently characterize the soil at this location. Additional surface soil sampling and analysis was appropriate to characterize surface soil conditions.

In addition to the specific locations and media described above, investigation of the general near-surface condition, particularly with regard to the potential presence of slag for surfacing, was considered important. Accordingly, additional exploration and testing was accomplished.

1.6 SUMMARY OF PRELIMINARY INVESTIGATIONS

Investigations to address the Phase I findings specified in the Work Plan (Landau Associates 1989b) were accomplished. The results were presented in the Preliminary Investigation Report (Landau Associates 1990a). Chemical data were validated and the data and validation package was reviewed and approved by EPA. Evaluation of those results identified the need for additional investigation, including groundwater, slag, Lincoln Avenue Ditch sediment, and marine sediment conditions. Following EPA, Ecology, and Tribe review (EPA 1990a) of the Preliminary Investigation Report, additional sampling was accomplished and reported (Landau Associates 1990b,c). Subsequently, inspection and sampling of the Graving Dock bottom was accomplished; no plan for this activity was submitted to EPA, Ecology, and the Tribe for review. The laboratory data for the Graving Dock bottom material were reviewed for validation purposes, and an addendum to Appendix D was transmitted to the EPA, Ecology, and the Tribe (Landau Associates 1991b). The results of the additional investigations and evaluations are presented in this Final Investigation Report.

2.0 SITE INVESTIGATION

The site investigation was accomplished in accordance with the Phase II Environmental Investigation Work Plan (Landau Associates 1989b) and subsequent sampling plans (Landau Associates 1990b,c), which were approved by EPA, Ecology, and the Tribe. The investigation included collection and analysis of samples of soil, ditch sediment, groundwater, marine sediment, and Graving Dock sediment, as specified in Table 1. The explorations and samplings were focused principally toward conditions identified by previous investigations at the Property and nearby properties as areas with potential environmental degradation due to past practices, or the movement of contaminated groundwater or sediments onto the Property. Blair Waterway Property site investigations were accomplished in December 1989 to February 1990, July to August 1990, and Graving Dock inspections in July 1991. Methods used for explorations and sample collection are summarized in Appendices A and B.

2.1 HYDROGEOLOGY AND GROUNDWATER QUALITY

Identification of groundwater conditions at the Property was an important aspect of the investigation; therefore, monitoring wells were installed to permit sampling of water from various groundwater zones beneath the Property and to permit measurement of groundwater level variations. Data from RCI (1988a) was considered for planning the locations and depths of new monitoring wells with respect to potential groundwater zones or aquifers. Five monitoring wells and two extraction wells installed by RCI were already present on the Property at the time of this investigation. Eighteen new wells were installed at ten locations during this investigation: 9 in the shallow aquifer (Wells BW-1s through BW-4s and BW-6s through BW-10s), 6 in the intermediate aquifer (Wells BW-1i, BW-3i, BW-4i, BW-5i, BW-7i, and BW-9i), and 3 in the deep aquifer (Wells BW-3d, BW-4d and BW-9d) (Figure 4). A variance for well construction regulations (WAC 173-160; Ecology 1989a) was obtained for shallow wells. The terms "aquifer," "shallow," "intermediate," and "deep" are discussed in Section 3.1. Exploration and sampling methods, boring logs, surveyed reference elevations, and well-completion diagrams are presented in Appendix A. Table 2 summarizes well construction details. Well BW-1d, identified in the work plan, was not installed. The Plan was modified to permit evaluation of groundwater quality in Well BW-1i and other Blair Waterway Property deep wells, and to install Well BW-1d only if results from other wells indicate significant

groundwater contamination in the intermediate aquifer. Well BW-1d was not installed because the results from Well BW-1i identified no significant contamination.

Groundwater sampling procedures are summarized in Appendix A. Samples collected from these wells in December 1989 and January 1990 were analyzed for metals, volatile and semivolatile organics, pesticides, and PCBs, plus p-tert-butylphenol and formaldehyde, with selected samples also analyzed for major cations and anions (Table 1). Additional sampling of 7 monitoring wells (BW-1i, BW-3i, BW-4i, BW-5i, BW-7i, BW-9i, and BW-9d) was accomplished in July and August 1990 for volatile organics and chlorinated phenols. Analytes were identified to permit evaluation with pertinent criteria and comparison with groundwater quality data reported by RCI at a nearby property. In addition to the evaluation of groundwater quality data from the 18 new monitoring wells, a review of available groundwater quality data (RCI 1990, 1991) from existing RCI monitoring wells on or near the Blair Waterway Property was also accomplished.

Stratigraphic information from soil borings and drilling for monitoring wells were used to evaluate site hydrogeology. Measurements of groundwater elevations were conducted on February 2, 1990 to investigate tidal influence on groundwater movement. The results of groundwater measurements are discussed in Section 3.1, and the data are presented in Appendix A. Single well variable head (slug) tests to estimate hydrogeologic characteristics of the soils were not accomplished because estimates of hydrogeologic characteristics reported by RCI (1988a) are considered adequate for the purposes of this investigation.

2.2 SOIL CONDITIONS

Soil conditions at various areas of interest were explored using a backhoe and hand equipment. Soil samples were collected for chemical analyses (Table 1) at many of the exploration locations. The locations of test pit explorations excavated by backhoe equipment are shown on Figure 5. Samples of selected materials, such as slag, material at the Graving Dock bottom, and spills of material on the railroad bed, were collected by hand. Exploration and sampling methods and logs of test pits are presented in Appendix A.

As discussed earlier, the sampling locations were based on the results of the Environmental Audit and subsequent site evaluations. The soil investigations included:

- Collection of five soil samples adjacent to the **railroad right-of-way** (BR1-1 through BR5-1) and analysis for total metals, semivolatile organics, PCBs, and pesticides. Samples of plastic beads and powder (RRS-1 and RRS-2) found along the **railroad tracks** were also taken for identification.

- Collection of two soil samples at the **Lincoln Avenue Ditch outlet fill** (BO1-1 and BO2-1) and analysis for EP Toxicity metals for comparison to previous information.
- Collection of two soil samples from the former **drum storage area** (BD1-1 and BD2-1) and analysis for PCBs, and volatile and semivolatile organics to evaluate if significant spills had occurred.
- Collection of two soil samples from the former **fuel area** (BF1-1 and BF2-1) and analysis for semivolatile organics and total petroleum hydrocarbons (TPH) to evaluate if significant spills had occurred.
- Four test pit explorations (BOLD-1, -2, -2A,and 3) from which three soil samples from the **sediment layer of the now buried former Lincoln Avenue Ditch** (BOLD-1, BOLD-2, and BOLD-3) were collected. Samples were analyzed for metals, volatile and semivolatile organics, PCBs, and pesticides. Two samples were analyzed for dioxins because earlier investigations of the current Lincoln Avenue Ditch sediments, as reported by AGI (1986) showed dioxins to be present, indicating a potential source of this constituent in the Lincoln Ditch drainage basin.
- Collection of six soil samples from **test pit explorations** (BT1-1 through BT6-1) at various locations on the Blair Waterway Property and analysis of samples for metals, semivolatile organics, and PCBs for identification of general soil conditions. Sample BT-2-1 was analyzed for EP Toxicity for arsenic.
- Test pits (BT-8 through BT-21) were excavated in the central Property area to define the extent of shallow buried **slag**.
- Collection of two samples (BW-S1 and BW-S2) of **slag** material for Toxicity Characteristics Leaching Procedure (TCLP) analysis.
- Collection of ten samples for visual examination and two samples which were composited into one (BG11/12) of material (sediment) at the **bottom of the Graving Dock**.

Explorations by backhoe excavation and visual inspections were also accomplished in the central Property area, the margins of the Graving Dock, and in the fill area at the outlet of the Lincoln Avenue Ditch to identify the possible presence and extent of slag. A diver inspected the underwater portion of the Graving Dock to identify and sample the bottom condition (Appendix A).

2.3 DITCH SEDIMENTS

Sediment quality in ditches provides an indication of surface water quality and general property conditions, as well as off property conditions. The prominent ditches, boundary and

Lincoln Avenue Ditch, transmit surface water flow from both on and off Property areas. Sediment samples were collected in December 1989 and January 1990, and July and August 1990 in accordance with the work plan at selected locations shown on Figure 6. The sampling locations were based on the results of the environmental audit and subsequent site evaluations. The samples were collected in the upper 1 ft, which appeared to be the maximum sediment depth. The samples of sediments were analyzed for the constituents identified in Table 1. The ditch sediment investigations included:

- Collection of four sediment samples in December 1989 (BLD1-1 through BLD4-1) from random locations along the **Lincoln Avenue Ditch**, and analysis for priority pollutants for comparison with previously collected data. Four additional samples (BLD5-1 through BLD8-1) were collected in August 1990 and analyzed for the same constituents.
- Collection of 12 sediment samples (BDD1-1 through BDD7-1 and BWD1-1 through BWD5-1) at random locations from the two **boundary ditches** (seven from the ditch adjacent to Domtar, five from the ditch adjacent to Weyerhaeuser), and analysis for total metals, volatile and semivolatile organics, and PCBs to provide data regarding potential off-property sources.
- Collection of one sample (BDP1-1) of the orange precipitate in the northeast (Domtar) **boundary ditch**, and analysis for total metals and cations/anions. The black precipitate identified during the Phase I environmental investigation was removed during a period of high precipitation; thus, no sample was collected.
- Collection of two samples (BOS1-1 and BOS2-1) from the **outfall and spillway** of Mud Lake and analysis for total metals, volatile and semivolatile organics, PCBs and pesticides to provide an indication of Mud Lake influence.

No sampling of Mud Lake sediments was accomplished during this phase of investigation since sediments were sampled and tested during previous studies (AGI 1986). Groundwater quality data from wells adjacent to the Mud Lake were reviewed to evaluate if any chemical impact to the groundwater has occurred due to sediments in the lined Mud Lake Impoundment.

2.4 MARINE SEDIMENT

Extensive marine sediment quality sampling and biological sampling of the Blair Waterway sediments adjacent to the Blair Waterway Property has been accomplished as part of the Milwaukee Waterway Fill/Blair Navigation Project; the Port expects to publish the data in March 1992. Dredging for the Blair Navigation Project is expected to remove all sediments

deposited since the original dredging of the waterway. Surface and core samples were collected at two locations, shown on Figure 6, to document sediment quality within the Property boundary and to permit comparison to other data for the Blair Waterway.

Subtidal marine sediment samples were collected in accordance with the work plan at two stations (BWS-1 and BWS-2), from three depth strata (0 cm to 2 cm, 2 cm to 88 cm, and 88 to 90+ cm). Samples in each depth strata represented a composite of three individual samples at each sample location in accordance with the Phase II Environmental Investigation Work Plan (Landau Associates 1989b). Samples were designated using the sample station and a depth interval qualifier, such as BWS-1-02, for the 0-2 cm interval at Sample Station BWS-1.

The samples were analyzed for constituents identified in the Puget Sound Dredged Disposal Analysis (PSDDA) program to allow comparison of the results to CBN/T ROD (EPA 1989a) sediment quality objectives, to Sediment Management Standards (Ecology 1991a), and to PSDDA screening and maximum levels (USACOE 1989). The PSDDA constituents include total metals, volatile and semivolatile organics, PCBs, pesticides, total volatile solids, total organic carbon, ammonia, and sulfide. Collection of marine sediment samples was accomplished by Herrera Environmental Consultants, Inc. (Herrera; 1990) under subcontract to Landau Associates. A summary of the marine sediment sampling activities and logs of samples are included in Appendix B. Sediment sampling procedures generally followed those described in the work plan (Landau Associates 1989b). Deviations from the work plan, necessitated by conditions encountered in the field, are described in Appendix B.

3.0 PHYSICAL AND CHEMICAL CONDITIONS

Evaluation of the analytical data for the Blair Waterway Property was accomplished in a phased manner. The first step in this section is identification of potential areas of concern, as discussed in this Section 3.0. The evaluation is accomplished by first examining the physical and chemical conditions associated with the potential source areas (identified in Section 2.0). Subsequent report sections will identify human health and environment-based criteria, compare chemical test results from potential areas of concern to these criteria, and evaluate potential pathways of contaminant migration and critical receptors for potential areas of concern. The need for analysis of cleanup alternatives is determined based on the combination of the evaluation steps. For those areas where analysis of cleanup alternatives may be warranted, cleanup action objectives are developed.

3.1 PHYSICAL CONDITIONS

3.1.1 Site Surface Conditions

The Blair Waterway Property is about 43.4 acres in size, about 8 acres of which is between the shoreline and pierhead line of the Blair Waterway. The Property boundaries have been surveyed and are described on the Record of Survey, Blair Waterway Property (Sitts & Hill 1990). The upland portion of the Property is generally level, ranging in elevation between approximately 16 and 20 ft MLLW.

Mud Lake, present in the northern portion of the Property (Figure 2), is a lined impoundment about 4 acres in size and containing sediment not suitable for open water disposal. This sediment is planned to be removed for use as fill in the Milwaukee Waterway. The Lincoln Avenue Ditch is a tidally-influenced drainageway in the central portion of the Property. The Graving Dock is a rectangular feature about 9 acres in size and excavated about 20 ft below grade, which was formerly used for constructing floating bridge pontoons. The Graving Dock is separated from the Blair Waterway by a soil dike and a sheet pile wall. The Graving Dock is planned to be filled, as requested by the Tribe (Tribe 1991). A small dock and skid launching facility is located at the southern corner of the Property. Several shop, storage, and electrical distribution structures (in various stages of repair), associated with former activities, are located in the central and southern portions of the Property.

3.1.2 Hydrogeologic Conditions

Hydrogeologic data from investigations conducted on the Property (described in Section 2.1) and at adjacent properties (RCI 1988a) identified five general hydrogeologic units, three aquifers separated by two lower permeability units or aquitards, within approximately 50 to 70 ft of the ground surface. These aquifers are referred to (sequentially from the surface) as the shallow (water table), intermediate, and deep aquifers (RCI 1988a). The aquitards are referred to as the upper aquitard (former tideflat muds) separating the shallow and intermediate aquifers, and the lower aquitard separating the intermediate and deep aquifers. The thickness, soil composition, and continuity of the aquitards vary laterally, indicating the probable interconnection of aquifers. Thus, the "aquifer" designation (used in this report for consistency with other investigations at nearby sites) is probably more appropriately replaced by the description "groundwater zone." Estimates of hydrogeologic parameters in the RCI (1988a) and CH2M Hill (1990) reports are considered adequate for the purposes of this investigation.

The general descriptions of soil in the five hydrogeologic units considered in this study are listed below. The log of Well BW-9d (Appendix A, Figure A-19) provides a general example of the five units.

Hydrogeologic Unit	General Description
Shallow Aquifer	Fill soils including hydraulically-placed gray fine to coarse SAND, silty fine SAND, and gray and light brown SILT; granular fill and debris including brown silty gravelly SAND, crushed rock, crushed slag, and minor construction debris including broken cement and asphaltic concrete, masonry, and lumber
Upper Aquitard	Gray to brownish gray laminated clayey SILT, fine sandy SILT, organic SILT, and interbedded SAND and silty SAND and minor PEAT layers associated with former tideflat deposits
Intermediate Aquifer	Gray fine to medium SAND, silty fine SAND, and minor interbedded SILT; sparse to abundant shells and shell fragments
Lower Aquitard	Gray laminated clayey SILT, organic SILT, with interbedded SAND and silty fine SAND
Deep Aquifer	Gray fine to coarse SAND, silty fine SAND; sparse shell fragments

Surface and groundwater elevations during a "high-to-low" tidal cycle on February 2, 1990 were measured from staff gauges in the Blair Waterway and Graving Dock and in

monitoring wells screened in shallow, intermediate, and deep aquifers. The tidal cycle measurements are presented both on figures and in tables in Appendix A. Figures 7-12 show contours of groundwater elevations at high and low tides in the shallow, intermediate, and deep aquifers, respectively. The major surface features on the site, which may influence hydrogeologic conditions in the various aquifers, are the Blair Waterway, the Lincoln Avenue Ditch (which is connected to the Blair Waterway), the Graving Dock (which penetrates the shallow and intermediate aquifers), and, depending on the condition of the liner, the Mud Lake Impoundment.

Groundwater flow includes complex interactions between the various aquifers and influence by tidal conditions. Evaluation of groundwater measurements suggests that:

- Shallow wells show little or no variation by tidal influence. However, because the upper range of the tide may exceed shallow groundwater elevations, shallow wells very close to the Blair Waterway or Lincoln Avenue Ditch could show some tidal influence. Groundwater elevation contours of shallow groundwater are generally similar for high and low tides (Figures 7 and 8). The lower low tide of the day generally drops below the base of the shallow aquifer.
- In the intermediate aquifer, groundwater flow is influenced by the Blair Waterway tides and the Graving Dock. Elevation contours of groundwater data (Figures 9 and 10) show a large change in hydraulic gradient in the area between the Blair Waterway and Alexander Avenue between low and high tides.
- Groundwater data in the deep aquifer indicate hydraulic gradients away from the Blair Waterway at high tide, and toward the Blair Waterway at low tide (Figures 11 and 12).
- Intermediate wells (with the exception of Well Group BW-9 adjacent to the Graving Dock) show greater amplitude of tidal influence than do deep wells. The amplitude of tidal influence in both aquifers decreases with distance from the Blair Waterway.
- Shallow groundwater elevations are generally higher than intermediate and deep groundwater elevations, indicating a downward gradient from the shallow aquifer. Short-term, tidally influenced, vertical gradient reversals occur between the intermediate and deep aquifers.
- The Graving Dock shows little (less than ½-ft) water level change with significant tidal range (about 12 ft).

Accordingly, shallow groundwater appears to be derived from components of local precipitation infiltration and flow from offsite. Flow of shallow groundwater onsite is both

downward to the intermediate aquifer and horizontally, southwest, toward the Blair Waterway or toward local surface influences (Lincoln Avenue Ditch and Graving Dock). The net groundwater flow direction in the intermediate aquifer appears to be toward the Blair Waterway from offsite, with local influence by the Graving Dock. The groundwater flow direction in the deep aquifer is toward the Blair Waterway. Insufficient data exist to identify detailed flow patterns.

RCI has installed two extraction wells (EW-4 and EW-10) and five monitoring wells on the Blair Waterway Property along the southeastern side of the Graving Dock. Groundwater movement will be influenced when pumping associated with the RCI groundwater cleanup (at the Blair Property) commences. It is the intent of the RCI system to capture the plume of contaminated groundwater on the Property. Limited testing (CH2M Hill 1990) of the extraction system does not provide sufficient data for appropriate evaluation of the extraction system capture radius. Additionally, the presence of the Graving Dock, filled or unfilled, will affect groundwater movement. It is unlikely that the existing RCI extraction wells at the Blair Waterway Property will capture contaminants identified (see Section 5.2.2) in the vicinity of Well BW-9i which lies on the opposite side of the graving dock from the extraction wells.

3.1.3 Soil Conditions

Borings for monitoring wells and backhoe explorations indicated that fill soil above the original Tideflat muds are generally greater than 4 ft thick. The exploration locations are shown on Figure 5. Logs of explorations and soil borings are presented in Appendix A. Fill soil includes silt, fine sand, construction debris, and granular material ranging from crushed rock to sandy gravel. The origin of the fill soil is probably material dredged from waterways and imported soil excavated from the nearby hillsides. Review of historical information on the Tideflat configuration (USGS 1981) shows, that prior to the filling of Tideflat areas, a tidal channel approximately 100 to 200 ft in width was situated along the northeastern Property boundary parallel to Alexander Avenue and narrowed in the vicinity of the Graving Dock. Shallow aquifer fill soil in the vicinity of this former tidal channel is expected to be thick and the upper aquitard (discussed below) may be locally discontinuous or absent. Fill soil and concrete construction rubble is present in the former Lincoln Avenue Ditch alignment (Figure 5).

Black, gravel-sized, crushed slag was identified in about a 4-acre area in the central Property portion (Figure 5) as a thin (generally 1 ft or less) surface and shallow subsurface layer, apparently placed as fill in the vicinity of site structures. Slag, ranging in thickness from

approximately 0.5 to 1.5 ft, was identified on the north, south, and east slopes, but not the dike side of the Graving Dock. Inspection and sampling of the Graving Dock bottom by a diver (Appendix A) did not identify slag to be present on its bottom, except close to the slope at the east corner; concrete pads and surfacing which were used to build pontoons are present over most of the bottom. The slag at the Graving Dock and central areas appears to be ASARCO slag. Only minor scattered slag was identified in road material, the area of fill material in the former Lincoln Avenue Ditch, and placed across the outlet of the existing Lincoln Avenue Ditch.

Two sets of backhoe test pit explorations were completed in areas with limited surface staining, the former fueling area (BF1, 2) and a drum storage area (BD1, 2). Visual observation indicated that the surface staining did not extend into the subsurface.

Backhoe test pit excavations (BOLD-1, -2, -2A, 3) were used to sample the buried sediment horizon of the former segment of the Lincoln Avenue Ditch which extended to the Blair Waterway on the south side of Lincoln Avenue. The buried sediment layer was generally about 6 inches and at a depth of 12 to 13 ft.

3.1.4 Marine Sediment Conditions

Marine sediment core samples were collected, at two locations shown on Figure 6, to depths of about 90 cm at the Blair Waterway Property at surface elevations 4.5 ft (BWS-1) and -0.9 ft (BWS-2) MLLW. Core samples were divided into 0 to 2 cm, 2 to 88 cm, and 88 to 90+ cm depth intervals for analysis. The Marine Sediment Sampling Report (Herrera 1990) in Appendix B describes sediment descriptions and sampling procedures. Sediment included medium to fine sand, silt, and clay with occasional plant and root fragments. An oil sheen on water was reported from Sample BWS-1 sediment at depths of 0 to 50 cm.

3.2 CHEMICAL CONDITIONS

The water, soil, and sediment samples were chemically analyzed by Analytical Resources, Inc. (ARI), under subcontract to Landau Associates, for the parameters identified in Table 1 and Tables C-2, C-3, and C-4 of Appendix C. Analytical procedures were in accordance with established and approved methods. Analytical results of constituents detected during this investigation are summarized in Tables C-5 to C-11 of Appendix C. Copies of the laboratory data sheets are provided in Appendix D to the Final Investigation Report (bound separately). Quality assurance validation of the laboratory procedures are also contained in Appendix D.

Detection limit goals which, in some cases, were not met for all analytes in a sample, are discussed in Appendix D.

Summaries of some chemical results from previous onsite investigations are attached as required by the EPA (Appendix C, Attachments C-1, C-2, and C-3), for information purposes. However, complete sample location and quality assurance information for these data were not available for review.

Analytical data and data validation reports presented in Appendix D to the Final Investigation Report (Landau Associates 1991b,c) were evaluated by the EPA Regional Quality Assurance Management Office (RQAMO). Comments by the EPA RQAMO were summarized in a memorandum provided as Attachment A to EPA (1990b) and in a subsequent memorandum (EPA 1991a). Contingent on the incorporation of EPA comments (EPA 1991a) into the final data reports, EPA concluded that the "Data Quality Objectives outlined in the QAPjP (Landau Associates 1989b) for this Project have been met."

3.2.1 Groundwater Quality

Groundwater samples were collected from the 18 new monitoring wells on the Blair Waterway Property in December 1989 and January 1990; seven of these wells were resampled in August 1990. The first set of samples were analyzed for metals and other inorganics, pesticides, PCBs, volatile organic compounds, semivolatile organic compounds, and formaldehyde (Table 1). The second set of sampling to confirm earlier results included analysis for volatile organics and phenols. A summary of constituents detected in groundwater is contained in Appendix C. The chemical laboratory data sheets are presented in Appendix D.

Arsenic was detected in shallow (water table) aquifer samples from Wells BW-6s and BW-8s. These wells are located in the central area of the site where slag is present on the surface or in shallow soil. Arsenic in the groundwater may have leached from the slag or from other upgradient sources.

Constituents detected in one or more intermediate groundwater samples include metals and inorganics, bis(2-ethylhexyl)phthalate, chloroform, formaldehyde, vinyl chloride and pentachlorophenol (PCP). Investigations for the RCI facility (RCI 1988a) identified contaminants including arsenic, volatile organics, phthalates, formaldehyde, PCP and other phenols, and PAH in groundwater upgradient from the Blair Waterway Property. Planned corrective action at the RCI facility involves monitoring and extracting contaminated groundwater within RCI property and within the contaminant plume identified on the southeast portion of the Blair Waterway

Property in the intermediate and deep aquifers. Specific constituents identified by RCI (1990, 1991) in this southeastern area include arsenic, chlorinated phenols, formaldehyde, benzene, methylene chloride, 1,2-dichloroethene, and trichloroethane. Based on a comparison of the results of this study and RCI (1988a, 1990, 1991) data, constituents detected in new monitoring wells during this study at the Blair Waterway Property that might be attributed to RCI include formaldehyde, bis(2-ethylhexyl)phthalate, various chlorinated phenols, and vinyl chloride. Section 5.2 contains a discussion of these constituents.

Previous studies of Mud Lake sediments reported detection of PAH, phthalates, and metals at highly variable concentrations in the sediment (summarized in AGI 1986 and Appendix C, Attachment C-3). Evaluation of the groundwater quality data from Monitoring Wells BW-1(s,i), BW-2(s), BW-3(s,i), and BW-4(s,i) near Mud Lake does not indicate concentrations of any of these constituents at levels significantly higher than at other Property monitoring wells. Thus, the data do not identify that leaching from Mud Lake sediments into the groundwater has occurred.

Constituents detected in one or more deep aquifer groundwater samples include conventionals, iron and manganese, and formaldehyde.

3.2.2 Soil and Ditch Sediment Quality

Soil samples were collected, in December 1989 and January 1990 at locations shown on Figure 5, from along the Property boundary adjacent to the railroad track (BR1-1 through BR5-1), from the Lincoln Avenue Ditch outlet fill area (B01-1 and B02-1), from the drum storage area (BD1-1 and BD2-1), from the fueling area (BF1-1 and BF2-1), and from test pits (BT1-1 through BT6-1) excavated 1 to 8 ft in depth using backhoe equipment. In July 1990, three samples were collected from the buried sediment horizon in the former Lincoln Avenue Ditch (BOLD-1 to BOLD-3).

In December 1989 and January 1990, ditch sediments (i.e., those from within surface drainage features) were collected from the Lincoln Avenue Ditch (BLD-1-1 through BLD4-1), the Weyerhaeuser Ditch (BWD1-1 through BWD5-1), the Domtar Ditch (BDD1-1 through BDD7-1), and the Mud Lake outfall and spillway (BOS1-1 and BOS2-1). Additional samples, BLD-5 to BLD-8, were collected from the Lincoln Avenue Ditch in July 1990. Samples of an orange precipitate in the Domtar Ditch (BDP1-1), and of plastic beads and powder found along the railroad track (RRS-1 and RRS-2) were also taken for identification. In July 1991, samples of material were collected from the bottom of the Graving Dock and two samples were composited

(BG-11/12) for analysis. The sediment, precipitate, powder, and Graving Dock bottom material sampling locations are shown on Figure 6.

Constituents detected at each of the sampling areas include:

- Central Area Slag: TCLP results from slag samples collected from the central area and Graving Dock sides include detections of arsenic.
- Railroad Track: Soil samples collected adjacent to the railroad right-of-way were analyzed for total metals, semivolatile organics, PCBs, and pesticides. Constituents detected in one or more samples include several metals (metals are naturally occurring in soil) and PAH. Samples of material spilled on the railroad bed were analyzed qualitatively, and defined to be plastic beads and calcium carbonate.
- Drum Storage Area: Samples collected from the drum storage area were analyzed for PCBs, and volatile and semivolatile organics. The constituents detected were toluene and bis(2-ethylhexyl)phthalate.
- Fuel Area: Samples collected from the fuel area were analyzed for semivolatile organics and TPH. No semivolatile organic constituents were detected. The laboratory scan for TPH (Appendix D) indicated the presence of a heavy organic outside of the normal TPH range in one of the samples. Communication with the laboratory indicates that this signature is associated with very "weathered" diesel oil or asphalt. This heavy organic may be associated with pieces of asphalt in the fill soil.
- Test Pits: Samples collected from the test pits were analyzed for total metals, semivolatile organics, and PCBs. Constituents detected in the samples include several metals. Several PAH were also detected in Sample BT4-1.
- Former Lincoln Avenue Ditch: Samples were collected from the buried sediment horizon of the former Lincoln Avenue Ditch alignment and analyzed for dioxins, volatile and semivolatile organics, PCBs, pesticides, and metals. Constituents from each of the above categories were detected.
- Lincoln Ditch Outlet Fill Area: Samples collected from the outlet fill area were analyzed for EP Toxicity metals. Low levels of barium were detected.
- Lincoln Avenue Ditch: Samples collected from the Lincoln Avenue Ditch were analyzed for priority pollutants. Constituents detected in one or more samples include several metals, PCBs, semivolatile organics (primarily PAH and phthalates), and acetone. Dioxins were detected in samples collected during earlier investigations, as reported by AGI (1986); thus, no additional analyses for dioxin in the Lincoln Avenue Ditch were accomplished during this investigation.
- Domtar Boundary Ditch: Samples collected from the Domtar Boundary Ditch were analyzed for metals, PCBs, and volatile and semivolatile organics. A single sample of orange precipitate was collected and analyzed for metals and major ions. Constituents detected in one or more samples include several metals, PCBs, acetone, carbon disulfide, and freon.

- Weyerhaeuser Boundary Ditch: Samples collected from the Weyerhaeuser Boundary Ditch were analyzed for metals, PCBs, and volatile and semivolatile organics. Constituents detected in one or more samples include arsenic and other metals, and semivolatile organics.
- Mud Lake Outfall and Spillway: Samples collected from the Mud Lake outfall and spillway were analyzed for total metals, PCBs, pesticides, and volatile and semivolatile organics. Constituents detected include several metals, PAH, phthalates, and acetone.
- Graving Dock Bottom Material: Two samples were collected and composited from the bottom material in the Graving Dock. This composited sample was analyzed for priority pollutants. Arsenic and other metals, PAH, and phthalates were detected in the composite sample.

Appendix C presents a complete summary of chemical test results. The chemical laboratory data sheets are presented in Appendix D. Concentrations of constituents detected in one or more soil or ditch sediment samples are listed in Table C-7. Concentrations of metals and major ions detected in the Domtar Boundary Ditch precipitate are listed in Table C-10.

The exceedance of both detection limit goals and numerical criteria prompted additional sampling in the Lincoln Avenue Ditch. Samples BLD-5 through BLD-8 were collected to better define contaminant distribution in the Lincoln Avenue Ditch.

3.2.3 Marine Sediment Quality

The marine sediment samples from Stations BWS-1 and BWS-2 (Figure 6) in the Blair Waterway were analyzed for the constituents identified in Table C-4 of Appendix C. Constituents detected in the marine sediment samples are listed in Table C-8 and include metals, semivolatile organic compounds, and PCBs.

4.0 NUMERICAL ENVIRONMENTAL CRITERIA

4.1 OVERVIEW OF APPROACH

This section presents a discussion of the approach used to evaluate soil, water, and sediment quality to identify whether any cleanup actions are appropriate. Evaluation of the need for cleanup action is generally made during a multiphased hazard assessment process. A specific, well-defined Federal or State regulatory standard for conducting these evaluation does not exist; therefore, the evaluation of the need for analysis of cleanup alternatives during the next phase at the Blair Waterway Property site was accomplished using conservative data screening techniques. This approach was approved by EPA, Ecology, and the Tribe, and is consistent with the requirements of the MOA. This screening approach takes into consideration constituent concentrations, source characteristics, exposure pathways, and the nature of receptors. The approach includes a comparison of site data to applicable Federal and State environmental requirements and criteria. These numerical screening criteria include both potential chemical-specific applicable or relevant and appropriate requirements (ARARs) and guidelines contained in to-be-considered (TBC) regulations. ARARs include requirements of all Federal and State environmental and public health laws, as required by the National Contingency Plan (NCP; EPA 1990b). TBCs include other Federal and State criteria, advisories, and guidance that may concern protection of human health and the environment and are pertinent to a site cleanup action. Criteria appropriate to evaluate both commercial and industrial use of the Property are presented.

During the screening process, chemical concentrations clearly below numerical screening criteria values were not evaluated further, while concentrations at or above criteria were evaluated further to assess the nature of the exceedance. State criteria for soil and water include site-specific cleanup standards that may be established at concentrations equal to area background concentrations. Therefore, although established numerical screening criteria may be exceeded, those concentrations could be representative of background concentrations which are established on a site-specific basis and, thus, cleanup action may not be warranted.

Exceedance or nonexceedance of numerical criteria alone does not determine whether a cleanup action will be needed. Rather, the criteria serve as useful guidelines which, when combined with knowledge of sources and pathways and receptors help identify areas where cleanup action may be warranted. Furthermore, the screening criteria are not specifically intended for use as cleanup levels if it is determined that a cleanup action is needed. Cleanup

levels and points of compliance for the evaluation of specific cleanup actions would be developed separately.

Chemical detection limits in some samples did not meet detection limit goals. The chemical detection limits may also exceed numerical screening criteria. In that case, the "nondetect" provides insufficient information to evaluate the sample chemistry with respect to these criteria. Sample detection limit results which exceed applicable screening criteria are identified in the groundwater and soil discussions.

During environmental investigations, a statistical approach is often used to identify exceedances of numerical criteria for soil and groundwater using analytical data from several samples collected within an area of potential exposure. This statistical determination allows for some individual samples to exceed the numerical criterion. However, for this evaluation, concentrations of a constituent for a single sample were directly compared to a numerical criterion. Since this investigation focused on areas of potential contamination rather than unbiased Property-wide sampling, this evaluation approach is considered to be conservative.

In addition to evaluation of numerical criteria, the MOA specifies that a health risk assessment may be conducted, as appropriate, to evaluate risks to human health and the environment. Most of the numerical criteria used in the screening process are human health-risk based, and have been established using the assumption of a "reasonable maximum exposure" (RME) scenario, which is defined to be the highest exposure that is reasonably expected to occur. These "risk-based" screening criteria in themselves provide an indication, based on conservative assumptions, as to potential risks to human health when compared to site-specific data. For all areas of the site except the Lincoln Avenue Ditch, comparison of these criteria to concentrations detected in soil and groundwater was judged to be a sufficiently stringent evaluation of risk to human health. If multiple constituents are present in an environmental media, or the potential for multiple pathways of exposure exists under current or potential land use conditions, as in the case of the Lincoln Avenue Ditch sediments, these multiple constituent/multiple pathway issues are evaluated to determine if further consideration by risk assessment is necessary to fully characterize potential hazard to human health at the site. This evaluation is provided in Section 5.4. Those numerical screening criteria used in this evaluation that are not human health-risk based are considered ecologically-risk based. The criteria used in the screening process for marine sediments have been established at levels which have been determined to be protective of the environment through toxicity testing on

sediment dwelling organisms and evaluating the health of benthic community structure. Similarly, the marine ambient water quality criteria were established at levels determined to be protective of marine aquatic life.

The screening criteria for groundwater, soil, ditch sediments, and marine sediments are discussed below. Comparison of screening criteria to analytical results is conducted in Section 5.0. Pathways of contaminant migration and critical receptors for potential areas of concern as well as recommendations for analysis of cleanup alternatives are discussed in Section 6.0.

4.2 NUMERICAL CRITERIA FOR GROUNDWATER

The screening criteria for constituents detected in the Blair Waterway Property groundwater samples are summarized in Table 3. The screening criteria consider the present and potential future use of the groundwater, and cross media transfer of contaminants from groundwater to surface water. At the present time, groundwater is not used as a source of drinking water at the site, and the location and zoning of the site and the surrounding area suggest that future use of near-surface (shallow, intermediate, and deep zone) groundwater aquifers as a drinking water source is unlikely. Additionally, near-surface groundwater meets the conditions specified by the Model Toxics Control Act (MTCA) Cleanup Regulation WAC 173-340 (Ecology 1991b) for exclusion as a potential source of drinking water. However, since criteria specific to use of groundwater as a drinking water source represent a conservative lower bound of criteria values for many constituents, they have been selected as screening criteria for use in this evaluation. The groundwater at this site also serves as a source of recharge to the Blair Waterway. Therefore, potential impact of the site groundwater on the Blair Waterway has also been considered in identifying the screening criteria to be used.

Five subgroups of screening criteria for groundwater were used for comparison to site conditions. Although they may be identified by other designation, including "cleanup standard", these criteria are used in this document only as a conservative means of screening data. Exceedances of these values do not necessarily trigger requirements for cleanup action. The five subgroups include Federal and State Drinking Water Standards; MTCA Method A Groundwater Cleanup Standards; MTCA Method B Groundwater Cleanup Standards; Reichhold Chemicals' Groundwater Protection Performance Standards; and Federal and State Surface Water Criteria. These numerical criteria are discussed below.

4.2.1 Federal and State Drinking Water Standards

Drinking water standards for public water supplies have been developed under the Federal Safe Drinking Water Act (40 CFR 141 and 143, EPA 1989b) and by the State Board of Health (WAC 248-54; Ecology 1988). These standards include Primary Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs). The MCLs are enforceable standards which have been established based on protection of human health, but also consider availability and performance of the best technology to treat the constituent, and the cost of treatment. SMCLs represent nonenforceable standards based on consideration of taste, color, and odor. Proposed MCLs (PMCL) and proposed SMCLs (PSMCL) are also available for several constituents. These are not promulgated standards and are only under consideration. Table 3 summarizes all existing and proposed drinking water standards used as screening criteria for constituents detected in groundwater samples from this Property.

4.2.2 MTCA Method A Cleanup Standards

The Method A Cleanup Standards for groundwater are specified in WAC 173-340-720 (Ecology 1991b) and include concentrations listed in Table 1 of the regulation. Cleanup standards are presented for 25 constituents, 8 of which were detected in groundwater at the Blair Waterway Property. Method A Table 1 concentrations for these constituents are included in Table 3 of this report. According to MTCA, these cleanup concentrations are intended to provide conservative cleanup levels for sites undergoing routine cleanup actions or those sites with relatively few hazardous substances, and are not appropriate for all sites. The basis for the Method A cleanup levels varies among constituents. In some cases the cleanup level is based on ingestion of groundwater as a drinking water source. Other bases for these values include applicable State and Federal law (MCLs and SMCLs). These cleanup concentrations have been set at values which consider the influence of multiple compounds which may be present and multiple exposure pathways which may be relevant.

4.2.3 MTCA Method B Cleanup Standards

Method B cleanup standards for groundwater are intended by MTCA to apply to all sites, but are designed for use at "non-routine" sites where constituents present may not be covered by Method A. Method B cleanup levels include concentrations established based on consumption of groundwater as a drinking water source using formulas specified in MTCA, as shown below. For the purpose of this evaluation, a screening criteria was calculated for a

constituent only if a drinking water standard or MTCA Method A cleanup standard was not available as a screening criteria for a constituent, or if the drinking water standard criterion is established using a higher allowable risk level than MTCA Method B. These criteria are included in Table 3 of this report.

$$\textit{Ground water cleanup level (noncarcinogens)} \ (\mu g/L) = \frac{RfD \times ABW \times UCF \times HQ}{DWIR \times INH}$$

where:

RfD	=	Reference Dose (mg/kg-day)
ABW	=	Average body weight during the period of exposure (16 kg)
UCF	=	Unit conversion factor (1,000 µg/mg)
HQ	=	Hazard quotient (1.0)
DWIR	=	Drinking water ingestion rate (1.0 liter/day)
INH	=	Inhalation correction factor.

$$\textit{Ground water cleanup level (carcinogens)} \ (\mu g/L) = \frac{RISK \times ABW \times LIFE \times UCF}{CPF \times DWIR \times DUR \times INH}$$

where:

RISK	=	Acceptable cancer risk level (1 in 1,000,000)
ABW	=	Average body weight during the period of exposure (70 kg)
LIFE	=	Lifetime (75 years)
UCF	=	Unit conversion factor (1,000 µg/mg)
CPF	=	Carcinogenic potency factor (kg-day/mg)
DWIR	=	Drinking water ingestion rate (2.0 liters/day)
DUR	=	Duration of exposure (30 years)
INH	=	Inhalation correction factor.

Unlike screening criteria identified using Method A, values derived using Method B formulas are based on ingestion only, and do not consider the influence of multiple compounds which may be present, or multiple exposure pathways.

4.2.4 Reichhold Chemicals, Inc. Groundwater Protection Performance Standards

These standards were established for the RCI facility in their RCRA permit (RCI 1988b), and are based on human health criteria, aquatic life criteria, and laboratory practical quantification limits (PQL). The standards are directly applicable to the RCI RCRA Permit-required cleanup at the Blair Waterway Property where groundwater contamination from

constituents originating from the RCI site has been reported (RCI 1988a) and, potentially, for unreported RCI-related contamination. RCI groundwater protection standards are used as screening criteria in this report and are included in Table 3.

4.2.5 Federal and State Surface Water Criteria

Because site groundwater discharges to the Blair Waterway, marine aquatic life criteria (including criteria based on fish consumption) developed pursuant to Section 304 of the Clean Water Act and administered under the State Water Pollution Control Act, and MTCA surface water cleanup standards were also considered as screening criteria. Marine aquatic life criteria were evaluated in all cases where criteria were available for constituents. MTCA surface water cleanup standards were used as screening criteria only for organic constituents with a potential for bioconcentration, because marine aquatic life criteria for inorganic constituents provide a more conservative screening basis for those constituents. These criteria do not apply directly to groundwater but, instead, apply directly to the surface water body to which it discharges. Therefore, attenuation of groundwater constituents as the groundwater migrates to the surface water body will be considered in determining whether or not an exceedance of these criteria warrants further consideration. Marine aquatic life criteria for constituents identified in Blair Waterway Property groundwater are provided in Table 3. MTCA surface water cleanup standards used as screening criteria include concentrations which are calculated based on consumption of fish exposed to contaminants in surface water using formulas specified in MTCA, as shown below.

$$\textit{Surface water cleanup level (noncarcinogens)} \ (\mu g/L) = \frac{RfD \times ABW \times UCF1 \times UCF2 \times HQ}{BCF \times FCR \times FDF}$$

where:

RfD	=	Reference Dose (mg/kg-day)
ABW	=	Average body weight during the period of exposure (70 kg)
UCF1	=	Unit conversion factor (1,000 µg/mg)
UCF2	=	Unit conversion factor (1,000 grams/liter)
BCF	=	Fish bioconcentration factor as defined in WAC 173-340-708(9) (unitless)
FCR	=	Fish consumption rate (54 grams/day)
FDR	=	Diet fraction (0.5)
HQ	=	Hazard quotient (1.0)

$$\textit{Surface water cleanup level (carcinogens)} \; (\mu g/L) = \frac{RISK \times ABW \times LIFE \times UCF1 \times UCF2}{CPF \times BCF \times FCR \times FDF \times DUR}$$

where:

RISK	=	Acceptable cancer risk level (1 in 1,000,000)
ABW	=	Average body weight during the period of exposure (70 kg)
LIFE	=	Lifetime (75 years)
UCF1	=	Unit conversion factor (1,000 µg/mg)
UCF2	=	Unit conversion factor (1,000 grams/liter)
CPF	=	Carcinogenic potency factor (kg-day/mg)
BCF	=	Fish bioconcentration factor as defined in WAC 173-340-708(9) (unitless)
FCR	=	Fish consumption rate (54 grams/day)
FDF	=	Diet fraction (0.5)
DUR	=	Duration of exposure (30 years).

The calculated values do not consider the influence of multiple compounds and multiple exposure pathways. Calculated values are not included in Table 3, but are discussed, as appropriate, in the discussion of individual constituents in Sections 5.2.1 through 5.2.3.

4.3 NUMERICAL CRITERIA FOR SOIL AND DITCH SEDIMENT

Cleanup standards for soil developed under authority of the MTCA were selected as screening criteria for comparison to concentrations of constituents detected in site soil and ditch sediment. There are currently no State or Federal cleanup level criteria for freshwater sediments. Therefore, soil cleanup standards were considered appropriate screening criteria for evaluation of ditch sediment quality, since the sediments are deposited in the ditches by surface water runoff. Additionally, in order to address these sediments as a potential source of marine sediment contamination, they are also compared to marine sediment criteria in a subsequent section.

The MTCA establishes soil cleanup levels at different concentrations, depending on site use. The March 21, 1990 MOA requires that the "properties comply with federal and state contamination law and can be used for commercial or industrial purposes." According to the MTCA definitions of "commercial" and "industrial" sites, cleanup levels based on direct contact with soil for "residential" and "commercial" sites are more stringent (WAC 173-340-740) than those which would be established for soil at an "industrial" site (WAC 173-340-745). MTCA allows determination of commercial site cleanup standards using Methods B and C of

WAC 173-340-740. Although the Blair Waterway Property meets the requirements stated in the MTCA for classification as an industrial site, and the Tribe has determined that the Property will only be used for industrial purposes (Tribe 1991), its potential for commercial use requires consideration of screening criteria based on commercial cleanup standards because MTCA states that criteria based on industrial cleanup levels may not represent sufficiently conservative values to accommodate commercial use of the Property. In order to appropriately evaluate site conditions for all potential future Property use, concentrations of constituents in soil will be compared to soil screening criteria established using MTCA cleanup standards for commercial and industrial site soil.

4.3.1 WAC 173-340-740 Soil Cleanup Standards, Methods A and B

The most stringent category of soil cleanup standards are defined in WAC 173-340-740, Methods A and B. These cleanup standards are designed to be applied to sites (e.g., residential and some types of commercial sites) which do not meet the requirements for classification as an industrial site. MTCA Method A cleanup standards for soil were established as conservative criteria for sites undergoing routine cleanup actions or sites with relatively few hazardous substances, and are not appropriate for use at all sites. Method A cleanup standards identify levels for 21 constituents included in Table 2 of WAC 173-340-740, 10 of which were detected in soil at the Blair Waterway Property. The cleanup standards specified in Table 2 of the regulation are based on several factors. If the cleanup standard is based on direct contact, the value is set with consideration of the influence of multiple compounds and exposure factors. Most of the soil cleanup standards included in Table 2 of the regulation are based on protection of groundwater. If a Method A Table 2 cleanup standard was available for a constituent detected in Blair Waterway Property soil for use as a screening criteria, it is included in Table 4 of this report. Screening criteria for soil were also established using WAC 173-340-740 Method B, which includes formulas for calculating soil cleanup standards based on direct contact with soil as repeated below.

$$\textit{Soil Cleanup Level (non-carcinogens mg/kg)} = \frac{RfD \times ABW \times UCF2 \times HQ}{SIR \times AB1 \times FOC}$$

Where:

RfD	=	Reference dose (mg/kg-day)
ABW	=	Average body weight over the period of exposure (16 kg)
UCF2	=	Unit conversion factor (1,000,000 mg/kg)
SIR	=	Soil ingestion rate (200 mg/day)
AB1	=	Gastrointestinal absorption rate (1.0)
FOC	=	Frequency of contact (1.0)
HQ	=	Hazard quotient (1.0)

$$\textit{Soil Cleanup Level (carcinogens mg/kg)} = \frac{RISK \times ABW \times LIFE \times UCF1}{CPF \times SIR \times AB1 \times DUR \times FOC}$$

Where:

RISK	=	Acceptable cancer risk level (1 in 1,000,000)
ABW	=	Average body weight over the period of exposure (16 kg)
LIFE	=	Lifetime (75 years)
UCF1	=	Units conversion factor (1,000,000 mg/kg)
CPF	=	Carcinogenic potency factor (kg-day/mg)
SIR	=	Soil ingestion rate (200 mg/day)
AB1	=	Gastrointestinal absorption rate (1.0)
DUR	=	Duration of exposure (6 years)
FOC	=	Frequency of contact (1.0)

Cleanup levels calculated with these formulas and used as screening criteria do not consider the influence of multiple compounds and exposure routes. Screening criteria for constituents detected in Blair Waterway Property soil, which were calculated using Method B formulas, are also included in Table 4. If the concentration of a constituent detected on site is below the MTCA 740 Methods A and B screening criteria it will be dismissed from further consideration, because the conservative value inherent in a "residential" cleanup standard indicates that no further action is necessary.

4.3.2 WAC 173-340-740 Soil Cleanup Standards, Method C

Commercial soil cleanup standards may also be determined using Method C of WAC 173-340-740. Method C includes calculation of soil cleanup standards based on direct contact

using the same formulas specified above for Method B but with an assumed soil ingestion rate of 100 mg/day and an assumed frequency of contact of 0.5. Changing these factors in the equations results in calculation of less stringent cleanup standards than those derived using Methods A and B. Cleanup standards based on Method C and used as screening criteria were calculated only for those constituents present in Blair Waterway Property soil at concentrations higher than WAC 173-340-740 Method B concentrations, and are summarized in Table 4. If the concentration of a constituent in Blair Waterway Property soil is below calculated Method C screening criteria it is dismissed from further evaluation, because it is presumed that concentrations below these criteria define conditions appropriate for commercial use of the Property.

4.3.3 WAC 173-340-745 Soil Cleanup Standards

MTCA cleanup standards for soil at industrial sites are defined in WAC 173-340-745, and are intended to be applied to sites which meet the following requirements:

- The site is zoned or has been otherwise officially designated for industrial use;
- The site is currently used for industrial purposes or has a history of use for industrial purposes;
- Adjacent properties are currently used or designated for use for industrial purposes;
- The site is expected to be used for industrial purposes for the foreseeable future due to site zoning, statutory or regulatory restrictions, comprehensive plans, adjacent land use, and other relevant factors; and
- The cleanup action provides for institutional controls implemented in accordance with WAC 173-340-440.

The allowance of a less stringent soil cleanup standard for industrial sites may only be granted with use of institutional controls, which may be administrative (e.g., restrictions on land use added to the deed) and/or physical (e.g., barriers to prevent access into certain areas), and are implemented to ensure the continued protection of human health and the environment. Under MTCA, long-term monitoring requirements, specified in WAC 173-340-410, may also be required if appropriate to the site.

Soil cleanup standards for industrial sites are established using Methods A and C specified in WAC 173-340-745. Method A includes a table (Table 3 of the regulation) which contains cleanup standards for a number of constituents. The basis for cleanup standards

included in this table are similar to those used in the MTCA 740 Method A table, with many cleanup standards based on protection of groundwater. If based on direct contact, the MTCA 745 Method A cleanup standard is adjusted to account for multiple constituents and exposure routes. If a constituent detected on the Blair Waterway Property is included in the MTCA 745 Method A Table 3, and its maximum concentration has exceeded previous screening criteria, the MTCA 745 Method A Table 3 value is included in Table 4 of this report as a screening criteria. Method C cleanup standards for industrial soils includes calculation of cleanup concentrations based on direct contact, using formulas provided in MTCA 745 Method C and repeated below.

$$\textit{Soil Cleanup Level (non-carcinogens mg/kg)} = \frac{RfD \times ABW \times UCF2 \times HQ}{SIR \times AB1 \times FOC}$$

Where:

RfD	=	Reference dose (mg/kg-day)
ABW	=	Average body weight over the period of exposure (70 kg)
UCF2	=	Unit conversion factor (1,000,000 mg/kg)
SIR	=	Soil ingestion rate (50 mg/day)
AB1	=	Gastrointestinal absorption rate (1.0)
FOC	=	Frequency of contact (0.4)
HQ	=	Hazard quotient (1.0)

$$\textit{Soil Cleanup Level (carcinogens mg/kg)} = \frac{RISK \times ABW \times LIFE \times UCF1}{CPF \times SIR \times AB1 \times DUR \times FOC}$$

Where:

RISK	=	Acceptable cancer risk level (1 in 100,000)
ABW	=	Average body weight over the period of exposure (70 kg)
LIFE	=	Lifetime (75 years)
UCF1	=	Units conversion factor (1,000,000 mg/kg)
CPF	=	Carcinogenic potency factor (kg-day/mg)
SIR	=	Soil ingestion rate (50 mg/day)
AB1	=	Gastrointestinal absorption rate (1.0)
DUR	=	Duration of exposure (20 years)
FOC	=	Frequency of contact (0.4)

If a constituent concentration detected in Blair Waterway Property soil exceeded the screening criteria defined by MTCA 740 Methods A, B and C, and the constituent was not represented in Table 3 (Method A) of MTCA 745, a cleanup standard for soil was calculated using these formulas for use as a screening criteria, and is included in Table 4 of this report. These calculated criteria do not include consideration of multiple constituents and multiple routes of exposure.

4.4 NUMERICAL CRITERIA FOR MARINE SEDIMENTS

The potentially applicable numerical criteria and guidelines for marine sediments are summarized in Table 5 and are discussed below.

4.4.1 Commencement Bay Nearshore/Tideflats Record of Decision (CBN/T ROD)

The CBN/T ROD (EPA 1989a) identified both sediment quality objectives (SQOs) and remedial action levels (RALs) for sediment contaminants in designated "problem areas" of the Commencement Bay Nearshore/Tideflats Superfund Site. The SQOs represent the concentrations of contaminants that would not be expected to have adverse environmental effects. The RALs represent the maximum concentrations of contaminants which are predicted to recover naturally and attain the SQOs within 10 years following source control. Sediment concentrations that exceed RALs may require sediment remedial actions (e.g., dredging, capping, or treatment). The Blair Waterway was not designated a "problem area" by the CBN/T ROD; thus, no RALs were developed for the Blair Waterway. The concentrations of contaminants identified in sediments for this investigation are appropriately compared to the SQOs for screening purposes related to cleanup requirements.

4.4.2 Sediment Management Standards, WAC 173-204

The Preliminary Investigation Report (Landau Associates 1990a) used the Interim Sediment Quality Evaluation Process for Puget Sound (Ecology 1989b) chemical criteria. The Sediment Management Standards, WAC 173-204 (Ecology 1991a), replaced the Interim Sediment Criteria and include three sets of criteria for marine sediments: Quality Standards, Source Control Standards, and Minimum Cleanup Levels. Marine Sediment Quality Standards, which correspond to "no significant health risk for humans" and "no acute or chronic adverse effects on biological resources," are listed in Table 5. Marine Sediment Source Control Standards address sediment quality in the vicinity of permitted discharges. The Minimum Cleanup Levels,

concentrations at which "minor adverse effects" may occur to biological resources, are listed in Table 5. The criteria in the Sediment Management Standards require that concentrations of nonpolar organic chemicals be normalized, using total organic carbon, prior to comparing to criteria. Because the CBN/T ROD presents criteria specifically for Commencement Bay, the Sediment Management Standards are provided for information only.

4.4.3 Puget Sound Dredged Disposal Analysis (PSDDA) Program

The PSDDA program established criteria to evaluate whether sediments dredged from Puget Sound are suitable for unconfined, open-water disposal (USACOE 1989). Sediments having contaminant concentrations below a screening level (SL) are deemed suitable for such disposal. Sediments having contaminant concentrations above a higher maximum level (ML) are unlikely to be suitable for such disposal, although biological testing may still be conducted to confirm the predictions of the ML. At contaminant concentrations between the SL and ML, biological testing would routinely be required to determine the suitability of the sediments for unconfined, open-water disposal. Therefore, comparison of the concentrations of contaminants found in sediments for this investigation to both the PSDDA SL and ML values serves as a useful initial screening of sediment quality.

5.0 COMPARISON OF SITE DATA TO NUMERICAL CRITERIA

5.1 OVERVIEW OF APPROACH

The concentrations of constituents detected in Blair Waterway Property groundwater, soil and ditch sediments, and marine sediments (Appendix C, Tables C-6 through C-8) are compared to numerical screening criteria in the following sections. The discussion in each section addresses constituents which exceed one or more of the numerical screening criteria presented in previous sections, and whether or not such criteria are directly pertinent for the conditions present (e.g., application of marine aquatic criteria to groundwater). Detected concentrations which exceed any of the screening criteria are summarized in tables within each section.

The Property location and use meet the MTCA requirements for application of industrial criteria. To expedite the property transfer process, the Tribe resolved (Tribe 1991) to restrict the use of the Blair Waterway Property to be consistent with industrial use zones M-2 and M-3 of the City of Tacoma zoning code. Accordingly, MTCA industrial use criteria are considered appropriate to evaluate the need for analysis of cleanup alternatives at the Blair Waterway Property.

5.2 GROUNDWATER

Detection limits reported by the laboratory for groundwater analyses exceeded numerical screening criteria for some analytes. Table 6 summarizes constituents for which detection limits exceeded numerical criteria. Detection limits for analytes which exceeded criteria, however, were commonly less than quantitation limits specified in the Work Plan (Landau Associates 1989b). The only instances in which detection limits exceeded specified quantitation limits were for formaldehyde in groundwater sample BW-4d-1 and rinsate blank sample BW-2i-1, and nickel in groundwater sample BW-3d-1. Detection limits and quantitation limits are discussed in Appendix D.

The concentrations of the various detected constituents in groundwater (Table C-6) were compared with the numerical screening criteria (Table 3). The following discussion addresses, by aquifer, constituents which exceed one or more of the numerical screening criteria presented in Table 3. Detected concentrations which exceed any of the screening criteria are summarized in Table 7.

The MTCA regulations require that cleanup levels for groundwater consider drinking water as the "highest beneficial use" at a site, unless groundwater is not presently used for drinking water and/or if groundwater at the site has insufficient quantity or quality to be used

as a source of drinking water. The MTCA also requires that Methods B and C soil cleanup levels be established using 100 times the groundwater cleanup level, unless it can be demonstrated that a higher soil concentration is protective of groundwater. Thus, MTCA requires a demonstration that groundwater is not acceptable for drinking water (WAC 173-340-721a) in order for less stringent cleanup/screening levels for both soil and groundwater to be applied for evaluation. Suitability of the shallow, intermediate, and deep aquifers as a potential drinking water source is discussed below.

5.2.1 Shallow Aquifer

5.2.1.1 Drinking Water Supply

The shallow aquifer at the Blair Waterway Property is not suitable as a drinking water source, due to insufficient quantity. The MTCA states that a sustainable yield of 0.5 gallons per minute (gpm) is required to qualify groundwater as a potential drinking water source. The average saturated thickness of the shallow aquifer at the Blair Waterway Property is approximately 3.3 ft during winter months and less during summer months. An estimate of shallow aquifer response to pumping, assuming a discharge of 0.5 gpm, a specific storage of 0.1, a hydraulic conductivity of 10^{-4} ft per minute, and a well efficiency of 50 percent, indicates that drawdown at a well exceeds the aquifer saturated thickness. Thus, the groundwater quantity available in the shallow aquifer is not sufficient to be considered as a potential drinking water supply, under the MTCA definition.

5.2.1.2 Aluminum, Chloride, Sulfate

Concentrations of aluminum and chloride were below the PSMCL and SMCL, respectively, for these constituents in all wells in the shallow aquifer. Sulfate exceeded the SMCL at Well BW-9s only (1,434 mg/L compared to SMCL of 250 mg/L and PMCL of 400/500 mg/L). These constituents were analyzed as general indicators of groundwater quality, and as an indicator of the interaction of groundwater with marine water from the Blair Waterway. Although some influence from marine water is evident in the shallow aquifer, the effect is not as pronounced as in the intermediate and deep aquifers. No additional evaluation regarding these constituents is appropriate, since concentrations of these constituents across the site are generally below levels of concern for human health, the shallow aquifer groundwater is not used as a drinking water source and is not considered a potential drinking water supply under MTCA, and no screening criteria exist for evaluation of impact on aquatic life.

5.2.1.3 Conductivity and pH

Measurements of conductivity exceed SMCL criteria in all but two wells in the shallow aquifer (Appendix A, Table A-2). Conductivity levels in the shallow aquifer wells suggest a relict marine water influence, as fill material was dredged from waterways and placed on former Tideflat sediments. Measurements of pH in groundwater from four shallow wells are less than the lower pH criterion (6.5 to 8.5), indicating acidic conditions (Appendix A, Table A-2). A slight yellow color reported in the four shallow wells with low pH suggests a high organic content, possibly associated with decaying organic matter. No surface acidic source is noted. No additional investigation of conductivity or pH values is suggested; however, pH and conductivity measurements should be collected during any future groundwater sampling.

5.2.1.4 Arsenic

Arsenic concentrations in exceedance of the MTCA Method A screening criterion were detected in shallow groundwater samples from Wells BW-6s (0.009 mg/kg) and BW-8s (0.049 mg/kg). The arsenic concentration at Well BW-8s also exceeded the marine chronic aquatic life criterion (0.013 mg/kg for pentavalent arsenic, 0.036 mg/kg for trivalent arsenic). Concentrations were less than the Federal Drinking Water Standard (0.05 mg/L), which is set at a higher risk allowance than the MTCA criterion. Concentrations detected in these wells is also less than the RCI RCRA permit groundwater protection standards for arsenic (0.05 mg/L). However, the presence of a deep utility trench between the RCI and Blair Waterway Property sites, at a depth below the bottom of the shallow aquifer, suggests that shallow aquifer flow between these sites does not occur; therefore, any arsenic in the shallow aquifer at RCI is not expected to be a source for the Blair Waterway Property shallow aquifer. At the Blair Waterway Property, arsenic in the shallow aquifer may be due to the presence of slag at the surface in the vicinity of these wells. Though the exceedance of numerical criteria for arsenic in shallow groundwater is small, the presence of slag should be further evaluated in terms of its potential to act as a long-term source of arsenic contamination to groundwater.

5.2.1.5 Beryllium and Selenium

Concentrations of Beryllium were measured at the PMCL (0.001 mg/L) and exceeded the MTCA Method B criterion (0.00002 mg/L), which is set at a lower acceptable risk level than the PMCL, at Wells BW-1s (0.001 mg/L), BW-3s (0.001 mg/L), and BW-10s (0.001 mg/L). Concentrations measured at Well BW-9s (0.002 mg/L) exceeded both criterion. Exceedance of the PMCL was not significant at Well BW-9s. Selenium concentrations for the sample from Well BW-6s (0.012 mg/L) slightly exceeded the Federal Drinking Water Standards (0.01 mg/L MCL), but was below the marine chronic aquatic life criteria (0.071 mg/L). Inadequate data are available to calculate a MTCA Method B criterion for selenium. Since exceedances are not significant, the extent is limited, and no known source for these constituents exists, no further action is proposed to address beryllium or selenium in the shallow aquifer.

5.2.1.6 Copper and Nickel

Copper concentrations are at or slightly greater than the marine chronic aquatic life criterion (0.0029 mg/L) in samples from Wells BW-1s (0.003 mg/L), BW-3s (0.003 mg/L), and BW-10s (0.010 mg/L). Nickel concentrations are slightly greater than the marine chronic aquatic life criterion (0.0083 mg/L) in samples from Wells BW-1s (0.03 mg/L), BW-3s (0.02 mg/L), and BW-9s (0.04 mg/L). Both copper and nickel are below Federal Drinking Water Standards and MTCA Method B criteria. Nickel is also below RCI RCRA permit standards, which, according to the permit, are based on background concentrations. Natural background concentrations, as used in this context and as defined by the MTCA, refers to the concentration of a hazardous substance consistently present in the environment which has not been influenced by localized human activities. Copper and nickel naturally occur in soil in the area due to the geologic processes that formed these materials.

The exceedances of the marine chronic aquatic life criterion are small in all cases and limited in extent. Concentrations of copper and nickel at the groundwater/surface water interface would be even lower, due to the attenuating capacity of the soil/groundwater system. Therefore, no further evaluation of copper and nickel in groundwater is appropriate for the shallow aquifer.

5.2.1.7 Iron and Manganese

The concentration of iron exceeds the SMCL (0.3 mg/L) in all wells in the shallow aquifer, except Well BW-7s. Concentrations range from over 150 mg/L (BW-9s) to less than

5 mg/L (BW-6s). The concentration of manganese in shallow aquifer wells exceeds the SMCL (0.05 mg/L) at all sampling locations, and exceeds the MTCA Method B criterion (0.53 mg/L) in all but one sampling location. Concentrations range from 0.077 mg/L to 8.34 mg/L. Marine chronic water quality criteria are not available for iron or manganese, and data are insufficient to calculate a MTCA Method B criterion for iron. Similar exceedances have also been reported in monitoring wells installed by RCI. The range of concentrations of iron and manganese detected in shallow groundwater are consistent with the natural background concentrations for the area reported by Ebbert et al. (1986) and reviewed by Hart Crowser (1991b). Since concentrations are consistent with the range of natural background concentrations, no further action is appropriate for iron and manganese in shallow aquifer groundwater.

5.2.1.8 Molybdenum

The concentration of molybdenum in the sample from Well BW-7s (0.018 mg/L) exceeded the RCI RCRA permit standard (0.015 mg/L), which is based on the laboratory PQL. However, the concentration detected is below the health-based MTCA Method B criterion (0.064 mg/L). Therefore, no further evaluation of molybdenum in shallow aquifer groundwater is appropriate.

5.2.1.9 Bis(2-ethylhexyl)phthalate

The marine chronic aquatic life criterion (3.4 µg/L), the MTCA Method B criterion (6.25 µg/L), and the RCI permit standard (10 µg/L) for bis(2-ethylhexyl)phthalate is exceeded in samples from two wells in the shallow aquifer (Wells BW-2s, at 33 µg/L and BW-9s, at 35 µg/L). The RCI standard is derived from the laboratory PQL. Concentrations of this constituent were similar to those found in the samples from monitoring wells installed by RCI. Bis(2-ethylhexyl)phthalate is present in plastics used in sampling and in the laboratory, and was detected in the laboratory blanks. No further evaluation of bis(2-ethylhexyl)phthalate is planned because of the suspicion of laboratory and sampling procedure sources. However, it should be included in any subsequent analyses.

5.2.1.10 Formaldehyde

Formaldehyde concentrations in exceedance of the RCI RCRA permit groundwater protection standard (50 µg/L, derived from the laboratory PQL) and the MTCA Method B groundwater screening criterion (1.4 µg/L) were found in eight of nine wells in the shallow

aquifer. Concentrations range from 190 µg/L to 2,390 µg/L. Formaldehyde was also detected, to a limited extent, in shallow aquifer groundwater samples on the RCI property. However, formaldehyde contamination of the shallow aquifer at the Blair Waterway Property is not expected to result from contamination on the RCI site, because of the presence of the utility trench between the properties. Because a different method of analysis was used for this investigation than for the RCI investigation, the results are in question. Due to the numerous detections of formaldehyde in all aquifers, additional evaluation of the chemical testing methods, as well as an evaluation of the RCI groundwater protection standard for formaldehyde, is appropriate. A comparison of formaldehyde analytical methods (Hart Crowser 1991a) suggests that RCRA Method 8315 is appropriate for future analyses. Formaldehyde should be included in the parameters for any future groundwater analyses, and data from the RCI annual groundwater sampling event should be reviewed to evaluate the progress of ongoing groundwater remediation by RCI.

5.2.2 Intermediate Aquifer

5.2.2.1 Drinking Water Quality

The intermediate aquifer at the Blair Waterway Property is not suitable for drinking water supply, due to naturally poor groundwater quality and the high potential for intrusion of salt water from the Blair Waterway if pumping were to be initiated. The MTCA assigns an upper bound concentration of 10,000 mg/L dissolved solids to represent acceptable concentrations for groundwater to be considered as a potential source of drinking water. The concentration of chloride and alkalinity, two common groundwater conventional parameters (Appendix C, Table C-6), are below the 10,000 mg/L dissolved solids concentration. Conductivity values measured in the intermediate aquifer in December 1989 (Appendix A, Table A-2) ranged from 857 micromhos near Alexander Avenue to 19,870 micromhos near the Blair Waterway. Elevated conductivity present near Wells BW-5i and BW-7i in the central portion of the Property indicates that the zone of fresh and salt water mixing extends beneath the central portion of the Property.

A relationship

$$KA = S \qquad \text{(USGS 1985)}$$

is used to estimate the total dissolved solid concentration from the conductivity value (where K is the specific conductance in micromhos, S is the dissolved solids concentration of mg/L, and A is a factor that may vary from 0.54 to 0.96, depending upon the solution concentration and

dominant ionic species). Using a relationship factor (A) of 0.6, the estimated dissolved solids concentration ranges from 524 to 11,922 mg/L in the intermediate aquifer.

Although only the upper end of the estimated dissolved solid concentration range in the intermediate aquifer exceeds the MTCA groundwater quality cutoff concentration for total dissolved solids, the elevated conductivity in the central portion of the Property is a good indicator of saltwater intrusion. A comparison of monitoring well stratigraphic data to Blair Waterway depth, and radius of influence information from groundwater simulations, shows that pumping from intermediate (or deep aquifers) has a high potential for inducing additional saltwater intrusion from the Blair Waterway. Therefore, the intermediate aquifer is not considered suitable as a drinking water source.

5.2.2.2 Aluminum, Chloride, Sulfate

Concentrations of aluminum, chloride, and sulfate exceed SMCLs or PMCLs at Well BW-9i in the intermediate aquifer. The concentrations detected indicate a brackish character, suggesting marine water influence and implying that this water is not suitable for drinking. Since concentrations are generally below levels of concern for human health and no screening criteria exist for evaluation of impact on aquatic life, no additional evaluation is appropriate.

5.2.2.3 Arsenic

Although arsenic was not detected in intermediate aquifer wells installed for this investigation, arsenic was reported in RCI Well MW-45i at concentrations of 1.5 mg/L (RCI 1990), which exceeds all identified screening criteria for this constituent. Arsenic was also reported in RCI Wells MW-44i and MW-46i at tentative concentrations (RCI 1990) of 0.0052 mg/L and 0.0038 mg/L, respectively, which are near or below the MTCA Method A cleanup screening level (0.005 mg/L). The arsenic in groundwater may be due to the presence of slag along the sides of the Graving Dock (which intersect the intermediate aquifer), or may be included in groundwater migration from RCI property. Groundwater protection standards were established as part of RCI's RCRA permit for chemicals of concern identified in groundwater at the RCI site, and for constituents that are known to be linked to substances used or generated by RCI. Although it is reported that RCI has not used arsenic or generated arsenic-containing materials (and there is no reported slag at the RCI site), a groundwater protection standard of 0.05 mg/L is established in the RCI permit. After RCI has completed groundwater remediation in the intermediate and deep aquifers, the permit conditions require that arsenic concentrations

be below 0.05 mg/L in monitoring results. However, it should be noted that although groundwater protection standards must be met when RCI ceases groundwater remediation, only 18 "indicator" chemicals will be routinely analyzed as part of RCI's groundwater monitoring program. Arsenic was not identified as an indicator chemical; therefore, arsenic will not be a part of routine analyses by RCI. Additional evaluation of arsenic in the intermediate aquifer in the vicinity of the Graving Dock is appropriate.

5.2.2.4 Beryllium

Concentrations of beryllium in Well BW-3i were equal to the PMCL (0.001 mg/L) but exceeded the MTCA Method B criterion (0.00002 mg/L, which is set at a lower risk level than the PMCL). All concentrations were at values close to the detection limit. No further action is proposed to address beryllium in the intermediate aquifer, since the concentrations are so low and of limited extent.

5.2.2.5 Copper

Concentrations of copper slightly exceeded the marine chronic aquatic life criterion (0.0029 mg/L) in samples from Well BW-3i (0.003 mg/L). However, the exceedance was very small and limited to the one well. Additionally, the attenuating capacity of the soil/groundwater system is likely to have further reduced the concentration prior to the groundwater/surface water interface. Therefore, no further evaluation of copper in the intermediate aquifer is appropriate.

5.2.2.6 Iron and Manganese

The concentration of iron exceeds the SMCL (0.3 mg/L) in five of six wells in the intermediate aquifer (Wells BW-1i, BW-4i, BW-5i, BW-7i, and BW-9i). Concentrations range from 10.5 mg/L to 38 mg/L. Data are insufficient to calculate a MTCA Method B criterion for iron. The concentration of manganese in intermediate aquifer wells exceeds the SMCL (0.05 mg/L) at all sampling locations, with concentrations ranging from 0.445 mg/L to 9.25 mg/L, but exceeds the MTCA Method B criterion (0.53 mg/L) in five of the six wells. Marine chronic water quality criteria are not available for iron or manganese. Similar exceedances have also been reported in monitoring wells installed by RCI. The range of concentrations of iron and manganese detected in the intermediate aquifer are consistent with the natural background

concentrations for the area reported by Ebbert et al. (1986) and by Hart Crowser (1991b). For this reason, no further action is appropriate for iron and manganese in the intermediate aquifer.

5.2.2.7 Pentachlorophenol (PCP)

PCP was not detected by the Port during the December 1989/January 1990 sampling event. Resampling in July and August 1990 for chlorophenolic organics detected PCP in Wells BW-4i, BW-5i, and BW-9i at concentrations less than the MCL (1 µg/L) and less than the MTCA Method B criterion (0.73 µg/L), which is based on a lower allowed risk level than the MCL. The concentration of PCP in Wells BW-4i, BW-5i, and BW-9i is also less than the groundwater protection standard in the RCI RCRA permit, and less than the concentration derived using the MTCA equation for cleanup levels of PCP in surface water (based on human consumption of fish taken from that water).

In 1990 and 1991, chlorinated phenols (including PCP) were reported in RCI Monitoring Well MW-45i at levels of 200 to 300 µg/L (RCI 1990; Appendix C, Attachment C-1). The level of PCP reported by RCI in Well MW-45i (RCI 1991) is greater than all screening criteria previously stated. Therefore, groundwater cleanup specified in the RCI RCRA Permit should be accomplished. Additionally, PCP, and any other chlorinated phenol contamination of groundwater that will be addressed by the RCI RCRA Interim Corrective Action, should continue to be monitored in Blair Waterway Property monitoring wells.

5.2.2.8 Bis(2-ethylhexyl)phthalate

The marine chronic aquatic life criterion for ambient marine water quality (3.4 µg/L) and the MTCA Method B criterion (6.25 µg/L) for bis(2-ethylhexyl)phthalate were exceeded in samples from two wells, BW-3i (4.6 µg/L) and BW-9i (26 µg/L) in the intermediate aquifer, and one, BW-9i, also exceed the RCI permit standard (10 µg/L). The RCI permit standard is derived from the laboratory PQL. Concentrations of this constituent were similar to those found in the samples from monitoring wells installed by RCI. Bis(2-ethylhexyl)phthalate is present in plastics used in sampling and in the laboratory, and was detected in the laboratory blanks. No further evaluation of bis(2-ethylhexyl)phthalate is planned because of the suspicion of laboratory and sampling procedure sources. However, it should be included in any subsequent analyses.

5.2.2.9 Formaldehyde

Formaldehyde concentrations ranging from 230 µg/L to 1,300 µg/L exceed the RCI RCRA permit standard (50 µg/L, derived from the laboratory PQL) and the MTCA Method B (1.4 µg/L) groundwater cleanup levels in five of six wells in the intermediate aquifer (Table 7). Formaldehyde was also detected in groundwater in most intermediate aquifer wells on the RCI property. As previously discussed, a different method of analysis was used for this investigation than in the analysis of RCI groundwater, and the results are in question. Due to the numerous detections, additional evaluation of the chemical testing methods and the relationship of contamination on the RCI site to Blair Waterway Property site contamination, as well as an evaluation of the RCI groundwater protection standard for formaldehyde, is appropriate. Comparison of formaldehyde analytical methods indicates that RCRA Method 8315 is more appropriate for future analyses (Hart Crowser 1991a). Formaldehyde should be included in the parameters for any future groundwater analysis, and data from RCI groundwater sampling should be reviewed to evaluate the progress of ongoing groundwater remediation by RCI.

5.2.2.10 Vinyl Chloride

The concentration of vinyl chloride in Well BW-9i (3.9 µg/L) exceeded the MCL (2 µg/L), the MTCA Method A criterion (0.2 µg/L), and the RCI permit standards (2 µg/L) during the initial January 1990 sampling and the confirmation sampling (PTB2-BW-9i) in July 1990 (Table 7). The concentration also exceeds the MTCA criterion for surface water (2.9 µg/L), which is calculated assuming a bioconcentration factor of 1.17. Well BW-9i is located near the Blair Waterway Property boundary across Alexander Avenue from the RCI site. Vinyl chloride is one of the chemicals detected on, and identified as a monitoring parameter for, the RCI site. Vinyl chloride has not been previously reported at the Blair Waterway Property. Vinyl chloride has high solubility in water, up to 2,763,000 µg/L (EPA 1985a, as cited in PHS 1988) and will not adsorb significantly to soil (PHS 1988); therefore, it is expected to be highly mobile in groundwater. Its detection suggests that a contamination plume may be extending from the RCI site onto the Blair Waterway Property. RCI presently reports vinyl chloride detected above 10 µg/L in RCI wells. The RCI RCRA permit standard is 2 µg/L. Definition of the extent of vinyl chloride contamination at concentrations below 10 µg/L, in RCI wells between the RCI site and the Blair Waterway Property site, is appropriate. RCI has taken steps to lower its analytical

detection limit for vinyl chloride and will incorporate a modified EPA Method 8240, which will achieve a detection limit of 2 µg/L. This modified method is to be used as of July 1991.

5.2.3 Deep Aquifer

5.2.3.1 Aluminum, Chloride, Sulfate

Concentrations of aluminum and sulfate were below PSMCLs and SMCLs respectively, in all deep aquifer wells. The concentration of chloride exceeded the SMCL (250 mg/L) at Wells BW-4d (586.8 mg/L) and BW-9d (2,045.9 mg/L). Marine water influence is believed to be the cause of the elevated concentration of chloride in these wells. Since concentrations are generally below levels of concern for human health, and no criteria exists for evaluation of impact on aquatic life, no additional evaluation is appropriate.

5.2.3.2 Iron and Manganese

The concentrations of iron and manganese exceed their respective SMCLs (0.3 mg/L for iron, 0.05 mg/L for manganese) in all deep aquifer wells. Concentrations of iron ranged from 0.525 to 1.09 mg/L, and manganese, from 0.167 to 0.354 mg/L. However, the concentration of manganese is below the MTCA Method B criterion (0.53 mg/L) in all cases. Data are insufficient to calculate a MTCA Method B criterion for iron. Marine chronic water quality criteria are not available for iron or manganese. Similar exceedances have also been reported in monitoring wells installed by RCI. The range of concentrations of iron and manganese detected in the deep aquifer are consistent with the natural background concentrations for the area, identified by Ebbert et al. (1986) and reviewed by Hart Crowser (1991b). For these reasons, no further action is appropriate for iron and manganese in the deep aquifer.

5.2.3.3 Formaldehyde

Formaldehyde concentration in exceedance of the RCI RCRA permit standard (50 µg/L, derived from the laboratory PQL) and the MTCA Method B groundwater criterion (1.4 µg/L) was found in one, BW-3d (600 µg/L), of three wells in the deep aquifer at the Blair Waterway Property. Formaldehyde was also detected in the deep aquifer on the RCI property and was also limited in extent. As previously discussed, a different method of analysis was used in this investigation than in the analysis of RCI groundwater, and the results are in question. Due to the numerous detections, additional evaluation of the chemical testing methods and the relationship of contamination on the RCI site to Blair Water Property site contamination, as well

as an evaluation of the RCI groundwater protection standard for formaldehyde, is appropriate. Comparison of formaldehyde analytical methods indicates that RCRA Method 8315 is more appropriate for future analyses (Hart Crowser 1991a). Formaldehyde should be included in the parameters for any future groundwater analysis, and data from the RCI annual groundwater sampling event should be reviewed to evaluate the progress of ongoing groundwater remediation by RCI.

5.2.4 Other Constituents Detected in Groundwater

Other constituents detected in groundwater, for which numerical screening criteria were not available, include alkalinity, calcium, magnesium, potassium, and sodium. These were analyzed as general indicators of groundwater quality and of the interaction of the Blair Waterway with the site groundwater. Therefore, additional evaluation of these constituents is not appropriate.

5.2.5 Previous Onsite Investigations

One or more samples collected from the Graving Dock dewatering wells during the previous investigations (AGI 1986) detected concentrations of metals, including arsenic, cadmium, chromium, chloride, iron, lead, manganese, nickel, and zinc, in concentrations above numerical screening criteria. No organic compounds were detected. The elevated levels of inorganics probably reflect the intrusion of marine water from the Blair Waterway due to pumping and potential leaching of metals from the slag that lines the Graving Dock.

5.3 SOIL AND DITCH SEDIMENT

Comparison of the soil and ditch sediment (former buried sediments and other ditch sediments) constituent concentration data to the criteria in Table 4 shows criteria were exceeded at some screening level (WAC 173-340-740 Methods A, B, and C, or WAC 173-340-745 Methods A and C) concentrations for arsenic, cadmium, PAH compounds, PCBs, and dioxins. The only detection limit reported by the laboratory for soil analyses, which exceeded screening criteria, was for benzene (MTCA screening criteria is 0.5 mg/kg and the reported laboratory detection limit was 5 mg/kg). However, the detection limit was below the quantitation limit specified in the Work Plan (Landau Associates 1989b).

The analytical results of TCLP analysis of slag samples exceed dangerous waste levels (WAC 173-303; Ecology 1989c) for arsenic in one of the two samples. Slag, probably from the

ASARCO Smelter, is present at the surface or at shallow depth in the central portion of the Property and lining three sides of the Graving Dock. Slag should be addressed during analysis of cleanup alternatives. Action associated with slag should be in accordance with Agency (Commencement Bay Nearshore/ Tideflats) policies for ASARCO slag.

Table 8 contains a summary of the constituents exceeding MTCA criteria for soil and ditch sediments; constituents exceeding MTCA Section 745 industrial criteria are so noted. Data which are not presented in Table 8 are below MTCA Section 740 Method A cleanup standards, which are the most stringent soil criteria used in this screening process. This section discusses those constituents which exceed one or more of the screening criteria. The only constituents exceeding MTCA Section 745 industrial criteria are arsenic, at several locations, and PCBs, only in the buried Lincoln Avenue Ditch sediment. The multiple contaminants in the Lincoln Ditch are discussed in Section 5.4. Recommendations regarding analysis of cleanup alternatives are described in Section 6.0.

5.3.1 Arsenic

The MTCA 173-340-740 Method A soil cleanup level screening criteria (20 mg/kg) was exceeded in the following samples: all Weyerhaeuser Boundary Ditch sediment samples, except BWD-3-1, (concentrations range from 43 mg/kg to 1,890 mg/kg); all Lincoln Avenue Ditch sediment samples (concentrations range from 27 mg/kg to 288 mg/kg); railroad right-of-way soil Samples BR-1-1 (23 mg/kg), BR-2-1 (46 mg/kg), and BR-3-1 (22/mg/kg); test pit exploration soil Samples BT-2-1 (120 mg/kg), BT-5-1 (81 mg/kg), BT-6-1 (30 mg/kg), and BT-9-1 (33 mg/kg); and all subsurface (buried) former Lincoln Avenue Ditch sediment samples (concentrations range from 44 mg/kg to 291 mg/kg). The MTCA 173-340-740 Method A soil cleanup level for arsenic is based on the background concentration of arsenic in the State of Washington. For this reason, a MTCA 173-340-740 Method B arsenic screening criteria for soil was not calculated, since the background concentrations in the State of Washington (Method A) are higher than a calculated MTCA Method B screening criteria would be. As shown in Table 8, the MTCA 173-340-740 Method C arsenic screening criteria (57 mg/kg) only slightly exceeds State background, and many of the soil and sediment samples previously identified are below the MTCA 173-340-740 Method C cleanup level (57 mg/kg).

Of all samples previously identified, only Weyerhaeuser Boundary Ditch sediment Samples BWD-4-1 and BWD-5-1, subsurface (buried) former Lincoln Avenue Ditch sediment Sample PTB2 BOLD-1, and Lincoln Avenue Ditch sediment Samples PTB2 BLD-7 and PTB2

BLD-8 exceed the MTCA 173-340-745 Method A (industrial) screening criteria for arsenic (200 mg/kg). This screening criteria is based on direct human contact with the material under the assumptions of an industrial exposure scenario, defined by the equations in Section 4.3. Arsenic in soil and the Weyerhaeuser Boundary Ditch sediment is interpreted to be, at least in part, related to slag present at the surface and in fill soil at the site. Arsenic in Lincoln Avenue Ditch sediment is interpreted to be, at least in part, related to arsenic reported in ditch sediment in the drainage upstream of the Blair Waterway Property that discharges to the Lincoln Avenue Ditch (RCI 1989). Arsenic in Lincoln Avenue Ditch sediment may also be due, in part, to onsite shallow groundwater or surface water runoff, which may carry particles of slag containing arsenic to the ditch. Because of its widespread distribution, arsenic in soil and ditch sediment indicates a need for analysis of cleanup alternatives. Cleanup alternatives should include, at a minimum, source control, specifically to sediment in the Weyerhaeuser Boundary Ditch, the Lincoln Avenue Ditch, and some surface and subsurface soil which contains slag. Arsenic concentrations associated with the subsurface (buried) former Lincoln Avenue Ditch sediment may require some form of institutional control but do not warrant analysis of cleanup alternatives, because their depth makes direct contact unlikely. Arsenic concentrations in the Lincoln Avenue Ditch and the Weyerhaeuser Boundary Ditch are discussed further in Sections 5.4 and 6.0.

The concentration (195 mg/kg) of arsenic in the composite sample BG-11/12 (Table C-11) of material from the Graving Dock bottom exceeded MTCA 173-340-740 soil cleanup criteria (20-57 mg/kg) but is less than the MTCA WAC 173-340-745 criteria (200 mg/kg). Although slag was not found at the base of the Graving Dock, the arsenic present in the bottom material is probably due, at least in part, to metals in the slag which lines the Graving Dock walls. The concentration of arsenic and other metals also exceed CBN/T ROD marine sediment criteria. Therefore, the mobility of this material must be limited to avoid its discharge to the Blair Waterway during filling of the Graving Dock. The Graving Dock bottom material is discussed further in Section 6.0.

5.3.2 Cadmium

The MTCA WAC 173-340-740 Method A soil screening criteria (2 mg/kg) for cadmium was slightly exceeded in one sample from the Weyerhaeuser Boundary Ditch (BWD-5-1). This Method A standard is based on protection of plants (based on research with food crops showing decreased crop production at higher cadmium concentrations). The MTCA WAC 173-340-740

Method B cleanup standard for cadmium (160 mg/kg) is based on direct human contact. The WAC 173-340-740 Method C (commercial) cleanup standard used as a screening criterion is 320 mg/kg. The cadmium concentration in the Weyerhaeuser Boundary Ditch sample (2.5 mg/kg) only slightly exceeded the MTCA Method A criterion, and is less than both the Methods B and C criteria. Since plant propagation is an unlikely future land use option for the Weyerhaeuser Boundary Ditch area, and the concentration of cadmium present is not expected to cause any adverse human health or environmental impacts, no further action is needed.

5.3.3 PAH

The MTCA WAC 173-340-740 Method A soil cleanup standard used as a screening criterion for carcinogenic PAH compounds was exceeded in two sediment samples (BLD-1-1 and BLD-3-1) from the Lincoln Avenue Ditch. The compound detected was benzo(b)fluoranthene/ benzo(k)fluoranthene, at 1.4 mg/kg and 1.6 mg/kg, respectively The two PAH compounds are combined in this analytical value and reported as one because of difficulty in analytical distinction. Chrysene was also detected in Sample BLD-3-1, at 1,700 µg/kg. The MTCA Method A criterion for carcinogenic PAH was also exceeded in Lincoln Avenue Ditch sediment samples PTB2-BLD7 [benzo(b)fluoranthene and benzo(k)fluoranthene concentration, at 2,500 µg/kg total, and the chrysene concentration, at 1,500 µg/kg] and PTB-2-BLD8 [benzo(b)fluoranthene and benzo(k)fluoranthene concentrations, at 2,000 µg/kg total, and the chrysene concentration, at 1,100 µg/kg]. Test pit exploration Sample BT-4-1 exceeded MTCA Method A criterion for carcinogenic PAH, with 1,900 µg/kg total benzo(b)fluoranthene and benzo(k)fluoranthene and 1,100 µg/kg chrysene. The MTCA WAC 173-340-740 Method A soil screening criterion is set at 1.0 mg/kg, which is based on direct contact using equations specified in Method B, with upward adjustment of the value to account for the practical quantification limit. The exceedance was below the MTCA WAC 173-340-740 Method C cleanup standard of 3.5 mg/kg carcinogenic PAH. PAH compounds were detected in other Lincoln Avenue Ditch sediment samples below the MTCA WAC 173-340-740 Method A screening criterion concentrations. The medium to high molecular weight PAH compounds detected have relatively high organic carbon partition coefficients, which indicates a strong tendency to adsorb to organic matter (PHS 1989). Therefore, although present in sediment, this factor and the low solubility of the PAH compounds indicate that transport of the constituents either in groundwater or dissolved in surface water (the Blair Waterway) is unlikely, except as adsorbed onto suspended sediments. However, the frequency of detection of PAH compounds in ditch

sediment and the presence of other constituents in the sediment (e.g., metals, PCBs) indicate that, at a minimum, source control and potential discharge to marine sediment remains an issue. Thus, the Lincoln Avenue Ditch system is an area needing further consideration, as discussed in Sections 5.4 and 6.0.

The MTCA WAC 173-340-740 Method A soil cleanup level screening criteria for carcinogenic PAH was slightly exceeded in composited Sample BG-11/12 from the bottom of the Graving Dock, with a concentration of 1.1 mg/kg. Detected constituents in this material are summarized in Appendix C, Table C-11. This concentration is below MTCA WAC 173-340-740 Method C soil cleanup criteria for carcinogenic PAH (3.5 mg/kg), and well below MTCA WAC 173-340-745 Method A industrial cleanup criteria for these constituents (20 mg/kg). Therefore, no further action related to PAH is needed for this material.

5.3.4 PCBs

PCBs were detected in most Lincoln Avenue Ditch sediment samples, but only two of the samples contained concentrations slightly in excess of the MTCA WAC 173-340-740 Method A cleanup standard (1.0 mg/kg) used as a screening criterion for soil. This criterion is based on direct contact with soil, using equations specified in MTCA WAC 173-340-740 Method B with upward adjustment of the value to account for the practical quantification limit. The Lincoln Avenue Ditch sediment samples were both below the MTCA WAC 173-340-740 Method C criterion (5.2 mg/kg) and MTCA WAC 173-340-745 criterion (10 mg/kg) for PCBs.

PCBs have low solubility in water and adsorb strongly to soil and sediment (PHS 1987); therefore, it is unlikely that PCBs will transport easily either in groundwater or dissolved in surface water, except as adsorbed to suspended sediment. Although PCB concentrations are under commercial/industrial land use criteria, sediments in the Lincoln Avenue Ditch will be subject to further evaluation and action to address source control and potential discharge to marine sediments for other constituents (i.e., arsenic, PAH compounds).

One of three samples of the buried ditch sediment horizon in the former Lincoln Avenue Ditch (BOLD-1 at 14.6 mg/kg) exceeds all MTCA soil cleanup standards used as screening criteria for PCBs. This sample is from a thin sediment horizon buried at a depth of 12-13 ft. Under MTCA regulations for subsurface soil, the point of compliance, which is defined to mean the point or points where cleanup levels established in MTCA shall be attained, extends to a depth of 15 ft. Since the extent of PCB contamination at this level is limited (one of three samples), and the low mobility of PCBs indicates that migration to groundwater and

subsequently to surface water is unlikely, a conditional point of compliance at a depth of 10-12 ft may be appropriate and further action may not be necessary. Use of a conditional point of compliance may trigger other requirements under the MTCA, such as use of institutional controls. These issues will be further discussed in Section 6.0 of this report.

5.3.5 Dioxins

Chlorinated dibenzo-p-dioxins and dibenzo furans (abbreviated as dioxins) were detected during this investigation in the subsurface (buried) sediment Samples BOLD-2 and BOLD-3 in the former Lincoln Avenue Ditch at concentrations (0.015 and 0.528 µg/kg, respectively) exceeding MTCA WAC 173-340-740 Method B and Method C criteria for soil (0.0067 µg/kg and 0.270 µg/kg, respectively), but below WAC 173-340-745 Method C criteria (0.880 µg/kg). These samples were obtained from a thin sediment horizon buried at a depth of 12-13 ft.

Dioxins had been previously detected in sediments in the Lincoln Avenue Ditch, in a 1986 study conducted by Applied Geotechnology, Inc. (AGI; 1986). Data from this study, in which the eastern portion and western portion of the Lincoln Avenue Ditch were sampled, are included in Appendix C as Attachment C-2. The study utilized toxicity equivalency factors established in 1985 (EPA 1985b) for determining a toxicity equivalent for all dioxin and furan congeners to that amount of tetrachlorodibenzodioxin (TCDD), and concluded that the TCDD equivalent totals for both samples (eastern portion and western portion of the Lincoln Avenue Ditch) were much less than the 1 µg/kg action level defined as a treatment standard under RCRA Part 268 Land Disposal Restrictions (Section 268.41). This action level is based on the allowable dioxin concentration in the waste extract for disposal of the waste at a hazardous waste landfill (based on performance of TCLP testing on the waste or waste treatment residual). As such, this action level does not apply to dioxins in the Lincoln Avenue Ditch. Additionally, when the 1986 AGI data are evaluated using the updated toxicity equivalency factors (EPA 1989a), concentrations of dioxins in sediments reported in the 1986 AGI study from both the east portion (0.236 µg/kg) and west portion (0.227 µg/kg) of the Lincoln Avenue Ditch exceed the MTCA WAC 173-340-740 Method B screening criterion. The concentrations, however, are less than the MTCA WAC 173-340-740 Method C and MTCA WAC 173-340-745 Method C soil cleanup screening criteria. Because concentrations of dioxin in Lincoln Avenue Ditch sediments sampled in 1986 are below MTCA WAC 173-340-740 Method C soil cleanup criteria, no further action on these sediments to address dioxins in the existing Lincoln Avenue Ditch is appropriate.

The subsurface (buried) sediment from the former Lincoln Avenue Ditch where dioxins were detected above MTCA WAC 173-340-740 Methods B and C soil cleanup criteria are at a depth of 12-13 ft. The sediments are buried; therefore, surface water runoff is not a consideration. Dioxins have low solubility in water and tend to adsorb strongly onto soil and sediment (Travis and Hattemer-Frey 1987), which limits the mobility of these constituents in subsurface soil and subsequent migration to groundwater. The extent of dioxin contamination is restricted to a thin, buried layer of former sediment, and the low mobility of dioxins in soil indicates that migration to groundwater and, subsequently, to surface water is unlikely. Therefore, a conditional point of compliance at a depth of 10-12 ft may be appropriate for the site and no further action may be necessary. Use of a conditional point of compliance may trigger other requirements under the MTCA, such as institutional controls. These issues will be further discussed in Section 6.0 of this report.

5.3.6 Other Constituents

Aluminum, calcium, magnesium, manganese, potassium, and sodium were detected in soil and sediment but do not have available numerical screening criteria. These constituents were analyzed as indicators of natural soil conditions and are not considered to be of concern. Freon, 2-hexanone, benzo(g,h,i)perylene, and phenanthrene were also detected and do not have available numerical criteria. Some of these compounds are generally found in association with other compounds [e.g., benzo(g,h,i)perylene and phenanthrene with other PAH]. Therefore, even though direct evaluation of these compounds was not conducted, indirect evaluation through associated compounds was conducted. No additional evaluation of these constituents is appropriate.

5.3.7 Previous Results

In addition to sampling the Lincoln Avenue Ditch in 1986, AGI also collected soil samples in the former Lincoln Avenue Ditch fill, the northeast drainage ditch and the drum storage area (AGI 1986). Samples collected from these locations were analyzed for organic and inorganic constituents. With the exception of dioxin (previously discussed) in the Lincoln Avenue Ditch, evaluation of the data indicates that there were no exceedances of the numerical screening criteria.

Based on the comparison of soil and sediment data to screening criteria, the following areas require no additional evaluation:

- There were no exceedances of numerical criteria in the boundary ditch samples near the Domtar Gypsum Facility. No further evaluation is warranted.
- There were no exceedances of numerical criteria in samples from the Mud Lake outfall and spillway areas. No additional evaluation is warranted.
- There were no exceedances of numerical criteria or concentrations of significance in the Lincoln Avenue Ditch outlet fill area. No buried slag was found in this area. No additional evaluation of this area is warranted.
- There were no exceedances of numerical criteria or concentrations of significance in the drum storage area. No additional evaluation in this area is warranted.
- There were no exceedances of numerical criteria or concentrations of significance in the fueling area. No additional evaluation of this area is warranted.

5.4 RISK EVALUATION FOR MULTIPLE CONTAMINANTS IN THE LINCOLN AVENUE DITCH AND THE WEYERHAEUSER BOUNDARY DITCH

There were no exceedances of numerical criteria, other than for arsenic, in either the Lincoln Avenue Ditch or the Weyerhaeuser Boundary Ditch; however, multiple constituents were detected at both locations. A screening level risk evaluation was conducted using ditch sediment data for samples from the Lincoln Avenue Ditch and the Weyerhaeuser Boundary Ditch to determine if the additive effect of multiple constituents represents a potential hazard to human health. This evaluation was accomplished using methodology described in MTCA for determining cleanup levels where multiple contaminants are present in soil at industrial sites. Since multiple constituents were detected at both locations, screening levels were established using equations specified in MTCA. When multiple constituents are present, MTCA further directs that calculated levels shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure.

To determine if combinations of constituents are present in concentrations that result in a human health risk greater than allowed for industrial sites, the equations specified in MTCA [WAC 173-340-745 (4)(a)(iii)(A) and (B); Ecology 1991b] were used to determine the hazard index and total excess carcinogenic risk that is associated with the constituents identified. A similar risk evaluation was not conducted with criteria derived by using equations specified in WAC 173-340-740, because previous screening efforts demonstrated that few constituents

exceeded these cleanup criteria. The equations specified in WAC 173-340-745 Method C were modified to solve for hazard quotient (in the case of noncarcinogenic constituents) or acceptable carcinogenic risk level (in the case of carcinogenic constituents). The highest concentration of each constituent detected at the eight Lincoln Avenue Ditch sample locations were used as input parameters in the equation to derive these values and provide a conservative evaluation. Use of these equations focused the risk evaluation on the soil ingestion pathway, which was considered the most likely pathway of exposure at the site. Other pathways, including groundwater and seafood ingestion, were not evaluated.

The hazard quotients and excess carcinogenic risks derived for each constituent are summarized in Table 9. In some cases, both carcinogenic and noncarcinogenic criteria were available, and both hazard quotient and excess cancer risk were calculated. No health-based criteria were available for some constituents, as indicated on Table 9. The sum of the hazard quotients for all constituents detected in the Lincoln Avenue Ditch is 0.083; for all constituents detected in the Weyerhaeuser Boundary Ditch, the sum is 0.54. Most of the hazard index value, in both cases, is due to arsenic. Since these hazard quotient values are both less than 1.0, adverse noncarcinogenic health effects are not considered likely as a result of exposure to contaminated soil in these areas. Concentration of noncarcinogenic constituents are below health-based levels which would be required for cleanup, even when using the highest concentrations detected onsite. Adjustment of criteria downward, to accommodate the hazard associated with the multiple substances in the Lincoln Avenue Ditch, is not necessary.

Total excess carcinogenic risk calculated for soil/sediment was prepared both with and without consideration of the contribution of risk due to onsite arsenic contamination. The presence of arsenic onsite is probably linked to the presence of the ASARCO slag. The total excess carcinogenic risk calculated for soil/sediment in the Lincoln Avenue Ditch is 2.3E-5 for all constituents. If the excess risk associated with arsenic is subtracted from this value, a total excess cancer risk of 8.4E-6 remains for all other constituents. Most of the remaining risk is due to the presence of PCBs and PAH compounds. The total excess carcinogenic risk associated with the highest concentrations detected in the Weyerhaeuser Boundary Ditch (including arsenic) is 9.8E-5. If the excess risk value associated with the presence of arsenic is subtracted from this value, an excess risk associated with all other constituents of 1.5E-7 remains. For both the Lincoln Avenue Ditch and Weyerhaeuser Boundary Ditch the presence of arsenic is the strongest influence of risk level and, if arsenic is not included in risk estimates, the excess risk

levels are below the acceptable benchmark cleanup value of 1E-5 specified by MTCA for industrial soils.

It must be noted that values calculated assume that the data collected are representative of site conditions and, by using the largest concentration detected, this risk screening evaluation approach is conservative. The equations specified by MTCA, and used in this screening level assessment to calculated potential health hazards associated with constituents onsite, also use conservative assumptions in calculating exposures. Although health-based criteria were not available for a few constituents, preventing the calculation of hazard quotient or excess risk values, the conservatism inherent in this screening level assessment is more likely to overestimate rather than underestimate the true risk. Based on the hazard index values and excess carcinogenic risks calculated, cleanup action associated with sediment in the Lincoln Avenue Ditch and Weyerhaeuser Boundary Ditch should be focused on arsenic.

5.5 MARINE SEDIMENT

Blair Waterway

The only marine sediment sample exceeding the SQOs identified in the CBN/T ROD was the surface (0 to 2 cm) sediment sample at Station BWS-1 (Table 10). The PCB concentration in that sample (280 µg/kg dry weight) exceeded the SQO (150 µg/kg dry weight) for PCBs in Commencement Bay. A RAL for PCBs in the Blair Waterway was not identified in the CBN/T ROD because the Blair Waterway was not identified as a "problem area." However, RALs for PCBs in the nearby Hylebos Waterway ranged between 240 to 300 µg/kg dry weight. Samples of sediment at the Property below the surface 0 to 2 cm show no exceedances of criteria.

Marine sediment Sample BWS-1-02 also exceeded Ecology's Marine Sediment Quality Standard for PCBs, which is calculated on a total organic carbon (TOC) normalized basis. The TOC-normalized concentration of PCBs was 53.8 mg/kg organic carbon, as compared to the sediment quality standard of 12 mg/kg carbon. This exceedance suggests that the concentration of PCBs would have adverse biological effects, but does not necessarily imply that remediation would be required. The TOC-normalized concentration of PCBs in Sample BWS-1-02 was less than the minimum cleanup level of 65 mg/kg organic carbon.

Comparisons of the sediment contaminant concentrations to PSDDA SLs and MLs indicated that none of the sediments analyzed had contaminant concentrations in excess of the PSDDA MLs, and the only sample exceeding an SL was the surface (0 to 2 cm) sample at

Station BWS-1, with a PCB concentration of 280 µg/kg dry weight as compared to the PSDDA SL of 130 µg/kg dry weight. Exceedance of a PSDDA SL indicates only that biological testing (i.e., bioassays) of the sediments would be required if the sediments were under consideration for dredging and unconfined, open-water disposal. In cases where contamination is limited to only a part of the sediment column (e.g., the uppermost 2 cm), sample compositing allowed under the PSDDA evaluation procedures might reduce the contaminant concentrations below the PSDDA SLs.

Landau Associates (1990a) suggested that the PCB concentration found in the surface sediment at Station BWS-1 warranted further evaluation of the magnitude and spatial distribution of the PCB contamination at this station. Dredging of the marine portion of the Property will be accomplished in conjunction with the Milwaukee Waterway Fill/Blair Waterway Dredging Project. No additional evaluation is warranted for property investigation purposes.

Lincoln Avenue Ditch

A comparison of the contaminant concentrations in the Lincoln Avenue Ditch sediments to the CBN/T ROD marine sediment criteria was accomplished because the ditch is tidally influenced.

An evaluation of data using marine sediment criteria is presented for information purposes because historic use of the ditch resulted in contaminated sediments in the ditch. Utility relocation planned by the City of Tacoma will include rerouting of the Lincoln Avenue Ditch drainage through a buried storm drain line. Following relocation, the open ditch will no longer be an active drainage conduit; thus, in itself, it will not represent a significant source of contaminants. It is anticipated that the open portions of the Lincoln Avenue Ditch will be filled during site development, similar to the filling of the former Lincoln Avenue Ditch along the southeastern side of the Lincoln Avenue right-of-way on the Blair Waterway Property. Thus, for the reasons identified above, evaluation for cleanup action is based on soil and not marine sediment criteria.

The constituents exceeding any of the applicable CBN/T ROD or PSDDA criteria are listed in Table 10. Three constituents, PCBs, arsenic, and bis(2-ethylhexyl)phthalate, exceeded the SQOs for Commencement Bay. PAH, metals, bis(2-ethylhexyl)phthalate, pentachlorophenol, and PCBs exceeded the PSDDA SLs in one or more of the sediment samples from the Lincoln

Avenue Ditch. Exceedance of PSDDA SLs is not considered significant because open-water disposal of Lincoln Avenue Ditch sediments is not planned.

The only constituent, based on available data in sediment samples, exceeding Ecology's Minimum Cleanup Levels was arsenic. It should be noted, however, that Ecology's sediment criteria for nonpolar semivolatile organic compounds are on a TOC normalized basis. Since the TOC content of the Lincoln Avenue Ditch sediment samples was not analyzed, the nonpolar organic contaminant concentrations cannot be compared with their respective sediment quality criteria.

Weyerhaeuser and Domtar Boundary Ditches

The boundary ditches adjacent to the Domtar and Weyerhaeuser properties are not tidally influenced. As required by the EPA (1991b), sediment data from each ditch is compared with CBN/T ROD marine sediment screening criteria to evaluate if the boundary ditches are potential sources of contaminants. This comparison is discussed below; however, concentration from samples are not presented in Table 10.

Concentrations of detected constituents in the boundary ditch adjacent to the Domtar property are generally low. PCBs were detected in one of the seven ditch sediment samples, (BDD-5-1) at a concentration of 150 µg/kg, which is equal to the CBN/T ROD SQO for PCBs. The 150 µg/kg concentration is less than the soil numerical environmental screening criteria. No other metal or organic constituents exceed SQOs. These data indicate that sediment in the Domtar Boundary Ditch is not a significant source of contaminants to the Blair Waterway.

Concentrations of arsenic in the boundary ditch adjacent to the Weyerhaeuser property exceed CBN/T ROD SQOs in three of five ditch sediment samples (BWD-2-1, BWD-4-1, and BWD-5-1). Concentrations of copper and zinc exceed SQOs in two of five ditch sediment samples (BWD-4 and BWD-5). The probable source of arsenic, copper, and zinc in the boundary ditch adjacent to the Weyerhaeuser property is ASARCO slag. Slag was placed at the Blair Waterway Property along the sides of the Graving Dock and in the central portion of the Property. No other metal or organic constituents in the ditch adjacent to Weyerhaeuser property exceed SQOs. These data indicate that the Weyerhaeuser Boundary Ditch is a potential, although limited, source of metal contaminants to the Blair Waterway. Appropriate action to address metals contamination in the Weyerhaeuser Boundary Ditch is discussed in conjunction with ASARCO slag requirements.

6.0 EVALUATION OF CONDITIONS AND REMEDIATION/DEVELOPMENT PROGRAMS

6.1 PATHWAY/RECEPTOR EVALUATION AND CLEANUP OBJECTIVES

The purpose of this section is to evaluate potential contaminant transport and receptors of concern for the areas identified in Sections 4.0 and 5.0 where screening level criteria were exceeded or a potential source of contamination is present. These areas, also shown on Figure 13, are:

- Shallow aquifer arsenic contamination
- Intermediate aquifer organic compound contamination originating primarily from the RCI property
- Intermediate aquifer arsenic contamination southeast of the Graving Dock
- Graving Dock slag and bottom material
- Slag in the central portion of the Property
- Lincoln Avenue Ditch (existing and former) sediment contamination (arsenic and organic chemicals)
- Weyerhaeuser Boundary Ditch sediment contamination with arsenic
- Mud Lake Impoundment contaminated sediments.

This evaluation considers both commercial and industrial criteria for determining the potential need for cleanup action. Since the Tribe has identified (Tribe 1991) industrial use for the Property, the need for cleanup objectives and analysis of cleanup alternatives will be based on industrial criteria and the evaluation of pathways and receptors.

6.1.1 Shallow Aquifer

The primary constituent of concern in the shallow aquifer is arsenic. The principal source of the arsenic is believed to be near-surface slag fill and, as such, will be addressed by source-related cleanup activities. No further action or analysis of cleanup alternatives are recommended for the shallow aquifer. This aquifer is not currently used as a source of drinking water and is unlikely to be used as a source in the future, because of its quantity limitations.

6.1.2 Intermediate Aquifer

Constituents of concern in the intermediate aquifer are organic compounds and arsenic. Groundwater in the intermediate aquifer (or other aquifer systems that may be interconnected to the intermediate aquifer) is not presently used as drinking water and, as discussed in Section 5.2, does not have characteristics suitable for a potential drinking water source. Thus, direct human consumption of groundwater is not considered a potential pathway of concern. Worker exposure to contaminated groundwater from the intermediate aquifer is not likely during shallow excavations for construction of surface facilities.

Contaminants in the intermediate aquifer in the southeastern portion of the Blair Waterway Property, including arsenic, chlorinated phenols, formaldehyde, benzene, methylene chloride, 1,2-dichloroethane, and trichloroethane, have been reported by RCI (1988a, 1990, 1991). Groundwater analytical results for samples from monitoring wells installed during this investigation identify organic chemicals; including vinyl chloride, pentachlorophenol, bis(2-ethylhexyl)phthalate, and formaldehyde at other locations on the Blair Waterway Property.

Organic contamination in the intermediate aquifer migrates from the RCI facility and, potentially, discharges into the Graving Dock and the Blair Waterway. The tidal fluctuation effect between the intermediate aquifer and the Graving Dock may be inducing flow of water from a portion of the Graving Dock through the slag on the Graving Dock sides and contributing to elevated arsenic concentrations in RCI Well MW-45i (RCI 1990, 1991). Chemical conditions of the material at the bottom and the water in the Graving Dock (e.g., reducing conditions) may also be enhancing arsenic solubility. Potential migration pathways and receptors of concern include:

- Discharge of contaminated groundwater to the Blair Waterway, the Graving Dock, or ditches which discharge to the Blair Waterway; and subsequent uptake of the contamination by aquatic organisms and potential consumption of those organisms by humans.
- Direct human contact with contaminated groundwater emanating from the waterway bank of the Property or within the Graving Dock area, and human consumption of the groundwater.

The cleanup action objectives for the intermediate aquifer are to:

- Minimize contact of humans and aquatic life with contaminated groundwater
- Identify and control the contaminant source(s) to the extent practicable

- As required by their RCRA permit, RCI will reduce the concentration of contaminants in groundwater at certain portions of the Blair Waterway Property to concentrations below relevant protection standards.

Additional actions, which are appropriate but not strictly cleanup objectives, are to:

- Monitor groundwater to assess RCI cleanup
- Assess extent of arsenic contamination southeast of Graving Dock.

Groundwater Protection Standards are the groundwater cleanup levels for the RCI corrective action program. The protection standards in the RCI RCRA permit are greater than concentrations identified in recent State and Federal regulations and standards for pentachlorophenol, vinyl chloride, and arsenic. Because groundwater protection standards for these and other constituents are issued by the EPA in the RCI RCRA program permit, they are considered appropriate to evaluate contaminant concentrations in groundwater for protection of human health and the environment at the Blair Waterway Property.

Corrective action planned at the RCI facility involves monitoring and extracting contaminated groundwater from the intermediate and deep aquifers within the RCI property. The objective of the RCI groundwater remediation program on the Blair Waterway Property is to remove organic chemical contaminants from the intermediate aquifer to the southeast of the Graving Dock. The RCI corrective action at the Blair Waterway Property should be accomplished.

Results of this investigation suggest that organic chemical contamination (vinyl chloride in Monitoring Well BW-9i exceeding RCI standards, and pentachlorophenol in Monitoring Wells BW-4i, BW-5i, and BW-9i less than RCI standards) is present to the northwest of the Graving Dock. Vinyl chloride and pentachlorophenol are constituents targeted for cleanup by RCI, but have not been previously reported to be northwest of the Graving Dock. Additional evaluation of these detections by EPA and RCI is recommended. Additionally, monitoring and evaluation of new extraction system data is recommended to assess cleanup progress, and to assess the effectiveness of the RCI groundwater cleanup program related to the presence of arsenic in the aquifer and the organic chemical contamination northwest of the Graving Dock near Well BW-9i. Additional investigation of the extent of intermediate aquifer arsenic adjacent to the Graving Dock is recommended during the next phase. Any further action, including analysis of cleanup alternatives, should be based on the results of additional investigation.

The RCI program does not address shallow groundwater at the Blair Waterway Property. Pumping planned for the intermediate aquifer is intended to maintain an upward flow gradient from the deep to the intermediate aquifer. Although pumping from the intermediate aquifer will locally increase the downward gradient from the shallow to the intermediate aquifer in the vicinity of Extraction Wells EW-4 and EW-10 (Figure 4), pumping influence is not anticipated to extend across the Graving Dock and, thus, will not increase migration of arsenic contamination noted in the vicinity of shallow aquifer Monitoring Wells BW-6S and BW-8S (northwest of the Graving Dock) to the intermediate aquifer.

RCI extraction wells (EW-4 and EW-10), located to the southeast of the Graving Dock, are completed in the intermediate aquifer. The Graving Dock excavation extends to the base of the intermediate aquifer, and the water in the Graving Dock communicates directly with the intermediate aquifer. When the Graving Dock is filled, RCI should accomplish a general reevaluation of the groundwater remedial program at the Blair Waterway Property, including an assessment of the capture effectiveness of the existing extraction wells.

6.1.3 Slag

Slag is present at several locations, including the central Property area and three sides of the Graving Dock. TCLP results show that the slag contains several heavy metals, including arsenic. Arsenic and some metals have also been detected in shallow groundwater, soil, and ditch sediments, and are believed to be associated with the presence of slag on the Property. Potential migration pathways and receptors of concern include:

- Direct contact with and/or ingestion of metals from the slag, or contaminated soil and ditch sediments
- Potential discharge of slag-associated contaminants to ditch sediments and/or to marine sediments in the Blair Waterway, and associated concerns related to aquatic life
- Long-term leaching of slag-associated contaminants to the groundwater and subsequent discharge to the Blair Waterway, and potential impact to aquatic organisms.

As discussed earlier, potential human ingestion of groundwater is considered unlikely, because the shallow and intermediate groundwater aquifers are not considered to be viable drinking water sources.

Analysis of cleanup alternatives is warranted to address slag-related metals contamination. The cleanup objectives for slag-contaminated environmental media are:

- Minimize direct human contact with contaminated material
- Minimize surface water transport of contaminants to the Blair Waterway
- Reduce leaching of metals from slag to groundwater.

6.1.4 Graving Dock Bottom Material

The thin, 6-inch layer of soft, loose material at the bottom of the Graving Dock contains arsenic and thallium exceeding MTCA WAC 173-340-740 commercial soil screening criteria but not MTCA WAC 173-340-745 industrial criteria. The material contains metals (arsenic, copper, and zinc) at concentrations exceeding CBN/T ROD marine sediment criteria. Potential migration pathways and receptors of concern include:

- Direct human contact
- Discharge of this material to the Blair Waterway; thus, impacting marine aquatic organisms/receptors.

Because concentrations of these metals are less than industrial criteria, and since the material is in a thin layer and not exposed to human contact or currently able to migrate directly by surface water movement to the Blair Waterway, no analysis of cleanup alternatives is recommended. Since the Tribe has elected to fill the Graving Dock, consideration of possible movement of the material during the filling process is important. Accordingly, precautions are appropriate to avoid direct discharge of this material to the Blair Waterway during the filling program.

6.1.5 Existing Lincoln Avenue Ditch and Former (Buried) Lincoln Avenue Ditch Alignment

Contaminant levels in some samples from the existing Lincoln Avenue Ditch exceed screening criteria for arsenic in soil. Risk evaluation of the combined effects of multiple contaminants in the Ditch suggests that arsenic is the major risk-related contaminant. Potential migration pathways and receptors with potential to contact this material include:

- Surface water discharge of arsenic or arsenic-contaminated suspended sediment from the Lincoln Avenue Ditch to the Blair Waterway, with potential impact on aquatic organisms
- Leaching of contaminants from ditch sediments to groundwater and subsequent discharge to surface water, with potential impact on aquatic organisms
- Direct contact (dermal and incidental ingestion) with contaminated sediments by persons working in the ditch or excavations in the ditch area during any future construction activities.

Evaluation of cleanup alternatives for the existing Lincoln Avenue Ditch is appropriate. The cleanup objectives for the Lincoln Avenue Ditch include:

- Minimize potential human contact with contaminated sediments.

- Minimize transport of contaminated sediment in surface water to the marine environment
- Minimize leaching of contaminants into groundwater.

The City of Tacoma plans to install a buried storm drain across the Blair Waterway Property for Lincoln Avenue drainage, pursuant to Puyallup Settlement Supplemental Agreements. Construction of the storm drain will allow the existing ditch channel to be isolated from the Blair Waterway. The buried storm drain could physically isolate any contaminants in the future drainage from human contact. Source control and investigation of facilities that contribute contaminants to the Lincoln Avenue drainage system have been initiated by EPA [Science Applications International Corporation (SAIC) 1990]. Prevention of continued contamination of marine sediments by discharge of contaminants will be accomplished only by source control, which is beyond the scope of this property transfer consideration.

Contaminant levels in some samples from the former (buried) Lincoln Avenue Ditch exceed at least some of the screening criteria for arsenic, PCBs, and dioxins, as discussed in Section 5.0. Contamination associated with the former Lincoln Avenue Ditch is in a thin (approximately 0.5 ft thick) sediment layer buried beneath 12-13 ft of fill material. Potential migration pathways and receptors for this material include:

- Leaching of contaminants from ditch sediments to groundwater and subsequent discharge to marine surface water, with potential impacts to aquatic organisms
- Direct contact of construction workers with sediments during future site development.

Contaminant concentrations exceed industrial screening criteria in only one of these samples, and in the thin sediment layer at 12-13 ft below ground surface. This suggests that a conditional point of compliance, considering future Property development activities, and associated institutional controls should be sufficient, rather than an active cleanup. Associated institutional controls should be developed to minimize potential future human contact with buried contaminants.

6.1.6 Weyerhaeuser Boundary Ditch Sediment

Arsenic contaminant levels in Weyerhaeuser Boundary Ditch sediments exceed CBN/T ROD SQOs for marine sediments, and exceed soil industrial MTCA WAC 173-340-745 screening criteria for soil at the northeast end of the ditch. Potential migration pathways and receptors of concern include:

- Direct human contact resulting in inhalation or ingestion
- Surface water transport of sediment to the Blair Waterway, with potential impact to aquatic organisms
- Leaching into shallow groundwater.

Cleanup objectives for the Weyerhaeuser boundary ditch are to:

- Control the source of arsenic to the ditch
- Minimize human contact with arsenic contaminated sediment (Section 6.1.3)
- Reduce possible sediment migration to the Blair Waterway
- Reduce possible leaching of arsenic to the shallow groundwater.

Analysis of cleanup alternatives is appropriate to address the presence of arsenic in this sediment. Alternatives could include no action, removal of the ditch sediment, filling the ditch, paving the ditch, or other actions.

6.1.7 Mud Lake Sediments

Removal of sediments in the lined Mud Lake Impoundment is planned by the Port in conjunction with the Milwaukee Waterway Fill Project. Two potential pathways of contaminant migration from Mud Lake sediments have been identified:

- Release of contaminants from sediment to surface water, or suspension of contaminated sediment in the water column and subsequent surface water discharge from the outfall. Receptors of primary concern from this pathway are aquatic organisms.
- Leaching of contaminants from sediment to groundwater, and subsequent discharge to surface water if the Mud Lake Impoundment lining is not intact. Since it is unlikely that groundwater will be used as a drinking water source, the primary receptors of concern are aquatic organisms.

Following Mud Lake sediment removal, sampling of the underlying soil for documentation of residual conditions is recommended. Any additional cleanup action should be based on screening of residual soil sampling results.

6.1.8 Marine Sediments

Landau Associates (1990a) recommended additional investigation and evaluation of marine sediment conditions due to detection of PCBs in shallow sediments at levels greater than CBN/T ROD SQOs. Dredging of shallow sediments at the Property is planned by the Port in conjunction with the Milwaukee Waterway Fill/Blair Waterway Dredging Project. No action, in addition to the planned dredging, is appropriate.

6.2 REMEDIAL ACTIONS AT NEARBY SITES AND PROPERTY DEVELOPMENT ACTIVITIES

6.2.1 Reichhold Chemicals, Inc., RCRA Interim Corrective Action

Remedial activities to address soil and groundwater contamination at the Reichhold Chemicals, Inc. (RCI) facility have been initiated under the RCI RCRA Permit (RCI 1988b). Specific areas of the RCI facility have been capped or covered to reduce contaminant migration in surface water and/or further infiltration of contamination into the groundwater. Shallow depth groundwater cleanup is planned only at the RCI facility, and includes an interceptor drain along a portion of the RCI property boundary along Alexander Avenue. Intermediate depth groundwater cleanup involves extraction wells in the RCI facility property and in the southeastern portion of the Blair Waterway Property, as discussed earlier. The existing system at the Blair Waterway Property is not expected to capture any contaminants to the north or west of the Graving Dock. Filling of the Graving Dock will change groundwater flow conditions and RCI extraction well influence. Water pumped from intermediate depth extraction wells will be treated to remove metal and organic contaminants. The treatment system is presently operating in a "batch" rather than a "continuous" mode of operation.

6.2.2 Lincoln Avenue Ditch System Investigation

The Lincoln Avenue Ditch on the Blair Waterway Property receives runoff from industrial properties located northeast of Alexander Avenue, through a system of ditches and storm drains. These industrial properties include RCI, Northwest Processors, and Chemical Processors, Inc., located northwest of the Blair Waterway Property in an area referred to as TSD

Alley. Information on contaminated sediments in these drainages are presented in RCI (1989) and SAIC (1990). No active remediation of the ditches adjacent to the RCI site is required by the RCI RCRA Permit. Further evaluation of environmental conditions in the vicinity of the TSD Alley drainage system is addressed in EPA Consent Orders to individual property owners.

6.2.3 Milwaukee Waterway Fill/Blair Waterway Dredging Project

The Port proposes to fill the Milwaukee Waterway, to construct a fisheries habitat area at the mouth of the Milwaukee Waterway, and to dredge the Blair Waterway (dredging approximately 2.5 million cy of material) for navigation consistent with the Puyallup Tribe of Indians Settlement Agreement. Currently, implementation of the Milwaukee Waterway Fill/Blair Waterway Dredging Project is under evaluation as an alternative for implementing the Sitcum Waterway Cleanup under an EPA CERCLA Administrative Order on Consent. That is, EPA will evaluate use of the Milwaukee Waterway as a nearshore confined disposal site for Sitcum Waterway sediments (and for Blair Waterway dredge material). Under this alternative, EPA would be combining a development and navigational project with a CERCLA waterway remedial project, consistent with the CBN/T ROD. If EPA selects this alternative as the cleanup remedy, final design plans and requirements for dredging of the Sitcum and Blair Waterways, for dredging of the Blair Waterway sediments, and for design of the Milwaukee Waterway Fill site and habitat would be developed and implemented under a subsequent EPA CERCLA Consent Decree. Current plans are to begin remediation in early fall 1992.

The Blair Waterway dredging will increase the channel depth adjacent to the Property. The side slope cut associated with berth dredging at the Blair Waterway Property will remove a layer of sediment shoreward of the pierhead line, intersecting the upland surface at about the existing top of bank. This dredging will remove the contaminated sediments from the Blair Waterway Property.

6.2.4 Mud Lake Sediment Removal

Mud Lake is a lined impoundment and contains contaminated sediments previously dredged from the Blair Waterway. It is proposed that these sediments be removed from the Blair Waterway Property in conjunction with dredging of the Blair Waterway. Recommendations for sampling residual soil following sediment removal is presented in Section 6.1.7.

6.2.5 Lincoln Avenue Utility Relocation

The City of Tacoma plans to construct a buried storm drain to relocate the Lincoln Avenue storm water outfall within the Lincoln Avenue utility easement on the Blair Waterway Property. The present Lincoln Avenue Ditch segments on the Blair Waterway Property will be abandoned. The City will also construct a new (deeper) force sewer main in the easement and beneath the Blair Waterway to permit dredging of the channel to the new depth. Dredging in the Blair Waterway for utility placement is proposed to be accomplished as part of the Blair Waterway Dredge Project. The City of Tacoma Water Department has rerouted the water service main and abandoned the segment on the Blair Waterway Property. Tacoma City Light electric lines and towers will be removed. Relocation and modification of utilities are required by the Puyallup Tribe of Indians Settlement Agreement (U.S. Congress 1989).

6.2.6 Blair Waterway Property Berth Expansion

The Tribe anticipates that the width of the berth along the Blair Waterway will be increased in order to accommodate large container ships (Puyallup International Inc. 1991). This development cut (dredging and excavation) will, primarily, intercept clean fill and native soils. The cut may intersect the thin contaminated sediment horizon of the former (buried) Lincoln Avenue Ditch. The volume of this buried sediment horizon is small compared to the total volume of material to be removed. Engineering features can be incorporated in the berth excavation and construction design to isolate and contain any buried Lincoln Avenue Ditch sediment contamination exposed during the berth excavation.

6.2.7 Graving Dock Filling

The disposition and possible filling of the Graving Dock was addressed in the Puyallup Tribe of Indians Settlement Agreement (U.S. Congress 1989). The Tribe has determined that the Port is to fill the Graving Dock (Tribe 1991). Design to accomplish this activity is to consider environmental conditions, which are summarized in Sections 6.1.3 and 6.1.4.

6.2.8 Property Development

The MOA requires cleanup criteria of the Property to permit industrial and commercial use of the Property by the Tribe. To expedite the property transfer process, the Tribe has resolved (Tribe 1991) to restrict the use of the Blair Waterway Property to be consistent with industrial use zones M-2 and M-3 of the City of Tacoma Zoning Code. The Property location

and use meet the MTCA requirements for industrial criteria purposes. Accordingly, MTCA industrial use criteria are considered appropriate for cleanup evaluation of the Blair Waterway Property.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Evaluation of site conditions at the Blair Waterway Property included: explorations, collection of samples, chemical analyses, identification of numerical environmental and human health-based screening criteria, and comparison of chemical analytical results to the screening criteria. Samples of soil, former (buried) sediment, Lincoln Avenue Ditch and boundary ditch sediments, marine sediments, and groundwater from monitoring wells installed during this investigation were obtained for analyses. Evaluation of analytical results and results of other investigations show that cleanup alternatives should be evaluated for some conditions at the Blair Waterway Property, in accordance with the MOA. The issues identified by this investigation are summarized below.

7.1 SHALLOW AQUIFER

The primary constituent of concern in the shallow aquifer groundwater is arsenic. The principal source of the arsenic is believed to be near-surface slag deposits and, as such, will be addressed by source-related cleanup activities for the slag. No analysis of cleanup alternatives is recommended for the shallow aquifer. This aquifer is not currently used as a drinking water source, and is unlikely to be used as a source in the future because of its quantity limitations. It is recommended that shallow groundwater not be used as a drinking water source.

7.2 INTERMEDIATE AQUIFER

Contaminated intermediate aquifer groundwater conditions at the Blair Waterway Property require cleanup. Constituents identified by RCI and this investigation in the intermediate aquifer include arsenic, formaldehyde, chlorinated phenols, and vinyl chloride. RCI should undertake the required RCRA corrective action (groundwater remediation) for the intermediate aquifer at the Property; pumping has not yet been initiated. Additional investigation to define the extent of arsenic contamination southeast of the Graving Dock is recommended during the next phase.

Analytical results for this investigation indicate the presence of vinyl chloride northwest of the Graving Dock, an area not presently addressed by the RCI system. Evaluation of this detection by EPA and RCI with respect to the RCI remedial system is recommended. Although it is anticipated that the RCI groundwater remediation will address intermediate aquifer contaminants located southeast of the Graving Dock, no long-term operation data are available

to assess extraction system performance relative to the entire Property. Additionally, it is anticipated that the existing system will not address groundwater contamination north of the Graving Dock.

It is recommended that near-surface groundwater not be used for drinking water. (Potable water may be available from aquifers present below several hundred feet depth.) Periodic sampling of groundwater is recommended to monitor RCI cleanup action progress and near-surface groundwater quality. New groundwater extraction well test data for the RCI system at the site should be evaluated, when available. Groundwater movement should be evaluated after the Graving Dock is filled.

7.3 SLAG

Slag contains numerous metals, including arsenic. The slag is present at the surface or at shallow depth in soil in the central portion of the Property and lining the Graving Dock. Analysis of cleanup alternatives to address slag and related arsenic contamination in the Weyerhaeuser Boundary Ditch should be considered during the next stage of the Property Transfer process. Metals contamination of Graving Dock bottom material should be considered only in conjunction with measures to avoid material discharge to the Blair Waterway during filling of the Graving Dock.

7.4 LINCOLN AVENUE DITCH AND FORMER (BURIED) LINCOLN AVENUE DITCH

Among the multiple organic and inorganic contaminants present in the Lincoln Avenue Ditch at low concentration, only concentrations of arsenic exceed screening criteria for an industrial property. An analysis of cleanup alternatives to address the existing contaminated sediment should be developed during the next stage of the property transfer process. Planned storm drain construction by the City of Tacoma will not eliminate long-term discharge of potentially contaminated sediments to the Blair Waterway, or address contributing sources upgradient of the Blair Waterway. EPA and Ecology should address upstream source issues to reduce continued impact on marine sediment quality.

The buried sediment horizon of the former Lincoln Avenue Ditch segment contains metal and organic contaminants, including arsenic, PCBs, and dioxins. Of these, only arsenic and PCBs exceed the screening criteria for an industrial property. The thin (0.5 ft) sediment horizon is buried at a depth of 12-13 ft below ground surface, making direct contact during non-intrusive site activity unlikely. A conditional point of compliance and institutional controls are

expected to be necessary for this buried soil. Specific institutional controls should be developed during the next phase.

7.5 MUD LAKE SEDIMENT

The Port plans to remove Mud Lake sediment for use as nearshore fill in the Milwaukee Waterway Fill Project. Testing of residual soil is recommended following excavation of Mud Lake sediment. The need for any additional action will be determined following sampling and analysis of residual soil.

7.6 MARINE SEDIMENT

No action for marine sediment cleanup is triggered by CBN/T ROD SQO criteria. Dredging planned for the Blair Waterway will remove any contaminated surface sediment adjacent to the Property. No additional action is recommended.

* * * * * * *

This Blair Waterway Property Final Investigation Report is prepared for the Port of Tacoma to support and guide subsequent steps in the property transfer process consistent with CERCLA and the Puyallup Settlement Agreement, and completes the reporting requirement in the MOA, Paragraph IIIA7. Evaluation of environmental data has been accomplished to assess compliance with appropriate Federal and State contamination law and property use for commercial and industrial purposes. This report is intended to provide the Port of Tacoma, the Puyallup Tribe of Indians, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology with an understanding of environmental conditions at the Blair Waterway Property. Conclusions, opinions, and recommendations presented in this report are based on site investigations conducted on the dates identified, evaluation of chemical data using criteria identified by review of Federal and State regulations, and through discussions with EPA and Ecology personnel. Changing circumstances in the environment, and Property use subsequent to these site investigations, could alter conditions upon which the conclusions, opinions, and recommendations presented in this report are based. This investigation

information is provided for the purpose of environmental evaluation and is not intended to provide design parameters for Property development or construction.

Landau Associates has accomplished this environmental investigation in a manner consistent with the MOA and CERCLA guidelines, and in accordance with generally accepted methods for property transfer environmental studies practiced in the Puget Sound area at the time our services were accomplished. Our services were completed in general accordance with the Phase II Environmental Investigation Work Plan and subsequent sampling plans which incorporated review comments by EPA and Ecology representatives. No other warranty or representation, express or implied, is applicable.

LANDAU ASSOCIATES, INC.

By:

Robert G. Fulton, P.E.
Vice President

and

Brian F. Butler
Senior Project Geologist

and

Julie L. Wilson, Ph.D.
Senior Risk Analyst

RGF/BFB/JLW/sms
No. 118-03.43

8.0 REFERENCES

Applied Geotechnology, Inc. 1986. Site Assessment, Parcel No. 4, Port of Tacoma. Project No. 14, 809.002. Prepared for Port of Tacoma by Applied Geotechnology, Inc., Tacoma, Washington. 15 January 1986. (Sections included as Attachments C-2 and C-3 to Appendix C of this report.)

CH2M Hill. 1990. Extraction Well Startup Summary. Prepared for Reichhold Chemicals, Inc., Tacoma Facility by CH2M Hill, Bellevue, WA. January 1990.

Ebbert, J.C. et al. 1986. Water Quality in the Lower Puyallup River Basin and Adjacent Uplands, Pierce County, WA. Water Resources Investigation Report 86-4154.

Hart Crowser. 1991a. Draft Final Investigation Report, East-West Road Property, Port of Tacoma, WA. Prepared for Port of Tacoma by Hart Crowser, Seattle, WA. 6 March 1991.

Hart Crowser. 1991b. Technical Memorandum on the Occurrence of Iron and Manganese in Shallow Groundwater in the Port of Tacoma Area. May 29.

Herrera Environmental Consultants. 1990. Marine Sediment Sampling Activities Report, Phase II Environmental Investigation, Port of Tacoma Property Transfers, 13 February 1990.

Landau Associates. 1989a. Phase I Environmental Investigation Report, Blair Waterway Property. Prepared for Port of Tacoma by Landau Associates, Inc., Edmonds, Washington. 11 July 1989.

Landau Associates. 1989b. Work Plan, Phase II Environmental Investigation, Port of Tacoma, Property Transfers: Blair Waterway Property, Inner Hylebos Waterway Property, Upper Hylebos Waterway Property. Prepared for Port of Tacoma by Landau Associates, Inc., Edmonds, Washington. 4 December 1989.

Landau Associates. 1990a. Preliminary Investigation Report, Blair Waterway Property, Tacoma, Washington. Prepared for Port of Tacoma by Landau Associates, Inc., Edmonds, Washington. 16 April 1990.

Landau Associates. 1990b. Sampling Plan (plan for additional sampling, analysis, and activities for property transfer investigations for the Upper Hylebos, Inner Hylebos, and Blair Waterway Properties). Prepared for Port of Tacoma by Landau Associates, Inc., Edmonds, Washington. 12 July 1990.

Landau Associates. 1990c. Technical Memorandum. Addendum to July 12, 1990 Sampling Plan, Fill Soil, Former Lincoln Avenue Drainageway, Blair Waterway Property. 30 July 1990.

Landau Associates. 1991a. Draft Final Investigation Report, Blair Waterway Property, Tacoma, Washington. Prepared for Port of Tacoma. 25 June 1991.

Landau Associates. 1991b. Letter to Port of Tacoma re: Port of Tacoma Property Transfer Investigations, Addendum No. 2 to Appendix D, Blair Waterway Property Graving Dock Sediment Sample Data Quality Assurance and Chemical Laboratory Data Sheets. 13 November 1991.

Landau Associates. 1991c. Appendix D to the Final Investigation Report. 15 January 1991. Amended 5 July 1991.

Landau Associates. 1991d. Telephone conversation between Rob Zizette (Herrera) and Brian Butler (Landau), concerning marine sediment sampling procedures. 19 April 1991.

Puyallup International, Inc. 1991. Letter to Port of Tacoma re: Puyallup International, Inc.'s Development Plans for the Blair and Blair Backup Properties. 13 November 1991.

Puyallup Tribe of Indians. 1988 Agreement Between the Puyallup Tribe of Indians. Local Governments in Pierce County, the State of Washington, the United States of America, and Certain Private Property Owners: Technical Documents.

Puyallup Tribe of Indians. 1991. Puyallup Tribal Council Resolution No. 201191. 20 November 1991.

Reichhold Chemicals, Inc. 1988a. Tacoma Facility, Revised RCRA Part B Application (Volume 3, Section E). Prepared by CH2M Hill, Bellevue, WA. January 1988.

Reichhold Chemicals, Inc. 1988b. Permit No. WAD 009252891. Corrective Action Plan Parts IV and V.

Reichhold Chemicals, Inc. 1989. Tacoma Facility, Sediment and Surface Water Report, Offsite Drainageways. Prepared by CH2M Hill, Bellevue, WA. February 1989.

Reichhold Chemicals, Inc. 1990. Reichhold Tacoma Facility, Seventh Quarter (July 1990) Pre-corrective Action Ground Water Monitoring Results for U.S. EPA. Prepared by CH2M Hill, Bellevue, WA. 26 November 1990.

Reichhold Chemicals, Inc. 1991. Reichhold Tacoma Facility, Ninth Quarter (January 1991) Pre-corrective Action Ground Water Monitoring Results for U.S. EPA. Prepared by CH2M Hill, Bellevue, WA. 24 April 1991.

Science Applications International Corp. (SAIC). 1990. RCRA Facility Assessment PR/VSI Report. Prepared for U.S. EPA by Science Applications International Corp., Olympia, WA. February 1990.

Sitts & Hill Engineers, Inc. 1990. Record of Survey, Blair Waterway Property (Plan Map with Description). February 16, 1990.

Tacoma, City of. 1990. Land Use Regulatory Code. City of Tacoma, Tacoma, Washington.

Tacoma, Port of. 1990. Memorandum of Agreement Among the Puyallup Indian Tribe, the Port of Tacoma, the Washington Department of Ecology, and the U.S. Environmental Protection Agency regarding the implementation of the 27 August 1988 Puyallup Settlement Agreement. 8 March 1990.

Tacoma-Pierce County Health Department. 1988. Drainage Map, Commencement Bay - Nearshore/Tideflats Area. July 1, 1988.

Travis, Curtis C. and Holly A. Hattemer-Frey. 1987. Human Exposure to 2,3,7,8-TCDD. Chemosphere, Vol. 16, Nos. 10-12, pp 2331-2342.

U.S. Army Corps of Engineers, et al. (USACOE). 1989. Puget Sound Dredged Disposal Analysis. Management Plan Report, Unconfined Open Water Disposal of Dredged Material, Phase II, September 1989.

U.S. Congress. 1989. Puyallup Tribe of Indians Settlement Act of 1989. (P.L. 101.41).

U.S. Environmental Protection Agency. 1980. Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA).

U.S. Environmental Protection Agency. 1985a. Health and Environmental Effects Profile for Chloroethene. Cincinnati, OH: Environmental Criteria and Assessment Office. ECAO-CIN-PISS.

U.S. Environmental Protection Agency. 1985b. Health Assessment Document for Polychlorinated dibenzo-p-dioxins. EPA-600/8-84-014F.

U.S. Environmental Protection Agency. 1986. Quality Criteria for Water. Office of Water Regulations and Standards Document. EPA 440/5-86-001. May 1986.

U.S. Environmental Protection Agency. 1987. National Primary Drinking Water Regulations CFR Parts 141 and 142. Synthetic Organic Chemicals; Monitoring for Unregulated Contaminants. Federal Register 52(130):25890.

U.S. Environmental Protection Agency. 1988a. Drinking Water Regulations; Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper. Federal Register 53(160):31516.

U.S. Environmental Protection Agency. 1988b. Water Quality Criteria; Availability of Document, Appendix A. Federal Register 53(2):177.

U.S. Environmental Protection Agency. 1989a. Commencement Bay Nearshore/Tideflats Record of Decision (CBN/T ROD). Region 10, September.

U.S. Environmental Protection Agency. 1989b. Safe Drinking Water Act, National Primary and Secondary Drinking Water Regulations 40 CFR 141, 142, and 143. Federal Register 54(97):22062.

U.S. Environmental Protection Agency. 1989c. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans, Risk Assessment Forum, March 1989.

U.S. Environmental Protection Agency. 1990a. Letter providing review comments on Preliminary Investigation Reports for the Upper Hylebos, Blair Waterway, and Inner Hylebos Properties, dated May 25, 1990.

U.S. Environmental Protection Agency. 1990b. Draft National Upland Oil & Hazardous Substances Contingency Plan (NCP). 40 CFR 300 effective April 9, 1990.

U.S. Environmental Protection Agency. 1990c. Letter regarding comments pertaining to the Upper Hylebos, Inner Hylebos, and Blair Waterway Properties, Preliminary Reports. 25 May 1990.

U.S. Environmental Protection Agency. 1990d. National Primary and Secondary Drinking Water Regulations: Synthetic Organic Chemicals and Inorganic Chemicals. Federal Register 55(143):30370.

U.S. Environmental Protection Agency. 1990e. National Primary Drinking Water Regulations: Lead and Copper, Federal Register, 55(203):42409.

U.S. Environmental Protection Agency. 1990f. Ambient Water Quality Criteria. Federal Register 55(93):19988.

U.S. Environmental Protection Agency. 1991a. Memorandum: Review of Data Validation Reports for Tacoma Property Transfers, Phase II, Landau Associates, Inc. 7 March 1991.

U.S. Environmental Protection Agency. 1991b. August 13, 1991 Letter to Port of Tacoma regarding comments on the Blair Waterway Property Draft Final Investigation Report.

U.S. Environmental Protection Agency. 1991c. National Primary Drinking Water Regulations; Final Rule. Federal Register 56(20):3526.

U.S. Environmental Protection Agency. 1991d. Health Effects Assessment Summary Tables, Annual FY-1991.

U.S. Geological Survey. 1981. Historical Changes of Shoreline and Wetland at Eleven Major Deltas in the Puget Sound Region, Washington (Sheet 8).

U.S. Geological Survey. 1985. Hem, John D. Study and Interpretation of the Chemical Characteristics of Natural Water, Third Edition. U.S. Geological Survey Water-Supply Paper 2254. 1985.

U.S. Public Health Service (PHS). 1987. Toxicological Profile for Selected PCBs. Draft. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

U.S. Public Health Service (PHS). 1988. Toxicological Profile for Vinyl Chloride. Draft. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

U.S. Public Health Service (PHS). 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Draft. Agency for Toxic Substances and Disease Registry, Atlanta, GA.

Washington State Department of Ecology. 1988. Rules and Regulations of the State Board of Health Regarding Public Water Systems. Division of Health, Office of Environmental Health Program, WAC 248-54. February 1988.

Washington State Department of Ecology. 1989a. Department of Ecology Variance Approval to the Minimum Construction Standards for Construction and Maintenance of Wells (WAC 173-160). Letter from Gary E. Hanson, Water Resources Supervisor, to Brian F. Butler, Landau Associates, Inc. 28 November 1989.

Washington State Department of Ecology. 1989b. Interim Sediment Quality Evaluation Process For Puget Sound. October 1989.

Washington State Department of Ecology. 1989c. Dangerous Waste Regulations, WAC 173-303.

Washington State Department of Ecology. 1989d. Minimum Standards for Construction and Maintenance of Wells. WAC 173-160.

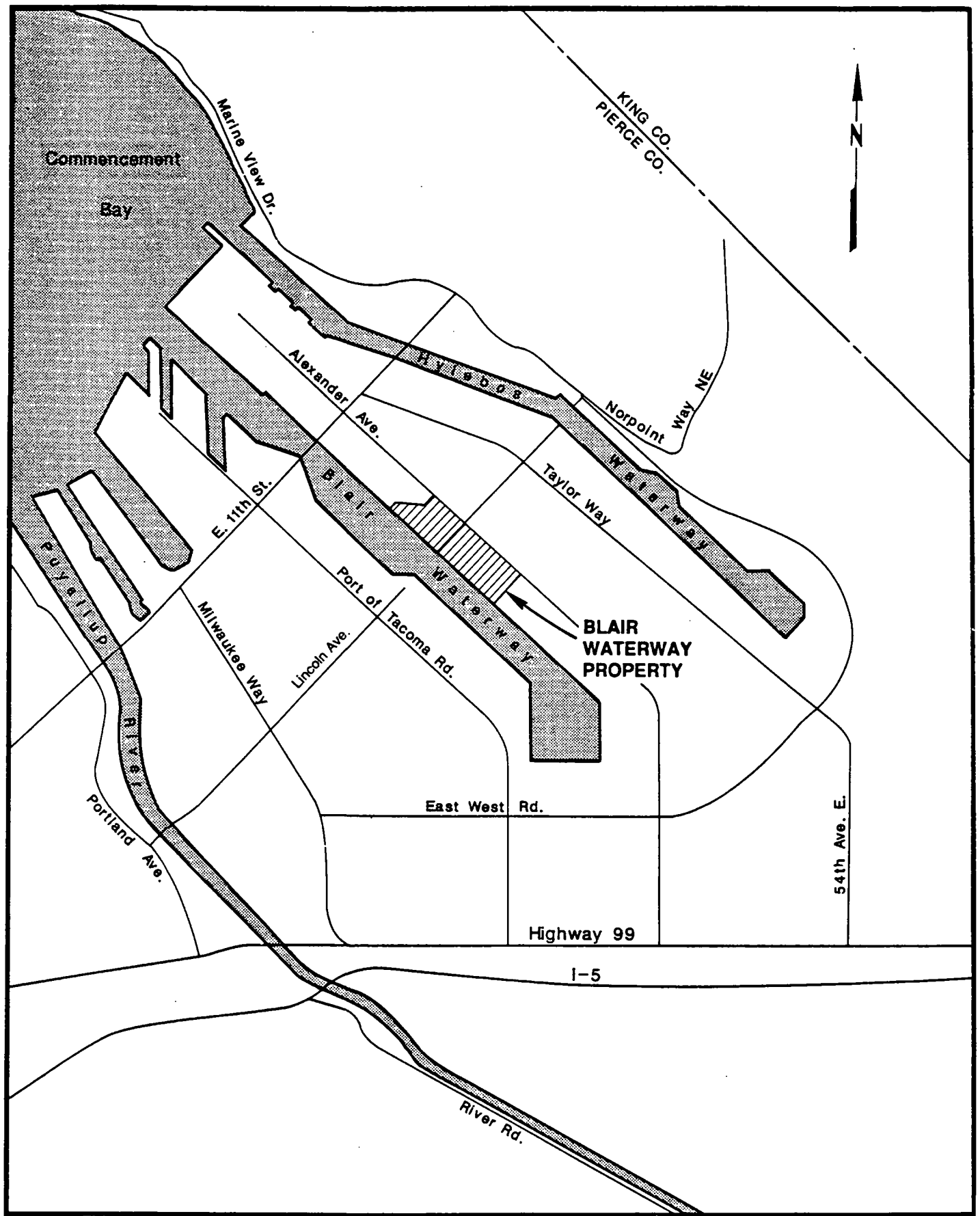
Washington State Department of Ecology. 1991a. Sediment Management Standards (WAC 173-204). 27 March 1991.

Washington State Department of Ecology. 1991b. Model Toxics Control Act (MTCA) (WAC 173-340). 28 February 1991.

Note: References for Quality Assurance and Data Validation appear with Appendix D (Bound Separately)

TEXT FIGURES

Figures 1 through 13
Blair Waterway Property



Source: Thomas Bros. Map, Pierce County, dated 1985.

LANDAU ASSOCIATES, INC.	Blair Waterway Property Vicinity Map

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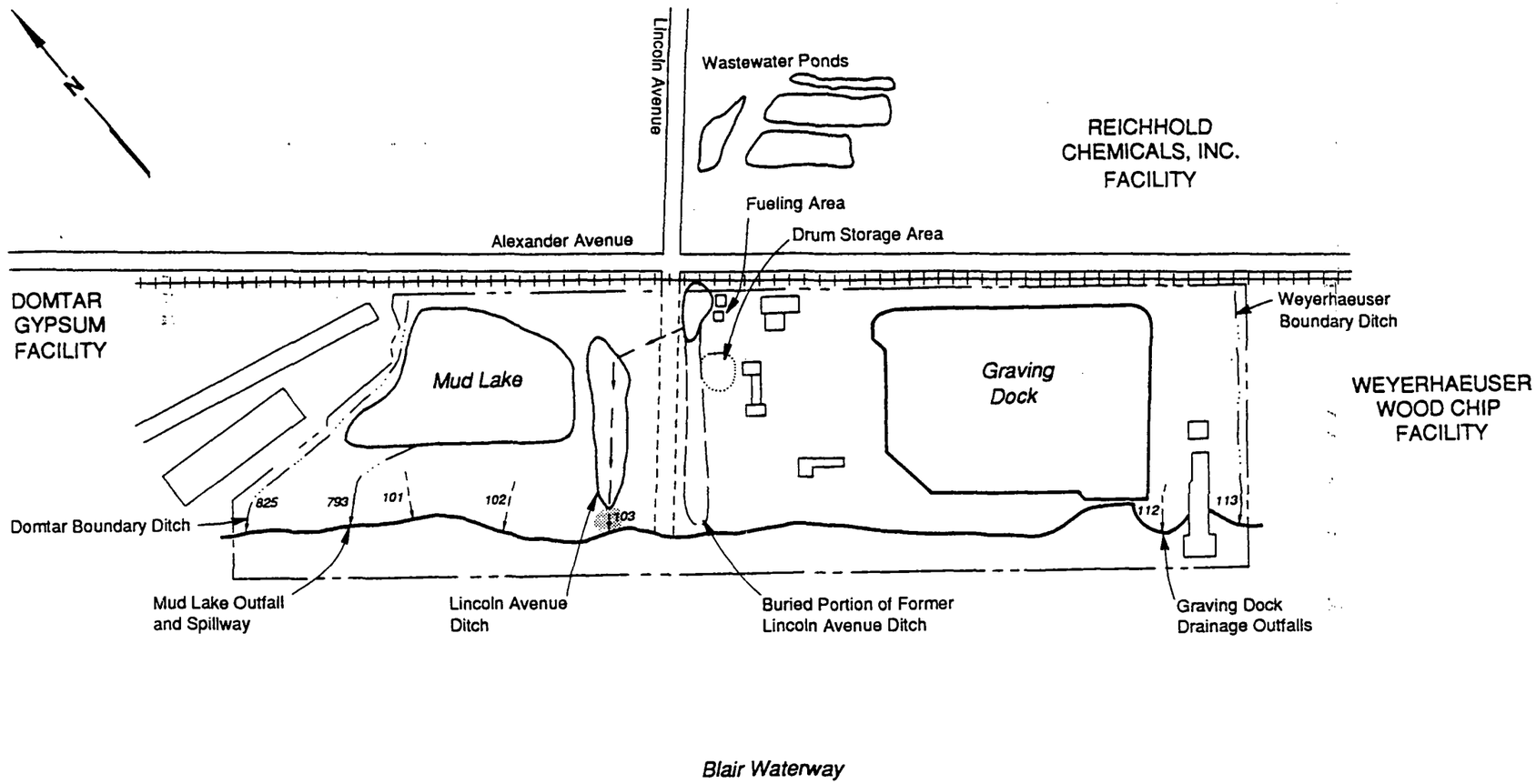
Figure 1



KEY

Shoreline

Property Boundary

102 Outfall Drainage Location and Identification (TPCHD 1988)

Outlet Fill Area

0 400 800

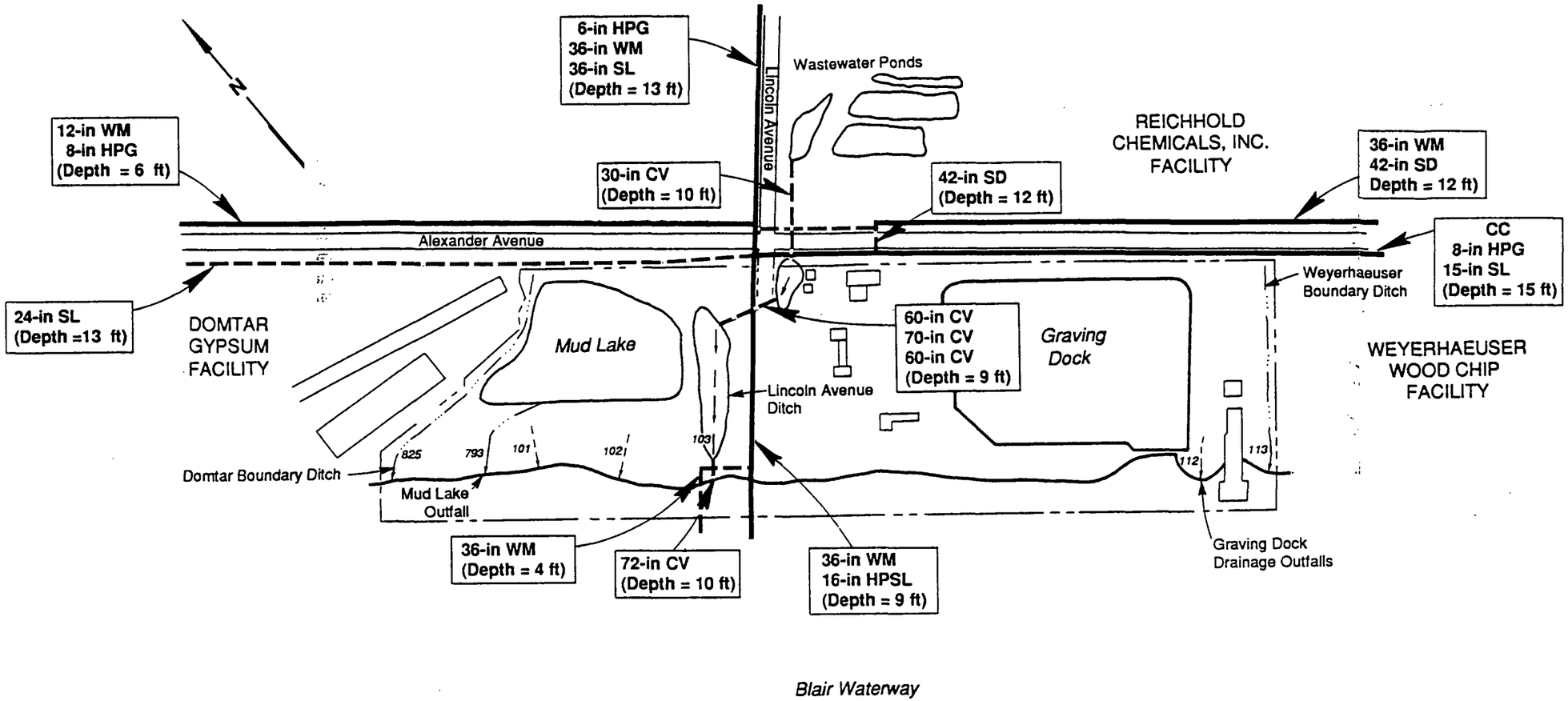
Scale in Feet

Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Plan Map

Figure 2



KEY

	Shoreline	SL	Sanitary Line
	Property Boundary	SD	Storm Drain
102	Outfall Drainage Location and Identification (TPCHD 1988)	HPSL	High Pressure Sanitary Line
	Multiple Utility Corridor	HPG	High Pressure Gas Main
	Single Utility	WM	Water Main
		CC	Communication Cables
		CV	Culvert
		(Depth = 9 ft)	Greatest Utility Depth in a Single Corridor

0 400 800
Scale in Feet

Notes: 1) This figure is for illustration purposes only. Please refer to text for details.

2) All underground utility locations and depths are approximate.

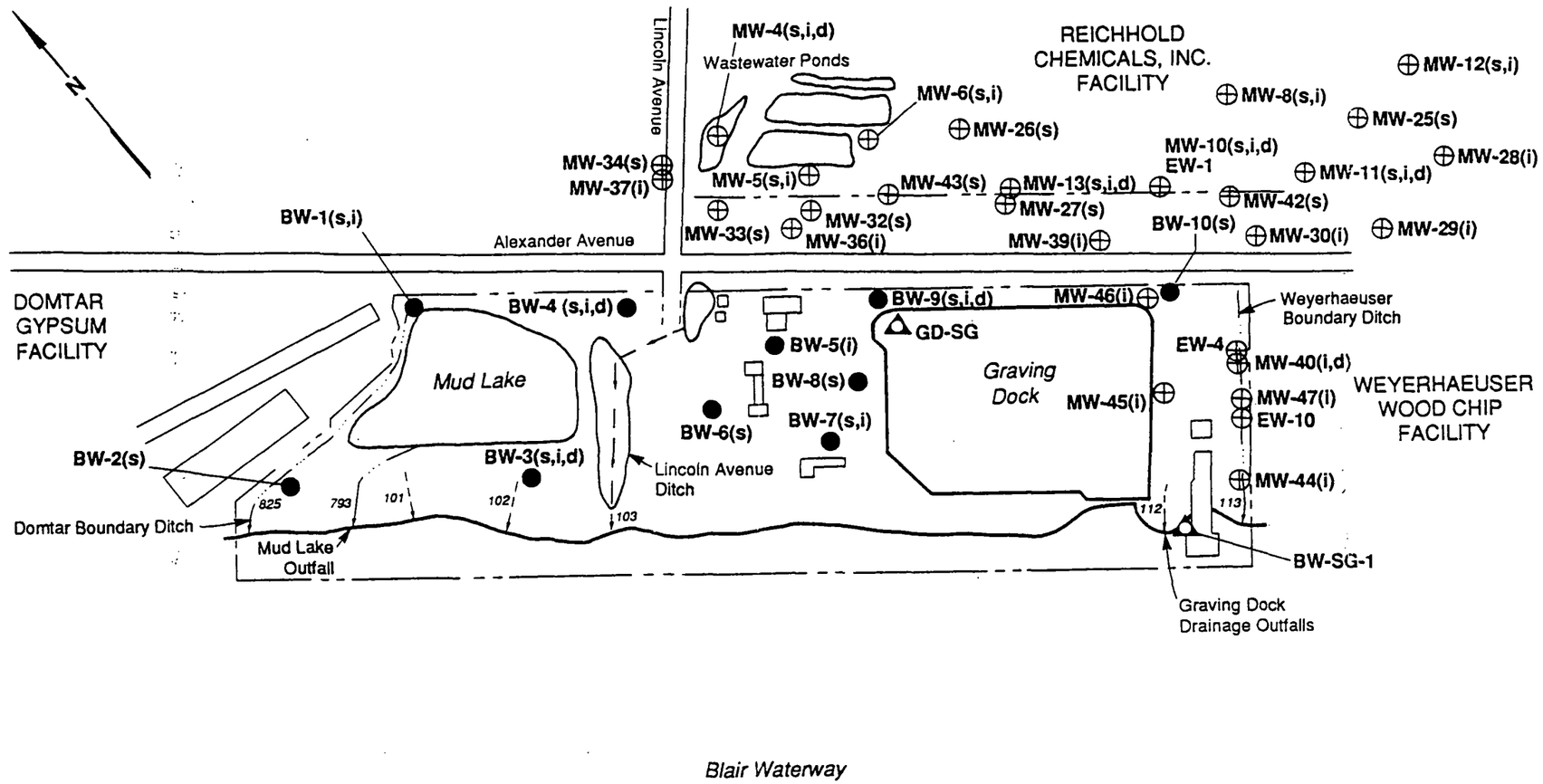
Sources: 1) Tacoma Public Works Dept.,Sanitary Utility Division
2) Tacoma Public Utilities Dept., Water Division
3) Washington Natural Gas Company
4) U.S. West Communications
(All by verbal communication)

LANDAU ASSOCIATES, INC.

Blair Waterway Property Underground Utilities

Figure 3

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



KEY

Shoreline

Property Boundary

102 — Outfall Drainage Location and Identification (TPCHD 1988)

BW-5(i) ● — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)

BW-SG-1 △ — Staff Gauge Location and Identification

MW-10(s) ⊕ EW-1 — Reichhold Chemicals, Inc. Monitoring Well (MW) and Extraction Well (EW)

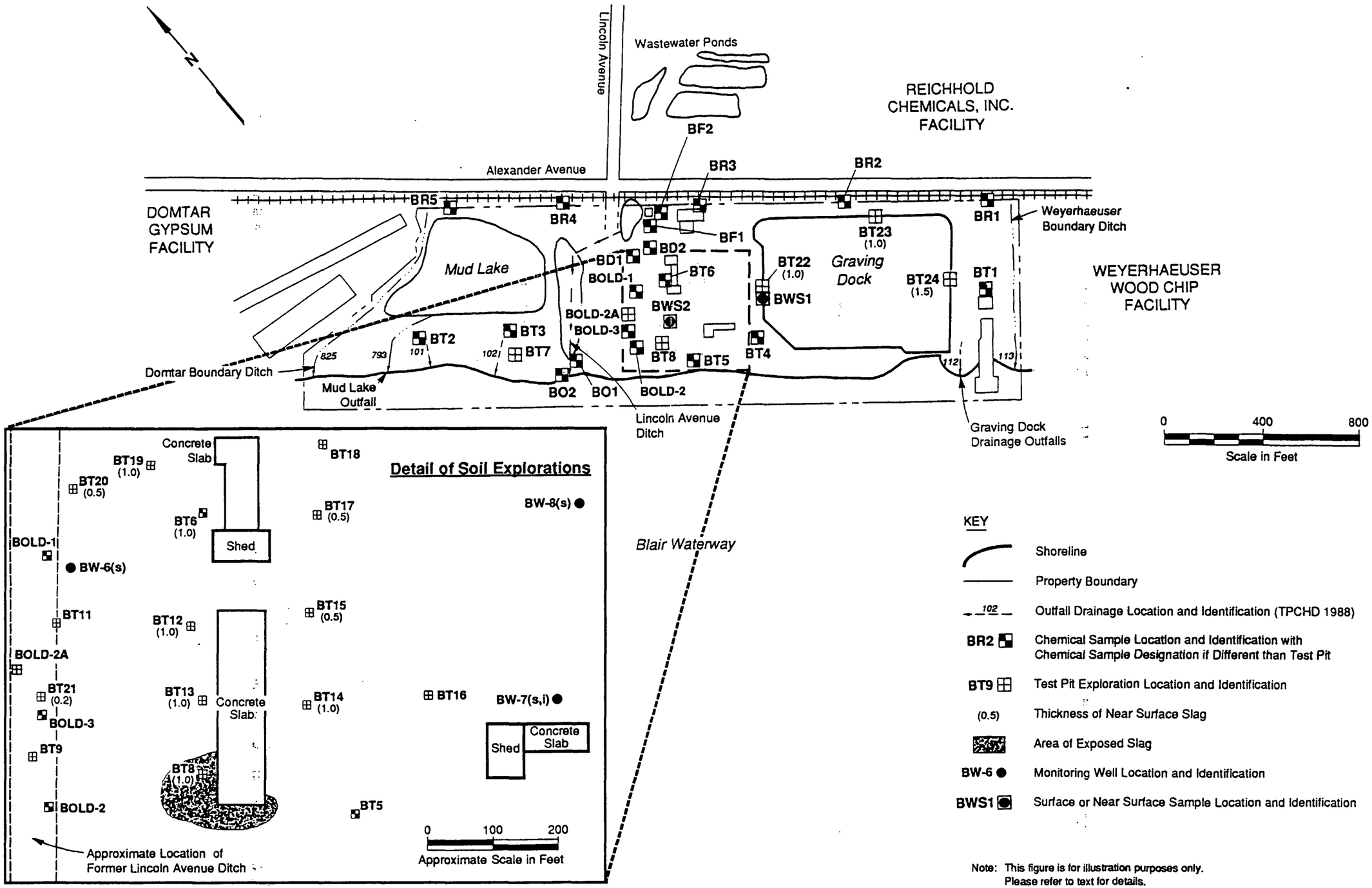
0 400 800
Scale in Feet

Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Monitoring Well Locations

Figure 4

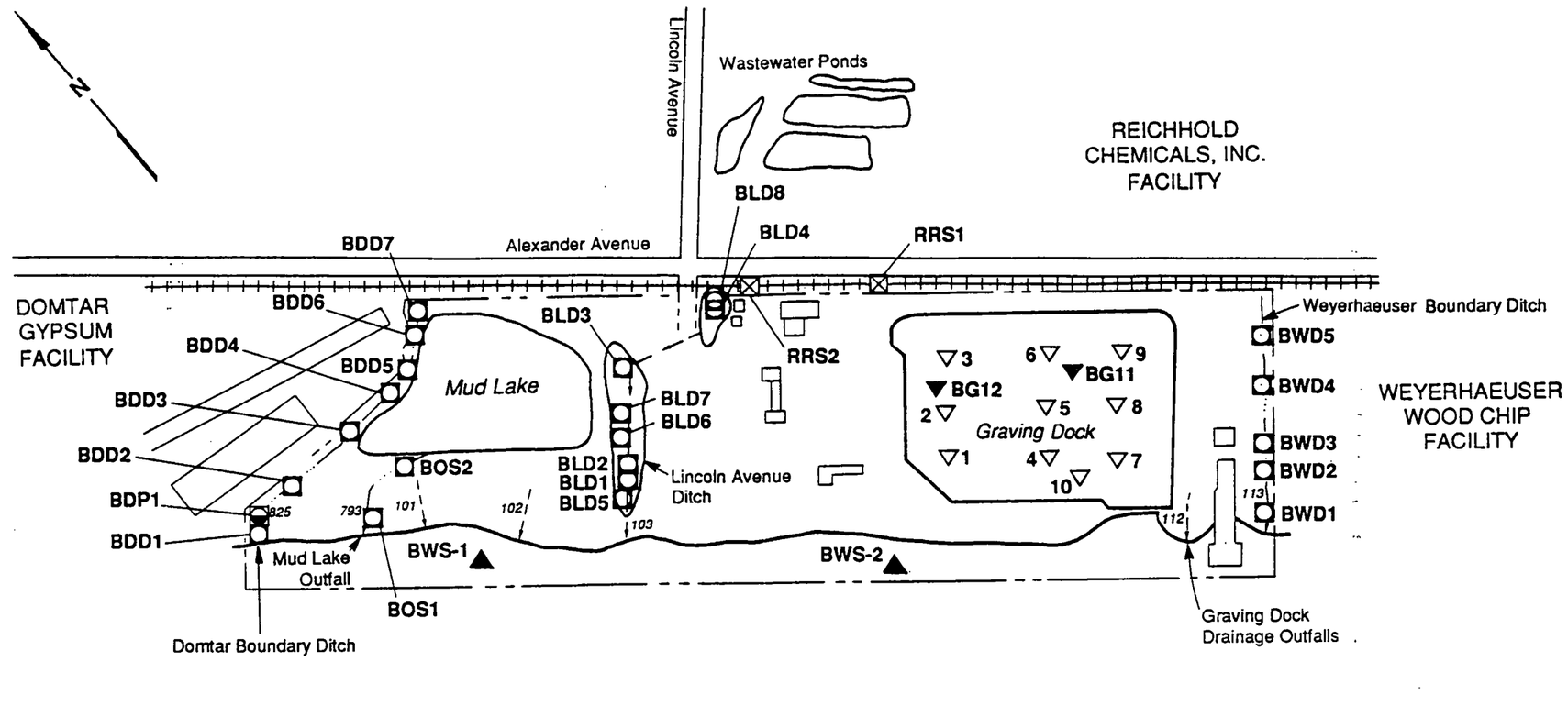


LANDAU ASSOCIATES, INC.

Blair Waterway Property Test Pit Locations

Figure 5

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92

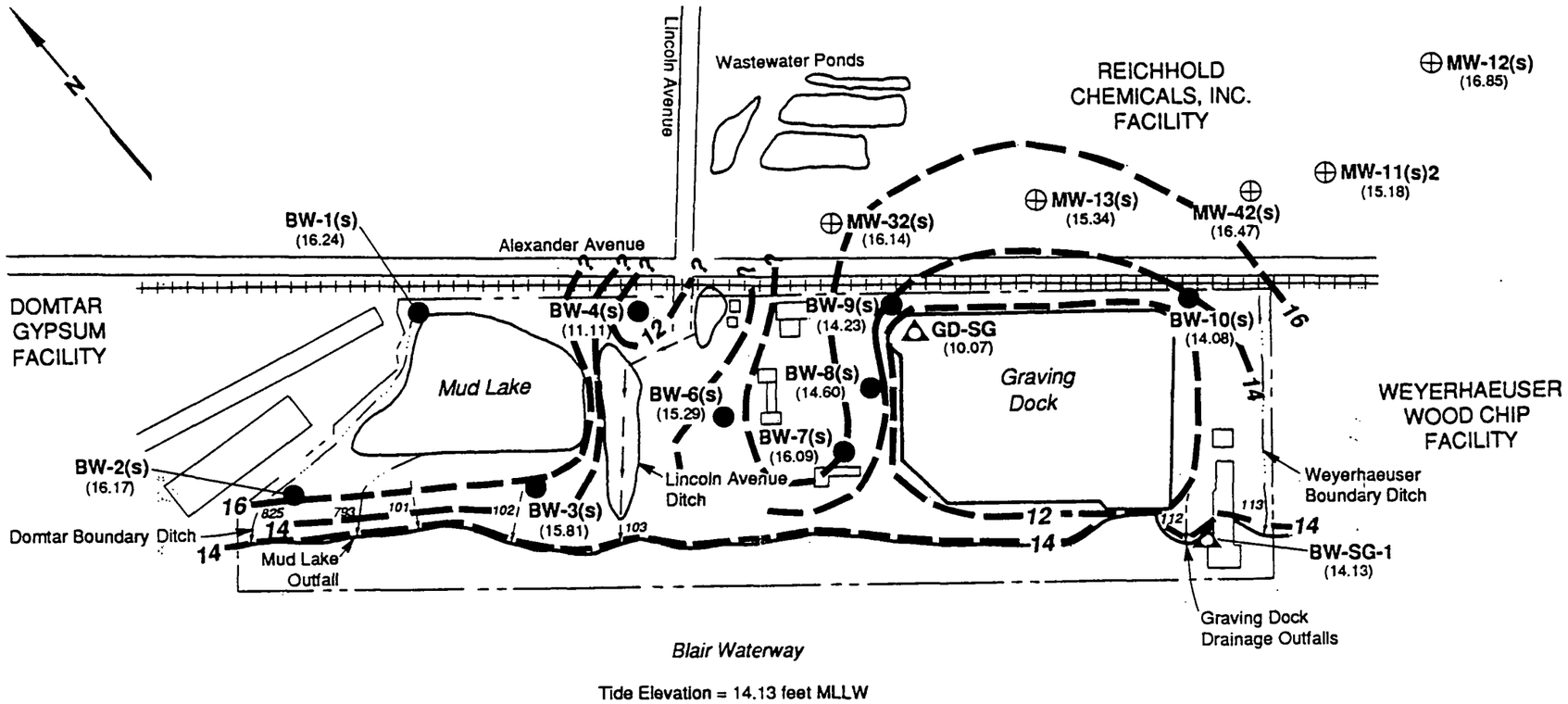


LANDAU ASSOCIATES, INC.

Blair Waterway Property Sediment Investigation Locations

Figure 6

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



KEY

- 12 — Inferred Groundwater Elevation Contour
- Shoreline
- Property Boundary
- 102 — Outfall Drainage Location and Identification (TPCHD 1988)
- BW-5(i) ● — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
- BW-SG-1 △ — Staff Gauge Location and Identification
- MW-4(i) ⊕ — Reichhold Chemicals, Inc. Well
- (16.31) — Groundwater or Surface Water Elevation (MLLW)

0 400 800
Scale in Feet

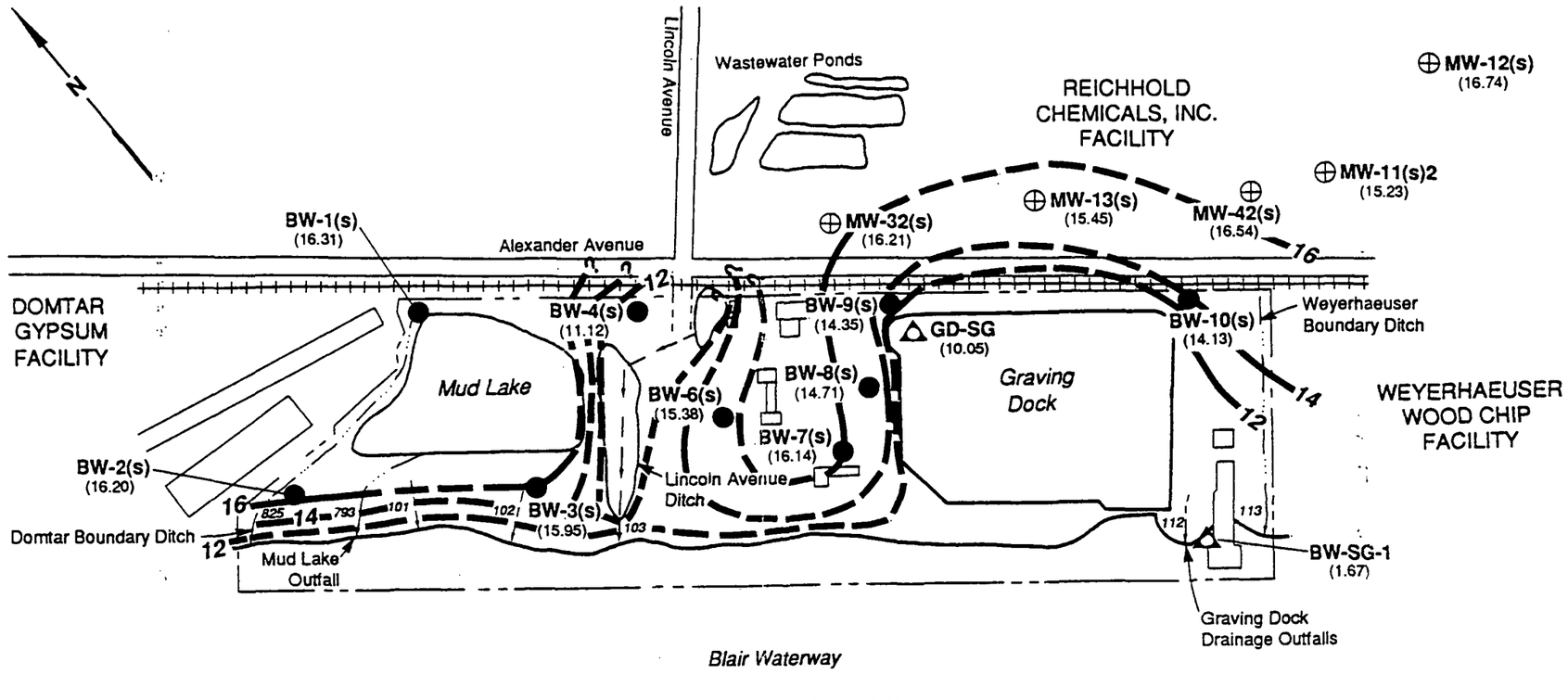
Notes: 1. This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Shallow Aquifer, High Tide, February 2, 1990

Figure 7

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



Tide Elevation = 1.67 feet MLLW

KEY

- 12 — Inferred Groundwater Elevation Contour
- Shoreline
- Property Boundary
- 102 — Outfall Drainage Location and Identification (TPCHD 1988)
- BW-5(i) ● — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
- BW-SG-1 △ — Staff Gauge Location and Identification
- MW-4(i) ⊕ — Reichhold Chemicals, Inc. Well
- (16.31) — Groundwater or Surface Water Elevation (MLLW)

0 400 800
Scale in Feet

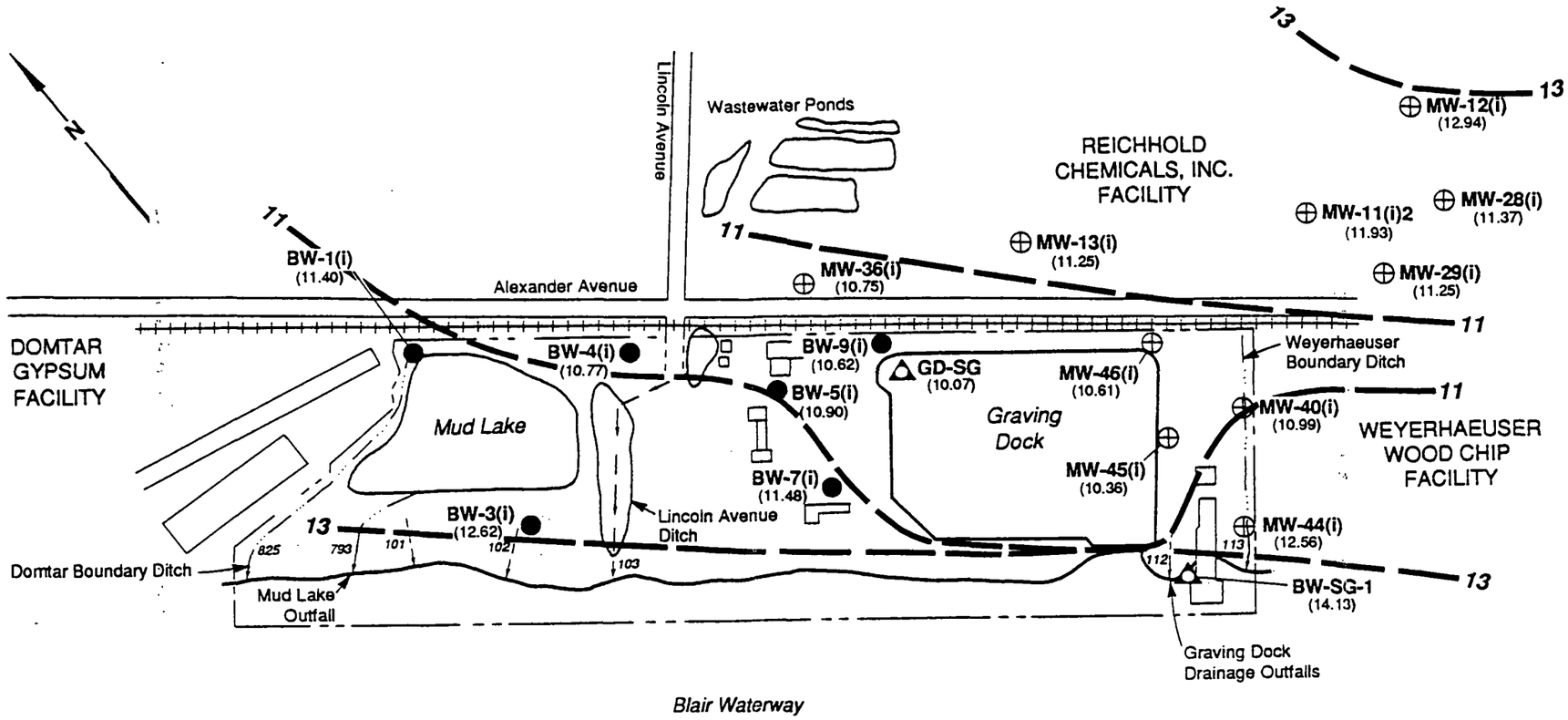
Notes:
1. This figure is for illustration purposes only. Please refer to text for details.
2. Inferred closely-spaced contours between the 12-foot contour and (either) tidal elevation or top of the upper aquitard are not shown.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Shallow Aquifer, Low Tide, February 2, 1990

Figure 8

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



Tidal Elevation = 14.13 feet MLLW

KEY

- 12 — Inferred Groundwater Elevation Contour
- Shoreline
- Property Boundary
- 102 — Outfall Drainage Location and Identification (TPCHD 1988)
- BW-5(i) ● — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
- BW-SG-1 △ — Staff Gauge Location and Identification
- MW-4(i) ⊕ — Reichhold Chemicals, Inc. Well
- (16.31) — Groundwater or Surface Water Elevation (MLLW)

0 400 800
Scale in Feet

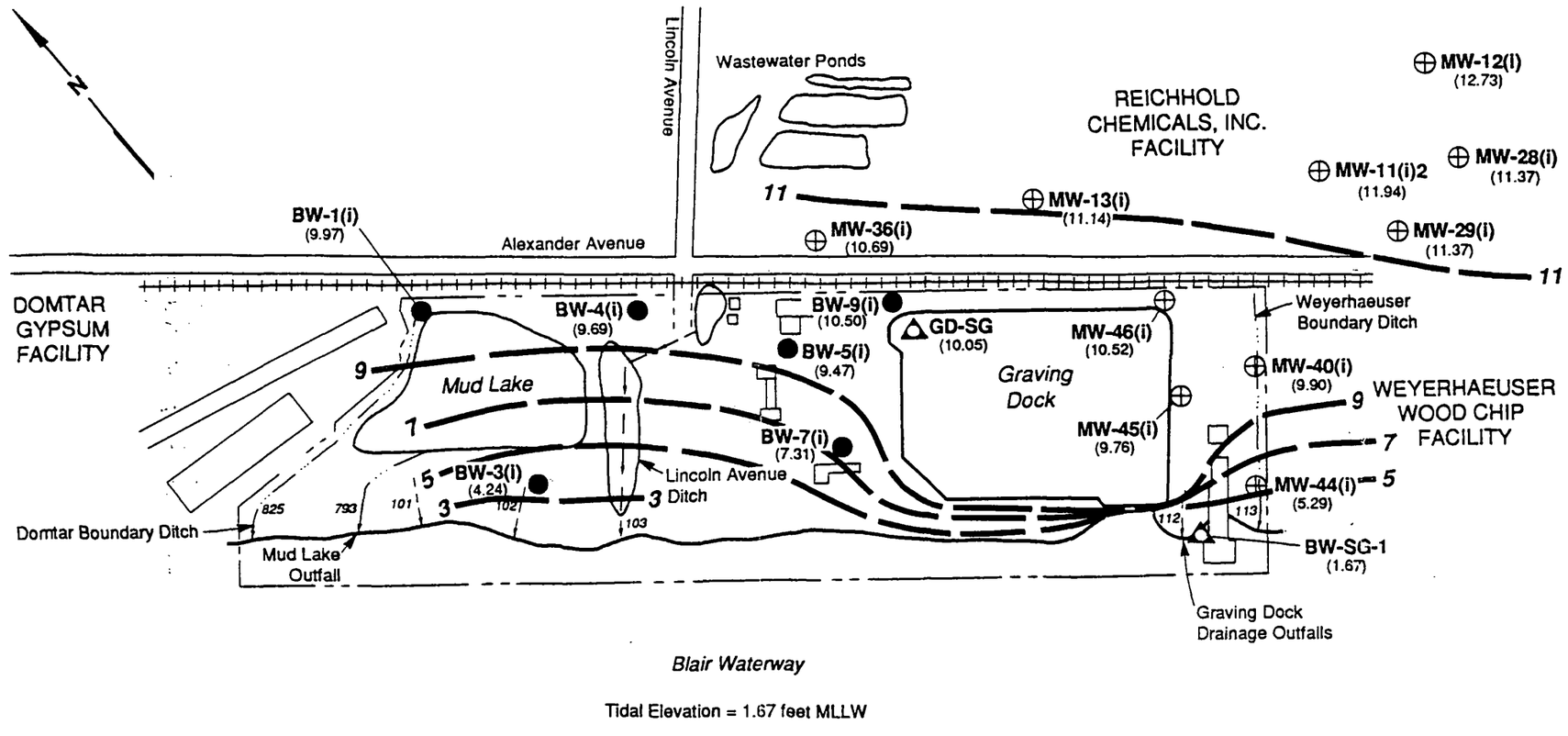
Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Intermediate Aquifer, High Tide, February 2, 1990

Figure 9

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



KEY

- 12 — Inferred Groundwater Elevation Contour
- Shoreline
- Property Boundary
- 102 — Outfall Drainage Location and Identification (TPCHD 1988)
- BW-5(i) ● — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
- BW-SG-1 △ — Staff Gauge Location and Identification
- MW-4(i) ⊕ — Reichhold Chemicals, Inc. Well
- (16.31) — Groundwater or Surface Water Elevation (MLLW)

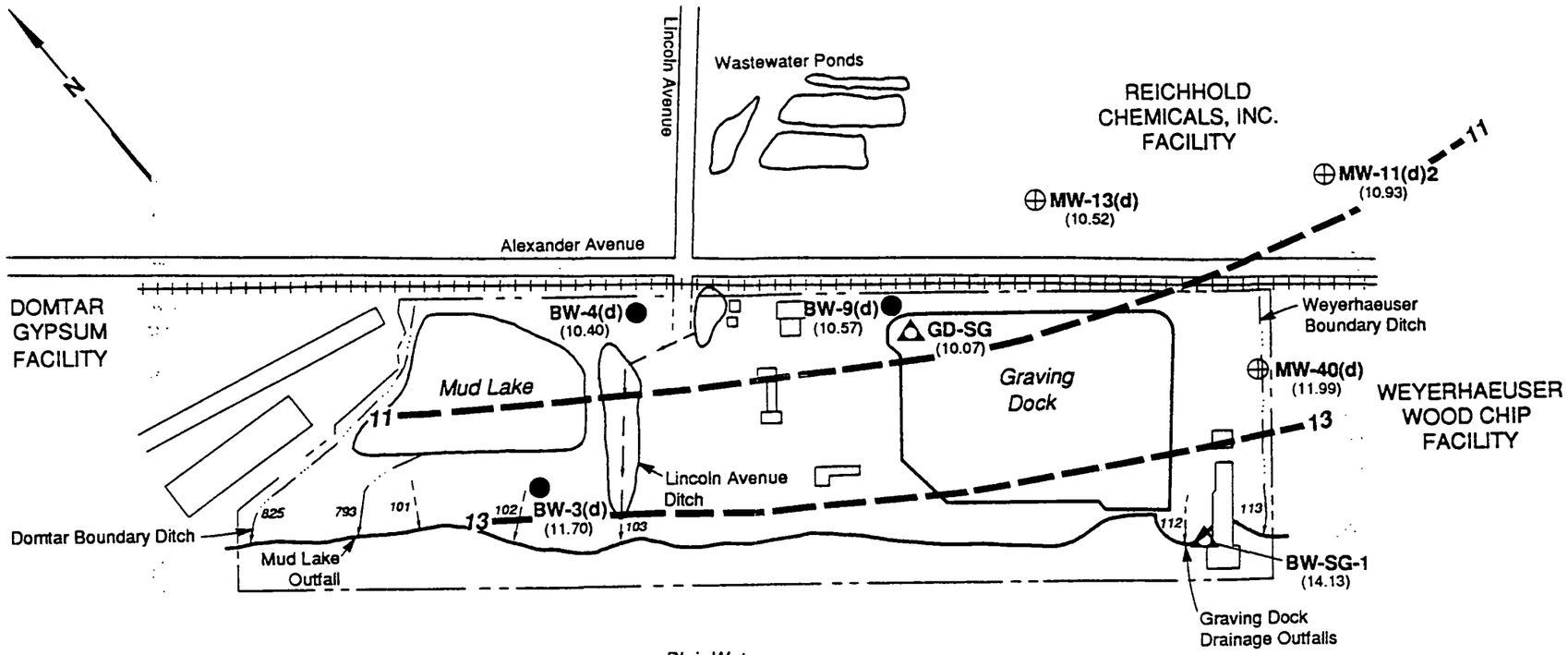
0 400 800
Scale in Feet

Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Intermediate Aquifer, Low Tide, February 2, 1990

Figure 10



KEY

- 11 — Inferred Groundwater Elevation Contour
- Shoreline
- Property Boundary
- 102 — Outfall Drainage Location and Identification (TPCHD 1988)
- BW-5(i) — Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
- BW-SG-1 — Staff Gauge Location and Identification
- MW-4(i) — Reichhold Chemicals, Inc. Well
- (16.31) — Groundwater or Surface Water Elevation (MLLW)

0 400 800
Scale in Feet

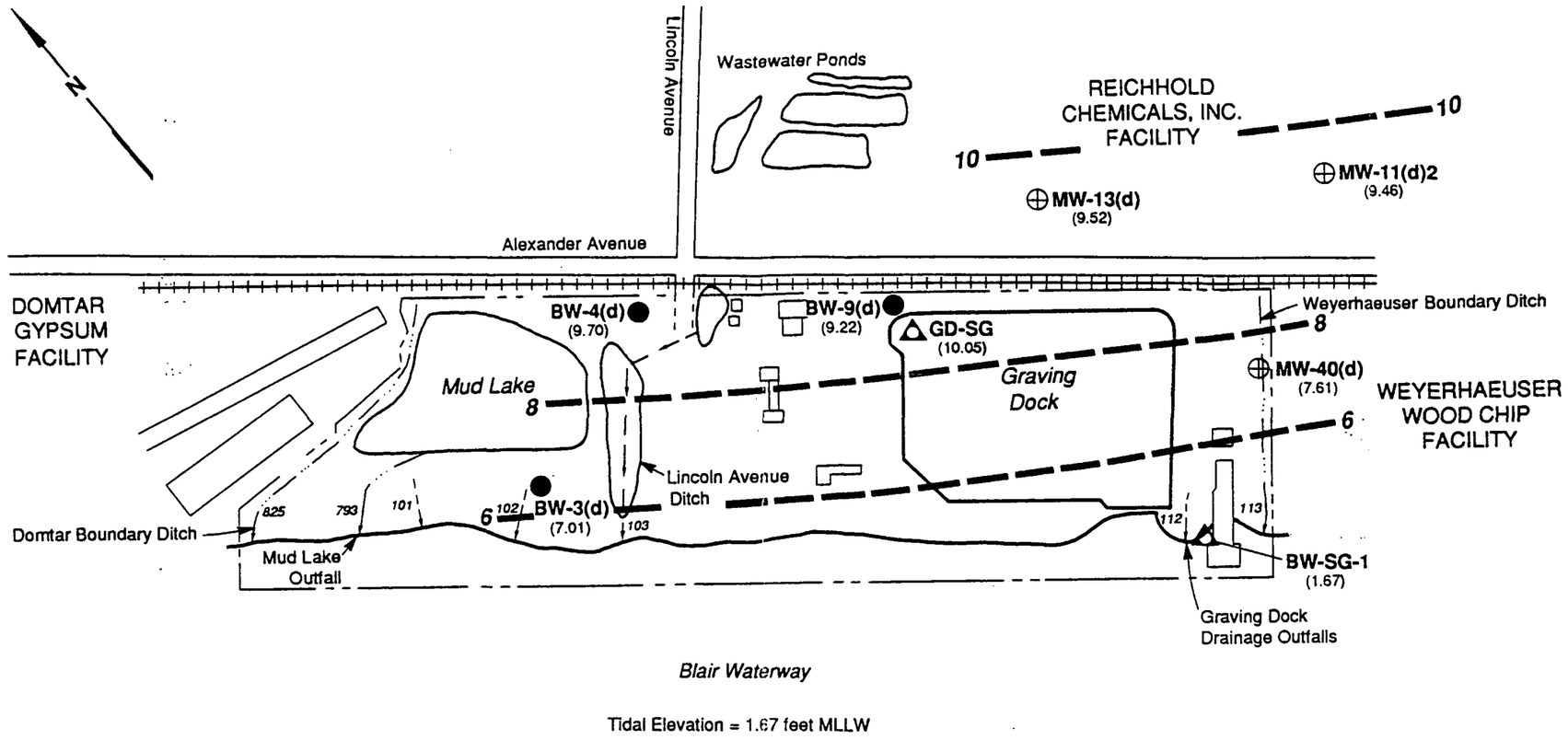
Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Deep Aquifer, High Tide, February 2, 1990

Figure 11

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



Tidal Elevation = 1.67 feet MLLW

KEY

8	Inferred Groundwater Elevation Contour
	Shoreline
	Property Boundary
102	Outfall Drainage Location and Identification (TPCHD 1988)
BW-5(i)	Monitoring Well Location and Identification (s = shallow, i = intermediate, d = deep)
BW-SG-1	Staff Gauge Location and Identification
MW-4(i)	Reichhold Chemicals, Inc. Well
(16.31)	Groundwater or Surface Water Elevation (MLLW)

0 400 800
Scale in Feet

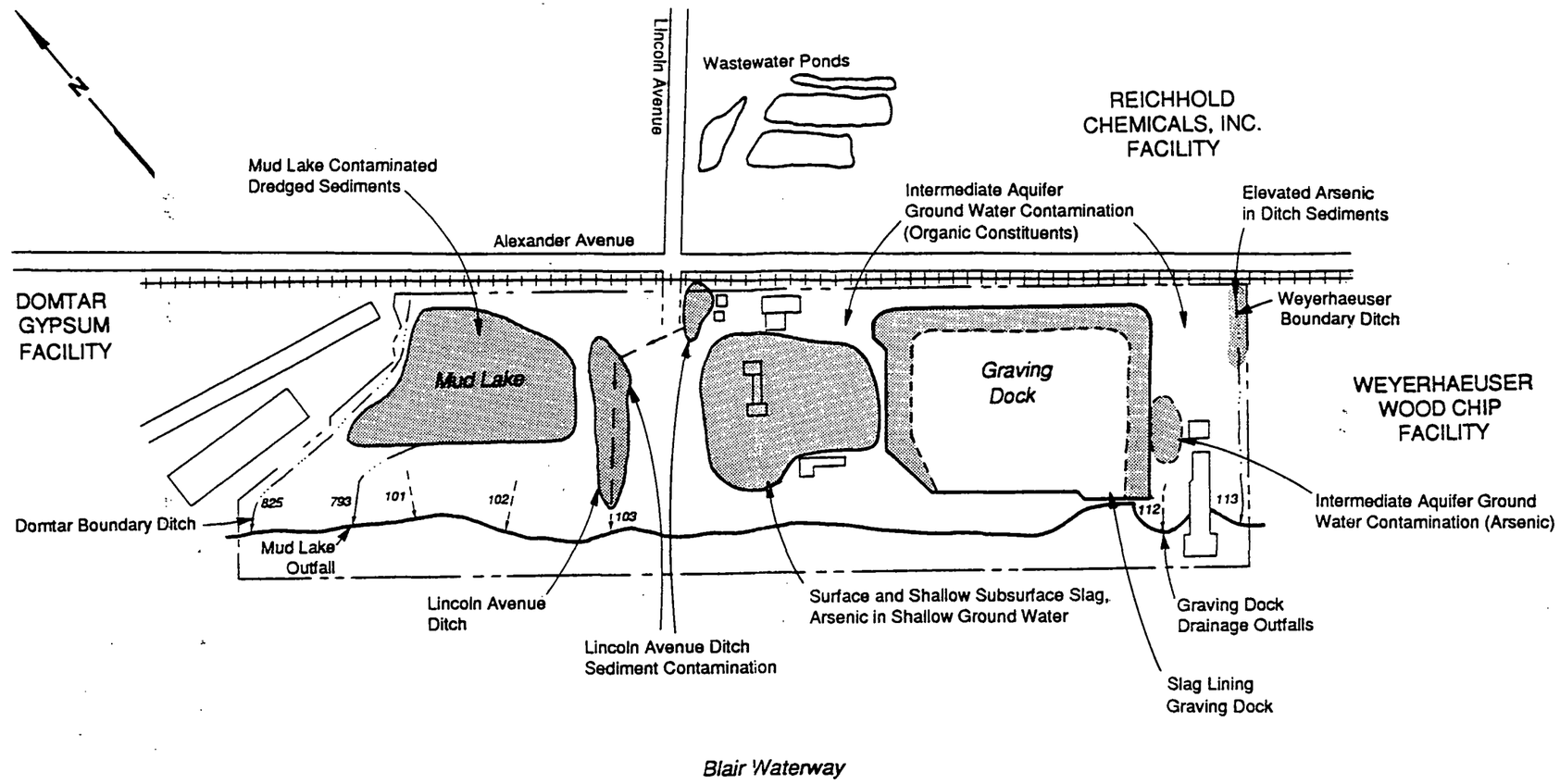
Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Groundwater Elevation Contour Map
Deep Aquifer, Low Tide, February 2, 1990

Figure 12

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92



KEY

Shoreline

Property Boundary

102 Outfall Drainage Location and Identification (TPCHD 1988)

Areas for Additional Action

0 400 800

Scale in Feet

Note: This figure is for illustration purposes only. Please refer to text for details.

LANDAU ASSOCIATES, INC.

Blair Waterway Property Areas for Additional Action

Figure 13

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92

TEXT TABLES

Tables 1 through 10
Blair Waterway Property

TABLE 1

SAMPLE COLLECTION AND ANALYSES SUMMARY
BLAIR WATERWAY PROPERTY

Matrix	No. of Samples	Analytical Parameters[a]														
		Total Metals	Dissolved Metals	EP Tox Metals	TCLP Metals	Volatiles	Semi-Volatiles	PCBs	Dioxins	Pesti-cides	Formal-dehyde	Cations/ Anions	TPH GC-FID	PSDDA	Chloro-phenols	Conven-tionals
Ground Water																
- 1st Sampling	20		20			20	20	20		20	20	7				
- 2nd Sampling	8					8									8	
Sediment																
- Lincoln Ave. Drainageway	9	9		5[b]		9	9	9		9						
- Boundary Ditches	12	12		12[b]		12	12	12		5						
- Outfall and Spillway	2	2		2[b]		2	2	2		2						
- Marine[c]	6													6		
- Graving Dock	1	1				1	1	1		1			1			1[d]
Soil																
- Outlet Fill Area Test Pits	2			2												
- Buried Sediment Layer Former Lincoln Ave. Ditch	3	3				3	3	3	2	3						
- Drum Storage Area Test Pits	2					2	2	2								
- General Site Test Pits	7	7					7	7								
- Fueling Area Test Pits	2						2						2			
- Railroad Spur Test Pits	5	5					5	5		5						
- Railroad Spill Samples	2	(Qualitative analysis for plastic and calcium carbonate)														
Ditch Precipitates	1	1										1[e]				
Slag	2				2											

(a) Tables C-2 through C-4 in Appendix C identify complete lists of the analytes.

(b) Only if total metals were sufficiently elevated to warrant EP Toxicity metal analysis for DW designation.

(c) Marine sediments were analyzed for chemicals having screening levels (SL) defined by PSDDA and for conventional parameters.

(d) Sample was analyzed for solids, total organic carbon, sulfide, cyanide, and total halogens.

(e) Precipitate samples analyzed for calcium, chloride, and sulfide.

TABLE 2

MONITORING WELL CONSTRUCTION DATA SUMMARY
BLAIR WATERWAY PROPERTY

Location	Ground Elevation (ft., MLLW)(a)	Top of PVC Casing Elevation (ft., MLLW)(a)	Depth to Screen Below Ground Surface (ft.)		Screen Elevation (MLLW, ft.)(a)	
			Top	Bottom	Top	Bottom
BW-1s	18.4	20.14	4.0	9.0	14.4	9.4
BW-1l	17.9	20.05	25.0	30.0	-7.1	-12.1
BW-2s	18.9	21.10	5.0	10.0	13.9	8.9
BW-3s	16.8	18.34	3.5	8.5	13.3	8.3
BW-3i	18.8	20.71	23.0	28.0	-4.2	-9.2
BW-3d	17.7	19.59	66.5	71.5	-48.8	-53.8
BW-4s	17.3	19.38	4.5	8.5	12.8	8.8
BW-4i	17.0	19.14	15.5	20.5	1.5	-3.5
BW-4d	17.7	19.43	32.0	37.0	-14.3	-19.3
BW-5i	17.5	19.83	15.5	20.5	2.0	-3.0
BW-6s	18.4	20.19	8.0	13.0	10.4	5.4
BW-7s	17.7	19.89	5.0	10.0	12.7	7.7
BW-7l	17.5	19.98	27.5	32.5	-10.0	-15.0
BW-8s	17.6	19.85	5.0	10.0	12.6	7.6
BW-9s	16.1	18.40	4.0	7.5	12.1	8.6
BW-9i	16.0	18.09	19.5	24.5	-3.5	-8.5
BW-9d	16.0	17.62	44.0	49.0	-28.0	-33.0
BW-10s	20.5	22.79	6.0	9.0	14.5	11.5
BW-SG-1	18.12(b)					

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Survey mark on steel dock painted orange.

TACOMA\BLAIR\BWFIN-2.WK1

TABLE 3

NUMERICAL CRITERIA
GROUNDWATER CONSTITUENTS
BLAIR WATERWAY PROPERTY

Detected Constituents	Federal Drinking Water Standards (a)	Marine Aquatic Life Criteria (b)	MTCA Method A Cleanup Levels Table 1 (c)	MTCA Method B Human Health Based Concentrations (d)	Reichhold Chemical, Inc. Ground Water Protection Standards (e)
INORGANIC CONSTITUENTS (mg/L)					
Alkalinity	-	-	-	Inadequate Data	-
Aluminum	0.05(PSMCL)	-	-	-	-
Antimony	0.01/0.005(PMCL)	0.5(tri) (f)	-	0.0064	0.01
Arsenic	0.05(MCL)	0.013(pent) 0.036(tri)	0.005	-	0.05
Beryllium	0.001(PMCL)	-	-	0.00002	0.175
Cadmium	0.005(MCL)	0.0093	0.005	-	0.01
Calcium	-	-	-	Inadequate Data	-
Chloride	250(SMCL)	-	-	-	-
Chromium	0.1(MCL)	0.05(hex) 10.3(acute-tri)	0.05 (total)	- 16(tri)	0.05
Copper	1.3(PMCL) 1.0(SMCL)	0.0029	-	0.59	0.0029
Iron	0.3(SMCL)	-	-	Inadequate Data	-
Lead	0.05(MCL) 0.015(PAL)	0.0056	0.005	Inadequate Data	0.05
Magnesium	-	-	-	Inadequate Data	-
Manganese	0.05(SMCL)	-	-	0.53	0.536 (s) 0.736 (i)
Mercury	0.002(MCL) 0.002(PMCL)	0.000025	0.002	-	0.002
Molybdenum	-	-	-	0.064	0.015
Nickel	0.1(PMCL)	0.0083	-	0.32	0.05 (s) 0.016 (i,d)
Potassium	-	-	-	Inadequate Data	-
Selenium	0.01(MCL) 0.05(PMCL)	0.071	-	-	-
Silver	0.05(MCL) 0.1(PSMCL)	0.0023(acute)	-	-	0.05
Sodium	-	-	-	Inadequate Data	-
Sulfate	400/500(PMCL) 250(SMCL)	-	-	-	-
Thallium	0.002/0.001(PMCL)	2.13(acute)	-	0.001	-
Zinc	5.0(SMCL)	0.086	-	3.2	0.086
VOLATILE ORGANICS (ug/L)					
Vinyl Chloride	2.0(MCL)	-	0.2	-	2.0
Chloroform	100(MCL)	-	-	7.2	-
Toluene	1000(PMCL)	5000	40	-	5000
Formaldehyde	-	-	-	1.4	50
SEMIVOLATILE ORGANICS (ug/L)					
Chrysene	0.2(PMCL)	300(acute) (g)	0.1 (h)	-	
bis(2-Ethylhexyl)Phthalate	-	3.4	-	6.25	10
Fluoranthene	-	300(acute) (g)	-	640	-
Pentachlorphenol	1.0(MCL)	7.9	-	0.73	50
Phenol	-	5800(acute)	-	9600	1000
Pyrene	-	300(acute) (g)	-	480	-
CONVENTIONALS					
pH	6.5-8.5(SMCL)	-	-	-	-
Conductivity (umhos/cm)	700(SMCL)	-	-	-	-

NUMERICAL CRITERIA
GROUNDWATER CONSTITUENTS
BLAIR WATERWAY PROPERTY

(a) Federal Drinking Water Standards including maximum contaminant levels (MCL); secondary maximum contaminant levels (SMCL); proposed maximum contaminant levels (PMCL); and proposed secondary maximum contaminant levels (PSMCL).
Where more than one PMCL is listed, alternative MCL options are being proposed.

(b) Criteria are for marine aquatic life chronic exposure. When chronic exposure criteria were not available, acute exposure criteria were used and noted on the table. When criteria were available for different oxidation states the oxidation state is noted in parentheses (i.e., trivalent, pentavalent, and hexavalent).

(c) *Groundwater cleanup levels from the Model Toxics Control Act (MTCA), WAC 173-340-720, Table 1, Method A. February 28, 1991.*

(d) Human Health-based concentrations calculated using the formulas specified in the text of this report. Concentration calculated only for those compounds for which there were no Federal Drinking Water Standards or MTCA Table 1 cleanup levels. The following chronic oral reference doses (RfD) (mg/kg/day) and oral cancer potency factors (CPF) (mg/kg/day)-1 were used: antimony RfD=0.0004; beryllium CPF=4.3; copper RfD=0.037; chromium Rfd=1; manganese RfD=0.01 (absorption factor=3); molybdenum RfD=0.004; nickel RfD=0.02; thallium RfD=0.00007; zinc RfD=0.2; chloroform CPF=0.0061; formaldehyde CPF=0.03; chrysene CPF=11.5; bis(2-ethylhexyl)phthalate CPF=0.014; fluoranthene RfD=0.04; pentachlorophenol CPF=0.12; phenol RfD=0 pyrene RFD=0.03. Compounds for which there were inadequate data to calculate human health-based concentrations are noted in the table.

(e) Designations s,i, and d indicate that criteria is for the shallow, intermediate or deep aquifer respectively.

(f) Proposed criteria, EPA 1990. Federal Register, Vol. 55, No. 93, May 14.

(g) Criteria is for total PAH.

(h) Criteria is for total carcinogenic PAH.

REFERENCES:

Federal Drinking Water Standards

EPA 1991c. Federal Register, Vol. 56, No. 20, January 30.
EPA 1990d. Federal Register, Vol. 55, No. 143, July 25.
EPA 1990e. Federal Register, Vol. 55, No. 203, October 19.
EPA 1989b. Federal Register, Vol. 54, No. 97, May 22.
EPA 1988a. Federal Register, Vol. 53, No. 160, August 18.
EPA 1987. Federal Register, Vol. 52, No. 130, July 8.

Aquatic Life Criteria

EPA 1990f. Federal Register, Vol. 55, No. 93, May 14.
EPA 1988b. Federal Register, Vol. 53, No. 2, January 5.
EPA 1986. Quality Criteria for Water, Gold Book, EPA 440/5-86-001, May 1.

MTCA Cleanup Levels

Ecology 1991b. Model Toxics Control Act, Chapter 173-340 WAC, February 28.

Human Health Based Concentrations

EPA 1991d. Health Effects Assessment Summary Tables, Annual - Fy-1991.

Reichhold Chemical, Inc. Ground Water Protection Standards

Reichhold Chemical, Inc. 1988b. Permit No. WAD009252891 Corrective Action Plan Parts IV and V.

TACOMA\BLAIR\BWFIN-3.WK1

TABLE 4
NUMERICAL CRITERIA SUMMARY, SOIL AND DITCH SEDIMENT CONSTITUENTS
BLAIR WATERWAY PROPERTY

Constituents Detected	MTCA Cleanup Levels 740 Method A (Table 2)[a]	MTCA Cleanup Levels 740 Method B[b][c]	MTCA Cleanup Levels 740 Method C[c][d]	MTCA Cleanup Levels 745 Method A[e]	MTCA Cleanup Levels 745 Method C[c][f]
Inorganic Constituents (mg/kg)					
Antimony	--	32	--	--	--
Arsenic	20	--	57[g]	200	--
Barium	--	4000	--	--	--
Beryllium	--	400	--	--	--
Cadmium	2.0	--	160[h]	10[h]	--
Chromium	100	--	--	500	--
Cobalt	--	--	--	--	--
Copper	--	2960	--	--	140000
Lead	250	--	--	1000	--
Mercury	1.0	--	--	1.0	--
Nickel	--	1600	--	--	--
Selenium	--	240	--	--	--
Silver	--	240	--	--	--
Thallium	--	5.6	22.4	--	245
Vanadium	--	560	--	--	--
Zinc	--	16000	--	--	--
Volatile Organics (mg/kg)					
Acetone	--	8000	--	--	--
Benzene	0.5	--	--	0.5	--
2-Butanone	--	4000	--	--	--
Carbon Disulfide	--	8000	--	--	--
cis 1,2-Dichloroethene	--	800	--	--	--
trans 1,2-Dichloroethene	--	1600	--	--	--
Ethylbenzene	20	--	--	20	--
Freon	--	Inadequate data	--	--	--
2-Hexanone	--	Inadequate data	--	--	--
Toluene	40	--	--	40	--
Total Xylenes	20	--	--	20	--

TABLE 4
NUMERICAL CRITERIA SUMMARY, SOIL AND DITCH SEDIMENT CONSTITUENTS
BLAIR WATERWAY PROPERTY

Constituents Detected	MTCA Cleanup Levels 740 Method A (Table 2)[a]	MTCA Cleanup Levels 740 Method B[b][c]	MTCA Cleanup Levels 740 Method C[c][d]	MTCA Cleanup Levels 745 Method A[e]	MTCA Cleanup Levels 745 Method C[c][f]
Semivolatile Organics (mg/kg)					
Carcinogenic PAHs -Benzo(a)anthracene -Benzo(a)pyrene -Benzo(b)fluoranthene -Benzo(k)fluoranthene -Chrysene -Dibenz(a,hy)anthracene -Indeno(1,2,3-cd)pyrene	1.0	--	3.5	20	--
Anthracene	--	24000	--	--	--
Benzo(g,h,i)perylene	--	Inadequate data	--	--	--
bis(2-ethylhexyl)-phthalate	--	71	--	--	--
Butylbenzylphthalate	--	16000	--	--	--
Di-n-octylphthalate	--	1600	--	--	--
Fluoranthene	--	3200	--	--	--
Fluorene	--	3200	--	--	--
Pentachlorophenol	--	8.3	--	--	--
Phenanthrene	--	Inadequate data	--	--	--
Pyrene	--	2400	--	--	--
Pesticides/PCBs					
PCB Mixtures -Arochlor 1248 -Arochlor 1254 -Arochlor 1260	1.0	--	5.2	10	--
Dioxins/Furans					
Chlorinated Dibenzofurans -Total Hexa Furans -Total Hepta Furans	--	0.0000067	0.00027	--	0.00088
Chlorinated Dibenzodioxins -Total Hexa Dioxins -Total Hepta Dioxins -Total Octa Dioxins	--	--	--	--	--

TABLE 4

NUMERICAL CRITERIA SUMMARY, SOIL AND DITCH SEDIMENT CONSTITUENTS
BLAIR WATERWAY PROPERTY

(a) Soil cleanup levels from the Model Toxics Control Act (MTCA), WAC 173-340-740, Table 2, Method A.

(b) Human health-based concentrations for soil calculated using the formulas specified in the text of this report and taken from the MTCA, WAC 173-340-740, Method B. Concentrations calculated only for those compounds for which there was no MTCA Table 2 cleanup levels.

(c) The following chronic oral reference doses (RfD) (mg/kg/day) and oral potency factors (CPF) $(mg/kg/day)^{-1}$ were used: antimony RfD=0.0004; arsenic CPF=1.7; barium RfD=0.05; beryllium CPF=4.3; cadmium RfD=0.0005; copper RfD=0.037; nickel RfD=0.02; selenium RfD=0.003; silver RfD=0.003; thallium RfD=0.00007; vanadium RFD=0.007; zinc RfD=0.2; acetone RfD=0.1; 2-butanone RfD=0.05; carbon disulfide RfD=0.1; cis-1,2-dichloroethene RfD=0.01; trans 1,2-dichloroethene RfD=0.02; carcinogenic PAH [benzo(a)pyrene] CPF=11.5; anthracene RfD=0.3; bis (2-ethylhexyl)phthalate CPF=0.014; butylbenzylphthalate RfD=0.2; di-n-octylphthalate RfD=0.02; fluoranthene RfD=0.4; fluorene RfD=0.04; pentachlorophenol CPF=0.12; pyrene RfD=0.03; and dioxins/furans (2,3,7,8-TCDD) CPF=150,000. Compounds for which there were inadequate data to calculate human health-based concentrations are noted in the table.

(d) Human health-based concentrations for commercial soil calculated using the formulas specified in the text of this report and taken from the MTCA, WAC 173-340-740, Method C. Method C concentrations were calculated only for constituents whose detected concentrations onsite exceeded MTCA Methods A or B concentrations (WAC 173-340-740).

(e) Soil cleanup levels from the MTCA, WAC 173-340-745, Table 3, Method A.

(f) Human health based concentrations for soil calculated using the formulas specified in the text of this report and taken from the MTCA, WAC 173-340-745, Method C. Concentrations calculated only for those compounds for which there was no MTCA Table 3 cleanup level.

(g) Assumes absorption factor of 40 percent.

(h) Calculated using the cadmium RfD for food.

REFERENCES

Ecology 1991b. Model Toxics Control Act, Chapter 173-340 WAC, February 28.

EPA 1991c. Health Effects Assessment Summary Tables, Annual FY 1991.

EPA 1989c. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans, March.

TABLE 5

COMMENCEMENT BAY SEDIMENT CLEANUP OBJECTIVES, PSDDA SCREENING LEVELS AND MAXIMUM LEVELS, AND ECOLOGY SEDIMENT MANAGEMENT STANDARDS
MARINE SEDIMENTS
BLAIR WATERWAY PROPERTY

	Commencement Bay (CBN/T ROD)[a]	Sediment Management Standards[b]				PSDDA[c]	
		Sediment Quality Standards		Sediment Cleanup Screening Standards			
	Sediment Cleanup Objective	dry wt	TOC	dry wt	TOC	Screening Level (SL)	Maximum Level (ML)
METALS							
Antimony	150	--	--	--	--	20	200
Arsenic	57	57	--	93	--	57	700
Cadmium	5.1	5.1	--	6.7	--	0.96	9.6
Chromium	--	260	--	270	--	--	--
Copper	390	390	--	390	--	81	810
Lead	450	450	--	530	--	66	660
Mercury	0.59	0.41	--	0.59	--	0.21	2.1
Nickel	>140	--	--	--	--	140	--
Silver	6.1	6.1	--	6.1	--	1.2	6.1
Zinc	410	410	--	960	--	160	1,600
Tributyl Tin	--	--	--	--	--	30	--
ORGANIC COMPOUNDS							
Low Molecular Weight PAH	5,200	--	370	--	780	610	6,100
Naphthalene	2,100	--	99	--	170	210	2,100
Acenaphthylene	1,300	--	66	--	66	64	640
Acenaphthene	500	--	16	--	57	63	630
Fluorene	540	--	23	--	79	64	640
Phenanthrene	1,500	--	100	--	480	320	3,200
Anthracene	960	--	220	--	1200	130	1,300
2-Methylnaphthalene	670	--	38	--	64	67	670

TABLE 5

COMMENCEMENT BAY SEDIMENT CLEANUP OBJECTIVES, PSDDA SCREENING LEVELS AND MAXIMUM LEVELS, AND ECOLOGY SEDIMENT MANAGEMENT STANDARDS
MARINE SEDIMENTS
BLAIR WATERWAY PROPERTY

	Commencement Bay (CBN/T ROD)[a]	Sediment Management Standards[b]				PSDDA[c]	
		Sediment Quality Standards		Sediment Cleanup Screening Standards			
	Sediment Cleanup Objective	dry wt	TOC	dry wt	TOC	Screening Level (SL)	Maximum Level (ML)
High Molecular Weight PAH	17,000	--	960	--	5300	1,800	51,000
Fluoranthene	2,500	--	160	--	1200	630	6,300
Pyrene	3,300	--	1,000	--	1400	430	7,300
Benz(a)anthracene	1,600	--	110	--	270	450	4,500
Chrysene	2,800	--	110	--	460	670	6,700
Benzofluoranthenes	3,600	--	230	--	450	800	8,000
Benzo(a)pyrene	1,600	--	99	--	210	680	6,800
Indeno(1,2,3-c,d)pyrene	690	--	34	--	88	69	5,200
Dibenzo(a,h)anthracene	230	--	12	--	33	120	1,200
Benzo(g,h,i)perylene	720	--	31	--	78	540	5,400
Chlorinated Organic Compounds							
1,3-Dichlorobenzene	170	--	--	--	--	170	--
1,4-Dichlorobenzene	110	--	3.1	--	9	26	260
1,2-Dichlorobenzene	50	--	2.3	--	2.3	19	350
1,2,4-Trichlorobenzene	51	--	0.81	--	1.8	6.4	64
Hexachlorobenzene	22	--	0.38	--	2.3	23	230
Total PCBs	150	--	12	--	65	130	2,500
Phthalates							
Dimethyl phthalate	160	--	53	--	53	160	--
Diethyl phthalate	200	--	61	--	110	97	--
Di-n-butyl phthalate	1,400	--	220	--	1700	1,400	--

TABLE 5

COMMENCEMENT BAY SEDIMENT CLEANUP OBJECTIVES, PSDDA SCREENING LEVELS AND MAXIMUM LEVELS, AND ECOLOGY SEDIMENT MANAGEMENT STANDARDS
MARINE SEDIMENTS
BLAIR WATERWAY PROPERTY

	Commencement Bay (CBN/T ROD)[a]	Sediment Management Standards[b]				PSDDA[c]	
		Sediment Quality Standards		Sediment Cleanup Screening Standards			
	Sediment Cleanup Objective	dry wt	TOC	dry wt	TOC	Screening Level (SL)	Maximum Level (ML)
Butyl benzyl phthalate	900	--	4.9	--	64	470	--
Bis(2-ethylhexyl)phthalate	1,300	--	47	--	78	3,100	--
Di-n-octyl phthalate	6,200	--	58	--	4500	6,200	--
Phenols							
Phenol	420	420	--	1200	--	120	1,200
2-Methylphenol	63	63	--	63	--	10	72
4-Methylphenol	670	670	--	670	--	120	1,200
2,4-Dimethylphenol	29	29	--	29	--	10	50
Pentachlorophenol	360	360	--	690	--	69	690
Miscellaneous Extractables							
Benzyl alcohol	73	57	--	73	--	10	73
Benzoic acid	650	650	--	650	--	216	690
Dibenzofuran	540	--	15	--	58	54	540
Hexachloroethane	--	--	--	--	--	1,400	14,000
Hexachlorobutadiene	11	--	3.9	--	6.2	29	290
N-Nitrosodiphenylamine	28	--	11	--	11	22	220
Volatile Organics							
Trichloroethene	--	--	--	--	--	160	1,600
Tetrachloroethene	57	--	--	--	--	14	210
Ethylbenzene	10	--	--	--	--	10	50
Total xylenes	40	--	--	--	--	12	160

TABLE 5

COMMENCEMENT BAY SEDIMENT CLEANUP OBJECTIVES, PSDDA SCREENING LEVELS AND MAXIMUM LEVELS, AND ECOLOGY SEDIMENT MANAGEMENT STANDARDS
MARINE SEDIMENTS
BLAIR WATERWAY PROPERTY

	Commencement Bay (CBN/T ROD)[a]	Sediment Management Standards[b]				PSDDA[c]	
		Sediment Quality Standards		Sediment Cleanup Screening Standards			
	Sediment Cleanup Objective	dry wt	TOC	dry wt	TOC	Screening Level (SL)	Maximum Level (ML)
Pesticides							
Total DDT	--	--	--	--	--	6.9	69
p,p'-DDE	9	--	--	--	--	--	--
p,p'-DDD	16	--	--	--	--	--	--
p,p'-DDT	34	--	--	--	--	--	--
Aldrin	--	--	--	--	--	10	--
Chlordane	--	--	--	--	--	10	--
Dieldrin	--	--	--	--	--	10	--
Heptachlor	--	--	--	--	--	10	--
Lindane	--	--	--	--	--	10	--

(a) The Commencement Bay Sediment Cleanup Objectives are in the Commencement Bay Nearshore/Tideflats Record of Decision (CBN/T ROD). Metals in mg/kg dry weight, ppm; organic compounds in µg/kg dry weight, ppb. Source: U.S. EPA Commencement Bay Nearshore/Tideflats Record of Decision (CBN/T ROD) 1989. (EPA 1989a)

(b) The Washington Department of Ecology has established these Sediment Management Standards. The criteria for metals (mg/kg dry weight, ppm) and polar organic compounds (µg/kg dry weight, ppb) are on a dry weight basis. The criteria for nonpolar organic compounds are on a TOC-normalized basis (mg/kg organic carbon, ppm carbon). Source: Washington Department of Ecology WAC 173-204. 1991. (Ecology 1991a)

(c) The Puget Sound Dredged Disposal Analysis (PSDDA) program established these screening levels (SLs) and maximum levels (MLs). Metals in mg/kg dry weight, ppm; organic compounds in µg/kg dry weight, ppb. Source: U.S. Army Corps of Engineers et al. (USACOE 1989).

TABLE 6
LABORATORY DETECTION LIMITS AND NUMERICAL CRITERIA
GROUNDWATER
BLAIR WATERWAY PROPERTY

Analyte	Work Plan Quantitation Limit Goal	Reported Laboratory Detection Limit	Numerical Criteria
Metals (mg/L)			
Aluminum	1-2	1-2	0.05 (PSMCL)
Antimony	0.06	0.06	0.01/0.005 (PMCL), 0.0064 (MTCA)
Arsenic	0.01	0.01	0.005 (MTCA)
Beryllium		0.005	0.001 (PMCL), 0.00002 (MTCA)
Copper	0.025	0.025	0.0029 (marine chronic aquatic)
Mercury	0.002	0.0002	0.000025 (marine chronic aquatic)
Nickel	0.015	0.015	0.0083 (marine chronic aquatic)
Thallium	0.010	0.010	0.002/0.001 (PMCL), 0.001 (MTCA)
Volatile/Semivolatile Organics (µg/L)			
Vinyl Chloride	5-10	10[a]	2.0 (MCL), 0.2 (MTCA)
Chrysene	10-50	10	0.2 (PMCL), 0.1 (MTCA)
bis (2-Ethylhexyl)-phthalate	10-50	10	3.4 (marine chronic aquatic), 6.25 (MTCA)

(a) For data reported by RCI prior to July 1991 groundwater testing.

TABLE 7
EXCEEDANCES OF NUMERICAL CRITERIA
GROUNDWATER
BLAIR WATERWAY PROPERTY

	Field Measurements		INORGANICS (mg/L)											ORGANICS (µg/L)		
Sample	pH	Conductivity (umhos/cm)	Chloride	Sulfate	Aluminum	Arsenic	Beryllium	Copper	Iron	Manganese	Nickel	Selenium	Molybdenum	bis(2-Ethylhexyl) phthalate	Vinyl Chloride	Formaldehyde
BW-1i-1		1215							38	9.25						1300
BW-1s-1	5.13	2182					0.001	0.003	81.6	2.49	0.03					2390
BW-2s-1		1354							6.07	0.981				33		250
BW-3d-1		7400							0.525	0.18						600
BW-3i-1		5398					0.001	0.003		0.445				4.6		690
BW-3s-1	6.03	2755					0.001	0.003	80.2	2.70	0.02					2020
BW-4d-1		1363	586.8						0.738	0.354						
BW-4i-1		857							20.6	1.24						270
BW-4s-1									13.7	1.21						330
BW-5i-1		11720							21.5	1.40						230
BW-6s-1		1414				0.009			3.27	3.71		0.012				470
BW-7i-1		19870							10.5	0.866						
BW-7s-1										0.077			0.018			
BW-8s-1		1080				0.049			19.8	3.65						500
BW-9d-1		5683	2045.9						1.09	0.167						
BW-9i-1		5368	1645	374	0.1				19.4	1.19				26	3.9	1170
BW-9i-1 (dup)			1696	322	0.2					1.18					4.2	1300
BW-9s-1	6.04	1893		1434			0.002		154	8.34	0.04			35		1150
BW-10s-1	4.70						0.001	0.010	5.90	0.469						190
PTB2-BW-9i[(a)]		5535													3.1	
PTB2-BW-12i (dup of 9i)		5535													3.1	
CRITERIA																
Federal Drinking Water Standards	6.5 to 8.5 (SMCL)	700 (SMCL)	250 (SMCL)	250 (SMCL) 400/500 (PMCL)	0.05 (PSMCL)	0.05 (MCL)	0.001 (PMCL)	1.3 (PAL) 1.0 (SMCL)	0.3 (SMCL)	0.05 (SMCL)	0.1 (PMCL)	0.01 (MCL) 0.05 (PMCL)			2.0 (MCL)	
Aquatic Life Criteria						0.013 (pent) 0.036(tri)		0.0029			0.0083	0.071		3.4		
MTCA Method A Table 1						0.005									0.2	
MTCA Method B Human Health Based Concentrations							0.00002	0.59		0.53	0.32		0.064	6.25		1.4
Reichhold Protection Standards						0.05	0.175	0.0029		0.536(s) 0.736(i)	0.05(s) 0.016(i,d)		0.015	10	2.0	50

(a) Samples preceeded by "PTB2-" were collected during the second groundwater sampling event.

02/21/92 TACOMA\BLAIR\BWFIN-7.TAB

TABLE 8
EXCEEDANCE OF NUMERICAL CRITERIA FOR SOIL AND DITCH SEDIMENTS
BLAIR WATERWAY PROPERTY

	Inorganics (mg/kg)			Organics (µg/kg)					
Sample	Arsenic	Cadmium	Thallium	Benzo(a) fluoranthene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Chrysene	PCBs (Aroclor 1248)	Dioxins/ Furans (TEF equivalent)
BWD-1-1	43	–	–	–	–	–	–	–	–
BWD-2-1	67	–	–	–	–	–	–	–	–
BWD-4-1	656	–	–	–	–	–	–	–	–
BWD-5-1	1890	2.5	–	–	–	–	–	–	–
BLD-1-1	137	–	–	–	1400[a]	1400[a]	–	–	–
BLD-2-1	27	–	–	–	–	–	–	–	–
BLD-3-1	84	–	–	–	1600[a]	1600[a]	1700	–	–
BLD-4-1	54	–	–	–	–	–		–	–
BR-1-1	23	–	–	–	–	–		–	–
BR-2-1	46	–	–	–	–	–		–	–
BR-3-1	22	–	–	–	–	–		–	–
BT-2-1	120	–	–	–	–	–		–	–
BT-4-1	–	–	–	–	1900[a]	1900[a]	1100	–	–
BT-5-1	81	–	–	–	–	–	–	–	–
BT-6-1	30	–	–	–	–	–		–	–
BT-9-1	33	–	–	–	–	–		–	–
PTB2 BOLD-1	291	–	–	–	–	–		14600	–
PTB2 BOLD-2	45	–	–	–	–	–		–	0.015
PTB2 BOLD-3	44	–	–	–	–	–		–	0.528
PTB2 BLD-5	178	–	–	–	–	–		2000	–
PTB2 BLD-6	187	–	–	–	–	–		–	–

TABLE 8
EXCEEDANCE OF NUMERICAL CRITERIA FOR SOIL AND DITCH SEDIMENTS
BLAIR WATERWAY PROPERTY

	Inorganics (mg/kg)			Organics (µg/kg)					
Sample	Arsenic	Cadmium	Thallium	Benzo(a) fluoranthene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Chrysene	PCBs (Aroclor 1248)	Dioxins/ Furans (TEF equivalent)
PTB2 BLD-7	288	–	–	–	2500	2500	1500	1400	–
PTB2 BLD-8	285	–	–	–	2000	2000	1100	–	–
BG 11/12	195	–	39	160[b]	630[b]	630[b]	310[b]	–	–
CRITERIA									
MTCA 740 Method A	20	2.0	–	1000	1000[c]	1000[c]	1000	1000[d]	–
MTCA 740 Method B	–	160[e]	5.6	–	–	–	–	–	0.0067
MTCA 740 Method C	57[f]	320[e]	22.4	3500	3500	3500[b]	3500[b]	5200[c]	0.270
MTCA 745 Method A	200	10[e]	–	2000	20000	20000[b]	20000[b]	10000[c]	–
MTCA 745 Method C	–	–	245	–	–	–	–	–	0.880

(a) Reported as benzo(b)fluoranthene and benzo(k)fluoranthene.
(b) Exceedance noted is for sum of carcinogenic PAH, not individual PAH compounds.
(c) The benzo(b,k)fluoranthene criteria is based on total carcinogenic PAH.
(d) The PCB criterion is based on total PCBs.
(e) The cadmium criterion is calculated using the cadmium RfD for food.
(f) Assumes 40 percent absorption.

04/14/92 TACOMA\BLAIR\BWFIN-8.TAB

TABLE 9

CONSTITUENTS DETECTED IN SITE SOIL AND THEIR
ASSOCIATED RISK AND/OR HAZARD QUOTIENT
BLAIR WATERWAY PROPERTY

Constituent	Oral Potency factor[a] $(mg/kg/day)^{-1}$	Oral Reference Dose[a] (mg/kg/day)	Lincoln Avenue Drainageway Concentration (mg/kg)	Excess Carcinogenic Risk	Hazard Quotient	Weyerhaeuser Ditch Concentration (mg/kg)	Excess Carcinogenic Risk	Hazard Quotient
Arsenic	1.7E+O	1E-3	288	1.5E-5	8E-2	1890	9.8E-5	5.4E-1
Barium	–	5E-2	48.8	–	2.8E-4	147	–	8.4E-4
Cadmium	–	5E-4	1.5	–	8.6E-4	2.5	–	1.4E-3
Chromium (III)	–	1E+1	43.8	–	1.3E-6	27.3	–	7.8E-7
Copper	–	0.037	128	–	9.9E-04	468	–	3.6E-3
Lead	NA	NA	89	–	–	179	–	–
Mercury	–	3E-4	0.14	–	1.3E-4	–	–	–
Nickel	–	2E-2	31	–	4.4E-4	44	–	6.3E-4
Zinc	–	2E-1	334	–	4.8E-4	1190	–	1.7E-3
PCBs	7.7E+0	–	2	1.2E-6	–	–	–	–
Anthracene	–	3E-1	0.140	–	1.3E-7	–	–	–
Benzo(a)anthracene	11.5	–	0.600	5.3E-7	–	–	–	–
Benzo(a)pyrene	11.5	–	0.480	4.2E-7	–	–	–	–
Benzo(b,k)fluoranthene	11.5	–	2.5	2.1E-6	–	0.109	9.5E-8	–
Benzo(g,h,i)perylene	NA	NA	0.170	–	–	0.061	–	–
bis(2-ethylhexyl)phthalate	1.4E-2	2E-2	8.0	8.0E-9	1.1E-4	0.150	1.6E-10	1.6E-6
Chrysene	11.5	–	1.7	1.5E-6	0–	0.068	5.9E-8	–
Fluoranthene	–	4E-2	2.4	–	1.7E-5	0.038	–	2.7E-7
Fluorene	–	4E-2	0.100	–	7.1E-7	–	–	–
Pentachlorophenol	1.2E-1	3E-2	0.290	2.0E-9	2.8E06	–	–	–
Pyrene	–	3E-2	2.0	–	1.9E-5	0.028	–	2.7E-7
Acetone	–	1E-1	0.170	–	4.9E-7	0.0098	–	2.8E-8
Carbon Disulfide	–	1E-1	0.0027	–	7E-9	–	–	–
Dioxins	1.5E+5	–	0.000236	2.7E-6	–	–	–	–
Total Excess Cancer Risk								
with arsenic				2.3E-5			9.8E-5	
without arsenic				8.4E-6			1.5E-7	
Total Hazard Index					8.3E-2			5.4E-1

NA = Criteria not available.

(a) Source: EPA 1991c. Health Effects Summary Tables, Annual FY-1991.

02/23/92 TACOMA\BLAIR\BWFIN-9.TAB

TABLE 10

EXCEEDANCE OF NUMERICAL CRITERIA
MARINE SEDIMENT
BLAIR WATERWAY PROPERTY

	MARINE	LINCOLN AVENUE DITCH										NUMERICAL CRITERIA(h)	
SAMPLE I.D.:	BWS-1-02	BLD-1-1	BLD-1-1 (1:10)(a)	BLD-3-1	BLD-3-1 (1:10)	BLD-3-1 (1:20)	BLD-4-1 (1:0.3)	BLD-5-1	BLD-6-1	BLD-7-1	BLD-8-1	Comm. Bay SQO(b)	PSDDA SL(c)
CONSTITUENT		CONCENTRATION											
METALS (mg/kg)													
Arsenic		137	NA(d)	84	NA	NA	NA	178	187	288	285	57	57
Cadmium		1.5	NA	1.3	NA	NA	NA					5.1	0.96
Copper		128	NA	107	NA	NA	NA	86.9		125	90.3	390	81
Lead		89	NA	72	NA	NA	NA			85		450	66
Zinc		334	NA	273	NA	NA	NA	189		334	274	410	160
PCBs (ug/kg)													
Aroclor 1254/1260	280	500	NA		NA	NA	NA	2000	190	1400	470	150(e)	130(e)
SEMI-VOLATILE ORGANICS (ug/kg)													
Anthracene				140 M(f)								960	130
Benzo(a)anthracene										600 M		1600	450
Benzofluoranthenes(g)		1400	2000		1600 J5					2500	2000	3600	800
bis(2-Ethylhexyl)phthalate		3400	5000		6900	7200		1500		8000	4200	1300	3100
Chrysene			870 M		1700 M					1500	1100	2800	670
Fluoranthene			840 M	860	1300 M					2400	1100	2500	630
Fluorene				100 M								540	64
Pentachlorophenol		290 M		190 M								360	69
Phenanthrene										590 J5		1500	320
Pyrene		910	920 M	2000	1700 J		510			1900	960	3300	430

All results reported on a dry weight basis.

(a) (1:10) Indicates dilution ratio.
(b) Sediment quality objectives (SQOs) from the CBN/T ROD.
(c) PSDDA screening levels (SLs).
(d) NA Indicates constituent not analyzed.
(e) The PCB criterion is based on total PCBs.
(f) J and M data qualifiers are defined in Appendix Table C-5.
(g) Reported as the sum of the benzofluoranthenes.
(h) CBN/T ROD Sediment Quality Objectives are used to evaluate environmental quality; thus, the Ecology sediment management standards (which also require TOC-normalization of nonpolar organic compounds) are not used in this table.

TACOMA\BLAIR\BWFIN-10.WK1

APPENDIX A.

APPENDIX A

Explorations and Sampling Procedures Blair Waterway Property

APPENDIX A
EXPLORATIONS AND SAMPLING PROCEDURES
BLAIR WATERWAY PROPERTY

This section presents the procedures used by Landau Associates during the on-land exploration and sampling for the Phase II Environmental Investigation of the Blair Waterway Property. The procedures are described herein by sample matrix (groundwater, soil and ditch sediments, and precipitate).

GROUNDWATER INVESTIGATIONS

Monitoring Well Program

Eighteen groundwater monitoring wells were installed (9 screened in the shallow aquifer, 6 screened in the intermediate aquifer, and 3 screened in the deep aquifer). Well design, installation, and development were in accordance with procedures outlined in the following sections.

Drilling, sampling, and well installation requirements were identified by an experienced Landau Associates' geologist or engineer at each location. Soils encountered during drilling for the wells were classified in general accordance with the Unified Soil Classification System (USCS) presented on Figure A-1. Soil profile and well logs for the monitoring wells are presented on Figures A-2 through A-20.

Monitoring Well Soil Borings

Borings for monitoring wells were drilled using truck-mounted equipment. Soil samples were collected using a 2.42-inch ID split-barrel sampler at least every 5 ft and at shorter intervals as required to identify geologic zones. Prior to and after drilling, the drilling derrick, temporary steel casing, and downhole equipment were cleaned using a high-pressure hot water washer, as required by the Washington State Department of Ecology (WAC 173-160-530; Ecology 1989d).

The shallow aquifer wells were drilled with 6-inch inside diameter (ID) hollow-stem auger equipment to depths of less than 1 to 1-1/2 ft into the fine-grained soils (upper aquitard) underlying the upper aquifer. The intermediate and deep aquifer wells were drilled with cable tool equipment using a temporary steel casing step-down procedure to isolate sequential aquifers.

The step-down procedure involved installing sequentially smaller temporary casings after penetrating each aquitard as a preventive measure to reduce the potential for cross-contamination of aquifers. The temporary steel casing was filled with "Pure Gold" grout prior

to stepping down with sequentially smaller casing and continuation of drilling. For the intermediate wells, an 8-inch diameter casing was installed through the shallow aquifer and into the upper portion of the upper aquitard. Pure Gold grout was then pumped into the 8-inch casing. A 6-inch diameter casing was then placed inside the 8-inch casing and drilling continued into the intermediate aquifer. Drilling procedures for the deep aquifer wells used a similar procedure with one additional step-down to separate the intermediate and deep aquifers. Temporary steel casing was stepped down from 10-inch to 8-inch to 6-inch as drilling proceeded.

Monitoring Well Construction and Installation

Monitoring wells were constructed in accordance with Washington State Department of Ecology (1989a) (WAC 173-160) requirements. A variance was requested and obtained from the Department of Ecology for construction of shallow wells (Ecology 1989a).

Well screens in the shallow aquifer ranged from 3.5 to 5.0 ft in length and, where possible, were constructed with screens extending across the top of the zone of saturation. Wells in the intermediate and deep aquifer were constructed using a 5-ft screen length, with the screens placed just below the bottom of the confining aquitard. Prior to installation of the monitoring wells, all well casing, screen, and centralizing devices were inspected for damage and were cleaned using a high-pressure, hot-water washer, as required by WAC 173-160-530. Well materials consisted of 2-inch diameter, flush-threaded PVC well casing and screen with Viton O-ring seals at each threaded joint. The well casing was installed to the target depth through the temporary casing or hollow-steam auger and the total length was verified and documented. A stainless-steel centralizing device was installed at the top of the screen in all intermediate and deep wells to permit the installation of a uniform sand filter pack. Well casing alignment was verified by lowering a 1.66-inch outside diameter (OD) by 3-ft long bailer into the well.

A filter pack of pre-sized, pre-washed No. 10-20 Colorado silica sand was installed around the well screen, extending from the bottom of the borehole to approximately 3 ft above the screen for intermediate and deep wells. The variance (noted above) allowed the filter pack to extend 0.5 to 2 ft above the screen for the shallow-aquifer wells. A 1- to 2-ft layer of fine sand (No. 20-40) was placed above the sandpack in intermediate and deep wells when a high solids bentonite grout seal was to be used. The filter pack was installed by carefully pouring sand down the annulus between the well casing and the temporary casing, as the temporary casing was slowly withdrawn. During filter pack placement, the distribution and depth of the filter pack was monitored with a weighted tape.

Bentonite pellets were placed above the filter pack to provide a near-surface borehole seal in shallow wells. Pellets were allowed to hydrate for at least 30 minutes prior to completing well construction. The borehole annulus for intermediate and deep wells was sealed using either a high-solids bentonite grout (American Colloid Pure Gold grout) and/or bentonite pellets. The annulus space grout seal was installed using a tremie pipe with side discharges to prevent grout injection into the sandpack. Pure Gold grout was mixed to a density of 10.2 pounds per gallon (American Colloid density specification) and checked in the field using a mud balance. As conditions dictated, the annulus seal for intermediate and deep wells was constructed using bentonite chips in conjunction with Pure Gold grout. The surface of each well was finished using bentonite chips (as required) and a concrete surface seal. Locking steel monuments were set in the surface seal and a concrete pad was constructed around each well at ground surface to divert rainfall away from the well casing. In accordance with WAC 173-160, three steel pipes were set in concrete around each wellhead for protection.

The elevation (top of well casing and ground surface) and location coordinates of each well were surveyed by the Port of Tacoma Engineering Department. The elevation is reported as Port of Tacoma Datum (MLLW). These data are presented in Table A-1.

Residual soil cuttings and water generated from drilling activities were contained in Department of Transportation approved steel barrels (DOT 17H) and stored at a secured area onsite.

Well Development

Development was accomplished after monitoring wells were allowed to settle for a minimum of 24 hours. Wells were developed to remove sediment introduced during installation activities, and to establish hydraulic continuity between the filter pack and the formation. A centrifugal pump was used to purge water from the screen interval. Pumping continued until the wells were visibly free of sediments and the turbidity of the discharge water was low. Development water was contained in Department of Transportation approved steel barrels (DOT 17E) and stored at a secured area onsite.

GROUNDWATER SAMPLING AND SAMPLE HANDLING

Sample Collection

Each monitoring well was sampled in December 1989 and January 1990 using a non-dedicated bladder pump, except Well BW-4S which was sampled with a peristaltic pump. Seven monitoring wells in the intermediate and deep aquifer were sampled in July and August 1990. Water level was measured from the top of the PVC casing prior to sampling the well and

measurements were recorded to the nearest 0.01 ft. Each well was purged with a bladder pump or peristaltic pump until at least three well volumes had been removed.

Sample containers were filled directly from the pump discharge into the appropriate sample container immediately following purging. Samples collected for metals analysis were field-filtered using a 0.45 µm in-line filter attached to the pump discharge. The sample from Well BW-4S was collected with the peristaltic pump, except for the volatile organics sample which was collected with a polyethylene disposable bailer. Volatile organics sample containers were filled with no headspace remaining.

Conductivity, pH, and temperature were measured during sample collection. These measurements are summarized in Table A-2. The conductivity and pH meters were calibrated, following procedures provided with the instrument, prior to commencement of sampling and at least once every four hours during sampling. Calibration adjustments were recorded in a log book maintained for each meter. Four replicate field measurements were made using the following procedures:

- Rinse a 250 ml plastic beaker three times with sample water.
- Rinse the electrode, dip cell, and temperature compensation probe by storing them in sample water for at least one minute.
- Set the automatic temperature compensator to the "on" position.
- Fill the beaker with sample water; set the probes in the beaker until the reading stabilizes. Read temperature, pH, and conductivity measurements and record on the Sample Collection Form.
- Measure and record three additional replicates by repeating the last step.
- Note any problems or significant observations in the "comments" section of the Sample Collection Form.

Sample Documentation and Handling

Relevant information relating to field activities and sampling was documented on the appropriate form and in a bound field notebook. Sample labels, attached to each sample container, were completed with project name, sample number, location, date, time, and identity of sampling personnel. A Sample Collection Form was completed at the time of sampling to document the sample. In addition, each sample was recorded on the Chain-of-Custody Record and the Sample Analysis Request Packing List which accompanied the sample during collection, transfer, analysis, and storage.

Samples were placed on ice in coolers and transported to the testing laboratory by a member of the sampling team at the end of each working day. The Chain-of-Custody record and Sample Analysis Request Packing List accompanied each day's samples to the laboratory.

Equipment Decontamination

Equipment used for sampling was appropriately decontaminated prior to and after each use to minimize the possibility of cross-contaminating samples. Decontamination of non-dedicated sampling equipment consisted of the following steps:

- Flush pump and tubing with Alconox soap and water
- Wash exterior of pump and tubing with Alconox soap and water
- Flush pump and tubing with drinking water
- Rinse exterior of pump and tubing with drinking water
- Flush pump and tubing with deionized water
- Rinse exterior of pump and tubing with deionized water.

Water used during decontamination was discharged to the ground.

Tidal Influence Measurements

Staff gauges were installed in the Blair Waterway near the southeast corner of the site and in the Graving Dock near its northwest corner.

Measurements of groundwater elevations in wells were collected on February 2, 1990, between approximately 8:00 a.m. and 6:00 p.m., to identify the influences to groundwater elevations of tidal changes. High tide occurred at approximately 9:10 a.m. and low tide, at approximately 4:30 p.m. The specific data for wells installed for this investigation are presented in Table A-3. Water level measurements at high, mid, and low tide are summarized in Table A-4. Concurrently, CH2M Hill measured the RCI wells on the property. These results are presented in Table A-5. Data from Table A-3 for each well is presented graphically, along with a reference curve of tidal elevation in the Blair Waterway, on Figures A-21 and A-30. The tidal response of water in the Graving Dock is summarized in Table A-3 and shown graphically on Figure A-31.

SURFACE SOIL, DITCH SEDIMENT, AND PRECIPITATE SAMPLING PROCEDURES

Surface soil samples for chemical analysis were collected at the Blair Waterway Property from backhoe explorations at the drum storage area, the outlet fill area, the fueling area, adjacent to the railroad right-of-way, and from six other explorations. Seventeen shallow test pits were excavated to identify the approximate extent and thickness of buried slag in the central portion of the Property and along the Graving Dock sides. Four additional deep test pits (BOLD-1, -2, -2A, and -3) were excavated in July and August 1990 to sample the buried ditch sediment horizon on the old Lincoln Avenue Ditch alignment. Ditch sediment samples were collected at the Mud Lake outfall and spillway, the Lincoln Avenue Ditch, the Domtar Boundary Ditch, and the Weyerhaeuser Boundary Ditch. One precipitate sample was collected from the

Domtar Boundary Ditch in December 1989 and January 1990. Four additional samples were collected from the Lincoln Avenue Ditch, and two slag samples were collected during additional activities in July and August 1990. The locations and ground surface elevations were established by survey as summarized in Tables A-6 and A-7, and the exploration locations are shown on Report Figures 5 and 6. Logs of backhoe explorations (Test Pit Logs) are presented in Table A-8.

Soil and Ditch Sediment

Tractor-mounted backhoe equipment was used to excavate for surface soil and test pit explorations. Soil samples were collected from the sidewalls of the backhoe test pits and were composited from approximately the upper 2 ft of the excavation. Ditch sediment samples were collected from the ditch bottom and consisted of the upper 1 ft of sediment. Ditch sediment samples from the sediment horizon of the former Lincoln Avenue Ditch were collected from below approximately 12 ft of fill material; this sediment averaged 2-3 inches in thickness. Soil and ditch sediment samples to be analyzed for volatile organic compounds were collected by stripping away soil exposed to the atmosphere, and sampling undisturbed soil with a clean stainless-steel spoon. The soil or sediment was immediately placed in a small (2 oz.) jar, which was completely filled. The sample container rim was wiped with clean, unscented, undyed tissue paper before tightening the lid.

Soil or sediment samples for other chemical analyses were collected by sampling undisturbed soil with a clean stainless-steel spoon, and placing the soil or sediment into a large stainless-steel bowl where it was thoroughly homogenized prior to filling sample containers.

Precipitate Associated with Drainageway

Precipitate samples were collected using a clean stainless-steel spoon to lift the precipitate from the sediment and deposit it directly into the sample containers. The sample container rim was wiped with a clean, unscented, undyed tissue paper before tightening the lid.

Diving Inspection of the Graving Dock Bottom

An inspection of the bottom of the (flooded) Graving Dock was accomplished by Underwater Specialists, Inc., under contract to Landau Associates, on July 15, 1991. The purpose of the inspection was to identify whether slag was present on the bottom of the Graving Dock. A "hard hat" diver, tended by a surface launch, accomplished the inspection. A Landau Associates' representative documented activities and evaluated samples.

Prior to the inspection, Stations 1 through 9 (Figure 6) were located between concrete pads (shown on construction design plans) in an attempt to sample soil exposed between pads.

Locations of these stations were marked on opposite sides of the Graving Dock, for visual reference by the boat crew. Additional Stations 10 through 12 were added during the activity to complete the inspection and collect samples of bottom material for chemical analysis (Stations BG-11 and BG-12; Figure 6).

The diving inspection included: 1) visiting Stations 1 through 9 to collect samples of bottom material; and 2) excavating approximately 1-2 ft into material at two stations (Stations 1 and 10), using water jet equipment, to collect additional samples for examination by the Landau Associates' representative. Samples were collected because the visibility in the Graving Dock water was poor, preventing in-place examination.

Concrete surfacing was present at Stations 2, 3, 4, 5, 6, 8, 9, and 11, suggesting that surfacing may be more extensive than indicated by design plans. Brown, coarse sand and gravel fill, or fine, gray native sand, was present on the bottom where concrete was not present. No investigation for slag was accomplished beneath the concrete surfacing. Slag was identified only at Station 9, near the side slope at the eastern corner of the Graving Dock, where it had apparently spilled.

A thin (6-inch) layer of dark colored, loose material with abundant organic debris was present at most stations at the bottom of the Graving Dock. Samples of this material were collected at Stations 11 and 12 (Samples BG-11 and BG-12). During inspection activities, the thin layer of dark colored material was disturbed and became suspended in the water. A small, oily sheen was noted on the water surface when the material at Station 4 was inspected.

The dark, organic, bottom material, had a slight oily or phenolic sheen, and a slight to moderate smell of hydrogen sulfide, suggesting reducing conditions in the bottom material. The brass fittings on the diver's equipment turned black during the 3- to 4-hour inspection. The blackened brass may be due to precipitation of a mineral onto the brass, such as a metal sulfide, which also suggests reducing conditions at the bottom of the Graving Dock.

Representative samples of material from the Graving Dock bottom stations were placed in new, 1-quart plastic containers; sealed, iced, transported to Landau Associates' facilities, and examined. Following the examination and discussions with Port representatives, analysis of the dark organic-rich material was authorized and accomplished. All samples obtained for inspection purposes were returned to the Graving Dock area of the site.

Sample Documentation and Handling

Relevant information relating to field activities and sampling was documented on the appropriate form and in a bound field notebook. Sample labels, attached to each sample container, were completed with project name, sample number, location, date, time, and identity of sampling personnel. A Sample Collection Form was completed at the time of sampling to

document the sample. In addition, each sample was recorded on the Chain-of-Custody Record and the Sample Analysis Request Packing List which accompanied the sample during collection, transfer, analysis, and storage.

Samples were placed on ice in coolers and transported to the testing laboratory by a member of the sampling team at the end of each working day. The Chain-of-Custody record and Sample Analysis Request Packing List accompanied each day's samples to the laboratory.

Equipment Decontamination

Equipment used for sampling was appropriately decontaminated prior to and after each use to minimize the possibility of cross-contaminating samples. Decontamination of sampling equipment consisted of the following steps:

- Wash with Alconox soap and water
- Rinse with drinking water
- Rinse with deionized water

Decontamination water was discharged to the ground.

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS[2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than #200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on #4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly-graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/silt mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through #4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly-graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than #200 sieve size)	SILT AND CLAY (Liquid Limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty- or clayey-fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid Limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand or silty soil
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
HIGHLY ORGANIC SOIL				PT	Peat; humus; swamp soil with high organic content

Notes:
1. Dual letter symbols (i.e., SM-SP) for a sand or gravel indicate a soil with an estimated 5-15% fines. Multiple letter symbols (i.e., ML/CL) indicates borderline or multiple soil classifications. Only the first letter symbol's respective pattern is shown on logs.
2. Soil descriptions shown on logs use the terminology and general approach for the *Visual-Manual Procedure, Description and Identification of Soils*, as outlined in ASTM D 2488.
3. Soil descriptions (which are based on estimated values) are as follows: Primary Soil Type(s) - i.e., "GRAVEL", "SAND", "SILT", "CLAY", etc.
   Secondary Soil Type(s) (>15%) - i.e., "gravelly", "sandy", "clayey", etc.
   Modifier(s) (>5% and ≤15%) - i.e., "with gravel", "with sand", "with clay", etc.
   Minor Component(s) (≤5%) - i.e., "trace gravel", "trace sand", "trace clay", etc.

KEY

Blows Required to Drive a 2.42-in. I.D. Split Spoon Sampler 1 Foot

23(a) ← Indicates Hammer Weight and Drop (Note 1)

■ ← Indicates Undisturbed Sample

☒ ← Indicates Disturbed Sample

□ ← Indicates Sample Attempt with No Recovery

ATD ▽ ← Indicates Approximate Water Elevation at Time of Drilling

Notes: 1) (a) 140-lb. Hammer - 30-in. Drop

(b) 300-lb. Hammer - 30-in. Drop

(c) Grab Sample

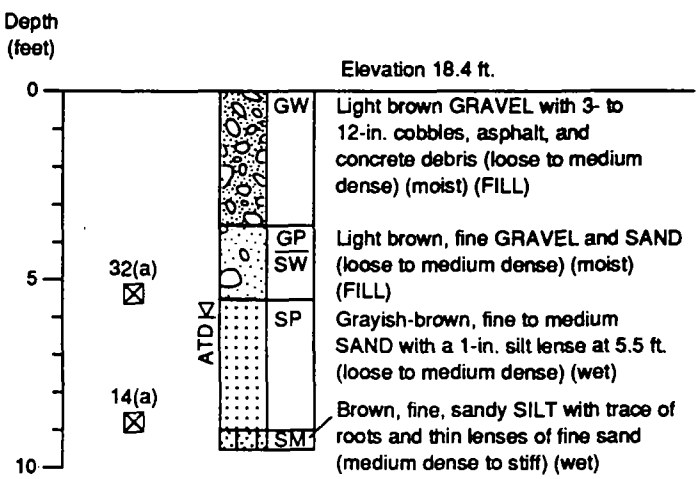
2) Datum: Port of Tacoma (Mean Lower Low Water)

LANDAU ASSOCIATES, INC.	Key to Soil Profiles

Figure A-2

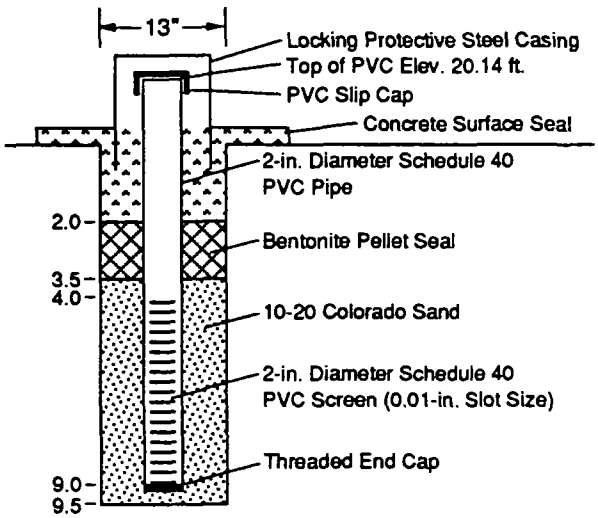
Well BW-1s

Soil Profile



Boring Completed 12/1/89
Total Depth 9.5 Feet

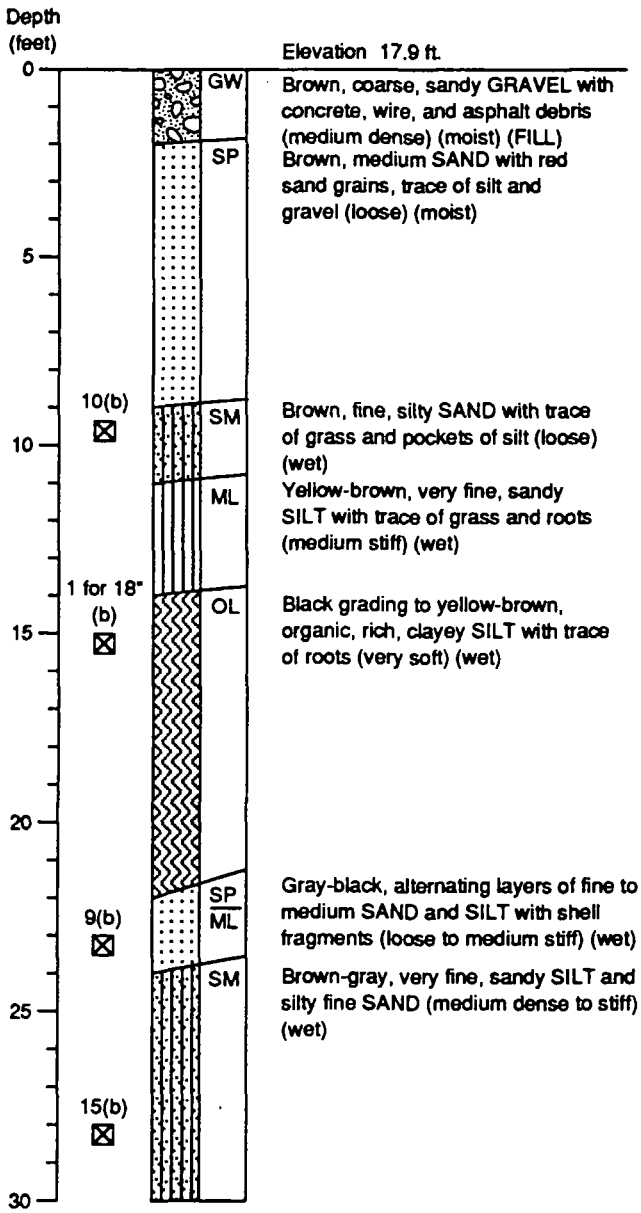
Well Detail



LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-1s

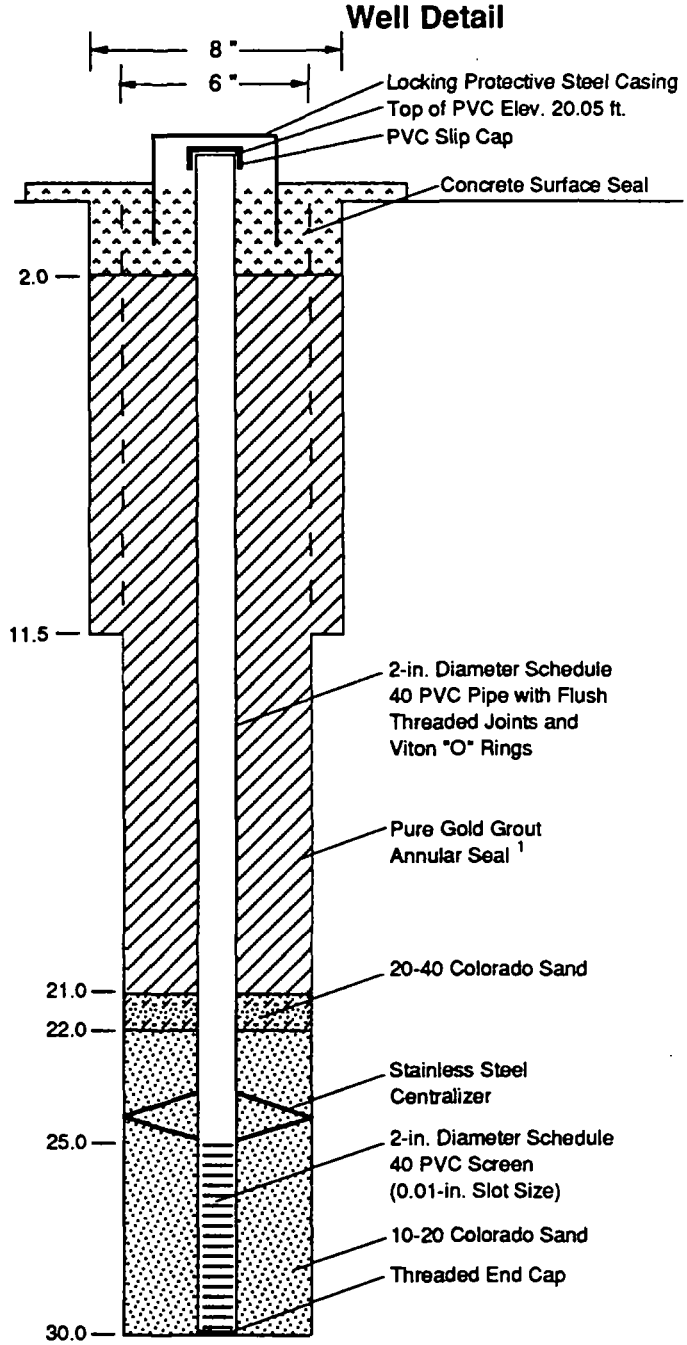
Well BW-1i

Soil Profile



Boring Completed 12-21-89
Total Depth of 30 Feet

Well Detail

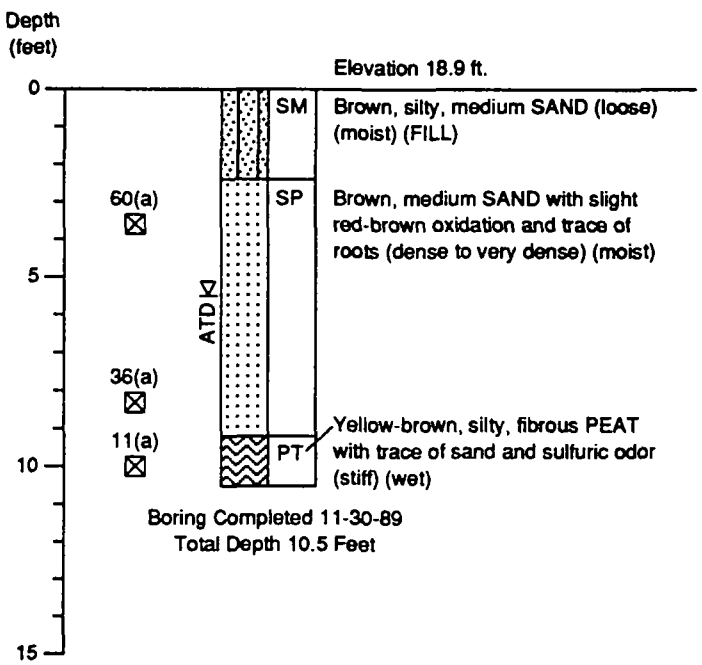


Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

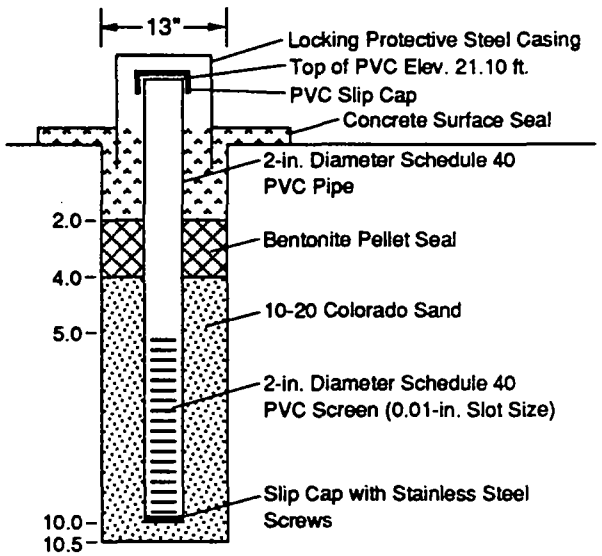
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-1i

Well BW-2s

Soil Profile



Well Detail



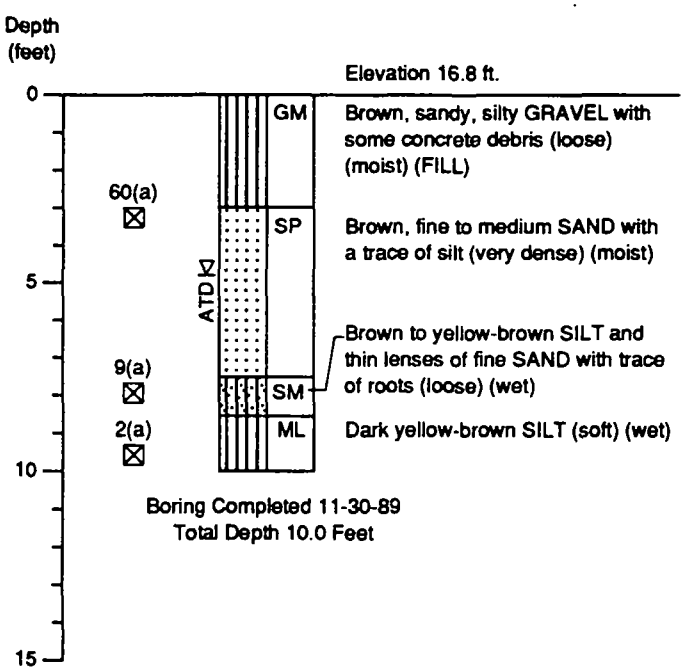
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-2s

Figure A-5

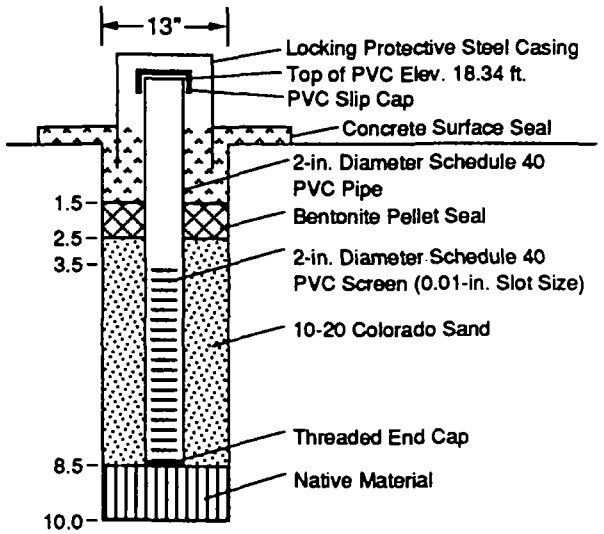
118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92

Well BW-3s

Soil Profile



Well Detail

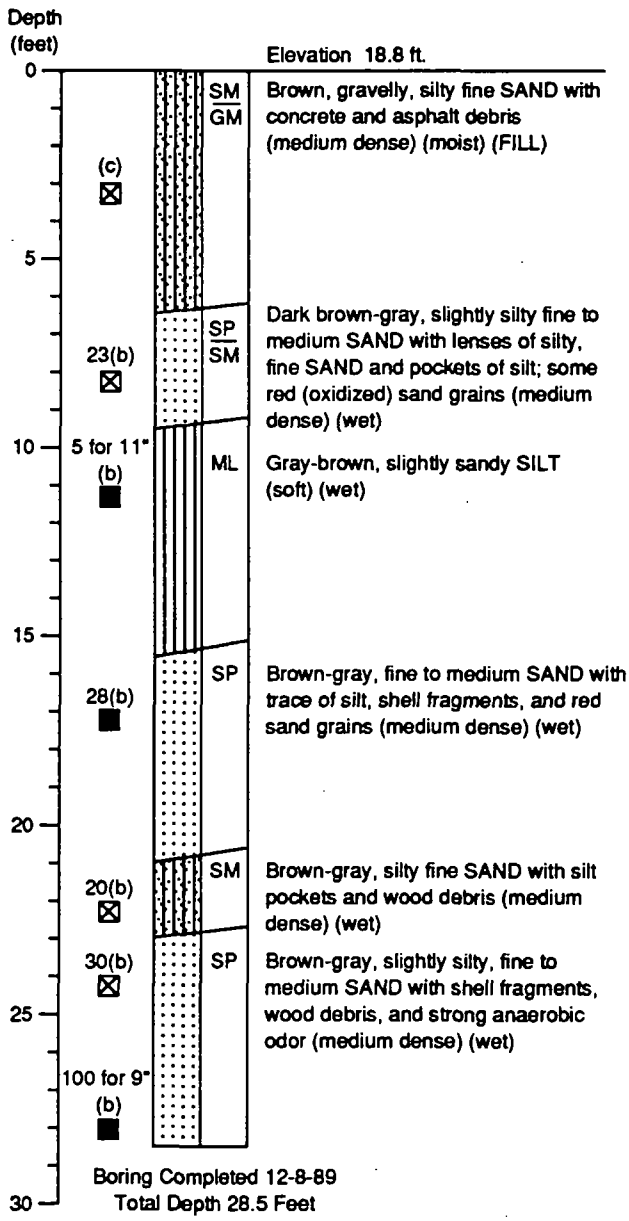


LANDAU ASSOCIATES, INC.	Soil Profile and Well Details for Well BW-3s

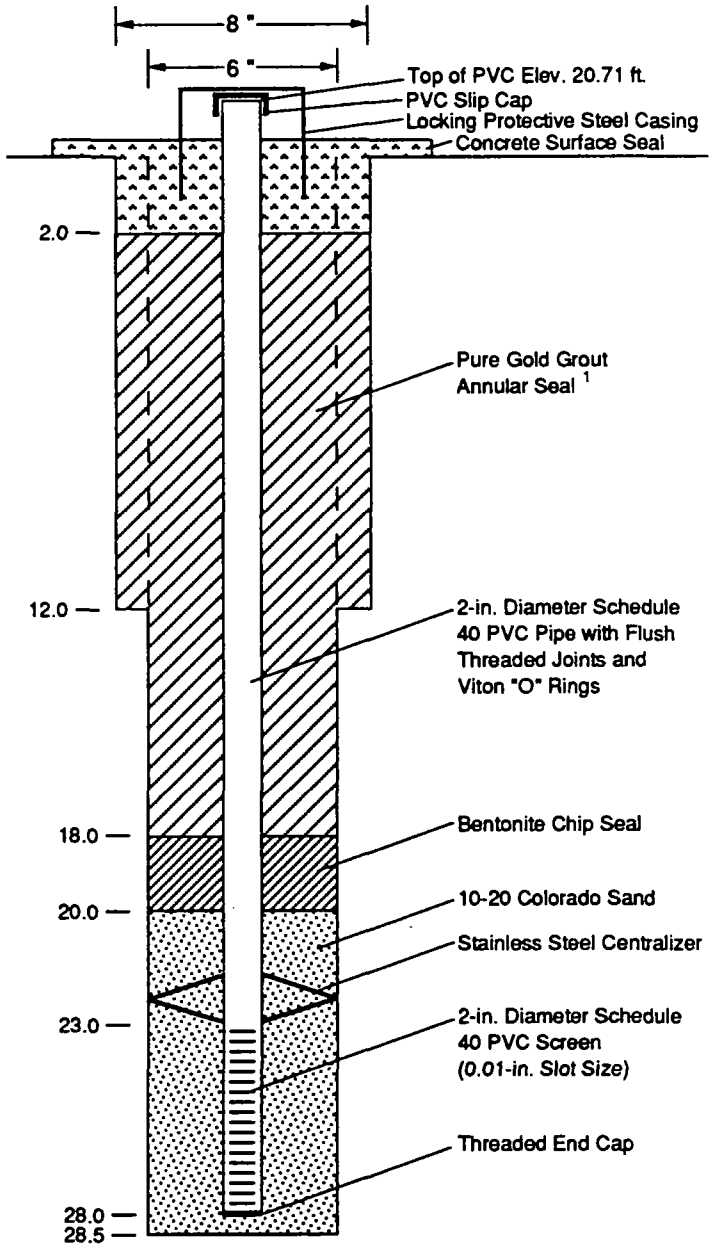
Figure A-6

Well BW-3i

Soil Profile



Well Detail

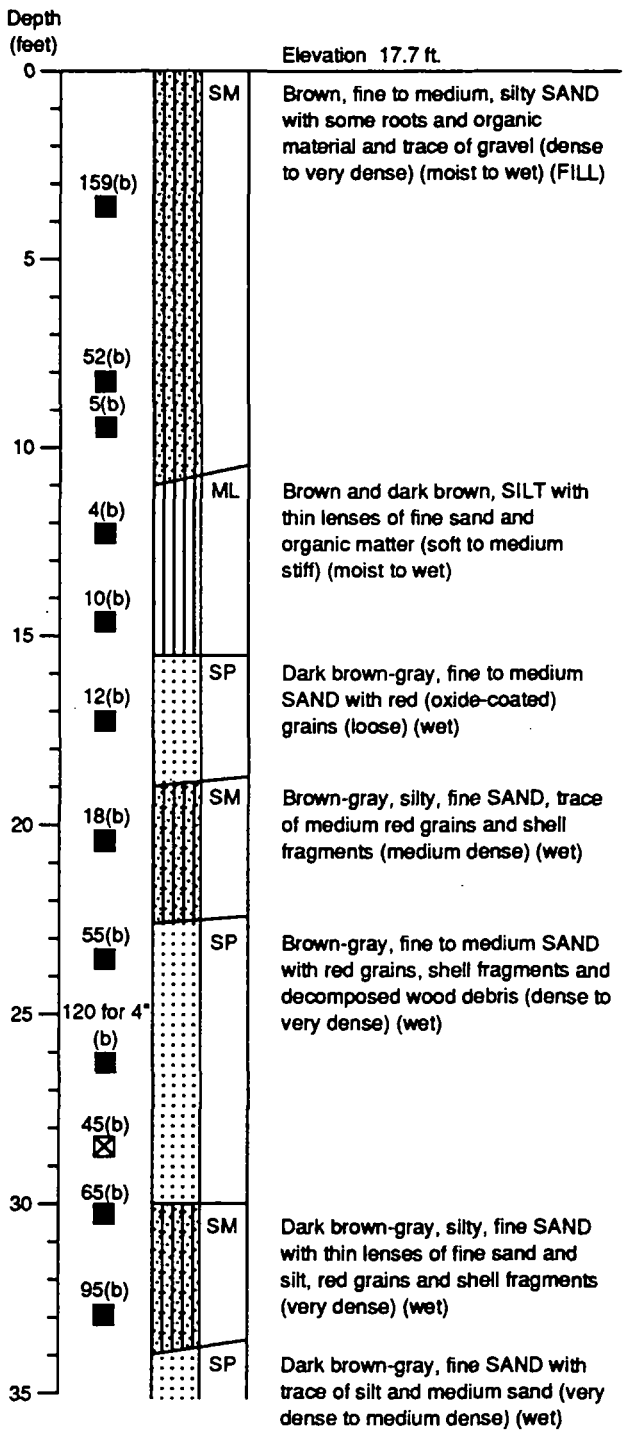


Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-3i

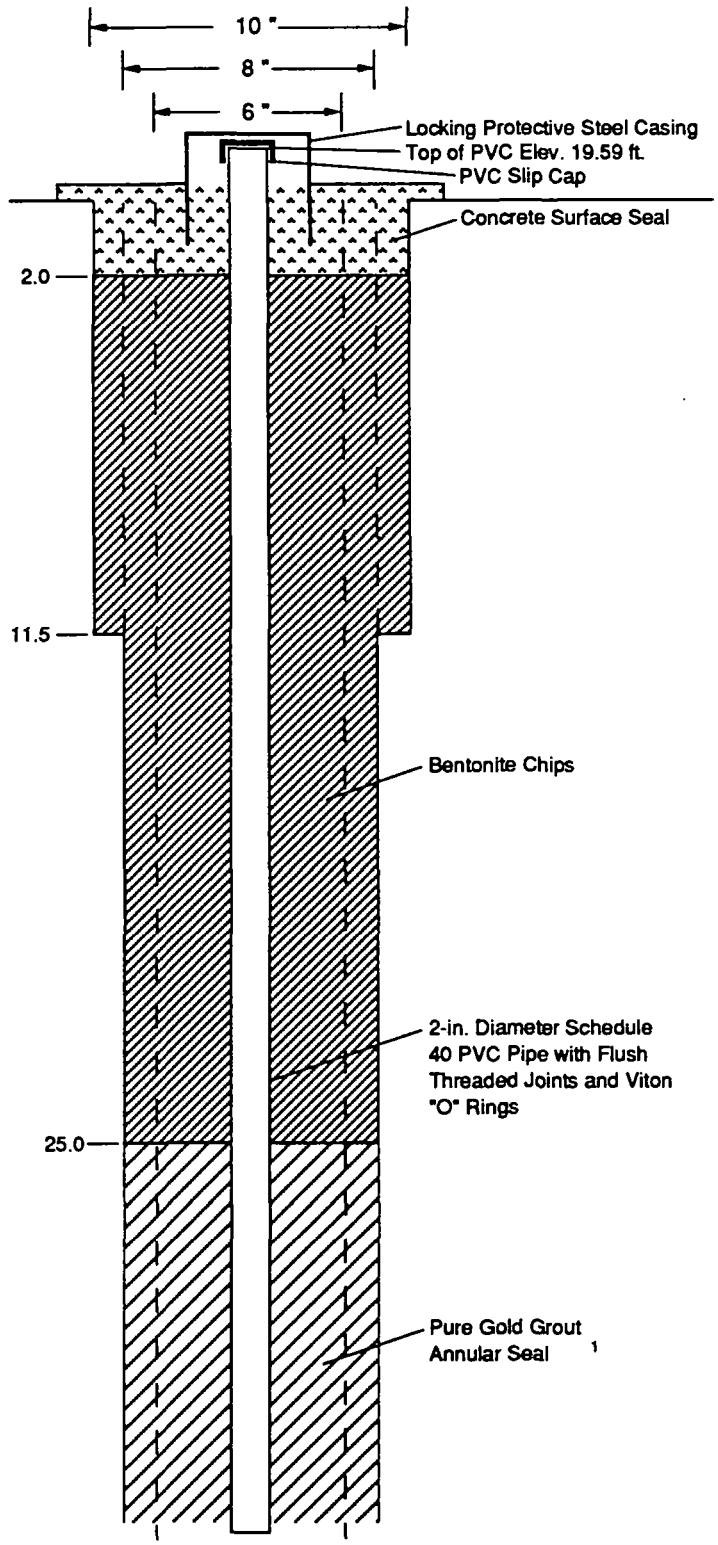
Well BW-3d

Soil Profile



(Continued Next Page)

Well Detail

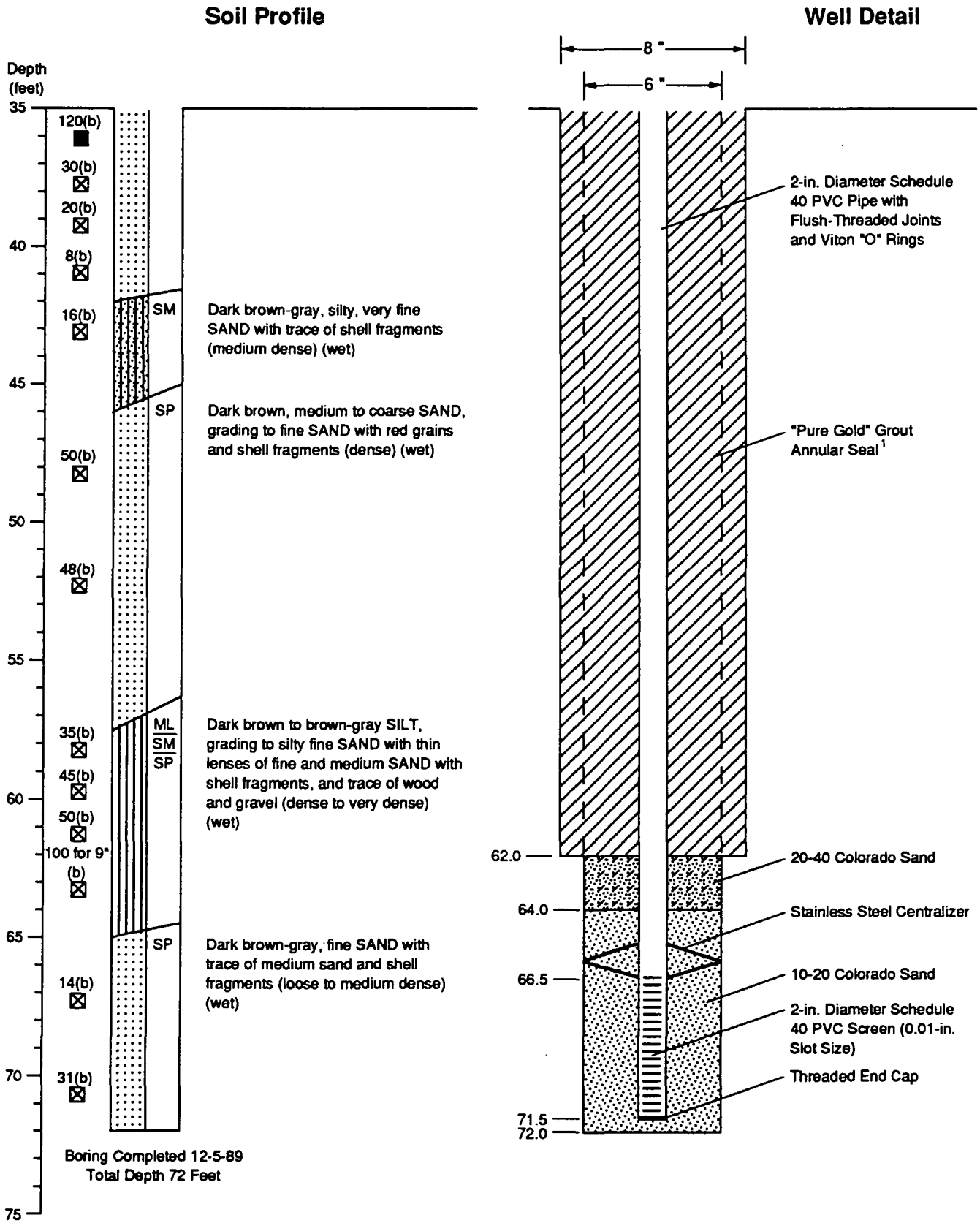


(Continued Next Page)

Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-3d

Well BW-3d
(Continued)



LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-3d (Continued)

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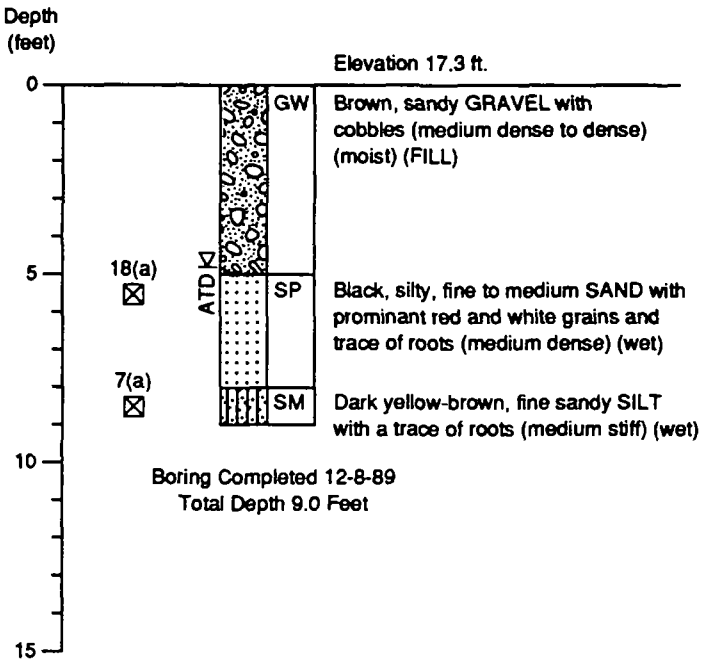
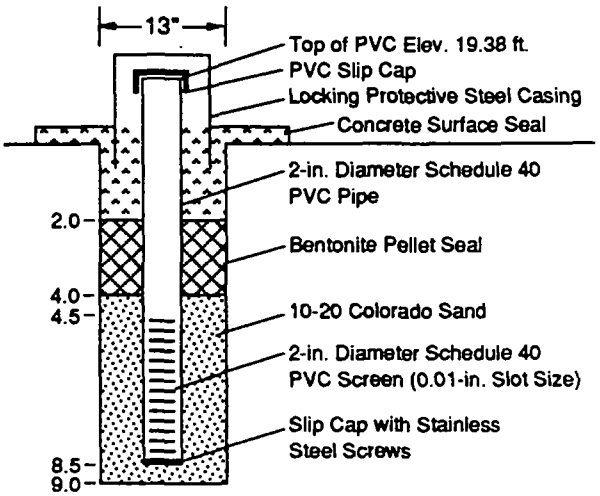
Figure A-8 (2 of 2)

Well BW-4s

Soil Profile



Well Detail



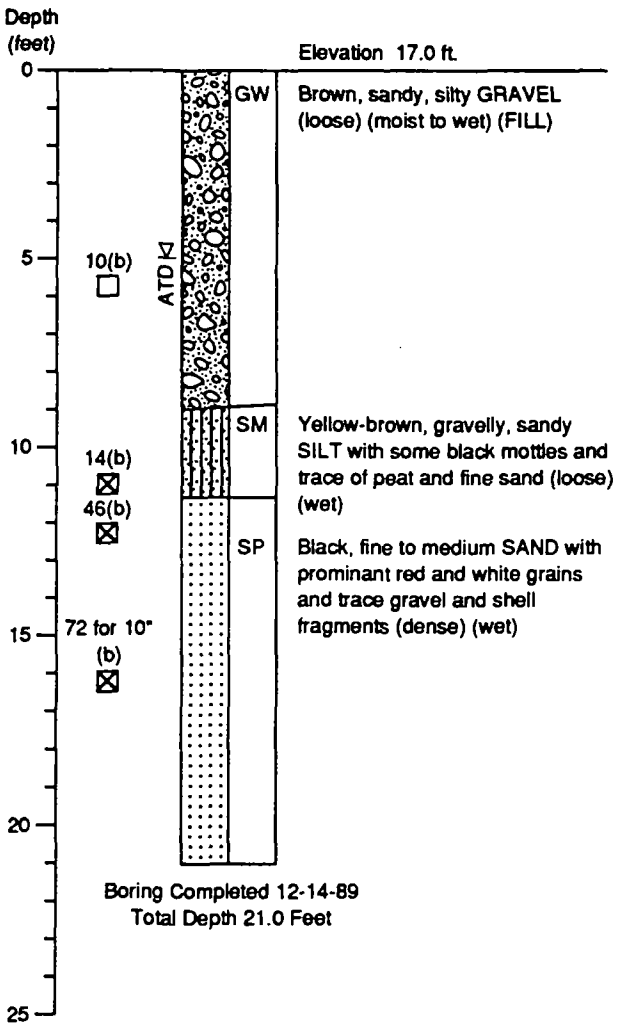
LANDAU ASSOCIATES, INC.	Soil Profile and Well Details for Well BW-4s

Figure A-9

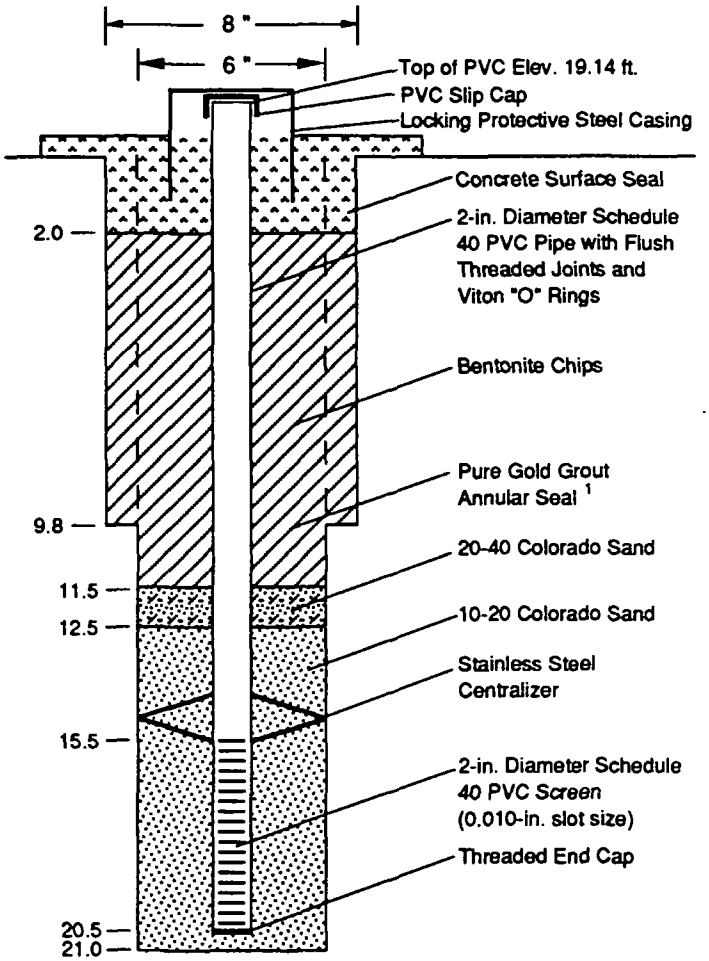
118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92

Well BW-4i

Soil Profile



Well Detail

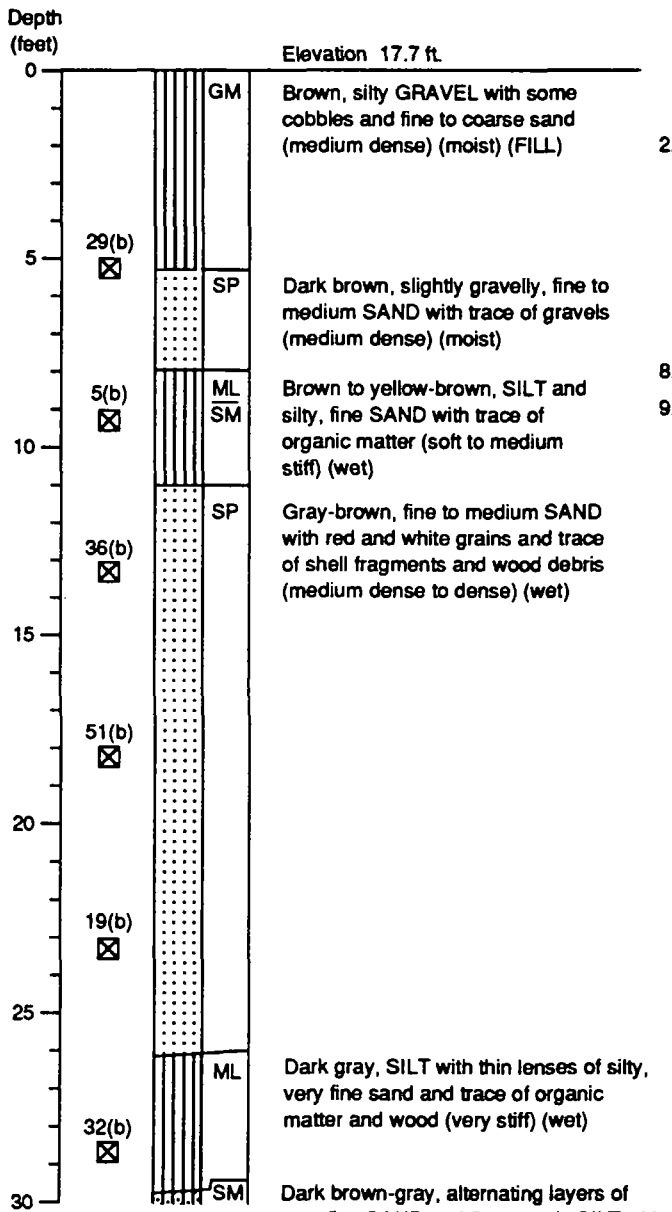


Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-4i

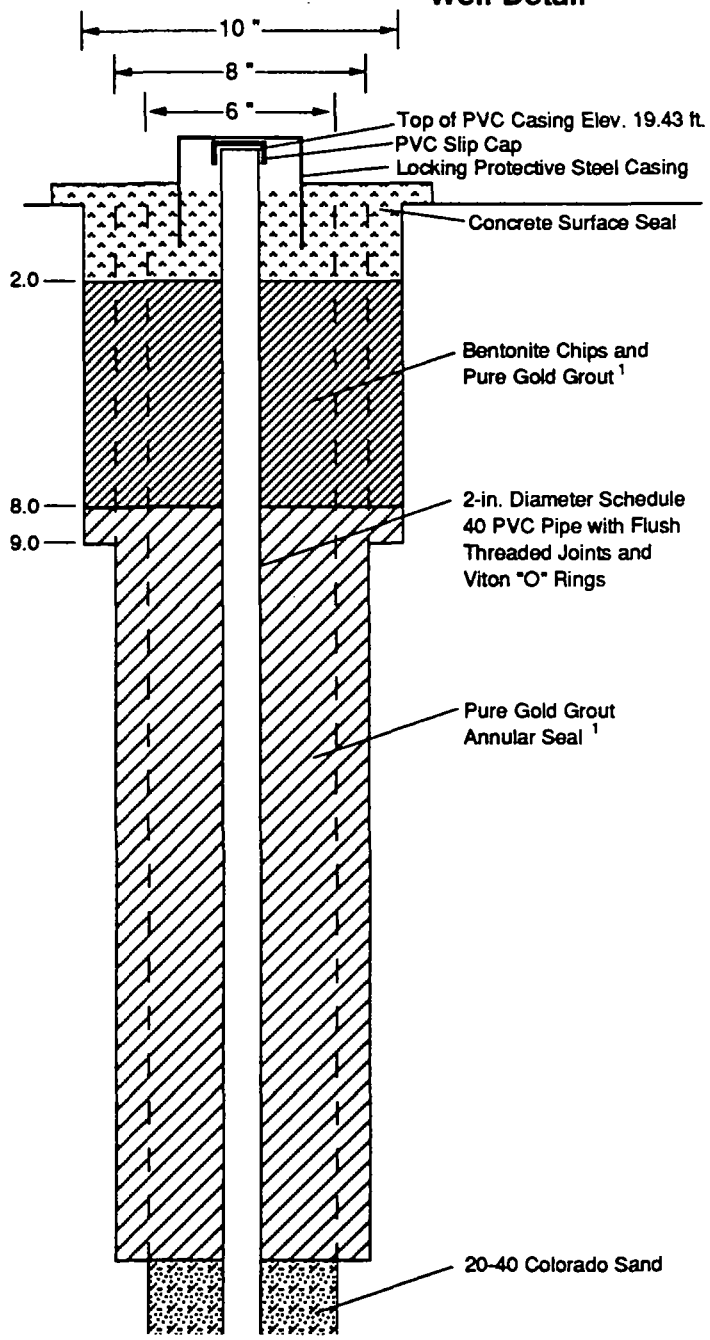
Well BW-4d

Soil Profile



(Continued Next Page)

Well Detail



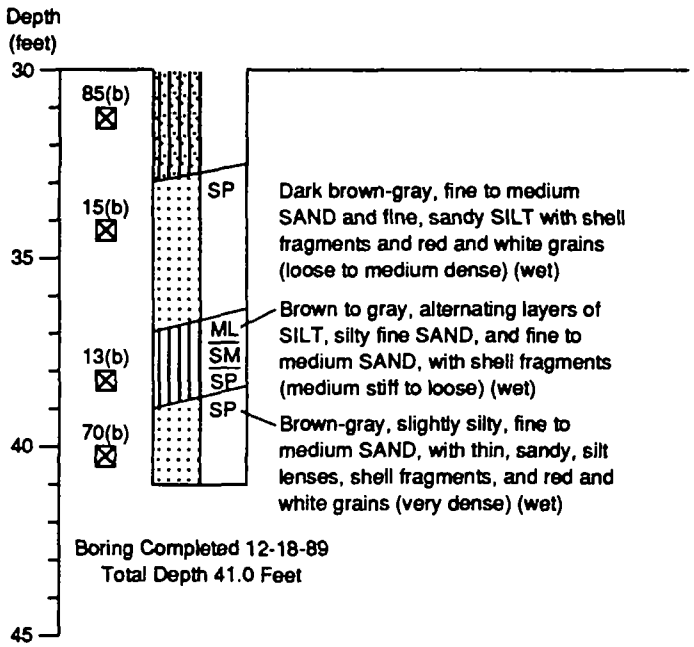
(Continued Next Page)

Note: [1] Pure Gold Grout is manufactured by American Colloid Company.

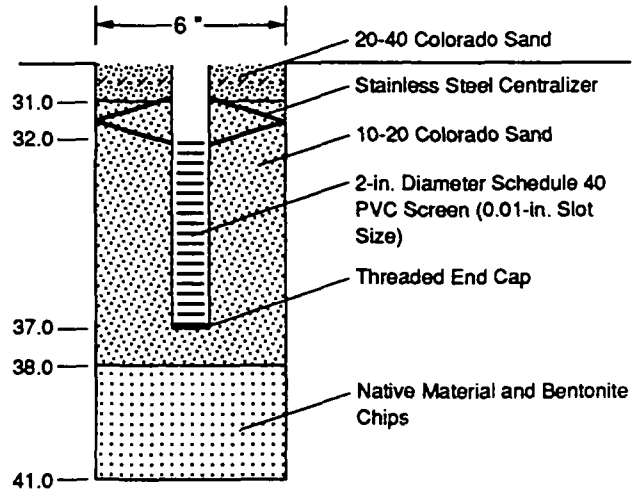
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-4d

Well BW-4d
(Continued)

Soil Profile



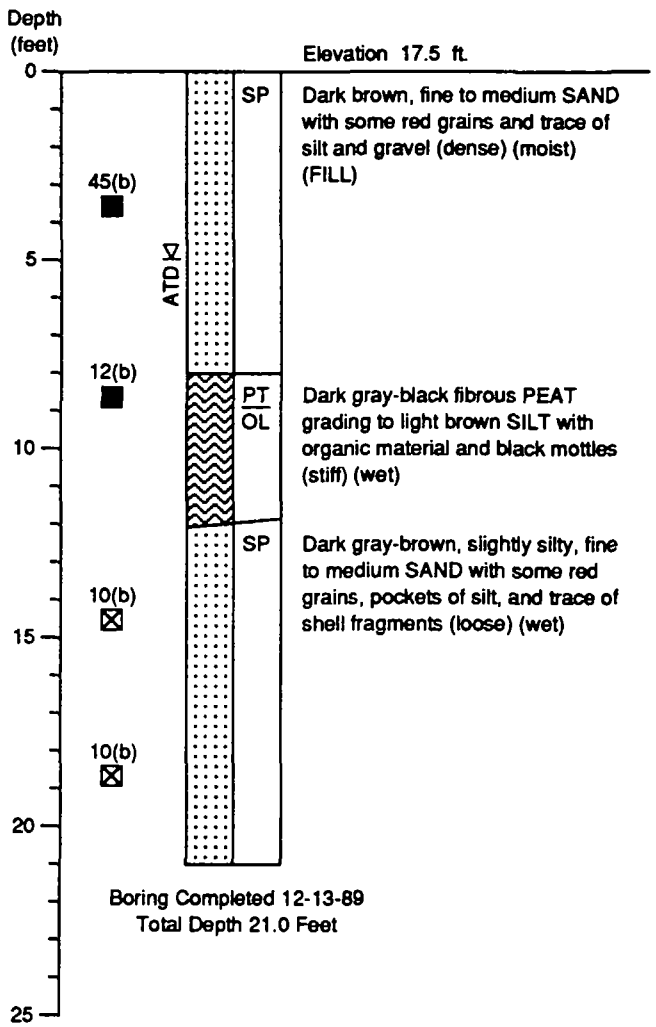
Well Detail



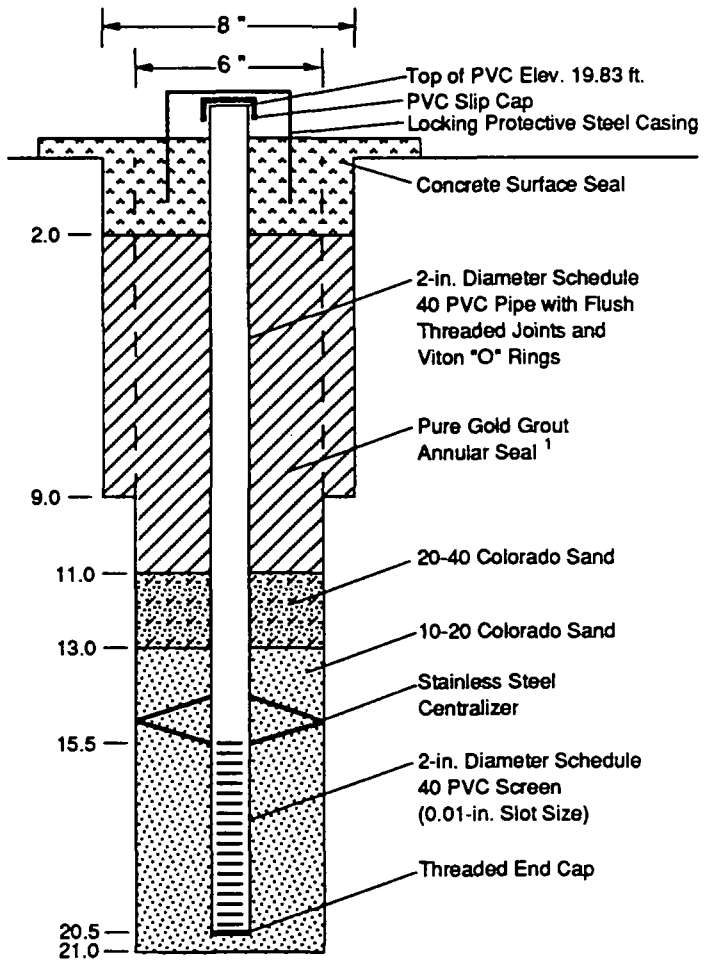
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-4d (Continued)

Well BW-5i

Soil Profile



Well Detail

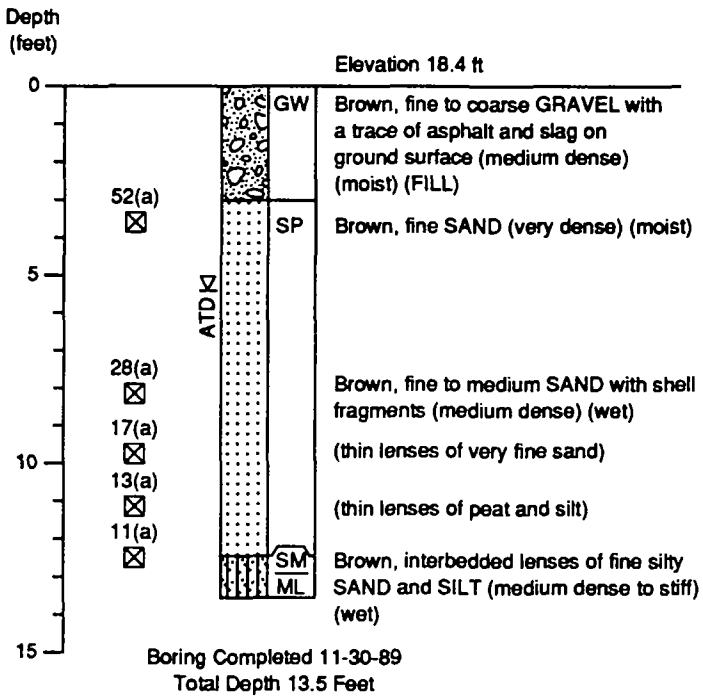


Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

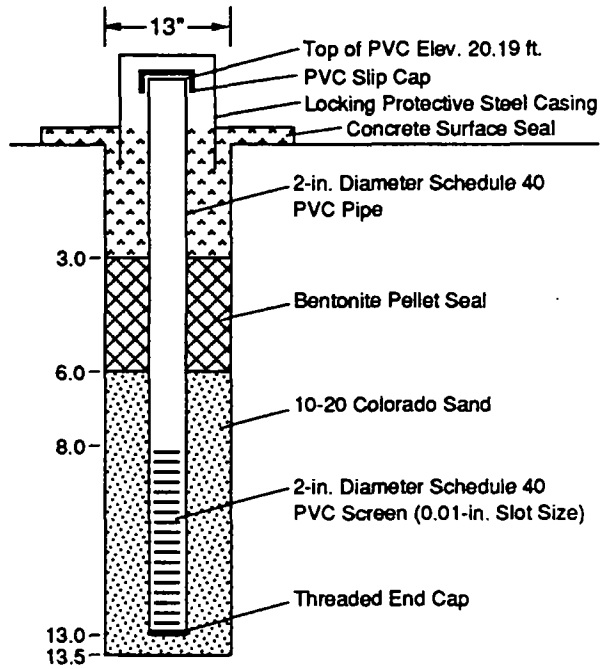
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-5i

Well BW-6s

Soil Profile



Well Detail

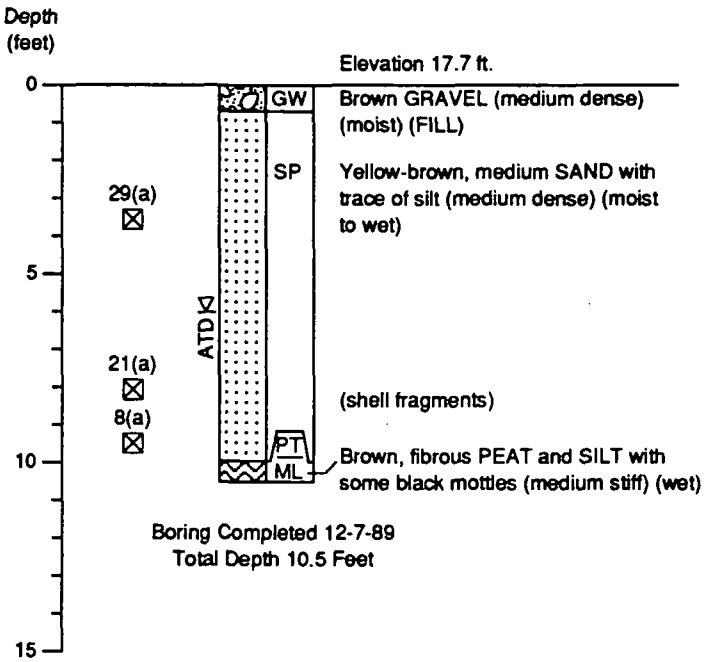


LANDAU ASSOCIATES, INC.	Soil Profile and Well Details for Well BW-6s

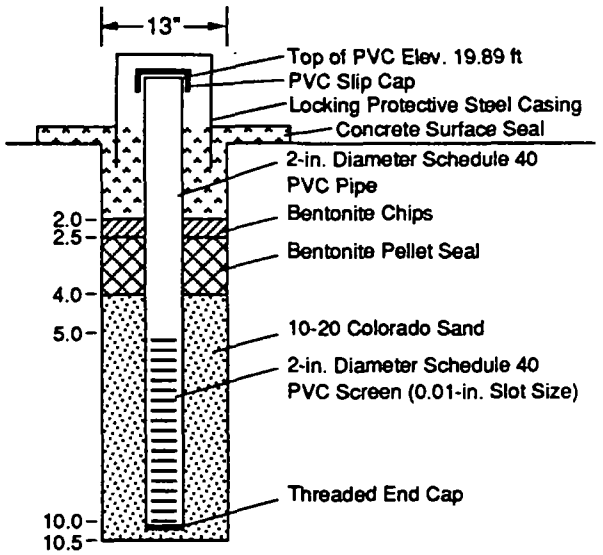
Figure A-13

Well BW-7s

Soil Profile



Well Detail

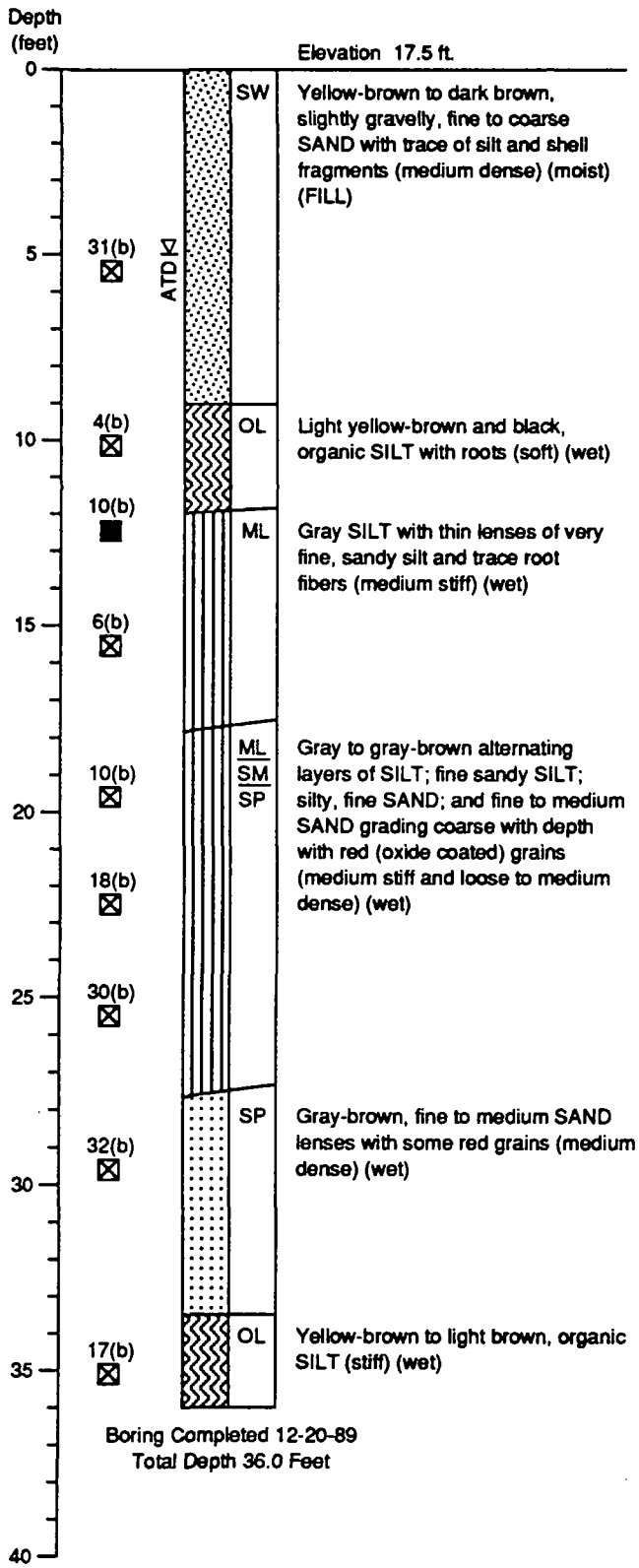


LANDAU ASSOCIATES, INC.	Soil Profile and Well Details for Well BW-7s

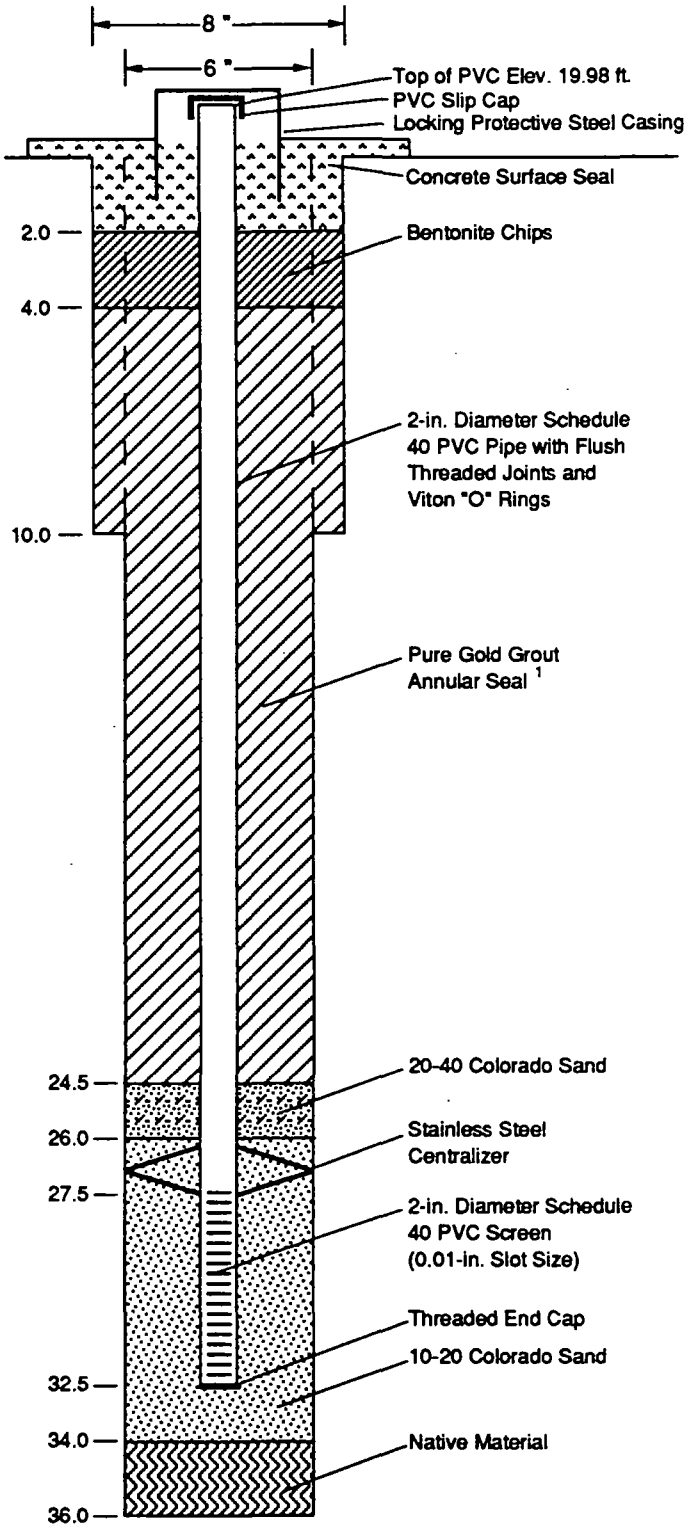
Figure A-14

Well BW-7i

Soil Profile



Well Detail



Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

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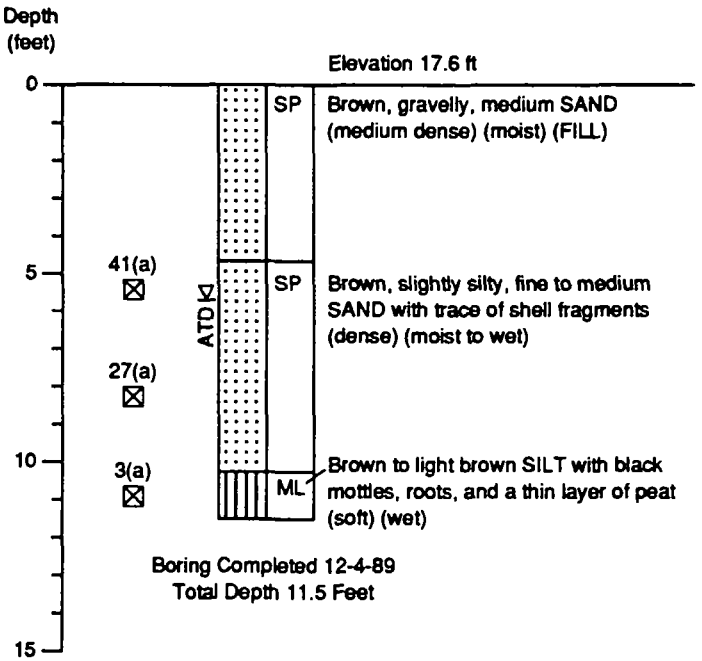
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-7i

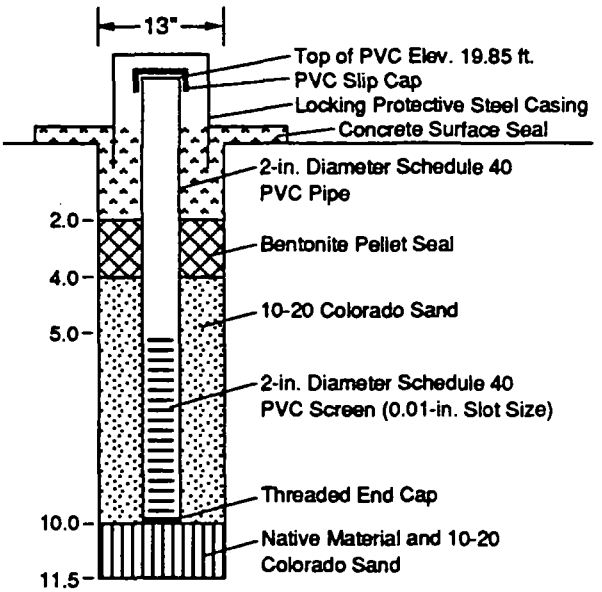
Figure A-15

Well BW-8s

Soil Profile



Well Detail

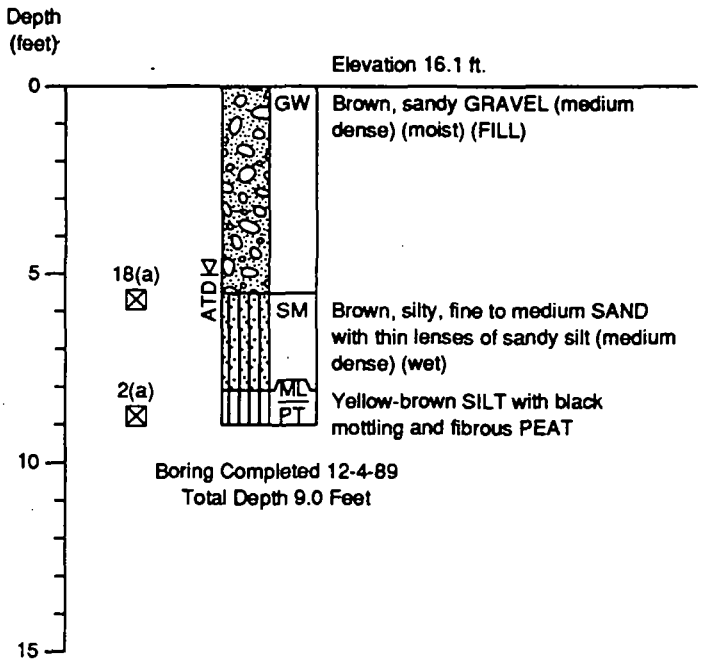


LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-8s

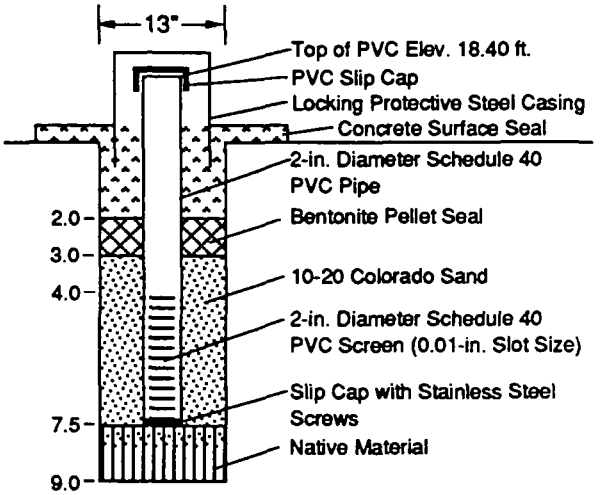
Figure A-16

Well BW-9s

Soil Profile



Well Detail

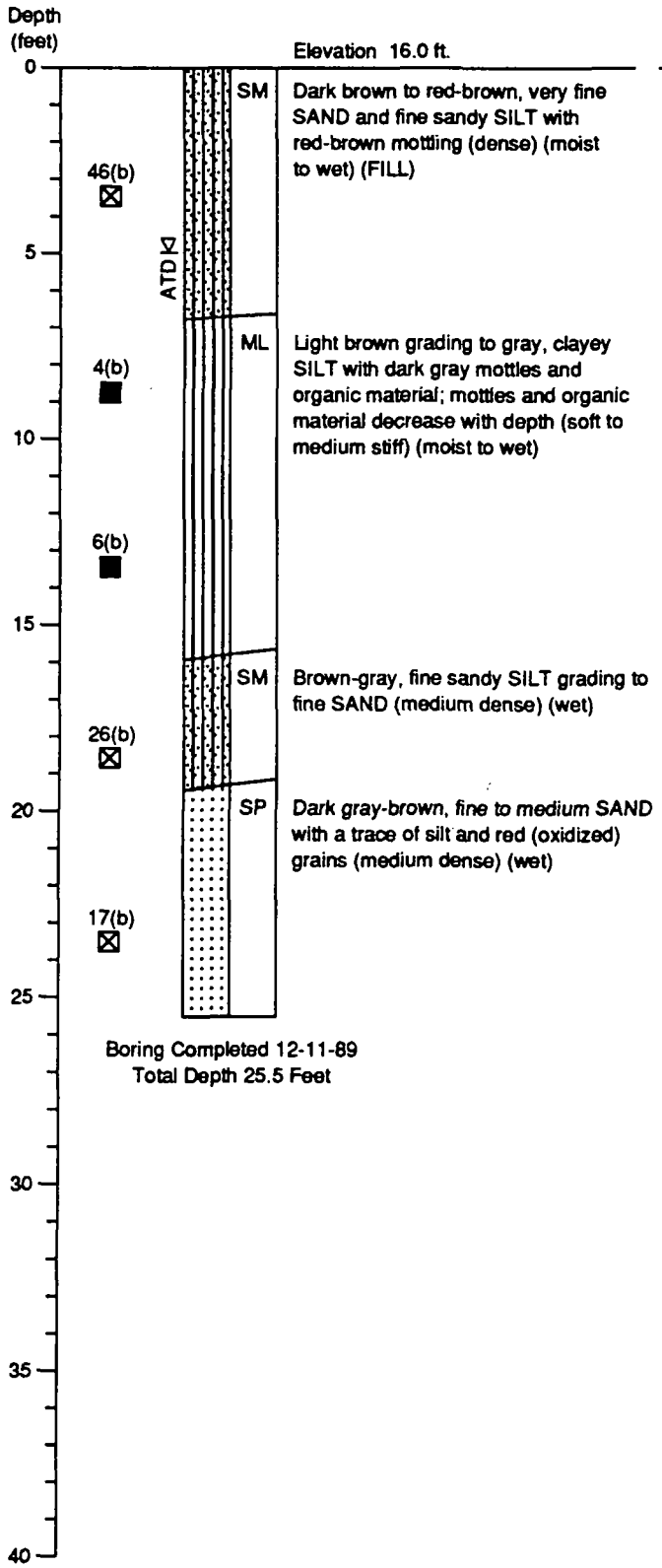


LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-9s

Figure A-17

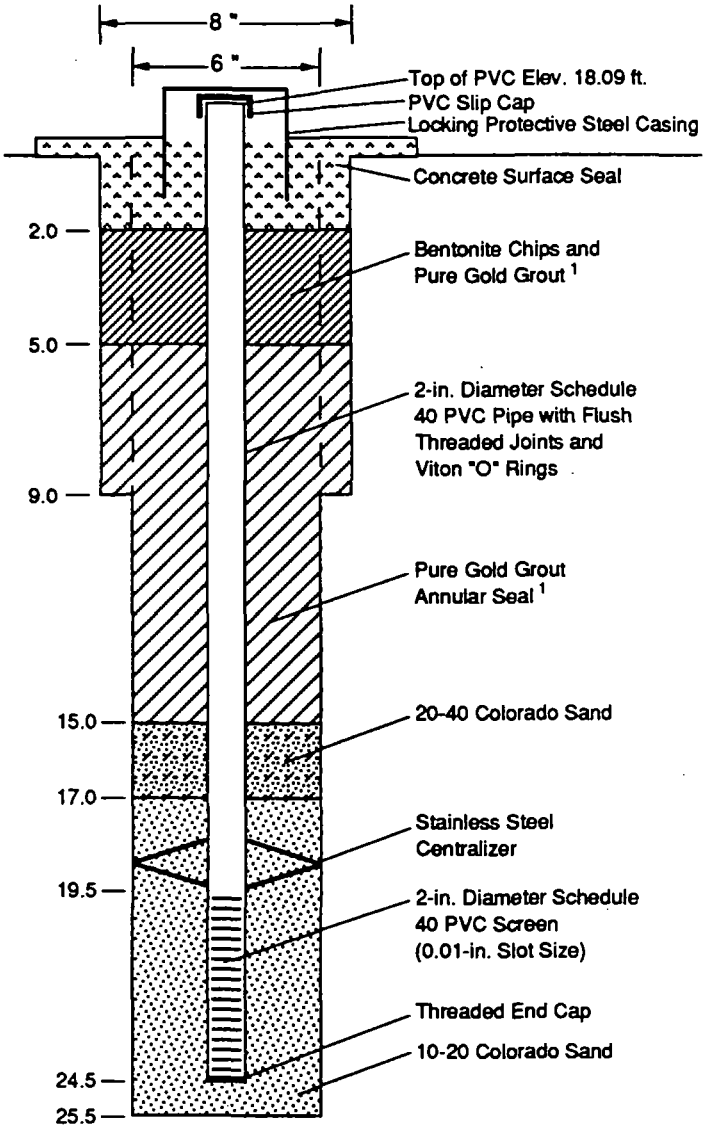
Well BW-9i

Soil Profile



Boring Completed 12-11-89
Total Depth 25.5 Feet

Well Detail



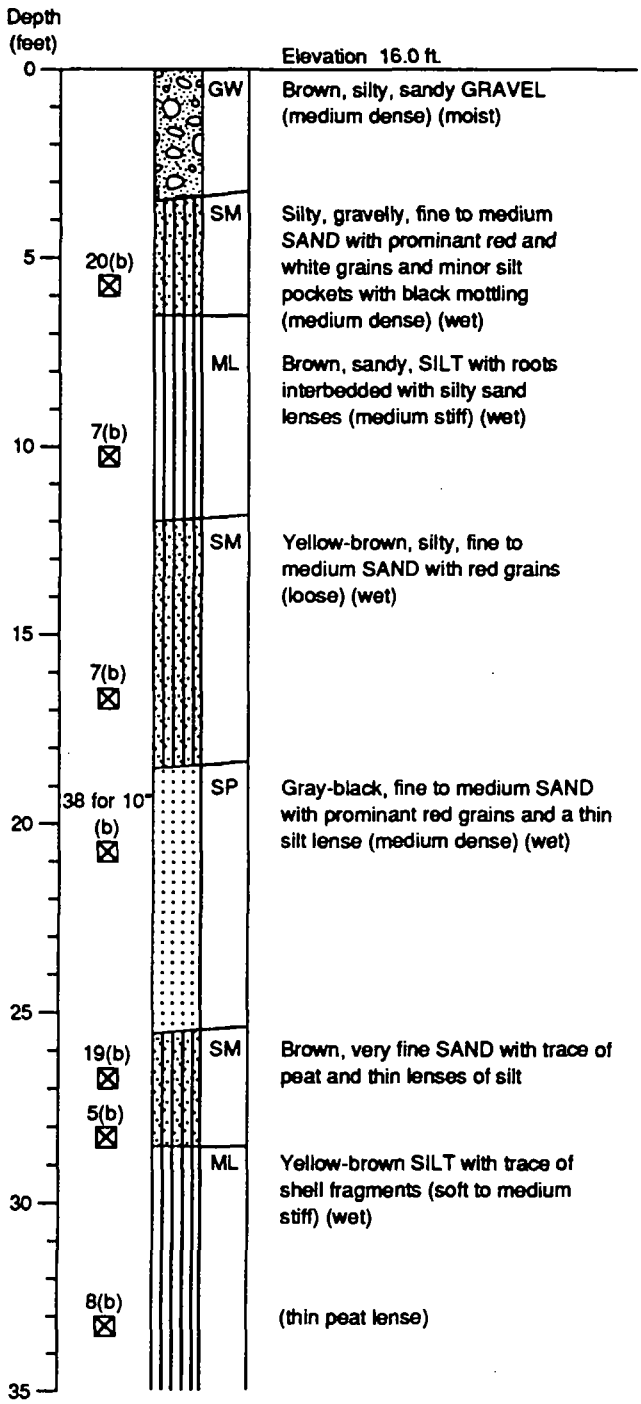
Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-9i

Figure A-18

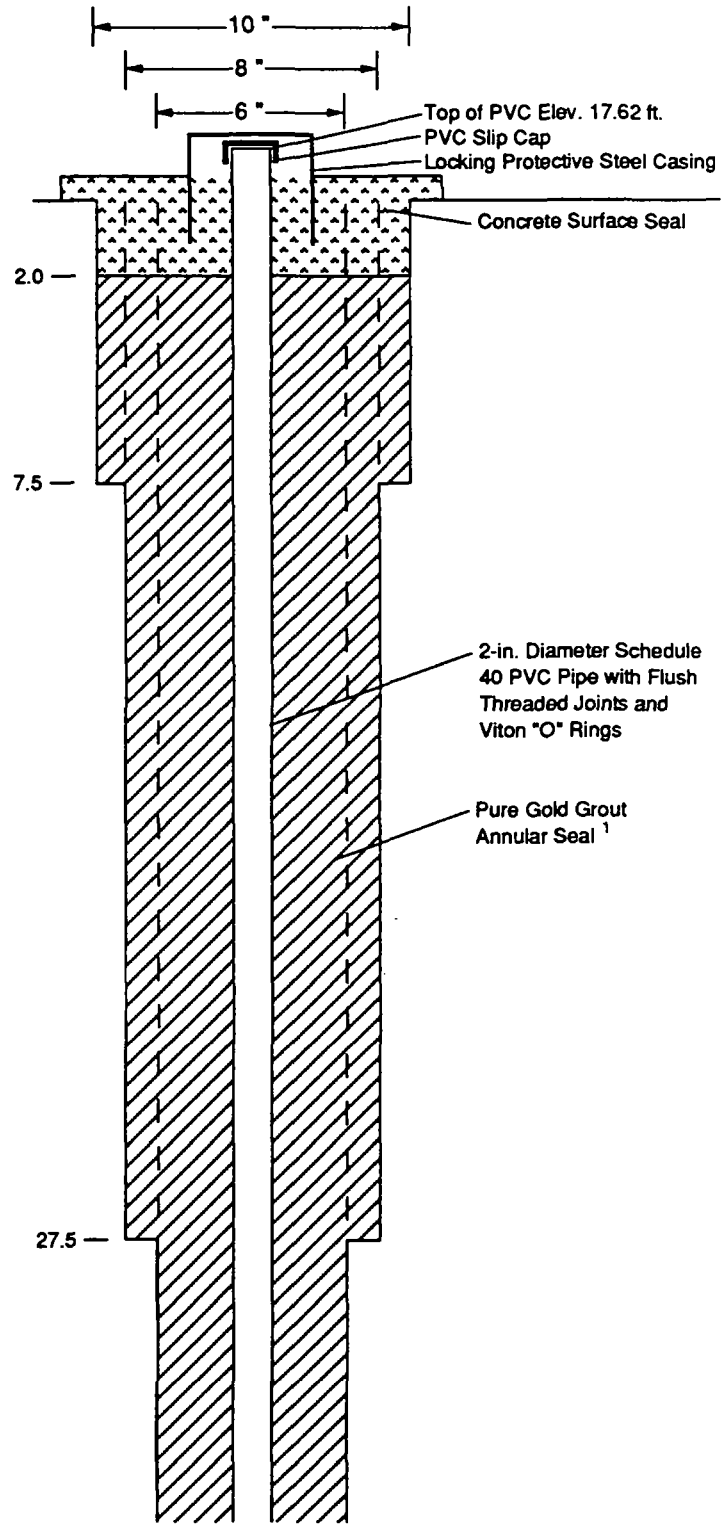
Well BW-9d

Soil Profile



(Continued Next Page)

Well Detail



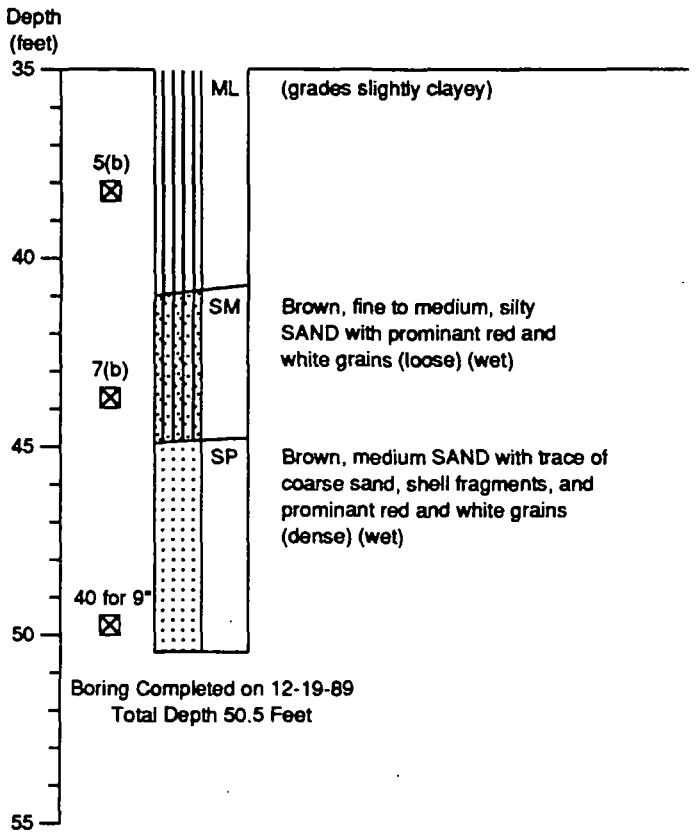
(Continued Next Page)

Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

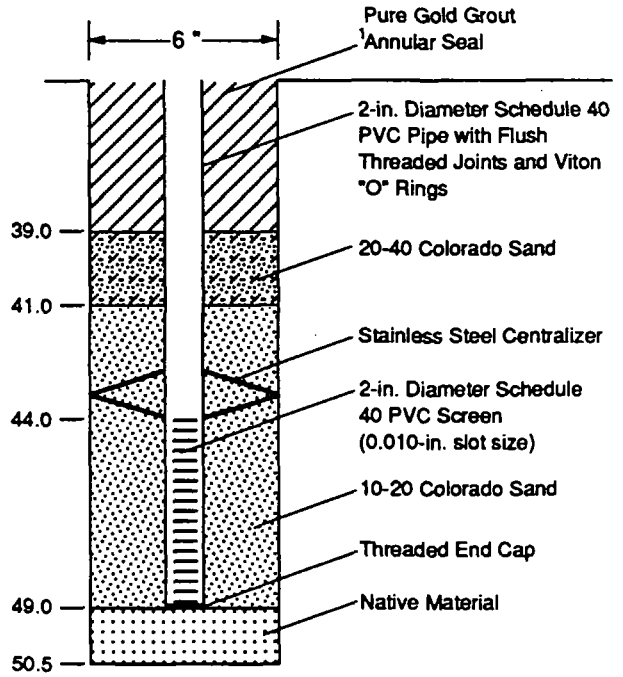
LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-9d

Well BW-9d
(Continued)

Soil Profile



Well Detail



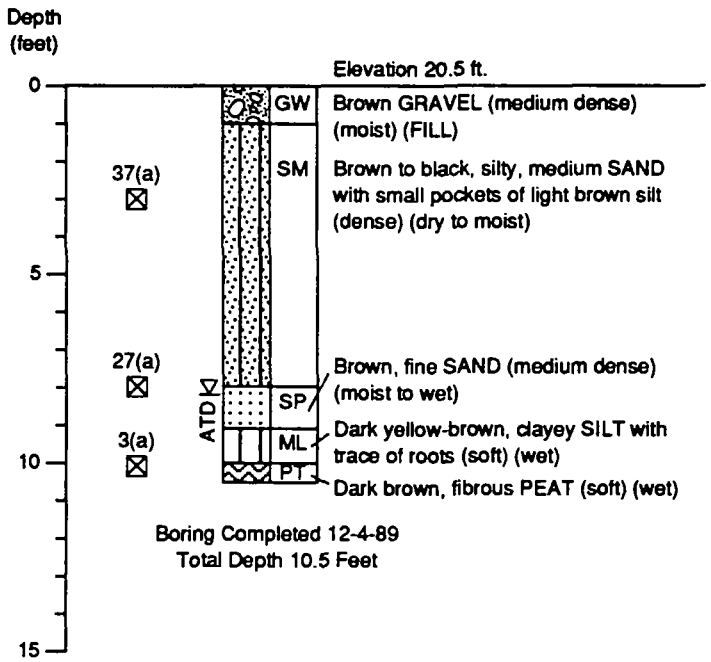
Note: [1]Pure Gold Grout is manufactured by American Colloid Company.

LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-9d (Continued)

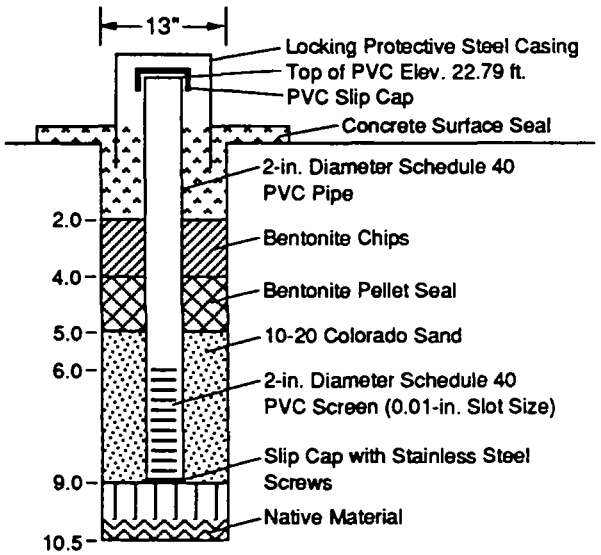
Figure A-19 (2 of 2)

Well BW-10s

Soil Profile

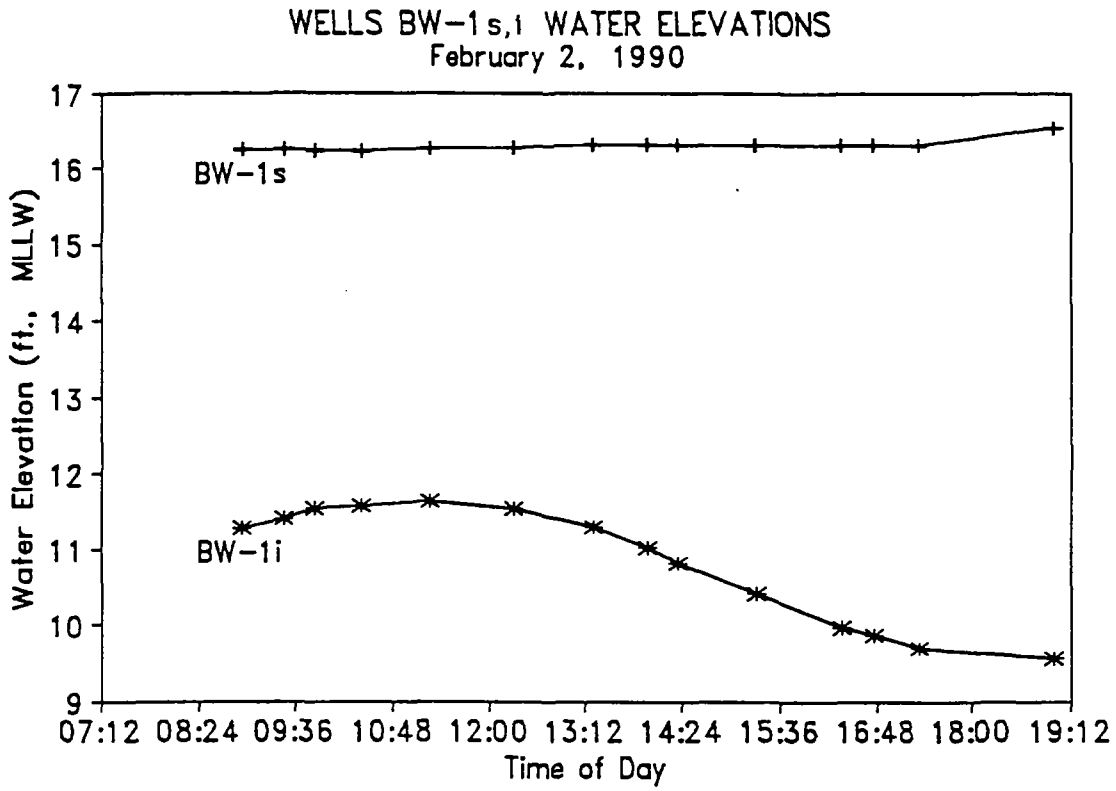


Well Detail



LANDAU ASSOCIATES, INC.	Soil Profile and Well Detail for Well BW-10s

Figure A-20



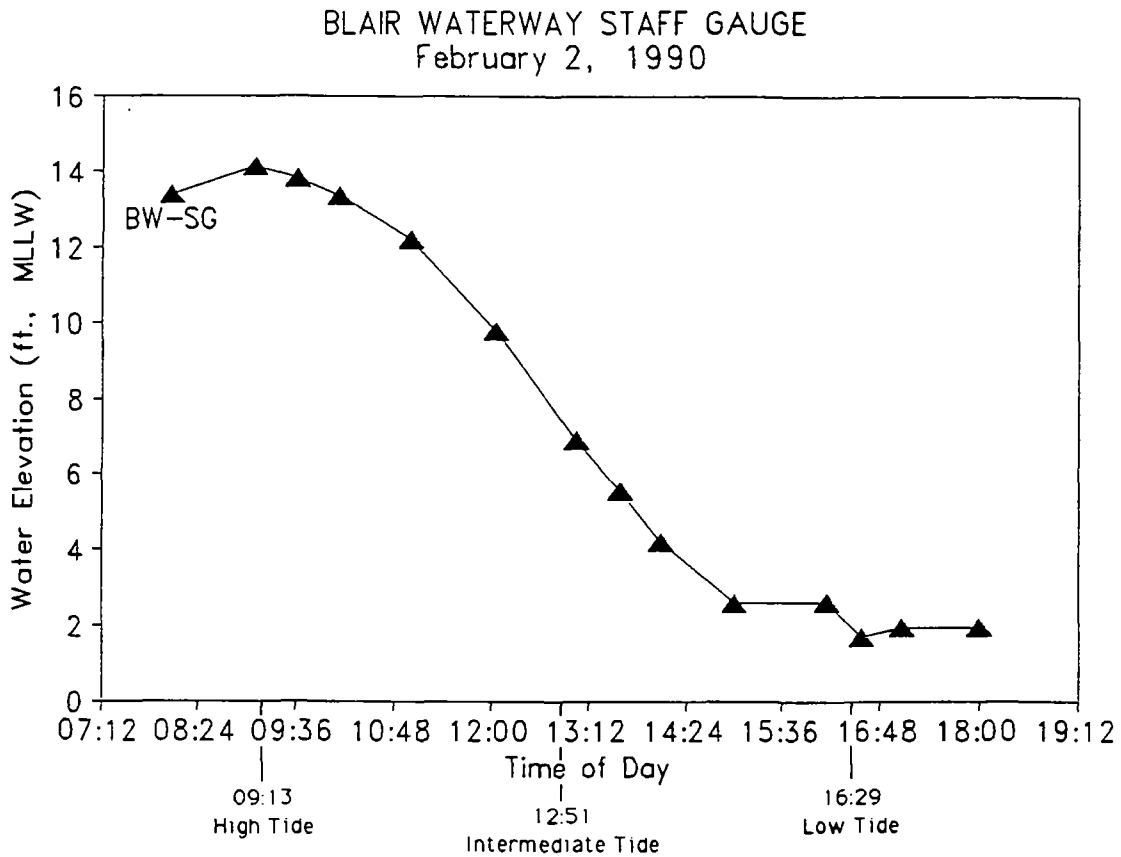


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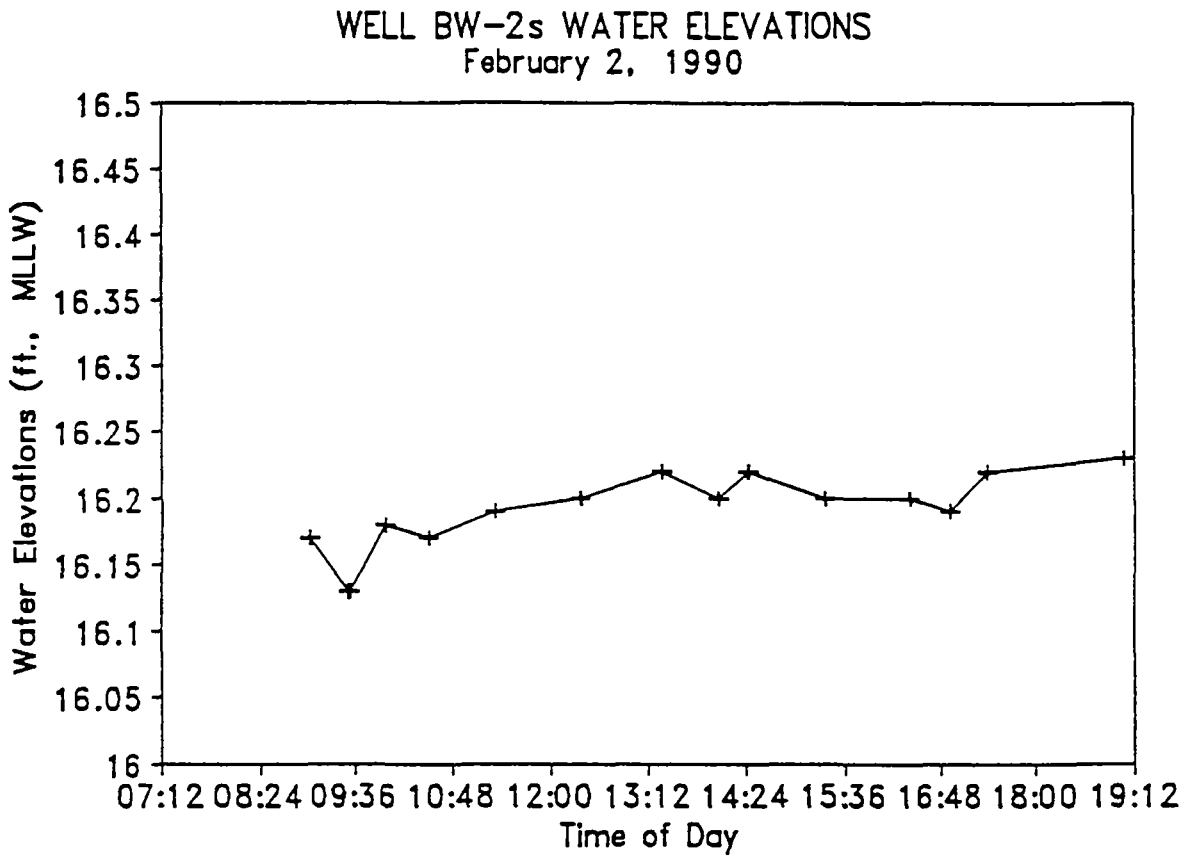
Figure A-21



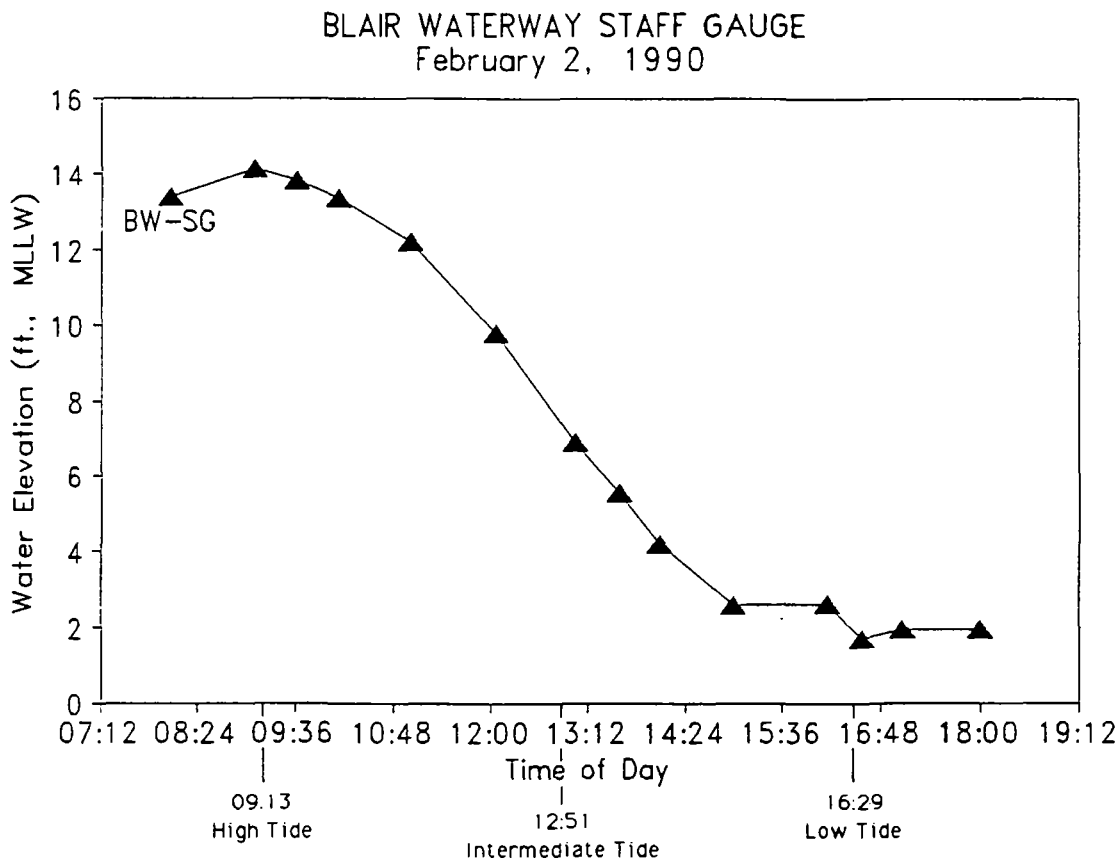


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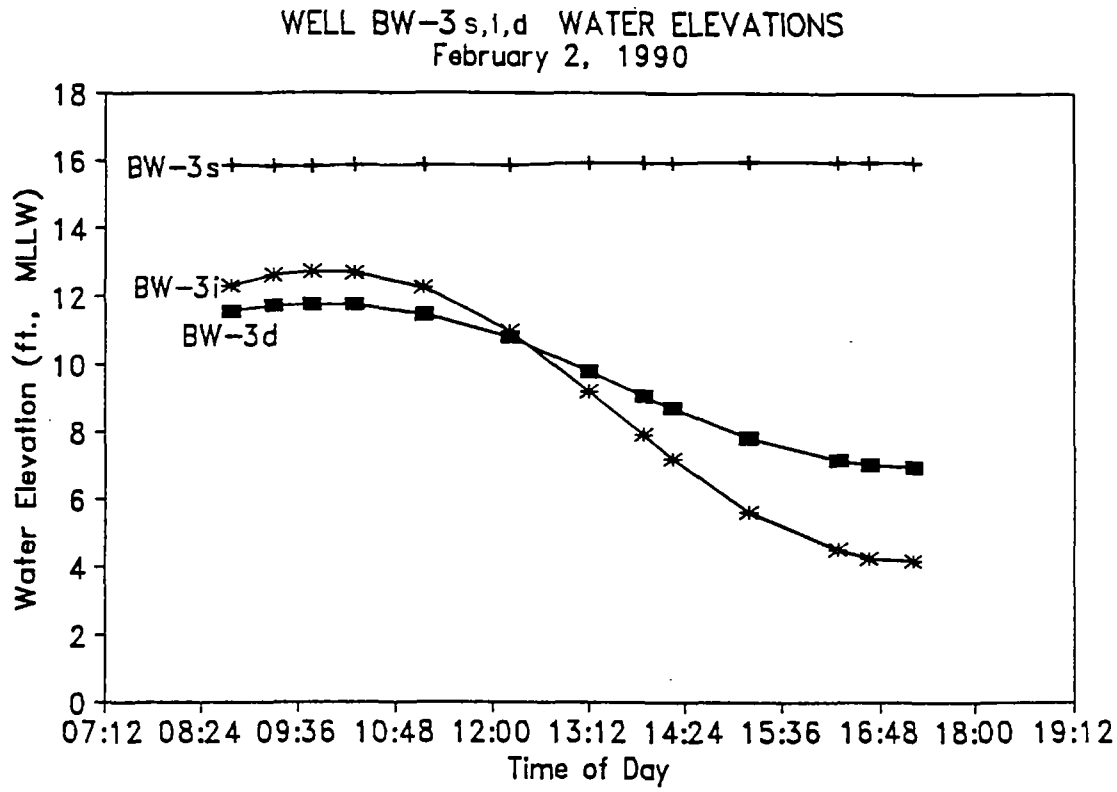
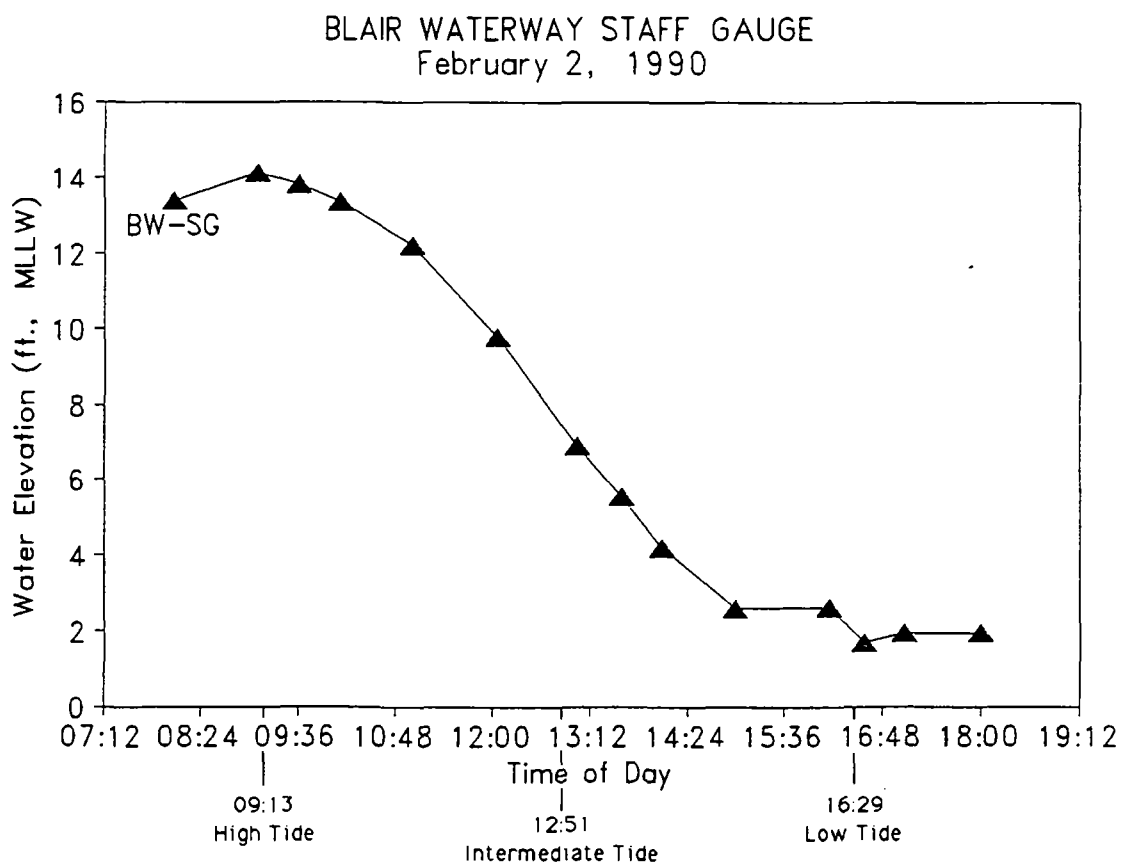
Figure A-22

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92





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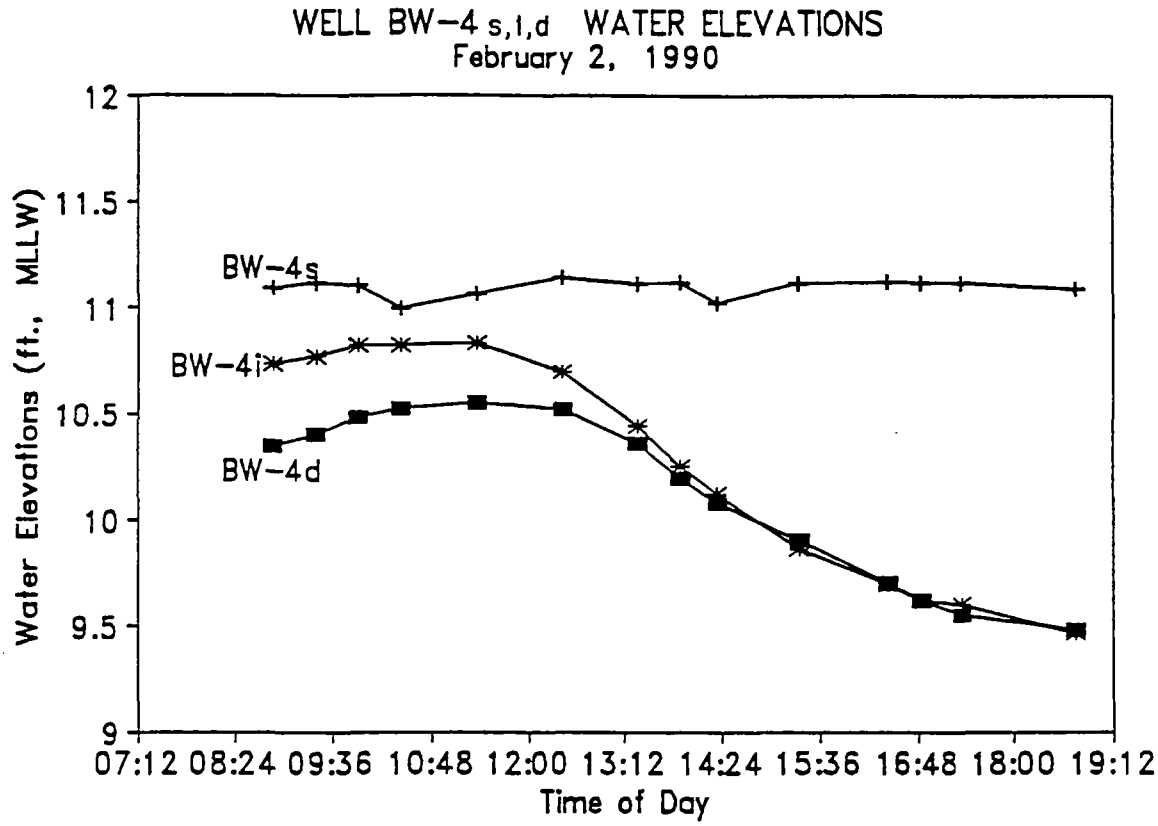
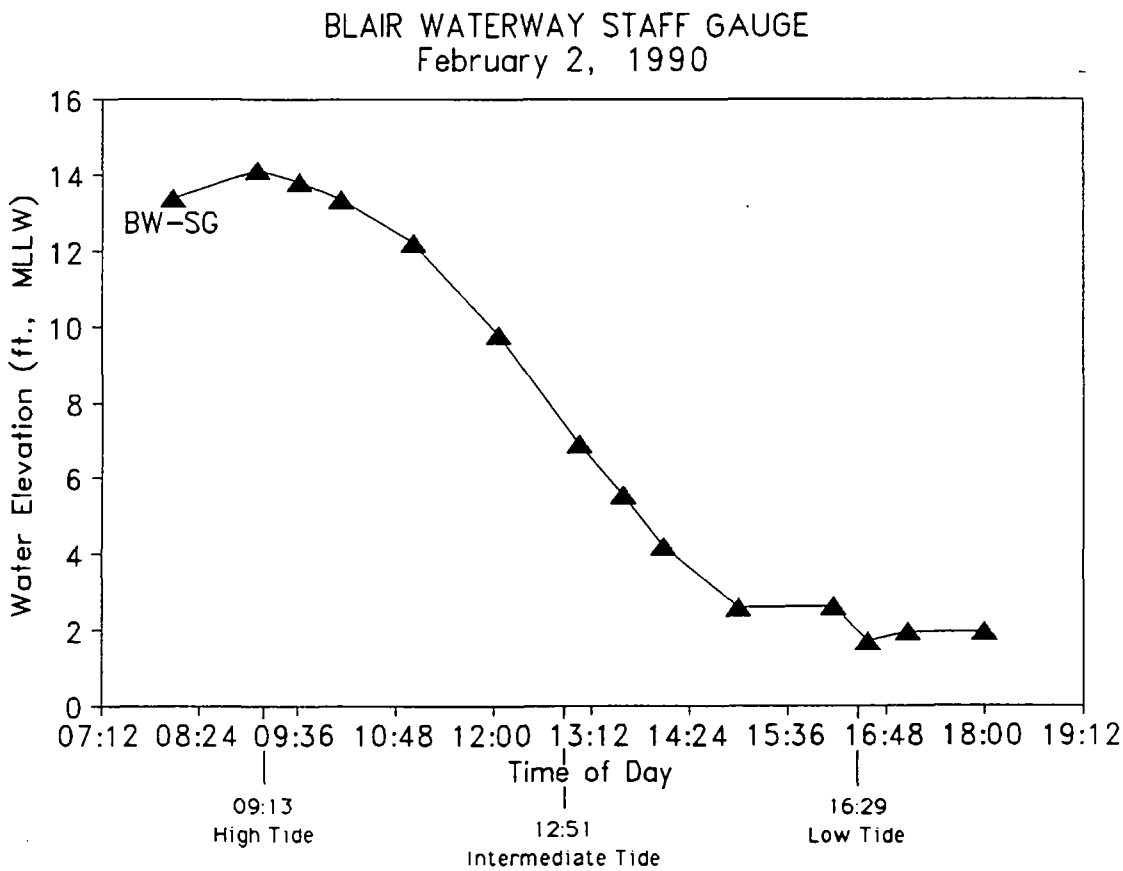
LANDAU ASSOCIATES, INC. | Tidal Influence Investigation - February 2, 1990

Figure A-23





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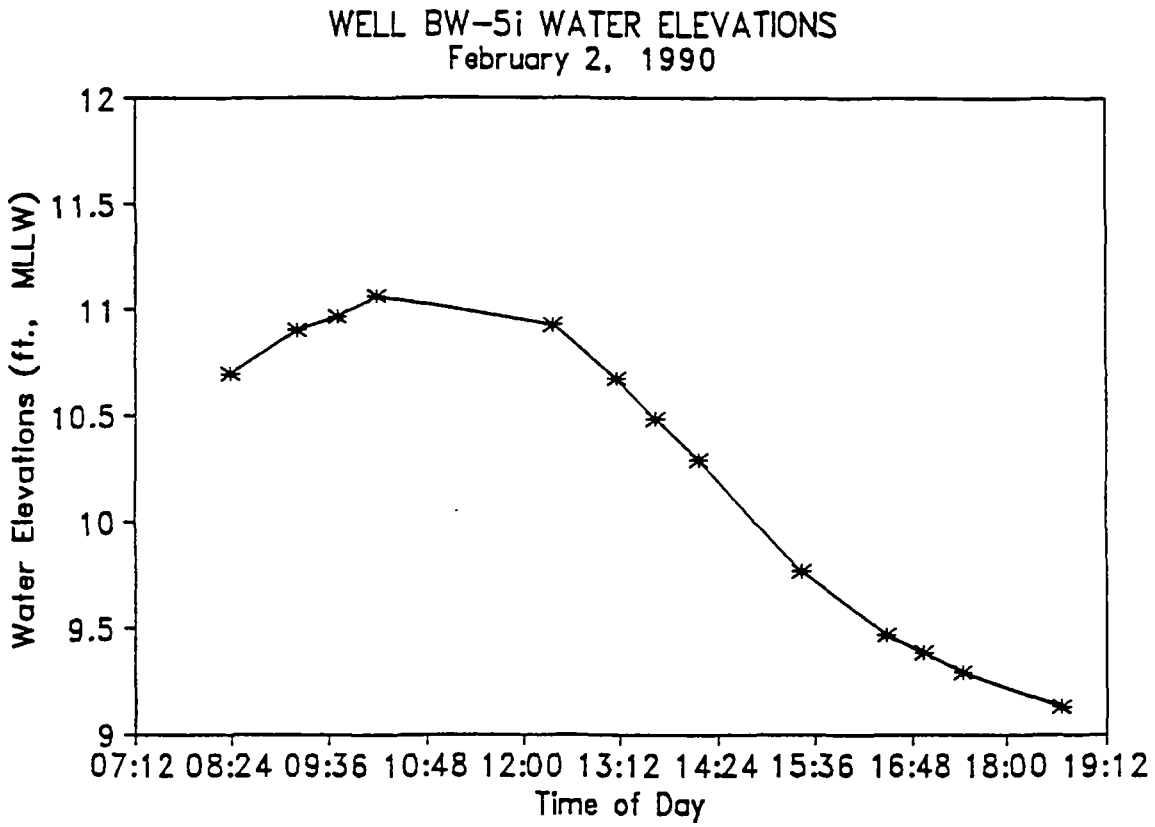
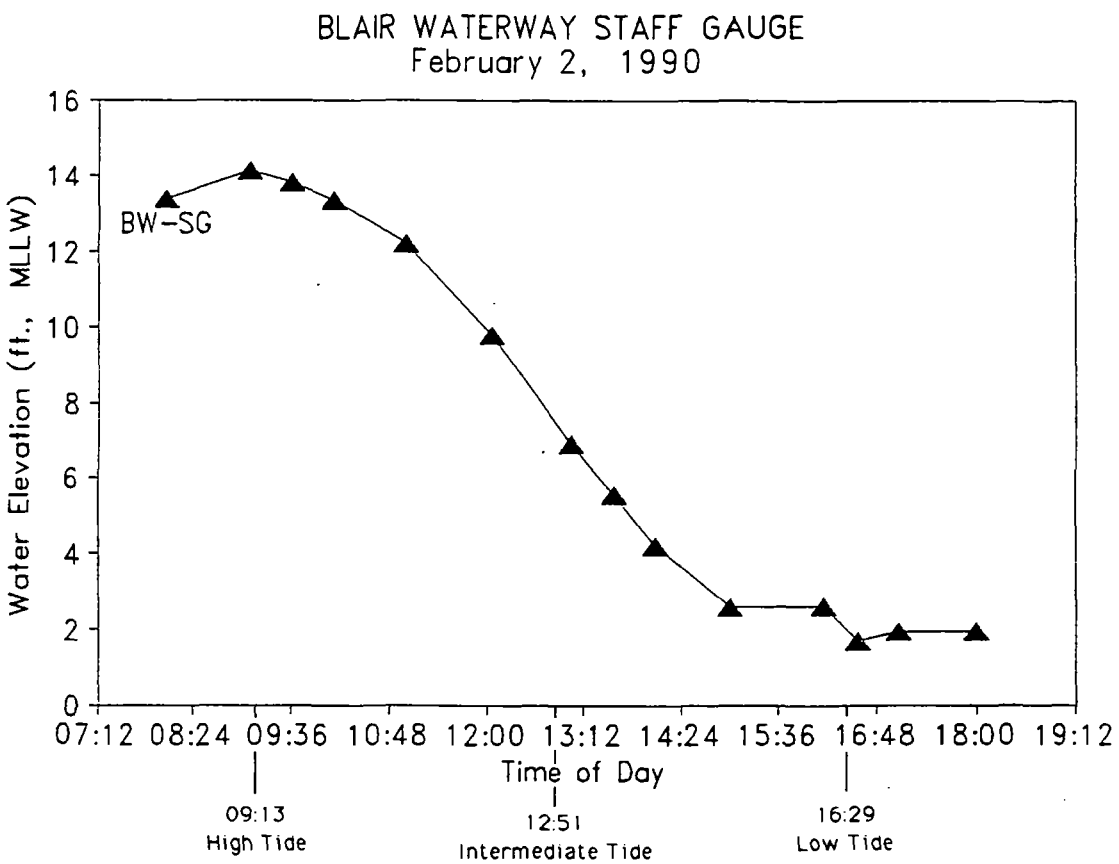
LANDAU ASSOCIATES, INC.	Tidal Influence Investigation - February 2, 1990

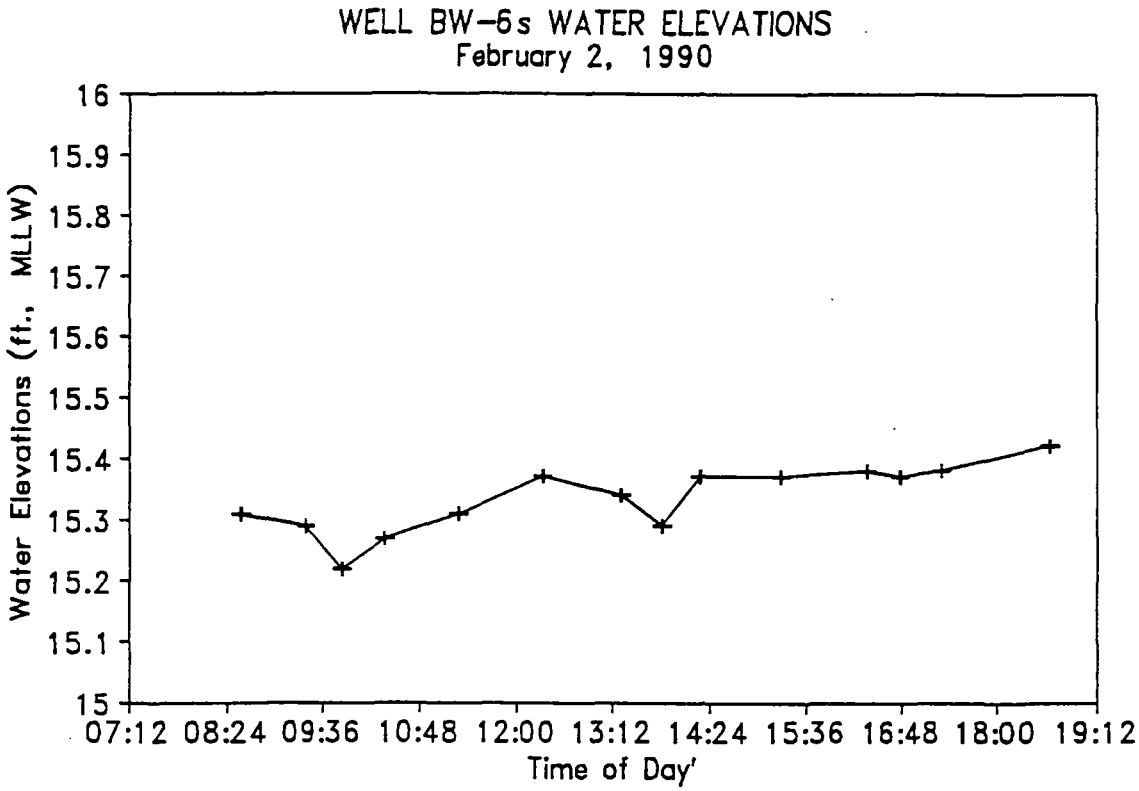
Figure A-24

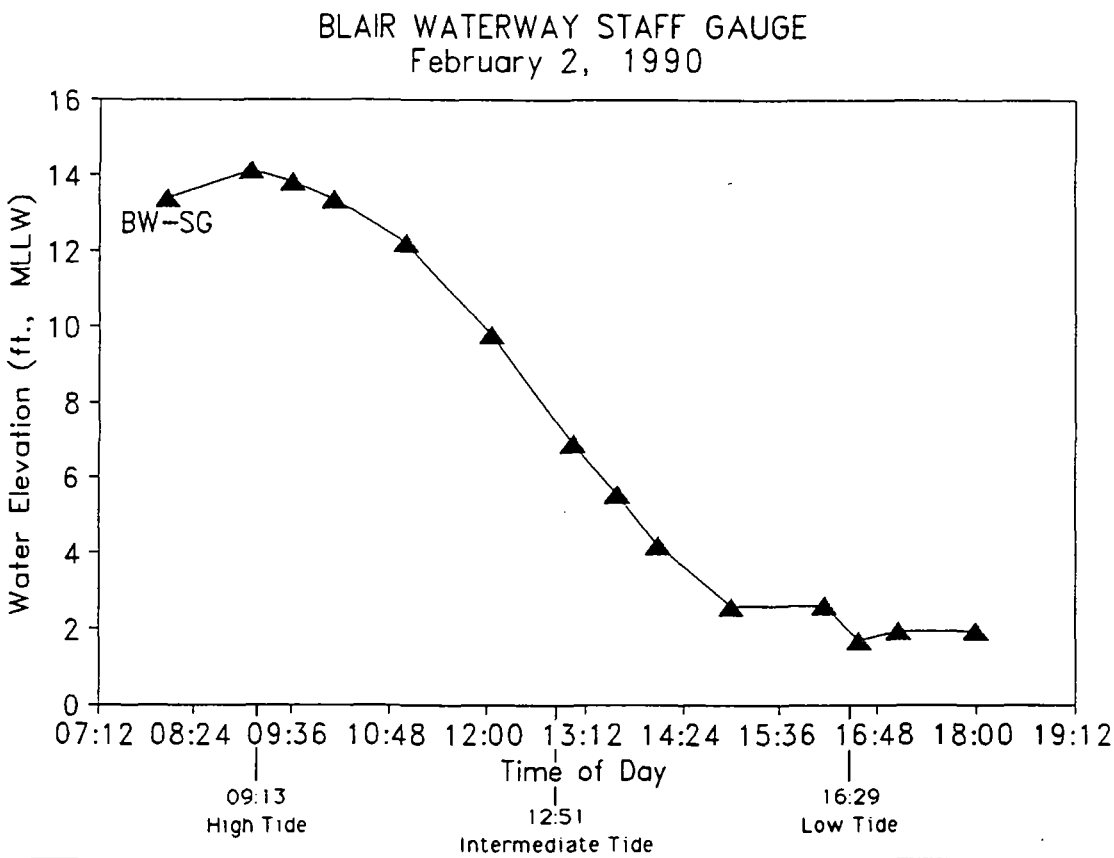




LANDAU ASSOCIATES, INC. | Tidal Influence Investigation - February 2, 1990

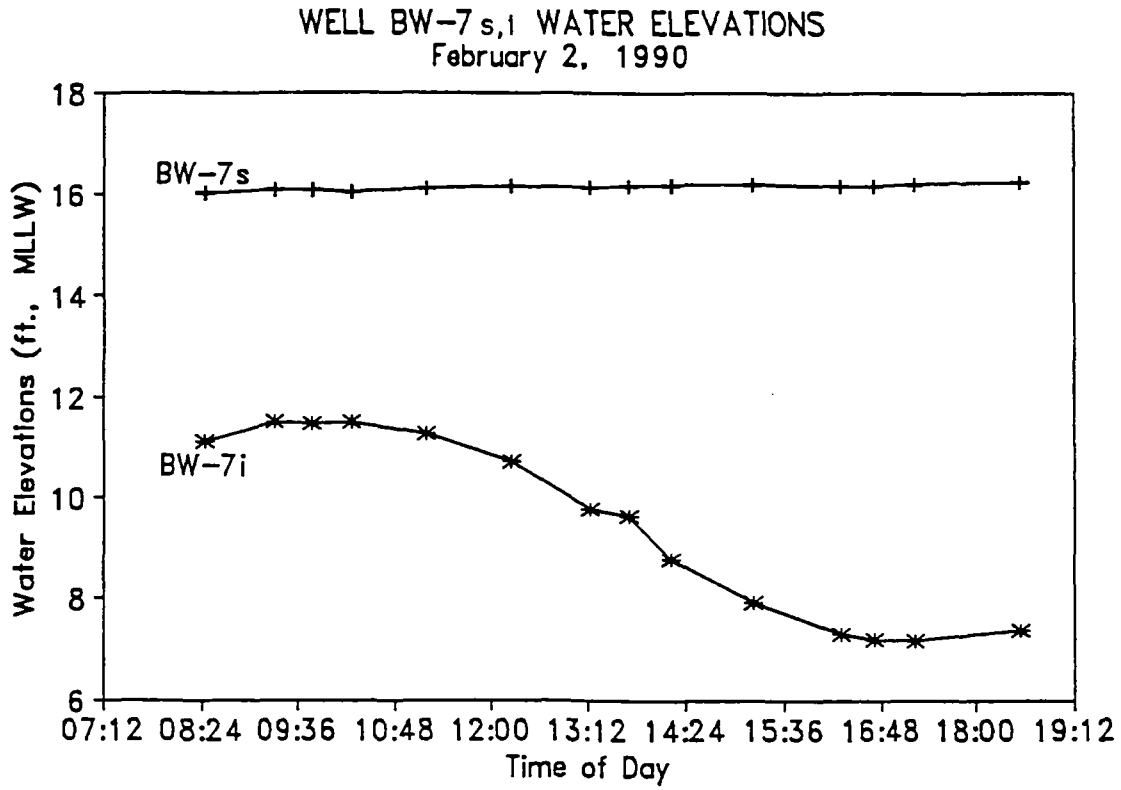
Figure A-25

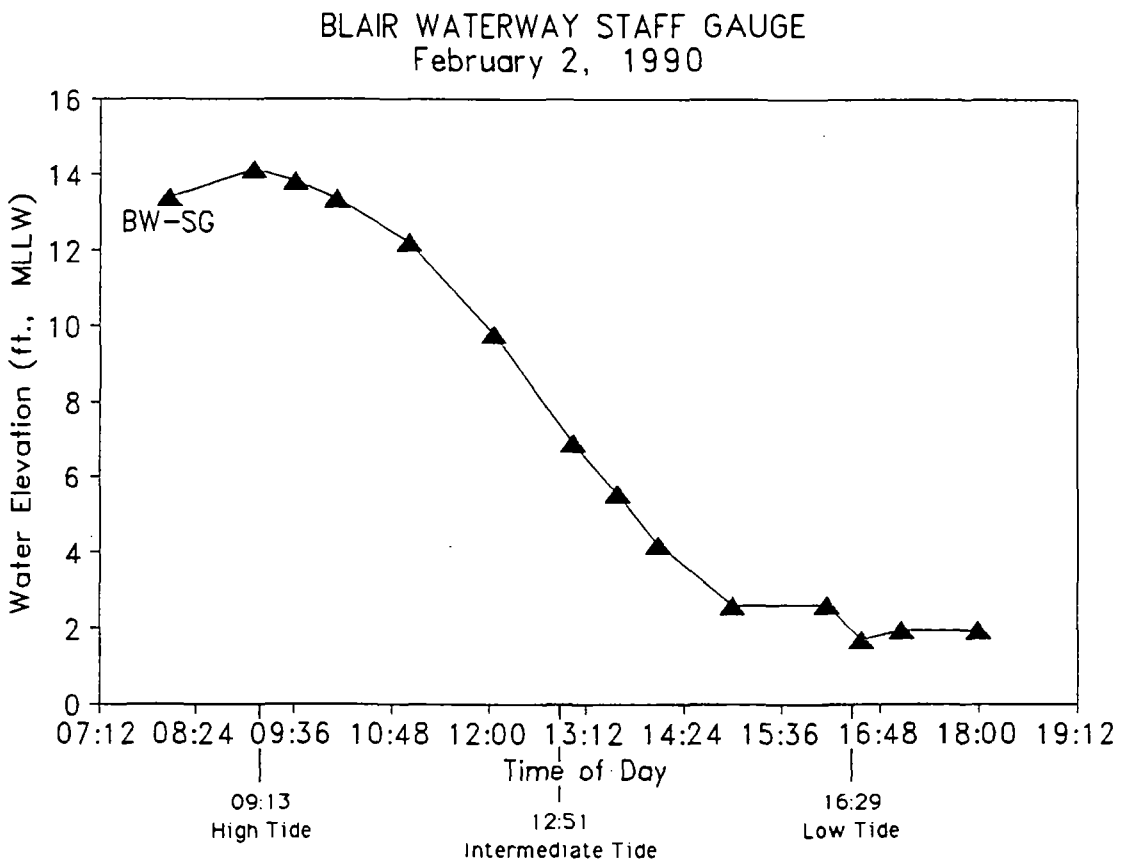




LANDAU ASSOCIATES, INC. | Tidal Influence Investigation - February 2, 1990

Figure A-26





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LANDAU ASSOCIATES, INC.

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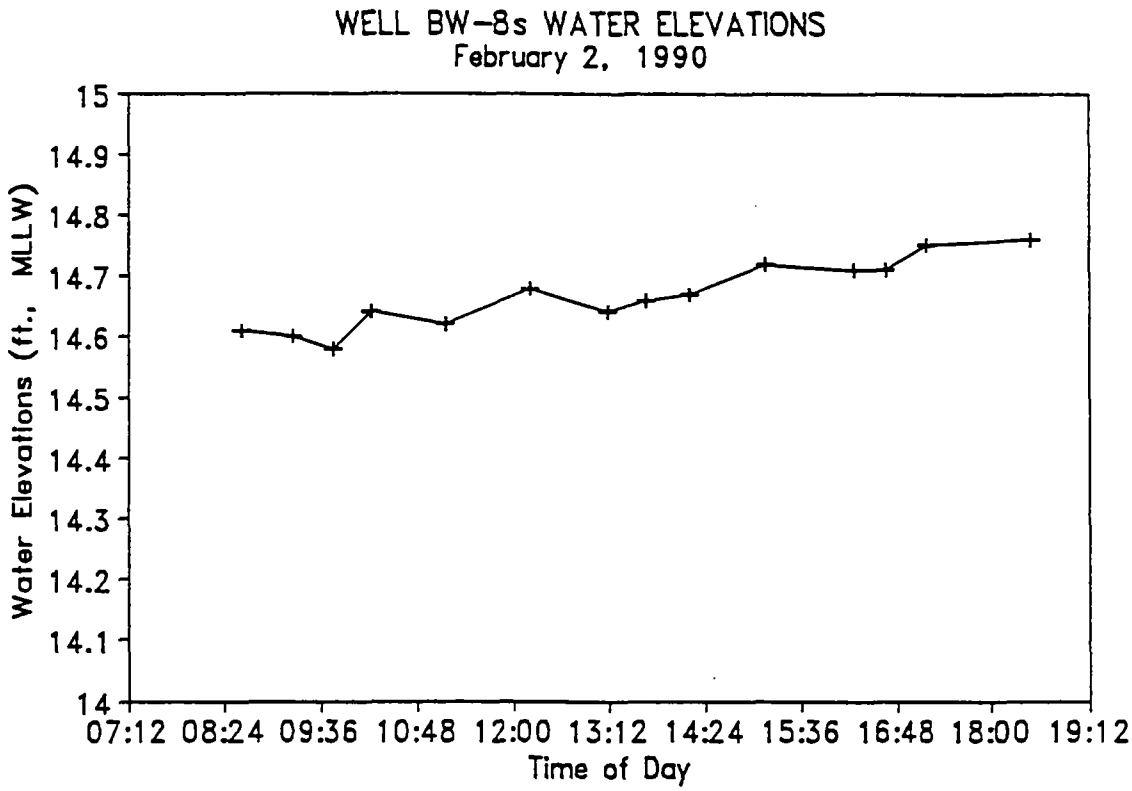
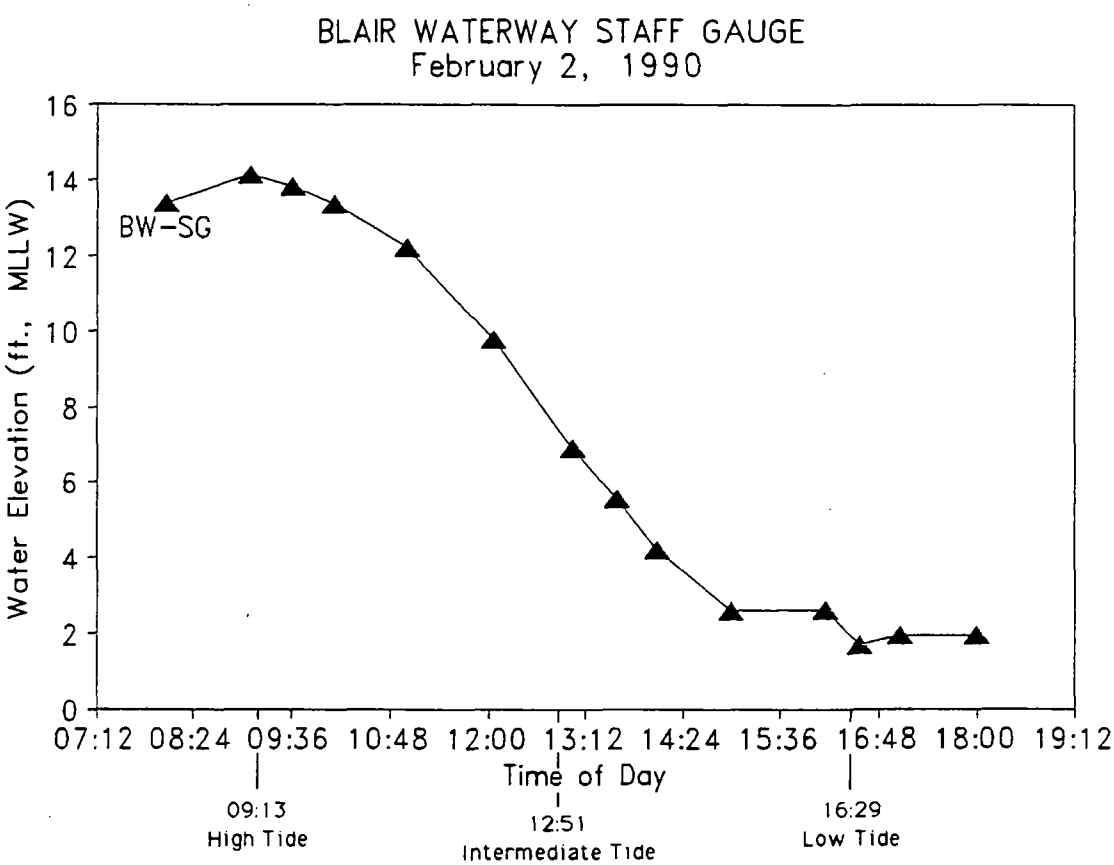
Figure A-27





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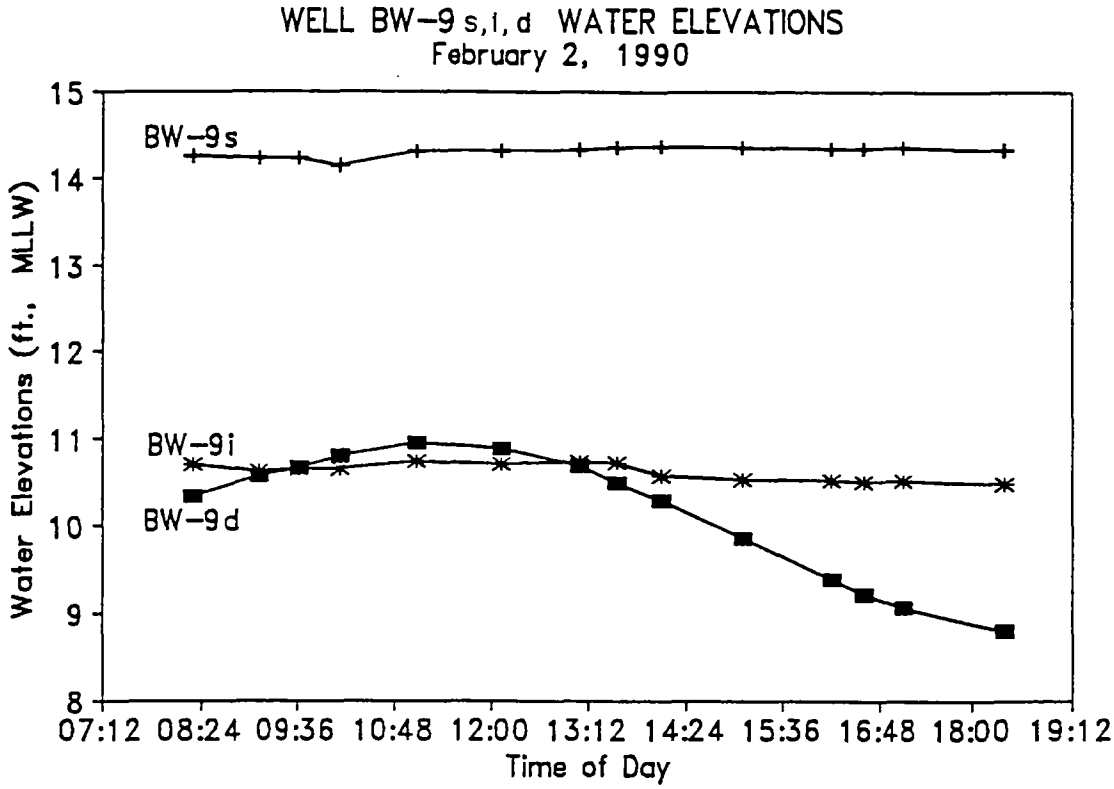
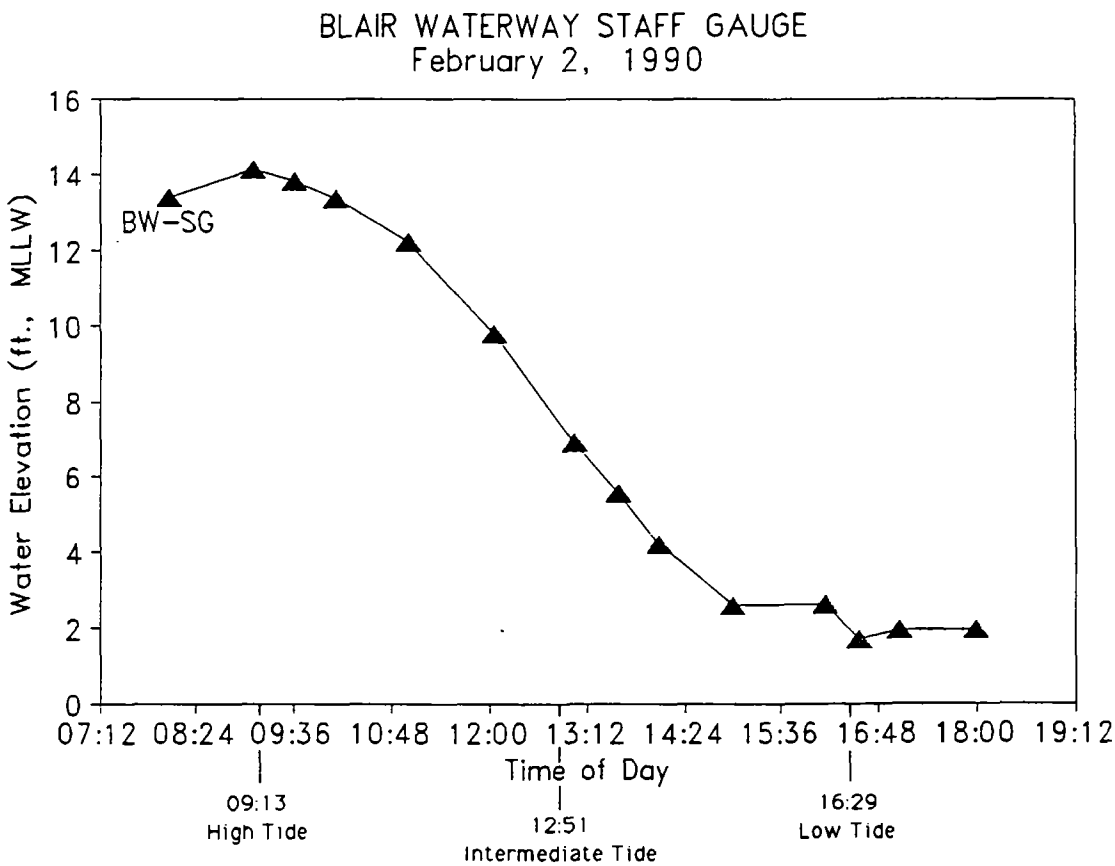
LANDAU ASSOCIATES, INC.

Tidal Influence Investigation - February 2, 1990

Figure A-28

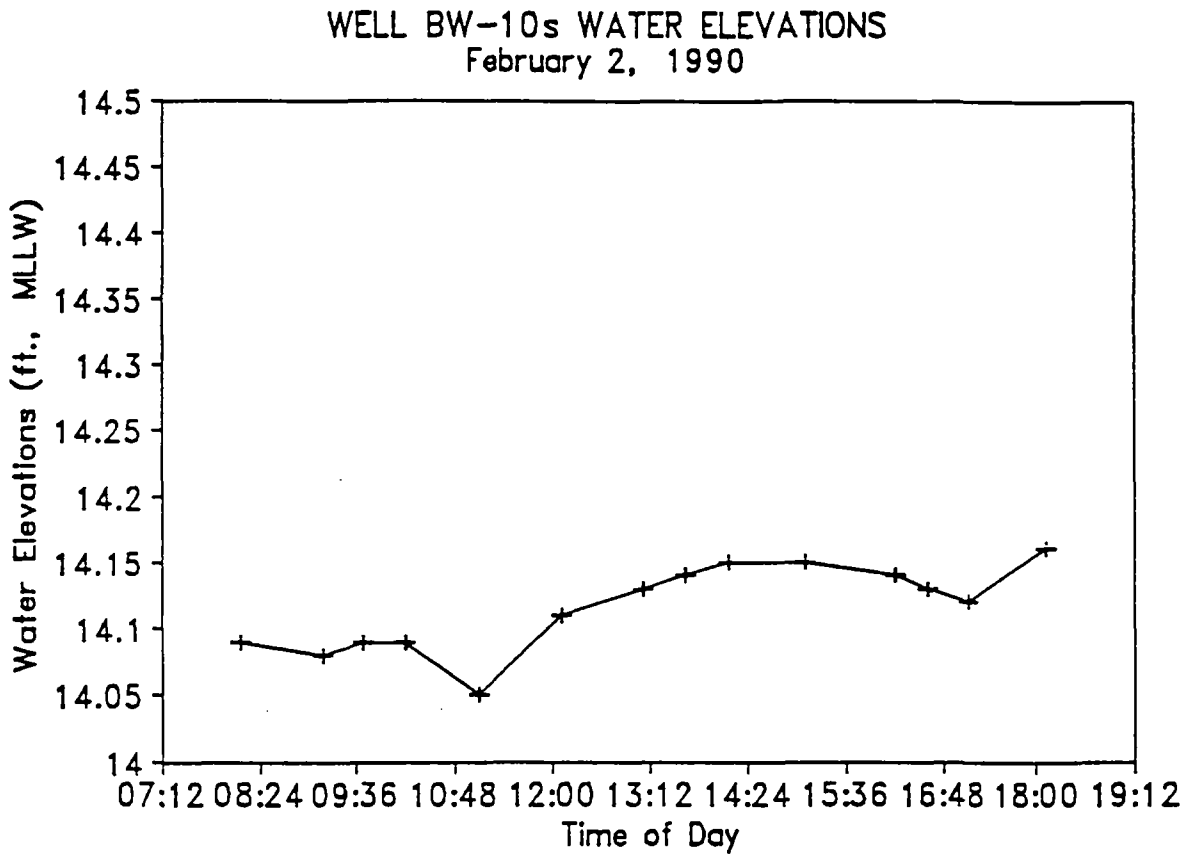


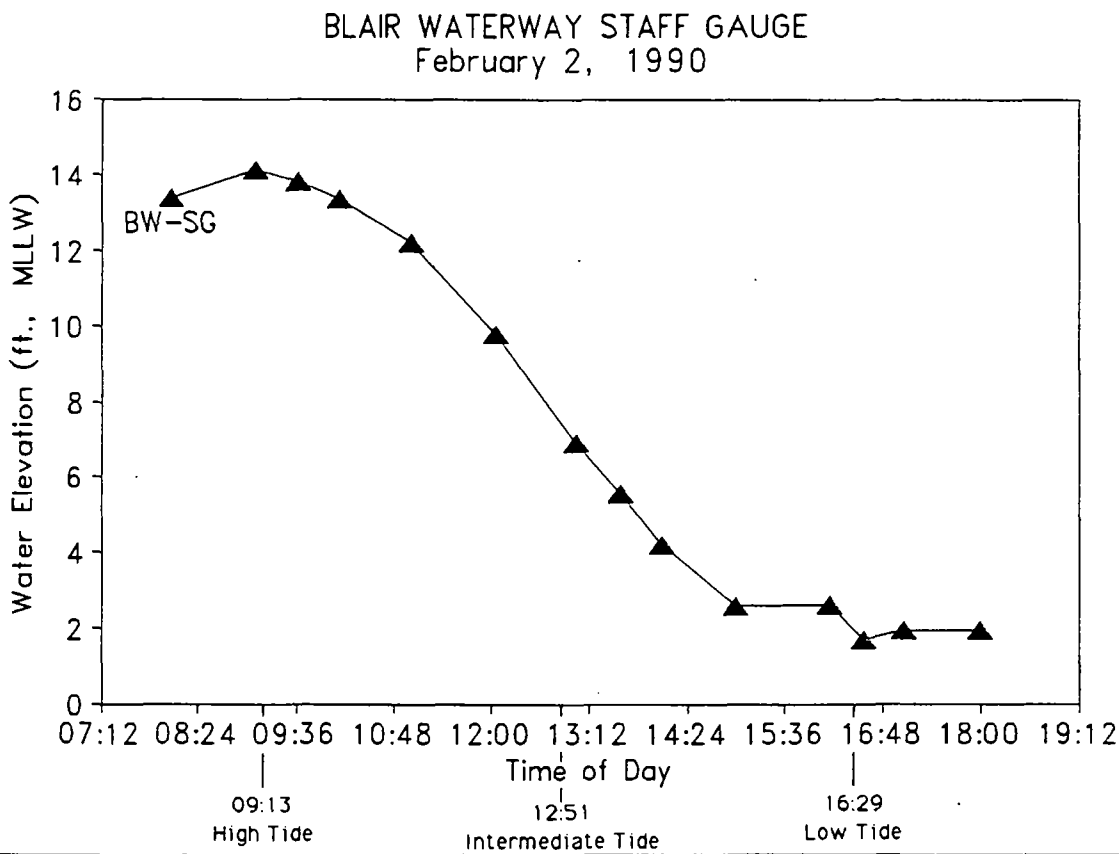


LANDAU ASSOCIATES, INC. | Tidal Influence Investigation - February 2, 1990

Figure A-29

118-03.43 Port of Tacoma/Blair Waterway Property/Final Investigation Report 2/92





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LANDAU ASSOCIATES, INC.

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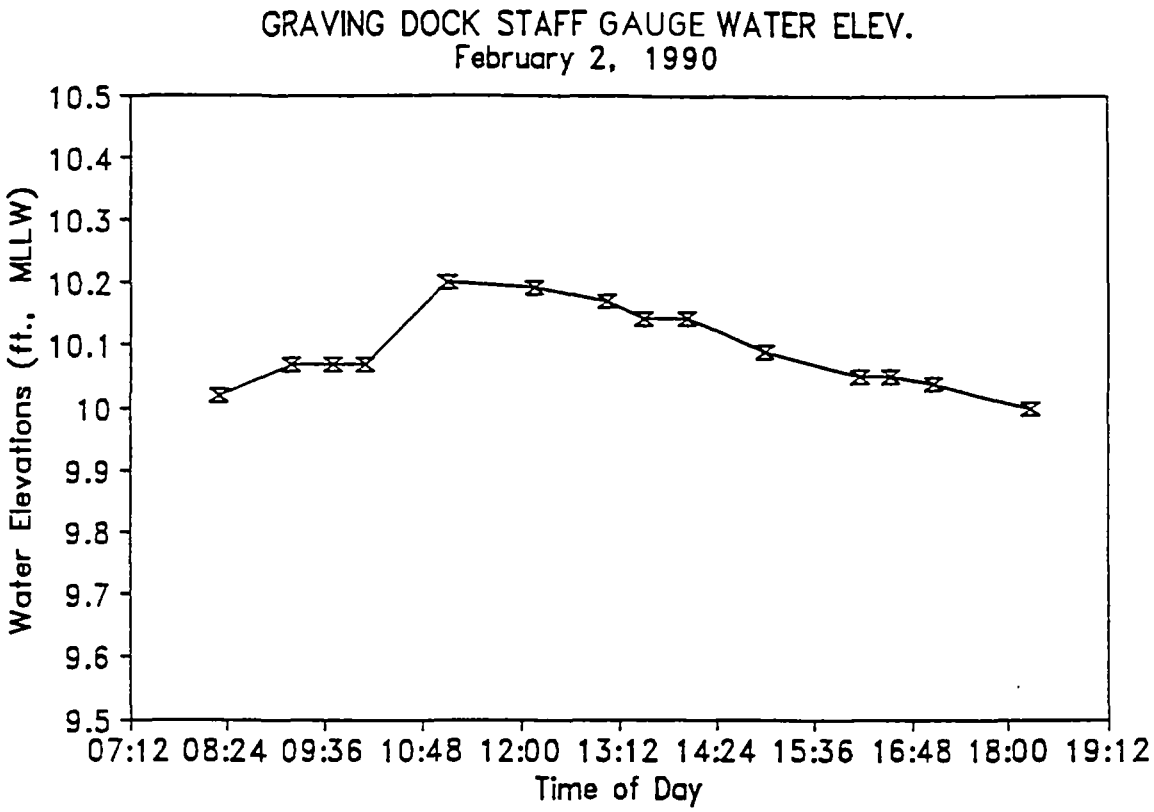
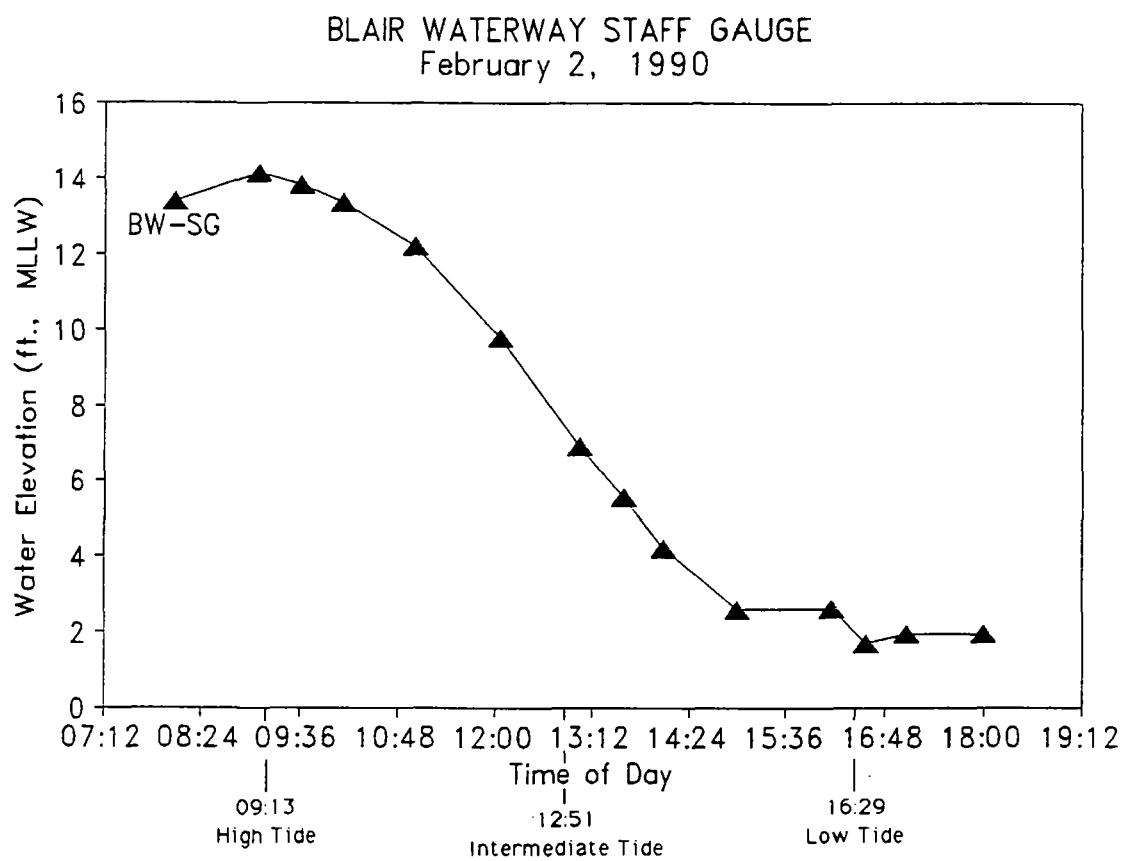
Figure A-30





LANDAU ASSOCIATES, INC. | Tidal Influence Investigation - February 2, 1990

Figure A-31

TABLE A-1

MONITORING WELL AND STAFF GAUGE ELEVATION AND LOCATION SUMMARY
BLAIR WATERWAY PROPERTY

Feature	Ground Elevation (ft., MLLW)(a)	Top of Well Casing (ft., MLLW)(a)	North Coordinate(b)	East Coordinate(b
Monitoring Wells				
BW-1s	18.4	20.14	711451.5	1530681.0
BW-1i	17.9	20.05	711438.0	1530660.0
BW-2s	18.9	21.10	711339.5	1530147.5
BW-3s	16.8	18.34	710839.0	1530628.0
BW-3i	18.8	20.71	710893.0	1530577.5
BW-3d	17.7	19.59	710862.0	1530596.0
BW-4s	17.3	19.38	711049.0	1531113.5
BW-4i	17.0	19.14	711070.0	1531092.5
BW-4d	17.7	19.43	711032.0	1531130.0
BW-5i	17.5	19.83	710737.0	1531328.5
BW-6s	18.4	20.19	710681.0	1531097.0
BW-7s	17.7	19.89	710341.5	1531188.5
BW-7i	17.5	19.98	710322.0	1531208.0
BW-8s	17.6	19.85	710476.0	1531351.0
BW-9s	16.1	18.40	710636.5	1531555.0
BW-9i	16.0	18.09	710619.0	1531573.0
BW-9d	16.0	17.62	710599.0	1531595.0
BW-10s	20.5	22.79	710040.5	1532171.0
Staff Guages				
BW-SG-1	18.1(c)	-	709581.5	1531750.0
BW-GD-SG	7.5	-	710520.0	1531620.0

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Coordinate Datum: Washington State plane coordinates, south zone.
(c) Survey mark on steel dock painted orange (18.12 ft.).

TACOMA\BLAIR\BWFINA-1.WK1

TABLE A-2

SUMMARY OF GROUND WATER SAMPLE FIELD MEASUREMENTS
BLAIR WATERWAY PROPERTY

Sample I.D.	Date Measured	pH (a)	Conductivity(a) (uhmos)	Temperature(b) (degrees Celcius)	Comments
BW-1s	12/13/89	5.13	2182	9.1	
BW-1i	01/10/90	6.53	1215	13.3	
BW-2s	12/13/89	6.72	1354	11.7	
BW-3s	12/13/89	6.03	2755	11.3	slightly silty
BW-3i	12/14/89	8.48	5398	11.6	yellow/brown color
BW-3d	01/11/90	7.68	7400	11.2	silty
BW-4s	12/15/89	6.56	416	10.6	
BW-4i	12/19/89	6.91	857	10.5	
BW-4d	01/10/90	7.61	1363	13.3	
BW-5i	12/15/89	6.94	11720	11.1	light yellow/brown color
BW-6s	12/12/89	6.88	1414	12.7	
BW-7s	12/12/89	7.50	391	8.6	
BW-7i	01/10/90	7.16	19870	13.1	suspended peat
BW-8s	12/12/89	6.76	1080	12.2	
BW-9s	12/13/89	6.04	1893	9.1	
BW-9i	12/15/89	6.89	5368	11.2	yellow/brown color
BW-9d	01/10/90	7.36	5683	12.1	
BW-10s	12/12/89	4.70	408	8.8	
PTB2-BW-1s	07/26/90	6.497	1106	13.1	light gray color; trace of suspended sand
PTB2-BW-3s	07/26/90	7.69	3933	14.1	light yellow/brown color; brackish odor
PTB2-BW-4i	07/25/90	6.885	764	12.9	light yellow/brown color
PTB2-BW-5i	07/24/90	6.95	10258	13.5	slight yellow color
PTB2-BW-7i	07/24/90	7.252	16880	13.2	gray color; suspended black particles
PTB2-BW-9i	07/25/90	6.95	5535	13.1	yellow/brown color
PTB2-BW-9d	07/25/90	7.73	3310	12.8	light gray color

(a) Value is the average of four observations.
(b) Value is a single observation.

TACOMA\BLAIR\BWFINA-2.WK1

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

Graving Dock Staff Gauge			Blair Waterway Staff Gauge		
Time	Staff Gauge Reading (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Staff Gauge Reading (ft.)	Water Elevation (ft.,MLLW)(a)
08:18	12.35	10.02	08:05	18.47	13.39
09:11	12.40	10.07	09:07	19.21	14.13
09:42	12.40	10.07	09:37	18.89	13.81
10:06	12.40	10.07	10:08	18.43	13.35
11:06	12.53	10.20	11:01	17.30	12.22
12:10	12.52	10.19	12:04	14.85	9.77
13:03	12.50	10.17	13:03	11.98	6.90
13:30	12.47	10.14	13:35	10.62	5.54
14:02	12.47	10.14	14:05	9.27	4.19
15:01	12.42	10.09	15:00	7.65	2.57
16:09	12.38	10.05	16:09	7.68	2.60
16:32	12.38	10.05	16:34	6.75	1.67
17:04	12.37	10.04	17:04	7.00	1.92
18:18	12.33	10.00	18:00	7.00	1.92

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-1i			BW-1s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:56	8.78	11.27	08:59	3.90	16.24
09:27	8.65	11.40	09:27	3.90	16.24
09:51	8.52	11.53	09:53	3.91	16.23
10:25	8.48	11.57	10:27	3.92	16.22
11:15	8.42	11.63	11:17	3.88	16.26
12:18	8.52	11.53	12:19	3.87	16.27
13:18	8.76	11.29	13:20	3.83	16.31
13:59	9.04	11.01	14:00	3.84	16.30
14:21	9.23	10.82	14:23	3.83	16.31
15:18	9.63	10.42	15:20	3.83	16.31
16:21	10.08	9.97	16:22	3.83	16.31
16:45	10.19	9.86	16:47	3.83	16.31
17:20	10.36	9.69	17:21	3.83	16.31
19:00	10.49	9.56	19:02	3.61	16.53

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-2s

Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
09:01	4.93	16.17
09:31	4.97	16.13
09:32	4.97	16.13
09:58	4.92	16.18
10:30	4.93	16.17
11:19	4.91	16.19
12:23	4.90	16.20
13:23	4.88	16.22
14:03	4.90	16.20
14:26	4.88	16.22
15:22	4.90	16.20
16:25	4.90	16.20
16:55	4.91	16.19
17:24	4.88	16.22
19:05	4.87	16.23

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATER PROPERTY
FEBRUARY 2, 1990

BW-3d			BW-3i			BW-3s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:46	8.06	11.53	08:46	8.43	12.28	08:44	2.51	15.83
09:17	7.89	11.70	09:18	8.09	12.62	09:15	2.53	15.81
09:46	7.85	11.74	09:48	7.99	12.72	09:44	2.53	15.81
10:18	7.84	11.75	10:12	8.03	12.68	10:16	2.51	15.83
11:09	8.13	11.46	11:10	8.46	12.25	11:08	2.51	15.83
12:13	8.82	10.77	12:14	9.77	10.94	12:11	2.48	15.86
13:12	9.80	9.79	13:14	11.53	9.18	13:10	2.43	15.91
13:53	10.53	9.06	13:54	12.81	7.90	13:51	2.44	15.90
14:15	10.90	8.69	14:17	13.51	7.20	14:13	2.44	15.90
15:12	11.78	7.81	15:14	15.11	5.60	15:11	2.40	15.94
16:16	12.43	7.16	16:17	16.20	4.51	16:16	2.40	15.94
16:40	12.58	7.01	16:41	16.47	4.24	16:39	2.39	15.95
17:13	12.65	6.94	17:14	16.56 (b)	4.15	17:12	2.38	15.96

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

(b) Review of field data suggests that the depth-to-water measurement was incorrectly recorded in the field. The depth in feet was recorded as 18.56 feet but was apparently 16.56 feet; thus the measurement shown is 16.56 feet.

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-4d			BW-4i			BW-4s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:54	9.08	10.35	08:51	8.41	10.73	08:52	8.29	11.09
09:25	9.03	10.40	09:22	8.37	10.77	09:24	8.27	11.11
09:54	8.95	10.48	09:57	8.32	10.82	09:55	8.28	11.10
10:25	8.91	10.52	10:28	8.32	10.82	10:26	8.39	10.99
11:20	8.88	10.55	11:23	8.31	10.83	11:21	8.32	11.06
12:24	8.91	10.52	12:27	8.44	10.70	12:26	8.24	11.14
13:20	9.07	10.36	13:24	8.70	10.44	13:22	8.27	11.11
13:52	9.24	10.19	13:55	8.89	10.25	13:54	8.26	11.12
14:20	9.35	10.08	14:24	9.02	10.12	14:21	8.36	11.02
15:20	9.53	9.90	15:23	9.28	9.86	15:22	8.27	11.11
16:23	9.73	9.70	16:26	9.45	9.69	16:25	8.26	11.12
16:50	9.81	9.62	16:53	9.52	9.62	16:51	8.27	11.11
17:21	9.88	9.55	17:24	9.54	9.60	17:22	8.27	11.11
18:44	9.95	9.48	18:48	9.68	9.46	18:45	8.29	11.09

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-5I

Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:23	9.14	10.69
09:13	8.93	10.90
09:43	8.87	10.96
10:12	8.77	11.06
12:22	8.91	10.92
13:09	9.16(b)	10.67
13:38	9.35	10.48
14:10	9.54	10.29
15:26	10.06	9.77
16:28	10.36	9.47
16:56	10.45	9.38
17:27	10.54	9.29
18:40	10.70	9.13

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

(b) Review of field data suggests that the depth-to-water measurement was incorrectly recorded in the field. The depth in feet was recorded as 6.16 feet but was apparently 9.16 feet; thus the measurement shown is 9.16 feet.

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-6s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:34	4.88	15.31
09:23	4.90	15.29
09:51	4.97	15.22
10:22	4.92	15.27
11:17	4.88	15.31
12:20	4.82	15.37
13:18	4.85	15.34
13:49	4.90	15.29
14:17	4.82	15.37
15:17	4.82	15.37
16:21	4.81	15.38
16:47	4.82	15.37
17:18	4.81	15.38
18:38	4.77	15.42

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-7i			BW-7s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:26	8.89	11.09	08:28	3.88	16.01
09:18	8.50	11.48	09:19	3.80	16.09
09:47	8.51	11.47	09:49	3.82	16.07
10:16	8.50	11.48	10:17	3.86	16.03
11:12	8.72	11.26	11:14	3.78	16.11
12:15	9.29	10.69	12:17	3.75	16.14
13:14	10.23	9.75	13:16	3.77	16.12
13:43	10.35	9.63	13:46	3.75	16.14
14:14	11.20	8.78	14:15	3.71	16.18
15:13	12.05	7.93	15:15	3.70	16.19
16:17	12.67	7.31	16:19	3.75	16.14
16:42	12.79	7.19	16:44	3.73	16.16
17:14	12.82	7.16	17:15	3.70	16.19
18:33	12.61	7.37	18:35	3.66	16.23

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-8s

Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:37	5.24	14.61
09:15	5.25	14.60
09:45	5.27	14.58
10:14	5.21	14.64
11:09	5.23	14.62
12:13	5.17	14.68
13:11	5.21	14.64
13:40	5.19	14.66
14:12	5.18	14.67
15:10	5.13	14.72
16:15	5.14	14.71
16:40	5.14	14.71
17:11	5.10	14.75
18:29	5.09	14.76

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-9d			BW-9i			BW-9s		
Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)	Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:17	7.28	10.34	08:18	7.39	10.70	08:19	4.15	14.25
09:09	7.05	10.57	09:07	7.47	10.62	09:06	4.17	14.23
09:39	6.96	10.66	09:37	7.44	10.65	09:40	4.17	14.23
10:09	6.82(b)	10.80	10:08	7.44	10.65	10:10	4.25	14.15
11:02	6.68	10.94	11:04	7.36	10.73	11:05	4.09	14.31
12:08	6.74	10.88	12:07	7.39	10.70	12:05	4.08	14.32
13:05	6.93(c)	10.69	13:06	7.36	10.73	13:07	4.07	14.33
13:32	7.13	10.49	13:34	7.37	10.72	13:35	4.04	14.36
14:03	7.33	10.29	14:06	7.52	10.57	14:07	4.03	14.37
15:04	7.76	9.86	15:06	7.56	10.53	15:07	4.04	14.36
16:10	8.23	9.39	16:12	7.58	10.51	16:13	4.05	14.35
16:35	8.40	9.22	16:36	7.59	10.50	16:38	4.05	14.35
17:05	8.55	9.07	17:07	7.57	10.52	17:09	4.04	14.36
18:22	8.82	8.80	18:24	7.61	10.48	18:26	4.07	14.33

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Review of field data suggests that the depth-to-water measurement was incorrectly recorded in the field. The depth in feet was recorded as 9.82 feet but was apparently 6.82 feet; thus the measurement shown is 6.82 feet.
(c) Review of field data suggests that the depth-to-water measurement was incorrectly recorded in the field. The depth in feet was recorded as 9.93 feet but was apparently 6.93 feet; thus the measurement shown is 6.93 feet.

TABLE A-3

SURFACE WATER AND GROUND WATER ELEVATIONS MEASURED DURING TIDAL CYCLE
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

BW-10s

Time	Depth To Water (ft.)	Water Elevation (ft.,MLLW)(a)
08:10	8.70	14.09
09:11	8.71	14.08
09:41	8.70	14.09
10:12	8.70	14.09
11:05	8.74	14.05
12:07	8.68	14.11
13:07	8.66	14.13
13:38	8.65	14.14
14:10	8.64	14.15
15:06	8.64	14.15
16:12	8.65	14.14
16:36	8.66	14.13
17:07	8.67	14.12
18:08	8.63	14.16

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

\TACOMA\BLAIR\BWA-SG\3- .WK1

TABLE A-4

SURFACE WATER AND GROUND WATER ELEVATIONS
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

HIGH TIDE
(approx. 9:00-10:00 a.m.)

WELL	TIME	WATER ELEVATION (ft.,MLLW)(a)
BW-SG-1	09:07	14.13
GD-SG	09:11	10.07
BW-1s	09:27	16.24
BW-1i	09:27	11.40
BW-2s	09:01	16.17
BW-3s	09:15	15.81
BW-3i	09:18	12.62
BW-3d	09:17	11.70
BW-4s	09:24	11.11
BW-4i	09:22	10.77
BW-4d	09:25	10.40
BW-5i	09:13	10.90
BW-6s	09:23	15.29
BW-7s	09:19	16.09
BW-7i	09:18	11.48
BW-8s	09:15	14.60
BW-9s	09:06	14.23
BW-9i	09:07	10.62
BW-9d	09:09	10.57
BW-10s	09:11	14.08
Monitoring Wells Installed by Reichhold(b)		
MW-40i	-	10.99
MW-40d	-	11.99
MW-42s	-	16.47
MW-44i	-	12.56
MW-45i	-	10.36
MW-46i	-	10.61

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Exact time of measurement not reported on Reichhold wells. Data collected by CH2M Hill for Reichhold Chemicals, Inc. as summarized in Table A-5

SURFACE WATER AND GROUND WATER ELEVATIONS
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

MID TIDE
(approx. 1:00-2:00 p.m.)

MONITORING WELL	TIME	WATER ELEVATION (ft.,MLLW)(a)
BW-SG-1	13:03	6.90
GD-SG	13:03	10.17
BW-1S	13:20	16.31
BW-1I	13:18	11.29
BW-2S	12:23	16.20
BW-3S	13:10	15.91
BW-3I	13:14	9.18
BW-3D	13:12	9.79
BW-4S	12:26	11.14
BW-4I	12:27	10.70
BW-4D	12:24	10.52
BW-5I	13:09	10.67
BW-6S	13:18	15.34
BW-7S	13:16	16.12
BW-7I	13:14	9.75
BW-8S	13:11	14.64
BW-9S	13:07	14.33
BW-9I	13:06	10.73
BW-9D	13:05	10.69
BW-10S	13:07	14.13

Monitoring Wells Installed by Reichhold.(b)

MW-40i		
MW-40d	-	10.83
MW-42s	-	10.65
MW-44i	-	16.55
MW-45i	-	8.98
MW-46i	-	10.30
	-	10.56

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Exact time of measurement not reported on Reichhold wells. Data collected by CH2M Hill for Reichhold Chemicals, Inc. as summarized in Table A-5

TABLE A-4

SURFACE WATER AND GROUND WATER ELEVATIONS
BLAIR WATERWAY PROPERTY
FEBRUARY 2, 1990

LOW TIDE
(approx. 4:00-5:00 p.m.)

MONITORING WELL	TIME	WATER ELEVATION (ft.,MLLW)(a)
BW-SG-1	16:34	1.67
GD-SG	16:32	10.05
BW-1S	16:22	16.31
BW-1I	16:21	9.97
BW-2S	16:25	16.20
BW-3S	16:39	15.95
BW-3I	16:41	4.24
BW-3D	16:40	7.01
BW-4S	16:25	11.12
BW-4I	16:26	9.69
BW-4D	16:23	9.70
BW-5I	16:28	9.47
BW-6S	16:21	15.38
BW-7S	16:19	16.14
BW-7I	16:17	7.31
BW-8S	16:40	14.71
BW-9S	16:38	14.35
BW-9I	16:36	10.50
BW-9D	16:35	9.22
BW-10S	16:36	14.13
Monitoring Wells Installed by Reichhold.(b)		
MW-40i	-	9.90
MW-40d	-	7.61
MW-42s	-	16.54
MW-44i	-	5.29
MW-45i	-	9.76
MW-46i	-	10.52

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Exact time of measurement not reported on Reichhold wells. Data collected by CH2M Hill for Reichhold Chemicals, Inc. as summarized in Table A-5.

TACOMA\BLAIR\BWFINA-4.WK1

TABLE A-5

MONITORING WELL GROUND WATER ELEVATIONS
REICHHOLD CHEMICALS, INC.
FEBRUARY 2, 1990

		2/2/90 - High Tide		2/2/90 - Intermediate Tide		2/2/90 - Low Tide	
Monitoring Location	Reference Elevation	Depth to Water (ft.)	Water Elevation (ft.,MLLW)(a)	Depth to Water (ft.)	Water Elevation (ft.,MLLW)(a)	Depth to Water (ft.)	Water Elevation (ft.,MLLW)(a)
REICHHOLD WELLS							
MW-11S2	18.19	3.01	15.18	2.96	15.23	2.96	15.23
MW-11I2	20.18	8.25	11.93	8.23	11.95	8.24	11.94
MW-11D2	19.51	8.58	10.93	8.54	10.97	10.05	9.46
MW-12S	18.09	1.24	16.85	1.29	16.80	1.35	16.74
MW-12I	17.21	4.27	12.94	4.50	12.71	4.48	12.73
MW-13S	19.73	4.39	15.34	4.34	15.39	4.28	15.45
MW-13I	19.78	8.53	11.25	9.34	10.44	8.64	11.14
MW-13D	19.92	9.4	10.52	8.66	11.26	10.40	9.52
MW-16S	18.83	2.14	16.69	2.12	16.71	2.12	16.71
MW-16I	19.00	7.09	11.91	7.13	11.87	7.12	11.88
MW-22S	19.04	2.86	16.18	2.82	16.22	1.79	17.25
MW-22I	18.89	7.05	11.84	7.14	11.75	7.15	11.74
MW-22D	18.76	8.38	10.38	7.91	10.85	8.44	10.32
MW-28I	23.14	11.77	11.37	11.66	11.48	11.77	11.37
MW-29I	21.41	10.16	11.25	10.06	11.35	10.04	11.37
MW-32S	19.27	3.13	16.14	3.11	16.16	3.06	16.21
MW-36I	18.85	8.10	10.75	8.08	10.77	8.16	10.69
MW-40I	17.34	6.35	10.99	6.51	10.83	7.44	9.90
MW-40d	16.82	4.83	11.99	6.17	10.65	9.21	7.61
MW-42s	17.37	0.90	16.47	0.82	16.55	0.83	16.54
MW-44I	16.99	4.43	12.56	8.01	8.98	11.70	5.29
MW-45I	18.09	7.73	10.36	7.79	10.30	8.33	9.76
MW-46I	20.05	9.44	10.61	9.49	10.56	9.53	10.52

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).

Source: CH2M Hill field data February 2, 1990.

TACOMA\BLAIR\BWFINA-5.WK1

TABLE A-6

SOIL SAMPLE ELEVATION AND LOCATION SUMMARY
BLAIR WATERWAY PROPERTY

Sample Identification	Ground Elevation (ft., MLLW)(a)	North Coordinate(b)	East Coordinate(b)
BR1	15.8	710017.0	1532239.0
BR2	17.6	710459.0	1531784.5
BR3	17.7	710774.0	1531459.0
BR4	16.9	711095.0	1531131.5
BR5	17.2	711481.0	1530720.0
BF1	17.8	710832.0	1531245.5
BF2	17.8	710840.5	1531261.5
BD1	17.3	710756.5	1531148.5
BD2	17.1	710770.5	1531181.5
BO1	16.3	710672.0	1530764.5
BO2	16.1	710668.0	1530710.5
BT1	17.3	709844.5	1532018.0
BT2	16.7	711074.0	1530384.5
BT3	17.7	710874.5	1530608.5
BT4	17.8	710243.0	1531216.5
BT5	17.2	710375.5	1531013.0
BT6	18.2	710658.0	1531162.0
BT7	17.6	710860.5	1530555.5
BT8	18.0	710466.0	1530979.0
BT9	18.2	710520.5	1530930.0
(c)			
BT11	18.1	710637.0	1531061.5
BT12	18.3	710582.5	1531083.0
BT13	18.1	710504.0	1531015.0
BT14	18.4	710450.0	1531062.0
BT15	18.3	710516.0	1531129.5
BT16	17.8	710437.0	1531132.0
BT17	18.2	710611.5	1531229.0
BT18	18.2	710642.5	1531273.0
BT19	17.8	710730.0	1531199.0
BT20	18.2	710716.5	1531147.0
BT21	18.1	710548.0	1530983.0
BT22	17.0	710440.5	1531441.0
BT23	16.3	710346.0	1531848.0
BT24	17.3	709903.5	1531947.0
BOLD1	17.8	710726.5	1531061.5
BOLD2	17.9	710683.0	1530980.0
BOLD2A	17.9	710634.5	1530945.5
BOLD3	18.3	710570.0	1530903.5
BWS1	12.8	710425.5	1531439.0
BWS2	17.6	710493.5	1530990.0

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Coordinate Datum: Washington State plane coordinates, south zone.
(c) Sample identification BT10 is omitted from the location summary and represents a blind field duplicate at location BT9.

TACOMA\BLAIR\BWFINA-6.WK1

TABLE A-7

SEDIMENT SAMPLE SURVEY DATA
BLAIR WATERWAY PROPERTY

SAMPLE I.D.	GROUND ELEVATION (ft., MLLW)(a)	NORTH COORDINATE(b)	EAST COORDINATE(b)
BWD1	12.1	709575.5	1531944.0
BWD2	17.1	709602.0	1531976.5
BWD3	15.7	709645.0	1532007.5
BWD4	15.8	709810.0	1532165.0
BWD5	16.1	709872.5	1532228.0
BLD1	3.8	710795.5	1530821.0
BLD2	3.4	710826.5	1530845.0
BLD3	3.2	710992.0	1530987.5
BLD4	4.9	710890.0	1531226.0
BLD5	1.2	710710.0	1530782.0
BLD6	3.1	710869.5	1530876.0
BLD7	2.9	710918.5	1530933.5
BLD8	4.3	711127.5	1530907.5
BOS1	14.2	711161.5	1530225.0
BOS2	16.2	711228.0	1530325.0
BDD1	12.3	711372.0	1529993.0
BDD2	13.0	711379.5	1530145.0
BDD3	14.3	711373.0	1530345.0
BDD4	14.9	711365.0	1530552.0
BDD5	16.0	711407.0	1530607.0
BDD6	15.5	711457.0	1530650.5
BDD7	16.1	711481.0	1530683.0
BDP1	14.5	711376.5	1530000.0
BWS1	-4.5(c)	710720.5	1530483.0
BWS2	-0.9(c)	710193.0	1531077.0

(a) Elevation Datum: Port of Tacoma (Mean Lower Low Water).
(b) Coordinate Datum: Washington State plane coordinates, south zone.
(c) Approximate elevation based on tide table and water depth.

TACOMA\BLAIR\BWFINA-7.WK1

TABLE A-8

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BR1

Depth (ft)	USCS* Symbol	Description	Elevation 15.8 ft**
0.0-1.0	GM	Brown silty sandy GRAVEL (loose) (moist) (fill)	

Note: Test pit completed to 1.0-ft depth on 12 January 1990. Groundwater encountered at 0.5 ft. Test pit located in the bottom of a drainage ditch.

Test Pit BR2

Depth (ft)	USCS Symbol	Description	Elevation 17.6 ft
0.0-2.0	GM	Brown silty sandy GRAVEL with rounded 3 to 6-inch cobbles (loose) (moist) (fill)	
2.0-6.5	SM	Gray-brown silty fine SAND with pockets of silt (loose) (moist) (fill)	

Note: Test pit completed to 6.5-ft depth on 12 January 1990. Groundwater not encountered.

Test Pit BR3

Depth (ft)	USCS Symbol	Description	Elevation 17.7 ft
0.0-2.0	SP	Gray-brown slightly silty slightly gravelly fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 12 January 1990. Groundwater not encountered.

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* Unified Soil Classification System presented on Figure A-1.

** Ground surface elevations surveyed by Port of Tacoma Engineering Department using Port datum (MLLW).

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BR4

Depth (ft)	USCS Symbol	Description	Elevation 16.9 ft
0.0-0.5	SM	Dark brown silty fine SAND (loose) (moist) (fill)	
0.5-2.5	SP	Light brown slightly silty gravelly fine to medium SAND (loose) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 12 January 1990. Groundwater not encountered. Surface has localized ponded water.

Test Pit BR5

Depth (ft)	USCS Symbol	Description	Elevation 17.2 ft
0.0-1.0	ML	Light yellow-brown and gray-brown sandy SILT (soft) (moist) (fill)	
1.0-3.5	SP	Brown-gray slightly silty fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 3.5-ft depth on 12 January 1990. Groundwater not encountered.

Test Pit BF1

Depth (ft)	USCS Symbol	Description	Elevation 17.8 ft
0.0-2.0	GM/SM	Brown gravelly sandy SILT with a few red-brown mottles (hard to dense) (moist) (fill)	
2.0-7.0	SP	Gray-brown fine SAND with trace of gravel and few pieces of concrete rubble (loose) (moist to wet) (fill)	

Note: Test pit completed to 7.0-ft depth on 12 January 1990. Groundwater not encountered. Test pit could not be extended beyond 7-ft depth because of sidewall sloughing.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BF2

Depth (ft)	USCS Symbol	Description	Elevation 17.8 ft
0.0-2.0	GM/SM	Brown gravelly sandy SILT with concrete debris and roots (dense) (moist) (fill) (oil staining on the surface) (fill)	
2.0-6.0	SP	Brown-gray fine SAND with trace of gravel and few pieces of concrete rubble (loose) (moist to wet) (fill)	

Note: Test pit completed to 6.0-ft depth on 12 January 1990. Groundwater not encountered. Test pit could not be extended beyond 6 ft because of sidewall sloughing.

Test Pit BD1

Depth (ft)	USCS Symbol	Description	Elevation 17.3 ft
0.0-0.5	SP	Dark gray slightly silty fine to medium gravelly fine SAND with a trace of slag on the surface (loose) (moist) (fill)	
0.5-5.0	SP	Gray-brown fine SAND with trace of gravel and silt (loose) (moist) (fill)	

Note: Test pit completed to 5.0-ft depth on 12 January 1990. Groundwater not encountered.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BD2

Depth (ft)	USCS Symbol	Description	Elevation 17.1 ft
0.0-0.2	SW	Dark gray slightly silty SAND with gravel and trace amounts of slag on the surface (loose) (moist) (oil staining on the surface) (fill)	
0.2-1.0	GM/SP	Brown silty gravelly fine to medium SAND with some red-brown mottles (medium dense to dense) (moist) (fill)	
1.0-6.0	SP	Gray-brown fine to medium SAND with trace of silt and gravel (loose) (moist) (fill)	

Note: Test pit completed to 6.0-ft depth on 12 January 1990. Groundwater not encountered.

Test Pit BO1

Depth (ft)	USCS Symbol	Description	Elevation 16.3 ft
0.0-1.0	GM	Gray-brown silty sandy GRAVEL (loose) (moist) (fill)	
1.0-5.0	GW	Gray-brown fine sandy GRAVEL with trace of silt (medium dense) (moist) (fill)	
5.0-8.5	GW	Gray-brown slightly silty fine sandy GRAVEL with pockets of gray medium SAND and black SILT with high organic material content and anaerobic odor, plus an 8"x8"x3' piece of timber (loose) (moist) (fill)	

Note: Test pit completed to 8.5-ft depth on 12 January 1990. Groundwater seepage encountered at 7.5 ft.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BO2

Depth (ft)	USCS Symbol	Description	Elevation 16.1 ft
0.0-0.5	SP	Dark brown slightly silty gravelly fine SAND (loose) (moist) (fill)	
0.5-6.0	SW	Brown to light gray-brown gravelly fine to coarse SAND (loose) (moist) (fill)	

Note: Test pit completed to 6.0-ft depth on 12 January 1990. Groundwater not encountered.

Test Pit BT1

Depth (ft)	USCS Symbol	Description	Elevation 17.3 ft
0.0-3.0	SP	Brown fine to medium SAND with silt pockets (loose) (moist) (fill)	
3.0-4.0	SM/ML	Gray silty very fine SAND grading to clayey SILT (loose) (moist) (fill)	
4.0-8.0	ML	Gray clayey SILT with lenses of fine sand (soft) (moist to wet)	

Note: Test pit completed to 8-ft depth on 12 January 1990. Groundwater seepage from surface to 8 ft at four separate zones.

Test Pit BT2

Depth (ft)	USCS Symbol	Description	Elevation 16.7 ft
0.0-1.0	GW	Gray silty fine to coarse sandy GRAVEL (medium dense to dense) (moist) (fill)	
1.0-3.0	SM	Dark brown silty fine SAND with thin lenses of silt (loose) (moist) (fill)	
3.0-5.0	SM	Gray-brown fine sandy SILT and silty very fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 5-ft depth on 12 January 1990. Groundwater not encountered.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT3

Depth (ft)	USCS Symbol	Description — Elevation 17.7 ft
0.0-1.5	SW	Brown silty gravelly fine to coarse SAND with asphalt and concrete debris (medium dense to dense) (moist) (fill)
1.5-2.5	GW	Gray-brown silty fine to coarse sandy GRAVEL (very dense) (moist) (fill)
2.5-3.0	SP	Black slightly silty fine SAND with roots and organic odor (loose to medium dense) (moist) (fill)
3.0-5.5	SP	Gray-brown gravelly fine SAND with trace of silt (loose to medium dense) (moist) (fill)

Note: Test pit completed to 5.5-ft depth on 12 January 1990. Groundwater seepage encountered at 4.0 ft.

Test Pit BT4

Depth (ft)	USCS Symbol	Description — Elevation 17.8 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND (loose to medium dense) (moist) (fill)
0.5-3.0	SP	Brown fine SAND with trace of gravel (loose to medium dense) (moist) (fill)
3.0-6.0	SP	Brown fine SAND with yellow-brown silt pockets with shell fragments from gravel to cobble size (loose) (moist) (fill)

Note: Test pit completed to 6.0-ft depth on 12 January 1990. Groundwater not encountered.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT5

Depth (ft)	USCS Symbol	Description — Elevation 17.2 ft
0.0-1.0	GW	Yellow-brown grading to dark gray silty fine to coarse sandy GRAVEL with trace of slag on the surface (medium dense to dense) (moist) (fill)
1.0-3.0	SP	Gray-brown slightly silty fine SAND (loose) (moist) (fill)
3.0-3.5	SP	Black slightly silty fine SAND with roots and decomposed wood (loose) (moist) (fill)
3.5-6.0	SP	Brown slightly silty fine SAND with roots and trace of gravel (loose) (moist) (fill)

Note: Test pit completed to 6.0-ft depth on 12 January 1990. Groundwater not encountered.

Test Pit BT6

Depth (ft)	USCS Symbol	Description — Elevation 18.2 ft
0.0-0.5	GM	Gray silty GRAVEL with 1-inch layer at surface of red-brown (oxidized) silty gravel (medium dense to dense) (moist) (fill)
0.5-1.5		Black slag
1.5-3.5	SP	Brown slightly silty fine SAND with trace of gravel (loose) (moist) (fill)

Note: Test pit completed to 3.5-ft depth on 13 January 1990. Groundwater encountered at 3.0 ft.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT7

Depth (ft)	USCS Symbol	Description	Elevation 17.6 ft
0.0-4.0	SP	Brown slightly silty gravelly fine SAND with large chunks of asphalt debris (loose to medium dense) (moist) (fill)	
4.0-5.0	ML	Gray SILT with black mottles and roots (soft) (moist to wet)	

Note: Test pit completed to 5.0-ft depth on 12 January 1990. Groundwater seepage encountered at 4.0 ft.

Test Pit BT8

Depth (ft)	USCS Symbol	Description	Elevation 18.0 ft
0.0-1.0		Black slag	
1.0-1.3	SM	Yellow-brown silty fine SAND with trace of gravel (loose to medium dense) (moist) (fill)	
1.3-4.0	SP	Dark gray slightly silty fine SAND with trace of gravel (loose to medium dense) (moist) (fill)	

Note: Test pit completed to 4.0-ft depth on 13 January 1990. Groundwater not encountered.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT9*

Depth (ft)	USCS Symbol	Description	Elevation 18.2 ft
0.0-2.0	SM	Yellow-brown silty fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT11*

Depth (ft)	USCS Symbol	Description	Elevation 18.1 ft
0.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT12*

Depth (ft)	USCS Symbol	Description	Elevation 18.3 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.5		Black slag	
1.5-2.5	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 13 January 1990. Groundwater not encountered.

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* Test pit exploration to identify the presence or absence of slag. A general soil description is presented.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT13*

Depth (ft)	USCS Symbol	Description	Elevation 18.1 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.5		Black slag	
1.5-2.5	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT14*

Depth (ft)	USCS Symbol	Description	Elevation 18.4 ft
0.0-0.5	SW	Gray-brown slightly silty gravelly fine to coarse SAND with concrete debris and trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.5		Black slag	
1.5-2.5		Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 13 January 1990. Groundwater not encountered.

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* Test pit exploration to identify the presence or absence of slag. A general soil description is presented.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT15*

Depth (ft)	USCS Symbol	Description	Elevation 18.3 ft
0.0-0.5	SW	Gray-brown slightly silty gravelly fine to coarse SAND with concrete debris and trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.0		Black slag	
1.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT16*

Depth (ft)	USCS Symbol	Description	Elevation 17.8 ft
0.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT17*

Depth (ft)	USCS Symbol	Description	Elevation 18.2 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.0		Black slag	
1.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

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* Test pit exploration to identify the presence or absence of slag. A general soil description is presented.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT18*

Depth (ft)	USCS Symbol	Description	Elevation 18.2 ft
0.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT19*

Depth (ft)	USCS Symbol	Description	Elevation 17.8 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.5		Black slag	
1.5-2.5	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT20*

Depth (ft)	USCS Symbol	Description	Elevation 18.2 ft
0.0-0.5	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.5-1.0		Black slag	
1.0-2.0	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

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* Test pit exploration to identify the presence or absence of slag. A general soil description is presented.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT21*

Depth (ft)	USCS Symbol	Description	Elevation 18.1 ft
0.0-0.3	SW	Brown slightly silty gravelly fine to coarse SAND with a trace of slag on ground surface (medium dense to dense) (moist) (fill)	
0.3-0.5		Black slag	
0.5-2.0	SW	Brown slightly silty gravelly fine to coarse SAND (medium dense to dense) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 13 January 1990. Groundwater not encountered.

Test Pit BT22

Depth (ft)	USCS Symbol	Description	Elevation 17.0 ft
0.0-1.0	--	Black slag	
1.0-2.0	SM/ML	Gray silty fine SAND and SILT (loose) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 9 March 1990. Groundwater not encountered. Test pit located on the side slope of the Graving Dock.

Test Pit BT23

Depth (ft)	USCS Symbol	Description	Elevation 16.3 ft
0.0-1.0	—	Black Slag	
1.0-2.0	SM	Gray-brown silty very fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 2.0-ft depth on 9 March 1990. Groundwater not encountered. Test pit located on the side slope of the Graving Dock.

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* Test pit exploration to identify the presence or absence of slag. A general soil description is presented.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BT24

Depth (ft)	USCS Symbol	Description	Elevation 17.3 ft
0.0-1.5	—	Black slag	
1.5-2.5	SM	Red-brown silty very fine SAND (loose) (moist) (fill)	

Note: Test pit completed to 2.5-ft depth on 9 March 1990. Groundwater not encountered. Test pit located on the side slope of the Graving Dock.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BOLD-1

Depth (ft)	USCS Symbol	Description	Elevation 17.8 ft
0.0-1.0	GW	Light gray fine sandy GRAVEL (very dense) (dry) (fill)	
1.0-13.0	SM	Dark gray slightly gravelly silty SAND and sandy SILT with few cobbles to 6 inches (loose to soft) (moist to wet) (fill)	
13.0-13.5	ML	Black SILT with root fibers, two pieces of broken glass, a large powerline insulator, and small piece of plastic (soft) (moist to wet)	
13.5-16.0	ML	Dark gray clayey SILT (soft) (moist to wet)	

Note: No groundwater seepage observed. Total depth of test pit 16 ft. Ditch sediment contact at 13 ft. Sample BOLD-1 collected from 13.0-13.5 ft.

Test Pit BOLD-2

Depth (ft)	USCS Symbol	Description	Elevation 17.9 ft
0.0-1.0	GW	Light brown and gray slightly silty sandy GRAVEL (very dense) (dry) (fill)	
1.0-12.0	SP	Dark brown slightly silty, slightly gravelly fine SAND with scattered pieces of concrete and asphalt up to 2 ft in diameter and one piece of 4-inch pipe (loose) (moist to wet) (fill)	

Note: Groundwater seepage encountered at 5-6 ft. Test pit sidewall sloughing prevented exploration depth beyond 8-9 ft. Bucket depth to about 12 ft. No ditch sediment encountered. No chemical sample collected. Test pit sloughed to about 20 ft wide.

TEST PIT LOGS
BLAIR WATERWAY PROPERTY

Test Pit BOLD-2A

Depth (ft)	USCS Symbol	Description	Elevation 17.9 ft
0.0-1.5	GW	Light brown and gray slightly silty sandy GRAVEL (dense) (dry) (fill)	
1.5-13.0	SW	Dark gray silty gravelly SAND (medium dense) (moist to wet) (fill)	
13.0-13.2	ML	Black SILT with roots (soft) (moist)	
13.2-14.0	ML	Dark gray clayey SILT with trace of fine gravel (soft) (moist)	

Note: No groundwater encountered. Total depth of test pit 14 ft. Ditch sediment contact at 13 ft. Sample BOLD-2A collected from 13.0-13.2 ft.

Test Pit BOLD-3

Depth (ft)	USCS Symbol	Description	Elevation 18.3 ft
0.0-1.0	GW	Light brown and gray slightly silty sandy GRAVEL (very dense) (dry) (fill)	
1.0-13.0	SP	Dark brown slightly silty, slightly gravelly fine SAND with few cobbles to 4 inches and one thin localized 4-inch layer of white gypsum-like material (loose) (moist to wet) (fill)	
13.0-13.2	ML	Black SILT with roots (soft) (moist)	
13.2-14.0	ML	Dark gray clayey SILT (soft) (moist)	

Note: No groundwater seepage encountered. Sample BOLD-3 collected from 13.0-13.2 ft. Total depth of test pit 14 ft. Ditch sediment contact at 13 ft. Test pit sidewall sloughed until about 20 ft wide.

APPENDIX B

APPENDIX B

Marine Sediment Sampling Activities Blair Waterway Property

APPENDIX B
MARINE SEDIMENT SAMPLING ACTIVITIES
BLAIR WATERWAY PROPERTY

INTRODUCTION

Collection of marine sediment samples was accomplished by Herrera Environmental Consultants, Inc. (Herrera) under subcontract to Landau Associates, Inc. (Landau Associates). A summary of the marine sediment sampling activities is presented in the February 13, 1990 Herrera report (Herrera 1990; Attachment B-1). Key activities related to the Blair Waterway Property are indicated by vertical margin lines. Marine sediment sampling procedures generally complied with those described in the Phase I Environmental Investigation Work Plan (Landau Associates 1989b). Deviations from the work plan, necessitated by conditions encountered at the site, are described below.

SAMPLING PROCEDURE

At each of the two Blair Waterway Property stations (BWS-1 and BWS-2), the work plan specified the collection and analysis of composited sediment samples from only two strata (0-88 cm and 88-90 cm). The requirement of collecting multiple cores at each station to provide sufficient sediment for analysis (see below) allowed collection of sufficient surface sediment (0-2 cm) for a separate analysis of this stratum. Hence, composite samples were collected and analyzed from both the 0-2 cm and 2-88 cm strata.

At each of these stations, the work plan had specified the collection of three sediment cores to a depth of at least 90 cm. The initial intent had been that these sediment cores would be collected using a gravity corer. Sediment conditions encountered in the field would not allow sediment penetration for a single core to a depth of at least 90 cm using the coring device actually deployed. Consequently, an alternative method was used to allow sediment collection for deeper depths. This method employed the pumping of marine water down through the core tube as it was lowered into the sediment. Upon reaching the depth of maximum penetration for a previous core at that station, the corer was driven into the deeper sediment for collection of the next core portion. This necessitated the collection of a succession of sediment samples over the depth range of 2-88 cm. These samples were later composited into a single 2-88 cm sample at each station.

In addition, insufficient sediment was collected in three cores from either the 0-2 cm or 88-90 cm strata to conduct all of the required analyses. This necessitated, in the case of the 0-2 cm stratum, compositing of samples from more than three cores and, in the case of the 88-90 cm stratum, increasing the maximum depth sampled to 98 cm. Compositing of more than three core samples for the 0-2 cm stratum should not adversely affect interpretation of the resultant data, and may make the composite samples more representative of the general conditions at a given station. Collection of the deepest sample from a depth of 88-98 cm should, also, not adversely affect interpretation of the resultant data, because the intent of the 88-90 cm sample was to evaluate if sediment contamination observed at shallower depths extended deeper into the sediments. This interpretation is valid regardless of whether the sample was from 88-90 cm or 88-98 cm.

SAMPLING PROCEDURE DISCUSSION

There are two potential concerns with the methods employed (Herrera 1990) to extract sediment cores. First, the estimated depths of penetration achieved by these methods are less accurate than those that could be estimated from a single core penetrating to a similar maximum depth. Interpretation of the resultant data is not likely to be adversely affected because the results provide a general characterization of subsurface sediment contamination. The second concern is that pumping water down through the core tube to facilitate sediment penetration could introduce contamination to the deeper sediments. Assuming that the sediment core extracted was intact and undisturbed, any such contamination would be limited to the upper surface of this sediment core; once mixed with a substantially larger sediment volume in the core, the effect of such surficial contamination would probably be negligible.

The work plan (Landau Associates 1989b) states that sampling and analysis will be in accordance with PSEP protocols. Sampling procedures for volatile organics require that disturbances of the soil be minimized. Agency reviewers were concerned that volatile organic samples had been collected after samples were composited (mixed or blended with other samples). Discussion with Herrera (Landau Associates 1991d) concerning volatile organics sample collection procedures indicate PSEP procedures were followed because samples were collected directly from the top 2 cm of sediment out of the Van Veen grab sampling device prior to compositing samples for other analytes. At the request of Herrera, the description of volatile organic sampling (Herrera 1990) has been expanded to state that "volatile organic samples were collected prior to compositing."

ATTACHMENT B-1

Herrera Environmental Consultants
Marine Sediment Sampling Activities Report
February 13, 1990*

* Field Notes are not included. Chain-of-Custody Records are included here and in Appendix D (bound separately).

MARINE SEDIMENT SAMPLING ACTIVITIES REPORT

PHASE II ENVIRONMENTAL INVESTIGATION
PORT OF TACOMA
PROPERTY TRANSFERS

February 13, 1990

Prepared for

Landau Associates, Inc.
P.O. Box 1029
Edmonds, Washington 98020-9129

by

Herrera Environmental Consultants, Inc.
1414 Dexter Avenue North, Suite 200
Seattle, Washington 98109

Note: Handwritten change made to page 5 to address March 28, 1991, EPA comments, as approved by Herrera Environmental Consultants, April 19, 1991. BJ Burke

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- Substrate Sample Records
- Field Notes

INTRODUCTION

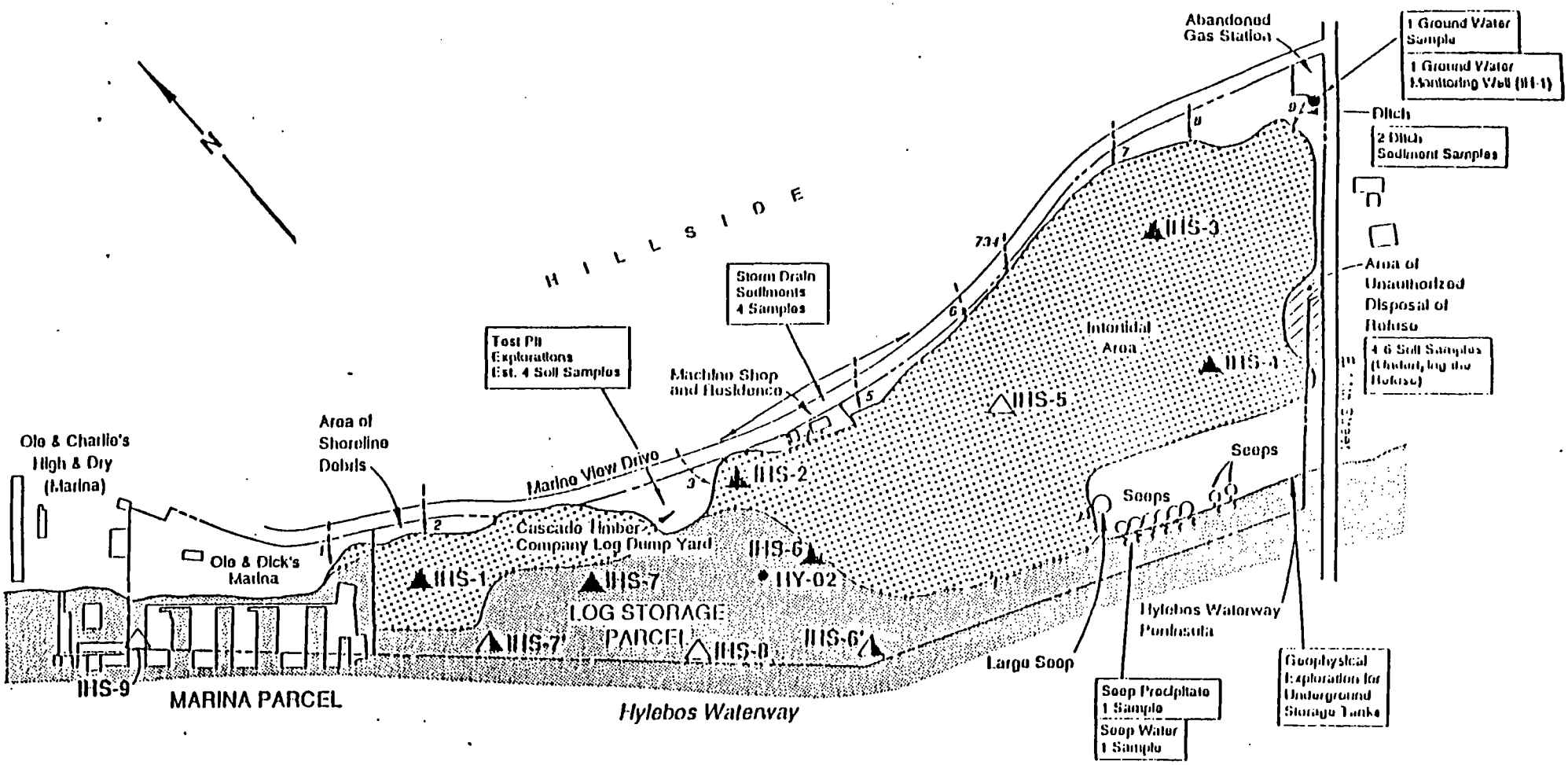
Samples of marine sediment were collected by Herrera Environmental Consultants, Inc. from the following three Port of Tacoma properties: Inner Hylebos Waterway, Upper Hylebos Waterway, and Blair Waterway (Figures 1, 2, and 3). Methods for sample collection were according to the Project Work Plan (Landau, 1989) and Puget Sound Estuary Program (PSEP) protocols (Tetra Tech, 1986 a, b, c). These sampling methods included those identified in the Health and Safety Plan and Quality Assurance Project Plan (Appendices A and B of the Project Work Plan). Specific sample collection methods and field observations are presented separately for surface sediment stations and sediment core stations.

SURFACE SEDIMENT STATIONS

Methods

Surface sediment samples were collected from four intertidal and two subtidal stations on the Inner Hylebos Waterway property (Figure 1), and two subtidal stations on the Upper Hylebos Waterway property (Figure 2). These surface sediment stations were sampled when the sediments were exposed to air during low tide conditions on the evening of January 10, 1990. The maximum low tide elevation at Tacoma was -2.7 ft. at 10:29 p.m. on the day of sample collection, and the samples were collected between 8:50 p.m. and 12:40 a.m. The sampling team members were Walter Trial, Rob Zisette, and Michael Spillane.

Stations positions on the Inner Hylebos Waterway property were located with a compass by walking due south from Marine View Drive for distances previously determined from the map in the Project Work Plan and presented in Figure 1. Station positions on the Upper Hylebos Waterway property were located by walking perpendicular to the shoreline for a predetermined distance. In order to sample exposed sediments, Station UHS-1 was relocated 3 m closer to shore and Station UHS-2 was relocated 6 m closer to shore than shown on the map in Figure 2. Also, Station UHS-2 was relocated 12 m to the northwest to avoid a bias from a drainage ditch discharge. All other surface sediment stations were located as identified from the map in Figure 1.



KEY

HY-02 ● Previous Sediment Sample Location and Designation

Shoreline

Outfall/Drainage Location and Designation (TPCHD 1988)

HIS-7▲ Intertidal and Subtidal Surface Sediment Station Location (Approximate) and Designation

HIS-6'▲ Alternate Subtidal Surface Sediment Station Location (Approximate) and Designation

HIS-8△ Intertidal and Subtidal Sediment Core Station Location (Approximate) and Designation

Subtidal Area

Intertidal Area (Approximate)

0 500 1000

Approximate Scale in Feet

Note: For illustration purposes, refer to text for details.

Figure 1

LANDAU ASSOCIATES, INC.

Inner Hylebos Property Sampling Plan

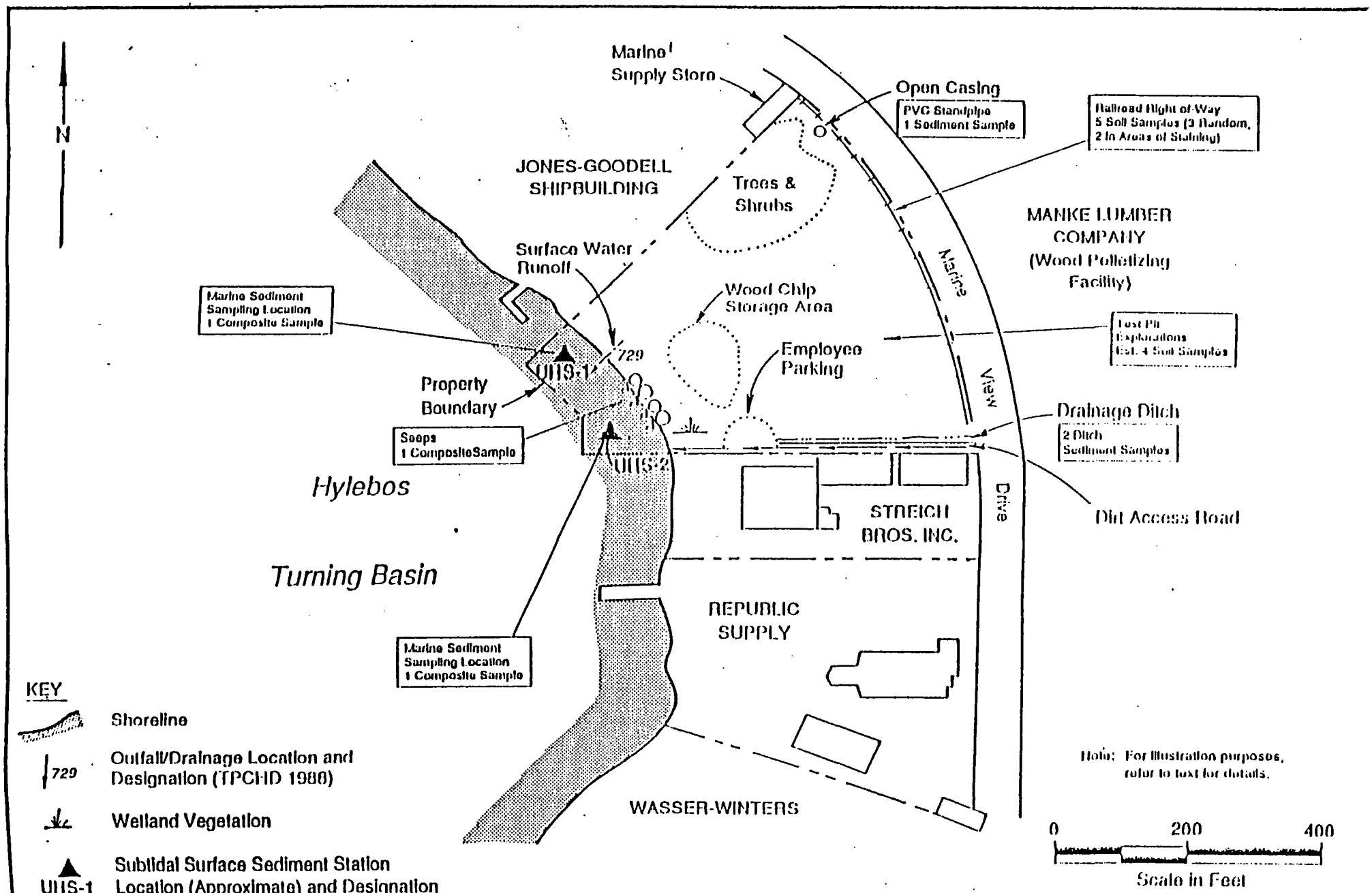
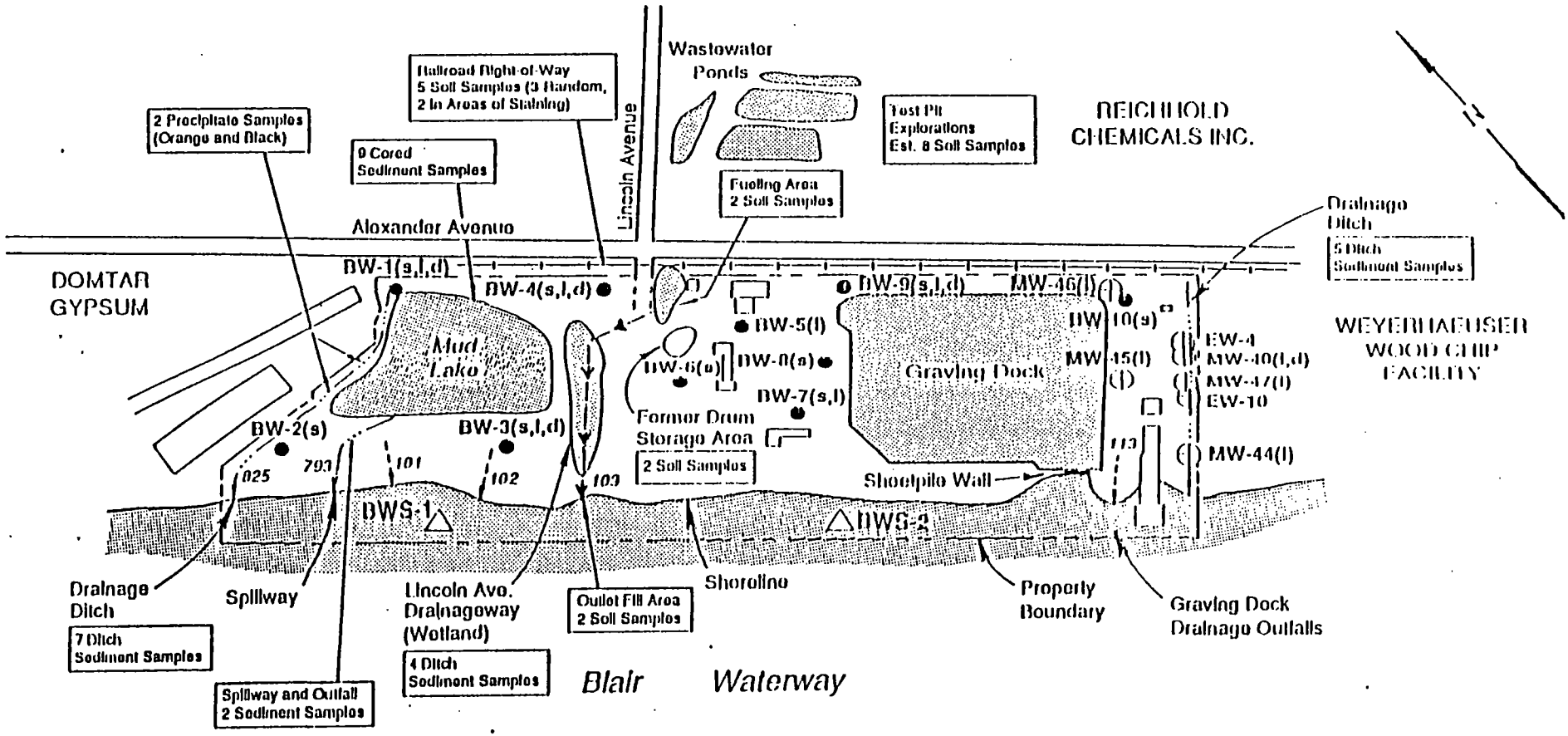


Figure 2

LANDAU ASSOCIATES, INC.

Upper Hylebos Property Sampling Plan



KEY

Shoreline

102 — Outfall/Drainage Location and Designation (TPCHD 1988)

BWS-1 — Subtidal Sediment Core Station Location (Approximate) and Designation

BW-5(i) — Phase II Monitoring Well Location and Designation (s=shallow; i=intermediate; d=deep)

EW-4 — Existing Monitoring and Extraction Wells Associated with Reichhold Chemicals Inc. Investigations

0 500 1000
Approximate Scale in Feet

Note: For illustration purposes, refer to text for details.

Figure 3

LANDAU ASSOCIATES, INC.

Blair Waterway Property Sampling Plan

Buoys were anchored at each surface sediment station at the time of sample collection. The exact position of the buoy anchors was determined the day after sample collection by the Port of Tacoma using standard survey techniques.

At each surface sediment station, five subsamples were collected and composited into one sample. Each subsample was collected with a stainless steel spatula to a depth of 2 cm and in a 10 cm square area. The subsamples were placed in a stainless steel mixing bowl and thoroughly mixed with a stainless steel spoon. The mixed sample was then placed in sample jars provided by the laboratory (Analytical Resources, Inc.). Large gravel and wood chips, greater that 3 cm in diameter, were excluded from the samples. Sample jars for volatile organics and sulfide analyses were filled directly from the top 2 cm of sediment in the sampler prior to mixing for composite samples. Indelible ink was used to label the sample jars with information identified in the Quality Assurance Project Plan. The samples were numbered according to the following sequence: 1) project initials (PT for Port of Tacoma), 2) station number (IHS-# for Inner Hylebos Sediment or UHS-# for Upper Hylebos Sediment), and 3) sampling depth interval (e.g., 02 for 0-2 cm).

The spatula, bowl, and spoon were decontaminated each time prior to use. The decontamination procedure included the following steps: initial rinse to remove most of the sediment, Alconox soap wash with a bristle brush, warm tap water rinse five times, and deionized water rinse four times. The equipment was then drained, the utensils were placed in the bowl, and the bowl was covered with clean aluminum foil.

Three extra samples were collected and submitted to the lab for quality control: field replicate, equipment wipe, and trip blank. The field replicate was collected at Station IHS-2 by doubling the number of subsamples and filling jars labeled for Station IHS-12 with the extra mixed sample. The replicate volatile organics and sulfide samples were collected as separate grabs. The equipment wipe sample was collected by wiping a decontaminated mixing bowl with a hexane-saturated cloth, which was provided by the laboratory. This procedure involved removing the cloth from a jar with decontaminated Solvex gloves and replacing the cloth in the jar after wiping the entire surface of the 40 cm diameter stainless steel bowl. In accordance with the Quality Assurance Project Plan, the bowl was previously used for the field replicate sample and the equipment wipe sample was labeled with the field replicate number followed by an RB (for rinsate blank). The trip blank was provided by the laboratory, transported in the cooler with the samples, and submitted to the lab as Trip Blank 1.

All samples were stored with ice in a cooler from the time of collection until they were hand-delivered to the lab the following day. A chain of custody record was submitted with the samples (see attached copy). The chain of custody record requested the following four groups of testing parameters for Puget Sound Dredge Disposal Analysis (PSDDA): semi-volatile (extractable) organics, volatile organics (VOA), metals, and conventionals. Only the volatile organics analysis was requested for the trip blank, while only semi-volatile (extractable) organics and metals analyses were requested for the equipment wipe. Matrix spike and matrix spike duplicate (MS/MSD) analyses were requested for the field duplicate. Also, tributyltin (TBT) analysis was requested for the sample from the station nearest Ole & Dick's Marina (IHS-1). Attached to the chain of custody record was a copy of Chapter 4.0 of the Project Work Plan, Chemical Analysis Procedures, which included the list of testing parameters, detection limits, and analytical methods.

Field Observations

Field observations of sediment type, color, odor, and debris were recorded in a bound waterproof notebook. Also recorded in the notebook were the names of samplers, station location measurements, sampling times, and photograph documentation. The notebook and photographs are secured by the Herrera Field Coordinator (Rob Zisette). A copy of the notebook is attached.

The substrate sample record is also attached, which summarizes field observations in a standard form. Different codes for sediment type and color at each station are listed in order of prevalence. For example, the surface sediment samples were typically described as silt/sand (code 5/4), which means silt was the primary sediment type and sand was the secondary sediment type.

General sediment characteristics were similar among the surface sediment stations at the two properties on the Hylebos Waterway. Surface sediment at the Inner Hylebos stations was predominantly silt with some sand and wood chips. Sediment color was brown at the surface (1.5 cm) with underlying black sediments that had a strong sulfide odor. Surface sediment at the Upper Hylebos stations was predominantly a brown-gray sand with considerable gravel, cobble, and silt. This sediment had no obvious odor or visible debris.

SEDIMENT CORE STATIONS

Methods

Sediment cores were collected from one intertidal and two subtidal stations on the Inner Hylebos Waterway property, and from two subtidal stations on the Blair Waterway property (see Figures 1 and 3). These sediment core stations were sampled on four consecutive days from January 16 to January 19, 1990. The sampling team members were Rob Zisette, Michael Spillane, and Mike Gibb.

Stations were located with the buoys positioned on January 11, 1990 by the Port of Tacoma using standard survey techniques. The buoy at Station IHS-8 was lost, but its position was determined with the sight lines and distance recorded at the time of buoy placement. Station IHS-9 was located with reference to the covered docks at Ole & Dick's Marina (i.e., midway between docks and in line with the eastern edge of the dock to the north).

At each sediment core station, three replicate cores were collected to a depth of at least 92 cm into the sediment. The cores were divided into a surface sample (0-2 cm), middle sample (2-88 cm) and a bottom sample (88-90 cm). To obtain enough sample for analysis, the lower depth limit for the bottom sample was increased from 90 cm to between 92 and 98 cm. Two additional shallow cores were collected at each station to obtain enough material for analysis of the surface sample. The replicate cores were taken within one meter of each other.

The coring apparatus, manufactured by Gibb Equipment Company, consisted of stainless steel core tubes that screw into a metal check-valve assembly and 3/4-inch metal pipe or conduit. The core tubes are 7 cm in diameter and 80 cm in length. The metal pipe was added to the assembly in 5-foot lengths as it was lowered through the space between two adjoining work boats. Once at the sediment surface, the depth of the coring assembly was marked for reference and pushed slowly into the sediment by hand. The corer was then driven with a slide hammer or jack hammer to a total penetration depth of 80 cm or less. The corer was quickly raised, capped, and disassembled while it was held vertically. In cases where the water depth exceeded 15 feet, a fabric plate (core catcher) was slipped under the core tube to prevent any loss of material as the apparatus was raised and disassembled.

Sediment core recovery (i.e., depth of sediment in the core tube) was measured by inserting a decontaminated meter stick in the top of the core tube. Appropriate core lengths were extruded for each sample into stainless steel mixing bowls. Sediment recovery was generally between 20 and 60 cm. Because the required total core length was 100 cm, each replicate core was collected in consecutive portions. In order to sample deeper core portions, marine water was pumped down through the core tube as it was lowered to the desired sampling depth. The pump rate increased with sediment density to a maximum rate of approximately 50 gpm at 50 psi. Once at the sampling depth, the corer was driven into the sediment to collect the next core portion.

A piston assembly was used as an alternative method for reaching the sampling depth in the soft sediment at Stations IHS-8 and IHS-9. With this method, the piston was held in the bottom of the core tube as the corer was lowered to the sampling depth. The next core portion was then collected by holding the piston stationary and driving the corer into the sediment.

Observations of sediment characteristics were recorded in the field notebook as the material was extruded from the core tube. After the material was extruded into the mixing bowl, sample jars for volatile organics and sulfide analysis were filled with sediment from one replicate core at the midpoint of the sample depth interval. Once all replicate cores were collected at a station, each of the three samples were thoroughly mixed with a stainless steel spoon and placed in the sample jars. The jars were labeled as noted for the surface sediment stations. The samples were numbered with the following depth intervals: 02 for the surface sample, 288 for the middle sample, and 8890 for the bottom sample.

The core tube, piston, mixing bowls, and spoons were decontaminated prior to use at each station according to the procedure described for the surface sediment stations. The core tube and piston were scrubbed with an Alconox and water solution and rinsed in marine water between core samples. Also, the check-valve assembly, metal pipe, and water pump were cleaned with Alconox and water and rinsed with tap or marine water before they were used for this project.

The samples were stored on ice in a secured cooler and delivered to the lab in two batches. The second batch of samples included a USEPA QA/QC reference sample

and a trip blank. The reference sample was sent by Joseph N. Blazevich from the EPA Region 10 Manchester Lab on January 4, 1990. The sample consisted of four 50 mL jars that were about two-thirds full of Sequim Bay Reference Material. This material was frozen until being transferred to a laboratory jar with a decontaminated spatula for analysis of semi-volatile organics, pesticides and PCBs. The reference sample was identified as Station IHS-13. The trip blank (Trip Blank 2) was transported with both sample batches for analysis of volatile organics. The attached chain of custody records also included a detailed analysis request list for the core samples (Chapter 4.0 of the Work Plan). Tributyltin (TBT) analysis was requested for the three core samples from the Inner Hylebos core station at Ole & Dick's Marina (IHS-9).

Field Observations

Field observations were recorded in a bound waterproof notebook and are summarized in the attached substrate sample records. Sediment characteristics were similar at the two subtidal stations on the Inner Hylebos Waterway property (IHS-8 and IHS-9). At both stations, the surface sediment was black, loose silt with a strong sulfide odor, and the bottom sediment was gray firm clay. The thickness of the black silt was 20 cm at Station IHS-9 and between 30 and 60 cm at Station IHS-8. The difference in thickness of black silt among the replicate cores at Station IHS-8 is likely related to differences in core locations. Station IHS-8 was the only station sampled on two consecutive days and log rafting activities made it difficult to maintain station position.

Sediment characteristics at the intertidal station on the Inner Hylebos Waterway property were consistently fine gray sand with wood chips, some gray clay, and a moderate sulfide odor.

Sediment characteristics were somewhat different at the two subtidal stations on the Blair Waterway property. The surface sediment was black, medium sand at both stations, but was about 90 cm thick at Station BWS-1 and only 30 cm thick at Station BWS-2. The underlying sediment at Station BWS-1 was a thin layer of gray clay (from 90 to 95 cm) followed by gray, fine sand (from 95 to 130 cm). Conversely, the underlying sediment at Station BWS-2 was a thick layer of gray clay (from 30 to 90 cm) followed by black, medium sand (from 90 to 120 cm). Also, a moderate sulfide odor was observed in all of the material from BWS-1, but not in material from BWS-2.

REFERENCES

Landau & Associates, Inc., 1989. Work Plan, Phase II Environmental Investigation Port of Tacoma Property Transfers. Prepared for Port of Tacoma. December 4, 1989.

Tetra Tech, Inc., 1986a. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program. March 1986.

_____, 1986b. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment, and Tissue Samples, Puget Sound Estuary Program. August 1986.

_____, 1986c. Recommended Protocols for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples, Puget Sound Estuary Program. December 1986.

SAMP-REP.DOC

ATTACHMENTS

118 02.22 Port of Tacoma/Work Plan 12-1-89

Landau Associates, Inc.
Edmonds, WA (206) 778-0907

Chain of Custody Record

Date 1-11-89
Page 1 of 1

Project Port of Tacoma Sediment Project No. 118-02.23
Client Port of Tacoma
Project Location Hylebos / Blair Waterway
Sampler's Name Rob Zisette, HEC

Lab Analytical Resources
Lab #
P.O. #

Marine Sediment

Testing Parameters *

	Sample No.	Date	Time	Location	No. of Containers	PSDA Semi-vol Organics	PSDA Conventionals	PSDA VOA	PSDA Metals (TAD)	Observations/Comments
PT-	IHS-1-02	1/11/90	0040	Inner Hylebos	5	X	X	X	X	+ Tributyltins (TBT)
PT-	IHS-2-02	1/10/90	2215		5					
PT-	IHS-3-02	1/10/90	2240		5					
PT-	IHS-4-02	1/10/90	2120		5					
PT-	IHS-6-02	1/10/90	2240		5					
PT-	IHS-7-02	1/10/90	2310		5					
PT-	IHS-12-02	1/10/90	2225		5					+ MS/MSD
PT-	UHS-1-02	1/11/90	0005	Upper Hylebos	5					
PT-	UHS-2-02	1/10/90	2355	" "	5					
	Trip Blank 1	1/5/90	—	—	1					Water
PT-	IHS-12-02-RB	1/10/90	2225	—	1	X			X	Hexane Equipment Wipe

* see attached list for PSDA Parameters, detection limits, and analytical methods

Special Shipment/Handling or Storage Requirements as per PSEP/PSDA

Method of Shipment Hand Deliver

Relinquished by	Received by	Relinquished by	Received by
Signature RM Zisette	Signature Terrie Hedger	Signature	Signature
Printed Name RK Zisette	Printed Name Terrie Hedger	Printed Name	Printed Name
Company	Company ARI	Company	Company
Date Time	Date 1-11-90 Time 13:15	Date Time	Date Time

5/87 INVOICE + DATA TO Brian Butler @ Landau

LANDAU ASSOCIATES, INC.

Chain of Custody Record

Landau Associates, Inc.
Edmonds, WA (206) 778-0907

Chain of Custody Record

Date 1/18/90
Page 1 of 1

Project Port of Tacoma Sediment Project No. 118-02.23
Client Port of Tacoma
Project Location Hylebos/Blair Waterways
Sampler's Name Rob Zisette (HEC)

Lab
Lab #
P.O. #

Testing Parameters *

Sample No.	Date	Time	Location	No. of Containers	PSDDA Org + Conv.	Particle Size (PSD)	PSDDA Metals (TAD)	PSDDA VOA	Sulfide	Tributyltins					Observations/Comments
PT-IHS-9-02	1/16/90	1300	Hylebos Waterway	5	X	X	X	X	X	X					* see attached sheets for
PT-IHS-9-288	1/16/90	1300		5						X					list of parameters
PT-IHS-9-8890	1/16/90	1300		5						X					analytical methods and
PT-IHS-8-02	1/17/90	1215		5											detection limits -
PT-IHS-8-288	1/17/90	1215		5											Puget Sound Dredge Disposal
PT-IHS-8-8890	1/17/90	1215		5											Analysis (PSDDA)
PT-BWS-2-02	1/18/90	1445	Blair Waterway	5											
PT-BWS-2-288	1/18/90	1445		5											
PT-BWS-2-8890	1/18/90	1445		5											

Special Shipment/Handling or Storage Requirements: according to PSEP + PSDDA

Method of Shipment: hand deliver

Relinquished by	Received by	Relinquished by	Received by
Signature: R R Zisette	Signature: Walter Trial	Signature: Walter Trial	Signature: Jan Hilkins
Printed Name: R R Zisette	Printed Name: Walter Trial	Printed Name: Walter Trial	Printed Name: JAN HILKINS
Company: Herrera Environmental Consultants	Company: Herrera Environmental Consultants	Company: Herrera Environmental Consultants	Company: A.R.I.
Date 1/18/90 Time 2200	Date 1/18/90 Time 2200	Date 1/19/90 Time 9:05	Date 1/19/90 Time 9:05

5/87

Landau Associates, Inc.
Edmonds, WA (206) 778-0907

Chain of Custody Record

Date 1/22/90
Page 1 of 1

Project Port of Tacoma Sediment Project No. 118-02.23
Client Port of Tacoma
Project Location Hylebos/Blair Waterways
Sampler's Name Rob Zisette

Lab
Lab #
P.O. #

Testing Parameters *

	Sample No.	Date	Time	Location	No. of Containers	PSDA Org + Conv.	Particle Size (PSD)	PSDA Metals	PSDA VOA	Sulfide						Observations/Comments
PT-	BWS-1-02	1/19/90	1005	Blair Waterway	5	X	X	X	X	X						
PT-	BWS-1-288	1/19/90	1005	↓	5	↓	↓	↓	↓	↓						
PT-	BWS-1-8890	1/19/90	1005	↓	5	↓	↓	↓	↓	↓						
PT-	IHS-5-02	1/19/90	1350	Hylebos Waterway	5	↓	↓	↓	↓	↓						
PT-	IHS-5-288	1/19/90	1350	↓	5	↓	↓	↓	↓	↓						
PT-	IHS-5-8890	1/19/90	1350	↓	5	↓	↓	↓	↓	↓						
PT-	IHS-13-02	1/19/90	1700	↓	1	↓										→ Semi-Volatiles, Pesticides + PCBs ONLY
Trip	Blank 2	1/18/90	—	—	1				X							~~[illegible]~~ also transported with last batch of samples.

* See attached list of parameters, analytical methods, and detection limits for Puget Sound Dredge Disposal Analysis (PSDDA)

Note: this is the last batch of marine sediment samples for this project.

Special Shipment/Handling or Storage Requirements according to PSEP and PSDDA

Method of Shipment hand deliver

Relinquished by	Received by	Relinquished by	Received by
RR Zisette	Terrie Hedger		
Signature RR Zisette	Signature Terrie Hedger	Signature	Signature
Printed Name Herrera Envi. Cons.	Printed Name ARI	Printed Name	Printed Name
Company	Company	Company	Company
Date 1-22-90 Time 11:11	Date 1-22-90 Time 11:11	Date Time	Date Time

5/87

SUBSTRATE SAMPLE RECORD

PROJECT NAME: Port of Tacoma Sediments

PROJECT NUMBER: Landau 118-02.23

DATE: 1/10-11/90 CREW: R. Zisette, W. Trial, M. Spillane GEAR: Spatula

STATION	REP.	TIME	WATER DEPTH	GRAB DEPTH	SEDIMENT TYPE	COLOR	ODOR	COMMENTS
IHS-3	A-E	2050	0	0-2 cm	5/4	BWN/B	1C	wood chips
IHS-4	A-E	2120	0	0-2	5/4	BWN/B	1C	wood chips
IHS-2	A-E	2215	0	0-2	5/4	BWN/B	1C	wood chips (large), worms
IHS-6	A-E	2240	0	0-2	5/4	BWN/B	1C	wood chips
IHS-7	A-E	2310	0	0-2	5/4	BWN/B	1B	wood chips (few)
UHS-2	A-E	2355	0	0-2	4/3/2/5	BWN/GY	3	No debris
UHS-1	A-E	0005	0	0-2	4/3/2/5	BWN/GY	3	No debris
IHS-1	A-E	0040	0	0-2	4/5	BWN/GY/B	1A	

SEDIMENT TYPE:

1 = rock
2 = cobble
3 = gravel
4 = sand
5 = silt
6 = clay
7 = wood chips
C = coarse sand
M = medium sand
F = fine sand

COLOR:

DO = drab olive
DOS = drab olive surface
G = green
GY = grey
B = black
BWN = brown

ODOR:

1 = H_2S smell
2 = petroleum smell
3 = no smell
A = slight odor
B = moderate odor
C = strong odor
D = overwhelming odor

Recorded by R. Zisette, Herrera Environmental Consultants

SUBSTRATE SAMPLE RECORD

PROJECT NAME: Port of Tacoma Sediments

PROJECT NUMBER: Landau 118-02.23

DATE: 1/16/90 CREW: R. Zisette, M. Soillane, M. Gibb GEAR: Gibb Corer with Piston

STATION	REP.	TIME	WATER DEPTH	GRAB DEPTH	SEDIMENT TYPE	COLOR	ODOR	COMMENTS
IHS-9		1100	18.5 ft					
	A	1145		0-20cm	5/4	B	1C	shell loose
	A	1145		20-92	4/5	GY	3	shell, more firm
	B	1330		0-92	same as Rep A, moved 1-2 ft between Reps			
	C	1420		0-92				
	D	1510		88-92				
	E	1540		88-90				
	F	1550		0-2				
↓	G	1605		0-2	↓			

SEDIMENT TYPE:

1 = rock
2 = cobble
3 = gravel
4 = sand
5 = silt
6 = clay
7 = wood chips
C = coarse sand
M = medium sand
F = fine sand

COLOR:

DO = drab olive
DOS = drab olive surface
G = green
GY = grey
B = black
BWN = brown

ODOR:

1 = H_2S smell
2 = petroleum smell
3 = no smell
A = slight odor
B = moderate odor
C = strong odor
D = overwhelming odor

SUBSTRATE SAMPLE RECORD

PROJECT NAME: Port of Tacoma Sediments PROJECT NUMBER: Landau 118-02-23

DATE: 1/17-18/90 CREW: R. Zisette, M. Spillane, M. Gibb GEAR: Gibb Corer with Piston and water Pump

STATION	REP.	TIME	WATER DEPTH	GRAB DEPTH	SEDIMENT TYPE	COLOR	CDOR	COMMENTS
IHS-8		1035	30.7 ft					1/17/90 - Piston
	A	1040		0-2 cm	5	B	1C	oil sheen
	B	1110		0-60	5	B	1C	oil sheen loose
↓	B	1215		60-92	6	GY	3	firm
IHS-8		0950	31.2 ft					1/18/90 - Water Pump
	C	1000		0-30	5	B	1C	oil sheen
	C	1115		30-53	6	GY	3	
	C	1130		53-63	6/5	GY/B	1B	
	C	1130		63-95	6	GY	3	
	D	1020		0-30	5	B	1C	oil sheen
	D	1020		30-58	6/5	GY/B	1B	
	D	1240		58-96	6	GY	3	
↓	E	1100		0-2	5	B	1C	oil sheen
BWS-2		1345	7.5 ft					1/18/90 - Water Pump
	A	1410		0-2	4/5	B	3	
	B	1430		0-30	4/5	B	3	
	B	1430		30-35	6/4	GY	3	
	B	1430		35-40	4	B	3	
	B	1430		40-81	6	GY	3	
	B	1445		81-98	4MF	B	3	
	C	1500		0-4	4/6	B/BWN	3	roots
	C	1500		4-30	4	B	3	
	C	1500		30-87	6	GY	3	
	C	1515		87-98	4	B	3	
	C	1515		98-113	4	B	3	discard
	D	1530		0-~30	4	B	3	
	D	1530		~30-98	6	GY	3	
	D	1545		98-105	6	GY	3	discard
	D	1545		105-122	4	B	3	discard
↓	E	1600		0-2	4/6	B/BWN	3	roots

Recorded by R. Zisette, Herrera Environmental Consultants

SUBSTRATE SAMPLE RECORD

PROJECT NAME: Port of Tacoma Sediments PROJECT NUMBER: Landau 118-02.23

DATE: 1/19/90 CREW: R. Zisette, M. Spillane, M. Gibb GEAR: Gibb Corer with Water Pump

STATION	REP.	TIME	WATER DEPTH	GRAB DEPTH	SEDIMENT TYPE	COLOR	ODOR	COMMENTS
BWS-1		0930	14.7 ft					
	A	0940		0-98 cm	4M/5/3	B	IB	high silt @ 0-10, 43-50 and 80-85
	A	1005		98-102	6	GY	IB	discard
	A	1005		102-130	4F	GY	IB	discard
	B	1020		0-50	4M/3	B	IB	oil sheen
	B	1035		50-55	6	GY	IB	
	B	1035		55-79	4F	GY	IB	
	B	1045		79-88	4M/3	B	IB	
	B	1045		88-93	6	GY	IB	
	B	1045		93-98	4F	GY	IB	
	B	1045		98-131	4F	GY	IB	discard
	C	1110		0-85	4M/3/5	B	IB	oil sheen @ 0-2 cm
	C	1130		85-88	6/4F	BWN/GY	IB	wood chip @ 88 cm
	C	1130		88-98	4F	GY	IB	
	C	1130		98-113	4F	GY	IB	discard
	D	1145		0-2	4M/5	B	IB	
↓	E	1145		0-2	4M/5	B	IB	
IHS-5		1310	5.9 ft					
	A	1320		0-92	4F/5/6	GY/BWN	IB	wood chips @ 0-41 and 72-92
	B	1420		0-61	4F/5/6	GY	IB	wood chips + shell @ 51 cm
	B	1440		61-88	4M	GY	IB	wood chips
	B	1440		88-98	4F	GY	IB	
	B	1440		98-138	4F	GY	IB	discard
	C	1500		0-63	4F/5/6	GY	IB	wood/bark chips
	C	1515		63-73	6/4F	GY	IB	
	C	1515		73-98	4F	GY	IB	wood chips
	C	1515		98-106	4F	GY	IB	wood chips; discard
	D	1525		0-2	4F/5	GY/BWN	IB	
↓	E	1530		0-2	4F/5	GY/BWN	IB	

Recorded by R. Zisette, Herrera Environmental Consultants

APPENDIX C

APPENDIX C

Summary of Chemical Results Blair Waterway Property

APPENDIX C
SUMMARY OF CHEMICAL RESULTS
BLAIR WATERWAY PROPERTY

Table C-1 provides a key to the sample numbers and ARI report numbers. Tables C-2 through C-4 provide lists of the analytes of each sample matrix. Table C-5 provides definitions of the data qualifiers used both in the data tables in this report and in the ARI laboratory data sheets. Tables C-6 through C-11 provide a summary of the concentrations of detected constituents. Attachments C-1, C-2, and C-3 provide information from offsite, or previous onsite investigations. (Laboratory data sheets and quality assurance information are presented in Appendix D, bound separately).

TABLE C-1

SAMPLE AND ARI REPORT NUMBERS
BLAIR WATERWAY PROPERTY

Property/Matrix	Sample Number	ARI Report Number
Ground Water[a]	PTB-BW-1s-1	4152
	PTB-BW-1i-1	4393
	PTB-BW-2s-1	4152
	PTB-BW-2i-1	4152
	PTB-BW-3s-1	4152
	PTB-BW-3i-1	4152
	PTB-BW-3d-1	4393
	PTB-BW-4s-1	4152
	PTB-BW-4s-2	4393
	PTB-BW-4i-1	4152
	PTB-BW-4d-1	4393
	PTB-BW-5i-1	4152
	PTB-BW-6s-1	4152
	PTB-BW-7s-1	4152
	PTB-BW-7i-1	4393
	PTB-BW-8s-1	4152
	PTB-BW-9s-1	4152
	PTB-BW-9s-2	4393
	PTB-BW-9i-1	4152
	PTB-BW-9d-1	4393
	PTB-BW-10s-1	4152
	PTB-BW-10i-1	4152
	PTB2-BW-1I	6714
	PTB2-BW-3I	6714
	PTB2-BW-4I	6714
	PTB2-BW-5I	6714
	PTB2-BW-7I	6714
	PTB2-BW-9I	6714
	PTB2-BW-11I	6714
	PTB2-BW-12I	6714

TABLE C-1

SAMPLE AND ARI REPORT NUMBERS
BLAIR WATERWAY PROPERTY

Property/Matrix	Sample Number	ARI Report Number
Soils		
- Outlet Fill Area	PTB-BO-1-1	4436
	PTB-BO-2-1	4436
- Drum Storage Area	PTB-BD-1-1	4436
	PTB-BD-2-1	4436
- Fueling Area	PTB-BF-1-1	4436
	PTB-BF-2-1	4436
- Railroad Spur	PTB-BR-1-1	4436
	PTB-BR-2-1	4436
	PTB-BR-3-1	4436
	PTB-BR-4-1	4436
	PTB-BR-5-1	4436
	PTB-RRS-1	4436
	PTB-RRS-2	4436
- General Area (test pits)	PTB-BT-1-1	4436
	PTB-BT-2-1	4436
	PTB-BT-3-1	4436
	PTB-BT-4-1	4436
	PTB-BT-5-1	4436
	PTB-BT-6-1	4437
	PTB-BT-9-1	4437

TABLE C-1

SAMPLE AND ARI REPORT NUMBERS
BLAIR WATERWAY PROPERTY

Property/Matrix	Sample Number	ARI Report Number
Ditch Sediments		
- Lincoln Ave. Drainageway	POT-BLD-1-1	4379
	POT-BLD-2-1	4379
	POT-BLD-3-1	4379
	POT-BLD-4-1	4379
	POT-BLD-5-1	4379
	PTB2-BW-BLD-5	6740
	PTB2-BW-BLD-6	6740
	PTB2-BW-BLD-7	6740
	PTB2-BW-BLD-8	6740
	PTB2-BW-BOLD-1	6770
	PTB2-BW-BOLD-2	6772
	PTB2-BW-BOLD-3	6772
- Boundary Drainageways	POT-BWD-1-1	4379
	POT-BWD-2-1	4379
	POT-BWD-3-1	4379
	POT-BWD-4-1	4379
	POT-BWD-5-1	4379
	PTB-BDD-1-1	4437
	PTB-BDD-2-1	4437
	PTB-BDD-3-1	4437
	PTB-BDD-4-1	4437
	PTB-BDD-5-1	4437
	PTB-BDD-6-1	4437
	PTB-BDD-7-1	4437
- Outfall and Spillway	PTB-BOS-1-1	4437
	PTB-BOS-2-1	4437
Precipitates	PTB-BDP-1-1	4437

TABLE C-1

SAMPLE AND ARI REPORT NUMBERS
BLAIR WATERWAY PROPERTY

Property/Matrix	Sample Number	ARI Report Number
Marine Sediments		
	PT-BWS-2-02	4403
	PT-BWS-2-288	4403
	PT-BWS-2-8890	4403
	PT-BWS-1-02	4403
	PT-BWS-1-288	4403
	PT-BWS-1-8890	4403
Slag	PTB2-BW-S1	6739
	PTB2-BW-S2	6739
Graving Dock Sediment	BG-11 & 12	8666

(a) "s" = shallow sample, "i" = intermediate sample, "d" = deep sample.

TABLE C-2

GROUND WATER SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

DISSOLVED CATIONS AND METALS

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Iron
Lead
Manganese
Mercury
Molybdenum
Nickel
Selenium
Silver
Thallium
Zinc

SELECTED SAMPLES ALSO INCLUDED

Aluminum
Calcium
Magnesium
Potassium
Sodium

VOLATILE ORGANICS

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinylether
Chloroform
Chloromethane
cis-1,3-Dichloropropene
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
1,2-Dichloropropane
Ethyl Benzene
2-Hexanone
4-Methyl-2-pentanone
Methylene chloride
Styrene
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
1,2,2-Trifluoroethane
Trichlorofluoromethane
1,1,2-Trichloro-1,2,2-trifluoroethane
Vinyl acetate
Vinyl chloride
Xylenes (total)

TABLE C-2

GROUND WATER SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

SEMIVOLATILE ORGANICS

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzoic acid
Benzyl alcohol
bis(2-Chloroethoxy) methane
bis(2-Chloroethyl) ether
bis(2-Chloroisopropyl) ether
bis(2-Ethylhexyl)phthalate
4-Bromophenyl-phenylether
Butylbenzylphthalate
4-Chloro-3-methylphenol
4-Chloroaniline
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl-phenyl ether
Chrysene
Di-n-butylphthalate
Di-n-octylphthalate
Dibenz(a,h)anthracene
Dibenzofuran
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Fluoranthene
Fluorene
Formaldehyde
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
N-Nitroso-di-n-propylamine
N-nitrosodiphenylamine
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
p-tert-butyl phenol
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
2,3,4,6-Tetrachlorophenol
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

TABLE C-2

GROUND WATER SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

PESTICIDES/PCBS

Aldrin
Aroclor-1242/1016
Aroclor-1248
Aroclor-1254
Aroclor-1260
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Alpha-Chlordane
Gamma-Chlordane
4,4'-DDD
4,4'-DDE
4,4-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Ketone
Heptachlor
Heptachlor Epoxide
Methoxychlor
Toxaphene

CHLOROPHENOLICS

Pentachlorophenol
2,4,6-Trichlorophenol
2,3,6-Trichlorophenol
2,4,5-Trichlorophenol
3,4,5-Trichlorophenol
2,3,4-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,4,5-Tetrachlorophenol

CONVENTIONALS

Alkalinity
Chloride
Sulfate

TABLE C-3

SOIL AND DITCH SEDIMENT SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

METALS (Soil and Ditch Sediment)

Arsenic
Barium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Zinc

DITCH SEDIMENT SAMPLES ALSO INCLUDED

Antimony
Beryllium
Selenium
Silver
Thallium

PRECIPITATE SAMPLES ALSO INCLUDED

Aluminum
Calcium
Magnesium
Iron
Manganese
Sulfur
Carbonates
Chloride

VOLATILE ORGANICS (Soil and Ditch Sediment)

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinylether
Chloroform
Chloromethane
Dibromochloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
trans-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Ethyl Benzene
2-Hexanone
4-Methyl-2-pentanone
Methylene chloride
Styrene
Tetrachloroethene
1,1,2,2-Tetrachloroethane
Toluene
trans-1,3-Dichloropropene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
1,2,2-Trifluoroethane
Trichlorofluoromethane
1,1,2-Trichloro-1,2,2-Trifluorethane
Vinyl acetate
Vinyl chloride
Xylenes (total)

TABLE C-3

SOIL AND DITCH SEDIMENT SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

SEMIVOLATILE ORGANICS (Soil and Ditch Sediment)

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Benzoic acid
Benzyl alcohol
bis(2-Chloroethoxy) methane
bis(2-Chloroethyl) ether
bis(2-Chloroisopropyl) ether
bis(2-Ethylhexyl)phthalate
4-Bromophenyl-phenylether
Butylbenzylphthalate
4-Chloro-3-methylphenol
4-Chloroaniline
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl-phenyl ether
Chrysene
Di-n-butylphthalate
Di-n-octylphthalate
Dibenz(a,h)anthracene
Dibenzofuran
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
N-Nitroso-di-n-dipropylamine
N-nitrosodiphenylamine
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
p-tert-butyl phenol
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
2,3,4,6-Tetrachlorophenol
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

TABLE C-3

SOIL AND DITCH SEDIMENT SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

PESTICIDES/PCBS (Soil and Ditch Sediment)

Aldrin
Aroclor-1242/1016
Aroclor-1248
Aroclor-1254
Aroclor-1260
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Alpha-Chlordane
Gamma-Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Ketone
Heptachlor
Heptachlor Epoxide
Methoxychlor
Toxaphene

DIOXINS/FURANS (Selected Ditch Sediment Samples)

Furans:

2378-TCDF
Total TCDF
12378-PeCDF
23478-PeCDF
Total PeCDF
123478-HxCDF
123678-HxCDF
123789-HxCDF
234678-HxCDF
Total HxCDF
1234678-HpCDF
1234789-HpCDF
Total HpCDF
OCDF

Dioxins:

2378-TCDD
Total TCDD
12378-PeCDD
Total PeCDD
123478-HxCDD
123678-HxCDD
123789-HxCDD
Total HxCDD
1234678-HpCDD
Total HpCDD
OCDD

TOTAL PETROLEUM HYDROCARBONS (Soil)

TABLE C-4

MARINE SEDIMENT SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

METALS

Antimony
Arsenic
Cadmium
Chromium
Copper
Lead
Manganese
Mercury
Nickel
Silver
Zinc
Tributyl Tin

ORGANIC COMPOUNDS

Low Molecular Weight PAH
- Naphthalene
- Acenaphthylene
- Acenaphthene
- Fluorene
- Phenanthrene
- Anthracene
- 2-Methylnaphthalene

High Molecular Weight PAH
- Fluoranthene
- Pyrene
- Benz(a)anthracene
- Chrysene
- Benzofluoranthenes
- Benzo(a)pyrene
- Indeno(1,2,3-c,d)pyrene
- Dibenzo(a,h)anthracene
- Benzo(g,h,i)perylene

Chlorinated Organic Compounds
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- 1,2-Dichlorobenzene
- 1,2,4-Trichlorobenzene
- Hexachlorobenzene

Phthalates
- Dimethyl phthalate
- Diethyl phthalate
- Di-n-butyl phthalate
- Butyl benzyl phthalate
- Bis(2-ethylhexyl)phthalate
- Di-n-octyl phthalate

Phenols
- Phenol
- 2-Methylphenol
- 4-Methylphenol
- 2,4-Dimethylphenol
- Pentachlorophenol

Miscellaneous Extractables
- Benzyl alcohol
- Benzoic acid
- Dibenzofuran
- Hexachloroethane
- Hexachlorobutadiene
- N-Nitrosodiphenylamine

Volatile Organics
- Trichloroethene
- Tetrachloroethene
- Ethylbenzene
- Total xylenes

TABLE C-4

MARINE SEDIMENT SAMPLE ANALYTES
BLAIR WATERWAY PROPERTY

PESTICIDES/PCBS

Total DDT	Aroclor - 1221
p,p'-DDE	Aroclor - 1232
p,p'-DDD	Aroclor - 1242/1016
p,p'-DDT	Aroclor - 1248
Aldrin	Aroclor - 1254
Alpha-Chlordane	Aroclor - 1260
Dieldrin	
Heptachlor	
Lindane	

CONVENTIONALS

Total Volatile Solids
Total Organic Carbon
Ammonia
Sulfide
Grain Size

TABLE C-5

DATA QUALITY ASSURANCE QUALIFIERS FOR TABLES C-6, C-7, C-8, C-9, C-10, AND C-11 BLAIR WATERWAY PROPERTY

DATA QUALIFIER	DESCRIPTION
J	The analyte was analyzed for and was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample.
UJ	The analyte was analyzed for and was not present above the level of the associated value. The associated value may not accurately or precisely represent the concentration necessary to detect the analyte in this sample.
U	Indicates analyte was analyzed for but not detected above the level indicated. This flag is assigned by the laboratory.
M	Indicates an estimated value of analyte found and confirmed by analyst but with low spectral match parameters. This flag is assigned by the laboratory.
R	The data are unusable for all purposes. The analyte was analyzed for, but the presence or absence of the analyte has not been verified.
1	Blank contamination.
2	Quantitated value falls above the limit of the calibration curve and a dilution should be run.
3	Holding times not met: indicates low bias for most analytes with the exception of common laboratory contaminants.
4	Surrogate recovery outside control limits: bias variable.
5	Reported value below Contract Required Detection Limit (CRDL).

TABLE C-6

SUMMARY OF DETECTED CONSTITUENTS IN GROUND WATER
BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BW-1I-1	BW-1s-1	BW-2I-1 Rinsate Blank	BW-2s-1	BW-3d-1	BW-3I-1	BW-3s-1	BW-4d-1	BW-4I-1	BW-4s-1
CONSTITUENT	CONCENTRATION									
Formaldehyde (mg/L)	1.3	2.39	0.06 U	0.25	0.6	0.69	2.02	0.5 U	0.27	0.33
CONVENTIONALS (mg/L) (a)										
Alkalinity	NA (b)	NA	NA	NA	NA	NA	NA	408.8	324	92
Chloride	NA	NA	NA	NA	NA	NA	NA	586.8	66.5	8.1
Sulfate	NA	NA	NA	NA	NA	NA	NA	14.0	66.2	98.0
METALS (mg/L)										
Aluminum	NA	NA	NA	NA	NA	NA	NA	0.04	0.02 U	0.04
Antimony	0.05 UJ	0.05 U	0.05 U	0.05 U	0.05 UJ4	0.05 U	0.05 U	0.05 UJ4	0.05 U	0.05 U
Arsenic	0.005 U	0.001 U	0.001 U	0.001 U	0.005 U	0.001 U	0.001 U	0.005 U	0.001 U	0.001 U
Beryllium	0.001 U	0.001	0.001 U	0.001 U	0.001 U	0.001	0.001	0.001 U	0.001 U	0.001 U
Cadmium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Calcium	NA	NA	NA	NA	NA	NA	NA	40.2	119	36.2
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Copper	0.002 U	0.003	0.002 U	0.002 U	0.002 U	0.003	0.003	0.002 U	0.002 U	0.002 U
Iron	38.0	81.6	0.013	6.07	0.525	0.040	80.2	0.738	20.6	13.7
Lead	0.001 U	0.005 U	0.001 U	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001 U
Magnesium	NA	NA	NA	NA	NA	NA	NA	28.0	22.8	13.1
Manganese	9.25	2.49	0.001 U	0.981	0.180	0.445	2.70	0.354	1.24	1.21
Mercury	0.0001 UJ4	0.0001 U	0.0001 U	0.0001 U	0.0001 UJ4	0.0001 U	0.0001 U	0.0001 UJ4	0.0001 U	0.0001 U
Molybdenum	0.005 U	0.005 U	0.005 U	0.008	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Nickel	0.01 U	0.03	0.01 U	0.01 U	0.1 U	0.01 U	0.02	0.01 U	0.01 U	0.01 U
Potassium	NA	NA	NA	NA	NA	NA	NA	21.5	9.8	5.4
Selenium	0.005 U	0.005 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Silver	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Sodium	NA	NA	NA	NA	NA	NA	NA	219	39.5	23.9
Thallium	0.005 U	0.005 U	0.001	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U
Zinc	0.004	0.040	0.004 U	0.006	0.004 U	0.02 U	0.037	0.004	0.005	0.005
SEMIVOLATILE ORGANICS (ug/L)										
Fluoranthene	1 U	1 UJ3	1 U	1 U	1 U	1 U	1 UJ3	1 U	1 U	1 U
Pyrene	1 U	1 UJ3	1 U	1 U	1 U	1 U	1 UJ3	1 U	1 U	1 U
bis(2-Ethylhexyl)phthalate	1 U	1 UJ3	4.4 UJ1	33	1 U	4.6	7.2 UJ1	1 U	11 UJ1	15 UJ1
Chrysene	1 U	1 UJ3	1 U	1 U	1 U	1 U	1 UJ3	1 U	1 U	1 U
Phenol	2 R	3 UJ1	2 U	2 U	2 U	2 U	2 UJ1	0.8 J5	2 R	2 R
VOLATILE ORGANICS (ug/L)										
Vinyl chloride	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 J5	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Total Xylenes	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

TABLE C-6

SUMMARY OF DETECTED CONSTITUENTS IN GROUND WATER
BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BW-5l-1	BW-6s-1	BW-7l-1	BW-7s-1	BW-8s-1	BW-9d-1	BW-9l-1	BW-10l-1 (DUP 9l-1)	BW9s-1	BW-10s-1
CONSTITUENT	CONCENTRATION									
Formaldehyde (mg/L)	0.23	0.47	0.5 U	0.06 U	0.50	0.5 U	1.17	1.30	1.15	0.19
CONVENTIONALS (mg/L)										
Alkalinity	NA	NA	NA	NA	NA	598.9	1233	1240	1.0 U	NA
Chloride	NA	NA	NA	NA	NA	2045.9	1645	1696	46.5	NA
Sulfate	NA	NA	NA	NA	NA	169.1	374	322	1434	NA
METALS (mg/L)										
Aluminum	NA	NA	NA	NA	NA	0.02 U	0.1	0.2	NA	NA
Antimony	0.05 U	0.05 U	0.05 UJ4	0.05 U	0.05 U	0.05 UJ4	0.05 U	0.05 U	0.05 U	0.05 U
Arsenic	0.005 U	0.009 J4	0.01 U	0.001 J4	0.049 J4	0.005 U	0.001 U	0.001 U	0.001 U	0.001 J4
Beryllium	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002	0.001
Cadmium	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Calcium	NA	NA	NA	NA	NA	62.6	115	113	206	NA
Chromium	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Copper	0.002 U	0.002 U	0.002 U	0.002	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.010
Iron	21.5	3.27	10.5	0.008	19.8	1.09	19.4	18.9	154	5.90
Lead	0.005 U	0.005 U	0.01 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 U	0.001
Magnesium	NA	NA	NA	NA	NA	160	136	134	150	NA
Manganese	1.40	3.71	0.866	0.077	3.65	0.167	1.19	1.18	8.34	0.469
Mercury	0.0001 U	0.0001 U	0.0001 UJ4	0.0001 U	0.0001 U	0.0001 UJ4	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Molybdenum	0.009	0.006	0.007	0.018	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Nickel	0.1 U	0.01 U	0.1 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.04	0.01 U
Potassium	NA	NA	NA	NA	NA	68.3	83.9	82.8	29.1	NA
Selenium	0.005 U	0.012	0.01 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Silver	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Sodium	NA	NA	NA	NA	NA	1190	1500	1520	72.7	NA
Thallium	0.01 U	0.001 U	0.01 U	0.001 U	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.001 U
Zinc	0.02 U	0.005	0.004 U	0.004 U	0.024	0.004 U	0.02 U	0.02 U	0.029	0.028
SEMIVOLATILE ORGANICS (ug/L)										
Fluoranthene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pyrene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
bis(2-Ethylhexyl)phthalate	16 UJ1	1 U	1 U	1 U	1 U	1 U	26	20 UJ1	35	1 U
Chrysene	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Phenol	2 U	2 U	2 U	2 U	2 U	0.8 M	2 U	2 U	2 R	2 U
VOLATILE ORGANICS (ug/L)										
Vinyl chloride	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.9	4.2	1.0 U	1.0 U
Chloroform	1.1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	1.0 U	1.0 U	0.5 M	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Total Xylenes	1.0 U	1.0 U	0.6 J5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

TABLE C-6

SUMMARY OF DETECTED CONSTITUENTS IN GROUND WATER
BLAIR WATERWAY PROPERTY (c)

SAMPLE I.D.:	PTB2 BW-1I	PTB2 BW-3I	PTB2 BW-4I	PTB2 BW-5I	PTB2 BW-7I	PTB2 BW-9I	PTB2 BW-9D	PTB2 BW-11I Rinsate Bk.	PTB2 BW-12I Dup (BW-9I)
CONSTITUENT	CONCENTRATION								
CHLOROPHENOLS (ug/L)									
Pentachlorophenol	0.4 U	0.4 U	0.4	0.7	0.4 U	0.7	0.4 U	0.4 U	0.4 U
VOLATILE ORGANICS (ug/L)									
Vinyl chloride	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	3.1 J3	1.0 UJ3	1.0 UJ3	3.1 J3
1,1,1-Trichloroethane	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.0 UJ3	1.2 J3	1.0 UJ3

(a) pH, temperature, and conductivity values for groundwater samples are shown in Table A-2.
(b) NA Indicates constituent not analyzed.
(c) Analytes for samples PTB2-BW-1I through PTB2-BW-12I are specific to additional investigations conducted in August 1990, thus are different from previous ground water analyses.
NOTE: Refer to Table C-5 for definition of data qualifiers.

TACOMA\BLAIRBWF-C-6,C6A.WK1

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Boundary Ditch (Sediment)					Lincoln Avenue Ditch (Sediment)				
SAMPLE I.D.:	BWD-1-1	BWD-2-1	BWD-3-1	BWD-4-1	BWD-5-1	BLD-1-1	BLD-2-1	BLD-5-1 (DUP 2-1)	BLD-3-1	BLD-4-1
CONSTITUENT	CONCENTRATION									
METALS (mg/kg)										
Arsenic	43	67	11	656	1890	137	27	27	84	54
Barium	42.8 J4	28.0 J4	15.8 J4	26.4 J4	147 J4	43.7 J4	30.9 J4	30.4 J4	37.4 J4	22.0 J4
Cadmium	0.3	0.3	0.3 U	1.0	2.5	1.5	0.8	0.7	1.3	0.4
Chromium	25.0 J4	17.9 J4	12.7 J4	16.4 J4	27.3 J4	39.2 J4	21.0 J4	19.9 J4	36.4 J4	16.8 J4
Copper	74.3	62.2	15.8	468	396	128	52.6	46.4	107	34.6
Lead	24	30	7	179	68	89	41	38	72	24
Mercury	0.07 UJ4	0.05 UJ4	0.05 UJ4	0.05 UJ4	0.08 UJ4	0.21 UJ4	0.08 UJ4	0.09 UJ4	0.16 UJ4	0.09 UJ4
Nickel	20	17	6	13	44	28	15	14	24	12
Zinc	178	165	25.8	828	1190	334	125	118	273	97.3
EP TOXICITY (mg/L)										
Arsenic	0.05 U	NA (a)	NA	0.25	0.05 U	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	0.03 U	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs (ug/kg)										
Aroclor 1254	80 U	80 U	80 U	80 U	80 U	500	80 U	80 U	400 U	80 U
Aroclor 1260	80 U	80 U	80 U	80 U	80 U	160 U	80 U	80 U	160 U	80 U

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Boundary Ditch (Sediment)					Lincoln Avenue Ditch (Sediment)				
SAMPLE I.D.:	BWD-1-1	BWD-2-1	BWD-3-1	BWD-4-1	BWD-5-1	BLD-1-1	BLD-2-1	BLD-5-1 (DUP 2-1)	BLD-3-1	BLD-4-1
CONSTITUENT	CONCENTRATION									
SEMIVOLATILE ORGANICS (ug/kg)										
Anthracene	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	140 M	51 M
Benzo(a)anthracene	110 U	73 U	89 U	76 U	120 U	240	90 M	90 M	2200 U	600 U
Benzo(a)pyrene	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	2200 U	600 U
Benzo(b)fluoranthene	120	73 U	78 J5(b)	64 J5	120 U	1400 (b)	250 (b)	420 (b)	1600 J5	600 U
Benzo(g,h,i)perylene	110 U	73 U	89 U	61 J5	120 U	170 U	170 M	100 U	2200 U	600 U
Benzo(k)fluoranthene	110 U	73 U	78 J5(b)	45 J5	120 U	1400 (b)	250 (b)	420 (b)	1600 J5	600 U
bis(2-Ethylhexyl)phthalate	240	73 U	89 U	91	150	3400	690	1100	6900	600 U
Butylbenzylphthalate	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	220 U	36 U
Chrysene	130	73 U	89 U	53 J5	68 J5	600	170	210 J5	1700 M	600 U
Dibenz(a,h)anthracene	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	2200 U	600 U
Di-n-octylphthalate	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	2200 U	600 U
Fluoranthene	140	73 U	89 U	38 J5	120 U	620	220	310	860	180
Fluorene	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	100 M	36 U
Indeno(1,2,3-cd)pyrene	110 U	73 U	89 U	76 U	120 U	170 U	130 U	100 U	2200 U	600 U
Pentachlorophenol	570 U	360 U	440 U	380 U	590 U	290 M	630 U	520 U	190 M	55 M
Phenanthrene	60 M	73 U	89 U	76 U	120 U	210	81 J5	110	240	100 M
Pyrene	90 J5	73 U	89 U	28 J5	120 U	910	250	330	2000	510
VOLATILE ORGANICS (ug/kg)										
2-Butanone	25	9.4 U	11 U	10 U	15 U	20 U	14 U	15 U	26 UJ4	14 UJ4
2-Hexanone	2.8 M	5.0 U	5.9 U	5.5 U	7.9 U	11 U	7.5 U	7.8 U	14 UJ4	7.5 UJ4
Acetone	97 UJ1	11 UJ1	13 UJ1	6.9 UJ1	9.8 UJ1	19 UJ1	15 UJ1	14 UJ1	32 UJ14	14 UJ14
Carbon disulfide	2.0 J5	2.5 U	2.9 U	2.8 U	3.9 U	5.4 U	3.8 U	3.9 U	2.7 J45	1.4 J45
Freon	9.4 UJ1	6.3 UJ1	7.3 UJ1	6.9 U	9.8 U	14 U	9.4 U	9.8 U	18 UJ4	9.4 UJ4
Toluene	0.9 UJ1	0.8 UJ1	0.7 UJ1	1.4 U	2.0 U	2.7 U	1.9 U	2.0 U	3.5 UJ4	1.9 UJ4
Total Xylenes	1.9 U	1.3 U	1.5 U	1.4 U	2.0 U	2.7 U	1.9 U	2.0 U	2.8 MUJ14	1.2 MUJ14

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Mud Lake (Soil)		Boundary Ditch (Sediment)						
SAMPLE I.D.:	BOS-1-1	BOS-2-1	BDD-1-1	BDD-2-1	BDD-3-1	BDD-4-1	BDD-5-1	BDD-6-1	BDD-7-1
CONSTITUENT	CONCENTRATION								
METALS (mg/kg)									
Arsenic	9	9	5 U	8 U	14	6 U	9 U	7 U	9 U
Barium	14.7 J4	19.8 J4	9.4 J4	24.6 J4	23.7 J4	28.2 J4	36.5 J4	45.6 J4	50.1 J4
Cadmium	0.3 U	0.4	0.2 U	0.3 U	0.3 U	0.2	0.4 U	0.5	0.4 U
Chromium	15.2 J4	15.8 J4	11.8 J4	19.9 J4	19.8 J4	15.0 J4	15.6 J4	13.5 J4	18.0 J4
Copper	20.9 J4	25.8 J4	9.5 J4	27.6 J4	27.2 J4	17.1 J4	13.1 J4	19.1 J4	23.2 J4
Lead	3 U	13	2 U	4 U	7	9	14	23	28
Mercury	0.07 U	0.07 U	0.06 U	0.07 U	0.06 U	0.09 U	0.10 U	0.07 U	0.10
Nickel	17	12	7	14	10	9	9	11	11
Zinc	57.7 J4	39.1 J4	19.0 J4	54.3 J4	35.9 J4	41.0 J4	79.2 J4	127 J4	126 J4
EP TOXICITY (mg/L)									
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs (ug/kg)									
Aroclor 1254	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	50 U	50 U	50 U	50 U	50 U	50 U	150	50 U	50 U

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Mud Lake (Soil)		Boundary Ditch (Sediment)						
SAMPLE I.D.:	BOS-1-1	BOS-2-1	BDD-1-1	BDD-2-1	BDD-3-1	BDD-4-1	BDD-5-1	BDD-6-1	BDD-7-1
CONSTITUENT	CONCENTRATION								
SEMIVOLATILE ORGANICS (ug/kg)									
Anthracene	78 U	75 U	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Benzo(a)anthracene	78 U	41 M	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Benzo(a)pyrene	78 U	96	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Benzo(b)fluoranthene	78 U	350 (b)	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Benzo(g,h,i)perylene	78 U	75 U	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Benzo(k)fluoranthene	78 U	350 (b)	83 U	99 U	120 U	100 U	120 U	95 U	92 U
bis(2-Ethylhexyl)phthalate	78 U	75 U	83 U	99 U	140	310	650	300	400
Butylbenzylphthalate	78 U	75 U	83 U	99 U	120 U	100 U	130 M	95 U	92 U
Chrysene	78 U	110	83 U	99 U	120 U	100 U	120 U	82 J5	64 M
Dibenz(a,h)anthracene	78 U	75 U	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Di-n-octylphthalate	78 U	960	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Fluoranthene	78 U	52 J5	83 U	99 U	120 U	100 U	75 J5	63 J5	92 U
Fluorene	78 U	75 U	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Indeno(1,2,3-cd)pyrene	78 U	75 U	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Pentachlorophenol	390 U	380 U	420 U	490 U	580 U	500 U	610 U	480 U	460 U
Phenanthrene	78 U	39 J5	83 U	99 U	120 U	100 U	120 U	95 U	92 U
Pyrene	78 U	39 J5	83 U	99 U	120 U	100 U	52 J5	51 J5	92 U
VOLATILE ORGANICS (ug/kg)									
2-Butanone	10.2 U	9.2 U	9.4 U	12.1 U	12.7 UJ3	11.2 UJ3	14.5 UJ3	11.4 UJ3	10.8 UJ3
2-Hexanone	2.7 U	2.5 U	2.5 U	3.2 U	3.4 UJ3	3.0 UJ3	3.9 UJ3	3.0 UJ3	2.9 UJ3
Acetone	4.1 U	16	3.7 U	4.9 U	27 J3	4.5 UJ3	37 J3	15 J3	4.3 UJ3
Carbon disulfide	2.7 U	2.5 U	2.5 U	3.2 U	3.4 UJ3	3.1 J3	3.9 UJ3	3.0 UJ3	2.9 UJ3
Freon	2.7 U	2.5 U	2.5 U	3.2 U	3.4 UJ3	3.0 UJ3	3.9 UJ3	12 J3	2.9 UJ3
Toluene	1.4 U	1.2 U	1.2 U	1.6 U	1.7 UJ3	1.5 UJ3	1.9 UJ3	1.5 UJ3	1.4 UJ3
Total Xylenes	1.2 M	2.5 U	2.5 U	3.2 U	3.4 UJ3	3.0 UJ3	3.9 UJ3	3.0 UJ3	2.9 UJ3

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Railroad Right-of-Way (Soil)					Test Pit Explorations (Soil)				
SAMPLE I.D.:	BR-1-1	BR-2-1	BR-3-1	BR-4-1	BR-5-1	BT-1-1	BT-2-1	BT-3-1	BT-4-1	BT-5-1
CONSTITUENT	CONCENTRATION									
METALS (mg/kg)										
Arsenic	23	46	22	11	8	9	120	8	6	81
Barium	43.7 J4	47.1 J4	17.1 J4	45.2 J4	35.9 J4	15.4 J4	27.7 J4	22.6 J4	12.7 J4	17.1 J4
Cadmium	0.4	0.2 U	0.2 U	0.2	0.2 U	0.2 U	0.2	0.2 U	0.2 U	0.3
Chromium	18.6 J4	18.0 J4	12.9 J4	19.5 J4	15.2 J4	12.6 J4	15.2 J4	13.4 J4	13.3 J4	12.7 J4
Copper	28.5	62.5	54.2	26.8	23.3	17.8	123	19.1	11.8	61.2
Lead	16	24	13	24	23	3 U	58	10	2	40
Mercury	0.31 J4	0.04 U	0.05 U	0.03 J4	0.05 J4	0.08 J4	0.04 U	0.04 U	0.03 U	0.03 U
Nickel	14	19	7	14	10	8	10	9	7	8
Zinc	95.5	258	73.7	44.4	41.5	30.7	295.0	34.3	25.6	238
EP TOXICITY (mg/L)										
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs (ug/kg)										
Aroclor 1254	60 U	60 U	60 U	60 U	60 U	50 U	50 U	50 U	50 U	50 U
Aroclor 1260	60 U	60 U	60 U	60 U	60 U	50 U	50 U	50 U	50 U	50 U

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Railroad Right-of-Way (Soil)					Test Pit Explorations (Soil)				
SAMPLE I.D.:	BR-1-1	BR-2-1	BR-3-1	BR-4-1	BR-5-1	BT-1-1	BT-2-1	BT-3-1	BT-4-1	BT-5-1
CONSTITUENT	CONCENTRATION									
SEMIVOLATILE ORGANICS (ug/kg)										
Anthracene	94 U	69 U	76 U	60 U	71 U	66 U	72 U	65 U	110	69 U
Benzo(a)anthracene	94 U	47 M	76 U	60 U	71 U	66 U	72 U	65 U	550	69 U
Benzo(a)pyrene	94 U	64 J5	76 U	60 U	71 U	66 U	72 U	65 U	490	69 U
Benzo(b)fluoranthene	330 (b)	320 (b)	76 U	60 U	71 U	66 U	72 U	65 U	1900 (b)	69 U
Benzo(g,h,i)perylene	94 U	120 M	76 U	60 U	71 U	66 U	72 U	65 U	61 U	69 U
Benzo(k)fluoranthene	330 (b)	320 (b)	76 U	60 U	71 U	66 U	72 U	65 U	1900 (b)	69 U
bis(2-Ethylhexyl)phthalate	76 M	50 J5	63 M	60 U	71 U	66 U	72 U	65 U	61 U	48 M
Butylbenzylphthalate	94 U	69 U	76 U	60 U	71 U	66 U	72 U	65 U	61 U	69 U
Chrysene	180	140	76 U	60 U	71 U	66 U	72 U	65 U	1100	69 U
Dibenz(a,h)anthracene	94 U	69 U	76 U	60 U	71 U	66 U	72 U	65 U	89	69 U
Di-n-octylphthalate	94 U	69 U	76 U	60 U	71 U	66 U	72 U	65 U	61 U	69 U
Fluoranthene	250	110	76 U	60 U	37 J5	66 U	72 U	34 J5	1700	69 U
Fluorene	94 U	69 U	76 U	60 U	71 U	66 U	72 U	65 U	61 U	69 U
Indeno(1,2,3-cd)pyrene	94 U	92 M	76 U	60 U	71 U	66 U	72 U	65 U	190	69 U
Pentachlorophenol	470 U	340 U	380 U	300 U	360 U	330 U	360 U	320 U	310 U	340 U
Phenanthrene	51 J5	69 U	76 U	60 U	71 U	66 U	72 U	65 U	77	69 U
Pyrene	180	99	76 U	60 U	41 J5	66 U	72 U	38 J5	2600	69 U
VOLATILE ORGANICS (ug/kg)										
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Freon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Test Pit Exploration (Soil)		Outlet Fill (Soil)		Drum Storage Area (Soil)		Fuel Area (Soil)		Railroad Tracks (Material)	
SAMPLE I.D.:	BT-6-1	BT-9-1 (DUP 6-1)	BO-1-1	BO-2-1	BD-1-1	BD-2-1	BF-1-1	BF-2-1	PTB RRS-1	PTB RRS-2
CONSTITUENT	CONCENTRATION									
METALS (mg/kg)										
Arsenic	30	33	NA	NA	NA	NA	NA	NA	NA	NA
Barium	16.6 J4	16.4 J4	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.2	0.2 U	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	12.3 J4	11.7 J4	NA	NA	NA	NA	NA	NA	NA	NA
Copper	18.7 J4	15.2 J4	NA	NA	NA	NA	NA	NA	NA	NA
Lead	9	11	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	0.03 U	0.05 U	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	10	10	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	208 J4	222 J4	NA	NA	NA	NA	NA	NA	NA	NA
EP TOXICITY (mg/L)										
Arsenic	NA	NA	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Barium	NA	NA	0.045	0.06	NA	NA	NA	NA	NA	NA
Cadmium	NA	NA	0.002 U	0.002 U	NA	NA	NA	NA	NA	NA
Chromium	NA	NA	0.005 U	0.005 U	NA	NA	NA	NA	NA	NA
Lead	NA	NA	0.03 U	0.03 U	NA	NA	NA	NA	NA	NA
Mercury	NA	NA	0.0001 U	0.0001 U	NA	NA	NA	NA	NA	NA
Selenium	NA	NA	0.05 U	0.05 U	NA	NA	NA	NA	NA	NA
Silver	NA	NA	0.003 U	0.003 U	NA	NA	NA	NA	NA	NA
PCBs (ug/kg)										
Aroclor 1254	50 U	50 U	NA	NA	50 U	50 U	NA	NA	NA	NA
Aroclor 1260	50 U	50 U	NA	NA	50 U	50 U	NA	NA	NA	NA

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY

	Test Pit Explorations (Soil)		Lincoln Avenue Outlet Fill (Soil)		Drum Storage Area (Soil)		Fuel Area (Soil)		Railroad Tracks (Material)	
SAMPLE I.D.:	BT-6-1	BT-9-1 (DUP 6-1)	BO-1-1	BO-2-1	BD-1-1	BD-2-1	BF-1-1	BF-2-1	PTB RRS-1	PTB RRS-2
CONSTITUENT	CONCENTRATION									
SEMIVOLATILE ORGANICS (ug/kg)										
Anthracene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Benzo(a)anthracene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Benzo(a)pyrene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Benzo(b)fluoranthene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Benzo(g,h,I)perylene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Benzo(k)fluoranthene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
bis(2-Ethylhexyl)phthalate	68 U	69 U	NA	NA	65 U	72	65 U	60 U	NA	NA
Butylbenzylphthalate	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Chrysene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Dibenz(a,h)anthracene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Di-n-octylphthalate	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Fluoranthene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Fluorene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Indeno(1,2,3-cd)pyrene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Pentachlorophenol	340 U	350 U	NA	NA	320 U	310 U	330 U	300 U	NA	NA
Phenanthrene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
Pyrene	68 U	69 U	NA	NA	65 U	61 U	65 U	60 U	NA	NA
VOLATILE ORGANICS (ug/kg)										
2-Butanone	NA	NA	NA	NA	8.0 U	7.7 U	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	2.1 U	2.0 U	NA	NA	NA	NA
Acetone	NA	NA	NA	NA	3.2 U	3.1 U	NA	NA	NA	NA
Carbon disulfide	NA	NA	NA	NA	2.1 U	2.0 U	NA	NA	NA	NA
Freon	NA	NA	NA	NA	2.1 U	2.0 U	NA	NA	NA	NA
Toluene	NA	NA	NA	NA	1.1 U	0.9 M	NA	NA	NA	NA
Total Xylenes	NA	NA	NA	NA	1.1 U	1.0 U	NA	NA	NA	NA
MISCELLANEOUS										
Polyethylene Material	NA	NA	NA	NA	NA	NA	NA	NA	Present (c)	NA
Calcium Carbonate	NA	NA	NA	NA	NA	NA	NA	NA	NA	Present (c)

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY (d)

	Buried Former Lincoln Avenue Ditch (Sediment Layer)			Lincoln Avenue Ditch (Sediments)			
SAMPLE I.D.:	PTB2 BOLD-1	PTB2 BOLD-2	PTB2 BOLD-3	PTB2 BLD-5	PTB2 BLD-6	PTB2 BLD-7	PTB2 BLD-8
CONSTITUENT	CONCENTRATION						
METALS (mg/kg)							
Antimony	8	8 U	7 U	NA	NA	NA	NA
Arsenic	291	45	44	178	187	288	285
Barium	NA	NA	NA	35.8	23.7	48.8	33.4
Beryllium	0.5	0.5	0.3	NA	NA	NA	NA
Cadmium	1	0.4	0.3 U	0.3 U	0.2 U	0.5 U	0.5 U
Chromium	74.5	21.5	21	30.4	19.3	43.8	31.1
Copper	152	42.9	34.4	86.9	50.9	125	90.3
Lead	164	35	34	57	36	85	58
Mercury	0.56	0.11	0.1	0.14	0.08	0.14	0.13
Nickel	22	16	15	19	16	30	31
Selenium	12	8 U	7 U	NA	NA	NA	NA
Silver	0.5 U	0.5 U	0.4 U	NA	NA	NA	NA
Thallium	8 U	8 U	7 U	NA	NA	NA	NA
Zinc	318	48.4	69.4	189	138	334	274
PCBs (ug/kg)							
Aroclor-1248	14600	100 U	260	2000	190	1400	470
SEMIVOLATILE ORGANICS (ug/kg)							
Benzo(a)Anthracene	250 U	100 U	89 U	550 U	420 U	600 M	430 M
Benzo(a)Pyrene	250 U	100 U	89 U	550 U	420 U	480 M	700 U
Benzo(b)-Benzo(k)Fluoranthene	250 U	100 U	120	550 U	420 U	2500	2000
bis(2-Ethylhexyl)phthalate	13000	100 U	300	1500	840	8000	4200
Chrysene	250 U	110	89 U	300 J5	260 J5	1500	1100
Fluoranthene	250 U	120	89 U	260 J5	420 U	2400	1100
Phenanthrene	250 U	100 U	89 U	550 U	420 U	590 J5	700 U
Pyrene	250 U	92 J5	89 U	260 J5	180 J5	1900	960
VOLATILE ORGANICS (ug/kg)							
Acetone	100	75	30	39 J5	33 J5	170 J5	16 U
Benzene	1.2 J5	1.6 U	1.5 U	2.1 U	1.6 U	14 U	2.7 U
2-Butanone	33	19	7.3 M	16 U	12 U	100 U	20 U
cis-1,2-Dichloroethene	9.0	1.6 U	1.2 J5	2.1 U	1.6 U	14 U	2.7 U
Ethylbenzene	5.8	1.6 U	1.5 U	2.1 U	1.6 U	14 U	2.7 U
Toluene	4.4	1.6 U	1.5 U	2.1 U	1.6 U	14 U	2.7 U
Total Xylenes	8.8	1.6 U	1.5 U	2.1 U	1.6 U	14 U	2.7 U
trans-1,2-Dichloroethene	1.6 J5	1.6 U	1.5 U	2.1 U	1.6 U	14 U	2.7 U

TABLE C-7

SUMMARY OF DETECTED CONSTITUENTS IN SOIL AND DITCH SEDIMENT
BLAIR WATERWAY PROPERTY (d)

	Toxicity Equivalency	Buried Former Lincoln Avenue Ditch (Sediment Layer)			Lincoln Avenue Ditch (Sediments)			
SAMPLE I.D.:	Factor (e)	PTB2 BOLD-1	PTB2 BOLD-2	PTB2 BOLD-3	PTB2 BLD-5	PTB2 BLD-6	PTB2 BLD-7	PTB2 BLD-8
CONSTITUENT		CONCENTRATION						
DIOXINS/FURANS (ug/kg)								
Furans:								
2378-TCDF	0.1	NA	0.031	0.054	NA	NA	NA	NA
Total TCDF	0	NA	0.200	0.290	NA	NA	NA	NA
12378-PeCDF	0.05	NA	0.0045	0.050	NA	NA	NA	NA
23478-PeCDF	0.5	NA	0.0045	0.040	NA	NA	NA	NA
Total PeCDF	0	NA	0.088	1.000	NA	NA	NA	NA
123478-HxCDF	0.1	NA	0.0062	0.260	NA	NA	NA	NA
123678-HxCDF	0.1	NA	0.007	0.340 U	NA	NA	NA	NA
123789-HxCDF	0.1	NA	0.0035	0.040	NA	NA	NA	NA
234678-HxCDF	0.1	NA	0.00054 U	0.018	NA	NA	NA	NA
Total HxCDF	0	NA	0.150	5.300	NA	NA	NA	NA
1234678-HpCDF	0.01	NA	0.130	1.600	NA	NA	NA	NA
1234789-HpCDF	0.01	NA	0.0024 U	0.180	NA	NA	NA	NA
Total HpCDF	0	NA	0.240	6.800	NA	NA	NA	NA
OCDF	0.001	NA	0.110	8.400	NA	NA	NA	NA
Dioxins:								
2378-TCDD	1.0	NA	0.002	0.021	NA	NA	NA	NA
Total TCDD	0	NA	0.130	0.390	NA	NA	NA	NA
12378-PeCDD	0.5	NA	0.004	0.150	NA	NA	NA	NA
Total PeCDD	0	NA	0.120	0.650	NA	NA	NA	NA
123478-HxCDD	0.1	NA	0.0042	0.200	NA	NA	NA	NA
123678-HxCDD	0.1	NA	0.0085	1.100	NA	NA	NA	NA
123789-HxCDD	0.1	NA	0.0063	0.550	NA	NA	NA	NA
Total HxCDD	0	NA	0.110	4.400	NA	NA	NA	NA
1234678-HpCDD	0.01	NA	0.110	8.700	NA	NA	NA	NA
Total HpCDD	0	NA	0.210	22.000	NA	NA	NA	NA
OCDD	0.001	NA	0.760	74.000	NA	NA	NA	NA
Total 2378-TCDD Equiv.= (e)			0.015	0.528				

(a) NA Indicates constituent not analyzed.
(b) Reported as benzo(b)fluoranthene and benzo(k)fluoranthene.
(c) These analyses were performed for qualitative identification only and, thus, were not included in the data validation report.
(d) Analytes for samples PTB2-BOLD-1 through PTB2-BLD-8 are specific to additional investigations conducted in August 1990; thus, are different from previous soil and onshore sediment analyses.
(e) Calculated using EPA 1989 Interim Procedure (EPA 1989c).
NOTES: Refer to Table C-5 for definition of data qualifiers.
All results are reported on dry weight basis.
Sample locations are shown on Figures 5 and 6 in main body of text.

TACOMA\BLAIR\BWF-C7, BWFC7A.WK1

TABLE C-8

SUMMARY OF DETECTED CONSTITUENTS IN MARINE SEDIMENT
BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BWS-1-02	BWS-1-288	BWS-1-8890	BWS-2-02	BWS-2-288	BWS-2-8890
CONSTITUENT	CONCENTRATION					
CONVENTIONALS						
Ammonia (mg/kg)	10.7	6.2	6.3	24.9	8.0	2.5
Sulfide (mg/kg)	4.8 UJ3	10.3 UJ3	8.1 J3	9.1 UJ3	7.1 J3	7.1 UJ3
Total Volatile Solids (% dry wt.)	1.79	1.22	1.29	2.34	1.32	1.21
Total Organic Carbon (%)	0.5204	0.6027	0.4615	0.9361	0.5196	0.3304
METALS (mg/kg)						
Antimony	10.1 J4	13.1 J4	6.4 J4	2.45 J4	0.7 J4	0.2 J4
Arsenic	15 J4	11 J4	11 J4	5 UJ4	4 UJ4	5 UJ4
Cadmium	0.3	0.3	0.2	0.2 U	0.2 U	0.2 U
Copper	51.2	51.2	66.8	46	39.1	30.8
Lead	32	31	24	14	10	8
Manganese	519	481	459	416	378	416
Nickel	30	31	31	30	26	32
Zinc	113 J4	110 J4	89.4 J4	77 J4	58.4 J4	58.2 J4
PCBs (ug/kg)						
Aroclor 1254	20 U	20 U	10 J5	20 U	20 U	20 U
Aroclor 1260	280	20 U	20 U	20 U	20 U	20 U

TABLE C-8

SUMMARY OF DETECTED CONSTITUENTS IN MARINE SEDIMENT
BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BWS-1-02	BWS-1-288	BWS-1-8890	BWS-2-02	BWS-2-288	BWS-2-8890
CONSTITUENT	CONCENTRATION					
SEMIVOLATILE ORGANICS (ug/kg)						
Benzoic acid	21 J5	13 J5	19 M	140 UJ4	110 U	110 U
Naphthalene	33	16	54	14 UJ4	11 U	11 U
2-Methylnaphthalene	6 J5	6 J5	5 J5	6 J45	11 U	11 U
Acenaphthylene	8 J5	12 U	4 J5	14 UJ4	11 U	11 U
Acenaphthene	5 J5	5 J5	44	7 J45	11 U	11 U
Dibenzofuran	5 J5	4 M	16	12 J45	11 U	11 U
Fluorene	11	5 M	29	14 J45	11 U	11 U
Phenanthrene	79	50	100	190 J4	11 U	11 U
Anthracene	36	12	46	43 J4	11 U	11 U
Di-n-butylphthalate	11 U	12 U	59	14 UJ4	11 U	11 U
Fluoranthene	230	81	190	320 J4	11 U	11 U
Pyrene	200	130	210	230 J4	11 U	11 U
Benzo(a)anthracene	88	58	70	31 J4	11 U	11 U
bis(2-Ethylhexyl)phthalate	100	94	54	55 J4	26	5 J5
Chrysene	110	68	91	69 J4	11 U	11 U
Benzo(b)-Benzo(k)fluoranthene	150	130	140	62 J4	11 U	11 U
Benzo(a)pyrene	46	42	59	20 J4	11 U	11 U
Indeno(1,2,3-cd)pyrene	48	51	41	14 UJ4	11 U	11 U
Dibenz(a,h)anthracene	29 M	31 M	11 U	14 UJ4	11 U	11 U
Benzo(g,h,i)perylene	11 U	14 M	11 U	14 UJ4	11 U	11 U

NOTES: Refer to Table C-5 for definition of data qualifiers.
All results reported on a dry weight basis.

tacoma\blair\bwf-c8.wk1

TABLE C-9

SUMMARY OF TCLP METALS RESULTS IN SLAG SAMPLES
BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	PTB2 BW-S1		PTB2 BW-S2	
CONSTITUENT	CONCENTRATION			
TCLP METALS (mg/L)				
Arsenic	2.91		5.6	
Barium	0.163		0.146	
Cadmium	0.002	U	0.024	
Chromium	0.005	U	0.005	
Lead	1.79		1.06	
Mercury	0.0001	U	0.0001	U
Selenium	0.05	U	0.05	U
Silver	0.003	U	0.003	U

NOTE: Refer to Table C-5 for definition of qualifiers.

\TACOMA\BLAIR\BWF-C9.WK1

TABLE C-10

SUMMARY OF DETECTED CONSTITUENTS IN PRECIPITATE SAMPLES BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BDP-1-1	
CONSTITUENT	CONCENTRATION	
CONVENTIONALS (mg/kg)		
Chloride	8081	
Sulfate	3157	
METALS (mg/kg)		
Aluminum	14400	
Arsenic	95	
Barium	63.5	
Cadmium	1.3	
Calcium	8500	
Chromium	24.4	
Copper	45.4	J4
Iron	211000	
Lead	46	
Magnesium	4330	
Manganese	1570	
Mercury	0.22	U
Nickel	47	
Zinc	199	J4

NOTES: Refer to Table C-5 for definition of data qualifiers.
All results reported on dry weight basis.

TACOMA\BLAIR\BWF-C10.WK1

TABLE C-11

SUMMARY OF DETECTED CONSTITUENTS IN COMPOSITE GRAVING DOCK BOTTOM MATERIAL SAMPLE BLAIR WATERWAY PROPERTY

SAMPLE I.D.:	BG-11/12
CONSTITUENT	CONCENTRATION
CONVENTIONALS (a)	
Sulfide (mg/kg)	862.3
Total Organic Carbon (mg/kg)	9049
Solids (%)	58.8
METALS (mg/kg) (a)	
Antimony	21
Arsenic	195
Barium	25.4
Beryllium	0.5
Cadmium	0.8
Chromium	24.9
Cobalt	14.9
Copper	454
Lead	92
Manganese	120
Mercury	0.09
Molybdenum	19
Nickel	21
Silver	0.9
Thallium	39
Vanadium	53.9
Zinc	1440
TOTAL PETROLEUM HYDROCARBONS (mg/kg)	
Diesel Range Hydrocarbons	190
SEMIVOLATILE ORGANICS (ug/kg)	
Phenanthrene	130
Fluoranthene	290
Pyrene	130
Butylbenzylphthalate	1400
Benzo(a)anthracene	160
bis(2-Ethylhexyl)phthalate	500
Chrysene	310
Benzo(b)+Benzo(k)fluoranthene	630
VOLATILE ORGANICS (ug/kg)	
Acetone	8.4 J

(a) Samples from Stations BG-11 and BG-12 were composited for this analysis.

NOTE: Refer to Table C-5 for definition of qualifiers.

TACOMA\BLAIR\BWF-C11.WK1

ATTACHMENT C-1

Ground Water Monitoring Results
Reichhold Chemicals, Inc. Tacoma Facility

CH2M HILL

QUARTERLY GROUNDWATER MONITORING RESULTS

TO: U.S. Environmental Protection Agency
Washington State Department of Ecology

PREPARED BY: CH2M HILL NORTHWEST, Inc.

FROM: Reichhold Chemicals, Inc.

DATE: November 26, 1990

RE: Reichhold Tacoma Facility, Seventh Quarter (July 1990) Annual Pre-Corrective Action Groundwater Monitoring Results

PROJECT: SEA21487.WW.QM

This document presents precorrective action groundwater quality monitoring data collected, analyzed and submitted in accordance with Sections V.B. (4) and V.B. (5) of Reichhold RCRA Permit No. WAD 009-252-891. These analytical results represent annual (1990) groundwater sampling conducted during the seventh quarter (July) of the precorrective action monitoring program.

Forty-six precorrective action monitoring wells (stations) were scheduled for annual sampling in accordance with the permit (see Table 1). Station MW-45I was sampled and analyzed for the full list of Appendix IX (40 CFR Part 264) parameters. The remaining 45 stations were scheduled for sampling and analysis for a Modified List of Appendix IX parameters (see Table 6 of the permit). Dry subsurface conditions precluded the sampling of two of the shallow aquifer wells (MW-55S and 57S), and limited the sampling of four other shallow wells (MW-10S, 25S, 27S and 54S) to volatile organics and formaldehyde.

The July 1990 Modified Appendix IX analytical results are presented in Table 2. The July 1990 Full Appendix IX analytical results for station MW-45I are presented in Attachment B; these data are presented on a copy of the original laboratory data sheets. A complete list of sample analytes (Modified and Full Appendix IX parameters) and detection limits are presented in Attachment A, Tables A-1 through A-3. Analytical QA/QC data are presented in Attachment C, Tables C-1 through C-8).

Laboratory analytical difficulties were encountered with the Modified Appendix IX inorganics (Results presented in Table 2-4). The laboratory reanalyzed all samples for the inorganic parameters, however, QA/QC issues were not resolved. Based on these difficulties the inorganic data was flagged with a "T" for tentative usage. It is recommended that the inorganic

concentrations only be evaluated relative to past and future monitoring results; these data may not be adequate for any quantitative analysis.

Total organic analysis concentration (TOAC) results through July 1990 will be presented in a later submittal in accordance with Section V.B. (6) of the RCRA permit.

Table 1
Precorrective Action Wells (Stations) Sampled
7th Quarter - July 1990
Reichhold Chemicals, Inc.

Shallow Aquifer	Intermediate Aquifer	Deep Aquifer
MW-1S	MW-2I	MW-1D
MW-2S	MW-4I2[c]	MW-4D
MW-4S	MW-12I	MW-7D
MW-10S[a]	MW-28I	MW-10D2
MW-12S	MW-29I	MW-11D2
MW-23S	MW-36I	MW-13D
MW-25S[a]	MW-37I	MW-22D
MW-27S[a]	MW-39I	MW-40D
MW-32S	MW-41I	MW-49D
MW-33S	MW-44I	MW-53D
MW-34S	MW-45I[d]	MW-60D
MW-43S	MW-46I	
MW-51S	MW-48I	
MW-54S[a]	MW-50I	
MW-55[b]	MW-53I	
MW-56S	MW-58I	
MW-57S[b]	MW-59I	
MW-58S		

[a]MW-10S, MW-25S, MW-27S and MW-54S were scheduled for sampling however insufficient water volumes precluded sample collection for all parameters except volatile organics and formaldehyde.
[b]MW-55S and MW-57S were scheduled for sampling however insufficient water volumes precluded sample collection.
[c]MW-4I2 replaces MW-4I which was abandoned in May 1989.
[d]MW-45I was sampled and analyzed for the full list of Appendix IX (40 CFR Part 264) parameters.

Table 2-1
Volatile Compounds plus Formaldehyde
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	CHLORO-METHANE	BROMO-METHANE	VINYL CHLORIDE	CHLORO-ETHANE	ETHYLENE CHLORIDE	ACETONE	CARBON DI-SULFIDE	1,1-DI-CHLORO-ETHENE	1,2-DI-CHLORO-ETHENE	TRANS-1,2-DI-CHLORO-ETHENE	CHLORO-FORM	1,2-DI-CHLORO-ETHANE	2-BUTANONE	1,1,1-TRI-CHLORO-ETHANE	CARBON TETRA-CHLORIDE
MW-001D		10 U	10 U	10 U	10 U	5 U	28	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-001S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-002I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-002S2		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-004D		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-004D	FD	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-004I2		10 U	10 U	160	10 U	5 U	10	5 U	5 U	7	13	5 U	5 U	140	5 U	5 U
MW-004S		10 U	10 U	1 J	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-007D		10 U	10 U	10 U	10 U	5 U	23	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-010D2		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-010S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-011D2		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-012I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-012S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-013D		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-013D	FD	10 U	10 U	10 U	10 U	5 U	10 U	1 J	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-022D		10 U	10 U	10 U	10 U	5 U	10 U	3 J	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-023S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-025S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-027S		10 U	10 U	10 U	10 U	5 U	7 J	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-028I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-029I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-032S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-033S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	4 J	5 U	5 U	10 U	5 U	5 U
MW-034S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-036I		10 U	10 U	10 U	10 U	5 U	10 U	1 J	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-037I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-039I		10 U	10 U	10 U	10 U	5 U	14	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-040D		10 U	10 U	10 U	10 U	5 U	10 U	1 J	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-041I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-043S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	11	5 U	5 U	10 U	5 U	5 U
MW-044I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-046I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-048I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	4 J	5 U	5 U	10 U	5 U	5 U
MW-048I	FD	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-049D		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-050I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-051S		10 U	10 U	10 U	10 U	5 U	10	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-053D		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-053I		10 U	10 U	7 J	10 U	5 U	10 U	5 U	5 U	5 U	13	5 U	5 U	10 U	5 U	5 U
MW-053I	FD	10 U	10 U	6 J	10 U	5 U	10 U	5 U	5 U	5 U	13	5 U	5 U	10 U	5 U	5 U
MW-054S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-056S		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-058I		10 U	10 U	10 U	10 U	5 U	1 JB	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-058S		10 U	10 U	10 U	10 U	5 U	4 JB	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-059I		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U
MW-060D		10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier
- U Parameter analyzed for but not detected above the concentration listed
- J Indicates an estimated value
- R Value is unusable

Table 2-1 (continued)
Volatile Compounds plus Formaldehyde
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	VINYL ACETONE	BROMODI-CHLORO-METHANE	1,2-DI-CHLORO-PROPANE	CIS-1,3-DI-CHLORO-PROPENE	TRI-CHLORO-ETHENE	DIBROMO-CHLORO-METHANE	1,1,2-TRI-CHLORO-ETHANE	BENZENE	TRANS-1,3-DI-CHLORO-PROPENE	2-CHLORO-ETHYL-VINYL-ETHER	BROMO-FORM	METHYL-ISO-BUTYL-KETONE	2-HEXANONE	1,1,2,2-TETRA-CHLORO-ETHANE	1,1,2,2-TETRA-CHLORO-ETHYLENE
MW-001D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-001S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-002I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	52	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-002S2		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-004D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-004D	FD	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-004I2		10 U	5 U	5 U	5 U	5 U	5 U	5 U	29	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-004S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-007D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-010D2		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-010S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-011D2		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-012I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-012S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-013D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-013D	FD	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-022D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-023S		10 U	5 U	5 U	5 U	4 J	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	8
MW-025S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-027S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-028I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-029I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-032S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-033S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-034S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-036I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-037I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-039I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-040D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-041I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-043S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-044I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-046I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-048I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	30	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-048I	FD	10 U	5 U	5 U	5 U	5 U	5 U	5 U	30	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-049D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-050I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-051S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-053D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-053I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-053I	FD	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-054S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-056S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	4 J
MW-058I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-058S		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-059I		10 U	5 U	5 U	5 U	5 U	5 U	5 U	7	5 U	10 U	5 U	10 U	10 U	5 U	5 U
MW-060D		10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	10 U	10 U	5 U	5 U

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier U Parameter analyzed for but not detected above the concentration listed

J Indicates an estimated value

Table 2-1 (continued)
Volatile Compounds plus Formaldehyde
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	TOLUENE	CHLORO-BENZENE	ETHYL-BENZENE	STYRENE	TOTAL XYLENES	FORMAL-DEHYDE
MW-001D		5 U	5 U	5 U	5 U	5 U	50 U
MW-001S		5 U	5 U	5 U	5 U	5 U	200
MW-002I		5 U	5 U	5 U	5 U	5 U	830
MW-002S2		5 U	5 U	5 U	5 U	5 U	50 U
MW-004D		5 U	5 U	5 U	5 U	5 U	50 U
MW-004D	FD	5 U	5 U	5 U	5 U	5 U	50 U
MW-004I2		5 U	5 U	3 J	5 U	5 U	460
MW-004S		5 U	5 U	5 U	5 U	5 U	990
MW-007D		5 U	5 U	5 U	5 U	5 U	50 U
MW-010D2		5 U	5 U	5 U	5 U	5 U	50 U
MW-010S		5 U	5 U	5 U	5 U	5 U	50 U
MW-011D2		5 U	5 U	5 U	5 U	5 U	130
MW-012I		5 U	5 U	5 U	5 U	5 U	170
MW-012S		5 U	5 U	5 U	5 U	5 U	50 U
MW-013D		5 U	5 U	5 U	5 U	5 U	50 U
MW-013D	FD	5 U	5 U	5 U	5 U	5 U	50 U
MW-022D		5 U	5 U	5 U	5 U	5 U	50 U
MW-023S		5 U	5 U	5 U	5 U	5 U	50 U
MW-025S		5 U	5 U	5 U	5 U	5 U	50 U
MW-027S		5 U	5 U	5 U	5 U	5 U	50 U
MW-028I		5 U	5 U	5 U	5 U	5 U	50 U
MW-029I		5 U	5 U	5 U	5 U	5 U	50 U
MW-032S		5 U	5 U	5 U	5 U	5 U	50 U
MW-033S		5 U	5 U	5 U	5 U	5 U	50 U
MW-034S		2 J	5 U	5 U	5 U	5 U	50 U
MW-036I		5 U	5 U	5 U	5 U	5 U	50 U
MW-037I		5 U	5 U	5 U	5 U	5 U	140
MW-039I		5 U	5 U	5 U	5 U	5 U	120
MW-040D		5 U	5 U	5 U	5 U	5 U	50 U
MW-041I		5 U	5 U	5 U	5 U	5 U	220
MW-043S		5 U	5 U	5 U	5 U	5 U	50 U
MW-044I		5 U	5 U	5 U	5 U	5 U	50 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS					
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS					
MW-046I		5 U	5 U	5 U	5 U	5 U	130
MW-048I		5 U	5 U	5 U	5 U	5 U	5500
MW-048I	FD	5 U	5 U	5 U	5 U	5 U	5900
MW-049D		5 U	5 U	5 U	5 U	5 U	50 U
MW-050I		5 U	5 U	5 U	5 U	5 U	410
MW-051S		5 U	5 U	5 U	5 U	5 U	50 U
MW-053D		5 U	5 U	5 U	5 U	5 U	50 U
MW-053I		5 U	5 U	5 U	5 U	5 U	50 U
MW-053I	FD	5 U	5 U	5 U	5 U	5 U	50 U
MW-054S		5 U	5 U	5 U	5 U	5 U	50 U
MW-056S		5 U	5 U	5 U	5 U	5 U	50 U
MW-058I		5 U	5 U	5 U	5 U	5 U	50 U
MW-058S		5 U	5 U	5 U	5 U	5 U	50 U
MW-059I		5 U	5 U	5 U	5 U	5 U	5400
MW-060D		5 U	5 U	5 U	5 U	5 U	50 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-2
Semivolatile Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	PHENOL	BIS(2-CHLORO-ETHYL) ETHER	2-CHLORO-PHENOL	1,3-DI-CHLORO-BENZENE	1,4-DI-CHLORO-PHENOL	BENZYL ALCOHOL	1,2-DI-CHLORO-BENZENE	2-METHYL PHENOL	BIS(2-CHLORO-ISO-PROPYL) ETHER	4-METHYL-PHENOL	N-NITROSO-DI-N-PROPYL-AMINE	HEXA-CHLORO-ETHANE	NITRO-BENZENE	ISO-PHORONE	2-NITRO-PHENOL
MW-001D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-001S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-002I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-002S2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004D	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004I2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-007D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-010D2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-011D2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-012I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-012S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-013D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-013D	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-022D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-023S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-028I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-029I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-032S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-033S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-034S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-036I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-037I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-039I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-040D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-041I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-043S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-044I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDXI IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDXI IX ANALYTICAL RESULTS														
MW-046I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-048I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-048I	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-049D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-050I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-051S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053I	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-056S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-058I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-058S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-059I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-060D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-2 (continued)
Semivolatile Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	2,4-DI-METHYL-PHENOL	BENZOIC ACID	BIS(2-CHLORO-ETHOXY) METHANE	2,4-DI-CHLORO-PHENOL	1,2,4-TRI-CHLORO-BENZENE	NAPHTHA-LENE	4-CHLORO-ANILINE	HEXA-CHLORO-BUTA-DIENE	-CHLORO-METHYL-PHENOL	2-METHYL-NAPHTHA-LENE	HEXA-CHLORO-CYCLO-PENTA-DIENE	2,4,6-TRI-CHLORO-PHENOL	2,4,5-TRI-CHLORO-PHENOL	2-CHLORO-NAPTHA-LENE	2-NITRO-ANILINE
MW-001D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-001S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-002I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-002S2		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-004D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-004D	FD	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-004I2		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-004S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-007D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-010D2		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-011D2		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-012I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-012S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-013D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-013D	FD	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-022D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-023S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-028I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-029I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-032S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-033S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-034S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-036I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-037I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-039I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-040D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-041I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-043S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-044I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-046I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-048I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 J	10 U	10 U	50 U	10 U	50 U
MW-048I	FD	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-049D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-050I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-051S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-053D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-053I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-053I	FD	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-056S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-058I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-058S		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-059I		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U
MW-060D		10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	50 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-2 (continued)
Semivolatile Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	DIMETHYL PHTHALATE	ACENAPH-THYLENE	2,6-DI-NITRO-TOLUENE	3-NITRO-ANILINE	ACENA-PHTHENE	2,4-DI-NITRO-PHENOL	4-NITRO-PHENOL	DIBENZO-FURAN	2,4-DI-NITRO-TOLUENE	DIETHYL-HTHALATE	4-CHLORO-PHENYL-PHENYL-ETHER	FLUORENE	4-NITRO-ANILINE	4,6-DI-NITRO-METHYL-PHENOL	N-NITRO-SODI-PHENY-LAMINE
MW-001D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-001S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-002I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-002S2		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-004D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-004D	FD	10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-004I2		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-004S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-007D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-010D2		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-011D2		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-012I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-012S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-013D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-013D	FD	10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-022D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-023S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-028I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-029I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-032S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-033S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-034S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-036I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-037I		10 U	10 U	10 U	50 U	9 J	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-039I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-040D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-041I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-043S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-044I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-046I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-048I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-048I	FD	10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-049D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-050I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-051S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-053D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-053I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-053I	FD	10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-056S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-058I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-058S		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-059I		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U
MW-060D		10 U	10 U	10 U	50 U	10 U	50 U	50 U	10 U	10 U	10 U	10 U	10 U	50 U	50 U	10 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-2 (continued)
Semivolatile Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	4-BROMO-PHENYL-PHENYL-ETHER	HEXA-CHLORO-BENZENE	PENTA-CHLORO-PHENOL	PHENAN-THRENE	ANTHRA-CENE	DI-N-BUTYL-HTHALATE	FLUORAN-THENE	PYRENE	BUTYL-BENZYL-HTHALATE	3,3'-DI-CHLORO-ENZIDINE	BENZO(A) ANTHRA-CENE	CHRYSENE	BIS(2-ETHYL-HEXYL) HTHALATE	DI-N-OCTYL HTHALATE	BENZO(B) FLUORAN-THENE
MW-001D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-001S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-002I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-002S2		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-004D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-004D	FD	10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-004I2		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-004S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-007D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-010D2		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-011D2		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-012I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-012S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-013D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-013D	FD	10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-022D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-023S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-028I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-029I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-032S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-033S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-034S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-036I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-037I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-039I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-040D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-041I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-043S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-044I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS														
MW-046I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-048I		10 U	10 U	50 U	3 J	10 U	10 U	10 U	17	10 U	20 U	10 U	5 J	10 U	10 U	10 U
MW-048I	FD	10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-049D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-050I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-051S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-053D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-053I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-053I	FD	10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-056S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-058I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-058S		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-059I		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U
MW-060D		10 U	10 U	50 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U	10 U	10 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-2 (continued)
Semivolatile Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	BENZO(K) FLUORAN-THENE	BENZO(A) PYRENE	INDENO (1,2,3-D)PYRENE	DI-BENZ(A,H) ANTHRA-CENE	BENZO (G,H,I) PERYLENE	4(1,1-DI-METHYL-ETHYL-PHENOL	2,3,4,6-TETRA-CHLORO-PHENOL	-BENZYL--CHLORO-PHENOL
MW-001D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-001S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-002I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-002S2		10 U	10 U	10 U	10 U	10 U	5 J	10 U	10 U
MW-004D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004D	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-004I2		10 U	10 U	10 U	10 U	10 U	120	10 U	10 U
MW-004S		10 U	10 U	10 U	10 U	10 U	240	10 U	10 U
MW-007D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-010D2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-011D2		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-012I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-012S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-013D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-013D	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-022D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-023S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-028I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-029I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-032S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-033S		10 U	10 U	10 U	10 U	10 U	5 J	10 U	10 U
MW-034S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-036I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-037I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-039I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-040D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-041I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-043S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-044I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-045I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS							
MW-045I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS							
MW-046I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-048I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-048I	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-049D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-050I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-051S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-053I	FD	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-056S		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-058I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-058S		10 U	10 U	10 U	10 U	10 U	300	10 U	10 U
MW-059I		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
MW-060D		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier
- U Parameter analyzed for but not detected above the concentration listed
- J Indicates an estimated value
- R Value is unusable

Table 2-3
Pesticide/PCB and Herbicide Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	ALPHA-BHC	BETA-BHC	DELTA-BHC	GAMMA-BHC	HEPTA-CHLOR	ALDRIN	HEPTA-CHLOR EPOXIDE	ENDO-SULFAN I	DIELDRIN	4,4'-DDE	ENDRIN
MW-001D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-001S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-002I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-002S2		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-004D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-004D	FD	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-004I2		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-004S		0.050 U	0.050 U	0.050 U	0.070	0.050 U	0.050 U	0.070	0.050 U	0.10 U	0.10 U	0.10 U
MW-007D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-010D2		0.006 J	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.007 J	0.050 U	0.10 U	0.10 U	0.10 U
MW-011D2		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-012I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-012S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-013D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-013D	FD	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-022D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-023S		0.010 J	0.010 J	0.050 U	0.050 U	0.040 J	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-028I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-032S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-033S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-034S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-036I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-037I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-039I		0.050 U	0.006 J	0.050 U	0.050 U	0.030 J	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-040D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-041I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-043S		0.050 U	0.10	0.050 U	0.050 U	0.050 U	0.050	0.050 U	0.050 U	0.060 J	0.070 J	10 J
MW-044I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-45I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-45I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-046I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-048I		0.040 J	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-048I	FD	0.030 J	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-049D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-050I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-051S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-053D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-053I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-053I	FD	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-056S		0.050 U	0.10	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-058I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-058S		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-059I		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U
MW-060D		0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.10 U	0.10 U	0.10 U

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier
- U Parameter analyzed for but not detected above the concentration listed
- J Indicates an estimated value
- R Value is unusable

Table 2-3 (continued)
Pesticide/PCB and Herbicide Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	ENDO-SULFAN II	4,4'-DDD	ENDO-SULFAN SULFATE	4,4'-DDT	METHOXY-CHLOR	ENDRIN KETONE	ALPHA-CHLORDANE	GAMMA-CHLORDANE	TOXAPHENE	AROCLOR-1016	AROCLOR-1221
MW-001D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-001S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-002I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-002S2		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-004D		0.10 U	0.10 U	0.020 J	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-004D	FD	0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-004I2		0.10 U	0.10 U	0.040 J	0.10 U	0.050 J	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-004S		0.10 U	0.10 U	0.010 J	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-007D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-010D2		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.004 J	1.0 U	0.50 U	0.50 U
MW-011D2		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-012I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-012S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-013D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-013D	FD	0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-022D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-023S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-028I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-032S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-033S		0.10 U	0.10 U	0.020 J	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-034S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-036I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-037I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-039I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-040D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-041I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-043S		0.10 U	0.10 U	0.040 J	0.10 U	0.50 U	0.10 U	0.020 J	0.24 J	1.0 U	0.50 U	0.50 U
MW-044I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-45I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-45I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-046I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-048I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-048I	FD	0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-049D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-050I		0.10 U	0.10 U	0.030 J	0.10 U	0.50 U	0.22	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-051S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-053D		0.10 U	0.10 U	0.020 J	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-053I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-053I	FD	0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-056S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.27 J	0.50 U	1.0 U	0.50 U	0.50 U
MW-058I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-058S		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-059I		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U
MW-060D		0.10 U	0.10 U	0.10 U	0.10 U	0.50 U	0.10 U	0.50 U	0.50 U	1.0 U	0.50 U	0.50 U

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier
- U Parameter analyzed for but not detected above the concentration listed
- J Indicates an estimated value
- R Value is unusable

Table 2-3 (continued)
Pesticide/PCB and Herbicide Compounds
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	AROCLOR-1232	AROCLOR-1242	AROCLOR-1248	AROCLOR-1254	AROCLOR-1260	2,4-D	2,4,5-T	2,4'5-TP (SILVEX)
MW-001D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-001S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-002I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-002S2		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-004D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-004D	FD	0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-004I2		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-004S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-007D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-010D2		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-011D2		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-012I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-012S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-013D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-013D	FD	0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-022D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-023S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-028I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-032S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-033S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-034S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-036I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-037I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-039I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-040D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-041I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-043S		0.50 U	0.50 U	6.3	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-044I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-45I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS							
MW-45I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS							
MW-046I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-048I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-048I	FD	0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-049D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-050I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-051S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-053D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-053I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-053I	FD	0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-056S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-058I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-058S		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-059I		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U
MW-060D		0.50 U	0.50 U	0.50 U	1.0 U	1.0 U	0.50 U	0.25 U	0.25 U

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable

Table 2-4
Inorganic Compounds plus Molybdenum and Total Organic Carbon
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT	COPPER	CYANIDE
MW-001D		174 JT	2.0 UJT	1.2 T	32.0 UJT	2.0 UJT	4.0 UJT	86900 JT	7.0 UJT	13.0 UT	39.0 JT	10.0 UT
MW-001S		80.0 UT	2.0 UJT	1.3 T	32.0 UJT	2.0 UJT	4.0 UJT	24600 JT	7.0 UJT	13.0 UT	22.0 JT	10.0 UT
MW-002I		144 JT	2.0 UJT	1.9 T	55.0 JT	2.0 UJT	4.0 UJT	395000 JT	21.0 JT	13.0 UT	18.0 JT	10.0 UT
MW-002S2		80.0 UT	2.0 UJT	9.8 T	32.0 UJT	2.0 JT	4.0 UJT	58300 JT	7.0 UJT	13.0 UT	22.0 JT	10.0 UT
MW-004D		80.0 UT	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	38000 JT	7.0 UJT	13.0 UT	28.0 JT	10.0 UT
MW-004D	FD	80.0 UT	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	36600 JT	7.0 UJT	13.0 UT	25.0 JT	10.0 UT
MW-004I2		158 JT	2.0 UJT	3.9 T	116 JT	7.0 JT	4.0 UJT	1500000JT	11.0 JT	13.0 UT	55.0 JT	10.0 UT
MW-004S		107 JT	2.0 UJT	19.4 T	32.0 UJT	2.0 UJT	4.0 UJT	200000 JT	7.0 UJT	13.0 UT	31.0 JT	10.0 UT
MW-007D		90.0 JT	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	66600 JT	7.0 UJT	13.0 UT	30.0 JT	10.0 UT
MW-010D2		80.0 UT	2.0 UJT	1.1 T	32.0 UJT	2.0 UJT	4.0 UJT	55800 JT	7.0 UJT	13.0 UT	26.0 JT	10.0 UT
MW-011D2		382 T	2.0 UJT	1.4 T	44.0 JT	3.0 JT	4.0 JT	37000 JT	7.0 UJT	13.0 UT	22.0 JT	10.0 UT
MW-012I		80.0 UT	2.8 JT	6.4 T	32.0 UJT	2.0 UJT	4.0 UJT	9150 JT	7.0 UJT	13.0 UT	16.0 JT	10.0 UT
MW-012S		95.0 JT	2.8 JT	4.0 T	40.0 JT	2.0 JT	22.0 JT	59400 JT	12.0 JT	13.0 UT	16.0 JT	10.0 UT
MW-013D		80.0 UT	2.0 UJT	2.0 T	32.0 UJT	2.0 JT	4.0 JT	49700 JT	7.0 UJT	13.0 UT	27.0 JT	10.0 UT
MW-013D	FD	80.0 UT	2.0 UJT	1.2 T	32.0 UJT	2.0 UJT	4.0 UJT	7780 JT	7.0 UJT	13.0 UT	22.0 JT	10.0 UT
MW-022D		97.0 JT	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	9220 JT	7.0 UJT	13.0 UT	12.0 JT	10.0 UT
MW-023S		4780 T	2.0 UJT	1.9 T	32.0 UJT	3.0 JT	4.0 UJT	295000 JT	7.0 UJT	49.0 JT	61.0 JT	10.0 UT
MW-028I		220 T	2.0 UJT	1.3 T	150 JT	4.0 JT	4.0 UJT	746000 JT	7.0 UJT	13.0 UT	39.0 JT	10.8 T
MW-029I		80.0 UT	2.0 UJT	1.8 T	32.0 UJT	2.0 JT	4.0 UJT	45600 JT	17.0 JT	13.0 UT	19.0 JT	10.0 UT
MW-032S		1500 T	2.0 UJT	1.0 UT	32.0 UJT	3.0 JT	4.0 UJT	31400 JT	7.0 UJT	22.0 JT	25.0 JT	10.0 UT
MW-033S		80.0 UT	2.0 UJT	1.3 T	32.0 UJT	2.0 UJT	4.0 UJT	119000 JT	7.0 UJT	15.0 JT	38.0 JT	10.0 UT
MW-034S		124 JT	2.0 UJT	6.5 T	32.0 UJT	2.0 JT	4.0 UJT	7120 JT	7.0 UJT	13.0 UT	16.0 JT	10.0 UT
MW-036I		126 JT	2.0 UJT	2.4 T	45.0 JT	2.0 UJT	4.0 UJT	154000 JT	8.0 JT	13.0 UT	12.0 JT	10.0 UT
MW-037I		173 JT	2.0 UJT	3.0 T	32.0 UJT	2.0 UJT	4.0 UJT	9660 JT	24.0 JT	13.0 UT	23.0 JT	10.0 UT
MW-039I		80.0 UT	2.0 UJT	20.0 T	55.0 JT	2.0 JT	4.0 UJT	130000 JT	7.0 UJT	13.0 UT	31.0 JT	10.0 UT
MW-040D		80.0 UT	2.0 UJT	1.0 UT	148 JT	9.0 JT	4.0 JT	933 UJT	8.0 JT	13.0 UT	33.0 JT	10.0 UT
MW-041I		505 T	2.6 JT	2.1 T	72.0 JT	2.0 UJT	4.0 UJT	841000 JT	7.0 UJT	13.0 UT	77.0 JT	10.0 UT
MW-043S		851 T	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	21000 JT	7.0 UJT	19.0 JT	30.0 JT	10.0 UT
MW-044I		80.0 UT	2.0 UJT	5.2 T	34.0 JT	2.0 JT	20.0 JT	46600 JT	7.0 UJT	13.0 UT	18.0 JT	10.0 UT
MW-45I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-45I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-046I		103 JT	2.0 UJT	3.8 T	32.0 UJT	3.0 JT	4.0 UJT	34000 JT	8.0 JT	13.0 UT	24.0 JT	10.0 UT
MW-048I		80.0 UT	2.0 UJT	2.0 T	47.0 JT	5.0 JT	4.0 UJT	50300 JT	7.0 JT	13.0 UT	25.0 JT	10.0 UT
MW-048I	FD	80.0 UT	2.0 UJT	1.0 UT	44.0 JT	4.0 JT	4.0 UJT	45600 JT	7.0 UJT	13.0 UT	13.0 JT	10.0 UT
MW-049D		80.0 UT	2.0 UJT	1.4 T	34.0 JT	2.0 JT	4.0 UJT	176000 JT	7.0 JT	13.0 UT	26.0 JT	10.0 UT
MW-050I		80.0 JT	2.0 UJT	8.7 T	52.0 JT	8.0 JT	4.0 UJT	197000 JT	7.0 UJT	13.0 UT	33.0 JT	10.0 UT
MW-051S		3800 T	2.0 UJT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	36300 JT	7.0 UJT	41.0 JT	48.0 JT	10.0 UT
MW-053D		80.0 UT	2.0 UJT	1.0 UT	52.0 JT	2.0 UJT	4.0 UJT	491000 JT	7.0 UJT	13.0 UT	25.0 JT	19.5 T
MW-053I		131 JT	2.0 UJT	1.3 T	33.0 JT	2.0 JT	4.0 UJT	536000 JT	39.0 JT	13.0 UT	25.0 JT	10.0 UT
MW-053I	FD	80.0 UT	2.0 UJT	1.6 T	32.0 UJT	2.0 UJT	27.0 JT	8470 JT	7.0 UJT	13.0 UT	13.0 JT	10.0 UT
MW-056S		2430 T	2.2 JT	1.0 UT	32.0 UJT	2.0 UJT	4.0 UJT	15500 JT	32.0 JT	13.0 UT	39.0 JT	10.0 UT
MW-058I		1860 T	4.0 JT	11.0 T	1670 JT	45.0 JT	51.0 JT	933 UJT	180 JT	460 T	236 JT	10.0 UT
MW-058S		426 T	2.0 UJT	8.7 T	40.0 JT	3.0 JT	5.0 JT	34600 JT	7.0 UJT	13.0 UT	25.0 JT	10.0 UT
MW-059I		80.0 UT	2.0 UJT	1.2 T	68.0 JT	2.0 JT	4.0 UJT	23700 JT	7.0 UJT	13.0 UT	26.0 JT	10.0 UT
MW-060D		312 T	2.0 UJT	1.0 UT	32.0 UJT	2.0 JT	9.0 JT	50900 JT	7.0 UJT	13.0 UT	19.0 JT	10.0 UT

Units: ug/L

Subsample (SS) FD Field Duplicate

Data Qualifier
- U Parameter analyzed for but not detected above the concentration listed
- J Indicates an estimated value
- R Value is unusable
- T For tentative usage only due to unresolved analytical difficulties

Table 2-4 (continued)
Inorganic Compounds plus Molybdenum and Total Organic Carbon
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	MOLYBDENUM	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM
MW-001D		72 JT	4.33 JT	107000 T	35.0 JT	0.30 T	15.0 UT	207 JT	33800 T	1.0 URT	8.0 URT	156000 JT
MW-001S		597 T	19.0 JT	5310 T	166 JT	0.40 T	15.0 UT	141 JT	3780 JT	1.0 URT	8.0 URT	15000 JT
MW-002I		26200 T	2.60 JT	101000 T	992 JT	1.20 T	15.0 UT	68.0 JT	55900 T	1.0 URT	8.0 URT	818000 JT
MW-002S2		10000 T	1.30 JT	6550 T	266 JT	0.40 T	15.0 UT	96.0 JT	6380 T	1.0 URT	19.0 RT	15100 JT
MW-004D		925 T	1.30 JT	30700 T	54.0 JT	0.30 T	15.0 UT	117 JT	25900 T	1.0 URT	8.0 URT	231000 JT
MW-004D	FD	701 T	7.60 JT	29700 T	47.0 JT	1.30 T	15.0 UT	133 JT	24900 T	1.0 URT	13.0 RT	224000 JT
MW-004I2		125000 T	4.90 JT	179000 T	3120 JT	1.40 T	15.0 UT	177 JT	73200 T	1.0 URT	15.0 RT	795000 JT
MW-004S		6250 T	2.90 JT	29300 T	242 JT	0.50 T	5490 T	130 JT	34400 T	1.0 URT	8.0 URT	197000 JT
MW-007D		597 T	10.3 JT	92200 T	63.0 JT	0.30 T	15.0 UT	148 JT	35400 T	1.0 URT	8.0 URT	321000 JT
MW-010D2		213 T	1.50 JT	96800 T	58.0 JT	0.03 UT	15.0 UT	96.0 JT	40700 T	1.0 URT	9.0 JRT	522000 JT
MW-011D2		31000 T	6.10 JT	71100 T	718 JT	0.40 T	26500 T	32.0 UJT	52800 T	1.0 URT	25.0 RT	635000 JT
MW-012I		822 T	3.60 JT	21100 T	95.0 JT	0.03 T	23.0 T	32.0 UJT	26000 T	1.0 URT	15.0 RT	264000 JT
MW-012S		12000 T	2.10 JT	176000 T	745 JT	0.03 UT	15.0 UT	32.0 UJT	69700 T	1.0 URT	11.0 RT	1220000JT
MW-013D		1050 T	3.40 JT	159000 T	243 JT	0.03 UT	15.0 UT	32.0 UJT	68300 T	1.3 RT	28.0 RT	1230000JT
MW-013D	FD	48 JT	2.90 JT	7900 T	11.0 JT	0.20 T	15.0 UT	32.0 UJT	13500 T	1.0 URT	20.0 RT	106000 JT
MW-022D		326 T	1.30 JT	19500 T	59.0 JT	0.20 T	15.0 UT	32.0 UJT	26800 T	1.0 URT	8.0 URT	368000 JT
MW-023S		31000 T	4.60 JT	4290 JT	266 JT	0.03 UT	643 T	201 JT	8020 T	1.0 URT	9.0 JRT	40100 JT
MW-028I		16700 T	3.00 JT	398000 T	977 JT	0.03 UT	247 T	68.0 JT	122000 T	1.0 URT	36.0 RT	1490 UJT
MW-029I		3640 T	6.50 JT	134000 T	468 JT	0.03 UT	15.0 UT	84.0 JT	52700 T	1.0 URT	19.0 RT	805000 JT
MW-032S		5870 T	2.10 JT	8380 T	397 JT	0.03 UT	15.0 UT	127 JT	3370 JT	1.0 URT	10.0 RT	13700 JT
MW-033S		443 T	3.30 JT	10800 T	446 JT	0.30 T	42.0 T	229 JT	3960 JT	1.0 URT	10.0 RT	26000 JT
MW-034S		10600 T	2.20 JT	3720 JT	111 JT	0.03 UT	15.0 UT	85.0 JT	6020 T	1.0 URT	12.0 RT	16000 JT
MW-036I		3050 T	1.00 UJT	334000 T	294 JT	0.60 T	15.0 UT	32.0 UJT	126000 T	25.3 RT	8.0 URT	1490 UJT
MW-037I		1010 T	2.80 JT	3730 JT	27.0 JT	0.10 T	15.0 UT	105 JT	4750 JT	1.0 URT	8.0 URT	95100 JT
MW-039I		20900 T	2.10 JT	371000 T	1280 JT	0.50 T	15.0 UT	132 JT	116000 T	4.7 RT	8.0 URT	1490 UJT
MW-040D		122000 T	3.00 JT	486000 T	10300 JT	0.03 UT	15.0 UT	32.0 UJT	110000 T	1.0 URT	33.0 RT	1540000JT
MW-041I		5800 T	5.80 JT	575000 T	4740 JT	0.03 UT	15.0 UT	224 JT	120000 T	4.4 RT	16.0 RT	1490 UJT
MW-043S		268 T	4.50 JT	4060 JT	177 JT	0.10 T	15.0 UT	148 JT	4690 JT	1.0 URT	8.0 URT	13600 JT
MW-044I		20200 T	2.00 JT	11600 T	546 JT	0.20 T	15.0 UT	32.0 UJT	18500 T	1.7 RT	20.0 RT	37900 JT
MW-45I		SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-45I	FD	SEE ATTACHMENT B FOR FULL APPENDIX IX ANALYTICAL RESULTS										
MW-046I		18800 T	2.80 JT	63200 T	732 JT	1.60 T	15.0 UT	69.0 JT	57300 T	1.0 URT	18.0 RT	899000 JT
MW-048I		63900 T	2.80 JT	99300 T	2590 JT	0.03 UT	74.0 T	113 JT	45500 T	1.0 URT	8.0 URT	203000 JT
MW-048I	FD	58200 T	1.80 JT	88100 T	2320 JT	0.03 UT	71.0 T	99.0 JT	42500 T	1.0 URT	10.0 RT	185000 JT
MW-049D		2230 T	1.90 JT	365000 T	212 JT	0.20 T	15.0 UT	97.0 JT	79000 T	1.1 RT	11.0 RT	850000 JT
MW-050I		110000 T	1.50 JT	304000 T	1270 JT	0.90 T	15.0 UT	94.0 JT	118000 T	3.5 RT	12.0 RT	2300000JT
MW-051S		1570 T	4.20 JT	15000 T	722 JT	0.50 T	15.0 UT	245 JT	8490 T	1.0 URT	8.0 JRT	35100 JT
MW-053D		161 T	3.30 JT	220000 T	159 JT	0.10 T	15.0 UT	32.0 UJT	93300 T	1.0 URT	12.0 RT	1710000JT
MW-053I		6310 T	3.60 JT	29600 T	365 JT	0.03 UT	2230 T	32.0 UJT	7320 T	1.0 URT	26.0 RT	15500 JT
MW-053I	FD	172 T	3.00 JT	17200 T	43.0 JT	0.03 UT	15.0 UT	32.0 UJT	18900 T	1.0 URT	13.0 RT	189000 JT
MW-056S		1850 T	3.70 JT	2360 T	87.0 JT	0.03 UT	15900 T	124 JT	6130 T	1.0 URT	11.0 RT	8250 JT
MW-058I		967 T	1.50 JT	2360 UT	458 JT	0.03 UT	469 T	479 JT	1390 UT	1.0 URT	15.0 RT	1490 UJT
MW-058S		28700 T	3.00 JT	66200 T	665 JT	0.03 UT	24500 T	32.0 UJT	48900 T	1.0 URT	15.0 RT	58900 JT
MW-059I		7920 T	6.70 JT	65400 T	781 JT	0.03 UT	24.0 T	98.0 JT	53200 T	1.0 URT	18.0 RT	588000 JT
MW-060D		1080 T	4.80 JT	165000 T	249 JT	0.03 UT	15.0 UT	32.0 UJT	71100 T	1.0 URT	25.0 RT	1270000JT

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier
U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable
T For tentative usage only due to unresolved analytical difficulties

Table 2-4 (continued)
Inorganic Compounds plus Molybdenum and Total Organic Carbon
Modified Appendix IX Analytical Results
Reichhold Chemicals, Inc.
July 1990

STATION	SS	THALLIUM	VANADIUM	ZINC	AVERAGE TOC
MW-001D		3.0 URT	16.0 UJT	52.0 JT	9.62
MW-001S		3.0 URT	16.0 UJT	35.0 JT	5.09
MW-002I		3.0 URT	51.0 JT	35.0 JT	112.75
MW-002S2		3.0 URT	16.0 UJT	32.0 JT	1.85
MW-004D		3.0 URT	16.0 UJT	38.0 JT	30.50
MW-004D	FD	3.0 URT	16.0 UJT	36.0 JT	35.83
MW-004I2		4.1 RT	19.0 JT	88.0 JT	29.20
MW-004S		3.0 URT	16.0 UJT	43.0 JT	82.60
MW-007D		3.0 URT	16.0 UJT	27.0 JT	2.92
MW-010D2		3.0 URT	16.0 UJT	28.0 JT	4.18
MW-011D2		3.0 URT	16.0 UJT	36.0 JT	12.10
MW-012I		3.0 URT	16.0 UJT	50.0 JT	32.25
MW-012S		3.0 URT	16.0 UJT	46.0 JT	30.50
MW-013D		3.0 URT	16.0 UJT	42.0 JT	6.48
MW-013D	FD	3.0 URT	16.0 UJT	57.0 JT	6.48
MW-022D		3.0 URT	16.0 UJT	18.0 JT	12.35
MW-023S		3.0 URT	16.0 UJT	192 JT	2.67
MW-028I		3.0 URT	16.0 UJT	54.0 JT	10.44
MW-029I		3.0 URT	17.0 JT	43.0 JT	37.73
MW-032S		3.0 URT	16.0 UJT	116 JT	18.18
MW-033S		3.0 URT	16.0 UJT	74.0 JT	13.63
MW-034S		3.0 URT	16.0 UJT	27.0 JT	20.23
MW-036I		5.1 RT	21.0 JT	37.0 JT	329.00
MW-037I		3.0 URT	74.0 JT	33.0 JT	20.35
MW-039I		3.0 URT	16.0 UJT	33.0 JT	43.73
MW-040D		3.0 URT	29.0 JT	29.0 JT	8.18
MW-041I		3.0 URT	16.0 UJT	88.0 JT	40.80
MW-043S		3.0 URT	16.0 UJT	386 JT	7.27
MW-044I		3.0 URT	16.0 UJT	60.0 JT	98.98
MW-45I		SEE ATTACHMENT B FOR			
MW-45I	FD	FULL APPENDIX IX RESULTS			
MW-046I		3.0 URT	16.0 UJT	111 JT	79.58
MW-048I		3.0 URT	16.0 UJT	34.0 JT	27.30
MW-048I	FD	3.0 URT	16.0 UJT	30.0 JT	30.43
MW-049D		3.0 URT	16.0 UJT	37.0 JT	5.51
MW-050I		3.0 URT	22.0 JT	40.0 JT	248.75
MW-051S		3.0 URT	16.0 UJT	189 JT	6.11
MW-053D		3.0 URT	16.0 UJT	24.0 JT	14.45
MW-053I		3.0 URT	16.0 UJT	40.0 JT	13.75
MW-053I	FD	3.0 URT	16.0 UJT	36.0 JT	9.79
MW-056S		3.0 URT	16.0 UJT	100 JT	8.42
MW-058I		3.0 URT	429 JT	488 JT	45.83
MW-058S		3.0 RT	16.0 UJT	37.0 JT	6.01
MW-059I		3.0 URT	16.0 UJT	24.0 JT	105.50
MW-060D		3.0 URT	16.0 UJT	77.0 JT	62.15

Units: ug/L
Subsample (SS) FD Field Duplicate
Data Qualifier
U Parameter analyzed for but not detected above the concentration listed
J Indicates an estimated value
R Value is unusable
T For tentative usage only due to unresolved analytical difficulties

ATTACHMENT A
SAMPLE ANALYTES
AND DETECTION LIMITS

Table A-1.1
Volatile Compounds
Modified Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limit (µg/l)
Acetone	10
Benzene	5
Bromodichloromethane	5
Bromoform	5
Bromomethane	10
2-Butanone	10
Carbon Disulfide	5
Carbon Tetrachloride	5
Chlorobenzene	5
Chloroethane	10
2-Chloroethylvinylether	10
Chloroform	5
Chloromethane	10
cis-1,3-Dichloropropene	5
Dibromochloromethane	5
1,1-Dichloroethane	5
1,2-Dichloroethane	5
1,1-Dichloroethene	5
1,2-Dichloropropane	5
Ethylbenzene	5
Formaldehyde	50
2-Hexanone	10
4-Methyl-2-Pentanone	10
Methylene Chloride	5
Styrene	5
1,1,2,2-Tetrachloroethane	5
Tetrachloroethene	5
Toluene	5
Total Xylenes	5
Trans-1,2-Dichloroethene	5
Trans-1,3-Dichloropropene	5
1,1,1-Trichloroethane	5
1,1,2-Trichloroethane	5
Trichloroethene	5
Vinyl Acetate	10
Vinyl Chloride	10

Table A-1.2
Semivolatile Compounds
Modified Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limit (µg/l)	Compound	Detection Limit (µg/l)
Acenaphthene	10	Dimethyl Phthalate	10
Acenaphthylene	10	2,4-Dimethylphenol	10
Anthracene	10	4,6-Dinitro-2-Methylphenol	50
Benzo(a)Anthracene	10	2,4-Dinitrophenol	50
Benzo(b)Fluoranthene	10	2,4-Dinitrotoluene	10
Benzo(k)Fluoranthene	10	2,6-Dinitrotoluene	10
Benzo(g,h,i)Perylene	10	Fluoranthene	10
Benzo(a)Pyrene	10	Fluorene	10
Benzoic Acid	50	Hexachlorobenzene	10
Benzyl Alcohol	10	Hexachlorobutadiene	10
2-benzyl-4-chlorophenol	20	Hexachlorocyclopentadiene	10
bis(2-Chloroethoxy)Methane	10	Hexachloroethane	10
bis(2-Chloroethyl)Ether	10	Indeno(1,2,3-cd)Pyrene	10
bis(2-Chloroisopropyl)Ether	10	Isophorone	10
bis(2-Ethylhexyl)Phthalate	10	2-Methylnaphthalene	10
1,4-Benzoquinone	10	2-Methylphenol	10
4-Bromophenyl-phenylether	10	4-Methylphenol	10
Butylbenzylphthalate	10	N-Nitroso-Di-n-Propylamine	10
4-Chloro-3-Methylphenol	10	N-Nitrosodiphenylamine[a]	10
4-Chloroaniline	10	Naphthalene	10
2-Chloronaphthalene	10	2-Nitroaniline	50
2-Chlorophenol	10	3-Nitroaniline	50
4-Chlorophenyl-phenylether	10	4-Nitroaniline	50
Chrysene	10	Nitrobenzene	10
Di-n-Butylphthalate	10	2-Nitrophenol	10
Di-n-Octyl Phthalate	10	4-Nitrophenol	50
Dibenzo(a,h)Anthracene	10	4-Tert-butyl Phenol	10
Dibenzofuran	10	Pentachlorophenol	50
1,2-Dichlorobenzene	10	Phenanthrene	10
1,3-Dichlorobenzene	10	Phenol	10
1,4-Dichlorobenzene	10	Pyrene	10
3,3-Dichlorobenzidine	20	2,3,4,6-Tetrachlorphenol	20
2,4-Dichlorophenol	50	1,2,4-Trichlorobenzene	10
Total Diethylphthalate	10	2,4,5-Trichlorophenol	50
Dimethylaniline	10	2,4,6-Trichlorophenol	10

[a]Cannot be separated from diphenylamine.

Table A-1.3
Pesticide/PCB and Herbicide Compounds-
Modified Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limits (µg/l)
Aldrin	0.05
Alpha-BHC	0.05
Alpha-Chlordane	0.50
Aroclor-1016	0.50
Aroclor-1221	0.50
Aroclor-1232	0.50
Aroclor-1242	0.50
Aroclor-1248	0.50
Aroclor-1254	1.0
Aroclor-1260	1.0
Beta-BHC	0.05
2,4-DD	0.50
4,4'-DDD	0.10
4,4'-DDE	0.10
4,4'-DDT	0.10
Delta-BHC	0.05
Dieldrin	0.10
Endosulfan I	0.05
Endosulfan II	0.10
Endosulfan Sulfate	0.10
Endrin	0.10
Endrin Ketone	0.10
Gamma-BHC (Lindane)	0.05
Gamma-Chlordane	0.50
Heptachlor	0.05
Heptachlor Epoxide	0.05
Methoxychlor	0.50
Toxaphene	1.0
2,4,5-T	0.25
2,4,5 TP (Silvex)[a]	0.25

Table A-1.4
Inorganic Compounds And TOC
Modified Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limits (µg/l)
Aluminum	80.0
Antimony	2.0
Arsenic	1.0
Barium	32.0
Beryllium	2.0
Cadmium	4.0
Calcium	932
Chromium	7.0
Cobalt	13.0
Copper	6.1
Cyanide	10.0
Iron	21
Lead	1.0
Magnesium	2,360
Manganese	2.4
Mercury	0.03
Molybdenum	15.0
Nickel	32.0
Potassium	1,390
Selenium	1.0
Silver	8.0
Sodium	1,490
Thallium	3.0
Vanadium	16.0
Zinc	13.5
Total Organic Carbon	1,000

Table A-2.1
Volatile Compounds
Full Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limit (µg/l)	Compound	Detection Limit (µg/l)
Acetone	10	1,4-Dioxane	500
Acetonitrile	200	Ethyl benzene	5.0
Acrolein	100	Ethyl Methacrylate	20
Acrylonitrile	100	Formaldehyde	50
Allyl chloride	10	2-Hexanone	10
Benzene	5.0	Iodomethane	5.0
Bromodichloromethane	5.0	Isobutanol	200
Bromoform	5.0	Methacrylonitrile	5.0
Bromomethane	10	4-Methyl-2-pentanone (MIBK)	10
2-Butanone (MEK)	10	Methylene Chloride	5.0
Carbon disulfide	5.0	Styrene	5.0
Carbon tetrachloride	5.0	1,1,1,2-Tetrachloroethane	5.0
Chlorobenzene	5.0	1,1,2,2-Tetrachloroethane	5.0
Chloroethane	10	Tetrachloroethene	5.0
Chloroform	5.0	trans-1,4-Dichloro-2-butene	5.0
Chloromethane	10	trans-1,3-Dichloropropene	5.0
Chloroprene	5.0	Toluene	5.0
cis-1,3-Dichloropropene	5.0	Total xylenes	5.0
trans-1,3-Dichloropropene	5.0	1,1,1-Trichloroethane	5.0
DBCP (1,2-Dibromo-3-chloropropane)	10	1,1,2-Trichloroethane	5.0
EDB (1,2-Dibromoethane)	10	Trichloroethene	5.0
Dibromochloromethane	5.0	Trichlorofluoromethane	5.0
Dibromomethane	5.0	1,2,3-Trichloropropane	5.0
Dichlorodifluoromethane	20	Vinyl acetate	10
1,1-Dichloroethane	5.0	Vinyl chloride	10
1,2-Dichloroethane	5.0		
1,1-Dichloroethene	5.0		
1,2-Dichloroethene (Total)	5.0		
1,2-Dichloropropane	5.0		

Table A-2.2
Semivolatile Compounds
Full Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limit (µg/l)	Compound	Detection Limit (µg/l)
a,a-Dimethylphenethylamine	20	2,4-Dinitrophenol	100
Acenaphthene	20	2,4-Dinitrotoluene	20
Acenaphthylene	20	2,6-Dinitrotoluene	20
Acetophenone	20	Diphenylamine	20
2-Acetylaminofluorene	200	Disulfoton	100
4-Aminobiphenyl	20	Ethyl methanesulfonate	20
Aniline	20	Famphur	–
Anthracene	20	Fluoranthene	20
Aramite	20	Fluorene	20
Benzo(a)anthracene	20	Hexachlorobenzene	20
Benzo(b)fluoranthene	20	Hexachlorobutadiene	20
Benzo(k)fluoranthene	20	Hexachlorocyclopentadiene	20
Benzo(g,h,i)perylene	20	Hexachloroethane	20
Benzo(a)pyrene	20	Hexachlorophene	–
Benzyl alcohol	20	Hexachloropropene	20
bis(2-Chloroethoxy methane)	20	Indeno(1,2,3-c,d)pyrene	20
bis(2-Chloroethyl)ether	20	Isophorone	20
bis(2-Chloroisopropyl)ether	20	Isosafrole	40
bis(2-Ethylhexyl)phthalate	20	Methapyrilene	20
4-Bromophenyl phenyl ether	20	Methyl methanesulfonate	20
Butyl benzyl phthalate	20	Methyl parathion	100
4-Chloro-3-methylphenol	20	2-Methylphenol	20
4-Chloroaniline	20	3/4-Methylphenol	20
2-Chloronaphthalene	20	2-Methylnaphthalene	20
2-Chlorophenol	20	5-Nitro-o-toluidine	20
4-Chlorophenyl phenyl ether	20	N-Nitroso-di-n-propylamine	20
Chrysene	20	N-Nitrosodi-n-butylamine	20
Di-n-butyl phthalate	20	N-Nitrosodiethylamine	20
Di-n-octyl phthalate	20	N-Nitrosodimethylamine	20
Dibenz(a,h)anthracene	20	N-Nitrosodiphenylamine	20
1,2-Dichlorobenzene	20	N-Nitrosomethylethylamine	20
1,3-Dichlorobenzene	20	N-Nitrosomorpholine	20
1,4-Dichlorobenzene	20	N-Nitrosopiperidine	20
3,3'-Dichlorobenzidine	40	N-Nitrosopyrrolidine	20
Dibenzofuran	20	1,4-Naphthoquinone	20
2,4-Dichlorophenol	20	1-Naphthylamine	20
2,6-Dichlorophenol	20	2-Naphthylamine	20
Diethyl phthalate	20	2-Nitroaniline	100
Dimethoate	–	3-Nitroaniline	100
Dimethyl phthalate	20	4-Nitroaniline	100
7,12-Dimethylbenz(a)-anthracene	20	Nitrobenzene	20
3,3'-Dimethylbenzidine	20	Phorate	200
2,4-Dimethylphenol	20	2-Picoline	20
4,6-Dinitro-2-methylphenol	100	Pronamide	20
1,3-Dinitrobenzene	20	Pyrene	20
2-Nitrophenol	100	Pyridine	40

Table A-2.2
Semivolatile Compounds
Full Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limit (µg/l)	Compound	Detection Limit (µg/l)
4-Nitrophenol	100	Safrole	20
4-Nitroquinoline-1-oxide	–	2sec-Butyl-4,6-dinitro-phenol	20
2-Toluidine	20	Sulfotepp	100
o,o,o-Triethylphosphorothioate	20	1,3,5-Trinitrobenzene	20
Parathion	100	1,2,4,5-Tetrachloro-benzene	20
p-Dimethylaminoazobenzene	20	2,3,4,6-Tetrachlorophenol	100
4-Phenylenediamine	–	Thionazin	100
Pentachlorobenzene	20	1,2,4-Trichlorobenzene	20
Pentachloroethane	20	2,4,5-Trichlorophenol	100
Pentachloronitrobenzene	100	2,4,6-Trichlorophenol	20
Pentachlorophenol	100		
Phenacetin	20		
Phenanthrene	20		
Phenol	20		

Table A-2.3
Pesticide/PCB and Herbicide Compounds
Full Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

MW-45I (Only) Detection Limit (µg/l)	Compound	MW-45I (Field Duplicate Only) Detection Limit (µg/l)
0.50	Aldrin	0.50
10	Aroclor-1016	10
10	Aroclor-1221	10
10	Aroclor-1232	10
10	Aroclor-1242	10
10	Aroclor-1248	10
10	Aroclor-1254	10
10	Aroclor-1260	10
0.25	alpha-BHC	0.25
0.50	beta-BHC	0.50
5.0	Chlordane	5.0
10	Chlorobenzilate	10
25	2,4-D	62
1.0	4,4'-DDD	1.0
0.50	4,4'-DDE	0.50
1.0	4,4'-DDT	1.0
0.50	delta-BHC	0.50
30	Diallate	30
0.50	Dieldrin	0.50
1.0	Dimethoate	1.0
1.0	Disulfoton	1.0
0.50	Endosulfan I	0.50
1.0	Endosulfan II	1.0
1.0	Endosulfan sulfate	1.0
0.50	Endrin	0.50
1.2	Endrin aldehyde	1.2
1.0	Ethyl parathion	1.0
1.0	Famphur	1.0
0.25	gamma-BHC (Lindane)	0.25
0.50	Heptachlor	0.50
0.50	Heptachlor epoxide	0.50
1.0	Isodrin	1.0
2.0	Kepone	2.0
5.0	Methoxychlor	5.0
1.0	Methyl parathion	1.0
1.0	Phorate (Thimet)	1.0
1.0	Sulfotepp	1.0
2.5	2,4,5-T	1.2
1.0	Thionazin	1.0
20	Toxaphene	20
25	2,4,5-TP (Silvex)	12
1.0	o,o,o-Triethylphosphorothioate	1.0

Table A-2.4
Inorganic Compounds
Full Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

Compound	Detection Limits (µg/l)
Antimony	300
Arsenic	100
Barium	50
Beryllium	10
Cadmium	25
Chromium	50
Cobalt	50
Copper	100
Cyanide, Total	10
Lead	20
Mercury	0.20
Molybdenum	20
Nickel	200
Selenium	20
Silver	10
Sulfide, Total	50
Thallium	25
Tin	500
Vanadium	50
Zinc	100

Table A-2.5
Dioxin/Furan Compounds-Full
Appendix IX Analyses
July 1990
Reichhold Chemicals, Inc.

MW-45I Only Detection Limit (µg/l)	Compound	MW-45I (Field Duplicate Only) Detection Limit (µg/l)
0.43	HxCDDs (total)	0.28
0.23	HxCDFs (total)	0.16
0.28	PeCDDs (total)	0.28
0.070	TCDFs (total)	0.12
0.15	PeCDFs (total)	0.073
0.10	2,3,7,8-TCDD	0.042
0.10	TCDDs (total)	0.042

Table A-3
Groundwater Field Parameters
July 1990
Reichhold Chemicals, Inc.

Compound
pH
Specific Conductance
Temperature

ATTACHMENT B

FULL APPENDIX IX

LABORATORY DATA SHEETS

MW-45I

FULL APPENDIX IX
ANALYTICAL RESULTS

Enseco

Volatile Organics
Appendix IX List
Method 8240

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA
Enseco ID: 1082610
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 16 JUL 90

Parameter	Result	Units	Reporting Limit
Acetone	ND	ug/L	10
Acetonitrile	ND	ug/L	200
Acrolein	ND	ug/L	100
Acrylonitrile	ND	ug/L	100
Allyl chloride	ND	ug/L	10
Benzene	8.6	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Bromomethane	ND	ug/L	10
2-Butanone (MEK)	ND	ug/L	10
Carbon disulfide	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Chloroethane	ND	ug/L	10
Chloroform	ND	ug/L	5.0
Chloromethane	ND	ug/L	10
Chloroprene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	10
1,2-Dibromoethane (EDB)	ND	ug/L	10
Dibromomethane	ND	ug/L	5.0
trans-1,4-Dichloro-2-butene	ND	ug/L	5.0
Dichlorodifluoromethane	ND	ug/L	20
1,1-Dichloroethane	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	5.0
1,2-Dichloroethene (total)	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
cis-1,3-Dichloropropene	ND	ug/L	5.0
trans-1,3-Dichloropropene	ND	ug/L	5.0
1,4-Dioxane	ND	ug/L	500
Ethylbenzene	ND	ug/L	5.0
Ethyl methacrylate	ND	ug/L	20
Iodomethane	ND	ug/L	5.0
Isobutanol	ND	ug/L	200
2-Hexanone	ND	ug/L	10
Methacrylonitrile	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Michael Blades
Approved By: Jeff Lowry

Enseco

Volatile Organics
Appendix IX List (CONT.)
Method 8240

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA Enseco ID: 1082610
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 16 JUL 90

Parameter	Result	Units	Reporting Limit
Methyl methacrylate	ND	ug/L	20
4-Methyl-2-pentanone (MIBK)	ND	ug/L	10
Propionitrile	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Trichlorofluoromethane	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
Vinyl acetate	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Xylenes (total)	ND	ug/L	5.0
Toluene-d8	97	%	--
4-Bromofluorobenzene	100	%	--
1,2-Dichloroethane-d4	101	%	--

ND = Not detected
NA = Not applicable

Reported By: Michael Blades Approved By: Jeff Lowry

Enseco

Semivolatile Organics
Appendix IX List
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA
Enseco ID: 1082610
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
Acenaphthene	ND	ug/L	20
Acenaphthylene	ND	ug/L	20
Acetophenone	ND	ug/L	20
2-Acetylaminofluorene	ND	ug/L	200
4-Aminobiphenyl	ND	ug/L	20
Aniline	ND	ug/L	20
Anthracene	ND	ug/L	20
Aramite	ND	ug/L	20
Benzo(a)anthracene	ND	ug/L	20
Benzo(b)fluoranthene	ND	ug/L	20
Benzo(k)fluoranthene	ND	ug/L	20
Benzo(g,h,i)perylene	ND	ug/L	20
Benzo(a)pyrene	ND	ug/L	20
Benzyl alcohol	ND	ug/L	20
4-Bromophenyl phenyl ether	ND	ug/L	20
Butyl benzyl phthalate	ND	ug/L	20
2-sec-Butyl-4,6-dinitro-phenol	ND	ug/L	20
4-Chloroaniline	ND	ug/L	20
bis(2-Chloroethoxy)-methane	ND	ug/L	20
bis(2-Chloroethyl) ether	ND	ug/L	20
bis(2-Chloroisopropyl)-ether	ND	ug/L	20
4-Chloro-3-methylphenol	ND	ug/L	20
2-Chloronaphthalene	ND	ug/L	20
2-Chlorophenol	41	ug/L	20
4-Chlorophenyl phenyl ether	ND	ug/L	20
Chrysene	ND	ug/L	20
Dibenz(a,h)anthracene	ND	ug/L	20
Dibenzofuran	ND	ug/L	20
Di-n-butyl phthalate	ND	ug/L	20
1,2-Dichlorobenzene	ND	ug/L	20
1,3-Dichlorobenzene	ND	ug/L	20
1,4-Dichlorobenzene	ND	ug/L	20
3,3'-Dichlorobenzidine	ND	ug/L	40
2,4-Dichlorophenol	ND	ug/L	20
2,6-Dichlorophenol	ND	ug/L	20
Diethyl phthalate	ND	ug/L	20

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones
Approved By: Jeff Lowry

Enseco

Semivolatile Organics
Appendix IX List (CONT.)
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA Enseco ID: 1082610
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
Dimethoate	ND	ug/L	--
p-Dimethylaminoazobenzene	ND	ug/L	20
7,12-Dimethylbenz(a)-anthracene	ND	ug/L	20
3,3'-Dimethylbenzidine	ND	ug/L	20
a,a-Dimethylphenethylamine	ND	ug/L	20
2,4-Dimethylphenol	ND	ug/L	20
Dimethyl phthalate	ND	ug/L	20
1,3-Dinitrobenzene	ND	ug/L	20
4,6-Dinitro-2-methylphenol	ND	ug/L	100
2,4-Dinitrophenol	ND	ug/L	100
2,4-Dinitrotoluene	ND	ug/L	20
2,6-Dinitrotoluene	ND	ug/L	20
Di-n-octyl phthalate	ND	ug/L	20
Diphenylamine	ND	ug/L	20
Disulfoton	ND	ug/L	100
bis(2-Ethylhexyl) phthalate	ND	ug/L	20
Ethyl methanesulfonate	ND	ug/L	20
Famphur	ND	ug/L	--
Fluoranthene	ND	ug/L	20
Fluorene	ND	ug/L	20
Hexachlorobenzene	ND	ug/L	20
Hexachlorobutadiene	ND	ug/L	20
Hexachlorocyclopentadiene	ND	ug/L	20
Hexachloroethane	ND	ug/L	20
Hexachlorophene	ND	ug/L	--
Hexachloropropene	ND	ug/L	20
Indeno(1,2,3-cd)pyrene	ND	ug/L	20
Isophorone	ND	ug/L	20
Isosafrole	ND	ug/L	40
Methapyrilene	ND	ug/L	20
3-Methylcholanthrene	ND	ug/L	20
Methyl methanesulfonate	ND	ug/L	20
2-Methylnaphthalene	ND	ug/L	20
Methyl parathion	ND	ug/L	100
2-Methylphenol	ND	ug/L	20
3/4-Methylphenol	ND	ug/L	20
Naphthalene	ND	ug/L	20

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones Approved By: Jeff Lowry

Enseco

Semivolatile Organics
Appendix IX List (CONT.)
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA Enseco ID: 1082610
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
1,4-Naphthoquinone	ND	ug/L	20
1-Naphthylamine	ND	ug/L	20
2-Naphthylamine	ND	ug/L	20
2-Nitroaniline	ND	ug/L	100
3-Nitroaniline	ND	ug/L	100
4-Nitroaniline	ND	ug/L	100
Nitrobenzene	ND	ug/L	20
2-Nitrophenol	ND	ug/L	20
4-Nitrophenol	ND	ug/L	100
4-Nitroquinoline-1-oxide	ND	ug/L	--
N-Nitroso-di-n-butylamine	ND	ug/L	20
N-Nitrosodiethylamine	ND	ug/L	20
N-Nitrosodimethylamine	ND	ug/L	20
N-Nitrosodiphenylamine	ND	ug/L	20
N-Nitroso-di-n-propylamine	ND	ug/L	20
N-Nitrosomethylethylamine	ND	ug/L	20
N-Nitrosomorpholine	ND	ug/L	20
N-Nitrosopiperidine	ND	ug/L	20
N-Nitrosopyrrolidine	ND	ug/L	20
5-Nitro-o-toluidine	ND	ug/L	20
Parathion	ND	ug/L	100
Pentachlorobenzene	ND	ug/L	20
Pentachloroethane	ND	ug/L	20
Pentachloronitrobenzene	ND	ug/L	100
Pentachlorophenol	220	ug/L	100
Phenacetin	ND	ug/L	20
Phenanthrene	ND	ug/L	20
Phenol	ND	ug/L	20
4-Phenylenediamine	ND	ug/L	--
Phorate	ND	ug/L	200
2-Picoline	ND	ug/L	20
Pronamide	ND	ug/L	20
Pyrene	ND	ug/L	20
Pyridine	ND	ug/L	40
Safrole	ND	ug/L	20
Sulfotepp	ND	ug/L	100
1,2,4,5-Tetrachlorobenzene	ND	ug/L	20
2,3,4,6-Tetrachlorophenol	300	ug/L	100
Thionazin	ND	ug/L	100

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones Approved By: Jeff Lowry

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Semivolatile Organics
Appendix IX List (CONT.)
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I
Lab ID: 010325-0002-SA
Enseco ID: 1082610
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
2-Toluidine	ND	ug/L	20
1,2,4-Trichlorobenzene	ND	ug/L	20
2,4,5-Trichlorophenol	160	ug/L	100
2,4,6-Trichlorophenol	ND	ug/L	20
O,O,O-Triethylphosphorothioate	ND	ug/L	20
1,3,5-Trinitrobenzene	ND	ug/L	20
Nitrobenzene-d5	63	%	--
2-Fluorobiphenyl	63	%	--
Terphenyl-d14	84	%	--
Phenol-d5	68	%	--
2-Fluorophenol	57	%	--
2,4,6-Tribromophenol	56	%	--

ND = Not detected
A = Not applicable

Reported By: Cheryl Jones
Approved By: Jeff Lowry

Enseco

Appendix IX Organochlorine Pesticides/PCBs

Method 608

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I 07/90
Lab ID: 053642-0001-SA Enseco ID: 155225
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 23 JUL 90

Parameter	Result	Units	Reporting Limit	
Aldrin	ND	ug/L	0.50	j
Aroclor 1016	ND	ug/L	10	
Aroclor 1221	ND	ug/L	10	
Aroclor 1232	ND	ug/L	10	
Aroclor 1242	ND	ug/L	10	
Aroclor 1248	ND	ug/L	10	
Aroclor 1254	ND	ug/L	10	
Aroclor 1260	ND	ug/L	10	
alpha-BHC	ND	ug/L	0.25	
beta-BHC	ND	ug/L	0.50	
delta-BHC	ND	ug/L	0.50	
gamma-BHC (Lindane)	ND	ug/L	0.25	
Chlordane	ND	ug/L	5.0	
Chlorobenzilate	ND	ug/L	10	
4,4'-DDD	ND	ug/L	1.0	
4,4'-DDE	ND	ug/L	0.50	
4,4'-DDT	ND	ug/L	1.0	
Diallate	ND	ug/L	150	
Dieldrin	ND	ug/L	0.50	
Endosulfan I	ND	ug/L	0.50	
Endosulfan II	ND	ug/L	1.0	
Endosulfan sulfate	ND	ug/L	1.0	
Endrin	ND	ug/L	0.50	
Endrin aldehyde	ND	ug/L	1.2	
Heptachlor	ND	ug/L	0.50	
Heptachlor epoxide	ND	ug/L	0.50	
Isodrin	ND	ug/L	1.0	
Kepone	ND	ug/L	2.0	
Methoxychlor	ND	ug/L	5.0	
Toxaphene	ND	ug/L	20	
Dibutyl chlorendate	86	%	--	

Note j : All Reporting Limits for this sample raised due to matrix interferences.

ND = Not detected
NA = Not applicable

Reported By: Mike Harrison Approved By: Lisa Stafford

The cover letter is an integral part of this report.
Rev 230787

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Appendix IX Organophosphate Pesticides

Method 614

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I 07/90
Lab ID: 053642-0001-SA Enseco ID: 155225
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 17 JUL 90

Parameter	Result	Units	Reporting Limit
Dimethoate	ND	ug/L	1.0
Disulfoton	ND	ug/L	1.0
Ethyl parathion	ND	ug/L	1.0
Famphur	ND	ug/L	1.0
Methyl parathion	ND	ug/L	1.0
Phorate (Thimet)	ND	ug/L	1.0
Sulfotepp	ND	ug/L	1.0
Thionazin	ND	ug/L	1.0
O,O,O-Triethylphosphorothioate	ND	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: Pat Trinidad Approved By: Marcia Reed

The cover letter is an integral part of this report.
Rev 230787

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Appendix IX Herbicides

Method 615

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I 07/90
Lab ID: 053642-0001-SA Enseco ID: 155225
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 27 JUL 90

Parameter	Result	Units	Reporting Limit	
2,4-D	ND	ug/L	25	j
2,4,5-T	ND	ug/L	2.5	
2,4,5-TP (Silvex)	ND	ug/L	25	

Note j : All Reporting Limits for this sample raised due to matrix interferences.

ND = Not detected
NA = Not applicable

Reported By: Kris Rogers Approved By: Lisa Stafford

The cover letter is an integral part of this report.
Rev 230787

Enseco

GENERAL INORGANICS

(Water)

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I 07/90
Lab ID: 053642-0001-SA Enseco ID: 155225
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Cyanide, Total	ND	mg/L	0.010	9010	12 JUL 90	13 JUL 90
Formaldehyde	ND	mg/L	0.050	Method 3500	NA	11 JUL 90
Sulfide, Total	ND	mg/L	0.050	9030	NA	26 JUL 90

ND = Not detected
NA = Not applicable

Reported By: Darlene Ogburn Approved By: Josefina Jones

The cover letter is an integral part of this report.
Rev 230787

Enseco

Appendix IX Metals and Inorganics, Total

Client Name: CH2M Hill
Client ID: RCI-GW-MW-045I 07/90
Lab ID: 053642-0001-SA Enseco ID: 155225
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Antimony	ND	mg/L	0.30	6010	17 JUL 90	07 AUG 90	!
Arsenic	1.5	mg/L	0.10	7060	17 JUL 90	06 AUG 90	o
Barium	0.19	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Beryllium	ND	mg/L	0.010	6010	17 JUL 90	07 AUG 90	!
Cadmium	ND	mg/L	0.025	6010	17 JUL 90	07 AUG 90	!
Chromium	ND	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Cobalt	ND	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Copper	ND	mg/L	0.10	6010	17 JUL 90	07 AUG 90	!
Lead	ND	mg/L	0.020	7421	17 JUL 90	02 AUG 90	G
Mercury	ND	mg/L	0.00020	7470	30 JUL 90	31 JUL 90	
Molybdenum	0.063	mg/L	0.020	6010	17 JUL 90	07 AUG 90	
Nickel	ND	mg/L	0.20	6010	17 JUL 90	07 AUG 90	!
Selenium	ND	mg/L	0.025	7740	17 JUL 90	06 AUG 90	G
Silver	ND	mg/L	0.010	6010	17 JUL 90	07 AUG 90	!
Thallium	ND	mg/L	0.025	7841	17 JUL 90	02 AUG 90	G
Tin	ND	mg/L	0.50	6010	17 JUL 90	07 AUG 90	!
Vanadium	0.062	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Zinc	ND	mg/L	0.10	6010	17 JUL 90	07 AUG 90	!

Note ! : All reporting limits raised due to interference created by high concentrations of dissolved solids.

Note o : Reporting Limit raised due to high level of analyte present in sample.

Note G : Reporting Limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Grace Chang Approved By: Barry Votaw

The cover letter is an integral part of this report.
Rev 230787

MW-45I FIELD DUPLICATE

FULL APPENDIX IX
ANALYTICAL RESULTS

Enseco

Volatile Organics
Appendix IX List
Method 8240

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA
Enseco ID: 1082609
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 16 JUL 90

Parameter	Result	Units	Reporting Limit
Acetone	ND	ug/L	10
Acetonitrile	ND	ug/L	200
Acrolein	ND	ug/L	100
Acrylonitrile	ND	ug/L	100
Allyl chloride	ND	ug/L	10
Benzene	8.2	ug/L	5.0
Bromodichloromethane	ND	ug/L	5.0
Bromoform	ND	ug/L	5.0
Bromomethane	ND	ug/L	10
2-Butanone (MEK)	ND	ug/L	10
Carbon disulfide	ND	ug/L	5.0
Carbon tetrachloride	ND	ug/L	5.0
Chlorobenzene	ND	ug/L	5.0
Chloroethane	ND	ug/L	10
Chloroform	ND	ug/L	5.0
Chloromethane	ND	ug/L	10
Chloroprene	ND	ug/L	5.0
Dibromochloromethane	ND	ug/L	5.0
1,2-Dibromo-3-chloro-propane (DBCP)	ND	ug/L	10
1,2-Dibromoethane (EDB)	ND	ug/L	10
Dibromomethane	ND	ug/L	5.0
trans-1,4-Dichloro-2-butene	ND	ug/L	5.0
Dichlorodifluoromethane	ND	ug/L	20
1,1-Dichloroethane	ND	ug/L	5.0
1,2-Dichloroethane	ND	ug/L	5.0
1,1-Dichloroethene	ND	ug/L	5.0
1,2-Dichloroethene (total)	ND	ug/L	5.0
1,2-Dichloropropane	ND	ug/L	5.0
cis-1,3-Dichloropropene	ND	ug/L	5.0
trans-1,3-Dichloropropene	ND	ug/L	5.0
1,4-Dioxane	ND	ug/L	500
Ethylbenzene	ND	ug/L	5.0
Ethyl methacrylate	ND	ug/L	20
Iodomethane	ND	ug/L	5.0
Isobutanol	ND	ug/L	200
2-Hexanone	ND	ug/L	10
Methacrylonitrile	ND	ug/L	5.0
Methylene chloride	ND	ug/L	5.0

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Michael Blades
Approved By: Jeff Lowry

Enseco

Volatile Organics
Appendix IX List (CONT.)
Method 8240

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA Enseco ID: 1082609
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 16 JUL 90

Parameter	Result	Units	Reporting Limit
Methyl methacrylate	ND	ug/L	20
4-Methyl-2-pentanone (MIBK)	ND	ug/L	10
Propionitrile	ND	ug/L	5.0
Styrene	ND	ug/L	5.0
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0
Tetrachloroethene	ND	ug/L	5.0
Toluene	ND	ug/L	5.0
1,1,1-Trichloroethane	ND	ug/L	5.0
1,1,2-Trichloroethane	ND	ug/L	5.0
Trichloroethene	ND	ug/L	5.0
Trichlorofluoromethane	ND	ug/L	5.0
1,2,3-Trichloropropane	ND	ug/L	5.0
Vinyl acetate	ND	ug/L	10
Vinyl chloride	ND	ug/L	10
Xylenes (total)	ND	ug/L	5.0
Toluene-d8	98	%	--
4-Bromofluorobenzene	101	%	--
1,2-Dichloroethane-d4	101	%	--

ND = Not detected
NA = Not applicable

Reported By: Michael Blades Approved By: Jeff Lowry

Enseco

Semivolatile Organics
Appendix IX List
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA
Enseco ID: 1082609
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
Acenaphthene	ND	ug/L	20
Acenaphthylene	ND	ug/L	20
Acetophenone	ND	ug/L	20
2-Acetylaminofluorene	ND	ug/L	200
4-Aminobiphenyl	ND	ug/L	20
Aniline	ND	ug/L	20
Anthracene	ND	ug/L	20
Aramite	ND	ug/L	20
Benzo(a)anthracene	ND	ug/L	20
Benzo(b)fluoranthene	ND	ug/L	20
Benzo(k)fluoranthene	ND	ug/L	20
Benzo(g,h,i)perylene	ND	ug/L	20
Benzo(a)pyrene	ND	ug/L	20
Benzyl alcohol	ND	ug/L	20
4-Bromophenyl phenyl ether	ND	ug/L	20
Butyl benzyl phthalate	ND	ug/L	20
2-sec-Butyl-4,6-dinitro-phenol	ND	ug/L	20
4-Chloroaniline	ND	ug/L	20
bis(2-Chloroethoxy)-methane	ND	ug/L	20
bis(2-Chloroethyl) ether	ND	ug/L	20
bis(2-Chloroisopropyl)-ether	ND	ug/L	20
4-Chloro-3-methylphenol	ND	ug/L	20
2-Chloronaphthalene	ND	ug/L	20
2-Chlorophenol	38	ug/L	20
4-Chlorophenyl phenyl ether	ND	ug/L	20
Chrysene	ND	ug/L	20
Dibenz(a,h)anthracene	ND	ug/L	20
Dibenzofuran	ND	ug/L	20
Di-n-butyl phthalate	ND	ug/L	20
1,2-Dichlorobenzene	ND	ug/L	20
1,3-Dichlorobenzene	ND	ug/L	20
1,4-Dichlorobenzene	ND	ug/L	20
3,3'-Dichlorobenzidine	ND	ug/L	40
2,4-Dichlorophenol	ND	ug/L	20
2,6-Dichlorophenol	ND	ug/L	20
Diethyl phthalate	ND	ug/L	20

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones
Approved By: Jeff Lowry

Semivolatile Organics
Appendix IX List
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
Dimethoate	ND	ug/L	--
p-Dimethylaminoazobenzene	ND	ug/L	20
7,12-Dimethylbenz(a)-anthracene	ND	ug/L	20
3,3'-Dimethylbenzidine	ND	ug/L	20
a,a-Dimethylphenethylamine	ND	ug/L	20
2,4-Dimethylphenol	ND	ug/L	20
Dimethyl phthalate	ND	ug/L	20
1,3-Dinitrobenzene	ND	ug/L	20
4,6-Dinitro-2-methylphenol	ND	ug/L	100
2,4-Dinitrophenol	ND	ug/L	100
2,4-Dinitrotoluene	ND	ug/L	20
2,6-Dinitrotoluene	ND	ug/L	20
Di-n-octyl phthalate	ND	ug/L	20
Diphenylamine	ND	ug/L	20
Disulfoton	ND	ug/L	100
bis(2-Ethylhexyl) phthalate	ND	ug/L	20
Ethyl methanesulfonate	ND	ug/L	20
Famphur	ND	ug/L	--
Fluoranthene	ND	ug/L	20
Fluorene	ND	ug/L	20
Hexachlorobenzene	ND	ug/L	20
Hexachlorobutadiene	ND	ug/L	20
Hexachlorocyclopentadiene	ND	ug/L	20
Hexachloroethane	ND	ug/L	20
Hexachlorophene	ND	ug/L	--
Hexachloropropene	ND	ug/L	20
Indeno(1,2,3-cd)pyrene	ND	ug/L	20
Isophorone	ND	ug/L	20
Isosafrole	ND	ug/L	40
Methapyrilene	ND	ug/L	20
3-Methylcholanthrene	ND	ug/L	20
Methyl methanesulfonate	ND	ug/L	20
2-Methylnaphthalene	ND	ug/L	20
Methyl parathion	ND	ug/L	100
2-Methylphenol	ND	ug/L	20
3/4-Methylphenol	ND	ug/L	20
Naphthalene	ND	ug/L	20

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones Approved By: Jeff Lowry

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Semivolatile Organics
Appendix IX List (CONT.)
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA
Enseco ID: 1082609
Matrix: AQUEOUS
Sampled: 09 JUL 90
Received: 11 JUL 90
Authorized: 11 JUL 90
Prepared: 12 JUL 90
Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
1,4-Naphthoquinone	ND	ug/L	20
1-Naphthylamine	ND	ug/L	20
2-Naphthylamine	ND	ug/L	20
2-Nitroaniline	ND	ug/L	100
3-Nitroaniline	ND	ug/L	100
4-Nitroaniline	ND	ug/L	100
Nitrobenzene	ND	ug/L	20
2-Nitrophenol	ND	ug/L	20
4-Nitrophenol	ND	ug/L	100
4-Nitroquinoline-1-oxide	ND	ug/L	--
N-Nitroso-di-n-butylamine	ND	ug/L	20
N-Nitrosodiethylamine	ND	ug/L	20
N-Nitrosodimethylamine	ND	ug/L	20
N-Nitrosodiphenylamine	ND	ug/L	20
N-Nitroso-di-n-propylamine	ND	ug/L	20
N-Nitrosomethylethylamine	ND	ug/L	20
N-Nitrosomorpholine	ND	ug/L	20
N-Nitrosopiperidine	ND	ug/L	20
N-Nitrosopyrrolidine	ND	ug/L	20
5-Nitro-o-toluidine	ND	ug/L	20
Parathion	ND	ug/L	100
Pentachlorobenzene	ND	ug/L	20
Pentachloroethane	ND	ug/L	20
Pentachloronitrobenzene	ND	ug/L	100
Pentachlorophenol	ND	ug/L	100
Phenacetin	ND	ug/L	20
Phenanthrene	ND	ug/L	20
Phenol	ND	ug/L	20
4-Phenylenediamine	ND	ug/L	--
Phorate	ND	ug/L	200
2-Picoline	ND	ug/L	20
Pronamide	ND	ug/L	20
Pyrene	ND	ug/L	20
Pyridine	ND	ug/L	40
Safrole	ND	ug/L	20
Sulfotepp	ND	ug/L	100
1,2,4,5-Tetrachlorobenzene	ND	ug/L	20
2,3,4,6-Tetrachlorophenol	220	ug/L	100
Thionazin	ND	ug/L	100

(continued on following page)

ND = Not detected
NA = Not applicable

Reported By: Cheryl Jones
Approved By: Jeff Lowry

Enseco

Semivolatile Organics
Appendix IX List (CONT.)
Method 8270

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I
Lab ID: 010325-0001-SA Enseco ID: 1082609
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 11 JUL 90
Authorized: 11 JUL 90 Prepared: 12 JUL 90 Analyzed: 29 JUL 90

Parameter	Result	Units	Reporting Limit
2-Toluidine	ND	ug/L	20
1,2,4-Trichlorobenzene	ND	ug/L	20
2,4,5-Trichlorophenol	140	ug/L	100
O,O,O-Triethylphosphorothioate	ND	ug/L	20
2,4,6-Trichlorophenol	ND	ug/L	20
1,3,5-Trinitrobenzene	ND	ug/L	20
Nitrobenzene-d5	59	%	--
2-Fluorobiphenyl	61	%	--
Terphenyl-d14	81	%	--
Phenol-d5	54	%	--
2-Fluorophenol	50	%	--
2,4,6-Tribromophenol	40	%	--

ND = Not detected
A = Not applicable

Reported By: Cheryl Jones Approved By: Jeff Lowry

Appendix IX Organochlorine Pesticides/PCBs

Enseco

Method 608

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I 07/90
Lab ID: 053642-0002-SA Enseco ID: 155226
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 23 JUL 90

Parameter	Result	Units	Reporting Limit	
Aldrin	ND	ug/L	0.50	j
Aroclor 1016	ND	ug/L	10	
Aroclor 1221	ND	ug/L	10	
Aroclor 1232	ND	ug/L	10	
Aroclor 1242	ND	ug/L	10	
Aroclor 1248	ND	ug/L	10	
Aroclor 1254	ND	ug/L	10	
Aroclor 1260	ND	ug/L	10	
alpha-BHC	ND	ug/L	0.25	
beta-BHC	ND	ug/L	0.50	
delta-BHC	ND	ug/L	0.50	
gamma-BHC (Lindane)	ND	ug/L	0.25	
Chlordane	ND	ug/L	5.0	
Chlorobenzilate	ND	ug/L	10	
4,4'-DDD	ND	ug/L	1.0	
4,4'-DDE	ND	ug/L	0.50	
4,4'-DDT	ND	ug/L	1.0	
Diallate	ND	ug/L	30	
Dieldrin	ND	ug/L	0.50	
Endosulfan I	ND	ug/L	0.50	
Endosulfan II	ND	ug/L	1.0	
Endosulfan sulfate	ND	ug/L	1.0	
Endrin	ND	ug/L	0.50	
Endrin aldehyde	ND	ug/L	1.2	
Heptachlor	ND	ug/L	0.50	
Heptachlor epoxide	ND	ug/L	0.50	
Isodrin	ND	ug/L	1.0	
Kepone	ND	ug/L	2.0	
Methoxychlor	ND	ug/L	5.0	
Toxaphene	ND	ug/L	20	
Dibutyl chlorendate	108	%	--	

Note j : All Reporting Limits for this sample raised due to matrix interferences.

ND = Not detected
NA = Not applicable

Reported By: Mike Harrison Approved By: Lisa Stafford

The cover letter is an integral part of this report.
Rev 230787

Appendix IX Organophosphate Pesticides

Method 614

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I 07/90
Lab ID: 053642-0002-SA Enseco ID: 155226
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 17 JUL 90

Parameter	Result	Units	Reporting Limit
Dimethoate	ND	ug/L	1.0
Disulfoton	ND	ug/L	1.0
Ethyl parathion	ND	ug/L	1.0
Famphur	ND	ug/L	1.0
Methyl parathion	ND	ug/L	1.0
Phorate (Thimet)	ND	ug/L	1.0
Sulfotepp	ND	ug/L	1.0
Thionazin	ND	ug/L	1.0
O,O,O-Triethylphosphorothioate	ND	ug/L	1.0

ND = Not detected
NA = Not applicable

Reported By: Pat Trinidad Approved By: Marcia Reed

The cover letter is an integral part of this report.
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Appendix IX Herbicides

Method 615

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I 07/90
Lab ID: 053642-0002-SA Enseco ID: 155226
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: 12 JUL 90 Analyzed: 27 JUL 90

Parameter	Result	Units	Reporting Limit	
2,4-D	ND	ug/L	62	j
2,4,5-T	ND	ug/L	1.2	
2,4,5-TP (Silvex)	ND	ug/L	12	

Note j : All Reporting Limits for this sample raised due to matrix interferences.

ND = Not detected
NA = Not applicable

Reported By: Kris Rogers Approved By: Lisa Stafford

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GENERAL INORGANICS

(Water)

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I 07/90
Lab ID: 053642-0002-SA Enseco ID: 155226
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date
Cyanide, Total	ND	mg/L	0.010	9010	12 JUL 90	13 JUL 90
Formaldehyde	ND	mg/L	0.050	Method 3500	NA	11 JUL 90
Sulfide, Total	ND	mg/L	0.050	9030	NA	26 JUL 90

ND = Not detected
NA = Not applicable

Reported By: Darlene Ogburn Approved By: Josefina Jones

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Appendix IX Metals and Inorganics, Total

Client Name: CH2M Hill
Client ID: RCI-GW-MW-165I 07/90
Lab ID: 053642-0002-SA Enseco ID: 155226
Matrix: AQUEOUS Sampled: 09 JUL 90 Received: 10 JUL 90
Authorized: 10 JUL 90 Prepared: See Below Analyzed: See Below

Parameter	Result	Units	Reporting Limit	Analytical Method	Prepared Date	Analyzed Date	
Antimony	ND	mg/L	0.30	6010	17 JUL 90	07 AUG 90	!
Arsenic	1.4	mg/L	0.10	7060	17 JUL 90	06 AUG 90	o
Barium	0.19	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Beryllium	ND	mg/L	0.010	6010	17 JUL 90	07 AUG 90	!
Cadmium	ND	mg/L	0.025	6010	17 JUL 90	07 AUG 90	!
Chromium	ND	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Cobalt	ND	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Copper	ND	mg/L	0.10	6010	17 JUL 90	07 AUG 90	!
Lead	ND	mg/L	0.020	7421	17 JUL 90	02 AUG 90	G
Mercury	ND	mg/L	0.00020	7470	30 JUL 90	31 JUL 90	
Molybdenum	0.068	mg/L	0.020	6010	17 JUL 90	07 AUG 90	
Nickel	ND	mg/L	0.20	6010	17 JUL 90	07 AUG 90	!
Selenium	ND	mg/L	0.020	7740	17 JUL 90	06 AUG 90	G
Silver	ND	mg/L	0.010	6010	17 JUL 90	07 AUG 90	!
Thallium	ND	mg/L	0.025	7841	17 JUL 90	02 AUG 90	G
Tin	ND	mg/L	0.50	6010	17 JUL 90	07 AUG 90	!
Vanadium	0.057	mg/L	0.050	6010	17 JUL 90	07 AUG 90	!
Zinc	ND	mg/L	0.10	6010	17 JUL 90	07 AUG 90	!

Note ! : All reporting limits raised due to interference created by high concentrations of dissolved solids.

Note o : Reporting Limit raised due to high level of analyte present in sample.

Note G : Reporting Limit raised due to matrix interference.

ND = Not detected
NA = Not applicable

Reported By: Grace Chang Approved By: Barry Votaw

The cover letter is an integral part of this report.
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ATTACHMENT C
QA/QC SUMMARY DATA
FOR JULY 1990 QUARTERLY ANALYSES

Attachment C
ANALYTICAL DATA QUALITY ASSURANCE
SEVENTH QUARTER (JULY 1990)
PRECORRECTIVE ACTION GROUNDWATER MONITORING PROGRAM
Reichhold Chemicals, Inc.

Groundwater samples were analyzed for a Modified List of Appendix IX parameters (Table 6 of the RCRA permit) including Target List Compounds (TCL) (volatiles, acid/base/neutral extractables, pesticides/PCBs, metals, cyanide), formaldehyde, molybdenum, herbicides, and total organic carbon. One groundwater sample and field duplicate was analyzed for the full list of Appendix IX (40 CFR Part 264) parameters. Sampling and laboratory analyses were conducted in accordance with the requirements under Reichhold's precorrective action program. CH2M HILL conducted for Reichhold a quality assurance program for these analyses in accordance with EPA CLP protocols and Reichhold's RCRA permit.

The July 1990 sample analyses were conducted by two laboratories under the EPA contract laboratory program (CLP). S-Cubed, San Diego, California, was responsible for analysis of the TCL, formaldehyde, molybdenum total organic carbon and herbicides. California Analytical Laboratory, Sacramento, California was responsible for the full Appendix IX analyses.

The analysis of groundwater samples for the TCL parameters were carried out by the latest EPA CLP protocols. These protocols are based on EPA SW846 methods and include additional QA/QC procedures. The protocols include:

- Chain-of-custody and preservation procedures
- Holding times
- Analytical methodology and detection limits
- QA/QC procedures
- QC control limits and rerun requirements
- Reporting requirements
- Documentation

Formaldehyde was analyzed by the NIOSH method, other parameters were analyzed by standard EPA methods (SW 846); an equivalent level of quality assurance was maintained as for the TCL parameters.

The overall completeness of the data with regard to the EPA criteria and control limits was above 90 percent for organic analyses and Appendix IX inorganics; for TCL metals the completeness was below 90 percent. Completeness is defined as the percent of data found valid in accordance with EPA CLP control limits and criteria; some of these limits and criteria are noted in the tables that follow. In general practice, 90 percent completeness represents high-quality data.

CLP analytical and quality assurance protocols for TCL are described in the EPA invitation for bid documents (IFBs WA 87-K025/027 and WA 87-J001/J003 or the latest updated version). Guidelines for independent review and validation of CLP data are given in EPA Sample Management Office Technical Directive Document No. HQ-8410-01, Contract No. 68-01-6699. Data reviews followed the above-noted guidelines. The quality assurance activities covered the following aspects of the analytical system:

- Sample chain-of-custody
- Sample preservation
- Sample holding times
- Sample preparation
- Instrument tuning, calibration, linearity, detection limits
- Standards
- Analytical methodology
- Laboratory contamination (blank)
- Accuracy measurements
- Precision measurements
- Data reduction (including identification, quality of chromatograms, and mass spectra)
- Documentation

Sample chain-of-custody, sample preservation, and sample holding times were documented as described in the CLP protocols. Sample holding times were reviewed to ensure that they were within EPA limits. Sample preparation, analytical methodology, usage of standards as established by laboratory records, and instrument output were carried out in accordance with CLP methods or an equivalent level of QA/QC for parameters not covered under the CLP (e.g., formaldehyde).

The analytical results were reviewed during and after analysis with regard to acceptability standards defined in the CLP protocols. The protocols define the level of effort for QC (the frequency with which the quality control procedures are to be carried out). Blank, accuracy, and precision measurements (defined below) were carried out at a 10 percent frequency in general as specified in the protocols. This same level of effort was maintained for the parameters not covered under the CLP protocols.

Instrument calibrations were also conducted at the level of frequency defined in the CLP protocols; an equivalent level of effort was maintained under CLP for calibration of parameters not covered (Appendix IX, formaldehyde).

The quality control data were also evaluated quantitatively. For the CLP parameters, EPA has established control limits for the evaluation of the data. These EPA limits are based on past data bases. Quality control data that are not within these limits were noted, and the impact on the results was evaluated. Over 90 percent of the organic data and Appendix IX inorganics were within limits; in general practice this is considered to be data of high quality. For the TCL metals analyses, significant deviations were encountered with the calibrations, control sample data, in addition to other analytical difficulties; the laboratory conducted reruns of the samples, however, the problems were not resolved and the data set has been flagged accordingly. For non-CLP parameters, precision and accuracy were used for quantitative qualification of data as further described below.

The quality control measurements that provide a quantitative assessment of the data are summarized in the tables presented in this supplement. These include accuracy, precision, and blank measurements; the meaning and usage of these are explained below. Other quality control parameters have been documented in accordance with EPA CLP protocols and are on file at CH2M HILL and the laboratory. Quality assurance review notes are also filed with these data. This documentation provides data of known quality from the most extensive state-of-the-art quality control procedures designed in this area of study.

ACCURACY MEASUREMENTS

Accuracy is the measure of the deviation between the true value and the observed test value. The accuracy of chemical test results is measured by establishing the average recovery. The recovery is determined by splitting a series of samples into two portions, spiking (adding a known quantity of the constituent of interest) one of the portions, and submitting both portions for laboratory and analysis as independent samples. In general, two types of recoveries are measured: matrix spike recoveries and surrogate spike recoveries. For a matrix spike, known amounts of standard compounds identical to the compounds present in the sample of interest are added to the sample. For a surrogate spike, the standards are chemically similar but not identical to the compounds in the fraction being analyzed. The purpose of the surrogate spike is to provide quality control on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. Surrogate spikes are generally done for organics analyses. Recovery values for the samples are presented in Tables C-1 and C-2 for TCL and Appendix IX organics, Table C-4 for TCL and Appendix IX metals, and Table C-7 for other parameters.

Perfect accuracy would be defined by 100 percent recovery. EPA control limits for CLP data are noted in tables for each parameter. Data that are outside these control

limits have been flagged as noted in the footnotes. For non-CLP parameters the accuracy measurement serves as a quantitative qualifier.

PRECISION MEASUREMENTS

Precision is a measure of the spread of data when more than one measurement is taken on the same sample. For duplicate measurements, precision can be expressed as the relative percent difference (RPD). Acceptable precision limits are based on past data bases. Precision measurements for Reichhold samples are presented in Table C-2 for organics, Table C-5 for metals and Table C-7 for other parameters. The EPA CLP control limits are noted, along with any data points outside the limits. For the CLP parameters, the data were again found to be within the listed control limits for above 90 percent of measurements.

BLANK MEASUREMENTS

A laboratory method blank is defined as an appropriate volume of "organic-free" water that has been processed exactly as a sample (same glassware, reagents, and solvents). A blank measurement helps distinguish observed test results that are caused by contamination or instrument error from those that are intrinsic to the sample. The laboratory contaminants found in blank measurements for Reichhold samples are summarized in Table C-3 for TCL and Appendix IX organics Table C-6 for TCL and Appendix IX metals, and Table C-8 for other parameters. All blanks meet CLP criteria in that laboratory contaminants were found to be below EPA-specified concentration levels. The data set has been qualified with regard to organics observed in blanks noting the letter "B" next to the reported concentrations if that same constituent were observed in the blanks.

Table C-1
Surrogate Percent Recovery Summary
TCL and Appendix IX Organics

	TCL Volatile Organics			TCL Semivolatile Organics						TCL Pesticide
Sample ID	Toluene-d8 (88-110)[a]	Bromofluoro-benzene (86-115)[a]	1,2-Dichloro ethane-d4 (76-114)[a]	Nitro benzene-d5 (35-114)[a]	2-Fluoro biphenyl (43-116)[a]	Terphenyl-d14 (33-141)[a]	Phenol-d5 (10-94)[a]	2-Fluoro phenol (21-100)[a]	2,4,6-Tribromo phenol (10-123)[a]	Dibutyl chlorendate (24-154)[b]
1756-1	102	102	95	70	76	72	36	33	35	45
1757-1	98	101	94	10*	78	61	73	70	92	18
1757-2	96	98	92	72	71	61	62	62	105	29
1757-3	99	100	98	69	67	73	81	81	96	66
1757-3 MS	96	100	92	80	78	84	83	78	108	58
1757-3 MSD	99	101	92	82	81	79	87	87	107	71
1757-4	95	96	96	74	78	82	76	76	96	38
1757-5	98	102	94	71	77	76	90	83	106	43
1757-6	99	107	95	71	68	70	71	71	80	73
1757-7	95	97	97	74	73	73	47	48	62	34
1757-8	98	99	94	74	80	81	68	72	84	64
1761-1	102	104	94	74	74	76	87	85	108	65
1761-2	98	97	93	85	83	88	70	66	101	79
1761-3	95	101	91							
1761-4	100	101	100	76	72	49	89	87	102	71
1761-5	100	99	95	83	83	75	81	72	102	54
1761-6	100	103	95	88	88	100	57	54	81	61
1761-7	98	100	94	68	69	69	77	70	114	68
1761-8	97	101	96	57	93	88	64	59	79	28
1761-9	102	99	91	69	66	51	72	65	108	35
1761-10	98	99	96	63	61	66	76	62	119	60
1769-1	99	97	102	58	50	64	23	34	58	69
1769-2	98	96	106	58	50	62	43	45	67	49
1769-3	98	98	103	57	55	54	50	43	64	72
1769-4	97	99	104	61	68	62	53	48	66	43
1769-5	96	97	105	35	49	71	53	73	100	35
1769-6	98	96	101							
1769-7	97	97	105							
1769-8	100	98	108	48	40*	51	31	43	64	69

Table C-1
(Continued)

	TCL Volatile Organics			TCL Semivolatile Organics						TCL Pesticide
Sample ID	Toluene-d8 (88-110)[a]	Bromofluoro-benzene (86-115)[a]	1,2-Dichloro ethane-d4 (76-114)[a]	Nitro benzene-d5 (35-114)[a]	2-Fluoro biphenyl (43-116)[a]	Terphenyl-d14 (33-141)[a]	Phenol-d5 (10-94)[a]	2-Fluoro phenol (21-100)[a]	2,4,6-Tribromo phenol (10-123)[a]	Dibutyl chlorendate (24-154)[b]
1769-10 MSD	97	96	102	56	52	54	48	47	65	
1769-11	98	98	109	70	67	79	20	18*	55	93
1773-1	99	99	88	67	79	79	35	44	71	33
1773-2	102	102	101	57	74	76	31	42	83	38
1773-3	98	98	98	32*	97	91	38	36	74	32
1773-4	96	100	94	73	79	83	37	46	100	29
1773-5	97	99	98	48	57	73	48	59	112	33
1775-1	101	102	95	67	67	74	61	55	89	43
1775-2	98	97	91	74	74	69	50	56	78	28
1775-3	97	100	98	61	62	77	37	32	65	66
1775-4	97	101	96	65	68	76	37	33	52	76
1775-5	99	99	92							
1779-1	99	100	99	51	58	64	33	40	90	49
1779-2	105	102	10	52	62	59	33	39	90	102
1779-3	103	100	98	56	62	63	30	36	80	67
1779-4	100	98	93	47	52	53	33	40	103	41
1779-5	103	101	98	57	66	63	28	34	71	86
1779-6	99	97	97							
1779-7	101	97	94	58	64	63	29	37	86	
1779-7 MS	103	98	95	71	74	67	39	45	90	
1779-7 MSD	101	98	93	74	74	67	41	44	82	
1779-8	97	95	96	69	73	66	41	47	76	91

Table C-1
(Continued)

Sample ID	App. IX Volatile Organics			App. IX Semivolatile Organics						App. IX Pesticide
	Toluene-d8 (88-110)[a]	Bromofluoro-benzene (86-115)[a]	1,2-Dichloro ethane-d4 (76-114)[a]	Nitro benzene-d5 (35-114)[a]	2-Fluoro biphenyl (43-116)[a]	Terphenyl-d14 (33-141)[a]	Phenol-d5 (10-94)[a]	2-Fluoro phenol (21-100)[a]	2,4,6-Tribromo phenol (10-123)[a]	Dibutyl chlorendate (24-154)[b]
MW-165 I	98	101	101	59	61	81	54	50	40	108
MW-045 I	97	100	101	63	63	84	68	57	56	86

Sample ID	App. IX Dioxins/Furans			
	13C-2,3,7,8-TCDF	13C-2,3,7,8, TCDD	13C-1,2,3,7,8-PeCDD	13C-1,2,3,6,7,8-HxCDD
MW-165 I	69	79	89	81
MW-045 I	74	89	91	84

*Value outside of EPA QC limit.
[a]CLP QC limit.
[b]CLP advisory limit.

Table C-2
Matrix Spike/Matrix Spike Duplicate Recovery
TCL and Appendix IX Organics

Fraction	Compound	Conc. Spike Added (µg/l) Spike	Conc. Spike Added (µg/l) Duplicate	Sample Result	Conc. MS (µg/l)	Percent Recovery	Conc. MSD (µg/l)	Percent Recovery	RPD	EPA QC Limits RPD	EPA QC Limits Recovery
TCL Organics											
Sample: 1757-3											
TCL VOA	1,1-Dichloroethene	50	50	0	36	72	36	72	0	14	61-145
	Trichloroethene	50	50	0	37	74	35	70	6	14	71-120
	Chlorobenzene	50	50	0	47	94	45	90	4	13	75-130
	Toluene	50	50	0	40	80	39	78	3	13	76-125
	Benzene	50	50	0	44	88	41	82	7	11	76-127
TCL B/N	1,2,4-Trichlorobenzene	100	100	0	80	80	85	85	6	28	39-98
	Acenapthene	100	100	0	90	90	90	90	0	31	46-118
	2,4-Dinitrotoluene	100	100	0	87	87	83	83	5	38	24-96
	Pyrene	100	100	0	83	83	78	78	6	31	26-127
	N-nitrosodi-N-propylamine	100	100	0	110	110	110	110	0	38	41-116
	1,4-Dichlorobenzene	100	100	0	76	76	82	82	8	28	36-97
TCL Acid	Pentachlorophenol	200	200	0	190	95	190	95	0	50	9-103
	Phenol	200	200	0	170	85	190	95*	11	42	12-89
	2-Chlorophenol	200	200	0	170	85	170	85	0	40	27-123
	4-Chloro-3-methylphenol	200	200	0	170	85	180	90	6	42	23-97
	4-Nitrophenol	200	200	0	200	100*	200	100*	0	50	10-80
TCL Pesticide	gamma-BHC(Lindane)	20	20	0	14	70	15	75	69	15	56-123
	Heptachlor	20	20	0	10	50	12	60	18	20	40-131
	Aldrin	20	20	0	13	65	14	70	74	22	40-120
	Dieldrin	50	50	0	32	64	37	74	14	18	52-126
	Endrin	50	50	0	36	72	35	70	28	21	56-121
	4,4'-DDT	50	50	0	33	66	38	74	11	27	38-127
Sample: 1769-10											
TCL VOA	1,1-Dichloroethene	50	50	0	43	86	43	86	0	14	61-145
	Trichloroethene	50	50	0	37	74	37	74	0	14	71-120
	Chlorobenzene	50	50	0	43	88	43	86	2	13	75-130
	Toluene	50	50	0	41	78	41	82	5	13	76-125
	Benzene	50	50	0	42	86	42	84	2	11	76-127

Table C-2
(continued)

Fraction	Compound	Conc. Spike Added (µg/l) Spike	Duplicate	Sample Result	Conc. MS (µg/l)	Percent Recovery	Conc. MSD (µg/l)	Percent Recovery	RPD	EPA QC Limits RPD	Recovery
TCL B/N	1,2,4-Trichlorobenzene	100		0	49	49	62	62	23	28	39-98
	Acenapthene	100		0	52	52	58	58	11	31	46-118
	2,4-Dinitrotoluene	100		0	48	48	50	50	4	38	24-96
	Pyrene	100		0	50	50	53	53	6	31	26-127
	N-nitrosodi-N-propylamine	100		0	72	72	76	76	5	38	41-116
	1,4-Dichlorobenzene	100		0	43	43	55	55	24	28	36-97
TCL Acid	Pentachlorophenol	200		0	110	55	130	65	17	50	9-103
	Phenol	200		0	86	43	99	50	14	42	12-89
	2-Chlorophenol	200		0	93	47	99	50	6	40	27-123
	4-Chloro-3-methylphenol	200		0	100	50	110	55	10	42	23-97
	4-Nitrophenol	200		0	120	60	140	70	15	50	10-80
TCL Pesticide	gamma-BHC(Lindane)	20	20	0	14	70	12	60	15	15	56-123
	Heptachlor	20	20	0	12	60	9	45	28	20	40-131
	Aldrin	20	20	0	11	55	9	45	20	22	40-120
	Dieldrin	50	50	0	34	68	30	60	12.5	18	52-126
	Endrin	50	50	0	38	76	31	62	20	21	56-121
	4,4'-DDT	50	50	0	*52	104	*45	90	14	27	38-127
Sample: 1779-7											
TCL VOA	1,1-Dichloroethene	50		0	45	90	45	90	0	14	61-145
	Trichloroethene	50		0	38	76	37	74	3	14	71-120
	Chlorobenzene	50		0	50	100	47	94	6	13	75-130
	Toluene	50		0	43	86	41	82	5	13	76-125
	Benzene	50		0	46	92	44	88	4	11	76-127
TCL B/N	1,2,4-Trichlorobenzene	100		0	87	87	91	91	4	28	39-98
	Acenapthene	100		0	73	73	120	60	0	42	46-118
	2,4-Dinitrotoluene	100		0	72	72	81	81	12	38	24-96
	Pyrene	100		0	63	63	67	67	6	31	26-127
	N-nitrosodi-N-propylamine	100		0	93	93	100	100	7	38	41-116
	1,4-Dichlorobenzene	100		0	70	70	73	73	4	28	36-97

Table C-2
(continued)

Fraction	Compound	Conc. Spike Added (µg/l) Spike	Duplicate	Sample Result	Conc. MS (µg/l)	Percent Recovery	Conc. MSD (µg/l)	Percent Recovery	RPD	EPA QC Limits RPD	Recovery
TCL Acid	Pentachlorophenol	200		0	140	70	130	65	7	50	9-103
	Phenol	200		0	80	40	87	44	8	42	12-89
	2-Chlorophenol	200		0	110	55	110	55	0	40	27-123
	4-Chloro-3-methylphenol	200		0	120	60	120	60	0	42	23-97
	4-Nitrophenol	200		0	74	37	87	44	16	50	10-80
TCL Pesticide	gamma-BHC(Lindane)	20	20	0	13	65	18	90	*32	15	56-123
	Heptachlor	20	20	0	11	55	15	75	*31	20	40-131
	Aldrin	20	20	0	10	50	17	85	*52	22	40-120
	Dieldrin	50	50	0	35	70	50	100	*35	18	52-126
	Endrin	50	50	0	33	66	54	108	*25	21	56-121
	4,4'-DDT	50	50	0	29	58	49	98	*51	27	38-127

Table C-2
(Continued)

Appendix IX Volatile Organics
Matrix Spike Report

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Sample: 010325-0002				
Units: ug/L				
Benzene	8.6	65	50	113
Chlorobenzene	ND	54	50	108
1,1-Dichloroethene	ND	55	50	110
Toulene	ND	55	50	110
Trichloroethene	ND	56	50	112

ND=not detected

Table C-2
(continued)

Appendix IX Semivolatile Organics
Matrix Spike Report

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Sample: 010325-0002				
Units: ug/L				
Acenaphthene	ND	38	48	79
4-Chloro0-3-methylphenol	ND	84	96	88
2-Chlorophenol	41	110	96	72
1,4-Dichlorobenzene	ND	25	48	52
2,4-Dinitrotoluene	ND	48	48	100
4-Nitrophenol	ND	84	96	88
N-Nitroso-di n-propylamine	ND	45	48	94
Pentachlorophenol	220	340	96	NC
Phenol	ND	76	96	79
Pyrene	ND	43	48	90
1,2,4-Trichlorobenzene	ND	27	48	56

NC = not calculated, calculation not applicable.

Table C-2
(continued)

Appendix IX Pesticides/Herbicides
Matrix Spike Report

Analyte	Sample	Concentration Matrix Spike	Concentration Amount Spiked	% Rec
Sample: 053642-0001				
Units: ug/L				
Aldrin	ND	0.086	0.20	43
gamma-BHC (Lindane)	ND	0.15	0.20	77
4,4'-DDT	41	0.43	0.50	85
Dieldrin	ND	0.42	0.50	84
Endrin	ND	0.46	0.50	92
Heptachlor	ND	0.10	0.20	52
Ethyl parathion	ND	9.4	10	94
2,4-D	ND	ND	5.0	NC
2,4,5-T	ND	ND	1.0	NC
2,4,5-TP (Silvex)	ND	ND	1.0	NC

ND = not detected.
NC = not calculated, calculation not applicable.

Table C-2
(continued)

Appendix IX Dioxins/Furans
Matrix Spike Report

Sample MW-045I Parameters	ng/L Found in Sample	ng/L Spiked	ng/L Found in MS Sample	% Recovery
Furans				
TCDFs (total)	ND	10	9.5	95
PeCDFs (total)	ND	10	9.2	92
HxCDFs (total)	ND	10	7.9	79
Dioxins				
TCDDs (total)	ND	10	8.9	89
PeCDDs (total)	ND	10	9.1	91
HxCDDs (total)	ND	10	8.9	89

	% Recovery
13C-2,3,7,8-TCDF	72
13C-2,3,7,8-TCDD	87
13C-1,2,3,7,8-PECDD	90
13C-1,2,3,6,7,8-HXCDD	88

ND = not detected.
NA = not applicable.

Table C-3
Method Blank Summary
TCL and Appendix IX Organics

ID	Date of Analysis	Fraction	Matrix	Concentration Level	Compound (HSL)	Conc.	Units
VBL11	7-11-90	TCL VOA	Water	Low	None detected		
VBL17	7-17-90	TCL VOA	Water	Low	Methylene chloride	3J	µg/l
VBL18	7-18-90	TCL VOA	Water	Low	Methylene chloride	3J	µg/l
VBL24	7-24-90	TCL VOA	Water	Low	Methylene chloride	3J	µg/l
					Acetone	2J	µg/l
ABL24	7-24-90	TCL VOA	Water	Low	None detected		
BC715	8-5-90	TCL SVOA	Water	Low	None detected		
BCL15	8-6-90	TCL SVOA	Water	Low	None detected		
BLC17	8-7-90	TCL SVOA	Water	Low	None detected		
BLC18	8-6-90	TCL SVOA	Water	Low	None detected		
BLC20	8-8-90	TCL SVOA	Water	Low	None detected		
BLC23	8-7-90	TCL SVOA	Water	Low	None detected		
BLC09	8-9-90	TCL SVOA	Water	Low	None detected		
BL813	8-13-90	TCL SVOA	Water	Low	None detected		
PBLK-1757	8-7-90	TCL Pest	Water	Low	None detected		
PBLK-1761	8-7-90	TCL Pest	Water	Low	None detected		
PBLK-1769	8-7-90	TCL Pest	Water	Low	Endosulfan sulfate	0.03J	µg/l
PBLK-1773	8-8-90	TCL Pest	Water	Low	None detected		
PBLK-1775	8-9-90	TCL Pest	Water	Low	None detected		

Table C-3
(continued)

ID	Date of Analysis	Fraction	Matrix	Concentration Level	Compound (HSL)	Conc.	Units
PBLK-1779	8-9-90	TCL Pest	Water	Low	None detected		
16 Jul 90-H	8-15-90	Appendix IX volatiles	"	Low	None detected		
12 Jul 90-A	8-12-90	Appendix IX semivolatiles	"	Low	None detected		
12 Jul 90-A	8-12-90	Appendix IX pesticides/PCBs	"	Low	None detected		
12 Jul 90-A	8-12-90	Appendix IX pesticides	"	Low	None detected		
12 Jul 90-A	8-12-90	Appendix IX herbicides	"	Low	None detected		
053642-001-MD	8-10-90	Appendix IX dioxins/furans	"	Low	None detected		

Table C-4
Metals Matrix Spike Sample Recovery
(Accuracy)

TCL Metals

Sample No. GW-MW001D
Concentration units = $\mu g/l$

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	1890.00		174.00	B	2000.00	85.8
Antimony	75-125	83.31		2.00	U	100.00	93.3
Arsenic	75-125	53.57		1.20		50.00	104.7
Barium	75-125	1750.00		32.00	U	2000.00	87.5
Beryllium	75-125	43.00		2.00	U	50.00	86.0
Cadmium	75-125	45.00		4.00	U	50.00	90.0
Calcium							
Chromium	75-125	169.00		7.00	U	200.00	84.5
Colbalt	75-125	439.00		13.00	U	500.00	87.8
Copper	75-125	242.00		39.00		250.00	81.2
Iron	75-125	1000.00		72.00	B	1000.00	92.8
Lead	75-125	20.29		4.33		20.00	101.4
Magnesium							
Manganese	75-125	466.00		35.00		500.00	86.2
Mercury	75-125	5.20		0.30		5.00	96.5
Molybdenum							
Nickel	75-125	534.00		207.00		500.00	65.4
Potassium							
Selenium	75-125	10.98		1.00		10.00	109.8
Silver	75-125	9.00	B	8.00	U	50.00	18.0
Sodium							
Thallium	75-125	52.83		3.00	U	50.00	105.7
Vanadium	75-125	431.00		16.00	U	500.00	86.2
Zinc	75-125	484.00		52.00		500.00	86.4

Table C-4
(continued)

TCL Metals

Sample No. GW-MW001D S
Concentration units = µg/l

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	1830.00		174.00	B	2000.00	82.8
Antimony	75-125	48.50		2.00	U	100.00	88.5
Arsenic	75-125	55.40		1.20		50.00	108.4
Barium	75-125	1720.00		32.00	U	2000.00	86.0
Beryllium	75-125	43.00		2.00	U	50.00	86.0
Cadmium	75-125	45.00		4.00	U	50.00	90.0
Calcium							
Chromium	75-125	173.00		7.00	U	200.00	86.5
Colbalt	75-125	445.00		13.00	U	500.00	89.0
Copper	75-125	254.00		39.00		250.00	86.0
Iron	75-125	1010.00		72.00	B	1000.00	93.8
Lead	75-125	20.11		4.33		20.00	78.9
Magnesium							
Manganese	75-125	464.00		35.00		500.00	85.8
Mercury	75-125	5.30		0.30		5.00	100.0
Molybdenum							
Nickel	75-125	627.00		207.00		500.00	84.0
Potassium							
Selenium	75-125	10.43		1.00	U	10.00	104.3
Silver	75-125	13.00		8.00	U	50.00	26.0
Sodium							
Thallium	75-125	42.57		3.00	U	50.00	85.1
Vanadium	75-125	428.00		16.00	U	500.00	85.6
Zinc	75-125	497.00		52.00		500.00	89.0

Table C-4
(continued)

TCL Metals

Sample No. GW-MW29IS
Concentration units = $\mu g/l$

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	1810.00		80.00	U	2000.00	90.5
Antimony	75-125	64.01		2.00	U	100.00	64.1
Arsenic	75-125	53.69		1.80		50.00	103.8
Barium	75-125	1600.00		32.00	U	2000.00	80.0
Beryllium	75-125	44.00		2.00	B	50.00	84.0
Cadmium	75-125	44.00		4.00	U	50.00	88.0
Calcium							
Chromium	75-125	193.00		17.00		200.00	88.0
Colbalt	75-125	444.00		13.00	U	500.00	88.8
Copper	75-125	227.00		19.00	B	250.00	83.2
Iron	75-125	4690.00		3640.00		1000.00	105.0
Lead	75-125	25.23		6.50		20.00	126.2
Magnesium							
Manganese	75-125	910.00		468.00		500.00	88.4
Mercury	75-125	3.10		0.03	U	5.00	62.0
Molybdenum							
Nickel	75-125	454.00		84.00		500.00	74.0
Potassium							
Selenium	75-125	11.07		1.00		10.00	110.7
Silver	75-125	15.00		19.00		50.00	-8.0
Sodium							
Thallium	75-125	31.03		3.00	U	50.00	62.1
Vanadium	75-125	441.00		17.00	B	500.00	84.8
Zinc	75-125	466.00		43.00		500.00	84.6

Table C-4
(continued)

TCL Metals

Sample No. GW-MW29IS
Concentration units = $\mu g/l$

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	2030.00		80.00	U	2000.00	101.5
Antimony	75-125	59.68		2.00	U	100.00	60.0
Arsenic	75-125	52.51		1.80		50.00	101.4
Barium	75-125	1670.00		32.00	U	2000.00	83.5
Beryllium	75-125	46.00		2.00	B	50.00	88.0
Cadmium	75-125	51.00		4.00	U	50.00	102.0
Calcium							
Chromium	75-125	203.00		17.00		200.00	93.0
Colbalt	75-125	470.00		13.00	U	500.00	94.0
Copper	75-125	252.00		19.00	B	250.00	93.2
Iron	75-125	5150.00		3640.00		1000.00	151.0
Lead	75-125	20.64		6.50		20.00	70.7
Magnesium							
Manganese	75-125	994.00		468.00		500.00	105.2
Mercury	75-125	3.90		0.03		5.00	78.0
Molybdenum							
Nickel	75-125	567.00		84.00		500.00	96.6
Potassium							
Selenium	75-125	10.96		1.00	U	10.00	109.6
Silver	75-125	29.00		19.00		50.00	20.0
Sodium							
Thallium	75-125	28.85		3.00	U	50.00	57.7
Vanadium	75-125	469.00		17.00	B	500.00	90.4
Zinc	75-125	513.00		43.00		500.00	94.0

Table C-4
(continued)

TCL Metals

Sample No. GW-MW60DS
Concentration units = $\mu g/l$

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	1880.00		312.00		2000.00	78.40
Antimony	75-125	68.01		2.00	U	100.00	68.00
Arsenic	75-125	32.75		1.00	U	50.00	65.50
Barium	75-125	1680.00		32.00	U	2000.00	84.00
Beryllium	75-125	46.00		2.00	B	50.00	88.00
Cadmium	75-125	52.00		9.00		50.00	86.00
Calcium							
Chromium	75-125	185.00		7.00	U	200.00	92.50
Colbalt	75-125	483.00		13.00	U	500.00	96.60
Copper	75-125	246.00		19.00	B	250.00	90.80
Iron	75-125	1020.00		1080.00		1000.00	-6.00
Lead	75-125	25.19		4.80		20.00	102.00
Magnesium							
Manganese	75-125	473.00		249.00		500.00	44.80
Mercury	75-125	5.30		0.30		5.00	96.50
Molybdenum							
Nickel	75-125	481.00		32.00	U	500.00	96.20
Potassium							
Selenium	75-125	14.15		1.00	U	10.00	141.50
Silver	75-125	18.00		25.00		50.00	14.00
Sodium							
Thallium	75-125	42.57		3.00	U	50.00	85.14
Vanadium	75-125	450.00		16.00	U	500.00	90.00
Zinc	75-125	516.00		77.00		500.00	87.80

Table C-4
(continued)

TCL Metals

Sample No. GW-MW60DS
Concentration units = $\mu g/l$

Analyte	Control Limit &R	Spiked Sample Result (SSR)	C	Sample Result (SR)	C	Spike Added (SA)	%R
Aluminum	75-125	1970.00		312.00		2000.00	82.9
Antimony	75-125	69.95		2.00	U	100.00	70.0
Arsenic	75-125	36.24		1.00	U	50.00	72.5
Barium	75-125	1570.00		32.00	U	2000.00	78.5
Beryllium	75-125	42.00		2.00	B	50.00	80.0
Cadmium	75-125	62.00		9.00		50.00	106.0
Calcium							
Chromium	75-125	180.00		7.00	U	200.00	90.0
Colbalt	75-125	446.00		13.00	U	500.00	89.2
Copper	75-125	227.00		19.00	B	250.00	83.2
Iron	75-125	971.00		1080.00		1000.00	-10.9
Lead	75-125	25.27		4.80		20.00	102.4
Magnesium							
Manganese	75-125	437.00		249.00		500.00	37.6
Mercury	75-125	5.10		0.10		5.00	100.0
Molybdenum							
Nickel	75-125	451.00		32.00	U	500.00	90.2
Potassium							
Selenium	75-125	11.15		1.00	U	10.00	115.1
Silver	75-125	20.00		25.00		50.00	-10.0
Sodium							
Thallium	75-125	52.83		3.00	U	50.00	105.6
Vanadium	75-125	417.00		16.00	U	500.00	83.4
Zinc	75-125	486.00		77.00		500.00	81.8

Table B-4
(continued)

Appendix IX Metals

Analyte	Sample Result	Spiked Sample Result	Amount Spiked	% Rec
Sample: 053642-0001				
Units: mg/l				
Antimony	ND	0.53	0.50	105
Barium	0.19	2.1	2.0	96
Beryllium	ND	0.044	0.050	88
Cadmium	ND	0.046	0.050	92
Chromium	ND	0.20	0.20	101
Cobalt	ND	0.46	0.50	92
Copper	ND	0.25	0.25	98
Molybdenum	0.063	0.23	0.20	82
Nickel	ND	0.50	0.50	100
Silver	ND	0.052	0.050	100
Vanadium	0.062	0.53	0.50	94
Zinc	ND	0.50	0.50	99
Sample: 053642-0001				
Units: mg/l				
Arsenic	1.5	1.4	0.040	NC
Sample: 053642-0001				
Units: mg/l				
Lead	ND	0.0071	0.020	36
Sample: 053642-0001				
Units: mg/l				
Selenium	ND	0.010	0.010	104

Table C-4
(continued)

Appendix IX Metals
(continued)

Analyte	Sample Result	Spiked Sample Result	Amount Spiked	% Rec
Sample: 053642-0001				
Units: mg/l				
Thallium	ND	0.026	0.050	53
Sample: 053642-001				
Units: mg/l				
Mercury	ND	0.00099	0.0010	99

ND = not detected.
NC = not calculated, calculation not applicable.

Table C-5
Metals Duplicates (Precision)

TCL Metals

Analyte	Control Limit	Sample		Duplicate	RPD
Sample No. GW-MW001D: Concentration Units (ug/l)					
Aluminum		1,890.00		1,830.00	3.2
Antimony	60.0	83.31		88.50	5.2
Arsenic	10.0	53.57		55.40	1.8
Barium		1,750.00		1,720.00	1.7
Beryllium		43.00		43.00	0.0
Cadmium		45.00		45.00	0.0
Calcium		80,100.00		79,700.00	0.5
Chromium		169.00		173.00	2.3
Cobalt		439.00		445.00	1.4
Copper		242.00		254.00	4.8
Iron		1,000.00		1,010.00	1.0
Lead	5.0	20.29		20.11	0.2
Magnesium		97,500.00		98,300.00	0.8
Manganese		466.00		464.00	0.4
Mercury	0.2	5.10		5.30	0.2
Molybdenum		475.00		446.00	6.3
Nickel		534.00		627.00	16.0
Potassium		32,300.00		32,500.00	0.6
Selenium	5.0	10.98		10.43	0.6
Silver		9.00	B	13.00	36.4
Sodium		146,000.00		144,000.00	1.4
Thallium	10.0	52.83		42.47	10.3
Vanadium		431.00		428.00	0.7
Zinc		484.00		497.00	2.7

Table C-5
(continued)

TCL Metals

Analyte	Control Limit	Sample	Duplicate	RPD
Sample No. GW-MW29ID: Concentration Units (ug/l)				
Aluminum		1,810.00	2,030.00	11.5
Antimony	60.0	64.07	59.68	4.4
Arsenic	10.0	53.69	52.51	1.2
Barium		1,600.00	1,670.00	4.3
Beryllium		44.00	46.00	4.4
Cadmium		44.00	51.00	14.7
Calcium		46,800.00	51,900.00	10.3
Chromium		193.00	203.00	5.1
Cobalt		444.00	470.00	5.7
Copper		227.00	252.00	10.4
Iron		4,690.00	5,150.00	9.3
Lead	5.0	25.23	20.64	4.6
Magnesium		137,000.00	153,000.00	11.0
Manganese		910.00	994.00	8.8
Mercury	0.2	3.10	3.40	0.8
Molybdenum		450.00	461.00	2.4
Nickel		454.00	567.00	22.1
Potassium		54,500.00	59,600.00	8.9
Selenium	5.0	11.07	10.96	0.1
Silver	10.0	15.00	29.00	63.6
Sodium		827,000.00	907,000.00	9.2
Thallium	10.0	31.03	28.85	2.2
Vanadium		441.00	469.00	6.2
Zinc		466.00	513.00	9.6

Table C-5
(continued)

TCL Metals

Analyte	Control Limit	Sample	Duplicate	RPD
Sample No. GW-MW60D D: Concentration Units (ug/l)				
Aluminum		1,880.00	1,970.00	4.7
Antimony	60.0	68.01	69.95	2.0
Arsenic	10.0	32.75	36.24	3.5
Barium		1,680.00	1,570.00	6.8
Beryllium		46.00	42.00	9.1
Cadmium		52.00	62.00	17.5
Calcium	5,000.0	7,430.00	7,780.00	4.6
Chromium		185.00	180.00	2.7
Cobalt		483.00	446.00	8.0
Copper		246.00	227.00	8.0
Iron		1,020.00	971.00	4.9
Lead	5.0	25.19	25.27	0.1
Magnesium	5,000.0	7,080.00	6,730.00	5.1
Manganese		473.00	437.00	7.9
Mercury	0.2	5.30	5.10	0.2
Molybdenum		481.00	427.00	11.9
Nickel		481.00	451.00	6.4
Potassium	5,000.0	12,700.00	12,100.00	4.8
Selenium	5.0	14.15	11.15	3.0
Silver	10.0	18.00	20.00	10.5
Sodium		95,400.00	91,300.00	4.4
Thallium	10.0	42.57	52.83	10.26
Vanadium		450.00	417.00	7.6
Zinc		516.00	586.00	6.0

Table C-6
(continued)

TCL Metals

Analyte	Initial Calibration Blank (ug/l)		Continuing Calibration Blank (ug/l) 1		2		3		Preparation Blank	
Aluminum	80.0	U	80.0	U	80.0	U	80.0	U	80.0	U
Antimony	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Arsenic	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Barium	32.0	U	32.0	U	32.0	U	32.0	U	32.0	U
Beryllium	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U
Cadmium	4.0	U	4.0	U	4.0	U	4.0	U	4.0	U
Calcium	933.0	U	933.0	U	933.0	U	933.0	U	933.0	U
Chromium	7.0	U	7.0	U	7.0	U	7.0	U	7.0	U
Cobalt	13.0	U	13.0	U	13.0	U	13.0	U	13.0	U
Copper	7.0	U	7.0	U	7.0	B	7.0	B	7.0	U
Iron	-42.0	B	-59.0	B	-56.0	B	-64.0	B	21.0	U
Lead	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Magnesium	2364.0	U	2364.0	U	2364.0	U	2364.0	U	2364.0	U
Manganese	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U
Mercury	0.03	U	0.02	U	0.03	U	0.03	U	0.03	U
Molybdenum	18.0	U	18.0	U	18.0	U	18.0	U	18.0	U
Nickel	32.0	U	32.0	U	32.0	U	32.0	U	32.0	U
Potassium	1389.0	U	1389.0	U	1389.0	U	1520.0	B	1389.0	U
Selenium	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
Silver	8.0	U	8.0	U	8.0	U	8.0	U	8.0	U
Sodium	1491.0	U	1491.0	U	1491.0	U	1491.0	U	1491.0	U
Thallium	3.0	U	3.0	U	3.0	U	3.0	U	3.0	U
Vanadium	16.0	U	16.0	U	16.0	U	16.0	U	-17.0	B
Zinc	14.0	U	14.0	U	14.0	U	14.0	U	16.0	B

Table C-6
(continued)

Appendix IX Metals			
Analyte	Result	Units	Reporting Limit
Antimony	ND	mg/l	0.060
Arsenic	ND	mg/l	0.0050
Barium	ND	mg/l	0.010
Beryllium	ND	mg/l	0.0020
Cadmium	ND	mg/l	0.0050
Chromium	ND	mg/l	0.010
Cobalt	ND	mg/l	0.010
Copper	ND	mg/l	0.020
Lead	ND	mg/l	0.0050
Mercury	ND	mg/l	0.00020
Nickel	ND	mg/l	0.040
Selenium	ND	mg/l	0.0050
Silver	ND	mg/l	0.010
Thallium	ND	mg/l	0.0050
Tin	ND	mg/l	0.10
Vanadium	ND	mg/l	0.010
Zinc	ND	mg/l	0.020

U = Parameter not detected above noted limit.
B = Parameter observed in blank.
ND = Not detected.

Table C-7
General Parameters Accuracy and Precision Measurement

Sample ID	Matrix Spike/Matrix Spike Duplicate			
	Spiked Sample Result (SSR)	Sample Result (SR)	Spike Added (SA)	Percent Recovery
Formaldehyde				
Units: µg/L				
RCI-GW-MW001D-(MS)	495	<0.02	500	99
RCI-GW-MW001D-(MSD)	597.3	<0.02	500	119.5
RCI-GW-MW4D-(MS)	557.4	<0.02	500	111.5
RCI-GW-MW4D-(MSD)	515.5	<0.02	500	103
RCI-GW-MW29I-(MS)	608.5	<0.02	500	121.7
RCI-GW-MW29I-(MSD)	600	<0.02	500	120
RCI-GW-MW12S-(MS)	467.5	<0.02	500	93.5
RCI-GW-MW12S-(MSD)	463	<0.02	500	92.6
RCI-GW-MW28I-(MS)	527.5	<0.02	500	105.5
RCI-GW-MW28I-(MSD)	512.5	<0.02	500	102.5
RCI-GW-MW60D-(MS)	495	<0.02	500	99
RCI-GW-MW60D-(MSD)	470	<0.02	500	94
Cyanide				
Units: µg/L				
RCI-GW-MW001D-(MS)	286.7	<0.02	200	93.4
RCI-GW-MW001D-(MSD)	194.8	<0.02	200	97.3
RCI-GW-MW29I-(MS)	199.5	<0.02	200	99.8
RCI-GW-MW29I-(MSD)	211.3	<0.02	200	105.6
RCI-GW-MW60D-(MS)	193.9	<0.02	200	92.4
RCI-GW-MW60D-(MSD)	196.6	<0.02	200	93.7

Table C-7
(continued)

Appendix IX General Parameters
Matrix Spike Duplicate Report

Analyte	Concentration			
	Sample	Matrix Spike	Amount Spiked	Percent Recovery
Sample: 053642-0001 **Unit: μg/L**				
Formaldehyde	ND	0.40	0.50	79
Sulfide, total	ND	0.18	0.20	92
Cyanide, total	ND	0.091	0.10	91

ND = not detected.
NC = not calculated, calculation not applicable.

Table C-8
General Paramters, Blank Summary

Analyte	Result	Units	Reporting Limit
Formaldehyde	ND	mg/l	0.050
Cyanide, total	ND	mg/l	0.010

ATTACHMENT C-2

Lincoln Drain Sediment Sampling
Applied Geotechnology, Inc.
January 15, 1986

Lincoln Drain Sediment
AGI Sampling
Concentration (ug/Kg)

	Eastern Portion	TCDD Equivalent	Western Portion	TCDD Equivalent	Toxicity Equivalency Factor
CHLORINATED DIBENZOFURAN					
Total Tetra-furans	ND	—	ND	—	0.1
Total Penta-furans	ND	—	ND	—	0.1
Total Hexa-furans	0.59	.0059	0.68	.0068	0.01
Total Hepta-furans	1.3	.0013	2.1	.0021	0.001
Total Octa-furans	ND	—	ND	—	0
CHLORINATED DIBENZODIOXIN					
Total Tetra-dioxin	ND	—	ND	—	1
Total Penta-dioxin	ND	—	ND	—	0.2
Total Hexa-dioxin	0.79	.032	ND	—	0.04
Total Hepta-dioxin	4.7	.0047	8.9	.0089	0.001
Total Octa-dioxin	37.7	0	49.1	0	0
Total		.0439		.0178	

The toxicity of the various dioxins and furans is evaluated by relating their toxicity to that of Tetrachlorodibenzodioxin (TCDD), the most toxic of all dioxins. TCDD is given the value 1 and the other compounds are given some fraction of 1. This fraction is the Toxicity Equivalency Factor (TEF). Multiplying the TEF by the measured concentration of a given compound results in a value with a toxicity equivalent to that amount of TCDD (EPA, 1985).

Dioxin and furans were detected in the sediment. However, no TCDD was detected, and the TCDD equivalent totals for both samples were much less than the 1 part per billion action level. We anticipate neither the EPA or WDOE would require dioxin cleanup.

From: Applied Geotechnology, Inc. Site Assessment
Parcel No. 4, Port of Tacoma, January 15, 1986

Note: Included in the Blair Waterway Property Draft Final Investigation Report at the request of the EPA.

ATTACHMENT C-3

Analytic Results: Compounds Detected in Mud Lake Sediment Applied Geotechnology, Inc. January 15, 1986

TABLE 5

Analytic Results: Compounds Detected
Mud Lake Sediment in Mud Lake

Parameter	Sample 03501	Sample 03502	Sample 03503	Sample 03504	Sample 03505
METALS (mg/kg)					
Copper	57	63	69	53	
Zinc	97.1	57.5	76.8	91.0	
Chromium	15.9	15.8	18.5	17.3	
Cadmium	0.48	0.25	0.36	0.43	
Lead	39.3	19.4	41.7	45.9	
Mercury	.040	.040	.043	.076	
Arsenic	8.2	10.8	15.3	9.2	
BASE/NEUTRAL EXTRACTIBLES					
Acenapthene	15,000.	190.	4,900.	14,700.	8,400.
1,4 Dichlorobenzidine	1,100.	—	—	1,000.	—
Fluoranthene	28,100.	660.	6,100.	21,000.	13,000.
Isophorone	—	20.	—	—	—
Napthalene	60,500.	570.	20,000.	52,000.	35,000.
Bis (2-ethyl hexyl) phthalate	114,000.	62,600.	34,000.	5,200.	11,000.
Di-n-octyl phthalate	2,200.	1,300.	650.	110.	250.
Benzo(a)anthracene	7,600.	240.	2,000.	7,000.	4,200.
Benzo(a)pyrene	3,600.	200.	1,200.	3,600.	1,400.
Benzo(b)fluoranthene and/or Benzo(k)	3,500.	220.	1,200.	3,800.	2,000.
Chrysene	7,300.	300.	2,100.	6,100.	3,900.
Acenapthylene	—	—	120.	200.	140.
Anthracene	—	50.	1,700.	5,700.	2,000.
Benzo(g,h,i) Perylene	—	—	—	1,500.	—
Fluorene	10,400.	130.	3,000.	9,100.	5,200.
Phenanthrene	45,500.	400.	12,000.	44,000.	22,000.
Pyrene	20,300.	520.	5,200.	16,000.	9,500.
Dibenzofuran	9,300.	90.	2,400.	8,000.	4,200.
2-methyl napthalene	9,300.	300.	3,800.	9,000.	5,800.
1-methyl napthalene	23,000.	600.	8,500.	19,000.	13,000.
1,1 biphenyl	85,000.	—	3,000.	8,000.	5,000.
1,5 dimethyl napthlene	6,800.	700.	3,000.	5,700.	3,700.

From: Applied Geotechnology, Inc. Site Assessment
Parcel No. 4, Port of Tacoma, January 15, 1986

Note: Included in the Blair Waterway Property Draft Final Investigation Report at the request of the EPA.

TABLE 5 (continued)

Analytic Results: Compounds Detected
Mud Lake Sediment in Mud Lake

Parameter	Sample 03501	Sample 03502	Sample 03503	Sample 03504	Sample 03505
4H-cyclopenta-(DEF) phenanthrene	17,000.	—	—	—	—
2-phenyl napthalene	47,000.	—	—	—	—
Retene	—	900.	—	—	—
9-methyl-9H fluorene	—	—	36,000.	—	75,000.
2-ethyl-napthalene	—	—	—	2,800.	—
4-methyl dibenzofuran	—	—	—	2,800.	—
ACID EXTRACTIBLES (ug/kg)					
None detected	—	—	—	—	—
VOLATILES (ug/kg)					
Benzene	2	—	—	—	—
1,1 Dichloroethane	—	2	—	—	—
Ethylbenzene	2	—	—	—	—
Toluene	2	—	—	—	2
Trichloroethylene	2	—	—	—	2
O-Xylene	2	—	—	—	2
OTHER COMPOUNDS (ug/kg)					
Acetone	260.	—	—	—	3
2-butanone	4.	—	—	—	2
Hexachlorabutadiene	2.5	9.2	6.9	5.5	1.7
Pentachlorobutadiene	1.9	5.8	6.0	2.8	3.4
Tetrachlorobutadiene	2.7	9.3	13.0	5.9	12.1

Notes:

1. Results from WDOE, 1984. Only detected compounds are reported; those compounds analyzed but not detected are not reported. Results on dry weight basis.
   — Indicates not detected; "Blank" indicates no analysis.

From: Applied Geotechnology, Inc. Site Assessment
Parcel No. 4, Port of Tacoma, January 15, 1986

Note: Included in the Blair Waterway Property Draft Final Investigation Report at the request of the EPA.

2. 03505 is a composite of all other samples.

3. Detection limits vary from 20 to 7,000 ug/kg.

4. Detection limits generally less than 700 ug/kg.

5. Detection limits generally 2 to 10 ug/kg.

From: Applied Geotechnology, Inc. Site Assessment
Parcel No. 4, Port of Tacoma, January 15, 1986

Note: Included in the Blair Waterway Property Draft Final Investigation Report at the request of the EPA.

APPENDIX D

APPENDIX D

Quality Assurance Information and Chemical Laboratory Data Sheets Final Investigation Report

- Blair Waterway Property
- Inner Hylebos Property
- Upper Hylebos Property

APPENDIX D

CHEMICAL LABORATORY DATA SHEETS
BLAIR WATERWAY PROPERTY

Laboratory data sheets, data validation, and quality assurance detail are provided under separate cover (limited copies). Data validation qualifiers are tabulated in Appendix D but not written in on the laboratory data sheets.