# COMPREHENSIVE SITE ASSESSMENT PHASE II FIELD INVESTIGATION REPORT VOLUME II (Appendix E through K)

Wilmington Facility
Wilmington, MA

Olin Corporation

PRINTED ON
JUN 25 1993

# COMPREHENSIVE SITE ASSESSMENT
# PHASE II FIELD INVESTIGATION REPORT
# VOLUME II (Appendix E through K)

Wilmington Facility
Wilmington, MA

Olin Corporation

JUNE 1993

REF. NO. 3683 (13)

CONESTOGA-ROVERS & ASSOCIATES

This report is printed on recycled paper.

# APPENDIX E

# APPENDIX E

# MONITORING WELL STRATIGRAPHIC AND INSTRUMENTATION LOGS

# HISTORIC MONITORING WELL
# STRATIGRAPHIC AND INSTRUMENTATION LOGS

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/24/86
Date End: 6/25/86

Sheet ___ of ___
Boring No: B-4
Location: See Plan
Surface Elev: ___

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/1/86 | 5.1' | ---- | Overnight. |

| Depth | Cas bl/ft | Sample No. | Sample Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-1.5' | 18" | 18" | 1-1-4 | 0.6' | S-1: Organic peat with fine sand and silt. | |
| | | S-2 | 1.5-3.0' | 18" | 18" | 7-12-16 | | S-2: Medium dense, fine, white gray sand. | |
| | | S-3 | 3.0-4.5' | 18" | 14" | 10-17-20 | 4.0' | S-3: Dense; medium to fine, brown silty sand. | |
| 5.0' | | S-4 | 4.5-6.0' | 18" | 16" | 12-18-20 | | S-4: Same as S-3. (moist) | |
| | | S-5 | 6.0-7.5' | 18" | 18" | 13-22-49 | | S-5: Same as S-3. (wet) | |
| | | S-6 | 7.5-9.0' | 18" | 18" | 11-13-14 | 9.6' | S-6: Same as S-3. (wet) | |
| 10.0' | | S-7 | 9.0-10.5' | 18" | 18" | 5-10-12 | | S-7: Medium dense, medium to fine, grey-white sand (wet). | |
| | | S-8 | 10.5-12.0 | 18" | 18" | 6-9-11 | | S-8: Same as S-7. (wet) | |
| | | S-9 | 12.0-13.5' | 18" | 6" | 12-34-28 | 13.1' | | |
| | | S-10 | 13.5-14.5' | 12" | 12" | 25-50 | | S-9: Very danse, medium to fine, grey silty sand w/gravel (wet). S-10: Same as S-9. (wet) | (1) (2) |
| 15.0' | | S-11 | 15.0-15.1' | 1" | 0" | 50/1 | | S-11: No recovery. | |
| 20.0' | | S-12 | 20.0-21.5' | 18" | 6" | 38-50-50 | 22.9' | S-12: Same as S-9. (wet) | |
| | | | | | | | | Terminated at 22.9'. Bedrock. | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

| COHESIVE CONSISTENCY (Blows/Foot) | | COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|---|---|
| 0 - 2 | VERY SOFT | 0 - 4 | VERY LOOSE |
| 2 - 4 | SOFT | 4 - 10 | LOOSE |
| 4 - 8 | MEDIUM STIFF | 10 - 30 | MEDIUM DENSE |
| 8 - 18 | STIFF | 30 - 50 | DENSE |
| 18+ | HARD | 50+ | VERY DENSE |

Remarks:
(1) To threaded casing 300 lb. hammer at 14.5'.
(2) To 5' intervals at 15.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/17/86
Date End: 6/17/86

Sheet 1 of 1
Boring No: T-1
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/13/86 | 6.2' | ------- | Overnight |

| Depth | Cas bl/ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2.0' | 24" | 12" | 5-8 | | S-1: Medium dense, dark brown to gray, medium to fine silty sand. | |
| | | | | | | 5-10 | | | |
| | | S-2 | 2.5'-4.0' | 18" | 8" | 16-13 | | S-2: Same as S-1. | |
| | | | | | | 8 | | | |
| 5.0' | | S-3 | 4.0-6.0' | 24" | 16" | 4-2 | | S-3: Same as S-1. (moist) | |
| | | | | | | 6-8 | | | |
| | | S-4 | 6.0-8.0' | 24" | 14" | 12-20 | | S-4: Same as S-1. (wet) | |
| | | | | | | 17-19 | | | |
| | * | S-5 | 8.0-10.0' | 24" | 10" | 8-11 | | S-5: Same as S-1. (wet) | |
| 10.0' | | | | | | 13-12 | | | |
| | * | S-6 | 10.0-12.0' | 24" | 24" | 6-8 | | S-6: Same as S-1. (wet) | |
| | | | | | | 12-12 | | | |
| | * | S-7 | 12.0-14.0' | 24" | 24" | 12-16 | | S-7: Same as S-1. (wet) | |
| | | | | | | 20-21 | | | |
| 15.0' | * | S-8 | 14.0-15.3' | 15" | 15" | 22-60 | 14.6' | | |
| | | | | | | 50/3 | | S-8: Very dense, dark to light grey, medium to fine, silty sand with gravel (wet). | (1) |
| | * | S-9 | 16.0-17.0' | 12" | 12" | 54-90 | | S-9: Same as S-8. (wet) | |
| | | | | | | | | | |
| | * | S-10 | 18.0-18.9' | 9" | 9" | 24-100/3 | | S-10: Same as S-8. (wet) | |
| 20.0' | * | S-11 | 19.0-20.0' | 12" | 6" | 50-50 | | S-11: Same as S-8. (wet) | |
| | * | S-12 | 20.0-21.7' | 19" | 6" | 12-34 | 21.0' | | |
| | | | | | | | 21.7' | S-12: Dense to medium dense course dark gray to brown sand with gravel (wet) | |
| | * | S-13 | 22.0-22.9' | 9" | 9" | 75-50/3 | | | |
| | | | | | | | | S-13: Same as S-8. (wet) | |
| 25.0' | | | | | | | | | |
| | | | | | | | 27.4' | | |
| | | | | | | | | Terminated at 27.4' depth; bedrock. | (2) |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 50+ | HARD |

COHESIONLESS DENSITY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Gomoulka
Helper: B. Marcoux
Inspector: B. Childs

Remarks: (1) High blow count due to cobble and/or boulder.
(2) Hole terminated at 20', lost casing, moved 3'.

* Those samples starred to be used for grain size distribution.

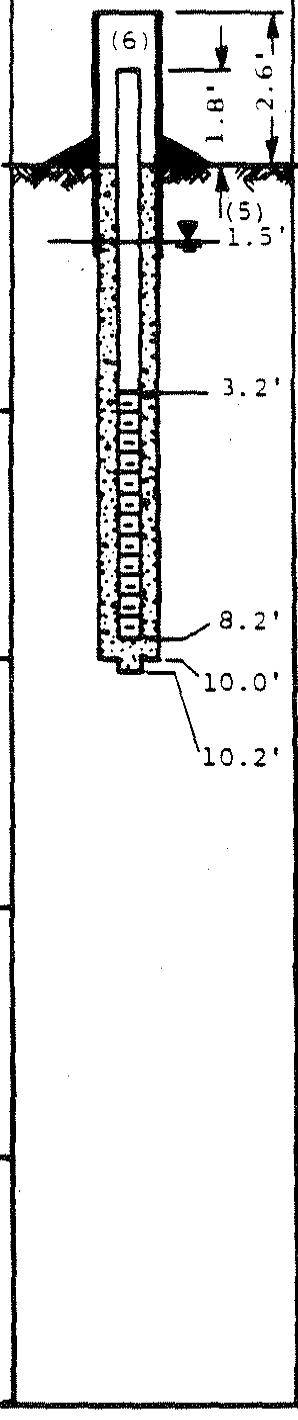
Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 8 | Date Installed: Oct. 28, 1977

Permeability(1) : 2 x $10^{-2}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 77.8 | 0 | SS-1A<br>SS-1B | 1-2-7-18 | 12 | SS-1A<br>~8" Fibrous peat.<br>SS-1B<br>~4" Dark brown silty fine sand. Organic material and fibrous material present. |
| 72.8 | 5 | SS-2 | 25-20-20-21 | 11 | SS-2<br>Slightly silty sandy gravel Particles are angular to subrounded up to 1 3/8" in size. |
| 67.8 | 10 | * | | | *Drove open-ended "A" rod with 200 lb weight.<br>Refusal at 10.2';<br>120 blows/no penetration |
| 62.8 | 15 | | | | |
| 57.8 | 20 | | | | |
| 52.8 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information

(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

(6) On May 31, 1978 the riser pipe and slotted pervious section were lifted approximately 1.4' while removing standpipe used to conduct permeability test. The existing dimensions for the riser pipe and slotted section are given.

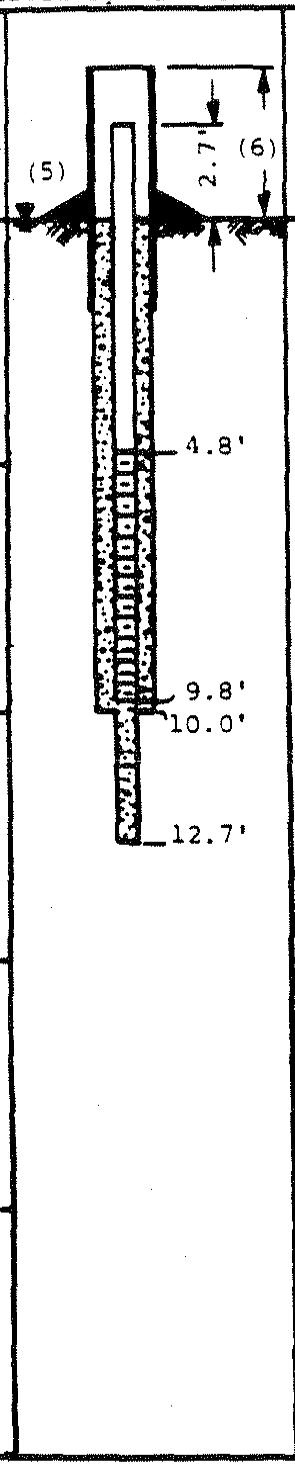
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 12 | Date Installed: Nov. 2, 1977

Permeability(1) : 4 x $10^{-3}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 82.0 | 0 | SS-1A<br>SS-1B | 1-1-2-3 | 17 | SS-1A<br>~8" Black sandy humus<br>SS-1B<br>~9" Brown organic silty fine sand. |
| 77.0 | 5 | SS-2 | 19-30-40-34 | 13 | SS-2<br>Light brown slightly silty, gravelly fine to coarse sand. |
| 72.0 | 10 | SS-3 * | 33-34-29-21 | 9 | SS-3<br>Gray slightly silty sandy gravel. Gravel is angular to subrounded and up to ~1 3/8" in size. |
| 67.0 | 15 | | | | *Drove open-ended "A" rod with 200-lb weight.<br>120 blows for last 2" of penetration. |
| 62.0 | 20 | | | | Recovered brownish-gray clayey, gravelly sand. |
| 57.0 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information

(5) Groundwater level is the average of seven measurements taken from November 2, 1978 to May 31, 1978.

(6) Prior to May 31, 1978, distance from ground surface to top of casing was 3.3'. Casing was removed to perform permeability test and replac to present "stickup" of 3.6'.

Geotechnical Engineers Inc.

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT
- ☐ NEW HAVEN, CT 203
- ☐ NEW LONDON, CT. 203.443-
- ☐ NEWARK, N.J. 201.589-
- ☐ PHILADELPHIA, PA. 215.563-

Page _____ of _____

Date 12-23-2

Job No. _____

Job Address Olin Chemical Wilmington, Mass.

Boring No. 3 (GW13)

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost water* or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 12' | Fine Light Brown Sand | | | | | | | | | | |
| 12' | 18' | Fine Light Brown Sand | | | | | | | | | | |
| | | Medium | | | | | | | | | | |
| | | Boulders | | | | | | | | | | |
| 18' | 18'6" | Refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | 5" PVC Slotted Well | | | | | | | | | | *After |
| | | installed | | | | | | | | | | Sealing |
| | | | | | | | | | | | | water fo |
| | | | | | | | | | | | | to [illegible] |
| | | | | | | | | | | | | 3'-7" |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ NEW HAVEN, CT 203.[illegible]
- ☐ NEW LONDON, CT 203.443.[illegible]
- ☐ NEWARK, N.J. 201.589.[illegible]
- ☐ PHILADELPHIA, PA. 215.563.[illegible]


Page _____ of _____

Date December 4th, 1990

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No 5 (GW

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in | Lost Water or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 4' | Fine to Medium Brown | | | | | | | | | | |
| | | Sand Heavily Stained | | | | | | | | | | |
| | | by Product | | | | | | | | | | |
| 4' | 10' | Brown Sand Fine to | | | | | | | | | | |
| | | Medium Grade | | | | | | | | | | |
| 10' | 12' | Brown Sand Fine to | | | | | | | | | | |
| | | Medium Grade, Small | | | | | | | | | | |
| | | to medium boulders | | | | | | | | | | |
| 12' | 12'6" | Refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | Installed 4" slotted | | | | | | | | | | |
| | | PVC pipe to 12'-6" | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, Jr.

Rig. No. 21

BORING GW-17D

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1500 |
| DATE: 3/3/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem augers | SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|---|
| S-1 | 0'-2' | 1 | 0 | | | very loose, brown, PEAT, little sand, wet | | |
| | | 1 | 0 | | | | | |
| S-2 | 2'-4' | 7 | 11 | | | medium dense, brown, SILT and fine SAND, trace clay, wet | | |
| | | 15 | 12 | | | | | |
| S-3 | 4'-6' | 9 | 15 | 5 | | Dense, brown-gray, fine to coarse SAND, little silt, trace gravel, wet | | |
| S-4 | 6'-8' | 19 | 20 | | | | | |
| | | 25 | 10 | | | | | |
| S-5 | 8'-9.5' | 15 | 100 | | | very dense, gray/brown, SAND, some silts, some gravel, wet, GLACIAL TILL | | |
| | | 70 | | 10 | | | | |
| | | | | | | Top of Rock, 13.0 feet | | |
| | | | | | | Run 1 13.0'-18.0', run 5.0 feet, recover 4.8 feet, 96% recovery | | |
| | | | | 15 | | | | |
| | | | | | | Run 2 18.0'-23.0', run 5.0 feet, recover 3.5, 70% recovery | | |
| | | | | 20 | | Bottom of boring, 23.0 feet | | |
| | | | | 25 | | | | |
| | | | | 30 | | | | |
| | | | | 35 | | | | |

NOTES: Monitoring well installed. Cement-bentonite slurry from 13.0 to 23.0'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at 1 feet and backfilled with uniform medium sand to 7.0 feet. Cement-bento slurry from 7.0 feet to ground surface. 5-foot long 6-inch diameter pro tive steel sleeve, with locking cap, placed on top.

MALCOLM PIRNIE INC

BORING GW-18D

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 2/24/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2½" hollow stem augers | SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONSTR. | REMA |
|---|---|---|---|---|---|---|---|---|
| S-1 | 0'-2' | 1 | 0 | | | Very loose, brown, PEAT and SAND, moist | | |
| S-2 | 2'-4' | 12 | 15 | | | Very dense, tan SAND, some gravel, some silt, moist | | |
| | | 20 | 20 | | | | | |
| S-3 | 4'-5' | 15 | 31 | 5 | | Very dense, brown/gray, SAND some gravel, some silt, wet, GLACIAL TILL | | |
| S-4 | 6'-8' | 12 | 24 | | | | | |
| | | 21 | 22 | | | | | |
| S-5 | 8'-10' | 30 | 28 | | | | | |
| | | 20 | 20 | 10 | | | | |
| S-6 | 11'-13' | 11 | 30 | | | | | |
| | | 50 | 40 | | | | | |
| | | | | 15 | | | | |
| | | | | 20 | | Top of rock, 19.9 feet Run 1 20.0 to 25.0 feet, run 5.0 feet recover 3.5 feet 70% recovery | | |
| | | | | 25 | | Run 2 25.0'-26.0', Run 1.0 foot Recover 0.0 feet, 0% recovery | | |
| | | | | 30 | | Bottom of boring, 26.0 feet | | |
| | | | | 35 | | | | |

NOTES: Monitoring well installed. Cement-bentonite slurry from 20.0' to 26.0'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at 19.5feet and backfilled with medium uniform sand. Cement-bentonite slurry from 10.0 feet to ground surface. 5-foot long 6-inch diameter protective steel sleeve, with locking cap, placed on top.

BORING GW-190

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 2/9/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2½" hollow stem augers | SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONSTR. | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Dense, brown, SILT and SAND, little gravel, frozen, FILL | | |
| S-1 | 2'-4' | 1 | 0 | | | Very loose, light gray, SILT, wet, GYPSUM SLUDGE | | |
| | | 0 | 0 | | | | | |
| S-2 | 4'-6' | 1 | 0 | 5 | | | | |
| | | 0 | 0 | | | | | |
| S-3 | 6'-7.5' | 1 | 1 | | | Very loose, brown, SILT and SAND, some organics, wet | | |
| S-4 | 7.5'-9.0' | 2 | 2 | | | | | |
| | | 2 | 12 | | | | | |
| S-5 | 9'-10' | 8 | 100 | 10 | | Grading to little gravel | | |
| | | | | | | Very dense brown/gray, SAND and gravel, little silt, wet, GLACIAL TILL | | |
| S-6 | 11'-12.5' | 12 | 25 | | | | | |
| S-7 | 12.5'-13.3' | 35 | 15 | | | | | |
| | | 100/.3' | | | | | | |
| S-8 | 14'-14.8' | 30 | | 15 | | | | |
| | | 100/.3' | | | | Boulder 15'-16.1' | | |
| | | | | | | Boulder, 16.5'-17.1' and 17.1'-17.8' | | |
| | | | | | | Boulder 18'-18.8' and 19.3'-19.9' | | |
| | | | | | | Top of rock 20.0 feet | | |
| | | | | 20 | | Run 1 20.0'-23.0' run 3.0 feet | | |
| | | | | | | Recover 2.0 feet, 67% recovery | | |
| | | | | | | Run 2 23.0'-24.3' Run 1.3 feet | | |
| | | | | | | Recover 0.0 feet 0% recovery | | |
| | | | | 25 | | (Core barrel broke) | | |
| | | | | | | Bottom of boring 24.3 feet | | |
| | | | | 30 | | | | |
| | | | | 35 | | | | |

NOTES: Monitoring well installed. Cement-bentonite slurry from 20.0' to 24.3'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at 19.7 feet and backfilled with medium uniform sand to 10.0 feet. Cement bentonite slurry from 10.0 feet to ground surface. 5-foot long 6-inch protective steel sleeve, with locking cap, placed on top.

MALCOLM PIRNIE INC

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/25/86
Date End: 6/25/86

Sheet 1 of 1
Boring No: B-5
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/1/86 | 6.5' | | Overnight |

| Depth | Cas bl/ ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-1.5' | 18" | 14" | 1-2-3 | | S-1: Loose, light brown, silty sand. | |
| | | S-2 | 1.5-3.0' | 18" | 18" | 2-2-2 | | S-2: Same as S-1. | |
| | | S-3 | 3.0-4.5' | 18" | 3" | 4-7-5 | | S-3: Same as S-1. | |
| 5.0' | | S-4 | 4.5-6.0' | 18" | 12" | 6-2-1 | | S-4: Same as S-1. | |
| | | S-5 | 6.0-7.5' | 18" | 12" | 1/12-1 | | S-5: Same as S-1 with some peat. (moist) | |
| | | S-6 | 7.5-9.0' | 18" | 2" | 1/18 | | S-6: Same as S-1. (wet) | |
| 10.0' | | S-7 | 9.0-10.5' | 18" | 10" | 8-18-17 | 10.0' | S-7: Dense, medium to fine, tan to light brown silty sand. | |
| | | S-8 | 10.5-12.0' | 18" | 18" | 9-15-20 | | S-8: Same as S-7. (wet) | |
| | | S-9 | 12.0-13.5' | 18" | 10" | 3-6-12 | | S-9: Same as S-7. (wet) | |
| 15.0' | | S-10 | 13.5-15.0' | 18" | 18" | 3-13-18 | | S-10: Same as S-7. (wet) | |
| | | S-11 | 15.0-16.5' | 18" | 16" | 6-12-19 | 16.5' | S-11: Same as S-7 with some gravels. (wet) | |
| | | S-12 | 16.5-17.5' | 12" | 12" | 44-50 | | S-12: Very dense, grey, medium to fine, silty sand with gravel, trace clay. | (1) |
| | | S-13 | 18.0-19.4' | 16" | 16" | 28-33-50/4 | 19.4' | S-13: Same as S-12 (wet). | |
| 20.0' | | | | | | | | Terminated at 19.4' depth. | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

Proportions used: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

Driller: T. Gomoulka
Helper: B. Marcoux
Inspector: R. Childs

COHESIVE CONSISTENCY (tons/foot²)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 15+ | HARD |

COHESIONLESS DENSITY (blows/foot)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Remarks: (1) Pushing pebble, blow count high.

Notes:
1) The STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING GW-22D

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 3/4/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2½" hollow stem augers | SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|---|
| S-1 | 0'-2' | 1 | 2 | | | Loose, brown, SAND, trace silt, wet, MISCELLANEOUS FILL (also contains construction lumber, metal strips, and chemical products) | | |
| | | 5 | 6 | | | | | |
| S-2 | 2'-4' | 6 | 5 | | | | | |
| | | 4 | 4 | | | | | |
| S-3 | 4'-6' | 3 | 2 | | | | | |
| | | 7 | 8 | 5 | | | | |
| S-4 | 6'-8' | 8 | 9 | | | | | |
| | | 14 | 28 | | | | | |
| S-5 | 8'-10' | 8 | 9 | | | | | |
| | | 14 | 28 | 10 | | Dense brown, fine SAND, little gravel, little silt, wet | | |
| S-6 | 10'-12' | 23 | 26 | | | | | |
| | | 18 | 21 | | | | | |
| S-7 | 12'-14' | 14 | 21 | | | | | |
| | | 25 | 26 | | | | | |
| S-8 | 14'-16' | 24 | 25 | 15 | | Dense gray/brown, SAND, some silt, some gravel, moist, GLACIAL TILL | | |
| | | 19 | 19 | | | | | |
| | | | | 20 | | | | |
| | | | | 25 | | | | |
| | | | | 30 | | | | |
| | | | | 35 | | Top of Rock 36.0 feet<br>Bottom of boring, 36.0 feet | | |

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slo well screen set at 35.0 feet and backfilled with uniform medium sand to 15.0 feet. Cement-bentonite slurry from 15.0 feet to ground surfa 5-foot long 6-inch diameter protective steel sleeve, with locking ca placed on top.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/19/86
Date End: 6/20/86

Sheet 1 of ___
Boring No: B-3
Location: See Plan
Surface Elev: ___

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/24/86 | 7.3' | | Overnight |

| Depth | Cas bl/ft | Sample No. | Sample Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-1.5' | 18" | 12" | 2-7-12 | 2.0' | S-1: Loose, light brown, medium sand and gravel fill. | |
| | | S-2 | 1.5-3.0' | 18" | 8" | 20-8-4 | | S-2: Same as S-1. | |
| 5.0' | | S-3 | 3.0'-4.5' | 18" | 10" | 4-1-2 | | S-3: Peat, fine silty sand with organics. | |
| | | S-4 | 4.5-6.0' | 18" | 12" | 1-1-1 | | S-4: Same as S-3. | |
| | | S-5 | 6.0-7.5' | 18" | 6" | 1-1-1 | 7.5' | S-5: Same as S-3 with some wood chips. (moist) | (1) |
| 10.0' | | S-6 | 7.5'-9.0' | 18" | 9" | 5-4-5 | | S-6: Loose, dark brown, medium fine silty sand. (wet) | |
| | | S-7 | 9.0-10.5' | 18" | 18" | 5-5-16 | | S-7: Same as S-6. (wet) | |
| | | S-8 | 10.5-11.10' | 16" | 16" | 15-28-50/4 | 11.7' | S-8: Same as S-6. (More gray) (wet) | (2) |
| | | S-9 | 12.0-12.11' | 11" | 11" | 40-50/5 | | S-9: Very dense, grey, medium to fine silty sand with gravel (wet). | (3) |
| | | S-10 | 13.5-14.5' | 12" | 12" | 22-60 | 15.0' | S-10: Same as S-9. (wet) | (4) |
| 15.0' | | | | | | | | Terminated at 15.0' depth. | (5) |
| 20.0' | | | | | | | | | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | 30.9' | Terminated at 30.9' bedrock. | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: W. Childs

| COHESIVE CONSISTENCY (BLOWS/FOOT) | | COHESIONLESS DENSITY (BLOWS/FOOT) | |
|---|---|---|---|
| 0 - 2 | VERY SOFT | 0 - 4 | VERY LOOSE |
| 2 - 4 | SOFT | 4 - 10 | LOOSE |
| 4 - 8 | MEDIUM STIFF | 10 - 30 | MEDIUM DENSE |
| 8 - 15 | STIFF | 30 - 50 | DENSE |
| 15+ | HARD | 50+ | VERY DENSE |

Remarks: (1) Pushing piece wood, blow count higher.
(2) (3) Pushing piece of gravel, blow count high.
(4) No samples after 15.0', OK by M. Bellotti.
(5) Boulder core 26.2'-28.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/ 2/86
Date End: 7/10/86

Sheet ___ of ___
Boring No: B-90
Location: See Plan
Surface Elev: ___

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/21/86 | 0.23' | | Overnight |

| Depth | Casbl/ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-9.0' | 24" | 24" | Weight of rod. | | S-1: Peat, organics with trace silty sand. (wet) | |
| 5.0' | | | | | | | | | |
| | | | | | | | 9.0' | | |
| 10.0' | | S-2 | 9.0-10.5' | 18" | 16" | 10-10-12 | | S-2: Loose, brown to gray medium to fine silty sand. (wet) | |
| | | S-3 | 10.5-12.5' | 24" | 24" | 5-9<br>9-5 | | S-3: Same as S-2. (wet) | |
| | | S-4 | 12.5-13.5' | 12" | 10" | 1-2 | | S-4: Same as S-2. (wet) | |
| 15.0' | | | | | | | | | (1) |
| 20.0' | | S-5 | 20.0-22.0' | 24" | 14" | 7-7<br>14-26 | | | |
| | | | | | | | 21.5' | S-5: Dense, gray, medium to fine silty sand with gravel. (wet) | |
| 25.0' | | ~~S-6~~ | ~~25.0-25.5'~~ | 5" | 1" | 65/5 | | S-6: Same as S-5. (wet) | (2)<br>(3) |
| 30.0' | | | | | | | | Terminated at 29.0'. | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 15+ | HARD |

COHESIONLESS DENSITY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks: (1) Boulder at 13.8' to 18.0'. (2) Hole moved after excessive boulders at 23.0'. (3) Terminated on boulders at 29.0' with OK from M. Bellotti, 7/10/86

Notes: (4) Boulder core at 15.8'-18.8'.

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingall
Nashua, NH 03
(603) 882-3

Client: OLIN CHEMICAL — Date: 11/24/87 — Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #3 Replacement — Ground Elev.: — Date Start: 11/18/87 — Date Complete: 11/18/87 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist:

| Depth | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | No samples required. |
| 5 | | | | | | | Moist to wet, fine to medium SAND, trace inorganic silt, trace fine to medium gravel. |
| 10 | | | | | | | |
| 15 | | | | | | 15'0" | |
| | | | | | | | Wet fine to medium SAND, trace to so inorganic silt, trace fine to coarse gravel, trace cobbles. |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | Run #1 | 39'6"- | 40'6" | 8 | min./foot | 39'6" | Refusal at 39'6" with hollow stem au |
| | | 40'6"- | 41'6" | 10 | min./foot | | Run #1 CORED ROCK from 39'6" to 41'6 Recovery 14/24" = 58.3% |

Type of Boring: — Casing Size: — Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL | Date: 11/24/87 | Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #3 Replacement | Ground Elev.: | Date Start: 11/18/87 | Date Complete: 11/18/87 | Drilling Foreman: M.Z. | Eng./Hydrol. Geologist:

| Elevation | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | Run #1 | 39'6"- | 40'6" | 8 min./foot | | | Run #1 CORED ROCK from 39'6" to 41'6". |
| | | 40'6"- | 41'6" | 10 min./foot | | | Recovery 14"/24" = 58.3% |
| | | | | | | 41'6" | End of boring at 41'6" |
| | | | | | | | Water level at 7'0" upon completion |
| | | | | | | | Set well point at 41'6" |
| 45 | | | | | | | |
| | | | | | | | Well Materials; |
| | | | | | | | 1 - 2" PVC end plug |
| | | | | | | | 1 - 10' x 2" PVC screen |
| 50 | | | | | | | 3 - 10' x 2" PVC riser |
| | | | | | | | 1 - 5' x 2" PVC riser |
| | | | | | | | 1 - protective locking casing |
| | | | | | | | 1 bag - sakrete sand |
| 55 | | | | | | | 3 bags - Portland cement |
| | | | | | | | 1 pail - bentonite pellets |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |
| 75 | | | | | | | |
| 80 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 te 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 te 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and er rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Sheet # ___ of ___

148 Pioneer Dr
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION  Date: 04/18/88  Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO. GW-31 SHALLOW  Ground Elev.  Date Start 04/12/88  Date Complete 04/12/88  Drilling Foreman M.Z.  Eng./Hydrol Geologist M.B.

| Depth (ft) | Sample No. | Sample Depth (ft) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | Dry, medium brown to orange, fine SAND, trace inorganic silt, trace root matter |
| 5 | | | | | | 4'0" | Moist to wet, fine SAND, trace inorganic silt. |
| 10 | | | | | | | |
| 15 | | | | | | 14'0" | Wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles. |
| | | | | | | 16'0" | End of boring at 16'0"<br>Set 2" STAINLESS STEEL well point 16'0"<br>Water level at 8'0" upon completion |
| 20 | | | | | | | |
| 25 | | | | | | | Well Materials;<br>1 - 2" end plugs<br>1 - 10' x 2" STAINLESS STEEL screen<br>1 - 5' x 2" STAINLESS STEEL riser<br>1 - 2' x 2" STAINLESS STEEL riser<br>1 - protective locking casing<br>2 bags-sakrete sand<br>8 bags-silica sand<br>1 pail-bentonite pellets |
| 30 | | | | | | | NOTE: NO SAMPLES REQUIRED<br>Boring 3' from B-2 Deep |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring  Casing Size:  Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:**
**Date End:**

**Sheet** 1 of 2
**Boring No:** GW-37
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | 1.0' | --- | Upon Completion |

| Depth | Casing Blows/ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 4" | 1-1 | | S-1: Black peat | |
| | | | | | | 3-4 | 2.0' | | |
| | | S-2 | 2.0-4.0' | 24" | 19" | 6-7 | | S-2: Yellow-brown, medium to fine sand, trace gravel | |
| | | | | | | 7-8 | | | |
| 5.0' | | S-3 | 4.0-6.0' | 24" | 24" | 6-8 | | S-3: Same as S-2 | |
| | | | | | | 8-9 | | | |
| | | S-4 | 6.0-8.0' | 24" | 18" | 9-10 | | S-4: Same as S-2 | |
| | | | | | | 11-11 | | | |
| | | S-5 | 8.0-10.0' | 24" | 24" | 4-7 | | S-5: Gray-brown, fine sand | |
| 10.0' | | | | | | 5-6 | | | |
| | | S-6 | 10.0-12.0' | 24" | 24" | 7-6 | | S-6: Same as S-5 | |
| | | | | | | 7-7 | | | |
| | | S-7 | 12.0-13.0' | 12" | 12" | 10-10 | 13.0' | S-7: Same as S-5 | |
| | | S-7A | 13.0-14.0' | 12" | 12" | 19-27 | | S-7A: Gray-brown, fine to coarse sand, gravel and boulders | |
| 15.0' | | | | | | | | | |
| | | S-8 | 17.0-17.5' | 6" | 6" | 55-50/0" | | S-8: Same as S-7A, boulders | |
| | | | | | | | | BOULDERS | |
| 20.0' | | S-9 | 19.0-19.5' | 6" | 6" | 61-50/0" | | S-9: Yellow-brown, coarse sand, gravel, pulverized boulders | |
| | | S-10 | 21.0-21.5' | 6" | 6" | 58-50/0" | | S-10: Yellow-brown, fine to coarse sand, gravel and boulders | |
| 25.0' | | S-11 | 25.5-26.0' | 6" | 4" | 28-50/6" | | S-11: Gray-brown, fine to coarse sand, gravel and boulders | |
| | | | | | | | 27.0' | | |
| 30.0' | | | | | | | | Started to core at 27.0'<br>RUN #1 27.0-32.0' RECOVERY: 56"<br>Core Time per/foot<br>14:-12:-12:-12:-11: | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 15 - 30 | HARD |

| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES**

See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:**
**Date End:**

**Sheet** 2 **of** 3
**Boring No:** GW-37
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 32.0' | Bedrock | |
| | | | | | | | | Bottom of Exploration at 32.0' | |
| 35.0' | | | | | | | | | |
| | | | | | | | | NOTE: Made several attempts getting down through boulders. Attempt #1 augered down to 21.5' augers going at angle, due to boulders. Attempt #2 augered to 14.0' - drove casing to 23.0' used roller bit to got to 26.0' - casing at angle to much to rock core | |
| 40.0' | | | | | | | | | |
| 45.0' | | | | | | | | NOTE: Hit boulder at 21.5' depth; boulder from 21.5 to 25.0' depth' hit another boulder or bedrock from 26.0 to 27.0' depth, using spinning shoe to get through boulders. | |
| 50.0' | | | | | | | | | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 15 - 30 | HARD |

| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES** Note: Drilling water coming up green when coring rock, lost drilling water at 30.0'

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No.: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 SHALLOW — Ground Elev.: — Date Start: 04/13/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL. |
| | | | | | | 0'6" | Moist to wet, fine SAND, trace inorganic silt. |
| 5 | | | | | | | |
| 10 | | | | | | 8'6" | Wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt. |
| 15 | | | | | | 14'0" | Wet, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles. |
| | | | | | | 15'0" | End of boring at 15'0"<br>Set 2" STAINLESS STEEL well point 15'0"<br>Water level at 7'0" upon completion |
| 20 | | | | | | | |
| | | | | | | | Well Materils;<br>1 - 2" end plugs<br>1 - 10' x 2" STAINLESS STEEL screen<br>1 - 5' x 2" STAINLESS STEEL riser<br>1 bag - sakrete sand<br>7 bags - silica sand<br>1 pail - bentonite pellets<br>1 bag - Portland cement |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring — Casing Size: — Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls S
Nashua, NH 0306
(603) 882-3

Client: OLIN CHEMICAL | Date: 11/24/87 | Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #3 Replacement | Ground Elev.: | Date Start: 11/18/87 | Date Complete: 11/18/87 | Drilling Foreman: M.Z. | Eng./Hydrol. Geologist:

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | No samples required. |
| | | | | | | | Moist to wet, fine to medium SAND, trace inorganic silt, trace fine to medium gravel. |
| 5 | | | | | | | |
| 10 | | | | | | | |
| 15 | | | | | | 15'0" | |
| | | | | | | | Wet fine to medium SAND, trace to some inorganic silt, trace fine to coarse gravel, trace cobbles. |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | Run #1 | 39'6"- | 40'6" | 8 | min./foot | 39'6" | Refusal at 39'6" with hollow stem aug |
| | | 40'6"- | 41'6" | 10 | min./foot | | Run #1 CORED ROCK from 39'6" to 41'6". Recovery 14"/24" = 58.3% |

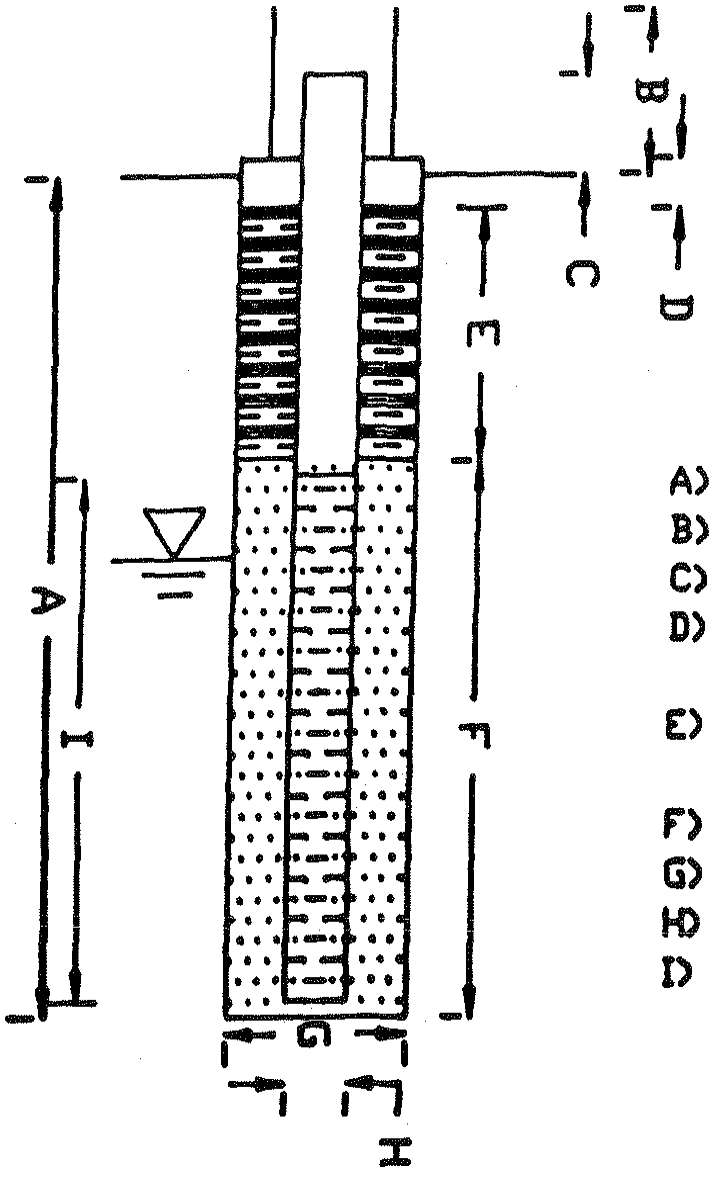
Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# MONITORING WELL DIAGRAM




A) Borehole Depth: 29.5'
B) Cover Pipe Stickup: 2.0' ±
C) Riser Pipe Stickup: 1.5' ±
D) Concrete Seal Thickness: 1.1'
E) Bentonite Seal Thickness: 14.0'
F) Sand Pack: 15.5'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: _____

Sheet 3 of 3
Boring No.: GW-37
Well No.: GW-37
Surface Elev.: _____

Sheet # ____ of ____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No. 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-31 DEEP — Ground Elev.: — Date Start: 04/11/88 — Date Complete: 04/12/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 2'0" | 2-3-4-4 | | | | Loose to medium dense, dry, fine SAND, trace inorganic silt, trace root matter. |
| | 2 | 2'0"- 4'0" | 5-5-5-6 | | | | |
| 5 | 3 | 4'0"- 6'0" | 7-6-7-8 | | | 4'0" | Medium dense, moist to wet, fine SAND, trace inorganic silt. |
| | 4 | 6'0"- 8'0" | 9-10-13-14 | | | | |
| | 5 | 8'0"- 10'0" | 7-10-9-14 | | | | |
| 10 | 6 | 10'0"- 12'0" | 7-8-10-10 | | | | |
| | 7 | 12'0"- 14'0" | 7-7-9-10 | | | | |
| 15 | 8 | 14'0"- 16'0" | 25-36-31-24 | | | 14'0" | Very dense, wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles, and boulders. |
| | 9 | 16'0"- 18'0" | 35-24-23-21 | | | | |
| | 10 | 18'0"- 20'0" | 18-28-46-51 | | | | |
| 20 | 11 | 20'0"- 20'9" | 49-120/3" | | | | |
| | Run #1 | 22'0" to 23'0" | 14 | min/foot | | 22'0" | Refusal at 22'0" with hollow stem auger Run #1 CORED ROCK from 22'0" to 27'0" Some fractures in rock, started with water return. Had total loss of water at 23'6". Recovery 25"/60" = 41.6% |
| | | 23'0" to 24'0" | 10 | " | | | |
| 25 | | 24'0" to 25'0" | 9 | " | | | |
| | | 25'0" to 26'0" | 10 | " | | | |
| | | 26'0" to 27'0" | 11 | " | | | |
| | | | | | | 27'0" | End of boring at 27'0" Set 2" STAINLESS STELL well point 22'0" Water level at 7'3" upon completion Well Materials; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 10' x 2" STAINLESS STEEL riser 1 - 2' x 2" STAINLESS STEEL riser 1 - protective locking casing 1 bag- sakrete sand 7 bags-silica sand 1 pail-bentonite pellets 1 bag -bentonite powder 3 bags-Portland cement |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No.: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-31 SHALLOW — Ground Elev.: — Date Start: 04/12/88 — Date Complete: 04/12/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | Dry, medium brown to orange, fine SAND, trace inorganic silt, trace root matter |
| 5 | | | | | | 4'0" | Moist to wet, fine SAND, trace inorganic silt. |
| 10 | | | | | | | |
| 15 | | | | | | 14'0" | Wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles. |
| 20 | | | | | | 16'0" | End of boring at 16'0"<br>Set 2" STAINLESS STEEL well point 16'0"<br>Water level at 8'0" upon completion<br><br>Well Materials;<br>1 - 2" end plugs<br>1 - 10' x 2" STAINLESS STEEL screen<br>1 - 5' x 2" STAINLESS STEEL riser<br>1 - 2' x 2" STAINLESS STEEL riser<br>1 - protective locking casing<br>2 bags-sakrete sand<br>8 bags-silica sand<br>1 pail-bentonite pellets<br><br>NOTE: NO SAMPLES REQUIRED<br><br>Boring 3' from B-2 Deep |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: — Hollow Stem Auger Size: 6¼

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No. 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 DEEP — Ground Elev.: — Date Start: 04/11/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL. |
| | 1 | 0'6"- 2'6" | 2-3-3-4 | | | 0'6" | Loose, dry, fine SAND, trace inorganic silt. |
| | 2 | 2'6"- 4'6" | 3-3-4-4 | | | | |
| 5 | 3 | 4'6"- 6'6" | 7-10-11-11 | | | 4'6" | Medium dense, moist to wet, fine SAND, trace inorganic silt. |
| | 4 | 6'6"- 8'6" | 10-11-12-13 | | | | |
| | 5 | 8'6"- 10'0" | 11-12-16 | | | 8'6" | Medium dense to dense, wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt. |
| 10 | 6 | 10'0"- 12'0" | 7-10-17-21 | | | | |
| | 7 | 12'0"- 14'0" | 12-14-16-17 | | | | |
| 15 | 8 | 14'0"- 16'0" | 43-40-24-30 | | | 14'0" | Very dense, wet, light grey to brown, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles, and boulders. |
| | 9 | 16'0"- 18'0" | 28-32-35-28 | | | | |
| | 10 | 18'0"- 20'0" | 13-12-13-20 | | | | |
| 20 | 11 | 20'0"- 22'0" | 21-16-47-20 | | | | |
| | 12 | 22'0"- 24'0" | 14-21-34-30 | | | 22'0" | Very dense, wet, fine to coarse SAND, and gravel, some cobbles, and inorganic silt. |
| 25 | 13 | 24'0"-25'10" | 29-38-33-120/4" | | | 24'0" | Very dense, wet, fine SAND, some inorganic silt, trace to some fine to coarse gravel, trace cobbles & boulders. |
| | Run #1 | 26'0"- | 27'0" 12 min./foot | | | 26'0" | Refusal at 26'0" with hollow stem auger<br>Run #1 CORED ROCK from 26'0" to 31'0"<br>Trace to some fractures, no loss of water.<br>Recovery 44"/60" = 73.3% |
| | | 27'0"- | 28'0" 15 | " | | | |
| | | 28'0"- | 29'0" 10 | " | | | |
| 30 | | 29'0"- | 30'0" 9 | " | | | |
| | | 30'0"- | 31'0" 11 | " | | | |
| | Well Materials; | | | | | 31'0" | End of boring at 31'0"<br>Set 2" STAINLESS STEEL well point 31'0"<br>Water level at 7'0" upon completion |
| | 1 - 2" end plugs | | | | | | |
| | 1 - 10' x 2" | | STAINLESS STEEL | | screen | | |
| 35 | 2 - 10' x 2" | | STAINLESS STEEL | | riser | | |
| | 1 - 2' x 2" | | STAINLESS STEEL | | riser | | |
| | 1 - protective locking casing | | | | | | |
| | 1 bag - sakrete sand | | | | | | |
| | 5 bags- silica sand | | | | | | |
| 40 | 1 pail- bentonite pellets | | | | | | |
| | 1 bag - bentonite powder | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6½ HSA & NX Core (2 1/8")

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

GW30DR

Sheet # ___ of ___

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/24/87 — Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #3 Replacement — Ground Elev.: — Date Start: 11/18/87 — Date Complete: 11/18/87 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist:

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | Run #1 | 39'6"- | 40'6" 8 min./foot | | | | Run #1 CORED ROCK from 39'6" to 41'6". |
| | | 40'6"- | 41'6" 10 min./foot | | | | Recovery 14"/24" = 58.3% |
| | | | | | | 41'6" | End of boring at 41'6" |
| | | | | | | | Water level at 7'0" upon completion |
| 45 | | | | | | | Set well point at 41'6" |
| | | | | | | | Well Materials; |
| | | | | | | | 1 - 2" PVC end plug |
| | | | | | | | 1 - 10' x 2" PVC screen |
| 50 | | | | | | | 3 - 10' x 2" PVC riser |
| | | | | | | | 1 - 5' x 2" PVC riser |
| | | | | | | | 1 - protective locking casing |
| | | | | | | | 1 bag - sakrete sand |
| 55 | | | | | | | 3 bags - Portland cement |
| | | | | | | | 1 pail - bentonite pellets |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |
| 75 | | | | | | | |
| 80 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 8" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

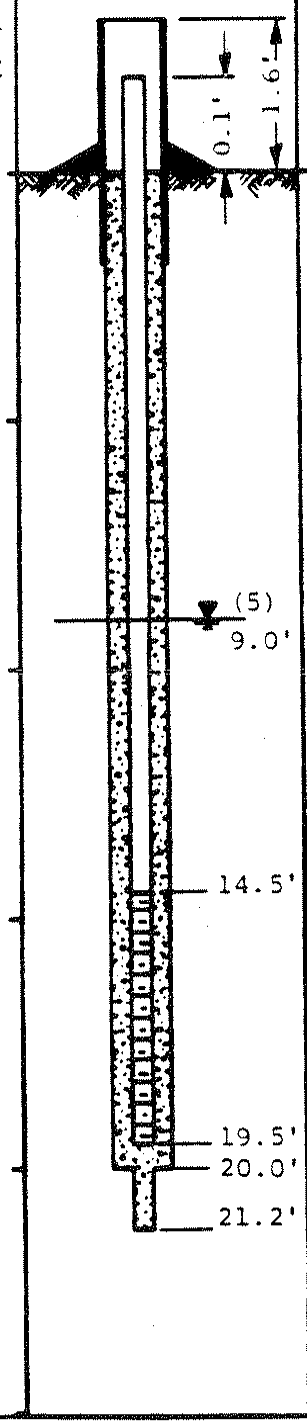
The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 1 | Date Installed: Oct. 26, 1977

Permeability(1) : $2 \times 10^{-2}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 87.8 | 0 | SS-1 | 2-6-7-7 | 17 | SS-1<br>∿8" Brown sandy loam.<br>∿2" Light brown gravelly sand.<br>∿1" Black medium sand<br>∿6" Light brown gravelly sand. |
| 82.8 | 5 | SS-2 | 5-1-1-1 | 5 | SS-2<br>Top 5" - light brown fine to coarse sand. Lost bottom 18". |
| | | SS-3 (overdrove 12") | 1/12" 1/12" 1/12" | 6 | |
| 77.8 | 10 | SS-4 | 2-1-1-4 | 9 | SS-3<br>∿2" Black organic fine sand.<br>∿4" Light brown fine to coarse sand.<br>SS-4<br>∿7" Gray-brown fine sand.<br>∿2" Black fibrous, organic medium sand. |
| 72.8 | 15 | SS-5 | 15-12-22-65 | 9 | SS-5<br>Tan-brown sandy gravel. Gravel is angular to sub-angular and up to ∿1 3/8" in size. |
| 67.8 | 20 | SS-6 | 48-44-100/2" | 6 | SS-6<br>Coarse sand and gravel. Gravel is angular and up to ∿1 3/8" in size. |
| 62.8 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of six measurements taken from November 2, 1977 to May 31, 1978.

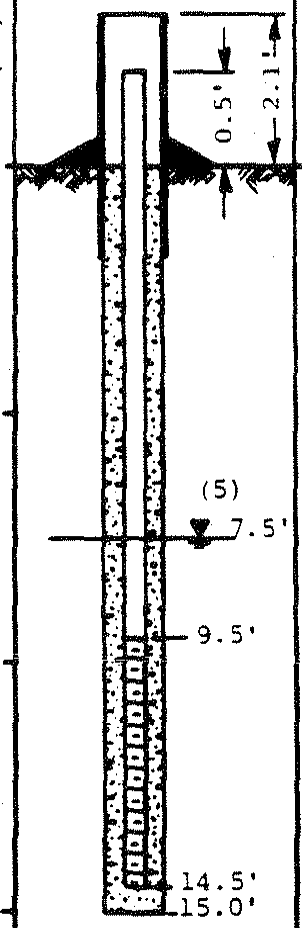
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 2 Date Installed: Nov. 1, 1977

Permeability(1) : 9 x $10^{-3}$ cm/sec Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 87.6 | 0 | | | | |
| | | SS-1 | 1-2-2-2 | 13 | SS-1<br>∿1" Humus.<br>∿12" Black silty fine sand with roots and fibers. Slight organic odor. |
| | | SS-2 | 5-8-10-10 | 18 | |
| 82.6 | 5 | SS-3 | 8-10-13-17 | 17 | SS-2<br>Yellow-tan fine sand. |
| | | SS-4 | 11-13-16-18 | 17 | SS-3<br>∿6" Gray fine sand.<br>∿4" Yellow medium sand.<br>∿7" Yellow-gray fine sand. |
| | | SS-5 | 11-11-12-14 | 15 | SS-4<br>Yellow-gray fine sand. |
| 77.6 | 10 | | | | |
| | | SS-6 | 29-37 | 7 | SS-5<br>Olive gray fine sand; strong odor. |
| 72.6 | 15 | * | | | SS-6<br>Brown gravelly fine to coarse sand.<br><br>*Refusal of chopping bit. |
| 67.6 | 20 | | | | |
| 62.6 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

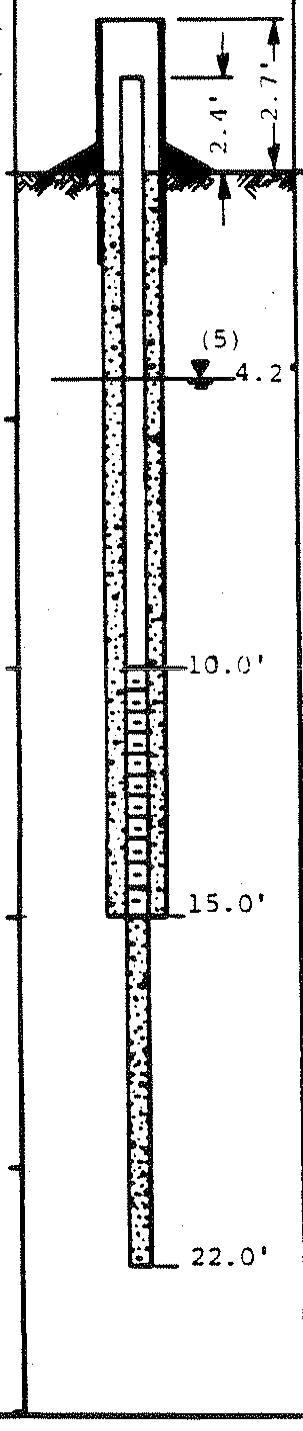
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 3 | Date Installed: Nov. 1, 1977

Permeability(1) : $2 \times 10^{-4}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 85.4 | 0 | SS-1A<br>SS-1B | 2-2-6-10 | 16 | SS-1A<br>~6" Dark gray fine sand and humus.<br>SS-1B<br>~10" Gray fine sand; slight odor similar to that of lagoons. |
| | | SS-2 | 26-37-43 | 15 | SS-2<br>Yellow-brown fine sand; slight chemical odor. |
| 80.4 | 5 | SS-3 | 26-38-31-32 | 21 | SS-3<br>Olive-brown silty fine sand. |
| 75.4 | 10 | SS-4A<br>SS-4B | 7-8-13-27 | 16 | SS-4A<br>~10" Yellow-brown fine sand; slight chemical odor.<br>SS-4B<br>~6" Gray and black micaceous sand and gravel. Gravel is angular to sub-rounded. |
| 70.4 | 15 | SS-5 | 50-40-42-41 | 15 | SS-5<br>Olive gray silty fine sandy gravel. Gravel is black and angular up to ~1/2" in size. Trace of mica flakes. |
| 65.4 | 20 | * | | | *Drove open-ended "A" rod with 200 lb weight. Refusal at 22'; 120 blows/0.5" |
| 60.4 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

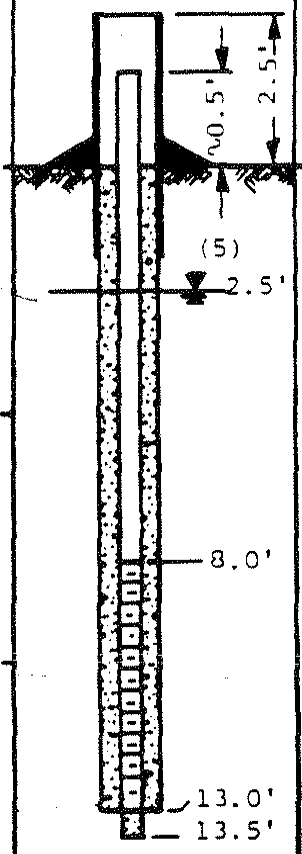
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 4 | Date Installed: Oct. 31, 1977

Permeability(1) : $5 \times 10^{-4}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 79.8 | 0 | SS-1 | 1-1-1-1 | 24 | SS-1<br>~3" Humus.<br>~21" Olive-brown fine sand. |
| | | SS-2 | 1-5-7-8 | 15 | SS-2<br>~6" Slightly sandy humus.<br>~9" Olive-brown slightly silty fine sand. |
| 74.8 | 5 | SS-3 | 9-12-16-17 | 15 | SS-3<br>Light olive-brown slightly silty fine to very fine sand. |
| 69.8 | 10 | SS-4 | 6-29-57-29 | 11 | SS-4<br>Tan silty very fine sand. |
| | | SS-5 | 60/6" | 3 | SS-5<br>Black angular rock fragments up to ~3/4" in size. |
| 64.8 | 15 | | | | |
| 59.8 | 20 | | | | |
| 54.8 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

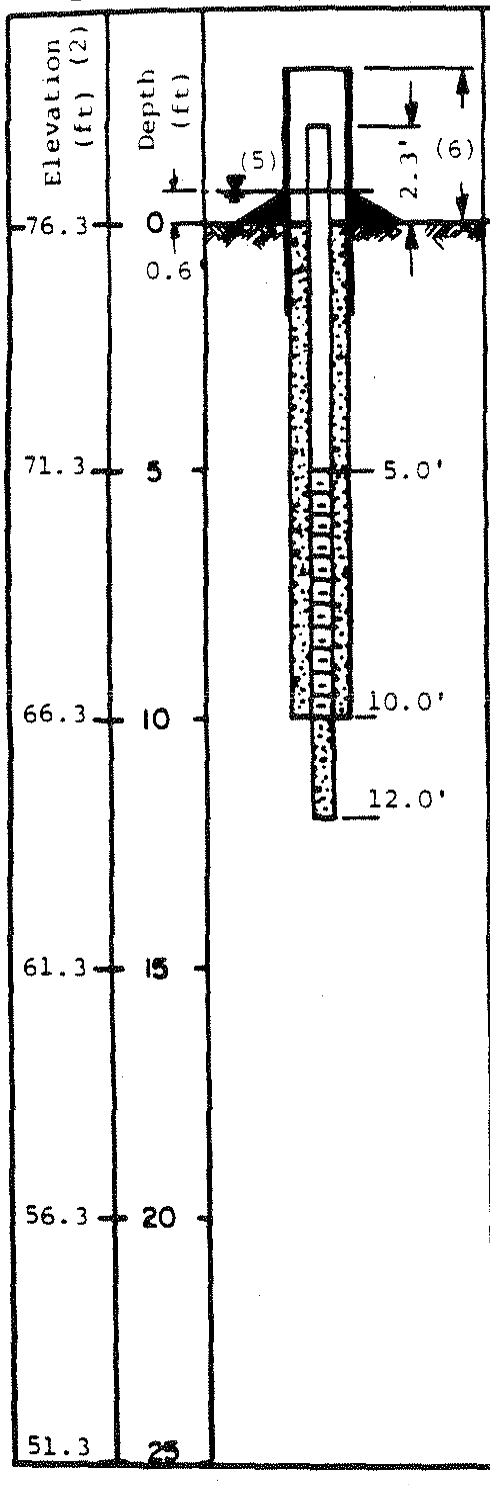
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 5 | Date Installed: Oct. 31, 1977

Permeability(1) : 6. x $10^{-3}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 76.3 | 0 | SS-1 | 1-1-1-1 | 12 | SS-1<br>Black sandy humus. |
| | | SS-2A<br>SS-2B | 1-1-2-4 | 15 | SS-2A<br>∿7" Dark gray silty fine sand; organic odor.<br>SS-2B<br>∿8" Dark gray silty fine sand; no odor. |
| 71.3 | 5 | SS-3 | 7-8-11-12 | 14 | SS-3<br>Gray-brown slightly silty fine sand. |
| 66.3 | 10 | SS-4 | 31-26-23-49 | 13 | SS-4<br>Gray slightly silty sand and gravel. Gravel is angular to subangular up to ∿3/4" in size. |
| 61.3 | 15 | | | | No refusal |
| 56.3 | 20 | | | | |
| 51.3 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.

(5) Groundwater level is the average of five measurements taken from November 2, 1977 to May 31, 1978. Water was not ponded around surface casing at time of measurements.

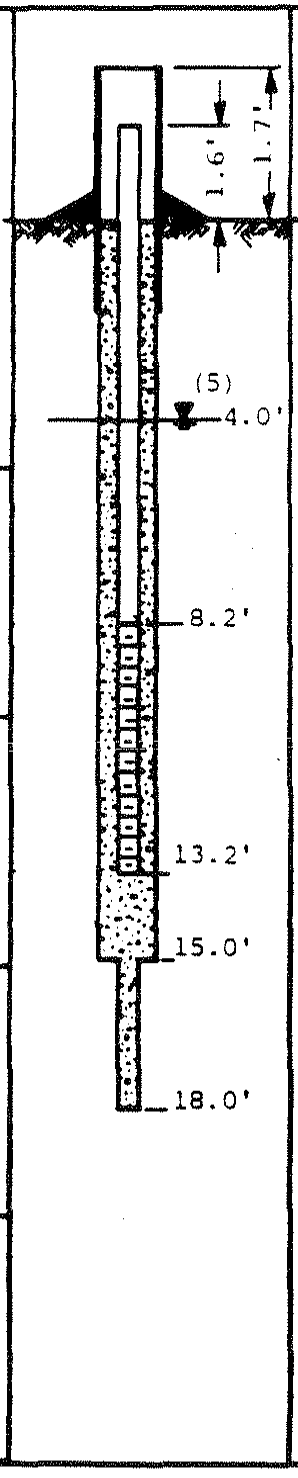
(6) Prior to May 31, 1978, distance from ground surface to top of casing was 3.4'. Casing was removed to perform permeability test and replaced to present "Stickup" of 3.1'.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 6 | Date Installed: Oct. 28, 1977

Permeability[1] : $1 \times 10^{-4}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 87.2 | 0 | SS-1 | 3-4-7-7 | 15 | SS-1<br>∿10" Dark brown loamy fine sand.<br>∿5" White fine material in layers. Similar to that in adjacent lagoon; strong ammonia odor. |
| | | SS-2 | 7-6-9-8 | 12 | SS-2<br>Dark brown loamy sand grading into black fine sand; strong odor. |
| 82.2 | 5 | SS-3 | 11-14-15-16 | 12 | SS-3<br>Yellow-brown slightly silty fine sand; strong ammonia odor. |
| 77.2 | 10 | SS-4 | 12-14-16-15 | 11 | SS-4<br>Similar to SS-3 with slight amount of gravel up to ∿½" in size. Odor similar to that of lagoons, less ammonia odor. |
| 72.2 | 15 | SS-5 | 10-45-39-89/5" | 7 | SS-5<br>Top - Silty fine sand. Bottom - Dark brown micaceous fine sand. Tip of spoon plugged with silty fine sand and piece of gravel ∿1 3/8" in size. |
| 67.2 | 20 | | | | |
| 62.2 | 25 | | | | |

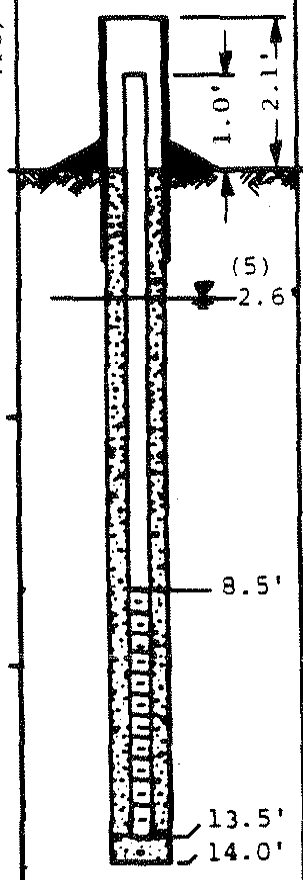
Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 7 | Date Installed: Oct. 27, 1977

Permeability(1) : $2 \times 10^{-4}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 82.7 | 0 | SS-1 | 1-1-1-1 | 12 | SS-1<br>Sandy peat. |
| 77.7 | 5 | SS-2 | 67-47-33-37 | 15 | SS-2<br>Sand and gravel mixed with fines similar to material in lagoons. Odor similar to odor of material in lagoons. |
| 72.7 | 10 | SS-3 | 35-21-47-60/3" | 14 | SS-3<br>Similar to SS-2 except more natural fine material; strong odor. |
| 67.7 | 15 | * | | | *120 blows on split spoon with 140 lb weight; no penetration. |
| 62.7 | 20 | | | | |
| 57.7 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 9

Permeability(1) :

Date Installed: -

Project No. : 77348

Soils Described by R. Gardner, GEI

| Elevation (ft) (2) | Depth (ft) | | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|---|
| | 0 | Well Not Installed | SS-1A<br>SS-1B | 5-7-6-17 | 10 | SS-1A<br>~5" Brown loamy fine to coarse sand. Trace of gravel.<br>SS-1B<br>~5" Tan silty fine sand. Trace of medium to coarse sand, gravel and mica flakes. |
| | 5 | | * | | | |
| | 10 | | | | | *Drilled rock - BX core.<br>100% recovery<br>RQD = 0%<br>Upper 12" is massive<br>Lower 18" is very broken.<br>Some high angle joints. |
| | 15 | | | | | |
| | 20 | | | | | |
| | 25 | | | | | |

Notes: (1) Not applicable.
(2) Not surveyed.
(3), (4) See first page of Appendix A for additional information.

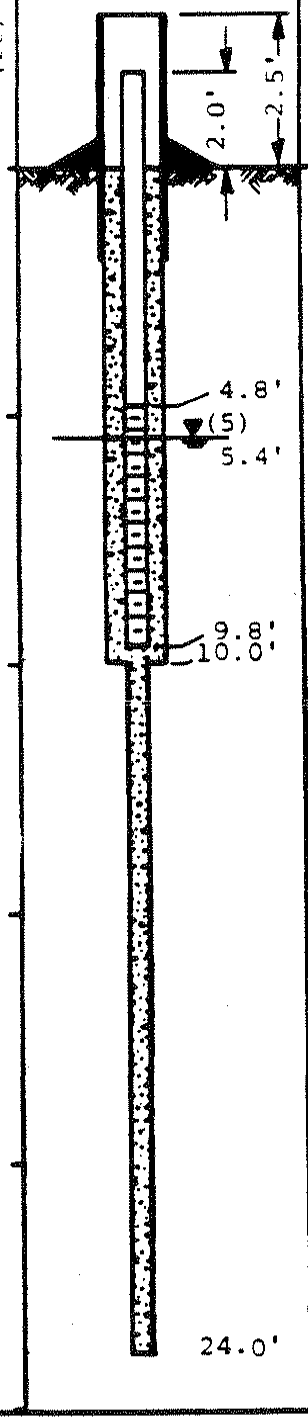
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 10 | Date Installed: Nov. 2, 1977

Permeability(1) : 1. x $10^{-2}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 87.1 | 0 | SS-1A<br>SS-1B | 1-1-1-2 | 14 | SS-1A<br>∿4" Black sandy humus.<br>SS-1B<br>∿10" Orange-brown fine sand; slight organic odor. |
| | | SS-2A<br>SS-2B | 4-6-12-20 | 13 | SS-2A<br>∿6" Similar to SS-1B<br>SS-2B<br>∿7" Similar to SS-1B except for presence of subangular gravel up to 1/2" in size. |
| 82.1 | 5 | SS-3 | 40-85 | 8 | SS-3<br>Yellow-tan silty fine sand. |
| | | * | | | *Drove open-ended "A" rod with 200-lb weight. Recovered slightly silty sand and gravel. |
| 77.1 | 10 | | | | |
| | | ** | | | **Drove open-ended "A" rod with 200-lb weight. No refusal. Recovered silty medium to coarse sand with material similar to that in nearby lagoon. |
| 72.1 | 15 | | | | |
| 67.1 | 20 | | | | |
| 62.1 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/10/86
Date End: 7/11/86

Sheet 1 of 1
Boring No: B-3
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/21/86 | 32" | -- | Upon Completion |

| Depth | Cas bl/ ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-6.5' | 18" | 18" | Weight of rod. | | S-1: Peat, organics with trace silt and sand. (moist) | |
| 5.0' | | | | | | | | | |
| | | S-2 | 6.5-8.0' | 18" | 18" | 15-29-29 | 7.4' | S-2: Medium dense, medium brown silty sand. (moist) | |
| | | S-3 | 8.0-9.5' | 18" | 12" | 4-2-6 | | S-3: Same as S-2. (wet) | |
| 10.0' | | S-4 | 9.5-11.0' | 18" | 18" | 3-5-9 | | S-4: Same as S-2. (wet) | |
| | | S-5 | 11.0-12.5' | 18" | 18" | 5-9-11 | | S-5: Same as S-2. (wet) | |
| | | S-6 | 12.5-14.0' | 18" | 18" | 4-6-9 | | S-6: Same as S-2. (wet) | |
| 15.0' | | S-7 | 14.0-15.5' | 18" | 18" | 7-8-11 | | S-7: Same as S-2. (wet) | |
| | | S-8 | 15.5-17.0' | 18" | 18" | 5-8-12 | | S-8: Same as S-2. (wet) | |
| | | S-9 | 17.0-19.5' | 6" | 2" | 50/6-50/0 | 17.0' | S-9: Very dense, grey, silty sand with gravel (wet). | (1) |
| 20.0' | | S-10 | 22.0-22.0' | 0" | 0" | 50/0 | | S-10: Boulder, no penetration. | |
| 25.0' | | | | | | | | Terminated at 27.2' on bedrock. | (2) |
| 30.0' | | | | | | | | | (3) |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 30+ | HARD |

COHESIONLESS DENSITY (BLOWS/FOOT)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: M. D'Ambrosio
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) Pushing stone for high blow count.
(2) Hole terminated at 27.5' - lost wrench moved 2'.
(3) Hole terminated at 27.4', lost shoe, moved another 2'.

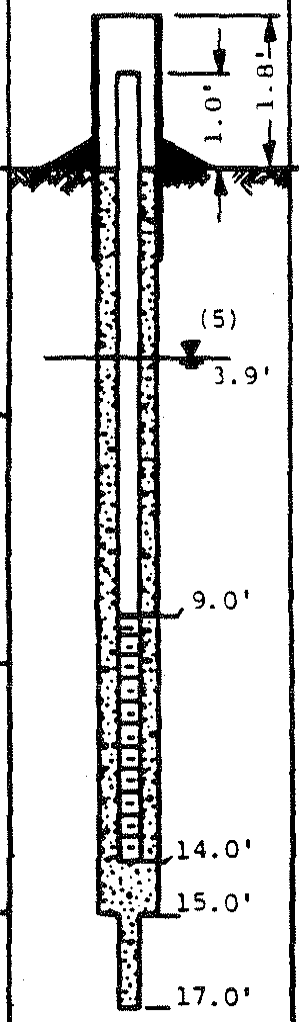
Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 11 | Date Installed: Oct. 31, 1977

Permeability(1) : $5 \times 10^{-4}$ cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI




| Elevation (ft) (2) | Depth (ft) | Split Spoon Sample No. and Location | Blows per 6" (3) | Rec. (in.) (4) | Sample Description |
|---|---|---|---|---|---|
| 85.6 | 0 | | | | |
| | | SS-1 | 1-2-3-3 | 11 | SS-1 Gray-brown sand and gravel mixed with material similar to that in lagoons. |
| | | SS-2 | 1/12"-1-1 | 4 | |
| 80.6 | 5 | SS-3 | 1-1 | 11 | SS-2 Dark brown slightly sandy forest mulch. |
| | | SS-4 | 3-4-4-4 | 11 | SS-3 Similar to SS-2. |
| 75.6 | 10 | | | | SS-4 Gray to olive-brown slightly silty fine sand. |
| | | SS-5 | 6-8-8-10 | 13 | SS-5 Gray-brown slightly silty fine sand; odor similar to that in lagoons. |
| 70.6 | 15 | SS-6 | 36-45-28-34 | 16 | SS-6 Brown silty sand and gravel. Gravel up to ~1" in size. |
| | | | | | No refusal. |
| 65.6 | 20 | | | | |
| 60.6 | 25 | | | | |

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT [illegible]
- ☐ NEW HAVEN, CT 203 [illegible]
- ☐ NEW LONDON, CT. 203.443-[illegible]
- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA. 215-563-94[illegible]

Page _____ of _____

Date December 7th, 1990

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No. 7 (GW15

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery In | Lost Water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 3' | Brown sand stained | | | | | | | | | | |
| | | with Product | | | | | | | | | | |
| 3' | 10' | Brown sand, fine to | | | | | | | | | | |
| | | medium grade | | | | | | | | | | |
| 10' | 19' | Brown sand, small to | | | | | | | | | | |
| | | medium boulder | | | | | | | | | | |
| 19' | 19'6" | Refusal | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | 3" PVC slotted well | | | | | | | | | | |
| | | installed | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203/852-[illegible]
- ☐ NEW HAVEN, CT 203/777-[illegible]
- ☐ NEW LONDON, CT. 203/443-[illegible]
- ☐ NEWARK, N.J. 201/589-12[illegible]
- ☐ PHILADELPHIA, PA. 215/563-[illegible]

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address Clin Corp. Willmington, Mass.

Boring No. 11 (GW

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 8' | Light brown sand fine | | | | | | | | | | |
| | | to medium grade | | | | | | | | | | |
| 10' | 14'6" | Light brown sand fine | | | | | | | | | | |
| | | to medium grade small | | | | | | | | | | |
| | | to medium boulders | | | | | | | | | | |
| 14'6" | 15' | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. Ro[illegible]

Rig. No. 21

BORING GW-17S

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 3/4/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem augers | SAMPLING METHOD: None taken |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | SAMPLE blows per 6" | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | 5 | | | | |
| | | | 10 | | | | |
| | | | 15 | | | | |
| | | | 20 | | | | |
| | | | 25 | | | | |
| | | | 30 | | | | |
| | | | 35 | | | | |
| | | | | | Bottom of boring 8.0 feet | | |

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slot well screen set at 8.0 feet and backfilled with medium uniform sand to 2.0 feet. Cement-bentonite slurry from 2.0 feet to ground surface 5-foot long 6-inch diameter protective steel sleeve, with locking cap placed on top.

BORING GW-16S

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 2/25/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem augers | SAMPLING METHOD: None taken |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | SAMPLE blows per 6" | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMA |
|---|---|---|---|---|---|---|---|
| | | | 5 | | | | |
| | | | 10 | | Bottom of boring 10.0 feet | | |
| | | | 15 | | | | |
| | | | 20 | | | | |
| | | | 25 | | | | |
| | | | 30 | | | | |
| | | | 35 | | | | |

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slo well screen set at 10.0 feet and backfilled with medium uniform sand to 3.0 feet. Cement-bentonite slurry from 3.0 feet to ground surfa 5-foot long 6-inch diameter protective steel sleeve, with locking ca placed on top.

BORING GW-19S

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 2/12/81 | LOCATION: Wilmington, CA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem augers | SAMPLING METHOD: None taken |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | SAMPLE blows per 6" | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | 5 | | | | |
| | | | 10 | | Bottom of boring 10.0 feet | | |
| | | | 15 | | | | |
| | | | 20 | | | | |
| | | | 25 | | | | |
| | | | 30 | | | | |
| | | | 35 | | | | |

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slo well screen set at 10.0 feet and backfilled with medium uniform sand to 3.5 feet. Cement-bentonite slurry from 3.5 feet to ground surface 5-foot long 6-inch diameter protective steel sleeve, with locking ca placed on top.

SHEET 1 OF 1

MALCOLM PIRNIE INC.

BORING GW-20

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 2/26/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem | SAMPLING METHOD: 2" split spoon |
| augers | 300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|---|
| S-1 | 0'-2' | 1 | 0 | | | Top soil and roots, 0.0'-1.0 feet | | |
| | | 4 | 12 | | | Medium dense, brown, SAND, some gravel, trace silt, moist Grading to dense, SAND and GRAVEL trace silt | | |
| S-2 | 2'-4' | 25 | 23 | | | | | |
| | | 17 | 15 | | | | | |
| S-3 | 4'-5.5' | 10 | 18 | | | | | |
| | | 40 | | 5 | | Very dense, gray/brown, SAND some silt, some gravel, moist, GLACIAL TILL | | |
| | | | | 10 | | | | |
| | | | | 15 | | Top of Rock 15.0 feet<br>Run 1, 15.0'-16.5' Run 15. feet<br>Recover 1.0', 67% recovery<br>Run 2, 16.5'-21.5' Run 5.0' Recover 3.9', 68% recovery | | |
| | | | | 20 | | | | |
| | | | | | | Bottom of boring 21.5 feet | | |
| | | | | 25 | | | | |
| | | | | 30 | | | | |
| | | | | 35 | | | | |

NOTES: Monitoring well installed. Cement-bentonite slurry from 15.0' to 21.5' Tip of 5.0 foot 0.010-inch machine slotted well screen set at 14.7' feet and backfilled with medium uniform sand to 8.0 feet. Ce bentonite slurry from 8.0 feet to ground surface. 5-foot long 6-inc diameter protective steel sleeve, with locking cap, placed on top.

BORING GW-21

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 3/5/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2½" hollow stem augers | SAMPLING METHOD: 2" split spoon<br>300 lb. hammer with 24" drop |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | blows per 6" | | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMARKS |
|---|---|---|---|---|---|---|---|---|
| S-1 | 0'-2' | 1 | 0 | | | Very loose, dark brown, PEAT, little sand, wet | | |
| | | 0 | 0 | | | | | |
| S-2 | 2'-4' | 5 | 6 | | | Medium dense, brown, SAND, trace silt, wet | | |
| | | 5 | 6 | | | | | |
| S-3 | 4'-6' | 9 | 11 | 5 | | Dense, brown/gray SAND, some SILT, some gravel, moist GLACIAL TILL | | |
| | | 12 | 11 | | | | | |
| | | | | 10 | | | | |
| | | | | 15 | | Top of Rock 15.0 feet<br>Run 1, 15.0'-17.5' Run 2.5' Recover 2.5', 100% recovery<br>Run 2, 17.5'-20.0' recover 2.0' 80% recovery | | |
| | | | | 20 | | Bottom boring, 20.0 feet | | |
| | | | | 25 | | | | |
| | | | | 30 | | | | |
| | | | | 35 | | | | |

NOTES: Monitoring well installed. Cement-bentonite slurry from 15.0' to 20.0' Tip of 5.0 foot 0.010-inch machine slotted pipe well screen se at 14.5' feet and backfilled with uniform medium sand to 4.0 feet. Cement-bentonite slurry from 4.0 feet to ground surface. 5-foot long inch protective steel sleeve, with locking cap, placed on top.

BORING GW-22S

| | |
|---|---|
| PROJECT: Olin-Wilmington | PROJECT NO: 284-10-1E00 |
| DATE: 3/5/81 | LOCATION: Wilmington, MA |
| DRILLING CONTRACTOR: Soil Exploration | INSPECTOR: CA Kraemer |
| DRILLING METHOD: 2¼" hollow stem augers | SAMPLING METHOD: None taken |
| ELEVATION: | DATUM: |

| SAMPLE no. | SAMPLE depth | SAMPLE blows per 6" | DEPTH | STRATA | SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN | WELL CONST. | REMAR |
|---|---|---|---|---|---|---|---|
| | | | 5 | | | | |
| | | | 10 | | | | |
| | | | 15 | | Bottom of boring 15.0 feet | | |
| | | | 20 | | | | |
| | | | 25 | | | | |
| | | | 30 | | | | |
| | | | 35 | | | | |

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine s
well screen set at 15.0 feet and backfilled with medium uniform sand
to 8.0 feet. Cement-bentonite slurry from 8.0 feet to ground surfac
5-foot long 6-inch diameter protective steel sleeve, with locking
placed on top.

# TEST BORING LOGS GW27

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/19/86
Date End: 6/19/86

Sheet 1 of 1
Boring No: B-2
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/20/86 | 7.2' | | Overnight |

| Depth | Cas bl/ ft | Sample No. | Sample Depth | Sample Pen. | Sample Rec. | Sample Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| 5.0' | | | | | | | 12.0' | Dark brown - gray, medium to fine sand. | (1) |
| 10.0' | | | | | | | 20.0' | Dark to light gray, medium to fine sand with gravels. (wet) | |
| 15.0' | | | | | | | | | |
| 20.0' | | | | | | | | Terminated at 20'. | |
| 25.0' | | | | | | | | | (2) |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (tons/sq ft)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 30+ | HARD |

COHESIONLESS DENSITY (blows/6 in)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Comoulka
Helper: B. Marcoux
Inspector: B. Childs

Remarks:
(1) No samples required.
(2) Hole moved after auger lost down hole at 13.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

| | |
|---|---|
| Project: | OLIN CHEMICAL, Wilmington, MA |
| Project No: | 60321.01 |
| Date Start: | 6/27/86 |
| Date End: | 6/27/86 |
| Sheet | 1 of 1 |
| Boring No: | B-6S |
| Location: | Sue Plan |
| Surface Elev: | |

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | |
| SIZE: | 2 1/4" ID | |
| HAMMER: | --- | |
| FALL: | --- | |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/30/86 | 0.6' | | Overnight |

| Depth | Cas bl/ft | Sample No. | Sample Depth | Sample Pen. | Sample Rec. | Sample Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 4.2' | Organic peat with trace fine sand and silt. | (1) |
| 5.0' | | | | | | | 12.0' | Gray, medium to fine sand and silt with gravel. (wet) | |
| 10.0' | | | | | | | | Terminated at 12.0'. | |
| 15.0' | | | | | | | | | |
| 20.0' | | | | | | | | | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

| COHESIVE CONSISTENCY (blows/foot) | | COHESIONLESS DENSITY (blows/foot) | |
|---|---|---|---|
| 0 - 2 | VERY SOFT | 0 - 4 | VERY LOOSE |
| 2 - 4 | SOFT | 4 - 10 | LOOSE |
| 4 - 8 | MEDIUM STIFF | 10 - 30 | MEDIUM DENSE |
| 8 - 15 | STIFF | 30 - 50 | DENSE |
| 50+ | HARD | 50+ | VERY DENSE |

Driller: T. Gomoulka

Helper: R. Marcoux

Inspector: B. Childs

Remarks: (1) No samples required.

Notes:

1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/26/86
Date End: 6/27/86

Sheet 1 of 1
Boring No: B-2D
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/27/86 | 0.6' | ---- | Overnight |

| Depth | Cas bl/ ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-1.5' | 18" | 12" | 1/12-7 | | S-1: Organic peat, trace fine sand and silt. (moist). | |
| | | S-2 | 1.5-3.0' | 18" | 12" | 2-10-12 | | S-2: Same as S-1. (wet) | |
| | | S-3 | 3.0-4.5' | 18" | 12" | 32-19-50 | 3.8' | S-3: Very dense, brown, medium to fine silty sand (wet). | |
| | | | | | | | 4.2' | | |
| 5.0' | | S-4 | 4.5-5.5' | 12" | 6" | 40-50 | | S-4: Very dense, medium to fine, grey, silty sand with gravel (wet). | (1) |
| 10.0' | | S-5 | 10.0-10.8' | 8" | 4" | 24-50/2 | | S-5: Same as S-4. (wet) | (2) |
| | | | | | | | 14.3' | | |
| 15.0' | | | | | | | | Terminated at 14.3' on bedrock. | |
| 20.0' | | | | | | | | | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | (3) |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (tons/foot²)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 30+ | HARD |

COHESIONLESS DENSITY (blows/foot)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Comoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) To threaded casing 300 ft. hammer at 6.0'.
(2) Pushing pebble, high blow count.
(3) Hole moved after excessive boulders at 14'.
(4) Boulder core at 11.0-12.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/3/86
Date End: 7/3/86

Sheet 1 of 1
Boring No: B-9S
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/21/86 | 0.22' | | Overnight |

| Depth | Cas bl/ ft | Sample No. | Sample Depth | Sample Pen. | Sample Rec. | Sample Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Peat, organics with trace of fine silty sand. | (1) |
| 5.0' | | | | | | | | | |
| 10.0' | | | | | | | 9.0' | | |
| | | | | | | | | Brown to gray, medium to fine silty sand. | |
| | | | | | | | 14.0' | | |
| 15.0' | | | | | | | | Terminated at 14.0'. | |
| 20.0' | | | | | | | | | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (ft.tons/sqft)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 30+ | HARD |

COHESIONLESS DENSITY (ft.tons/sqft)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) No samples needed.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/1/86
Date End: 7/2/86

Sheet 1 of 1
Boring No: B-7S
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | |
| SIZE: | 2 1/4" ID | |
| HAMMER: | --- | |
| FALL: | --- | |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 7/1/86 | 9.0' | ----- | Overnight. |

| Depth | Cas bl/ft | Sample No. | Sample Depth | Sample Pen. | Sample Rec. | Sample Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| 5.0' | | | | | | | 8.0' | Medium to fine, light brown, silty sand with gravels. (fill) | (1) |
| 10.0' | | | | | | | 10.0' | Peat organics with silty sand. (moist) | |
| | | | | | | | 13.0' | Light to dark brown, medium to fine silty sand. (wet) | |
| 15.0' | | | | | | | 19.0' | Gray, medium to fine, silty sand with gravels. (wet) | |
| 20.0' | | | | | | | | Terminated at 19.0'. | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

COHESIVE CONSISTENCY (Blows/foot)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 30+ | HARD |

COHESIONLESS DENSITY (Blows/foot)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Remarks: (1) No samples needed.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/27/86
Date End: 6/30/86

Sheet 1 of 2
Boring No: B-7D
Location: See Plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1 3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/30/86 | 9.0' | | Overnight |

| Depth | Cas bl/ft | Sample No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-1.5' | 18" | 12" | 4-5-7 | | S-1: Loose, light brown, medium to fine sand with gravel. (fill) | |
| | | S-2 | 1.5-3.0' | 18" | 12" | 9-20-22 | | S-2: Same as S-1. | |
| 5.0' | | S-3 | 3.0-4.5' | 18" | 12" | 7-6-6 | | S-3: Same as S-1. | |
| | | S-4 | 4.5-6.0' | 18" | 12" | 5-2-3 | | S-4: Same as S-1. | |
| | | S-5 | 6.0-7.5' | 18" | 4" | 2-10-4 | 8.0' | S-5: Same as S-1. | |
| | | S-6 | 7.5-9.0' | 18" | 18" | 2-2-2 | | S-6: Peat, organics with trace of silt. (moist) | |
| 10.0' | | S-7 | 9.0-10.5' | 18" | 2" | 5-6-13 | 10.0' | S-7: Very dense, light to dark brown, medium to fine silty sand (wet). | |
| | | S-8 | 10.5-12.0' | 18" | 18" | 16-22-31 | 13.0' | S-8: Same as S-7. (wet) | (1) |
| | | S-9 | 12-13.5' | 18" | 14" | 50-23-27 | | S-9: Very dense, grey, medium to fine silty sand with gravel (wet). | (2) |
| 15.0' | | S-10 | 13.5-14.4' | 10" | 9" | 27-50/5 | | S-10: Same as S-9 (wet). | |
| 20.0' | | S-11 | 20.0-21.5' | 18" | 9" | 34-27-19 | | S-11: Same as S-9. (wet) | |
| 25.0' | | S-12 | 25.0-26.5' | 18" | 9" | 12-13-17 | | S-12: Wash, fine gravel, medium sand. (wet) | (3) |
| 30.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

| COHESIVE CONSISTENCY (BLOWS/FOOT) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 50+ | HARD |

| COHESIONLESS DENSITY (BLOWS/FOOT) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) High blow count due to pushing pebble.
(2) Changed to threaded casing w/300lb hammer at 14.5'.
(3) Wash, material from sides of hole, not bottom.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/27/86
Date End: 6/27/86

Sheet 2 of 2
Boring No: B-7D
Location: See plan
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| TYPE: | Hollow Stem Auger | Split Spoon |
| SIZE: | 2 1/4" ID | 1-3/8" ID |
| HAMMER: | --- | 140 pounds |
| FALL: | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 6/30/86 | 0.9' | | Overnight |

| Depth | Cas bl/ft | Sample No. | Sample Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Note |
|---|---|---|---|---|---|---|---|---|---|
| 30.0' | | S-13 | 30.0-31.5' | 18" | 12" | 15-31-34 | | S-13: Wash, medium to fine, brown sand with gravel. (wet) | (1) |
| 35.0 | | S-14 | 35.0-35.5' | 6" | 0" | 50 | | S-14: ------- | |
| 40.0' | | S-15 | 40.0-41.5' | 18" | 4" | 66-44-24 | | S-15: Same as S-9. (wet) | |
| | | | | | | | | Terminated at 42.7', bedrock. | |
| 45.0' | | | | | | | | | |
| 50.0' | | | | | | | | | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (tons/foot)

| | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 15 | STIFF |
| 50+ | HARD |

COHESIONLESS DENSITY (blows/foot)

| | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks: (1) Boulder core at 36.9'-38.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

Sheet # ___ of ___

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No: SE-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-31 DEEP — Ground Elev: — Date Start: 04/11/88 — Date Complete: 04/12/88 — Drilling Foreman: M.Z. — Eng./Hydrol Geologist: M.B.

| Depth (ft) | Sample No. | Sample Depth (ft) | Blows per Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 2'0" | 2-3-4-4 | | | | Loose to medium dense, dry, fine SAND, trace inorganic silt, trace root matter. |
| | 2 | 2'0"- 4'0" | 5-5-5-6 | | | | |
| 5 | 3 | 4'0"- 6'0" | 7-6-7-8 | | | 4'0" | Medium dense, moist to wet, fine SAND, trace inorganic silt. |
| | 4 | 6'0"- 8'0" | 9-10-13-14 | | | | |
| | 5 | 8'0"- 10'0" | 7-10-9-14 | | | | |
| 10 | 6 | 10'0"- 12'0" | 7-8-10-10 | | | | |
| | 7 | 12'0"- 14'0" | 7-7-9-10 | | | | |
| 15 | 8 | 14'0"- 16'0" | 25-36-31-24 | | | 14'0" | Very dense, wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles, and boulders. |
| | 9 | 16'0"- 18'0" | 35-24-23-21 | | | | |
| | 10 | 18'0"- 20'0" | 18-28-46-51 | | | | |
| 20 | 11 | 20'0"- 20'9" | 49-120/3" | | | | |
| | Run #1 | 22'0" to 23'0" | 14 | min/ | foot | 22'0" | Refusal at 22'0" with hollow stem auger Run #1 CORED ROCK from 22'0" to 27'0" Some fractures in rock, started with water return. Had total loss of water at 23'6". Recovery 25"/60" = 41.6% |
| | | 23'0" to 24'0" | 10 | " | | | |
| 25 | | 24'0" to 25'0" | 9 | " | | | |
| | | 25'0" to 26'0" | 10 | " | | | |
| | | 26'0" to 27'0" | 11 | " | | | |
| 30 | | | | | | 27'0" | End of boring at 27'0" Set 2" STAINLESS STELL well point 22'0" Water level at 7'3" upon completion Well Materials; 1 - 2" end plugs; 1 - 10' x 2" STAINLESS STEEL screen; 1 - 10' x 2" STAINLESS STEEL riser; 1 - 2' x 2" STAINLESS STEEL riser; 1 - protective locking casing; 1 bag- sakrete sand; 7 bags-silica sand; 1 pail-bentonite pellets; 1 bag -bentonite powder; 3 bags-Portland cement |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Sheet # ____ of ____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION | Date: 04/18/88 | Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 SHALLOW | Ground Elev.: | Date Start: 04/13/88 | Date Complete: 04/14/88 | Drilling Foreman: M.Z. | Eng./Hydrol. Geologist: M.B.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL. |
| | | | | | | 0'6" | Moist to wet, fine SAND, trace inorganic silt. |
| 5 | | | | | | | |
| | | | | | | 8'6" | Wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt. |
| 10 | | | | | | | |
| | | | | | | 14'0" | Wet, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles. |
| 15 | | | | | | 15'0" | End of boring at 15'0"<br>Set 2" STAINLESS STEEL well point 15'0"<br>Water level at 7'0" upon completion |
| 20 | | | | | | | |
| | | | | | | | Well Materils;<br>1 - 2" end plugs<br>1 - 10' x 2" STAINLESS STEEL screen<br>1 - 5' x 2" STAINLESS STEEL riser<br>1 bag - sakrete sand<br>7 bags - silica sand<br>1 pail - bentonite pellets<br>1 bag - Portland cement |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No.: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 DEEP — Ground Elev.: — Date Start: 04/11/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

| Depth (Ft.) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | TOPSOIL. |
| | 1 | 0'6"- 2'6" | 2-3-3-4 | | | 0'6" | Loose, dry, fine SAND, trace inorganic silt. |
| | 2 | 2'6"- 4'6" | 3-3-4-4 | | | | |
| 5 | 3 | 4'6"- 6'6" | 7-10-11-11 | | | 4'6" | Medium dense, moist to wet, fine SAND, trace inorganic silt. |
| | 4 | 6'6"- 8'6" | 10-11-12-13 | | | | |
| | 5 | 8'6"- 10'0" | 11-12-16 | | | 8'6" | Medium dense to dense, wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt. |
| 10 | 6 | 10'0"- 12'0" | 7-10-17-21 | | | | |
| | 7 | 12'0"- 14'0" | 12-14-16-17 | | | | |
| 15 | 8 | 14'0"- 16'0" | 43-40-24-30 | | | 14'0" | Very dense, wet, light grey to brown, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles, and boulders. |
| | 9 | 16'0"- 18'0" | 28-32-35-28 | | | | |
| | 10 | 18'0"- 20'0" | 13-12-13-20 | | | | |
| 20 | 11 | 20'0"- 22'0" | 21-16-47-20 | | | | |
| | 12 | 22'0"- 24'0" | 14-21-34-30 | | | 22'0" | Very dense, wet, fine to coarse SAND, and gravel, some cobbles, and inorganic silt. |
| 25 | 13 | 24'0"-25'10" | 29-38-33-120/4" | | | 24'0" | Very dense, wet, fine SAND, some inorganic silt, trace to some fine to coarse gravel, trace cobbles & boulders. |
| | Run #1 | 26'0"- | 27'0" 12 min./foot | | | 26'0" | Refusal at 26'0" with hollow stem auger<br>Run #1 CORED ROCK from 26'0" to 31'0"<br>Trace to some fractures, no loss of water.<br>Recovery 44"/60" = 73.3% |
| | | 27'0"- | 28'0" 15 | " | | | |
| | | 28'0"- | 29'0" 10 | " | | | |
| 30 | | 29'0"- | 30'0" 9 | " | | | |
| | | 30'0"- | 31'0" 11 | " | | | |
| | Well Materials; | | | | | 31'0" | End of boring at 31'0"<br>Set 2" STAINLESS STEEL well point 31'0"<br>Water level at 7'0" upon completion |
| | 1 - 2" end plugs | | | | | | |
| | 1 - 10' x 2" STAINLESS STEEL screen | | | | | | |
| 35 | 2 - 10' x 2" STAINLESS STEEL riser | | | | | | |
| | 1 - 2' x 2" STAINLESS STEEL riser | | | | | | |
| | 1 - protective locking casing | | | | | | |
| | 1 bag - sakrete sand | | | | | | |
| | 5 bags- silica sand | | | | | | |
| 40 | 1 pail- bentonite pellets | | | | | | |
| | 1 bag - bentonite powder | | | | | | |

Type of Boring: — Casing Size: — Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/13/89
**Date End:** 11/13/89

**Sheet** 1 **of** 2
**Boring No:** GW-33
**Location:** #2 Shallow
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Hollow Stem Auger | Split Spoon |
| Size | 3-3/4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/13/89 | 7.0' | — | Upon Completion |

| Depth | Cas bl/ft | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 5.0' | | S-1 | 4.0-6.0' | AUGER | SAMPLE | | | S-1: Brown, fine to coarse sand and gravel, trace of cobbles | |
| 10.0' | | S-2 | 9.0-11.0' | AUGER | SAMPLE | | | S-2: Same as S-1 | |
| 15.0' | | S-3 | 14.0-16.0' | AUGER | SAMPLE | | | S-3: Same as S-1 | |
| 20.0' | | S-4 | 19.0-21.0' | AUGER | SAMPLE | | | S-4: Brown, fine to coarse sand | |
| 25.0' | | | | | | | | Terminated Exploration at | |
| 30.0' | | | | | | | | Installed Monitoring Well | |

**Driller:** R. Marcoux
**Helper:** L. Lowe
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 16 | STIFF |
| 16 - 32 | HARD |

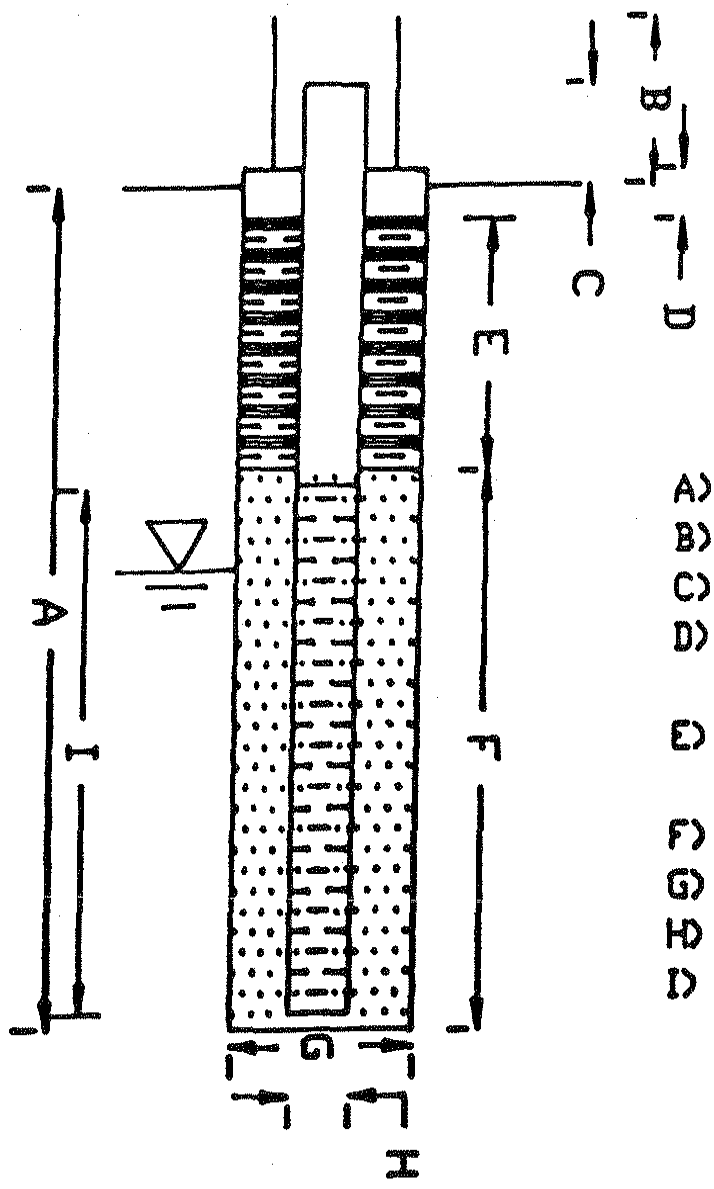
| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES**
See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 8.5'
F) Sand Pack: Bottom of 9.0'
G) Borehole Diameter: 8" - 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: L. Love
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/13/89

Sheet 2 of 2
Boring No.: GW-33
Well No.: _____
Surface Elev.: _____

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/8/89
**Date End:** 11/13/89

**Sheet** 1 **of** 2
**Boring No:** GW-33
**Location:** #1 Deep
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/13/89 | 7.0' | --- | Upon Completion |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 18" | 3-4 | | S-1: Light brown, fine sand | |
| | | | | | | 8-11 | | | |
| | | S-2 | 2.0-4.0' | 24" | 20" | 12-12 | | S-2: Brown, fine to medium sand, silt, gravel, cobbles | |
| | | | | | | 32-37 | | | |
| 5.0' | | S-3 | 4.0-5.0' | 12" | 12" | 37-65 | | S-3: Brown, fine to coarse sand, little silt, gravel, cobbles (wet) | |
| | | S-4 | 5.0-7.0' | 24" | 18" | 38-65 | | S-4: Same as S-3 | |
| | | | | | | 77-70 | | | |
| | | S-5 | 7.0-9.0' | 24" | 18" | 28-39 | | S-5: Same as S-3 | |
| | | | | | | 55-64 | | | |
| 10.0' | | S-6 | 9.0-11.0' | 24" | 12" | 23-31 | | S-6: Same as S-3 | |
| | | | | | | 48-48 | | | |
| | | S-7 | 11.0-13.0' | 24" | 14" | 12-33 | | S-7: Same as S-3 | |
| | | | | | | 50-45 | | | |
| | | S-8 | 13.0-15.0' | 24" | 10" | 11-13 | | S-8: Brown, fine to coarse sand, trace of silt, small amounts of gravel | |
| 15.0' | | | | | | 16-13 | | | |
| | | S-9 | 15.0-17.0' | 24" | 14" | 4-5 | | S-9: Brown, fine to medium sand, trace of gravel | |
| | | | | | | 11-14 | | | |
| | | S-10 | 17.0-19.0' | 24" | 12" | 3-4 | | S-10: Same as S-9 | |
| | | | | | | 8-7 | | | |
| 20.0' | | S-11 | 19.0-19.4' | 5" | 5" | 100/5" | | S-11: Fine to coarse sand - Advanced casing to 21.0' Cored rock 21.0-26.0' | |
| 25.0' | | | | | | | | Installed Monitoring Well | |
| | | | | | | | 26.0' | | |
| | | | | | | | | Terminated Exploration at 26.0' | |
| 30.0' | | | | | | | | | |

**Driller:** R. Marcoux
**Helper:** L. Lowe
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

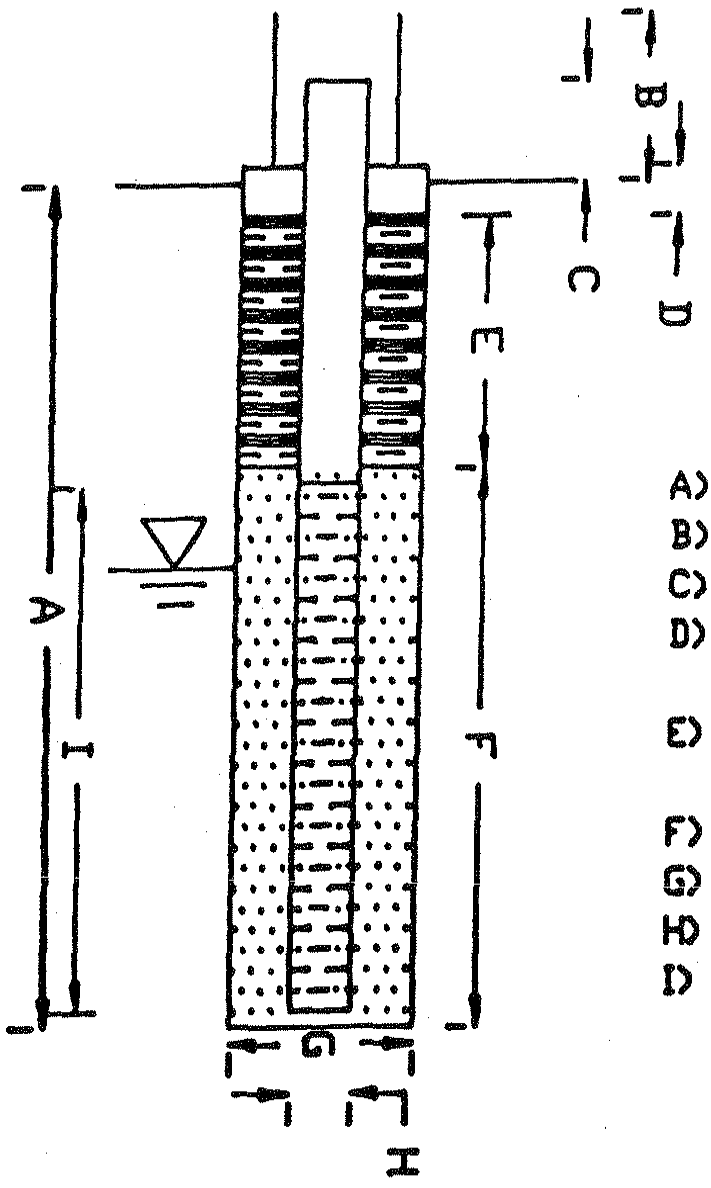
COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0 - 10%
LITTLE: 10 - 20%
SOME: 20 - 35%
AND: 35 - 50%

**NOTES**
See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 26.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: 11.5'
F) Sand Pack: 12.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: L. Lowe
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/13/89

Sheet 2 of 2
Boring No: GW-33
Well No: #1 Deep
Surface Elev: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. GW-33
LOCATION See Plan
PROJECT NO. 90718.01
SURFACE ELEV.
DEPTHS:
DATE START 11/8/89
COMPANY MILLER ENGINEERING & TESTING
OVERBURDEN
DATE END 11/13/89
DRILLER R. Marcoux
TOTAL
MEI REP None
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR FEED | DRILLING BEHAVIOR WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 21.0 | | | RUN #1:<br>Light gray, fine grained calc-silicate gneiss. Central one foot section of core highly fractured with no pieces greater than 4" long. Foliation trends 30 degrees to horizontal, as evident with thin (less than 1/2") felsic layers. Scattered thin felsic intrusions randomly oriented throughout core. Fracture sub-horizontal in central area, 45 degrees to horizontal in remaining section of core.<br>REC: 55"/60" = 92% RQD: 38"/60" = 63% | | | |
| | | | 26.0 | | | | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/17/89
**Date End:** 11/17/89

**Sheet** 1 **of** 2
**Boring No:** GW-34
**Location:**
#2 Shallow
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Hollow Stem Auger | Split Spoon |
| Size | 3-3/4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/17/89 | 9.0' | --- | Upon Completion |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 5.0' | | S-1 | 4.0-6.0' | AUGER | SAMPLE | | | S-1: Brown, fine to coarse sand, gravel, cobbles | |
| 10.0' | | S-2 | 9.0-11.0' | AUGER | SAMPLE | | | S-2: Same as S-1 | |
| 15.0' | | S-3 | 14.0-16.0' | AUGER | SAMPLE | | | S-3: Brown, fine to coarse sand | |
| 20.0' | | S-4 | 19.0-21.0' | AUGER | SAMPLE | | | S-4: Same as S-3 | |
| | | | | | | | | Terminated Exploration | |
| | | | | | | | | Installed Monitoring Well | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

**Driller:** R. Marcoux
**Helper:** R. Gagnon
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

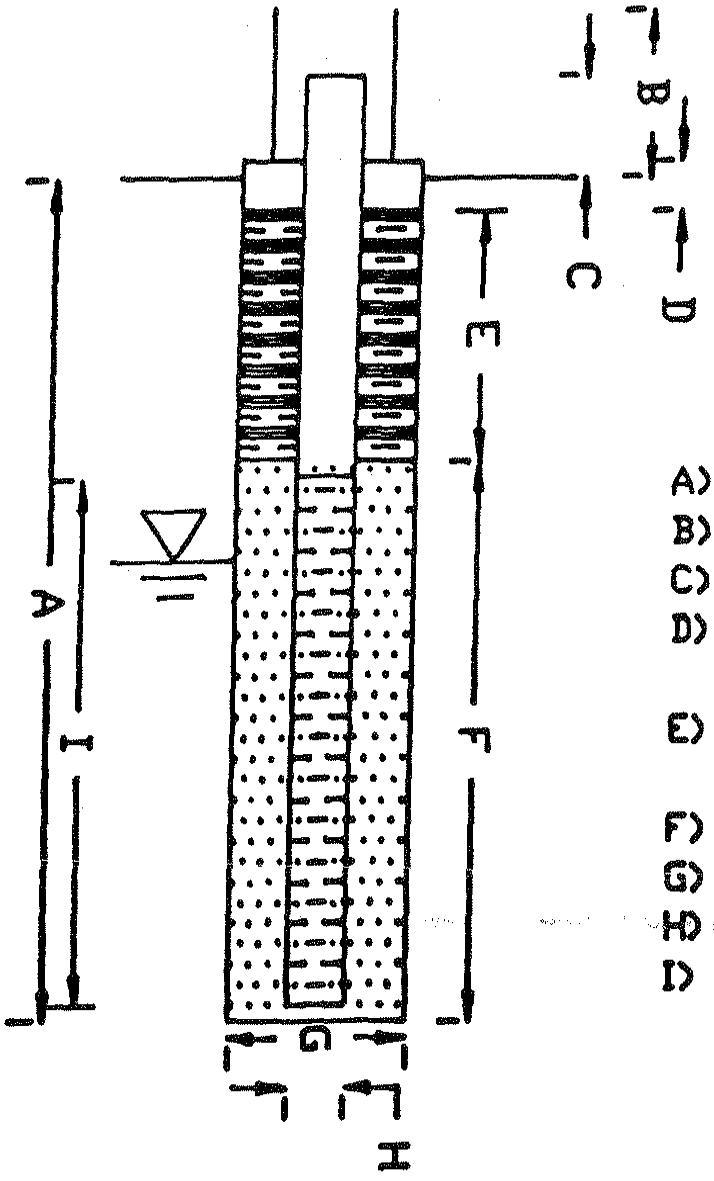
COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50> VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

**NOTES**
See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 8.0'
F) Sand Pack: Bottom to 9.0'
G) Borehole Diameter: 8" 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MULLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/17/89

Sheet 2 of 2
Boring No.: GW-34
Well No.: #2 Shallow
Surface Elev.: _____

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/14/89
**Date End:** 11/20/89

**Sheet** 1 **of** 3
**Boring No:** GW-34
**Location:** #1 Deep
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/19/89 | 17.0' | --- | Upon Completion |

| Depth | Casbl/ft | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 6" | 4-10 | | S-1: Light brown, fine to medium sand, little silt, some gravel | |
| | | | | | | 11-15 | | | |
| | | S-2 | 2.0-4.0' | 24" | 15" | 12-28 | | S-2: Same as S-1, some cobbles | |
| | | | | | | 60-48 | | | |
| 5.0' | | S-3 | 4.0-4.3' | 3" | 0" | 100/3" | | S-3: Same as S-2, pushed cobble - no recovery - sample from auger | |
| | | S-4 | 6.0-6.4' | 5" | 2" | 100/5" | | S-4: Brown, fine to coarse sand, gravel, cobbles-boulders | |
| | | S-5 | 8.0-10.0' | 24" | 12" | 45-46 | | S-5: (wet), brown, fine to coarse sand, gravel, cobbles-boulders | |
| 10.0' | | | | | | 57-68 | | | |
| | | S-6 | 10.0-10.7' | 8" | 5" | 42-100/2" | | S-6: Same as S-5 | |
| | | | | | | | 12.0' | | * |
| | | S-7 | 12.0-14.0' | 24" | 6" | 10-25 | | S-7: Fine to coarse sand, trace of fine gravel | |
| | | | | | | 21-29 | | | |
| 15.0' | | S-8 | 14.0-16.0' | 24" | 8" | 13-19 | | S-8: Same as S-7 | |
| | | | | | | 31-27 | | | |
| | | S-9 | 16.0-18.0' | 24" | 10" | No Blow | | S-9: Same as S-7 | |
| | | | | | | Counts - Retained | | | |
| | | S-10 | 18.0-20.0' | 24" | 8" | No Blow | | S-10: Same as S-7 | |
| 20.0' | | | | | | Counts - Retained | | | |
| | | S-11 | 20.0-22.0' | 24" | 8" | 10-27 | | S-11: Same as S-7 | |
| | | | | | | 17-16 | | | |
| | | S-12 | 22.0-24.0' | 24" | 11" | 9-18 | | S-12: Same as S-7 | |
| | | | | | | 23-20 | | | |
| 25.0' | | | 24.5 | Casing Refusal | | | | Cored rock from 24.5-26.0'. Lost grease fitting from core barrel. Roller cored to 26.0'. | |
| | | | | | | | | Cored rock from 26.0-31.0' - Boulders? | |
| 30.0' | | | | | | | | | |

**Driller:** R. Marcoux
**Helper:** R. Gagnon
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 16 | STIFF |
| 16 - 32 | HARD |

| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES**
* 12.0' pulled augers out and advanced casing
See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/14/89
**Date End:** 11/20/89

**Sheet** 2 **of** 3
**Boring No:** GW-34
**Location:**
#1 Deep
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Advanced casing to 34.5' | |
| 35.0' | | | | | | | | Installed Monitoring Well at 35.0' | |
| | | | | | | | | See attached sheet for Monitoring Well installation | |
| 40.0' | | | | | | | | | |
| 45.0' | | | | | | | | | |
| 50.0' | | | | | | | | | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

**Driller:** R. Marcoux
**Helper:** R. Gagnon
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

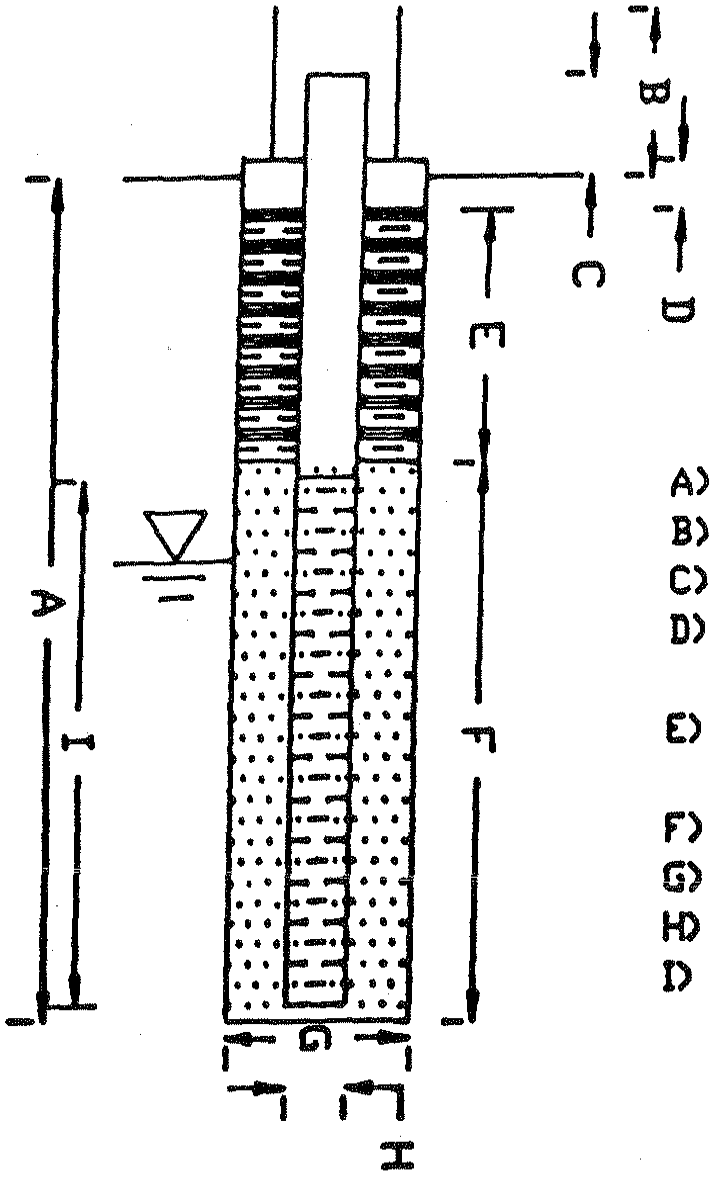
COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0 - 10%
LITTLE: 10 - 20%
SOME: 20 - 35%
AND: 35 - 50%

**NOTES**

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 33.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.0'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 19.0'
F) Sand Pack: 13.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/20/89

Sheet 3 of 3
Boring No: GW-34
Well No: #1 Deep
Surface Elev: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION
Wilmington, MA

BORING NO. GW-34 LOCATION See Plan

PROJECT NO. 90718.01
DATE START 11/14/89
DATE END 11/20/89

SURFACE ELEV.
COMPANY MILLER ENGINEERING & TESTING
DRILLER B. Marcoux
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR FEED | DRILLING BEHAVIOR WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 24.5 | | | RUN #1:<br>Upper 10" a medium grained non-foliated gabbro. Below 10" gabbro section, is a highly fractured area with numerous gravel-size, weathered rock fragments. The upper 6" of the fractured zone composed of a black, fine gravel basalt. Fragmented rock consists of a wide variety of igneous compositions.<br><br>REC: 36"/66" = 55% RQD: 12"/66" = 18% | | | |
| | | | 31.0 | | | | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/28/89
**Date End:** 11/28/89

**Sheet** 1 **of** 2
**Boring No:** GW-35
**Location:** #2 Shallow
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Hollow Stem Auger | Split Spoon |
| Size | 3-3/4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/28/89 | 9.0' | --- | Upon Completion |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 5.0' | | S-1 | 4.0-6.0' | AUGER SAMPLE | | | | S-1: Brown, fine to medium sand, silt, trace of gravel | |
| 10.0' | | S-2 | 9.0-11.0' | AUGER SAMPLE | | | | S-2: Same as S-1 | |
| 15.0' | | S-3 | 14.0-16.0' | AUGER SAMPLE | | | | S-3: Brown, fine to medium sand | |
| 20.0' | | S-4 | 19.0-21.0' | AUGER SAMPLE | | | | S-4: Same as S-3 | |
| | | | | | | | | Terminated Exploration at | |
| 25.0' | | | | | | | | Installed Monitoring Well | |
| 30.0' | | | | | | | | | |

**Driller:** R. Marcoux
**Helper:** R. Gagnon
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50> VERY DENSE

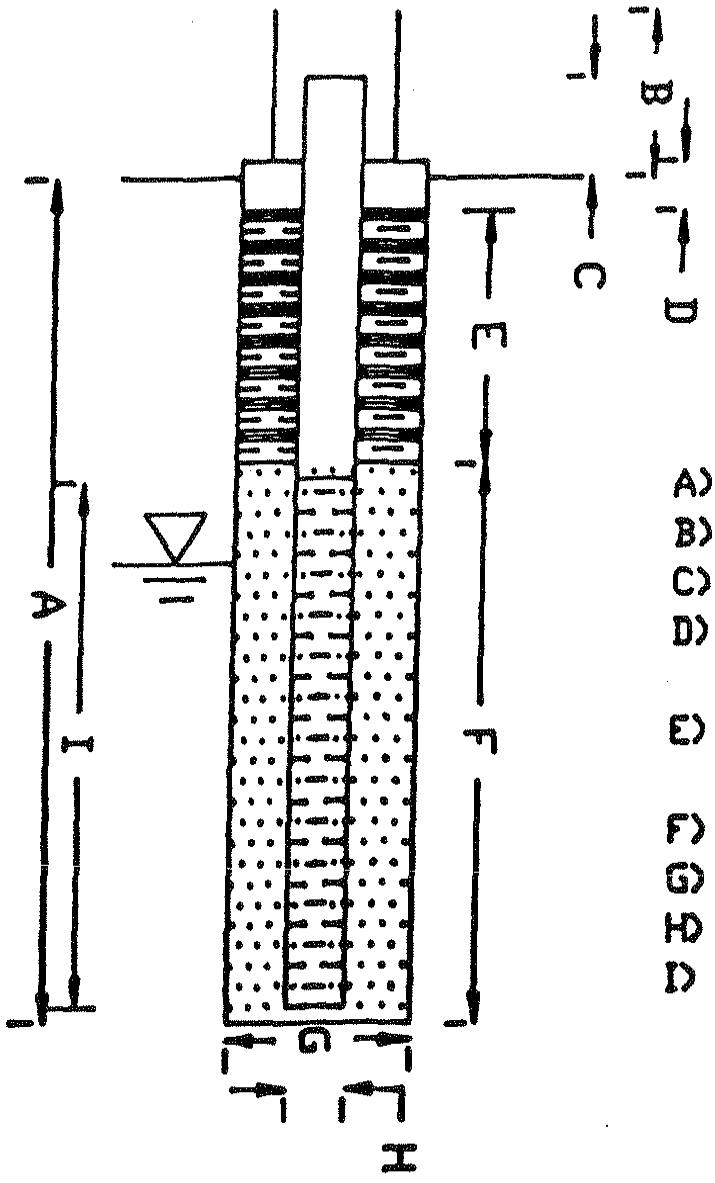
PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

**NOTES**

See attached sheet for Monitoring Well Installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 7.0'
F) Sand Pack: Bottom to 8.0'
G) Borehole Diameter: 8" 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/28/89

Sheet 2 of 2
Boring No.: GW-35
Well No.: #2 Shallow
Surface Elev.: _____

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/21/89
**Date End:** 11/28/89

**Sheet** 1 **of** 1
**Boring No:** GW-35
**Location:** #1 Deep
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID/3" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/28/89 | 9.0' | -- | Upon Completion |

| Depth | Cas bl/ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 8" | 4-5 | | S-1: Brown, fine to medium sand, silt, trace of gravel | |
| | | | | | | 5-7 | | | |
| | | S-2 | 2.0-4.0' | 24" | 12" | 6-8 | | S-2: Same as S-1 | |
| | | | | | | 7-9 | | | |
| 5.0' | | S-3 | 4.0-6.0' | 24" | 3" | 7-7 | | S-3: Fine to medium sand | |
| | | | | | | 2-4 | | | |
| | | S-4 | 6.0-8.0' | 24" | 12" | 3-7 | | S-4: (wet), brown, fine sand, silt, fine gravel | |
| | | | | | | 10-19 | | | |
| | | S-5 | 8.0-10.0' | 24" | 18" | 20-36 | | S-5: Same as S-4 | |
| 10.0' | | | | | | 38-43 | | | |
| | | S-6 | 10.0-11.2' | 14" | 12" | 23-64 | | S-6: Same as S-4, some cobbles | |
| | | | | | | 100/2" | 12.0' | | |
| | | S-7 | 12.0-14.0' | 24" | 10" | 17-33 | | S-7: Gray, fine to coarse sand, fine gravel | |
| | | | | | | 41-64 | | | |
| 15.0' | | S-8 | 14.0-16.0' | 24" | 12" | 20-85 | | S-8: Same as S-7 | |
| | | | | | | 45-45 | | | |
| | | S-9 | 16.0-18.0' | 24" | 10" | 12-26 | | S-9: Same as S-7 | |
| | | | | | | 29-47 | | | |
| | | S-10 | 18.0-20.0' | 24" | 14" | 8-35 | | S-10: Same as S-7 | |
| 20.0' | | | | | | 29-15 | 20.0' | | |
| | | S-11 | 20.0-22.0' | 24" | 18" | 5-12 | | S-11: Brown, fine to coarse sand, gravel | |
| | | | | | | 18-26 | | | |
| | | S-12 | 22.0-24.0' | 24" | 12" | 9-16 | | S-12: Same as S-11 | |
| | | | | | | 19-29 | | | |
| 25.0' | | S-13 | 24.0-26.0' | 24" | 12" | 10-13 | | S-13: Same as S-11 | |
| | | | | | | 26-18 | 26.0' | | |
| | | S-14 | 26.0-28.0' | 24" | 6" | 19-24 | | S-14: Same as S-11, cobbles - boulders | |
| | | | | | | 43-30 | | | |
| | | S-15 | 28.0-30.0' | 24" | 12" | 26-54 | | S-15: Same as S-14 | |
| 30.0' | | | | | | 14-11 | | | |

**Driller:** R. Marcoux
**Helper:** R. Gagnon
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE: 0 - 10%
LITTLE: 10 - 20%
SOME: 20 - 35%
AND: 35 - 50%

**NOTES**
See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/21/89
**Date End:** 11/28/89

**Sheet** 2 **of** 3
**Boring No:** GW-35
**Location:** #1 Deep
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID/3" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Encountered Boulders at 26.0' | |
| | | | | | | | | Drove 4" casing to 35.0' Refusal | |
| 35.0' | | | | | | | | Cored from 34.5-36.5' Telescoped 3" casing to 34.5' - Spun casing through boulders to 36.5-39.0'. Final depth of 40.5' Refusal | |
| | | | | | | | | Attempted to wash out - last wheel off roller cone - notified Mike Bolat | |
| 40.0' | | | | | | | | Installed Monitoring Well at 40.0' | |
| | | | | | | | | Terminated Exploration at | |
| 45.0' | | | | | | | | | |
| 50.0' | | | | | | | | | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

**Driller:** R. Marrow
**Helper:** R. Garnon
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 16 | STIFF |
| 16 - 32 | HARD |

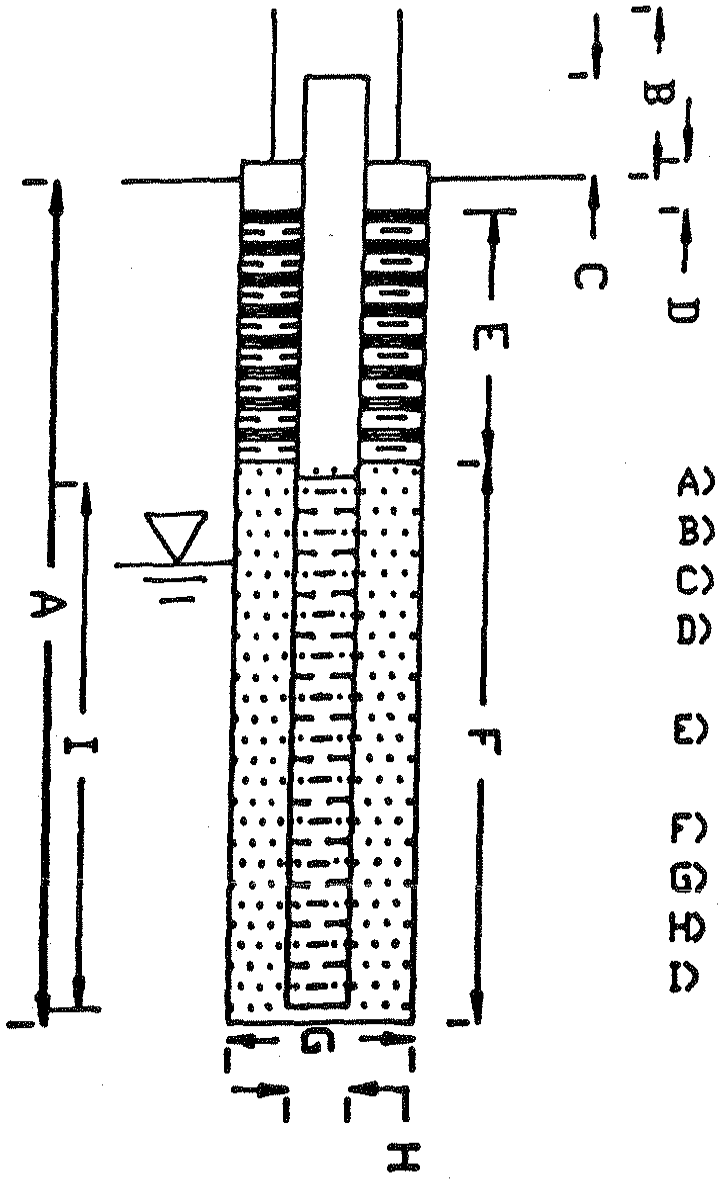
| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES**

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 40.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 27.0'
F) Sand Pack: Bottom to 28.0'
G) Borehole Diameter: 4" casing
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/25/89

Sheet 3 of 3
Boring No.: GW-35
Well No.: #1 Deep
Surface Elev.: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. GW-35
LOCATION Sea Plan
PROJECT NO. 90718.01
SURFACE ELEV.
DATE START 11/21/89
COMPANY MILLER ENGINEERING & TESTING
DATE END 11/28/89
DRILLER R. Marcoux
MEI REP None
DEPTHS:
OVERBURDEN
TOTAL
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR: FEED | DRILLING BEHAVIOR: WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 34.5 | | | RUN #1: Fine grained, weakly foliated, two-mica granite. Fracturing is sub-horizontal as widely spread (greater than 9") Little oxidation evident in fractures. REC: 23"/24" = 96% RQD: 20"/24" = 83% | | | |
| | | | 36.5 | | | RUN #2: Light gray, fine grained calc-silicate gneiss. Core is highly fractured with no sections greater than 4". REC: 30"/30" = 100% RQD: 4"/30" = 13% | | | |
| | | | 39.0 | | | | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/13/89
**Date End:** 11/16/89

**Sheet** 1 **of** 3
**Boring No:** GW-36
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/16/89 | 3.0' | --- | Upon Completion |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 18" | 1-1/12" | | S-1: 6" dark brown topsoil with leaves and roots, yellow-brown, fine to medium sand | |
| | | | | | | 2 | | | |
| | | S-2 | 2.0-4.0' | 24" | 21" | 4-6 | | S-2: Yellow-brown, medium to fine sand | |
| | | | | | | 8-16 | 4.0' | | |
| 5.0' | | S-3 | 4.0-5.0' | 12" | 12" | 48-57 | | S-3: Yellow-brown, fine to coarse sand and gravel, boulders | |
| | | | | | | | | NOTE: Hitting boulders - took next sample at 7.0' | |
| | | S-4 | 7.0-8.0' | 12" | 12" | 59-68 | | S-4: Yellow-brown, fine to coarse sand and gravel, boulders | |
| | | | | | | | 9.0' | | |
| 10.0' | | S-5 | 9.0-11.0' | 24" | 24" | 12-14 | | S-5: Yellow-brown, medium to fine sand, trace gravel (NOTE: Sand started to blow in augers) | |
| | | | | | | 21-21 | | | |
| | | S-6 | 11.0-13.0' | 24" | 24" | 7-9 | | S-6: Same as S-5 | |
| | | | | | | 14-18 | | | |
| | | S-7 | 13.0-15.0' | 24" | 8" | 11-19 | | S-7: Same as S-5 | |
| 15.0' | | | | | | 22-24 | | NOTE: Sand blowing in augers - no samples - down to 19.0' - switched to casing | |
| | | | | | | | 17.0' | | |
| 20.0' | | S-8 | 19.0-21.0' | 24" | 6" | 24-19 | | S-8: Yellow-brown, fine to coarse sand and gravel (poor recovery - rock stuck in tip of spoon) | |
| | | | | | | 19-17 | | | |
| | | S-9 | 21.0-23.0' | 24" | 12" | 7-12 | | S-9: Yellow-brown, fine to coarse sand, little gravel | |
| | | | | | | 14-17 | | | |
| | | S-10 | 23.0-25.0' | 24" | 18" | 10-12 | | S-10: Orange-brown, fine to coarse sand and gravel | |
| 25.0' | | | | | | 14-17 | 25.0' | | |
| | | S-11 | 25.0-26.0' | 12" | 8" | 59-47 | | S-11: Gray-brown, fine to coarse sand, gravel and boulders | |
| | | | | | | 50/0" | | NOTE: Kept hitting boulders - no samples down to 29.0' | |
| | | | | | | 24-42 | 29.0' | | |
| 30.0' | | S-12 | 29.0-31.0' | 24" | 1" | 34-30 | | S-12: Gray- brown, fine to coarse sand and gravel | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

**NOTES** See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/13/89
Date End: 11/16/89

Sheet 2 of 3
Boring No: GW-36
Location:
Surface Elev:

| | Casing | Sampler |
|---|---|---|
| Type | Flush Joint | Split Spoon |
| Size | 4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

Groundwater Observations

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Depth | Casbl/ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Gray-brown, fine to coarse sand and gravel | |
| | | | | | | | 33.0' | | |
| | | | | | | | | NOTE: Casing driving real hard at 33.0' | |
| 35.0' | | | | | | | | S-13: Gray, medium to fine sand, little to some silt, little fine gravel | |
| | | S-13 | 35.5-36.4' | 11" | 11" | 11 - 50/5" | 36.5' | Started to core at 36.5' | |
| | | | | | | | | RUN #1 36.5-41.5' RECOVERY: 56" Core Time per/foot 10:-7:-6:-9:-8: | |
| 40.0' | | | | | | | | | |
| | | | | | | | 41.5' | | |
| | | | | | | | | Bottom of Exploration at 41.5' | |
| | | | | | | | | NOTE: Reamed out core hole from 36.5-37.0' | |
| 45.0' | | | | | | | | Placed well point at 37.0' - filled core hole with sand and bentonite | |
| 50.0' | | | | | | | | | |
| | | | | | | | | NOTE: Made attempts (#1 at 26.6' depth and #2 at 9.7' depth) - boulders. | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50> VERY DENSE

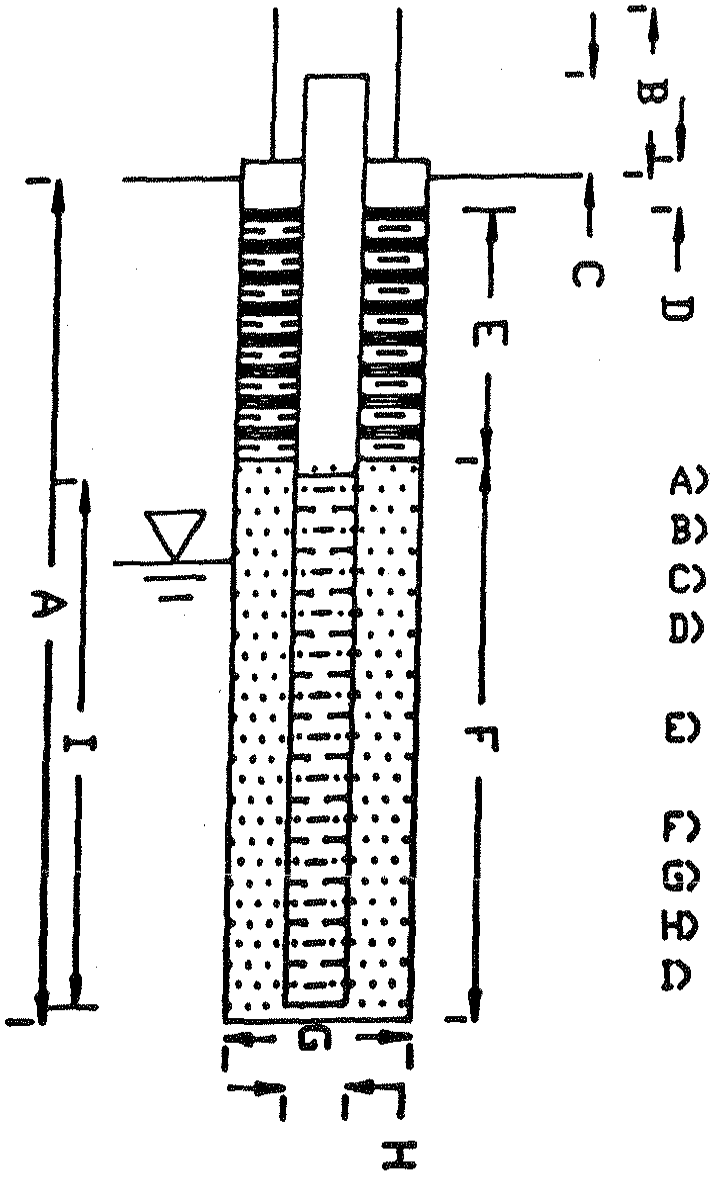
PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES

NOTE: Sample 13.0' had green color to it - drilling water during rock coring was green

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 37.0'
B) Cover Pipe Stickup: 2.0'
C) Riser Pipe Stickup: 1.5'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: 22.0'
F) Sand Pack: 14.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/16/89

Sheet 3 of 3
Boring No: GW-36
Well No: GW-36
Surface Elev: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL Wilmington, MA
BORING NO. GW-36
LOCATION See Plan
PROJECT NO. 90718.01
SURFACE ELEV.
DEPTHS:
DATE START 11/8/89
COMPANY Miller Engineering & Testing
OVERBURDEN
DATE END 11/13/89
DRILLER M. D'Ambrosio
TOTAL
MEI REP
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR FEED | DRILLING BEHAVIOR WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 36.5' | | | Dark grey to black, fine-grained calc-silicate gneiss, felsic intrusions oriented horizontally. Core moderately fractured throughout, but high RQD and recovery. No oxidation on fractured surfaces. | | | |
| | | | 41.5' | | | Recovery: 56" RQD - 51"/56" = 91% | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET ___ OF ___

TOTAL P.02

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. CW-27
LOCATION See Plan

PROJECT NO. 90718.01
SURFACE ELEV.
DATE START
COMPANY MILLER ENGINEERING & TESTING
DATE END
DRILLER M. D'Ambrosio
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR: FEED | DRILLING BEHAVIOR: WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 27.0' | | | RUN #1:<br>Dark gray to black, fine grained gneiss. Dominant foliation approximately 30 degrees from horizontal. Felsic layering averages 1" thick and is abundant throughout core length. Natural fractures are oriented approximately 40 degrees to horizontal and have an average spacing of approximately 9 inches. Some fracturing spaced closer, especially toward bottom fo core. Lower fractures exhibit oxidation more than upper fractures, indicating greater fracture flow at depth.<br>Fractures do not show preferred orientation relative to foliation.<br>REC: 56"/60" = 93% RQD: 42"/60" = 70% | | | |
| | | | 32.0' | | | | | | |

CORE LOSS
CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/8/89
**Date End:** 11/13/89

**Sheet** 1 **of** 3
**Boring No:** GW-38
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| **Type** | Hollow Stem Auger | Split Spoon |
| **Size** | 3-3/4" ID | 1-3/8" ID |
| **Hammer** | --- | 140 pounds |
| **Fall** | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/13/89 | 6.0' | --- | Upon Completion |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft. | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 12" | 2-10 | | S-1: Brown, fine to coarse sand, little gravel, fill | |
| | | | | | | 9-4 | | | |
| | | S-2 | 2.0-4.0' | 24" | 1" | 2-4 | | S-2: Same as S-1, rock in tip of spoon | |
| | | | | | | 8-8 | 4.0' | | |
| | | | | | | | 4.5' | S-3: Black peat | |
| 5.0' | | S-3 | 4.0-4.5' | | | | | | |
| | | S-3A | 4.5-6.0' | 18" | 12" | 3-4 | | S-3A: Brown, fine to medium peaty sand | |
| | | | | | | 5-6 | | | |
| | | S-4 | 6.0-8.0' | 24" | 24" | 10-19 | | S-4: Brown, medium to fine sand, trace gravel | |
| | | | | | | 19-26 | | | |
| 10.0' | | S-5 | 8.0-10.0' | 24" | 24" | 6-7 | | S-5: Same as S-4 | |
| | | | | | | 9-15 | | | |
| | | S-6 | 10.0-12.0' | 24" | 24" | 21-17 | | S-6: Same as S-4, sand blowing in augers | |
| | | | | | | 22-20 | | | |
| | | S-7 | 12.0-14.0' | 24" | 24" | 4-5 | | S-7: Grayish brown, fine to medium sand | |
| 15.0' | | | | | | 7-9 | 15.0' | S-8: Same as S-7, Gravel in tip of spoon | |
| | | S-8 | 14.0-16.0' | 24" | 24" | 6-8 | | Lost 1.0' sampling, due to sand blowing in augers | |
| | | | | | | 14-21 | | | |
| | | S-9 | 17.0-19.0' | 24" | 18" | 20-33 | | S-9: Brown, fine to coarse sand, gravel and boulders, trace silt | |
| | | | | | | 29-41 | | | |
| 20.0' | | S-10 | 19.0-21.0' | 24" | 20" | 40-30 | | S-10: Same as S-9 | |
| | | | | | | 31-35 | | | |
| | | S-11 | 21.0-23.0' | 24" | 17" | 12-18 | | S-11: Brown, fine to medium sand, little gravel | |
| | | | | | | 21-34 | | | |
| | | S-12 | 23.0-25.0' | 24" | 24" | 16-24 | | S-12: Brown, fine to coarse sand and gravel, boulders | |
| 25.0' | | | | | | 39-33 | | | |
| | | S-13 | 25.0-27.0' | 24" | 18" | 14-29 | | S-13: Same as S-12 | |
| | | | | | | 34-41 | | | |
| | | S-14 | 27.0-27.8' | 9" | 9" | 47-50/3" | 28.0' | S-14" Same as S-12 | |
| | | | | | | | | Started to core at 28.0' | |
| 30.0' | | | | | | | | | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

**NOTES**

See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/8/89
**Date End:** 11/13/89

**Sheet** 2 **of** 3
**Boring No:** GW-38
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Hollow Stem Auger | Split Spoon |
| Size | 3-3/4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | RUN #L 28.0-33.0' RECOVERY: 59" | |
| | | | | | | | 33.0' | | |
| 35.0' | | | | | | | | Bottom of Exploration at 33.0' | |
| | | | | | | | | NOTE: Reamed out core hole from 28.0' down to 30.5' - Had to reseat casing to keep sands from above going in to core hole - drove casing to 29.0' | |
| 40.0' | | | | | | | | See bottom of well screen at 30.5' | |
| | | | | | | | | NOTE: Used augers down to 21.0' depth; From 21.0' to 28.0' used 4.0" flush-joint casing. | |
| 45.0' | | | | | | | | | |
| 50.0' | | | | | | | | | |
| 55.0' | | | | | | | | | |
| 60.0' | | | | | | | | | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

| COHESIVE CONSISTENCY (Blows/Foot) | |
|---|---|
| 0 - 2 | VERY SOFT |
| 2 - 4 | SOFT |
| 4 - 8 | MEDIUM STIFF |
| 8 - 16 | STIFF |
| 16 - 32 | HARD |

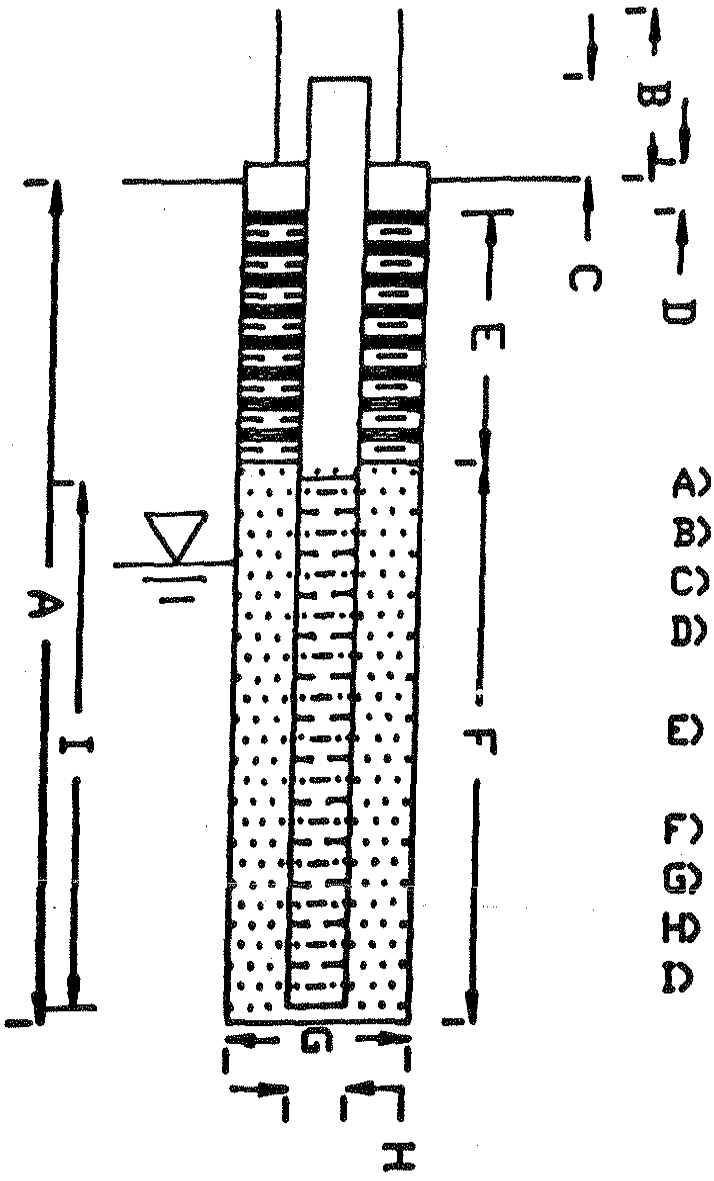
| COHESIONLESS DENSITY (Blows/Foot) | |
|---|---|
| 0 - 4 | VERY LOOSE |
| 4 - 10 | LOOSE |
| 10 - 30 | MEDIUM DENSE |
| 30 - 50 | DENSE |
| 50+ | VERY DENSE |

| PROPORTIONS USED | |
|---|---|
| TRACE | 0 - 10% |
| LITTLE | 10 - 20% |
| SOME | 20 - 35% |
| AND | 35 - 50% |

**NOTES**

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 30.5'
B) Cover Pipe Stickup: 2.0'
C) Riser Pipe Stickup: 1.5'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: From 14.0' to ground
F) Sand Pack: from 30.5 to 14.0'
G) Borehole Diameter: _____
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/13/89

Sheet 3 of 3
Boring No.: GW-38
Well No.: GW-38
Surface Elev.: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

**PROJECT:** OLIN CHEMICAL CORPORATION Wilmington, MA **BORING NO.** GW-18 **LOCATION** See Plan

**PROJECT NO.** 90718.01 **SURFACE ELEV.** _____ **DEPTHS:**

**DATE START** 11/8/89 **COMPANY** MILLER ENGINEERING & TESTING **OVERBURDEN** _____

**DATE END** 11/13/89 **DRILLER** M. D'Ambrosio **TOTAL** _____

**MEI REP** None **WATER** _____

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR: FEED | DRILLING BEHAVIOR: WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 28.0' | | | RUN #1:<br>Dark gray to black, very fine grained calc-silicate gneiss. Thin (less than 1 inch) felsic intrusions randomly oriented throughout core. Upper one foot heavily fractured with no pieces greater than 3" in size. Remainder of core moderately fractured with intersecting fractures trending 45 degrees from horizontal. Fracuture spacing averages 9", except for lower one foot of core, which exhibits closer spaced fractures (average 5"). Oxidation present on most fracture surfaces.<br>REC: 59"/60" = 98% RQD: 45"/60" = 70% | | | |
| | | | 33.0' | | | RUN #2:<br>Same general composition as RUN #1, fracturing in RUN #2 oriented approximately 20 degrees to horizontal and widely spread (79") on average. No densely fractured area as in RUN #1. Minimum oxidation on fractures compared to RUN #1.<br>REC: 56"/60" = 93% RQD: 51"/60" = 85% | | | |
| | | | 36.5' | | | | | | |
| | | | 41.5' | | | | | | |

CORE LOSS

CORE RECOVERY

**REMARKS:**

# TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

**Project:** OLIN CHEMICAL CORPORATION
Wilmington, MA
**Project No:** 90718.01
**Date Start:** 11/28/89
**Date End:** 11/28/89

**Sheet** 1 **of** 2
**Boring No:** GW-39
**Location:**
**Surface Elev:**

| | Casing | Sampler |
|---|---|---|
| Type | Hollow Stem Auger | Split Spoon |
| Size | 3-3/4" ID | 1-3/8" ID |
| Hammer | --- | 140 pounds |
| Fall | --- | 30 inches |

**Groundwater Observations**

| DATE | DEPTH | CASING AT | STABILIZATION PERIOD |
|---|---|---|---|
| 11/28/89 | 2.0' | --- | Upon Completion |
| | | | |
| | | | |
| | | | |

| Depth | Cas bl/ ft | SAMPLE No. | Depth | Pen. | Rec. | Blows/6" | Strata Change | Sample Description | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0.0-2.0' | 24" | 18" | 1-1 | | S-1: Dark black peat and peaty sand | |
| | | | | | | 3-1 | 2.0' | | |
| | | | | | | | | NOTE: No sample at 2.0' hitting boulders | |
| 5.0' | | S-2 | 4.0-5.5' | 18" | 18" | 14-28 | | S-2: Yellow-brown, fine to coarse sand, gravel and boulders, trace silt | |
| | | | | | | 35 | | | |
| | | | | | | | 8.0' | NOTE: No sample - hitting boulders | |
| 10.0' | | | | | | | | RUN #1: 8.0-13.0' RECOVERY: 56" Core Time per/foot 12:-9:-9:-14:-16: | |
| | | | | | | | 13.0' | | |
| 15.0' | | | | | | | | Bottom of Exploration at 13.0' | |
| 20.0' | | | | | | | | NOTE: Made four attempts getting down through boulders. Hitting refusals at 5.2', 5.7', 6.5', and 6.0'. Augered down to 8.0' depth, then switched to casing with spinning shoe. | |
| 25.0' | | | | | | | | | |
| 30.0' | | | | | | | | | |

**Driller:** M. D'Ambrosio
**Helper:** K. Smith
**Inspector:**

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

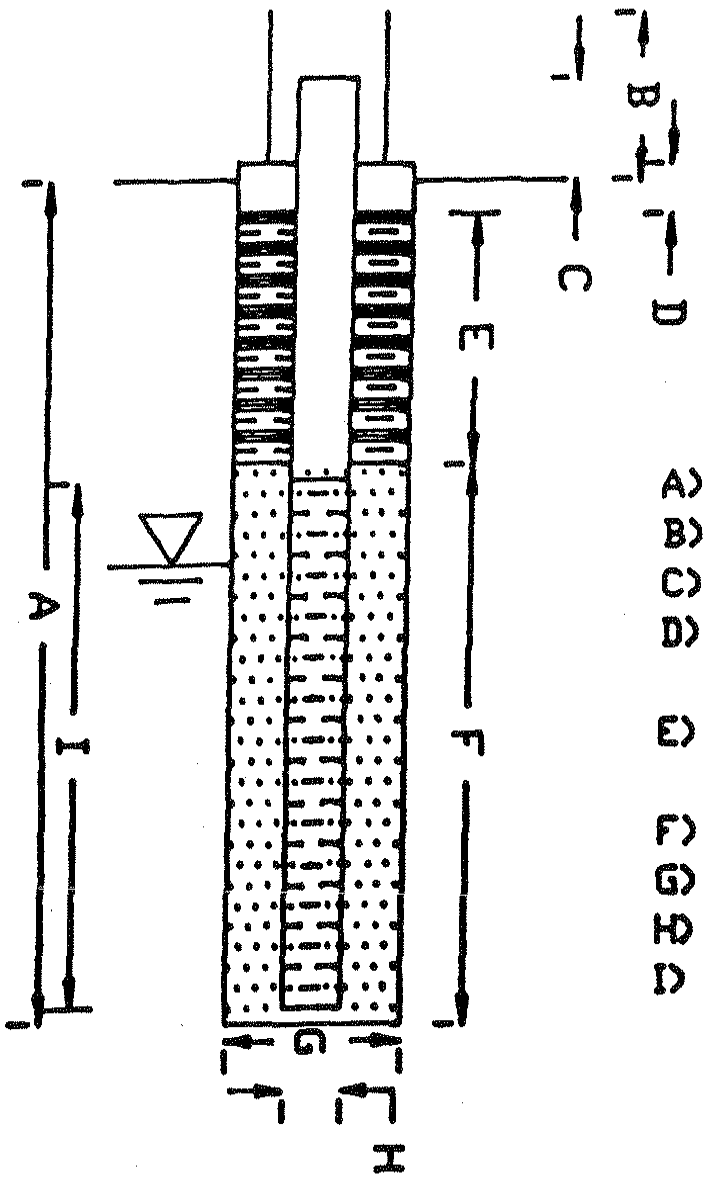
PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

**NOTES**

See attached sheet for Monitoring Well installation

**REMARKS:** THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

# MONITORING WELL DIAGRAM




A) Borehole Depth: 13.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.0'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: 1.0'
F) Sand Pack: 12.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/28/89

Sheet 2 of 2
Boring No.: GW-39
Well No.: GW-39
Surface Elev.: _____

# GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. GW-39
LOCATION See Plan
PROJECT NO. 90718.01
SURFACE ELEV.
DATE START 11/28/89
COMPANY MILLER ENGINEERING & TESTING
DATE END 11/28/89
DRILLER M. D'Ambrosio
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVIOR: FEED | DRILLING BEHAVIOR: WATER | NOTES |
|---|---|---|---|---|---|---|---|---|---|
| | | | 8.0' | | | RUN #1:<br>Light gray, medium grained auger gneiss, with abundant dime-size feldspar crystals in finer grained matrix in felsic layers. Foliation trend ranges from sub-horizontal to approximately 60 degrees. Fracturing trends to occur along the more felsic layers. Fracture spacing avarages about 10-12" throughout core length, with some closer spaced and intersecting sets. Alteration of feldspars to clay minerals evident on some fracture surfaces.<br>REC: 56"/60" = 93% RQD: 48"/60" = 80% | | | |
| | | | 13.0 | | | | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

29 Tyngs St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #1 [redacted] Sulfate Landfill SHALLOW #1 — Date Start: 11/11/87 — Date Complete: 11/11/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Elevation (Ft.) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'0" | 4-4- | | | | Medium stiff, moist organic SILT, some fine to medium SAND, trace root matter |
| | 1A | 1'0"- 2'0" | 8-7 | | | 1'0" | |
| | 2 | 2'0"- 4'0" | 7-8-8-8 | | | | Medium dense, dry to wet, fine SAND, trace to some inorganic silt. |
| 5 | 3 | 4'0"- 5'0" | 4-6 | | | | |
| | 4 | 5'0"- 7'0" | 4-6-10-11 | | | | |
| | 5 | 7'0"- 9'0" | 13-16-17-20 | | | | |
| 10 | 6 | 9'0"- 10'0" | 46-70 | | | 9'0" | |
| | 7 | 10'0"- 12'0" | 64-34-27-35 | | | | Very dense, wet, fine SAND, and fine to coarse gravel, some inorganic silt, and medium to coarse sand, trace to some cobbles, and boulders. |
| | 8 | 12'0"- 12'9" | 58-120/3" | | | | |
| 15 | 9 | 14'0"- 14'7" | 53-120/1" | | | | |
| | | | | | | 15'0" | End of boring at 15'0"<br>Set well point at 15'0"<br>Water level at 5'6" upon completion |
| 20 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>2 - 5' x 2" PVC screen<br>1 - 2" PVC slip cap<br>1 - protective locking casing<br>1 bag - sakrete sand<br>2 bags - Portland cement<br>3 bags - silica sand<br>2 pails- bentonite pellets<br>1 bag - bentonite powder |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: — Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
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(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-1D Sulfate Landfill DEEP #1 — Date Start: 11/12/87 — Date Complete: 11/12/87 — Drilling Foreman: P.N. — Eng./Hydrol Geologist: D.C.

| Depth (Ft.) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | 0'0"- 1'0" | 4-4- | | | | ~~Medium stiff, moist, organic SILT, some fine to medium sand, trace root matter.~~ |
| | 1A | 1'0"- 2'0" | 8-7 | | | 1'0" | Medium dense, dry to wet, fine SAND, trace to some inorganic silt. |
| | 2 | 2'0"- 4'0" | 7-8-8-8 | | | | |
| 5 | 3 | 4'0"- 5'0" | 4-6 | | | | |
| | 4 | 5'0"- 7'0" | 4-6-10-11 | | | | |
| | 5 | 7'0"- 9'0" | 13-16-17-20 | | | | |
| 10 | 6 | 9'0"- 10'0" | 46-70 | | | 9'0" | Very dense, wet, fine SAND, and fine to coarse gravel, some inorganic silt, and medium to coarse sand, some cobbles and boulders. |
| | 7 | 10'0"- 12'0" | 64-34-27-35 | | | | |
| | Run #1 | 12'6"- 13'6" | 14 min./foot | | | | |
| | | 13'6"- 14'6" | 17 min./foot | | | 12'6" | Run #1 NX CORED ROCK from 12'6" to 14'6". Recovery 24"/24" = 100%. |
| 15 | | | | | | 14'6" | End of boring at 14'6"<br>Set well point at 14'6"<br>Water level at 5'6" upon completion |
| 20 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>1 - 5' x 2" PVC riser<br>1 - 2" PVC slip cap<br>1 - protective locking casing<br>2 bags - sakrete sand<br>2 bags - Portland cement<br>3 bags - silica sand<br>2 pails- bentonite pellets<br>1 bag - bentonite powder |
| 25 | | | | | | | |
| 30 | | | | | | | NOTE : Blows And Soil Descriptions Used From SL-1S (Shallow), Per Client. |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO: Type #2 SL-2D Sulfate Landfill DEEP #2 — Date Start: 11/13/87 — Date Complete: 11/13/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Elevation | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'0" | 3-4- | | | | Loose, moist, fine to medium SAND, some organic silt, trace root matter. |
| | 1A | 1'0"- 2'0" | 9-9 | | | 1'0" | Medium dense, dry to wet, fine SAND, trace to some inorganic silt. |
| | 2 | 2'0"- 4'0" | 5-7-7-6 | | | | |
| 5 | 3 | 4'0"- 5'0" | 6-7 | | | | |
| | 4 | 5'0"- 7'0" | 7-10-10-12 | | | | |
| | 5 | 7'0"- 9'0" | 10-14-11-15 | | | | |
| 10 | 6 | 9'0"- 10'0" | 7-7 | | | | |
| | 7 | 10'0"- 12'0" | 6-9-9-8 | | | | |
| | 8 | 12'0"-12'10" | 27-120/4" | | | 12'0" | Very dense, wet, fine to medium SAND, fine to coarse gravel, some coarse and inorganic silt, few cobbles and boulders. |
| | Run #1 | 13'0"- | 14'0" 18 min./foot | | | 13'0" | Run #1 NX CORED ROCK from 13' to 15'. |
| 15 | | 14'0"- | 15'0" 21 min./foot | | | | Recovery 18"/24" = 75% |
| | | | | | | 15'0" | End of boring at 15'0"<br>Set well point at 15'0"<br>Water level at 5'7" upon completion |
| 20 | | | | | | | |
| 25 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>2 - 5' x 2" PVC riser<br>1 - protective locking casing<br>1 bag - sakrete sand<br>1 bag - Portland cement<br>3 bags - silica sand<br>2 pails- bentonite pellets<br>1 bag - bentonite powder |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-3D Sulfate Landfill DEEP #3 — Date Start: 11/20/87 — Date Complete: 11/20/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Depth (Feet) | Sample No | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 0'6" | 1- | | | | TOPSOIL. |
| | 1A | 0'6"- 2'0" | 2-2-3 | | | 0'6" | Loose, moist, fine SAND, some inorganic silt, trace root matter. |
| | 2 | 2'0"- 3'6" | 3-3-4- | | | | |
| | 2A | 3'6"- 4'0" | 5 | | | | |
| 5 | 3 | 5'0"- 7'0" | 9-11-11-12 | | | 3'6" | Medium dense, dry to wet, medium to coarse SAND, some fine sand, trace inorganic silt, and medium gravel. |
| | 4 | 7'0"- 9'0" | 15-10-8-12 | | | | |
| 10 | 5 | 10'0"- 12'0" | 5-5-6-6 | | | (1) | |
| | 6 | 12'0"- 13'6" | 7-13-10- | | | | |
| | 6A | 13'6"- 14'0" | 21 | | | | |
| 15 | 7 | 15'0"- 17'0" | 14-17-14-12 | | | | |
| | 8 | 17'0"- 17'7" | 29-120/1" | | | 17'0" (2) | Very dense, wet, fine to medium SAND, some medium to coarse gravel, and inorganic silt, few cobbles and boulders. |
| 20 | Run #1 | 19'0"- 20'0" | 6 min./foot | | | 19'0" | Run #1 NX CORED ROCK from 19' to 21'. Recovery 14"/24" = 58.3% |
| | | 20'0"- 21'0" | 10 min./foot | | | | |
| | | | | | | 21'0" | End of boring at 21'0"<br>Set well point at 21'0"<br>Water level at 12'6" upon completion |
| 25 | | | | | | | |
| | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>1 - 10' x 2" PVC riser<br>1 - 5' x 2" PVC riser<br>1 - protective locking casing<br>1 bag - sakrete sand<br>2 bags - Portland cement<br>2 bags - silica sand<br>1 pail - bentonite pellets<br>1 bag - bentonite powder |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Hygeia St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, , EAMES STREET, WILMINGTON, MA

BORING NO: Type #2 SL-4D Sulfate Landfill DEEP #4 — Date Start: 11/16/87 — Date Complete: 11/16/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Elevation | Sample No | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'0" | 1-2- | | | | Loose, moist TOPSOIL. |
| | 1A | 1'0"- 2'0" | 6-6 | | | 1'0" | Loose, moist GYPSUM. |
| | 2 | 2'0"- 4'0" | 3-4-4-4 | | | | |
| 5 | 3 | 4'0"- 4'0" | 120/0" | | | 4'0" | Very dense, dry, fine SAND, some medium to coarse gravel, and inorganic silt, few cobbles, and boulders. |
| | 4 | 5'0"- 7'0" | 15-29-31-36 | | | | |
| | 5 | 7'0"- 7'8" | 41-120/2" | | | | |
| | Run #1 | 8'0"- | 9'0" 3 min./foot | | | 8'0" | Run #1 NX CORED ROCK from 8'0" to 13'0". Recovery 14"/60" = 23.3% Weathered and many fractures. |
| 10 | | 9'0"- | 10'0" 3 " | | | | |
| | | 10'0"- | 11'0" 5 " | | | | |
| | | 11'0"- | 12'0" 9 " | | | | |
| | | 12'0"- | 13'0" 8 " | | | | |
| 15 | | | | | | 13'0" | End of boring at 13'0" Set well point at 10'8" (Due to obstruction in core hole). No water encountered upon completion |
| 20 | | | | | | | Well Materials; 1 - 2" PVC end plug; 1 - 5' x 2" PVC screen; 1 - 10' x 2" PVC riser; 1 - protective locking casing; 1 bag - sakrete sand; 2 bags - silica sand; 1 pail - bentonite pellets |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #2 SL-5D Sulfate Landfill DEEP #5 — Date Start: 11/17/87 — Date Complete: 11/17/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Depth (Feet) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 2'0" | 3-2-4-3 | | | | Loose to medium dense, dry to moist, fine SAND, some inorganic silt, trace medium to coarse sand, medium to coarse gravel, wood, and blasted rock. |
| | 2 | 2'0"- 4'0" | 9-5-6-8 | | | | |
| 5 | 3 | 5'0"- 7'0" | 3-3-5-4 | | | | |
| | 4 | 7'0"- 7'5" | 120/5" | | | 7'0" | Very dense, dry to moist, fine SAND, and medium to coarse gravel, some inorganic silt, and medium to coarse snad, few cobbles, and boulders, trace weathered rock. |
| 10 | 5 | 10'0"- 10'7" | 37-120/1" | | | | |
| | Run #1 | 13'0"- 14'0" | 8 min./foot | | | 13'0" | Run #1 NX CORED ROCK from 13'0" to 15'6". Recovery 23"/30" 76.6% |
| 15 | | 14'0"- 15'0" | 7 min./foot | | | | |
| | | 15'0"- 15'6" | 5 min./½ foot | | | 15'6" | End of boring at 15'6"<br>Set well point at 15'0"<br>No water encountered upon completion<br>NOTE : Water at 14'6" after 24 Hours |
| 20 | | | | | | | |
| 25 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>2 - 5' x 2" PVC riser<br>1 - protective locking casing<br>1 bag - sakrete sand<br>1 bag - Portland cement<br>2 bags - silica sand<br>1 pail - bentonite pellets<br>½ bag - bentonite powder |
| 30 | | | | | | | |
| 35 | | | | | | | NOTE : This hole was a second attempt. On the first attempt the hole went off due to blasted rock. Moved 4'0" forward. |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 ~~SL-6D~~ Sulfate Landfill DEEP #6 — Date Start: 11/18/87 — Date Complete: 11/18/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Elevation | Sample No | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 2'0" | 3-4-4-4 | | | | Loose, moist, fine SAND, some inorganic silt, trace blasted rock, medium to coarse gravel, and organic silt, mixed. |
| | 2 | 2'0"- 3'0" | 9-10- | | | | |
| | 2A | 3'0"- 4'0" | 5-4 | | | | |
| 5 | 3 | 5'0"- 7'0" | 2-3-3-5 | | | | |
| | 4 | 7'0"- 9'0" | 7-7-5-6 | | | 7'0" | Medium dense, moist, fine SAND, some organic silt, trace wood and root matter |
| 10 | 5 | 10'0"- 12'0" | 4-6-5-5 | | | 9'0" (1) | Medium dense, dry to moist to wet, fine SAND, trace to some inorganic silt. |
| | 6 | 12'0"- 14'0" | 6-7-7-8 | | | | |
| 15 | 7 | 15'0"- 17'0" | 35-30-31-44 | | | 14'6" (2) | Very dense, wet, fine to coarse SAND, some medium to coarse gravel, few cobbles, and boulders, trace inorganic silt. |
| 20 | Run #1 | 19'0"- 20'0" | 8 min./foot | | | 19'0" | Run #1 NX CORED ROCK from 19' to 21'. Recovery 24"/24" |
| | | 20'0"- 21'0" | 8 min./foot | | | | |
| | | | | | | 21'0" | End of boring at 21'0"<br>Set well point at 21'0"<br>Water level at 12'0" upon completion |
| 25 | | | | | | | |
| 30 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 10' x 2" PVC screen<br>1 - 10' x 2" PVC riser<br>1 - 5' x 2" PVC riser<br>1 - protective locking casing<br>1 bag - sakrete sand<br>1 bag - Portland cement<br>3 bags - silica sand<br>1 pail - bentonite pellets<br>½ bag - bentonite powder |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. Moisture content indicated may be affected by time of year and water added during the drilling process. Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual.

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #2 SL-7D Sulfate Landfill DEEP #7 — Date Start: 11/19/87 — Date Complete: 11/19/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Elevation | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'9" | 15-27-20-120/3" | | | | Very dense, dry, fine SAND, some inorganic silt, and medium to coarse gravel, few cobbles and boulders, trace weathered rock. |
| 5 | 2 | 4'0"- 5'1" | 67-47-120/1" | | | | |
| | 3 | 6'0"- 6'5" | 120/5" | | | | |
| | Run #1 | 7'0"- 8'0" | 6 min./foot | | | 7'0" | Run #1 NX CORED ROCK from 7'0" to 10'0". Recovery 28"/36" = 77.7% |
| | | 8'0"- 9'0" | 11 min./foot | | | | |
| 10 | | 9'0"- 10'0" | 10 min./foot | | | 10'0" | End of boring at 10'0"<br>Set well point at 10'0"<br>No water encountered upon completion |
| 15 | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 5' x 2" PVC screen<br>2 - 5' x 2" PVC riser<br>1 - protective locking casing<br>1 bag - sakrete sand<br>½ bag - Portland cement<br>2 bags - silica sand<br>½ pail - bentonite pellets<br>½ bag - bentonite powder |
| 20 | | | | | | | |
| 25 | | | | | | | NOTE : This hole is a second attempt. On the first attempt the hole was cored 2' to 5', with cobbles and boulders. Moved 3'0" and started new hole. |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

## Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO: Type #2 ~~SL-[illegible]~~ Sulfate Landfill DEEP #8 — Date Start: 11/19/87 — Date Complete: 11/19/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

| Depth | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 2'0" | 5-7-11-9 | | | 3 | Medium dense, dry, fine SAND, some medium to coarse sand, fine gravel, trace cobbles, root matter, inorganic and organic silt, (fill). |
| | Run #1 | 3'0"- | 4'0" 4 min./foot | | | 3'0" | Run #1 NX CORED ROCK from 3'0" to 6'0". Recovery 26"/36" = 72.2% Fractures. |
| 5 | | 4'0"- | 5'0" 7 min./foot | | | | |
| | | 5'0"- | 6'0" 9 min./foot | | | | |
| | | | | | | 6'0" | End of boring at 6'0"<br>Set well point at 6'0"<br>No water encountered upon completion |
| 10 | | | | | | | |
| | | | | | | | Well Materials;<br>1 - 2" PVC end plug<br>1 - 5' x 2" PVC screen<br>1 - 5' x 2" PVC riser<br>1 - buffalo box<br>1 bag - sakrete sand<br>1 bag - silica sand<br>½ pail - bentonite pellets |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring — Casing Size: — Hollow Stem Auger Size: 4½

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 12/18/87 — Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #5 Intereptor — Ground Elev.: — Date Start: 11/30/87 — Date Complete: 11/30/87 — Drilling Foreman: P.N. — Eng./Hydrol Geologist: D.C.

| Elevation | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | Sample description taken from Type #3<br><br>Moist to wet, fine to medium SAND, trace inorganic silt, trace fine to medium gravel. |
| 5 | | | | | | | |
| 10 | | | | | | | |
| 15 | | | | | | 15'0" | Wet, fine to medium SAND, trace to some inorganic silt, trace fine to coarse gravel, trace cobbles.<br><br>NOTE : AIR ROTARY performed 11/30/87 and;<br>1. 12" Roller bit to 38' in soil.<br>2. 12" Roller bit 38'-40' in bedrock<br>3. Set 10" casing to 40'<br>4. Installed 6" PVC monitor well at 38'<br>Gravel pack : 38' - 5'<br>Bentonite Plug : 5' - 3'<br>WELL MATERIALS;<br>30' x 6" PVC screen (.015)<br>10' x 6" PVC riser<br>8" protective locking casing<br>2 pail - bentonite pellets<br>3 - concrete - steel guard posts.<br>Gravel. |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | 38'0" | BEDROCK<br>12" Roller bit 38' to 40' in bedrock. |
| | | | | | | 40'0" | End of boring at 40'0"<br>Water level at 9'0" upon completion<br>Set 6" PVC monitor well at 38'0" |

Type of Boring: Casing Size:

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Sheet # ___ of ___

## Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-1 — Ground Elev.: — Date Start: 10/15/87 — Date Complete: 10/16/87 — Drilling Foreman: B.S. — Eng./Hydrol. Geologist: J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : No split-spoon samples required<br>auger probe<br>soil description made from auger |
| 5 | | | | | | | Medium dense, dry, to wet, fine to medium SAND, trace coarse sand and fine gravel, trace inorganic silt. |
| 10 | | | | | | | |
| | | | | | | 12'0" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand and inorganic silt. |
| 15 | | | | | | | |
| | Run #1 | 17'6"- | 18'6" | 17 min./foot | | 17'6" | Refusal with hollow-stem auger, spoon & carbide roller at 17'6".<br>CORED ROCK from 17'6" - 20'6"<br>**See below Recovered 26" = 72.2% |
| | | 18'6"- | 19'6" | 12 | " | | |
| 20 | | 19'6"- | 20'6" | 27 | " | | |
| | | | | | | 20'6" | End of boring at 20'6"<br>Water table at 10'8" upon completion<br>Unable to advance hollow-stem auger or carbide roller bit. |
| 25 | | | | | | | |
| 30 | | | | | | | ** NOTE : Unable to core past 3'0" - tools jamming in rock.<br>Many fractures and few voids.<br>No loss of water. |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-2 — Ground Elev. — Date Start 10/16/87 — Date Complete 10/18/87 — Drilling Foreman SEYMOUR/ JUINTA — Eng./Hydrol. Geologist J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : No split-spoon samples required auger probe<br>Soil description made from auger.<br><br>Medium dense, dry to wet, fine to medium SAND, trace coarse sand, and fine gravel, trace inorganic silt. |
| 5 | | | | | | | |
| 10 | | | | | | | |
| | | | | | | 11'0" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt. |
| 15 | | | | | | | |
| 20 | | | | | | | |
| | Run #1 | 23'0"- | 24'0" | 16 min./foot | | 23'0" | Refusal with hollow-stem auger, and carbide roller-bit at 23'0"<br>CORED ROCK from 23'0"- 28'0"<br>Recovered 20" = 33.3%<br>** See Below |
| 25 | | 24'0"- | 25'0" | 22 | " | | |
| | | 25'0"- | 26'0" | 18 | " | | |
| | | 26'0"- | 27'0" | 31 | " | | |
| | | 27'0"- | 28'0" | 17 | " | | |
| 30 | | | | | | 28'0" | End of boring at 28'0"<br>Water table at 10'2" upon completion<br><br>NOTE : Unable to advance hollow-stem auger or roller bit.<br>Few fractures, no detectable voids.<br>No loss of water. |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring — Casing Size: — Hollow Stem Auger Size: 3¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-3 — Ground Elev. — Date Start 10/18/87 — Date Complete 10/18/87 — Drilling Foreman SEYMOUR — Eng./Hydrol. Geologist J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : No split-spoon samples required<br>Soil description made from auger. |
| 5 | | | | | | | Medium dense, dry to wet, fine to medium SAND, trace coarse sand and fine gravel, trace inorganic silt. |
| 10 | | | | | | | |
| 15 | | | | | | 14'0" | Very dense, wet, coarse GRAVEL, cobbles and boulder, some fine to coarse sand, and inorganic silt. |
| 20 | | | | | | | |
| 25 | Run #1 | 24'0"- | 25'0" | 9 min./foot | | 24'0" | Refusal at 24'0"<br>CORED ROCK from 24'0" - 29'0"<br>Recovered 25" = 41.6%<br>Unable to advance hollow-stem auger or roller bit. Few fractures - no voids. No loss of water. |
| | | 25'0"- | 26'0" | 12 | " | | |
| | | 26'0"- | 27'0" | 10 | " | | |
| | | 27'0"- | 28'0" | 10 | " | | |
| | | 28'0"- | 29'0" | 10 | | | |
| 30 | | | | | | 29'0" | End of boring at 29'0"<br>Water level at 10'2" upon completion |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring — Casing Size: — Hollow Stem Auger Size: 3½

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No.: 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-4 — Ground Elev.: — Date Start: 10/19/87 — Date Complete: 10/19/87 — Drilling Foreman: SEYMOUR — Eng./Hydrol. Geologist: J.P.

| DEPTH | Sample Data: Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Soil and/or bedrock strata descriptions: Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : No split-spoon samples required<br><br>Soil description made from auger. |
| 5 | | | | | | | Medium dense, dry to wet, fine to medium SAND, trace coarse sand and fine gravel, trace inorganic silt. |
| 10 | | | | | | | |
| 15 | | | | | | 15'0" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt. |
| 20 | | | | | | | |
| 25 | | | | | | | |
| 30 | Run #1 | 29'0"- | 30'0" | 13 min./foot | | 29'0" | Refusal with hollow-stem auger and carbide roller bit at 29'0".<br>CORED ROCK from 29'0" - 32'0"<br>**See Below |
| | | 30'0"- | 31'0" | 28 " | | | |
| | | 31'0"- | 32'0" | 45 " | | | |
| | | | | | | 32'0" | End of boring at 32'0"<br>Water level at 10'1" upon completion |
| 35 | | | | | | | ** Recovered 0" = 0%<br>Few fractures- no voids.<br>No loss of water. |
| 40 | | | | | | | |

Type of Boring: Casing Size: — Hollow Stem Auger Size: 3¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No.: 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-5 — Ground Elev.: — Date Start: 10/19/87 — Date Complete: 10/20/87 — Drilling Foreman: SEYMOUR — Eng./Hydrol. Geologist: J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : No split-spoon samples required |
| | | | | | | | Soil description made from auger. |
| 5 | | | | | | | |
| 10 | | | | | | | Medium dense, dry to wet, fine to medium SAND, trace coarse sand, and fine gravel, trace inorganic silt. |
| 15 | | | | | | 15'0" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt. |
| 20 | | | | | | | |
| 25 | Run #1 | 24'0"- | 25'0" | | | 24'0" | Refusal with hollow-stem auger and roller bit at 24'0" |
| | | 25'0"- | 26'0" | | | | CORED ROCK from 24'0" to 29'0" |
| | | 26'0"- | 27'0" | | | | Recovered 6" = 10% Loss of water. |
| | | 27'0"- | 28'0" | | | | Very irregular core time, many seams and voids. Cored boulders and cobbles. |
| | | 28'0"- | 29'0" | | | | |
| 30 | | | | | | 29'0" | End of boring at 29'0" |
| | | | | | | | Water level at 9'8" upon completion |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 3½

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

## Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-6 — Ground Elev. — Date Start 10/20/87 — Date Complete 10/21/87 — Drilling Foreman SEYMOUR — Eng./Hydrol. Geologist J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'6" | 2-2-4 | | | | Medium dense, dry to wet, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt. |
| 5 | 2 | 4'0"- 5'6" | 6-5-10 | | | | |
| 10 | 3 | 9'0"- 10'6" | 8-6-7 | | | | |
| 15 | 4 | 14'0"- 15'6" | 4-4-6 | | | | |
| | | | | | | 17'6" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt. |
| 20 | 5 | 19'0"-19'10" | 42-80/4"-100/0" | | | | |
| 25 | 6 | 24'0"- 25'1" | 45-35-100/1" | | | | |
| 30 | 7 | 29'0"- 30'2" | 21-39-80/2" | | | | |
| | 8 | 32'0"- 32'0" | 100/0" | | | 32'0" | Refusal with hollow-stem auger, carbide roller bit and spoon at 32'0" |
| 35 | | | | | | | CORED ROCK from 32'0" - 37'0". Recovered 8" = 13.3% Irregular core times. Many seams & voids Loss of drill water. Cored cobbles & boulde |
| | | Well Materials: | | | | | |
| | | 1 - 2" PVC end plug | | | | 37'0" | End of boring at 37'0" |
| | | 1 - 10'x 2" PVC screen | | | | | Set well point at 28'0" |
| 40 | | 1 - 20'x 2" PVC riser | | | | | Water table at 10'0" upon completion. |
| | | 1 - 2" PVC slip cap | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

## Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-7 — Ground Elev.: — Date Start: 10/21/87 — Date Complete: 10/21/87 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'6" | 7-8-8 | | | | Medium dense, dry to wet, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt. |
| 5 | 2 | 4'6"- 6'0" | 6-7-6 | | | | |
| 10 | 3 | 9'6"- 11'0" | 4-4-6 | | | | |
| | | | | | | 13'0" | |
| 15 | 4 | 14'0"- 15'6" | 31-22-24 | | | | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand and inorganic silt. |
| 20 | 5 | 19'0"- 20'6" | 46-57-39 | | | | |
| | 6 | 23'0"- 23'0" | 100/0" | | | | |
| | Run #1 | 23'0"- | 24'0" 12 min./foot | | | 23'0" | Refusal with hollow-stem auger, carbide roller bit and spoon at 23'0" CORED ROCK from 23'0"- 28'0" Recovered 26" = 43.3% Few seams, no voids. No loss of water. |
| 25 | | 24'0"- | 25'0" 10 " | | | | |
| | | 25'0"- | 26'0" 13 " | | | | |
| | | 26'0"- | 27'0" 12 " | | | | |
| | | 27'0"- | 28'0" 15 | | | | |
| | | | | | | 28'0" | End of boring at 28'0" Water level at 9'10" upon completion |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

## Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-8 — Ground Elev. — Date Start 10/22/87 — Date Complete 10/22/87 — Drilling Foreman SEYMOUR — Eng./Hydrol. Geologist J.P.

| DEPTH | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | 1 | 0'0"- 1'6" | 4-5-3 | | | | Medium dense, dry to moist, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt. |
| 5 | 2 | 4'0"- 5'6" | 8-4-5 | | | | |
| 10 | 3 | 9'0"- 10'6" | 28-31-44 | | | 8'6" | Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand and inorganic silt. |
| 15 | 4 | 14'0"- 14'8" | 22-80/2"-100/0" | | | | |
| | 5 | 18'6"- 18'6" | 120/0" | | | | |
| | Run | #1 18'6"- | 19'6" | 12 min./foot | | 18'6" | Refusal with hollow stem auger, carbide roller bit, and spoon at 18'6". CORED ROCK from 18'6" - 23'6". Recovered 20" = 33.3% Few seams. No voids. No loss of water. |
| 20 | | 19'6"- | 20'6" | 12 | " | | |
| | | 20'6"- | 21'6" | 10 | " | | |
| | | 21'6"- | 22'6" | 12 | " | | |
| | | 22'6"- | 23'6" | 11 | " | | |
| 25 | | | | | | 23'6" | End of boring at 23'6" Water level at 9'10" upon completion |
| 30 | | | | | | | |
| 35 | | | | | | | |
| 40 | | | | | | | |

Type of Boring — Casing Size: — Hollow Stem Auger Size: 3¼

**Proportion Percentages**
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

**Granular Soils (blows per ft.)**
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

**Cohesive Soils (blows per ft.)**
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer failing 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

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- ☐ PHILADELPHIA, PA. 2

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address olin Corp. Willmington, Mass.

Boring No. 10

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost o Rem |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 1'6" | Brown sand fine to | | | | | | | | | | |
| | | medium grade | | | | | | | | | | |
| 1'6" | | Refusal (Possible Ledge) | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentin

Helper G. Birchard,

Rig. No. 21

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

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- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA. 215 563-[illegible]

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address Olin Corp. - Wilmington, Mass.

Boring No. 9

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in | Lost Water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 1'6" | Brown sand | | | | | | | | | | |
| 1'6" | | Refusal | | | | | | | | | | |
| | | (Possible Metal) | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Driller _____

Water level is _____ ft. below Ground surface _____ hrs. after completion

Helper _____

Water level is _____ ft. below Ground surface _____ hrs. after completion

Rig. No. _____

Boring stopped by _____

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203-[illegible]
- ☐ NEW HAVEN, CT 203-[illegible]
- ☐ NEW LONDON, CT. 203-443-[illegible]
- ☐ NEWARK, N.J. 201-589-[illegible]
- ☐ PHILADELPHIA, PA. 215-553-[illegible]

Page _____ of _____

Date Thursday, Dec. 4, 1980

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No. 3

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost Water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 8' | Light brown sand fine | | | | | | | | | | |
| | | to medium grade | | | | | | | | | | |
| 8' | 10' | Light brown sand fine | | | | | | | | | | |
| | | to medium grade | | | | | | | | | | |
| 10' | 11' | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ NEW HAVEN, CT 203.777-[illegible]
- ☐ NEW LONDON, CT. 203.443-[illegible]
- ☐ NEWARK, N.J. 201.589-[illegible]
- ☐ PHILADELPHIA, PA. 215.560-[illegible]


Page _____ of _____

Date December 4th, 1990

Job No. _____

Job Address Clin Corp. Wilmington, Mass.

Boring No. 6

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost Water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 4' | Brown sand, heavily | | | | | | | | | | |
| | | stained by Product | | | | | | | | | | |
| 4' | 8' | Brown sand | | | | | | | | | | |
| 8' | 10' | Brown sand small | | | | | | | | | | |
| | | boulders | | | | | | | | | | |
| 10' | 10'6" | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. Doe

Rig. No. 21

# NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

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- ☐ NEW LONDON, CT. 203-443-44[illegible]
- ☐ NEWARK, N.J. 201-589-[illegible]
- ☐ PHILADELPHIA, PA. 215-563-[illegible]

Page _____ of _____

Job No. _____

Boring No. 1

Date December 3rd, 1980

Job Address Olin Chemical Wilmington, Mass.

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in | Lost Water or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 10' | Fine Brown Sand | | | | | | | | | | |
| 10' | 14' | Fine Brown Sand | | | | | | | | | | |
| | | Medium Boulders | | | | | | | | | | |
| 14' | 14'6" | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

**CONTROL CO., INC.**
7 EDGEWATER PLACE
EAST NORWALK, CT 06855

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☐ NEWARK, N.J. 201/589-1282
☐ PHILADELPHIA, PA. 215/563-9490

Page _____ of _____

Date December 3rd, 1980

Job No. _____

Job Address Olin Chemical Wilmington, Mass.

Boring No. 2

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost Water or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 3' | Brown Sand | | | | | | | | | | |
| 3' | 3'-6" | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Brichard, J. Barker

Rig. No. 21

# CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
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☐ NEW LONDON, CT. 203/443-
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☐ PHILADELPHIA, PA. 215/563-94

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address Clin Corp. Wilmington, Mass.

Boring No 4

Fixed Datum used is _____

Ground Surface this boring is _____

| DEPTH From | DEPTH To | CLASSIFICATION Be Careful and Accurate | CASING BLOWS 0-27 | CASING BLOWS 28-54 | SAMPLE No. | Depth | No. of 30" Blows on Spoon 1st 6" | 2nd 6" | 3rd 6" | 4th 6" | Recovery in. | Lost Water * or Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0' | 10' | Fine Medium Brown Sand | | | | | | | | | | |
| 10' | 12'6" | Fine Medium Brown | | | | | | | | | | |
| | | Sand Small to Medium | | | | | | | | | | |
| | | Boulders | | | | | | | | | | |
| 12'6" | | Refusal | | | | | | | | | | |

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. Ba

Rig. No. 21

Leominster MA 01453
(617) 840-0391

# SOIL EXPLORATION CORP. STATE
## Geotechnical Drilling and Groundwater Monitor Wells

Nashua, NH 03060
(603) 882-3601

Client OLIN CHEMICAL — Date 12/18/87 — Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

| Depth (Ft.) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : NX CORE from 0'0" to 50'0"<br>CORED GROUT from 0'0" to 21'0"<br>CORED BEDROCK from 21'0" to 50'0". |
| | | | | | | | Run #1 0'0"- 5'0"<br>Recovery 18"/60" = 30% |
| 5 | | | | | | 5'0" | Run #2 0'5"- 10'0"<br>Recovery 60"/60" = 100% |
| 10 | | | | | | 10'0" | Run #3 10'0"- 15'0"<br>Recovery 60"/60" = 100% |
| 15 | | | | | | 15'0" | Run #4 15'0"- 20'0"<br>Recovery 60"/60" = 100% |
| 20 | | | | | | 20'0" | Run #5 20'0"- 21'0"<br>Recovery 12"/12" = 100% |
| | | | | | | 21'0" | Run #6 21'0"- 23'0"<br>Recovery 18"/24" = 75% |
| | | | | | | 23'0" | Run #7 23'0"- 24'0"<br>Recovery 12"/12" = 100% |
| 25 | | | | | | 24'0" | Run #8 24'0"- 28'0"<br>Recovery 48"/48" = 100% |
| 30 | | | | | | 28'0" | Run #9 28'0"- 32'0"<br>Recovery 30"/48" = 62.5% |
| | | | | | | 32'0" | Run #10 32'0"- 35'0"<br>Recovery 36"/36" = 100% |
| 35 | | | | | | 35'0" | Run #11 35'0"- 37'0"<br>Recovery 18"/24" = 75% |
| | | | | | | 37'0" | Run #12 37'0"- 40'0"<br>Recovery 36"/36" = 100% |
| 40 | | | | | | 40'0" | |

Type of Boring — Casing Size: 8" — NX Core

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Leominster, MA 01453
(617) 840-0391

# Geotechnical Drilling and Groundwater Monitor Wells

(603) 882-3601

Client: OLIN CHEMCIAL — Date: 12/18/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

| Depth | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | Run #13 40'0"- 43'0"<br>Recovery 34"/36" = 94.% |
| | | | | | | 43'0" | Run #14 43'0"- 48'0"<br>Recovery 48"/60" = 80% |
| 45 | | | | | | | |
| | | | | | | 48'0" | Run #15 48'0"- 50'0"<br>Recovery 24"/24" = 100% |
| 50 | | | | | | 50'0" | End of boring at 50'0"<br>No water encountered upon completion |
| 55 | | | | | | | NOTE : ROCK CORING was performed starting 12/14/87 to 12/17/87. |
| | | | | | | | AIR ROTARY was performed on 11/30/87 and;<br>1. 12" Roller bit to 18' in soil<br>2. 12" Roller bit 18' to 21' in bedrock<br>3. Set 8" Casing to 21' - drive casing with hammer to refusal.<br>4. Grouted inside and outside of 8" casing to surface.<br>80% Portland cement<br>20% Bentonite pellets |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |
| 75 | | | | | | | |
| 80 | | | | | | | |

Type of Boring: Casing Size: 8" NX Core

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-1
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 27'-4"
DATE START: 6/18/86
DRILLING FOREMAN T. Comulka
TOTAL DEPTH 32'-4"
DATE END: 6/18/86
MEAT REPRESENTATIVE W. Childs
WATER DEPTH 6.2'

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING lead | BEHAVOIR water | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | 27'-4" | | | Run #1: 27'-4" to 29'-7"<br>Dark grey-green fine-grained granodiorite, moderately fractured.<br>Rec: 2'-3"/2'-3" 100% RQD 4"/2'-3" 15% | 7-10 min/foot | No change in color<br>some loss | |
| | | | 29'-7" | | | Run #2: 29'-7" to 32'-4"<br>Same as run #1, with less fracturing.<br>Rec: 2'-9"/2'-9" 100% RQD 27"/33" 82% | 7-12 min/foot | No change in color | |
| | | | 32'-4" | | | Terminated at 32'-4" in bedrock. | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA — BORING NO. B-3 — LOCATION See Plan — SURFACE ELEV.

PROJECT NO. 60321.01 — BORING CO. Miller Eng'ring & Test. — DEPTH OF OVERBURDEN 30'-9"

DATE START: 6/23/86 — DRILLING FOREMAN T. Gomulka — TOTAL DEPTH 37'-9"

DATE END: 6/24/86 — MES&T REPRESENTATIVE W. Childs — WATER DEPTH 7'-3"

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING lead | BEHAVOIR water | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | 26'-2" | | | Run #1 26'-2" to 28'-0" Boulder<br>Dark grey, fine-grained granodiorite.<br>REC: 8"/22" 36% RQD 4"/8" 50% | 9 min/foot | No change in color | Run #1: Boulder not counted as part of 5' core. |
| | | | 28'-0" | | | | | | |
| | | | 30'-9" | | | | | | |
| | | | 33'-9" | | | Run #2 30'-9" to 33'-9"<br>Dark grey-green, fine-grained granodiorite highly fractured.<br>REC 26"/36" 72% RQD 15"/26" 58% | 9-11 min/foot | No change in color | Sand lense 32'-11" to 33"-9" |
| | | | 35'-9" | | | Run #3 33'-9" to 35'-9"<br>Same as Run #2, less fractured.<br>REC 20"/24" 83% RQD 15"/20" 75% | 10-12 min/foot | No change in color | |
| | | | 37'-9" | | | Run #4 35'-9" to 37'-9"<br>Same as Run #2, less fractured.<br>REC 22"/24" 92% RQD 15"/22" 68% | 10-12 min/foot | No change in color | |
| | | | | | | Terminated at 37'-9" in bedrock. | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMCIAL — Date: 12/18/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

| Elevation | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | Run #13 40'0"- 43'0"<br>Recovery 34"/36" = 94.% |
| | | | | | | 43'0" | Run #14 43'0"- 48'0"<br>Recovery 48"/60" = 80% |
| 45 | | | | | | | |
| | | | | | | 48'0" | Run #15 48'0"- 50'0"<br>Recovery 24"/24" = 100% |
| 50 | | | | | | 50'0" | End of boring at 50'0"<br>No water encountered upon completion |
| 55 | | | | | | | NOTE : ROCK CORING was performed starting 12/14/87 to 12/17/87. |
| | | | | | | | AIR ROTARY was performed on 11/30/87 and;<br>1. 12" Roller bit to 18' in soil<br>2. 12" Roller bit 18' to 21' in bedrock<br>3. Set 8" Casing to 21' - drive casing with hammer to refusal.<br>4. Grouted inside and outside of 8" casing to surface.<br>80% Portland cement<br>20% Bentonite pellets |
| 60 | | | | | | | |
| 65 | | | | | | | |
| 70 | | | | | | | |
| 75 | | | | | | | |
| 80 | | | | | | | |

Type of Boring — Casing Size: 8" — NX Core

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster MA 01453
(617) 840-0391

# SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client OLIN CHEMICAL | Date 12/18/87 | Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK | Ground Elev. | Date Start 11/30/87 | Date Complete 12/17/87 | Drilling Foreman P.N. | Eng./Hydrol. Geologist D.C.

| Depth (ft.) | Sample No. | Sample Depth (ft.) | Blows 6" Penetration | Rec. Inches | Casing Blows Per ft. | Strata Change Depth | Visual Identification of Soil and/or Rock Strata |
|---|---|---|---|---|---|---|---|
| | | | | | | | NOTE : NX CORE from 0'0" to 50'0"<br>CORED GROUT from 0'0" to 21'0"<br>CORED BEDROCK from 21'0" to 50'0". |
| | | | | | | | Run #1 0'0"- 5'0"<br>Recovery 18"/60" = 30% |
| 5 | | | | | | 5'0" | Run #2 0'5"- 10'0"<br>Recovery 60"/60" = 100% |
| 10 | | | | | | 10'0" | Run #3 10'0"- 15'0"<br>Recovery 60"/60" = 100% |
| 15 | | | | | | 15'0" | Run #4 15'0"- 20'0"<br>Recovery 60"/60" = 100% |
| 20 | | | | | | 20'0" | Run #5 20'0"- 21'0"<br>Recovery 12"/12" = 100% |
| | | | | | | 21'0" | Run #6 21'0"- 23'0"<br>Recovery 18"/24" = 75% |
| | | | | | | 23'0" | Run #7 23'0"- 24'0"<br>Recovery 12"/12" = 100% |
| 25 | | | | | | 24'0" | Run #8 24'0"- 28'0"<br>Recovery 48"/48" = 100% |
| 30 | | | | | | 28'0" | Run #9 28'0"- 32'0"<br>Recovery 30"/48" = 62.5% |
| | | | | | | 32'0" | Run #10 32'0"- 35'0"<br>Recovery 36"/36" = 100% |
| 35 | | | | | | 35'0" | Run #11 35'0"- 37'0"<br>Recovery 18"/24" = 75% |
| | | | | | | 37'0" | Run #12 37'0"- 40'0"<br>Recovery 36"/36" = 100% |
| 40 | | | | | | 40'0" | |

Type of Boring Casing Size: 8" NX Core

| Proportion Percentages | Granular Soils (blows per ft.) | | Cohesive Soils (blows per ft.) | |
|---|---|---|---|---|
| Trace 0 to 10% | 0 to 4 Very Loose | 30 to 50 Dense | 0 to 2 Very Soft | 8 to 15 Stiff |
| Some 10 to 40% | 4 to 10 Loose | Over 50 Very Dense | 2 to 4 Soft | 15 to 30 Very Stiff |
| And 40 to 50% | 10 to 30 Medium Dense | | 4 to 8 Medium Stiff | Over 30 Hard |

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-8
LOCATION See Plan
SURFACE ELEV.
PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 27'-2"
DATE START: 7/19/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 32'-2"
DATE END: 7/21/86
ME&T REPRESENTATIVE W. Childs
WATER DEPTH 32"

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING BEHAVOIR: feed | DRILLING BEHAVOIR: water | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | 27'-2" | | | Run #1 27'-2" to 28'-5"<br>Dark grey-green, fine-grained granodiorite with quartz veins, little fracturing.<br>REC 14"/15" 93% RQD 14"/14" 100% | 36 min/foot | Good recovery no change in color. | (1) Very dull coring bit accounts for very slow feed. |
| | | | 28'-5" | | | Run #2 28'-5" to 32'-2"<br>Dark grey-green, fine-grained granodiorite with quartz veins, little fracturing.<br>REC 40"/45" 89% RQD 31"/40" 78% | 12-15 min/foot | Good recovery<br>No change in color | |
| | | | 32'-2" | | | Terminated at 32'-2". | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-7D
LOCATION See Plan
SURFACE ELEV.
PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 42'-7"
DATE START: 7/1/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 50'-7"
DATE END: 7/1/86
MEAT REPRESENTATIVE W. Childs
WATER DEPTH 9'

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING feed | BEHAVOIR water | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Run #1 42'-7" to 44'-11"<br>Dark grey-green, fine-grained, highly fractured granodiorite.<br>REC 18"/28" 64% RQD 4"/18" 22% | 12-16 min/foot | No recovery | (1) First attempt 36'-9" to 38" boulder, not included in 5' core. |
| | | | 44'-11" | | | | | | |
| | | | 45'-6" | | | Run #2 44'-11" to 45'-6"<br>Dark grey-green, fine-grained highly fractured granodiorite<br>REC 5"/7" 71% RQD 4"/5" 80% | 15 min/foot | No recovery | |
| | | | 47'-7" | | | Run #3 45'-6" to 47'-7"<br>Dark grey-green, fine-grained, less fractured granodiorite.<br>REC 21"/25" 84% RQD 4"/21" 19% | 14-17 min/foot | No recovery | |
| | | | 50'-7" | | | Run #4 47'-7" to 50'-7"<br>Dark grey-green, fine-grained, lesa fractured granodiorite.<br>REC 35"/36" 97% RQD 22"/35" 63% | 12 min/foot | No recovery | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-6D
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 14'-3"
DATE START: 6/27/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 19'-3"
DATE END: 6/27/86
MEAT REPRESENTATIVE W. Childs
WATER DEPTH 6"

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING feed | BEHAVOIR water | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | 10.0 | | | | | | |
| | | | 14'-3" | | | Run #1 14'-3" to 19'-3"<br>Dark grey-green, fine-grained granodiorite. little fracturing.<br>REC 54"/60" 90% RQD 37"/54" 69% | 10-12 min/foot | No change in color<br>Little loss of water | (1) First attempt 11'-12' boulder, not included in 5' core. |
| | | | 15 | | | | | | |
| | | | 19'-3" | | | | | | |
| | | | 20 | | | Terminated at 19'-3" in bedrock. | | | |

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-4
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 22'-9"
DATE START: 6/25/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 27'-9"
DATE END: 6/25/86
ME&T REPRESENTATIVE W. Childs
WATER DEPTH 5'1"

| TYPE & SIZE OF HOLE | CORE RECOVERY % | ELEVATION | DEPTH | LOG | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION OF ROCK | DRILLING (feed) | BEHAVOIR (water) | NOTES: |
|---|---|---|---|---|---|---|---|---|---|
| | | | 22'-9" | | | Run #1 22'-9" to 27'-9"<br>Dark grey-green, fine-grained granodiorite with thin lense quartz. Highly fractured to 24'9"; less fractured 24'-9" to 27'-9".<br>REC 57//60" 95% RQD 28"/60" 47% | 10-16 min/foot | No color change<br>Some loss 22'-9" to 24'-9"<br>Little loss 24'-9" to 27'-9" | |
| | | | 27'-9" | | | Terminated at 27'-9" in bedrock. | | | |

CORE LOSS
CORE RECOVERY

REMARKS:

SHEET 1 OF 1

# CSA MONITORING WELL
# STRATIGRAPHIC AND INSTRUMENTATION LOGS

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-36)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-4D (Page 1 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 79.23 | | | | | |
| | GROUND SURFACE | 77.5 | | | | | |
| | SP-SAND, medium grained, brown, wet, outwash | | CEMENT/ BENTONITE GROUT | 1SS | | 8 | |
| 2.5 | – saturated | | 2"ø PVC PIPE | 2SS | | 14 | |
| 5.0 | SP-SAND, fine to medium grained, brown, saturated | | | 3SS | | 18 | |
| | Same, except fine grained, some silt | | BENTONITE PELLET SEAL | 4SS | | 16 | |
| 7.5 | | | 6"ø BOREHOLE | | | | |
| | SW-SAND, medium to coarse grained, trace gravel | | | 5SS | | 6 | |
| 10.0 | | | | 6SS | | 63 | |
| | GC-GRAVEL, some sand, ice-contact deposit | 66.0 | SAND PACK | | | | |
| 12.5 | | | | 7SS | | 41 | |
| | BEDROCK – spoon refusal | 63.5 | WELL SCREEN | | | | |
| 15.0 | END OF OVERBURDEN HOLE @ 14.2 FT. BGS | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

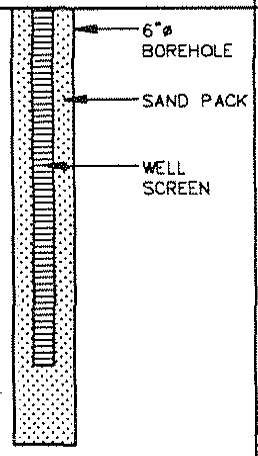
CHEMICAL ANALYSIS WATER FOUND STATIC WATER LEVEL

(L-37)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-4D (Page 2 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 12.5 | | | | | | | | |
| | BEDROCK(Gneiss): moderately fractured, fractures subvertical with minor weathering, fracturing/joints diminish @ 21.0 ft BGS | 63.5 | | | | | | |
| 15.0 | | | | | 1 | 80 | 0 | |
| 17.5 | | | | | | | | |
| 20.0 | | | | | 2 | | | |
| | END OF HOLE @ 21 FT. BGS | 56.5 | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
9.0 to 19.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
7.0 to 21.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

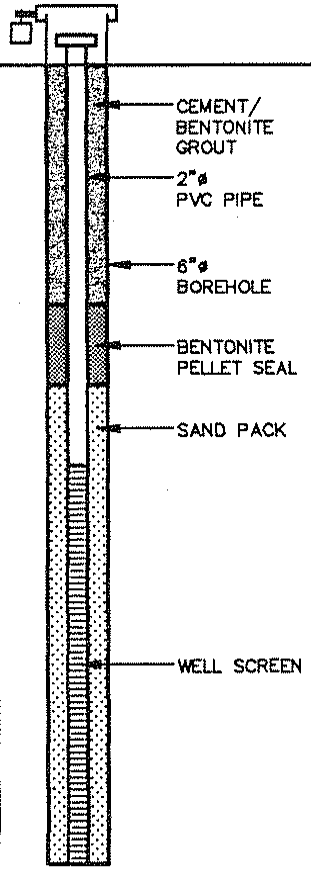
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-38)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40S
DATE COMPLETED: JULY 29, 1991
DRILLING METHOD: 4 1/4 " HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 88.46 | | | | | |
| | GROUND SURFACE | 86.4 | | | | | |
| | For statigraphy see log GW-40D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 66.4 | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

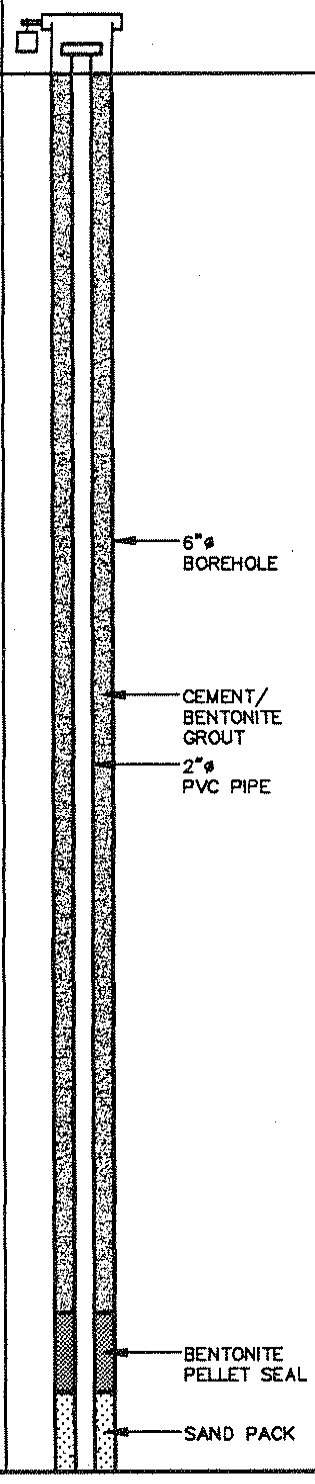
(L-39)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 1 of 3)
DATE COMPLETED: JULY 10, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 88.00 | | | | |
| | GROUND SURFACE | 86.4 | | | | |
| | SP-SAND(FILL), fine to medium grained, trace gravel, yellow brown, dry | | 1SS | X | 14 | |
| 2.5 | | | 2SS | X | 12 | |
| 5.0 | | | 3SS | X | 15 | |
| | | 79.4 | 4SS | X | 32 | |
| 7.5 | SP-SAND, fine to medium grained, dark brown, moist, outwash<br>– saturated | | 5SS | X | 42 | |
| 10.0 | | | 6SS | X | 32 | |
| 12.5 | | | 7SS | X | 46 | |
| | SW-SAND, fine to medium grained, brown, saturated, outwash | | | | | |
| 15.0 | | | 8SS | X | 23 | |
| 17.5 | | 68.9 | 9SS | X | 10 | |
| | ML-SILT, some fine sand, brown, outwash | 68.4 | | | | |
| | SW-SAND, fine, medium and coarse grained, brown, saturated, outwash | | 10SS | X | 12 | |
| 20.0 | | | 11SS | X | 6 | |
| 22.5 | | | 12SS | X | 6 | |
| | ML-SILT, some fine sand, brown, saturated | 62.9 | | | | |
| 25.0 | SW-SAND, fine to coarse grained, some fine to medium gravel, brown, saturated, ice-contact deposit | 61.9 | 13SS | X | 56 | |
| 27.5 | | | 14SS | X | 86 | |
| | SW/GW-SAND and GRAVEL, fine to coarse sand, fine to medium gravel, brown, saturated, ice-contact deposit | 58.4 | 15SS | X | 59 | |
| 30.0 | | | 16SS | X | 64 | |
| 32.5 | – coarse gravel, hard drilling to end of boring | | | | | |

MONITOR INSTALLATION




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-39)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 2 of 3)
DATE COMPLETED: JULY 10, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | 2"ø PVC PIPE | 17SS | X | 41 | |
| | | | SAND PACK | 18SS | X | >100 | |
| 37.5 | | | | | | | |
| | BEDROCK - spoon refusal | 47.4 | | | | | |
| 40.0 | END OF OVERBURDEN HOLE @ 40.0 FT. BGS | 46.4 | WELL SCREEN | | | | |
| 42.5 | | | 6"ø BOREHOLE | | | | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

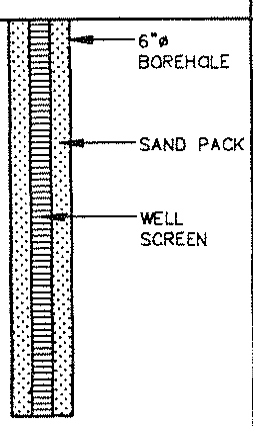
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-40)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 3 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH (ft BGS) | DESCRIPTION OF STRATA | ELEVATION (ft. AMSL) | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY (%) | RQD (%) | WATER RETURN (%) |
|---|---|---|---|---|---|---|---|---|
| | Overburden | |  | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | BEDROCK(Gneiss), slightly to maderately fractured, fractures are slightly weathered | 46.4 | | | | | | |
| 42.5 | | | | | 1 | 65 | 40 | |
| 45.0 | END OF HOLE @ 45 FT. BGS | 41.4 | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
35.0 to 45.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
33.0 to 45.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

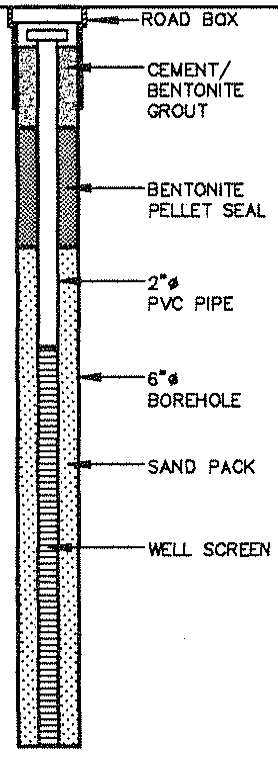
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-41)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42S
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 84.16 | | | | | |
| | GROUND SURFACE | 84.5 | | | | | |
| | For statigraphy see log GW-42D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| | END OF HOLE @ 18.5 FT. BGS | 66.0 | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
8.5 to 18.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-42)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 1 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 84.16 | | | | | |
| | GROUND SURFACE | 84.4 | | | | | |
| | GW-GRAVEL, some sand, brown, dry, ice-contact deposit | | ROAD BOX | 1SS | X | >100 | |
| 2.5 | | | | 2SS | X | 22 | |
| | SW-SAND, some silt, brown, wet | 80.4 | | | | | |
| 5.0 | | | | 3SS | X | 28 | |
| | | | | 4SS | X | 29 | |
| 7.5 | SP-SAND, medium to coarse grained, trace gravel, light brown, saturated, ice-contact deposit | | | | | | |
| | | | | 5SS | X | 26 | |
| 10.0 | | | | | | | |
| | | | | 6SS | X | 17 | |
| | | | 4"ø BOREHOLE | | | | |
| 12.5 | | | | 7SS | X | 14 | |
| | | | CEMENT/ BENTONITE GROUT | | | | |
| 15.0 | | | | 8SS | X | 6 | |
| | | | | 9SS | X | 23 | |
| 17.5 | | | 2"ø PVC PIPE | | | | |
| 20.0 | | | | 10SS | X | 11 | |
| | | | | 11SS | X | 9 | |
| 22.5 | | | | | | | |
| | GW/SW-GRAVEL and SAND, hard drilling to end of drilling | 60.9 | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| | | | BENTONITE PELLET SEAL | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | SAND PACK | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-42)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 2 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | 2"ø PVC PIPE; SAND PACK | | | | |
| 37.5 | | | | | | | |
| 40.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 39.0 FT. BGS | 45.4 | WELL SCREEN; 4"ø BOREHOLE | 12SS | | >100 | |
| 42.5 | | | | | | | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

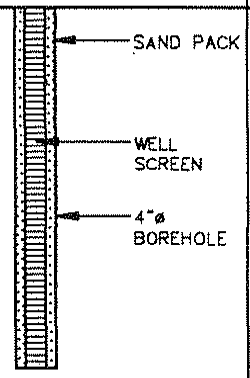
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-43)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 3 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 37.5 | | | | | | | | |
| | BEDROCK(Gneiss): slightly to moderately fractured, fractures are subvertical to near horizontal, little weathering on fractures | 45.2 | | | | | | |
| 40.0 | | | | | 1 | 55 | 45 | |
| 42.5 | | | | | | | | |
| | END OF HOLE @ 44 FT. BGS | 40.2 | SCREEN DETAILS:<br>Screened Interval:<br>34.0 to 44.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>30.0 to 44.0' BGS<br>Material -Coarse Sand | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

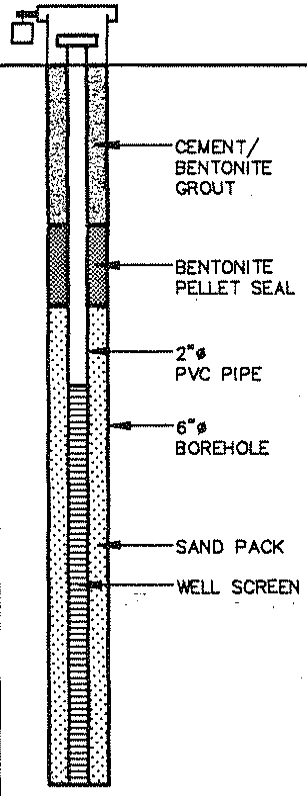
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-44)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43S
DATE COMPLETED: JUNE 24, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 87.36 | | | | | |
| | GROUND SURFACE | 85.6 | | | | | |
| | For statigraphy see log GW-43D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| | END OF HOLE @ 18.0 FT. BGS | 67.6 | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

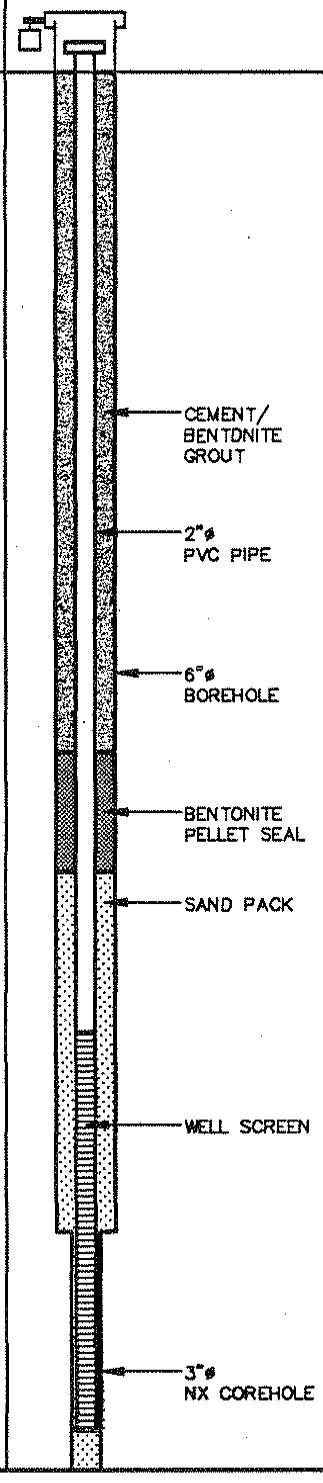
(L-45)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43D (Page 1 of 2)
DATE COMPLETED: JULY 17, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 87.97 | | | | |
| | GROUND SURFACE | 85.6 | | | | |
| | GW-GRAVEL, pebbles and well rounded boulders, some sand, brown, dry, ice-contact depasit | | 1SS | | 43 | |
| 2.5 | | | 2SS | | 46 | |
| 5.0 | – saturated | | 3SS | | 80 | |
| | | | 4SS | | 80 | |
| 7.5 | SW-SAND, fine to coarse grained, gravelly, brown, saturated | 78.1 | | | | |
| | – softer | | 5SS | | 23 | |
| 10.0 | Same, except trace gravel | | | | | |
| | | | 6SS | | 35 | |
| 12.5 | | | 7SS | | 26 | |
| 15.0 | GW-GRAVEL, same sand, very hard, cobbles | | 8SS | | 44 | |
| 17.5 | | | | | | |
| | | | 9SS | | 13 | |
| 20.0 | | | 10SS | | >100 | |
| | – very hard | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | 11SS | | 19 | |
| | SW-SAND, fine to coarse grained, some gravel, some silt, dense | 59.6 | | | | |
| 27.5 | | | | | | |
| | BEDROCK – spoon refusal | 56.6 | | | | |
| 30.0 | END OF OVERBURDEN HOLE @ 29.0 ft. BGS | | 12SS | | >100 | |
| 32.5 | | | | | | |

MONITOR INSTALLATION




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

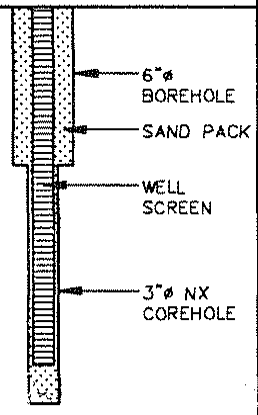
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-46)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43D (Page 2 of 2)
DATE COMPLETED: JULY 18, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 27.5 | | | | | | | | |
| | BEDROCK(Gneiss): moderately fractured, fractures are subvertical and slightly weothered | 56.6 | | | | | | |
| 30.0 | | | | | 1 | 60 | 70 | |
| 32.5 | | | | | | | | |
| 35.0 | END OF HOLE @ 35 FT. BGS | 50.6 | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
24.0 to 34.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
20.0 to 30.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-73)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 1 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Tap of Riser) | 83.97 | | | | | |
| | GROUND SURFACE | 83.5 | | | | | |
| | GW-GRAVEL(FILL), fine to medium, some sand, gray, dry | | | | | | |
| | – saturated | | | | | | |
| 2.5 | GW-GRAVEL, fine to medium, some sand, gray, saturated, ice-contact deposit | 81.0 | | 1SS | X | 34 | |
| 5.0 | SW-SAND, fine to coarse grained, some fine gravel, brown, saturated | 78.7 | | 2SS | X | 15 | |
| 7.5 | | | | 3SS | X | 11 | |
| 10.0 | SP-SAND, medium grained, brown | 74.5 | | 4SS | / | 3 | |
| 12.5 | SW-SAND, medium to coarse grained, some gravel, brown | 72.0 | 2"ø PVC PIPE | 5SS | X | 34 | |
| 15.0 | | | | 6SS | X | 32 | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | 7SS | X | 59 | |
| 20.0 | | | | 8SS | X | 91 | |
| 22.5 | SW-SAND, fine to coarse grained, some gravel trace silt | | 6"ø BOREHOLE | 9SS | X | 59 | |
| 25.0 | | | | 10SS | X | 42 | |
| 27.5 | GW-GRAVEL, fine, some sand, brown and black | 55.5 | | 11SS | X | 36 | |
| 30.0 | SW-SAND, fine grained, some silt, brown | 53.5 | | 12SS | X | 18 | |
| 32.5 | SP-SAND, fine to coarse grained, some gravel brown | 50.5 | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-73)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 2 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | | 13SS | | 17 | |
| | | | | 14SS | | 39 | |
| 37.5 | – chemical odor | | | | | | |
| | | | | 15SS | | 32 | |
| 40.0 | – strong chemical odor | | | | | | |
| | | | CEMENT/ BENTONITE GROUT | 16SS | | 23 | |
| 42.5 | | | | | | | |
| | | | 6"ø BOREHOLE | 17SS | | 62 | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| | | | 2"ø PVC PIPE | | | | |
| 50.0 | | | | | | | |
| | | | BENTONITE PELLET SEAL | 18SS | | 54 | |
| 52.5 | | | | | | | |
| | | | SAND PACK | | | | |
| 55.0 | | | | | | | |
| | | | | 19SS | | | |
| 57.5 | | | | 20SS | | >100 | |
| | SW-SAND, some broken weathered bedrock, green brown, product odor | 24.5 | | | | | |
| 60.0 | | | WELL SCREEN | | | | |
| | BEDROCK | 22.5 | | | | | |
| 62.5 | END OF OVERBURDEN HOLE @ 61.0 FT. BGS | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

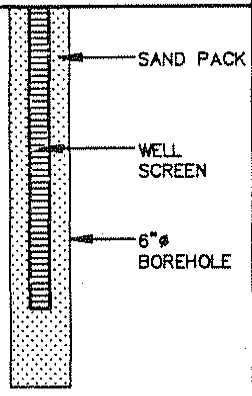
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-74)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 3 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | GROUND SURFACE | ft. AMSL 83.5 | | | | % | % | % |
| | Overburden | |  | | | | | |
| 60.0 | | 22.5 | | | | | | |
| 62.5 | BEDROCK(Gneiss): slightly fractured, fractures are sub-vertical and slightly weathered | | | | 1 | 45 | 50 | |
| 65.0 | | | | | | | | |
| 67.5 | END OF HOLE @ 67 FT. BGS | 16.5 | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
55.0 to 65.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
53.0 to 67.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-75)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44S
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 " ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 85.70<br>84.0 | | | | | |
| | For stratigraphy see log GW-44D | | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | BENTONITE PELLET SEAL | | | | |
| | | | 2"ø PVC PIPE | | | | |
| 10.0 | | | 6"ø BOREHOLE | | | | |
| 12.5 | | | | | | | |
| | | | SAND PACK | | | | |
| 15.0 | | | | | | | |
| | | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 64.0 | | | | | |
| 22.5 | | | SCREEN DETAILS:<br>Screened Interval:<br>10.0 to 20.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>8.0 to 20.0' BGS<br>Material -Coarse Sand | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

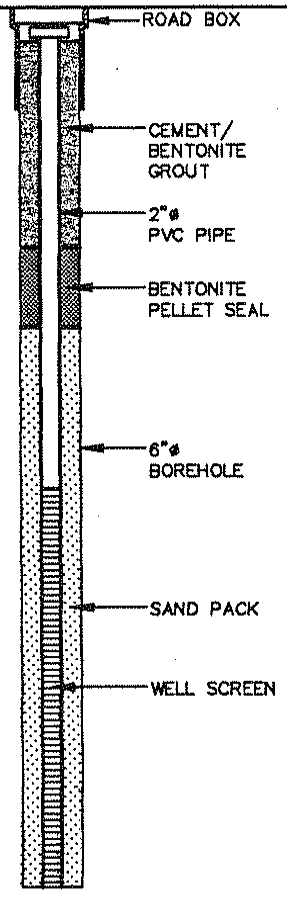
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-78)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45S
DATE COMPLETED: DECEMBER 11, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 89.43 | | | | | |
| | GROUND SURFACE | 89.9 | | | | | |
| | For stratigraphy see log GW-45D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | END OF HOLE @ 22.0 FT. BGS | 67.9 | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-76)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 1 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 89.36 | | | | | |
| | GROUND SURFACE | 89.8 | | | | | |
| | Asphalt | 89.5 | ROAD BOX | 1SS | X | | |
| | SW\GW-SAND and GRAVEL, coarse, cobbles, brown, dry, ice-contact deposit | | | | | | |
| 2.5 | | | | 2SS | X | 89 | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| | GW\SW-SAND and GRAVEL, fine to coarse, brown, saturated, ice-contact deposit | 80.8 | | | | | |
| 10.0 | | | | 3SS | X | 42 | |
| | | | 2"ø PVC PIPE | | | | |
| 12.5 | | | | 4SS | X | 83 | |
| | GW-GRAVEL, fine, some medium to coarse grained sand, brown, saturated | 75.8 | | | | | |
| 15.0 | | | | 5SS | X | 38 | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 20.0 | SW-SAND, medium to coarse grained, some fine rounded to subrounded gravel, brown, | 69.8 | | | | | |
| | | | | 6SS | X | 46 | |
| 22.5 | | | 6"ø BOREHOLE | | | | |
| 25.0 | | | | 7SS | X | 29 | |
| 27.5 | | | | | | | |
| | Same, except fine gravel | | | | | | |
| 30.0 | | | | 8SS | X | 32 | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-76)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 2 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | 6"ø BOREHOLE | 9SS | | 57 | |
| 37.5 | | | | | | | |
| 40.0 | | | CEMENT/ BENTONITE GROUT | 10SS | | >100 | |
| 42.5 | | | 2"ø PVC PIPE | | | | |
| 45.0 | | | | 11SS | | 85 | |
| 47.5 | | | BENTONITE PELLET SEAL | | | | |
| 50.0 | | | SAND PACK | 12SS | | 90 | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | WELL SCREEN | | | | |
| 60.0 | BEDROCK<br>END OF HOLE @ 60.0 FT. BGS | 29.8 | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

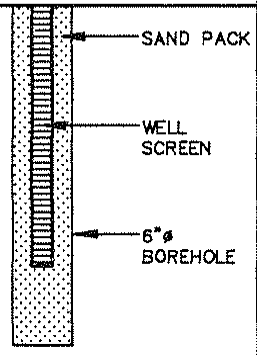
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-77)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 3 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | BEDROCK(Gneiss): moderatley to strongly fractured, fractures are sub-horizontal and sub-vertical with little weathering | 29.8 | | | 1 | 80 | 0 | |
| 62.5 | | | | | | | | |
| | END OF HOLE @ 63.5 FT. BGS | 26.3 | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
52.5 to 62.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
48.0 to 64.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

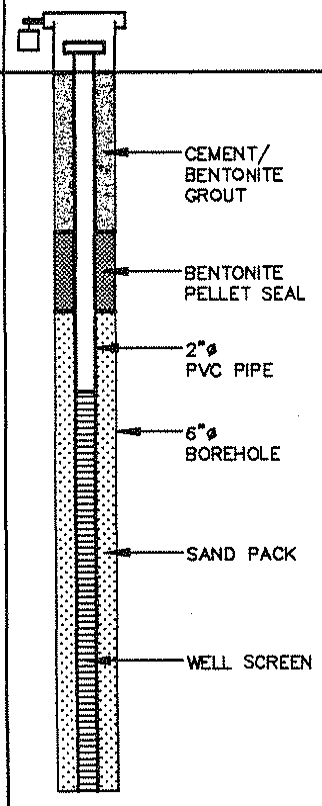
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-79)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-46D (Page 1 of 2)
DATE COMPLETED: JANUARY 31, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 85.90<br>84.2 | | | | | |
| | SP-SAND, fine grained, brown, saturated | | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | 1SS | X | 28 | |
| 5.0 | - very hard | | BENTONITE PELLET SEAL | 2SS | X | >100 | |
| 7.5 | | | 2"ø PVC PIPE | | | | |
| | | | 6"ø BOREHOLE | | | | |
| 10.0 | SC-SAND, some clay, some silt, trace gravel, dense, brown | 74.2 | | 3SS | X | >100 | |
| | | | SAND PACK | | | | |
| 12.5 | BEDROCK | 71.7 | | | | | |
| | END OF OVERBURDEN HOLE 14.0 FT. BGS | | | | | | |
| 15.0 | | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

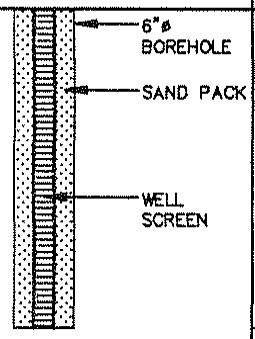
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-80)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-46D (Page 2 of 2)
DATE COMPLETED: J.W. MICHELS
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 12.5 | | | | | | | | |
| 15.0 | BEDROCK(Gneiss): black, moderately fractured, fractures are sub-vertical and weathered slightly | 70.2 | | | 1 | 60 | 75 | |
| 17.5 | | | | | | | | |
| | END OF HOLE @ 18 FT. BGS | 66.2 | SCREEN DETAILS:<br>Screened interval:<br>8.0 to 18.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>6.0 to 18.0' BGS<br>Material -Coarse Sand | | | | | |
| 20.0 | | | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

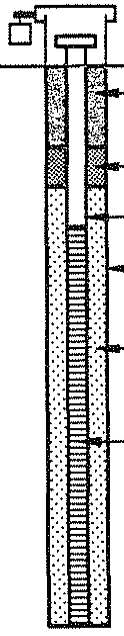
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-47)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-47 (Page 1 of 2)
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 93.18 | | | | | |
| | GROUND SURFACE | 91.6 | | | | | |
| | SW-SAND(FILL), fine to coarse grained, trace gravel, dry | | CEMENT/ BENTONITE GROUT | 1SS | X | 29 | |
| 2.5 | | | BENTONITE PELLET SEAL | 2SS | X | >100 | |
| | BEDROCK | 88.6 | | | | | |
| | END OF OVERBURDEN HOLE @ 4.0 FT. BGS | 87.6 | 2"ø PVC PIPE | | | | |
| 5.0 | | | 6"ø BOREHOLE | | | | |
| 7.5 | | | SAND PACK | | | | |
| 10.0 | | | WELL SCREEN | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

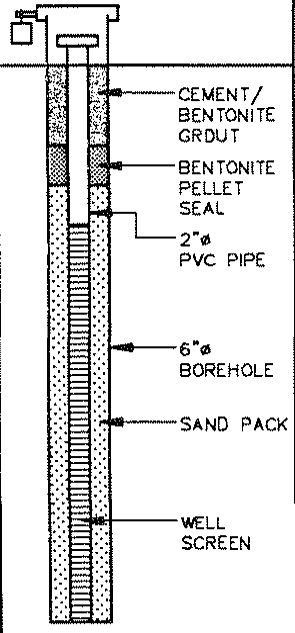
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-72)

PROJECT NAME: GW-47
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-47 (Page 2 of 2)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 14 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 2.5 | | | | | | | | |
| | BEDROCK(Gneiss): slightly fractured, fractures are slightly weathered and subhorizontal | 87.6 | | | | | | |
| 5.0 | | | | | 1 | 35 | 30 | |
| 7.5 | | | | | | | | |
| 10.0 | | | | | 2 | 75 | 60 | |
| 12.5 | | | | | | | | |
| | END OF HOLE @ 14 FT. BGS | 77.6 | | | | | | |
| 15.0 | | | | | | | | |
| 17.5 | | | | | | | | |
| 20.0 | | | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
4.0 to 14.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 14.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

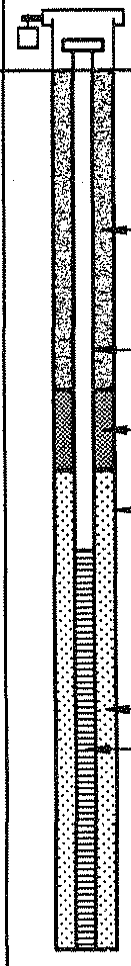
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-48)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48S
DATE COMPLETED: JULY 16, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 91.14 | | | | | |
| | GROUND SURFACE | 88.9 | | | | | |
| | For stratigraphy see log GW-48D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | CEMENT/ BENTONITE GROUT | | | | |
| 7.5 | | | 2"ø PVC PIPE | | | | |
| 10.0 | | | BENTONITE PELLET SEAL | | | | |
| 12.5 | | | 6"ø BOREHOLE | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | SAND PACK<br>WELL SCREEN | | | | |
| 20.0 | | | | | | | |
| 22.5 | END OF HOLE @ 22.0 FT. BGS | 66.9 | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
10.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

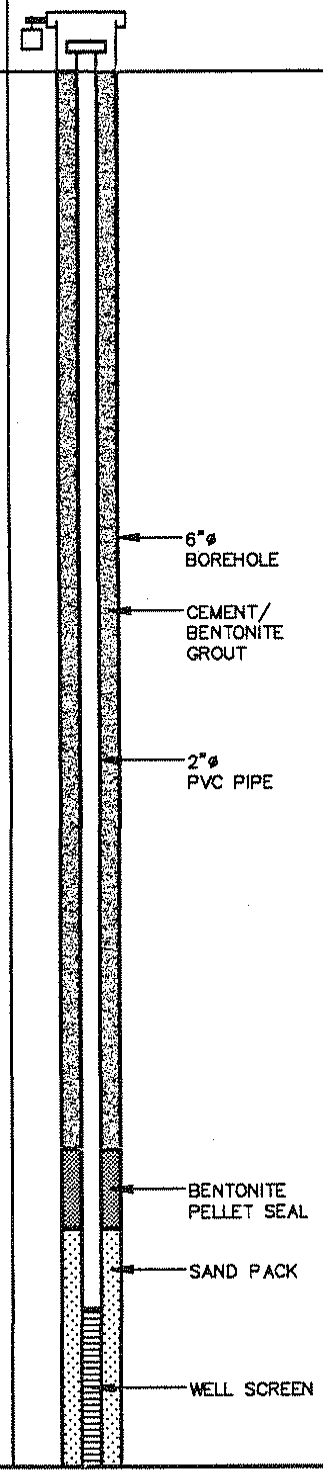
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-49)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 1 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 90.86 | | | | |
| | GROUND SURFACE | 89.0 | | | | |
| | ML/SW/GW-SILT, SAND and GRAVEL(FILL), rubble, dry | | 1SS | X | 38 | |
| 2.5 | – wood, garbage, very hard, odor | | 2SS | X | 25 | |
| 5.0 | – softer | | | | | |
| | | 82.0 | | | | |
| 7.5 | SC-SAND(FILL), some silt, some gravel, gray, moist | | 3SS | X | 5 | |
| 10.0 | – saturated | | 4SS | X | 2 | |
| 12.5 | – charcoal, wood fragments, wet to saturated | | 5SS | X | 11 | |
| | | 74.5 | 6SS | X | 2 | |
| 15.0 | SW-SAND, fine to medium grained, some silt, brown, saturated, outwash | | 7SS | X | 15 | |
| 17.5 | | | 8SS | X | 31 | |
| | | 69.5 | | | | |
| 20.0 | SW/GW-SAND and GRAVEL, fine to coarse grained, angular, brown gray, ice-contact deposit | | 9SS | X | >100 | |
| 22.5 | | 66.0 | | | | |
| | SM-SAND, some silt, some gravel, brown | | 10SS | X | 24 | |
| 25.0 | | | 11SS | X | 64 | |
| 27.5 | | | 12SS | X | >100 | |
| 30.0 | GW-GRAVEL, some sand, brown | | 13SS | X | 61 | |
| | | 58.0 | | | | |
| 32.5 | SW-SAND, some silt, some gravel, brown, ice-contact deposit | | 14SS | X | 51 | |




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

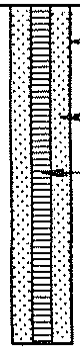
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-49)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 2 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | BEDROCK(Gneiss): slightly to moreately fractured with subvertical fractures, slightly weathered | 53.0 |  6"ø BOREHOLE; SAND PACK; WELL SCREEN | 15SS | X | 75 | |
| 37.5 | END OF OVERBURDEN HOLE @ 36.0 FT. BGS | | | | | | |
| 40.0 | | | | | | | |
| 42.5 | | | | | | | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

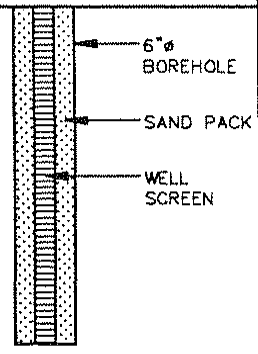
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-50)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 3 of 3)
DATE COMPLETED: JULY 16, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 35.0 | | 53.0 | | | | | | |
| 37.5 | BEDROCK(Gneiss): moderate to slightly fractured, fractures slighlty weathered | | | | 1 | 65 | 50 | |
| 40.0 | | 48.0 | | | | | | |
| | END OF HOLE @ 41 FT. BGS | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
31.0 to 41.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
29.0 to 41.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

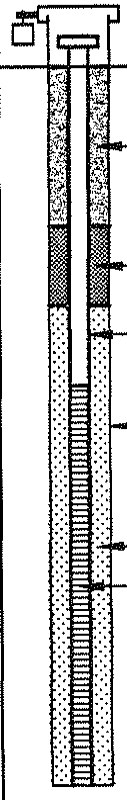
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-81)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-49D
DATE COMPLETED: DECEMBER 14, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 81.37 | | | | | |
| | GROUND SURFACE | 79.2 | | | | | |
| 2.5 | CL-CLAY, some sand, some silt, black, product odor | | CEMENT/ BENTONITE GROUT | 1SS | | | |
| | | | | 2SS | | | |
| 5.0 | SP-SAND(FILL), fine grained, black, saturated, slight odor | 75.2 | BENTONITE PELLET SEAL | 3SS | | 26 | |
| 7.5 | | | 2"ø PVC PIPE | | | | |
| 10.0 | CL-CLAY, some sand, some gravel, black, saturated | 69.2 | 6"ø BOREHOLE | 4SS | | 55 | |
| 12.5 | | | SAND PACK; WELL SCREEN | 5SS | | >100 | |
| 15.0 | | | | 6SS | | | |
| 17.5 | END OF HOLE @ 18.0 FT. BGS | 61.2 | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.0' BGS
Material -Coorse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

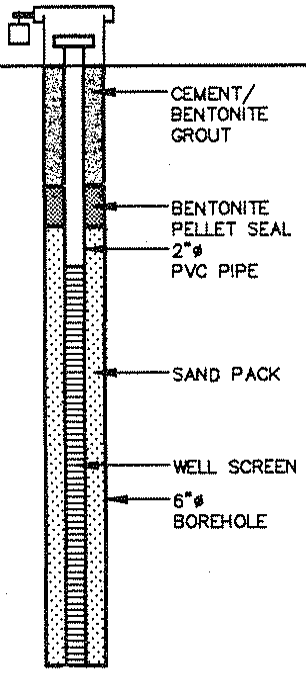
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-51)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50S
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 79.71 | | | | | |
| | GROUND SURFACE | 77.0 | | | | | |
| | For stratigraphy see log GW-50D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | END OF HOLE @ 15.0 FT. BGS | 62.0 | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
4.0 to 15.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-52)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 1 of 3)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 80.11 | | | | | |
| | GROUND SURFACE | 77.4 | | | | | |
| | OL-SILT, leaves, twigs, brown, dry, outwash | 76.4 | | | | | |
| | SP-SAND, medium grained, brown black, saturated | | | 1SS | | 2 | |
| 2.5 | | | | 2SS | | 12 | |
| | SW-SAND, coarse grained, some gravel, some silt, gray, saturated, outwash | | 6"ø BOREHOLE | 3SS | | 59 | |
| 5.0 | | | | 4SS | | 67 | |
| 7.5 | | | | 5SS | | 40 | |
| 10.0 | GW-GRAVEL, some sond, some silt, gray, saturated | 67.4 | | 6SS | | 53 | |
| | – very hard drilling to end of boring, ice-contact deposit | | CEMENT/ BENTONITE GROUT | 7SS | | 53 | |
| 12.5 | | | | | | | |
| 15.0 | | | | 8SS | | 19 | |
| 17.5 | | | 2"ø PVC PIPE | 9SS | | 43 | |
| 20.0 | | | | 10SS | | >100 | |
| 22.5 | | | | 11SS | | >100 | |
| 25.0 | | | | | | | |
| 27.5 | | | BENTONITE PELLET SEAL | | | | |
| 30.0 | | | | 12SS | | >100 | |
| | | | SAND PACK | | | | |
| 32.5 | GW-GRAVEL medium to coarse grained, same fine to coarse sand, hard, brown, ice-contact deposit | | WELL SCREEN | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

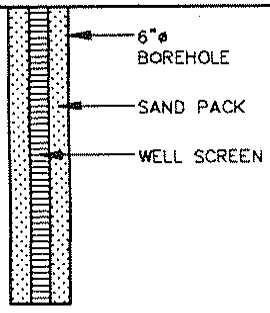
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-52)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 2 of 3)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 35.0 FT. BGS | 42.4 |  | | | | |
| 37.5 | | | | | | | |
| 40.0 | | | | | | | |
| 42.5 | | | | | | | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

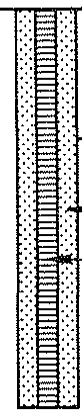
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-53)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 3 of 3)
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | BEDROCK(Gneiss): moderately fractured, fractures are slightly weathered and subvertical | 42.4 | | | | | | |
| 37.5 | | | | | 1 | | | |
| 40.0 | END OF HOLE @ 40 FT. BGS | 37.4 | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
30.0 to 40.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
28.0 to 40.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

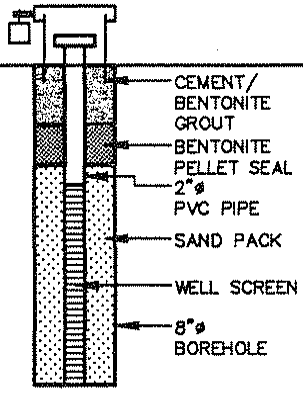
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-54)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51S
DATE COMPLETED: JUNE 19, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 84.59<br>82.9 |  | | | | |
| | For statigrapghy see log GW-51D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| | END OF HOLE @ 8.0 FT. BGS | 74.9 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

SCREEN DETAILS:
Screened interval:
3.0 to 8.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
2.5 to 8.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

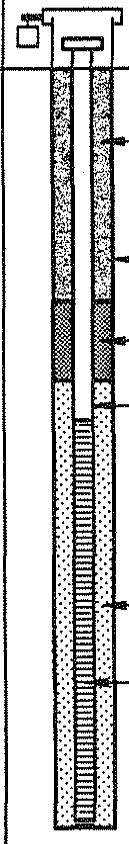
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-55)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51D (Page 1 of 2)
DATE COMPLETED: JUNE 20, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 84.52 | | | | | |
| | GROUND SURFACE | 82.8 | | | | | |
| | SP-SAND, medium grained, red brown, dry, outwash | | | 1SS | X | 5 | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | 2SS | X | 35 | |
| | SW-SAND, some gravel, brown, outwash | | | | | | |
| 5.0 | | | 6"ø BOREHOLE | 3SS | X | 68 | |
| | – saturated | | | 4SS | X | 71 | |
| 7.5 | | | BENTONITE PELLET SEAL | | | | |
| | GC-GRAVEL, some sand, brown, ice-contact deposits | 74.8 | 2"ø PVC PIPE | 5SS | X | 82 | |
| 10.0 | | | | | | | |
| 12.5 | | | SAND PACK | 6SS | X | 77 | |
| | BEDROCK – refusal | 68.8 | | | | | |
| 15.0 | END OF OVERBURDEN HOLE @ 14.0 FT. BGS | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

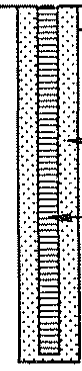
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-56)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51D (Page 2 of 2)
DATE COMPLETED: JUNE 19, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 12.5 | | | | | | | | |
| | BEDROCK(Gneiss): slightly fractured, fractures are slightly weathered and subvertical | 68.8 | | | | | | |
| 15.0 | | | | | 1 | 80 | 70 | |
| 17.5 | | | | | | | | |
| | END OF HOLE @ 19 FT. BGS | 63.8 | | | | | | |
| 20.0 | | | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
8.8 to 19.0' BGS
Length -10.2'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
7.8 to 19.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

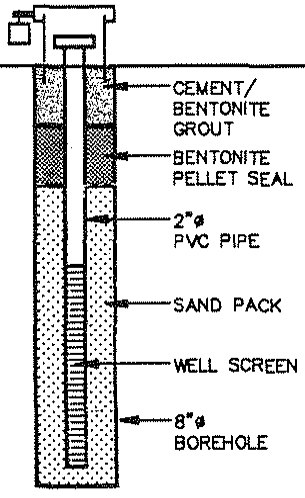
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-57)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 87.99<br>85.6 | | | | | |
| | For stratigraphy see log MW-52D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| | END OF HOLE @ 10.5 FT. BGS | 75.1 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 10.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-58)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52D (Page 1 of 2)
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 88.00 | | | | | |
| | GROUND SURFACE | 85.8 | | | | | |
| | SP-SAND, fine to medium grained, trace organics, loose, light tan brown, dry | | | 1SS | | 9 | |
| 2.5 | Same, except little organics, tan to gray brown | | | 2SS | | 30 | |
| | Same, except no organics, tan brown, dry to moist | | CEMENT/ BENTONITE GROUT | | | | |
| 5.0 | | | | 3SS | | 27 | |
| | Same, except trace silt in matrix, wet to saturated | | | 4SS | | >100 | |
| 7.5 | | | BENTONITE PELLET SEAL | | | | |
| | | | | 5SS | | 36 | |
| 10.0 | SW-SAND, fine to medium grained, same gravel, little silt, medium dense, brown, saturated, ice-contact deposit | 75.8 | 2"ø PVC PIPE | 6SS | | 24 | |
| 12.5 | Same, except some silt, olive gray and brown | | SAND PACK | 7SS | | 55 | |
| 15.0 | BEDROCK | 70.8 | | | | | |
| | END OF OVERBURDEN HOLE @ 15.0 FT. BGS | | 6"ø BOREHOLE | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | WELL SCREEN | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

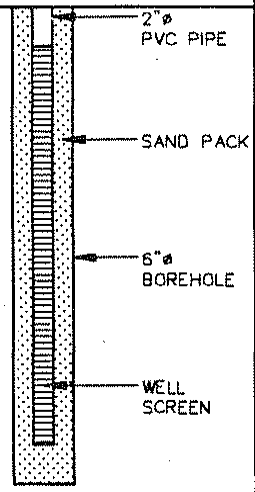
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-59)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52D (Page 2 of 2)
DATE COMPLETED: JUNE 18, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH (ft BGS) | DESCRIPTION OF STRATA | ELEVATION (ft. AMSL) | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY (%) | RQD (%) | WATER RETURN (%) |
|---|---|---|---|---|---|---|---|---|
| | Overburden | |  | | | | | |
| 12.5 | | | | | | | | |
| 15.0 | BEDROCK(Gneiss): moderately to strongly fractured, fractures decrease with depth, fractures are subvertical | 70.8 | | | | | | |
| 17.5 | | | | | 1 | 40 | 30 | |
| 20.0 | | | | | 2 | 80 | 75 | |
| 22.5 | END OF HOLE @ 22 FT. BGS | 63.8 | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
11.0 to 21.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

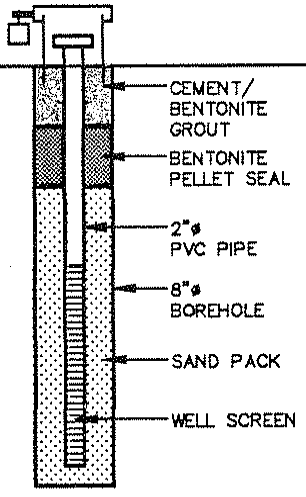
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-60)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 90.69 | | | | | |
| | GROUND SURFACE | 89.0 | | | | | |
| | For stratigraphy see log GW-53D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| | END OF HOLE @ 10.5 FT. BGS | 78.5 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 10.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

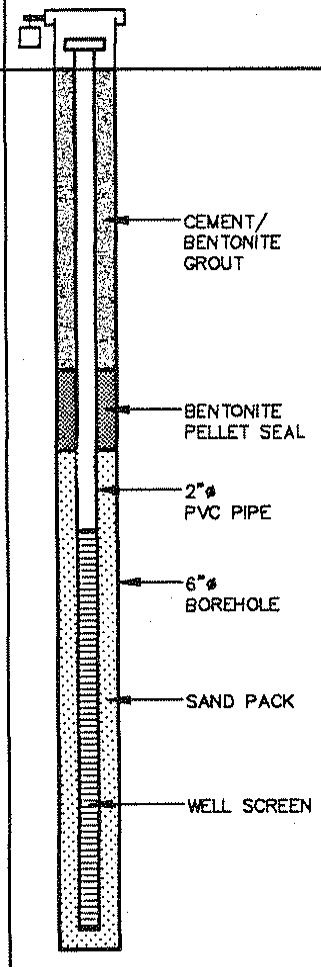
(L-61)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53D (Page 1 of 2)
DATE COMPLETED: JUNE 17, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 91.88 | | | | |
| | GROUND SURFACE | 89.3 | | | | |
| | SW-SAND, fine to medium grained, loose, light brown, moist, some asphalt and cancrete | | 1SS | | 14 | |
| 2.5 | | | 2SS | | 16 | |
| | | 85.3 | | | | |
| 5.0 | GP-GRAVEL, caarse, little coarse grained sand, dense, gray, wet, fill deposit, slight chemical odor | | 3SS | | 46 | |
| | | 83.3 | | | | |
| 7.5 | SW-SAND, medium to coarse grained, little gravel, dense, light brown, outwash, saturated, slight chemical odor | | 4SS | | 84 | |
| | | | 5SS | | >100 | |
| 10.0 | | 79.3 | 6SS | | >100 | |
| | GM-GRAVEL, meduim, some silt, very dense, olive green, saturated | | | | | |
| 12.5 | GP-GRAVEL, fine to coarse, some silt, loose, dense, olive green and brown, saturated, ice-contact deposit | | 7SS | | 52 | |
| | Same, except medium to coarse gravel, gniess, micaceous, same silt, dense, saturated | | 8SS | | >100 | |
| 15.0 | BEDROCK | 74.3 | | | | |
| | END OF OVERBURDEN HOLE @ 15.0 FT. BGS | | | | | |
| 17.5 | | | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

MONITOR INSTALLATION




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

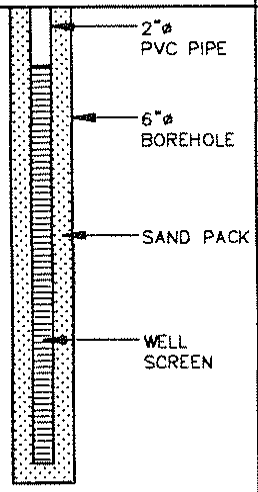
(L-62)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53D (Page 2 of 2)
DATE COMPLETED: JUNE 17, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.M.MICHELS

| DEPTH (ft BGS) | DESCRIPTION OF STRATA | ELEVATION (ft. AMSL) | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY (%) | RQD (%) | WATER RETURN (%) |
|---|---|---|---|---|---|---|---|---|
| | Overburden | | | | | | | |
| 12.5 | | | | | | | | |
| 15.0 | BEDROCK(Gneiss): slightly to moderately fractured, fractures are subvertical and slightly weathered | 74.3 | | | | | | |
| 17.5 | | | | | 1 | 70 | | |
| 20.0 | | | | | | | | |
| 22.5 | END OF HOLE @ 22 FT. BGS | 67.3 | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |




SCREEN DETAILS:
Screened Interval:
11.5 to 21.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.5 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

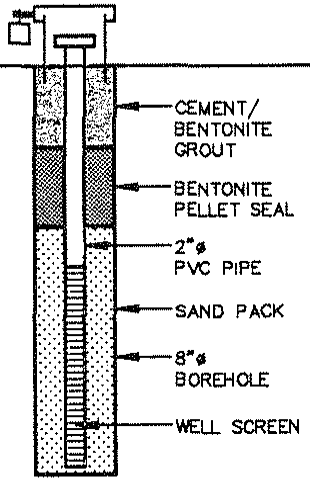
▼ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-63)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 88.69<br>86.4 |  | | | | |
| | Far statigraphy see lag GW-54D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | END OF HOLE @ 10.2 FT. BGS | 76.2 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened Interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
4.0 to 10.2' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

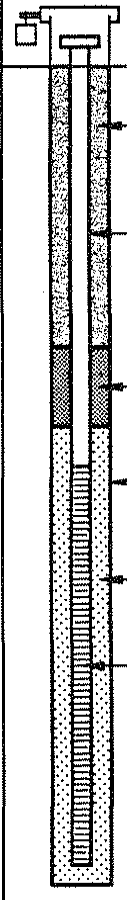
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-64)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54D (Page 1 of 2)
DATE COMPLETED: JUNE 14, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 89.15 | | | | | |
| | GROUND SURFACE | 86.6 | | | | | |
| | SP-SAND(FILL), medium grained, trace gravel, brown, moist | | CEMENT/ BENTONITE GROUT | 1SS | | 60 | |
| 2.5 | | | | 2SS | | 39 | |
| 5.0 | SW-SAND, fine to medium grained, some silt, some gravel, gray, saturated, ice-cantact deposit | | 2"ø PVC PIPE | 3SS | | >100 | |
| 7.5 | | | | 4SS | | 77 | |
| | | | BENTONITE PELLET SEAL | 5SS | | 57 | |
| 10.0 | GW-GRAVEL, some sand, brown | | 6"ø BOREHOLE | 6SS | | 100 | |
| 12.5 | | | SAND PACK | 7SS | | 83 | |
| 15.0 | | | WELL SCREEN | 8SS | | >100 | |
| | BEDROCK | 71.3 | | | | | |
| | END OF OVERBURDEN HOLE @ 15.3 FT. BGS | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

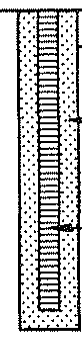
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-65)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54D (Page 2 of 2)
DATE COMPLETED: JUNE 14, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | ROD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  6"ø BOREHOLE; SAND PACK; WELL SCREEN | | | | | |
| 15.0 | BEDROCK(Gneiss): moderately fractured, fractures show slight weathering and decrease with depth | 71.3 | | | | | | |
| 17.5 | | | | | 1 | 65 | 60 | |
| 20.0 | END OF HOLE @ 20.5 FT. BGS | 66.1 | SCREEN DETAILS:<br>Screened Interval:<br>10.0 to 20.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>9.0 to 20.5' BGS<br>Material -Coarse Sand | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

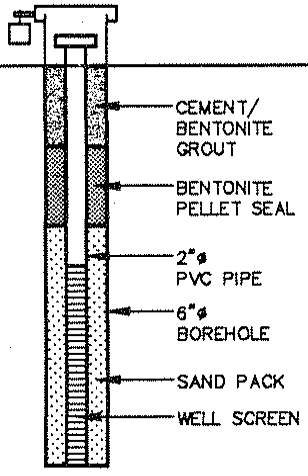
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-66)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55S
DATE COMPLETED: JULY 2, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 81.44<br>79.8 |  | | | | |
| | For statigraphy see log GW-55D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 69.8 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened Interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
4.0 to 10.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-67)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55D (Page 1 of 2)
DATE COMPLETED: JULY 2, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 81.73 | | | | | |
| | GROUND SURFACE | 79.7 | | | | | |
| 2.5 | SP-SAND, medium grained, brown, saturated, outwash | | CEMENT/ BENTONITE GROUT | 1SS | X | 9 | |
| | | | | 2SS | X | | |
| | | 76.2 | 2"ø PVC PIPE | | | | |
| 5.0 | SW-SAND, fine to coarse grained, some gravel, trace to some silt, gray, saturated, ice-contact deposit | | | 3SS | X | 45 | |
| 7.5 | – very hard | | BENTONITE PELLET SEAL | 4SS | X | 70 | |
| 10.0 | SW-SAND, fine to coarse grained, some gravel, gray, saturated | | 6"ø BOREHOLE | 5SS | X | 33 | |
| 12.5 | | | SAND PACK | | | | |
| | BEDROCK – auger refusal | 65.7 | | | | | |
| 15.0 | END OF OVERBURDEN HOLE @ 14.0 FT. BGS | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

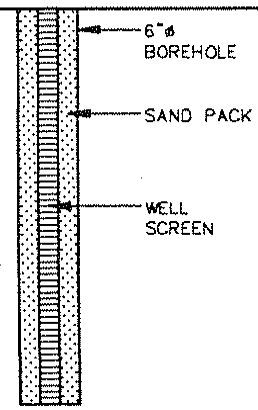
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L-68)

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55D (Page 2 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 12.5 | | | | | | | | |
| 15.0 | BEDROCK(Gneiss): moderately to strongly fractured, fractures are subvertical and slightly weathered | 65.7 | | | 1 | 75 | 45 | |
| 17.5 | | | | | | | | |
| 20.0 | END OF HOLE @ 20 FT. BGS | 59.7 | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.0 to 20.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

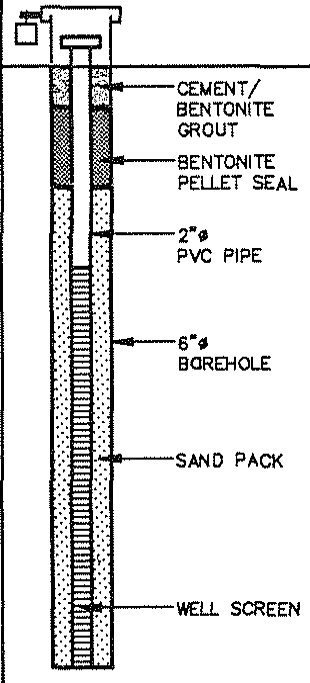
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-69)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56S
DATE COMPLETED: JULY 9, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 83.01<br>80.6 | | | | | |
| | Far statigraphy see log GW-56D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | END OF HOLE @ 15.0 FT. BGS | 65.6 | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened Interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0:"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 15.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

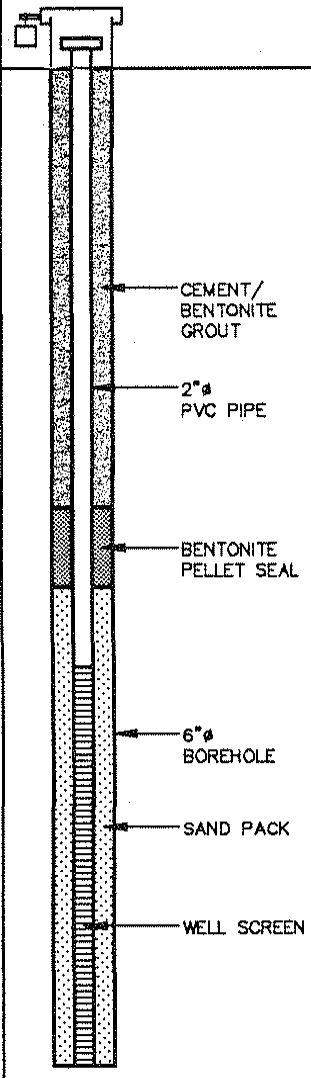
(L-70)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56D (Page 1 of 2)
DATE COMPLETED: JULY 8, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL |
|---|---|---|
| | REFERENCE POINT (Top of Riser) | 82.76 |
| | GROUND SURFACE | 80.5 |
| | SP-SAND, medium grained, brown, dry, outwash | |
| 2.5 | SW-SAND, fine to coarse grained, some gravel, trace silt, dry, ice-contact deposit — very hard | 78.2 |
| 5.0 | GW-GRAVEL, some fine to medium grained sand, trace silt, gray brown, saturated, ice-deposit contact | 75.5 |
| 7.5 | | |
| 10.0 | | |
| 12.5 | — very hard | |
| 15.0 | | |
| 17.5 | | |
| 20.0 | BEDROCK — auger refusal | 61.0 |
| | END OF OVERBURDEN HOLE @ 19.5 FT. BGS | |
| 22.5 | | |
| 25.0 | | |
| 27.5 | | |
| 30.0 | | |
| 32.5 | | |

MONITOR INSTALLATION




| SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|
| 1SS | X | 4 | |
| 2SS | X | 90 | |
| 3SS | X | >100 | |
| 4SS | X | 44 | |
| 5SS | X | 59 | |
| 6SS | X | 25 | |
| 7SS | X | 23 | |
| 8SS | X | 85 | |
| 9SS | X | >100 | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

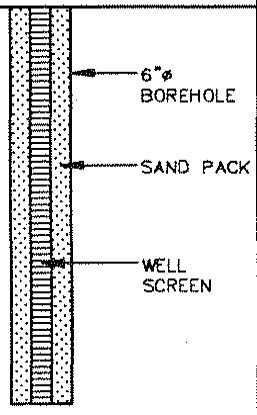
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-71)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56D (Page 2 of 2)
DATE COMPLETED: JULY 8, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 17.5 | | | | | | | | |
| 20.0 | BEDROCK(Gneiss): strongly fractured, fractures are highly weathered and subvertical to subharizontal | 61.0 | | | | | | |
| 22.5 | | | | | 1 | 40 | 45 | |
| 25.0 | END OF HOLE @ 25 FT. BGS | 55.5 | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
15.0 to 25.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
13.0 to 25.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-82)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-57D (Page 1 of 2)
DATE COMPLETED: JANUARY 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | DVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 94.99 | | | | | |
| | GROUND SURFACE | 95.3 | | | | | |
| | SW-SAND, fine to medium grained, some gravel, cobbles, brown, dry | | ROAD BOX | | | | |
| 2.5 | | | | 1SS | X | 97 | |
| | | | CEMENT/ BENTONITE GROUT | 2SS | X | >100 | |
| 5.0 | | | | | | | |
| 7.5 | Same, except fne to coarse grained, trace to some gravel | | | 3SS | X | 40 | |
| 10.0 | | | 2"ø PVC PIPE | 4SS | X | 37 | |
| 12.5 | – moist | | 6"ø BOREHOLE | 5SS | X | 31 | |
| 15.0 | – saturated | | | 6SS | X | 92 | |
| 17.5 | | | BENTONITE PELLET SEAL | 7SS | X | 82 | |
| 20.0 | | | SAND PACK | 8SS | X | >100 | |
| 22.5 | – very hard | | | | | | |
| 25.0 | | | | 9SS | X | >100 | |
| | BEDROCK | 69.3 | WELL SCREEN | | | | |
| 27.5 | END OF OVERBURDEN HOLE @ 26.0 FT. BGS | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

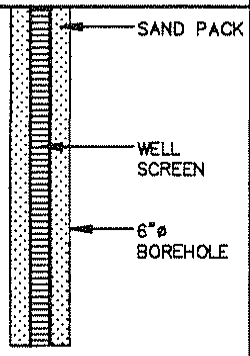
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-83)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-57D (Page 2 of 2)
DATE COMPLETED: JANUARY 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 25.0 | | | | | | | | |
| | BEDROCK(Gneiss): slightly to heavily fractured, fractures are sub-vertical and moderately weathered | 69.3 | | | 1 | 60 | 40 | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| | END OF HOLE @ 31 FT. BGS | 64.3 | SCREEN DETAILS:<br>Screened Interval:<br>21.0 to 31.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>18.0 to 31.0' BGS<br>Material -Coarse Sand | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 1 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 98.19 | | | | |
| | GROUND SURFACE | 96.1 | | | | |
| | SW-SAND, some silt, little gravel, stiff, medium grained, tan | | | 1SS | | 20 |
| | Same, except light tan | | | | | |
| 2.5 | | | | 2SS | | 57 |
| 5.0 | | | | 3SS | | 33 |
| | SW-SAND, trace gravel, stiff, medium to coarse grained, tan | | | 4SS | | 20 |
| 7.5 | | | | | | |
| | | | | 5SS | | 16 |
| 10.0 | Same, except orange iron stained, moist | | | | | |
| | | | 2"ø PVC PIPE | 6SS | | 15 |
| 12.5 | | | | 7SS | | 26 |
| | SW/GW-SAND and GRAVEL, firm, medium to coarse grained, light brown and gray, ice-contact depasit | 82.1 | | | | |
| 15.0 | | | | 8SS | | 15 |
| 17.5 | | | CEMENT/ BENTONITE GROUT | 9SS | | 22 |
| | | | | 10SS | | 19 |
| 20.0 | | | | | | |
| | | | | 11SS | | 16 |
| 22.5 | | | | 12SS | | 19 |
| | | | 6"ø BOREHOLE | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| | Same, with some iron staining | | | | | |
| 30.0 | | | | 13SS | | >100 |
| 32.5 | | | | | | |
| | Same, except light brown | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 2 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | 14SS | X | >100 |
| 37.5 | | | | | | |
| 40.0 | Same, with some clay | | | 15SS | X | >100 |
| 42.5 | | | 2"ø PVC PIPE | | | |
| 45.0 | | | | 16SS | X | 99 |
| 47.5 | | | | | | |
| 50.0 | Same, except gravel | | CEMENT/ BENTONITE GROUT | 17SS | X | 52 |
| 52.5 | | | | | | |
| 55.0 | Same, except little clay | | | 18SS | X | 60 |
| 57.5 | | | 6"ø BOREHOLE | | | |
| 60.0 | Same, except some clay | | | 19SS | X | 38 |
| 62.5 | | | | | | |
| 65.0 | | | | 20SS | X | 24 |
| | | | BENTONITE PELLET SEAL | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 3 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 67.5 | | | BENTONITE PELLET SEAL; 6"ø BOREHOLE | | | |
| 70.0 | SW-SAND, some clay, some gravel, light brown with iron staining, product odor | 27.1 | 2"ø PVC PIPE; SAND PACK | 21SS | X | 69 |
| 72.5 | | | | | | |
| 75.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 74.0 FT. BGS | 22.1 | WELL SCREEN | | | |
| 77.5 | | | | | | |
| 80.0 | | | | | | |
| 82.5 | | | | | | |
| 85.0 | | | | | | |
| 87.5 | | | | | | |
| 90.0 | | | | | | |
| 92.5 | | | | | | |
| 95.0 | | | | | | |
| 97.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

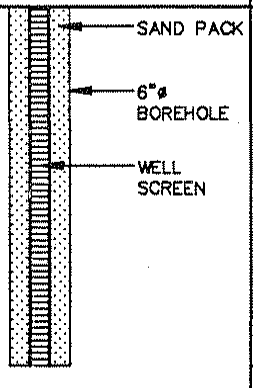
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-97)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 4 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA / NX / WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 72.5 | | | | | | | | |
| | BEDROCK(Gniess): dark gray to black with some white veins, fine grained, fractured | 22.1 | | | | | | |
| 75.0 | | | | | 1 | 90 | 0.0 | |
| 77.5 | | | | | | | | |
| | END OF HOLE @ 79 FT. BGS | 17.1 | | | | | | |
| 80.0 | | | SCREEN DETAILS:<br>Screened Interval:<br>70.0 to 80.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -PVC<br>Sand pack interval:<br>67.0 to 80.0' BGS<br>Material -# 2 Sand | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |
| 90.0 | | | | | | | | |
| 92.5 | | | | | | | | |
| 95.0 | | | | | | | | |
| 97.5 | | | | | | | | |
| 100.0 | | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-98)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58S
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 98.21<br>96.0 | | | | |
| | For stratigraphy see log GW-58D | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 5.0 | | | 6"ø BOREHOLE | | | |
| 7.5 | | | | | | |
| 10.0 | | | 2"ø PVC PIPE | | | |
| 12.5 | | | | | | |
| 15.0 | | | BENTONITE PELLET SEAL | | | |
| 17.5 | | | SAND PACK | | | |
| 20.0 | | | | | | |
| 22.5 | | | WELL SCREEN | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| | END OF HOLE @ 28.0 FT. BGS | 68.0 | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

SCREEN DETAILS:
Screened Interval:
18.0 to 28.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
16.0 to 28.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-86)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59S
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 85.08 | | | | | |
| | GROUND SURFACE | 85.3 | | | | | |
| | For stratigraphy see log GW-57D | | ROAD BOX | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | BENTONITE PELLET SEAL | | | | |
| | | | 2"ø PVC PIPE | | | | |
| 10.0 | | | 6"ø BOREHOLE | | | | |
| 12.5 | | | | | | | |
| | | | SAND PACK | | | | |
| 15.0 | | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 65.3 | | | | | |
| 22.5 | | | SCREEN DETAILS: Screened interval: 10.0 to 20.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 8.0 to 20.0' BGS Material -Coarse Sand | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-84)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 1 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 85.06 | | | | | |
| | GROUND SURFACE | 85.2 | | | | | |
| | SW-SAND, medium to coarse grained, some gravel, brown, moist | | ROAD BOX | | | | |
| 2.5 | | | | 1SS | X | 33 | |
| | GW-GRAVEL, some sand, brown, saturated | 81.2 | | | | | |
| 5.0 | | | | 2SS | X | >100 | |
| 7.5 | | | | 3SS | X | >100 | |
| | | | | 4SS | X | >100 | |
| 10.0 | | | | | | | |
| | Rock fragments, very hard | 74.2 | 2"ø PVC PIPE | 5SS | X | >100 | |
| 12.5 | | | | | | | |
| 15.0 | SW-SAND, medium to coarse grained, some gravel, brown, saturated | 70.2 | | 6SS | X | 34 | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | 7SS | X | 37 | |
| 20.0 | | | | 8SS | X | 35 | |
| 22.5 | | | 6"ø BOREHOLE | | | | |
| 25.0 | | | | 9SS | X | 44 | |
| 27.5 | | | | | | | |
| 30.0 | GW-GRAVEL, some sand | 55.2 | | 10SS | X | 47 | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

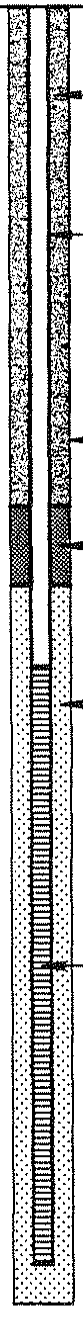
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-84)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 2 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | CEMENT/ BENTONITE GROUT | | | | |
| 37.5 | | | 2"ø PVC PIPE | | | | |
| 40.0 | | | | 11SS | X | 44 | |
| 42.5 | | | 6"ø BOREHOLE | | | | |
| 45.0 | | | BENTONITE PELLET SEAL | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | SAND PACK | 12SS | X | 62 | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | WELL SCREEN | | | | |
| | CL-CLAY(TILL), some sand, some gravel | 27.2 | | | | | |
| 60.0 | BEDROCK | 25.2 | | 13SS | X | | |
| | END OF OVERBURDEN HOLE @ 60.0 FT. BGS | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

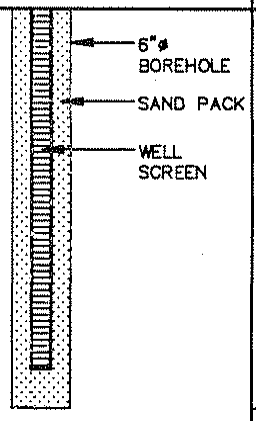
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-85)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 3 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | BEDROCK(Gneiss): slightly to moderately fractured, fractures ore sub-vertical | 25.2 | | | | | | |
| 62.5 | | | | | 1 | 70 | 60 | |
| 65.0 | END OF HOLE @ 65 FT. BGS | 20.2 | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
49.0 to 64.0' BGS
Length -15.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
47.0 to 65.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

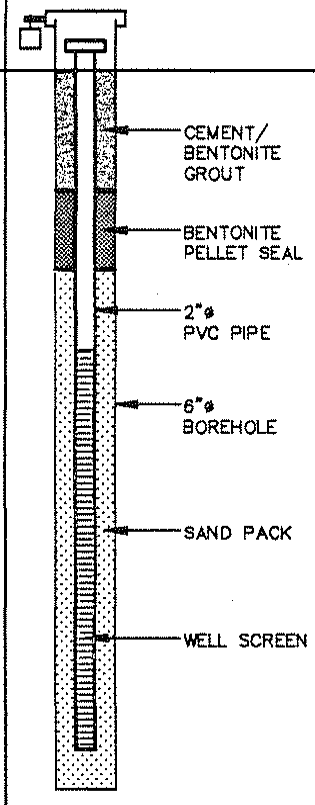
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-88)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-60S
DATE COMPLETED: APRIL 29, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 90.48<br>88.9 | | | | | |
| | For stratigraphy see log GW-60D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| | END OF HOLE @ 18.0 FT. BGS | 72.5 | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |




SCREEN DETAILS:
Screened interval:
7.0 to 17.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
5.0 to 18.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

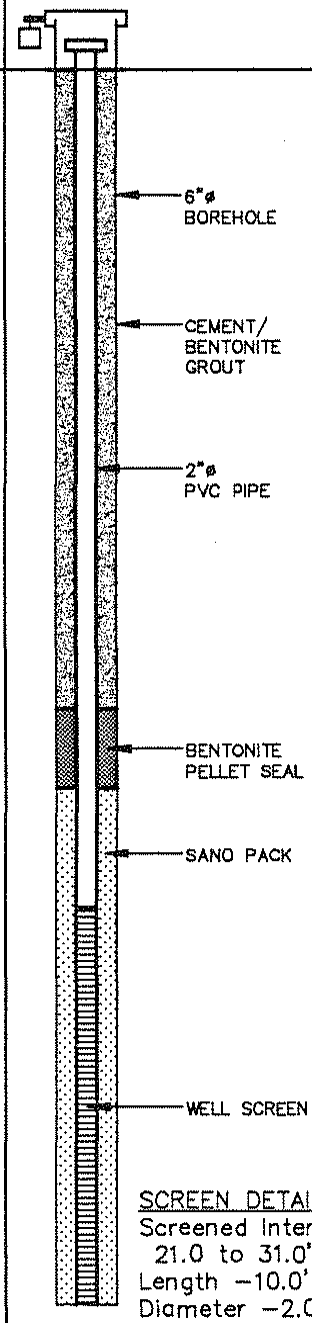
(L-87)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-60D
DATE COMPLETED: APRIL 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL |
|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 90.73 |
| | GROUND SURFACE | 88.6 |
| | SW-SAND(FILL), leaves, mulch, black, wet | |
| 2.5 | | |
| 5.0 | – black and brown humus, peat | |
| 7.5 | | |
| | GC-GRAVEL, some clay, some sand, dense, gray, ice-contact deposit | 80.6 |
| 10.0 | – very hard | |
| 12.5 | | |
| | SW-SAND, fine to coarse grained, brown, saturated | 74.6 |
| 15.0 | Same, with some silt, trace gravel, gray | |
| 17.5 | | |
| 20.0 | | |
| 22.5 | | |
| 25.0 | | |
| | BEDROCK | 62.6 |
| 27.5 | | |
| 30.0 | | |
| | END OF HOLE @ 26.0 FT. BGS | 57.6 |
| 32.5 | | |

MONITOR INSTALLATION




SAMPLE

| NUMBER | STATE | 'N' VALUE | OVA (ppm) |
|---|---|---|---|
| 1SS | X | 6 | |
| 2SS | X | 9 | |
| 3SS | X | 8 | |
| 4SS | X | 16 | |
| 5SS | X | 75 | |
| 6SS | X | 100 | |
| 7SS | X | 93 | |
| 8SS | X | >100 | |
| 9SS | X | 95 | |
| 10SS | X | 55 | |
| 11SS | X | 55 | |

SCREEN DETAILS:
Screened interval:
21.0 to 31.0' BGS
Length –10.0'
Diameter –2.0"
Slot # 10
Material –Plastic
Sand pack interval:
18.0 to 31.0' BGS
Material –Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

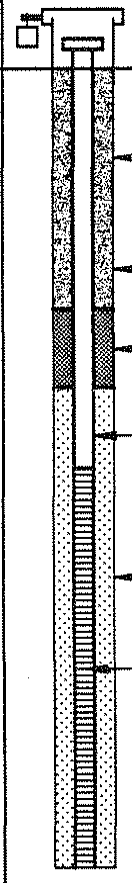
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-91)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61S
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 83.51<br>81.7 | | | | | |
| | For stratigraphy see log GW-61D | | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 5.0 | | | 6"ø BOREHOLE | | | | |
| 7.5 | | | BENTONITE PELLET SEAL | | | | |
| 10.0 | | | 2"ø PVC PIPE | | | | |
| 12.5 | | | SAND PACK | | | | |
| 15.0 | | | WELL SCREEN | | | | |
| 17.5 | | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 61.7 | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 20.0' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-89)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 1 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) 83.66<br>GROUND SURFACE 81.5 | | | | | | |
| | Humas | 81.0 | | | | | |
| | SP-SAND, medium grained, brown - saturated | | | 1SS | X | 6 | |
| 2.5 | SM-SAND, fine grained, some silt, brown | 79.0 | | 2SS | X | 15 | |
| 5.0 | SW-SAND, medium to coarse grained, brown | 76.5 | | 3SS | X | 12 | |
| 7.5 | | | | 4SS | X | 9 | |
| 10.0 | | | | | | | |
| | Same, except fine to medium grained | | 2"ø PVC PIPE | | | | |
| 12.5 | | | | 5SS | X | 23 | |
| 15.0 | ML-SILT, some very fine sand, brown | 66.5 | | 6SS | X | WH | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 20.0 | SW-SAND, fine to coarse grained, some silt, trace gravel, brown | 61.5 | | 7SS | X | 3 | |
| 22.5 | | | 6"ø BOREHOLE | | | | |
| 25.0 | | | | 8SS | X | 20 | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

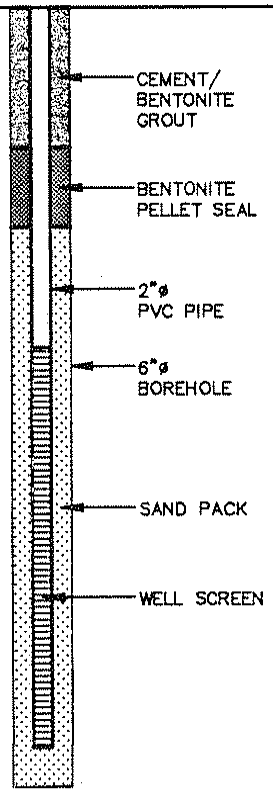
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-89)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 2 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | | | | | | |
| | GW-GRAVEL, some sand, silt and clay, dense | 45.5 | | | | | |
| 37.5 | | | | | | | |
| 40.0 | | | | | | | |
| 42.5 | | | | | | | |
| 45.0 | | | | | | | |
| 47.5 | | 33.5 | | | | | |
| | BEDROCK | | | | | | |
| | END OF OVERBURDEN HOLE @ 48.0 FT. BGS | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

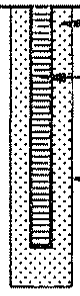
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (BEDROCK)

(L-90)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 3 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIT DRILL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  SAND PACK; WELL SCREEN; 6"ø BOREHOLE | | | | | |
| 47.5 | | 33.7 | | | | | | |
| | No recovery | | | | 1 | 0 | | |
| 50.0 | | | | | | | | |
| 52.5 | END OF HOLE @ 52 FT. BGS | 29.7 | SCREEN DETAILS: Screened interval: 41.0 to 51.0' BGS; Length -10.0'; Diameter -2.0"; Slot # 10; Material -Plastic; Sand pack interval: 38.0 to 52.0' BGS; Material -Medium Sand | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

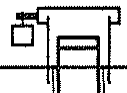
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 1 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 83.67<br>81.6 |  | | | |
| | For overburden stratigraphy see log GW-61D | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | 4"ø PVC PIPE | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 20.0 | | | | | | |
| 22.5 | | | 5"ø BOREHOLE | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 2 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | | | |
| 42.5 | | | 4"ø PVC PIPE | | | |
| 45.0 | | | | | | |
| 47.5 | | | | | | |
| 50.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 52.5 | | | | | | |
| 55.0 | | | 5"ø BOREHOLE | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 3 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 67.5 | | | 5"ø BOREHOLE; 4"ø PVC PIPE | | | |
| 70.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 72.5 | BEDROCK<br>END OF OVERBURDEN HOLE @ 105 FT. BGS | 9.6 | 4"ø HQ COREHOLE | | | |
| 75.0 | | | | | | |
| 77.5 | | | | | | |
| 80.0 | | | | | | |
| 82.5 | | | | | | |
| 85.0 | | | | | | |
| 87.5 | | | | | | |
| 90.0 | | | | | | |
| 92.5 | | | | | | |
| 95.0 | | | | | | |
| 97.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L120)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 4 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BLENDTREORCVKAL | RNUUNMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | | 5"ø BOREHOLE; 4"ø PVC PIPE | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | BEDROCK – for stratigraphy see log GW-61D | 9.6 | CEMENT/ BENTONITE GROUT | | | | | |
| 75.0 | | | 4"ø HQ COREHOLE | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |
| 90.0 | | | | | | | | |
| 92.5 | END OF HOLE @ 92 FT. BGS | -10.4 | | | | | | |
| 95.0 | | | | | | | | |
| 97.5 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

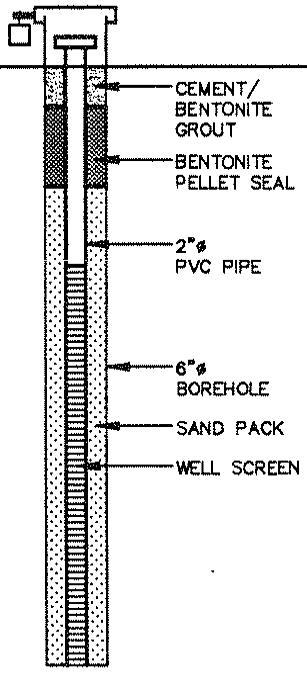
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-95)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62S
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE N VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 84.61<br>82.3 |  | | | | |
| | For stratigraphy see log GW-62D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | END OF HOLE @ 15.0 FT. BGS | 67.3 | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |



SCREEN DETAILS:
Screened interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 15.0' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

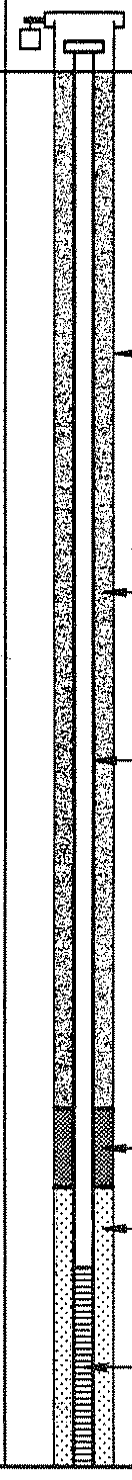
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-94)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62M (Page 1 of 2)
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 84.38<br>82.4 | | | | | |
| | For stratigraphy see log GW-62D | | | | | | |
| 2.5 | | | | | | | |
| 5.0 | | | | | | | |
| 7.5 | | | 6"ø BOREHOLE | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | CEMENT/ BENTONITE GROUT | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | 2"ø PVC PIPE | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | BENTONITE PELLET SEAL | | | | |
| | | | SAND PACK | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | WELL SCREEN | | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

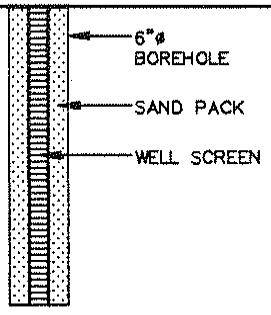
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-94)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62M (Page 2 of 2)
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| 35.0 | | |   | | | | |
| 37.5 | | | | | | | |
| 40.0 | END OF HOLE @ 40.0 FT. BGS | 42.4 | SCREEN DETAILS:<br>Screened interval:<br>30.0 to 40.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -Plastic<br>Sand pack interval:<br>28.0 to 40.0' BGS<br>Material -Medium Sand | | | | |
| 42.5 | | | | | | | |
| 45.0 | | | | | | | |
| 47.5 | | | | | | | |
| 50.0 | | | | | | | |
| 52.5 | | | | | | | |
| 55.0 | | | | | | | |
| 57.5 | | | | | | | |
| 60.0 | | | | | | | |
| 62.5 | | | | | | | |
| 65.0 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-92)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 1 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE N' VALUE | SAMPLE OVA (ppm) |
|---|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) 83.84<br>GROUND SURFACE 82.4 | | | | | | |
| | Roots, organic humas, black, wet | 81.4 | | 1SS | X | 9 | |
| 2.5 | SW-SAND, some silt, organic matter, black, saturated | | | 2SS | X | 15 | |
| 5.0 | | | | 3SS | X | 25 | |
| 7.5 | SW-SAND, fine to coarse grained, some gravel brown and black | 74.4 | | 4SS | X | 25 | |
| 10.0 | SP-SAND, fine to medium grained, loose, brown, Some, except medium grained | | | 5SS | X | 9 | |
| 12.5 | | | 2"ø PVC PIPE | 6SS | X | 8 | |
| 15.0 | | | | 7SS | X | 11 | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | 8SS | X | 9 | |
| 20.0 | | | | 9SS | X | 11 | |
| 22.5 | SW-SAND, fine to coarse grained, trace to some gravel, brown | 59.4 | 6"ø BOREHOLE | | | | |
| 25.0 | | | | 10SS | X | 18 | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

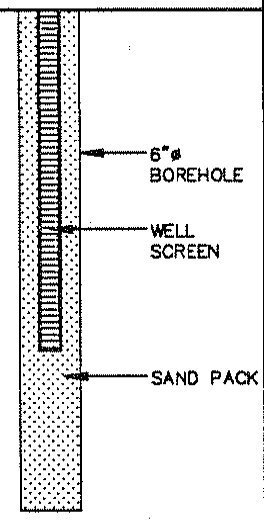
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L-93)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 4 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 65.0 | | | | | | | | |
| | BEDROCK – No recovery | 16.4 | | | | | | |
| 67.5 | | | | | 1 | 0 | | |
| 70.0 | BEDROCK(Quartzite): white and gray, medium grained, moderatley to heavily fractured | 12.4 | | | | | | |
| 72.5 | | | | | 2 | 20 | 30 | |
| 75.0 | END OF HOLE @ 75 FT. BGS | 7.4 | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |
| 90.0 | | | | | | | | |
| 92.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
61.0 to 71.0' BGS
Length –10.0'
Diameter –2.0"
Slot # 10
Material –Plastic
Sand pack interval:
58.0 to 75.0' BGS
Material –Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 1 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | For overburden stratigraphy see log GW-62D | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | 4"ø PVC PIPE | | | |
| 15.0 | | | | | | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | 5"ø BOREHOLE | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 2 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | | | |
| 42.5 | | | 4"ø PVC PIPE | | | |
| 45.0 | | | | | | |
| 47.5 | | | | | | |
| 50.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 52.5 | | | | | | |
| 55.0 | | | 5"ø BOREHOLE | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 3 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 67.5 | | | | | | |
| 70.0 | | | 4"ø PVC PIPE | | | |
| 72.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 75.0 | | | 5"ø BOREHOLE | | | |
| 77.5 | | | | | | |
| 80.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 80.0 FT. BGS | -80.0 | 3"ø NQ COREHOLE | | | |
| 82.5 | | | | | | |
| 85.0 | | | | | | |
| 87.5 | | | | | | |
| 90.0 | | | | | | |
| 92.5 | | | | | | |
| 95.0 | | | | | | |
| 97.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L122)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 4 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: NQ CORE
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIENDTRERCVKAL | RNUUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | | 5"ø BOREHOLE; CEMENT/ BENTDNITE GROUT; 4"ø PVC PIPE | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | BEDROCK(Gneiss): medasedimentary, black, fine grained, fractured, little iron staining, along fractures, some chlorite and talc along fractures, weathering | -80.0 | | | 1 | 75 | 0.0 | |
| 82.5 | | | | | 2 | 75 | 0.0 | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | 3 | 60 | 0.0 | |
| 90.0 | | | 3"ø NQ COREHOLE | | | | | |
| 92.5 | | | | | 4 | 80 | 0.0 | |
| 95.0 | | | | | | | | |
| 97.5 | | | | | 5 | 95 | 0.0 | |
| 100.0 | | | | | | | | |
| 102.5 | | | | | 6 | 90 | 0.0 | |
| 105.0 | END OF HOLE @ 105 FT. BGS | -105.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 1 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 83.66<br>82.0 | | | | |
| | For overburden stratigraphy see log GW-62D | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | 4"ø PVC PIPE | | | |
| 15.0 | | | | | | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | 5"ø BOREHOLE | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)

PROJECT NO.: 3683

CLIENT: OLIN

LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 2 of 6)

DATE COMPLETED: JANUARY 6, 1993

DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT

CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | | | |
| 42.5 | | | 4"ø PVC PIPE | | | |
| 45.0 | | | | | | |
| 47.5 | | | | | | |
| 50.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 52.5 | | | | | | |
| 55.0 | | | 5"ø BOREHOLE | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 3 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 67.5 | | | | | | |
| 70.0 | | | | | | |
| 72.5 | | | | | | |
| 75.0 | | | 4"ø PVC PIPE | | | |
| 77.5 | | | | | | |
| 80.0 | | | | | | |
| 82.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 85.0 | | | | | | |
| 87.5 | | | 5"ø BOREHOLE | | | |
| 90.0 | | | | | | |
| 92.5 | | | | | | |
| 95.0 | | | | | | |
| 97.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 4 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 100.0 | | | 5"ø BOREHOLE; 4"ø PVC PIPE; CEMENT/ BENTONITE GROUT | | | |
| 102.5 | | | | | | |
| 105.0 | BEDROCK | -23.0 | | | | |
| | END OF OVERBURDEN HOLE @ 105 FT. BGS | | | | | |
| 107.5 | | | 4"ø HQ COREHOLE | | | |
| 110.0 | | | | | | |
| 112.5 | | | | | | |
| 115.0 | | | | | | |
| 117.5 | | | | | | |
| 120.0 | | | | | | |
| 122.5 | | | | | | |
| 125.0 | | | | | | |
| 127.5 | | | | | | |
| 130.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L124)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 5 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIENDTRERDRCVKAL | RUNNUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | | 5"ø BOREHOLE; 4"ø PVC PIPE; CEMENT/ BENTONITE GROUT | | | | | |
| 102.5 | | | | | | | | |
| 105.0 | BEDROCK – for stratigraphy see log GW-62D | -23.0 | | | | | | |
| 107.5 | | | 4"ø HQ COREHOLE | | 1 | 100 | | |
| 110.0 | | | | | | | | |
| 112.5 | | | | | 2 | 100 | | |
| 115.0 | | | | | | | | |
| 117.5 | | | | | 3 | 100 | | |
| 120.0 | | | | | | | | |
| 122.5 | | | | | 4 | 100 | | |
| 125.0 | | | | | | | | |
| 127.5 | | | | | 5 | 100 | | |
| 130.0 | | | | | 6 | 100 | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (BEDROCK)

(L124)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 6 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIENDTRERORCVKAL | RNUUNMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| 132.5 | | | 4"ø HQ COREHOLE | | 6 | 100 | | |
| 135.0 | | | | | | | | |
| 137.5 | | | | | 7 | 100 | | |
| 140.0 | | | | | | | | |
| 142.5 | | | | | 8 | 100 | | |
| 145.0 | END OF HOLE @ 145 FT. BGS | -63.0 | | | | | | |
| 147.5 | | | | | | | | |
| 150.0 | | | | | | | | |
| 152.5 | | | | | | | | |
| 155.0 | | | | | | | | |
| 157.5 | | | | | | | | |
| 160.0 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L101)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-63S
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 82.82<br>81.1 | | | | |
| | For stratigraphy see log GW-63D | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 5.0 | | | BENTONITE PELLET SEAL | | | |
| 7.5 | | | 2"ø PVC PIPE | | | |
| 10.0 | | | 6"ø BOREHOLE | | | |
| 12.5 | | | SAND PACK | | | |
| 15.0 | | | WELL SCREEN | | | |
| 17.5 | END OF HOLE @ 18.0 FT. BGS | 63.1 | | | | |
| 20.0 | | | SCREEN DETAILS:<br>Screened Interval:<br>8.0 to 18.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -PVC<br>Sand pack interval:<br>6.0 to 18.0' BGS<br>Material -# 2 Sand | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-99)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-63D (Page 1 of 2)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 83.32 | | | | |
| | GROUND SURFACE | 81.1 | | | | |
| | SW-SAND, trace gravel, firm, fine to medium grained, tan | | | 1SS | X | 13 |
| 2.5 | | | | 2SS | X | 17 |
| | Same, except saturated | | | | | |
| 5.0 | | | | 3SS | X | 8 |
| | | | | 4SS | X | 12 |
| 7.5 | Same, except dark tan | | CEMENT/ BENTONITE GROUT | 5SS | X | 16 |
| 10.0 | Same, except little gravel | | | 6SS | X | 15 |
| | | | 6"ø BOREHOLE | | | |
| 12.5 | Same, except medium to coarse grained, some iron staining | | | 7SS | X | 24 |
| 15.0 | Same, except tan and gray | | | 8SS | X | 14 |
| 17.5 | | | BENTONITE PELLET SEAL | | | |
| | SW-SAND(TILL), some clay, gravel and weathered rock fragments, very stiff, medium to coarse grained, red and tan, iron staining | 62.1 | | 9SS | X | 64 |
| 20.0 | | | | | | |
| 22.5 | | | 2"ø PVC PIPE | | | |
| 25.0 | | | | 10SS | X | 49 |
| | SW-SAND, some clay, little gravel, very stiff, fine to coarse grained, gray | | SAND PACK | | | |
| 27.5 | | | | | | |
| | BEDROCK | 52.1 | WELL SCREEN | | | |
| 30.0 | END OF OVERBURDEN HOLE @ 29.0 FT. BGS | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

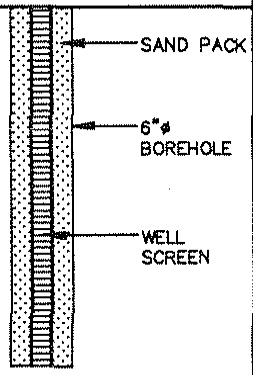
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L100)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-63D (Page 2 of 2)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 27.5 | | | | | | | | |
| | BEDROCK(Gneiss): gray, fine to medium grained | 52.1 | | | | | | |
| 30.0 | | | | | 1 | 80 | 0.0 | |
| 32.5 | | | | | | | | |
| | END OF HOLE @ 34 FT. BGS | 47.1 | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
24.0 to 34.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
19.0 to 34.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

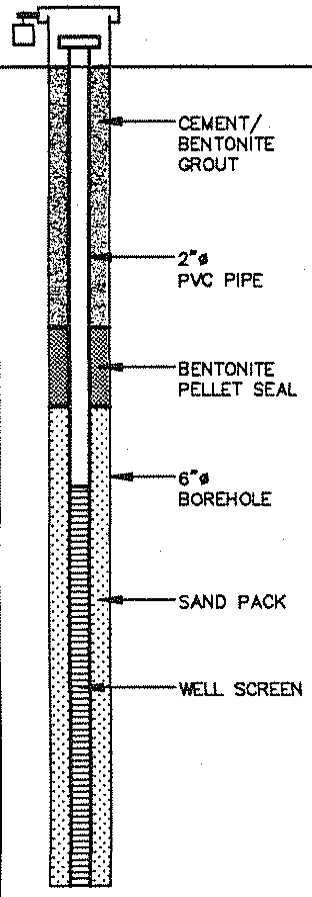
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L104)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64S
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 86.70<br>84.6 |  | | | |
| | For stratigraphy see log GW-64S | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | | | | | | |
| | END OF HOLE @ 20.5 FT. BGS | 64.1 | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
10.5 to 20.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
8.5 to 20.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L102)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64D (Page 1 of 3)
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 85.96 | | | | |
| | GROUND SURFACE | 84.1 | | | | |
| | OL—TOPSOIL, black | 83.8 | | | | |
| | SP—SAND, some silt, very soft, fine grained, tan | | | 1SS | | 4 |
| 2.5 | Same, except moist | | | 2SS | | 7 |
| | Same, except soft, moist, some oxidation | | | | | |
| 5.0 | | | | 3SS | | 12 |
| | Same, except soft, fine ta medium grained, gray, saturated | | | | | |
| 7.5 | | | | 4SS | | 11 |
| | | | | 5SS | | 12 |
| 10.0 | | | | | | |
| | | | 2"ø PVC PIPE | 6SS | | 7 |
| | Same, except coarse grained | | | | | |
| 12.5 | | | | 7SS | | 10 |
| | SW—SAND, soft, gray | 70.1 | | | | |
| 15.0 | | | | 8SS | | 9 |
| | Same, with little gravel, firm | | | | | |
| 17.5 | | | | 9SS | | 19 |
| | Same, except ice—contact deposit | | CEMENT/ BENTONITE GROUT | | | |
| | | | | 10SS | | 23 |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| | Same, except some gravel | | 6"ø BOREHOLE | | | |
| 25.0 | | | | 11SS | | 11 |
| 27.5 | | | | | | |
| | | | | 12SS | | 13 |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L102)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64D (Page 2 of 3)
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | SW-SAND, trace silt, trace gravel, firm, medium grained, gray | | | 13SS | | 9 |
| 37.5 | | | | | | |
| 40.0 | | | CEMENT/ BENTONITE GROUT | 14SS | | 12 |
| 42.5 | | | 6"ø BOREHOLE | | | |
| 45.0 | Same, except coarse grained | | | 15SS | | 24 |
| 47.5 | | | BENTONITE PELLET SEAL | | | |
| 50.0 | Same, except some silt | | 2"ø PVC PIPE | 16SS | | 10 |
| 52.5 | ML-SILT, some fine grained sand, gray, lamintated bedding | 32.1 | SAND PACK | | | |
| 55.0 | | | | 17SS | | 16 |
| 57.5 | | | | | | |
| 60.0 | SP-SAND, some silt, fine to medium grained, gray, laminated bedding | 26.1 | | 18SS | | 14 |
| 62.5 | | | | | | |
| 65.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 63.5 FT. BGS | 20.6 | WELL SCREEN | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

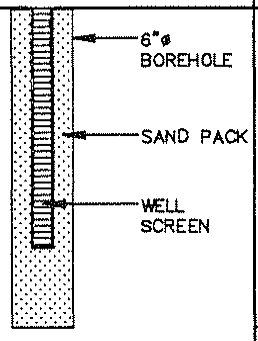
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L103)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64D (Page 3 of 3)
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIENDTRECORCVKAL | RNUUNMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 62.5 | | 20.6 | | | | | | |
| 65.0 | BEDROCK(Gneiss): gray, coarse grained, fractured | | | | 1 | 60 | 0.0 | 0 |
| 67.5 | | 16.1 | | | | | | |
| | END OF HOLE @ 68 FT. BGS | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |
| 90.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
56.0 to 66.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
47.0 to 68.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

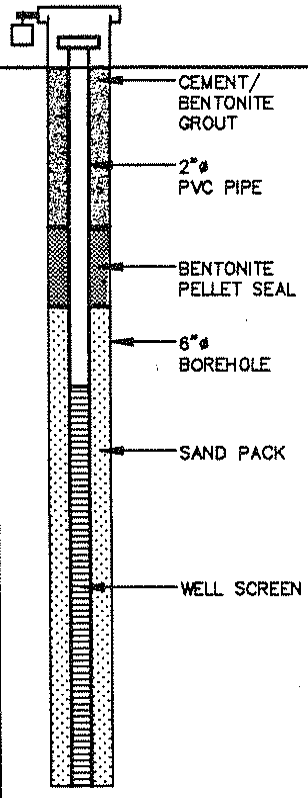
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L107)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65S
DATE COMPLETED: AUGUST 7, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 84.14<br>82.4 |  | | | |
| | For stratigrophy see log GW-65S | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| | END OF HOLE @ 18.0 FT. BGS | 64.4 | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
6.0 to 18.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 1 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 84.19 | | | | |
| | GROUND SURFACE | 82.4 | | | | |
| | SP-SAND(FILL), some organics, trace gravel, medium grained, brown | | | 1SS | | 17 |
| 2.5 | | | | 2SS | | 28 |
| | Same, except little gravel, little clay, moist | | | | | |
| 5.0 | | | | 3SS | | 13 |
| | Same, except saturated | | | | | |
| | | 75.4 | | 4SS | | 20 |
| 7.5 | PT-PEAT, fibrous plant material, very soft, black | | | | | |
| | | | | 5SS | | 2 |
| 10.0 | | 72.4 | | | | |
| | SW-SAND, trace gravel, stiff, medium to coarse grained, brown and gray | | 2"ø PVC PIPE | | | |
| 12.5 | | | | 6SS | | 22 |
| 15.0 | | 67.4 | | | | |
| | SP-SAND, some silt, stiff, fine grained, gray | | | | | |
| 17.5 | | | CEMENT/ BENTONITE GROUT | 7SS | | 17 |
| 20.0 | | | | | | |
| 22.5 | | | 6"ø BOREHOLE | 8SS | | 8 |
| 25.0 | | | | | | |
| 27.5 | | | | 9SS | | 27 |
| 30.0 | | | | | | |
| 32.5 | Same, except very fine grained | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 2 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | 10SS | X | 17 |
| 37.5 | Same, with some laminar bedding | | | 11SS | X | 23 |
| 40.0 | | | | | | |
| 42.5 | | | 2"ø PVC PIPE | 12SS | X | 19 |
| 45.0 | | | | | | |
| 47.5 | | | | 13SS | X | 22 |
| 50.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 52.5 | | | | 14SS | / | 38 |
| 55.0 | | | 6"ø BOREHOLE | | | |
| 57.5 | Same, except fine to medium grained | | | 15SS | X | 23 |
| 60.0 | | | | | | |
| 62.5 | | | | 16SS | X | 23 |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 3 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL |
|---|---|---|
| 80.0 | SW-SAND, very stiff, fine to caarse grained, gray | 2.4 |
| 82.5 | Same, except coarse grained | |
| 87.5 | SP-SAND, some silt, very stiff, fine to medium grained, gray | -5.6 |
| 92.5 | SW-SAND, some silt, clay and weathered rack fragments, very stiff to hard, fine to coarse grained, gray and white | -10.6 |
| 95.0 | BEDROCK | -13.1 |
| | END OF OVERBURDEN HOLE @ 95.5 FT. BGS | |

MONITOR INSTALLATION

| SAMPLE NUMBER | STATE | 'N' VALUE |
|---|---|---|
| 17SS | X | 26 |
| 18SS | X | 30 |
| 19SS | X | 47 |
| 20SS | X | >100 |
| 21SS | X | >100 |
| 22SS | X | >100 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

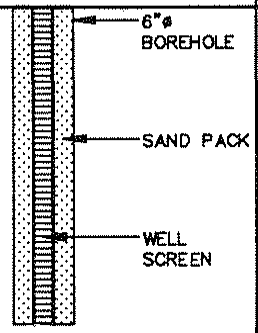
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (BEDROCK)

(L106)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 4 of 4)
DATE COMPLETED: AUGUST 6, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BLOW COUNT | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |   | | | | | |
| 95.0 | | -10.9 | | | | | | |
| | BEDROCK(Gneiss): light gray, medium to coarse grained, fractured | | | | 1 | 80 | 0.0 | |
| 97.5 | | | | | | | | |
| 100.0 | | -15.9 | | | | | | |
| | END OF HOLE @ 100.5 FT. BGS | | SCREEN DETAILS:<br>Screened Interval:<br>85.5 to 100.5' BGS<br>Length -15.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -PVC<br>Sand pack interval:<br>83.5 to 100.5' BGS<br>Material -# 2 Sand | | | | | |
| 102.5 | | | | | | | | |
| 105.0 | | | | | | | | |
| 107.5 | | | | | | | | |
| 110.0 | | | | | | | | |
| 112.5 | | | | | | | | |
| 115.0 | | | | | | | | |
| 117.5 | | | | | | | | |
| 120.0 | | | | | | | | |
| 122.5 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L108)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 1 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 90.32 | | | | |
| | GROUND SURFACE | 88.3 | | | | |
| | OL-TOPSOIL | 87.8 | | | | |
| | SP-SAND(FILL), some silt, trace gravel, soft, light brown, dry | | | 1SS | | 10 |
| 2.5 | Same, except fine to medium grained, very stiff | | CEMENT/ BENTONITE GROUT | 2SS | | 10 |
| 5.0 | | | | 3SS | | 45 |
| | SW-SAND, some gravel, fine to coarse grained, gray, damp to moist | 82.3 | | 4SS | | >100 |
| 7.5 | Same, except medium to coarse grained, saturated | | | 5SS | | 30 |
| 10.0 | SW/GW-SAND and GRAVEL, medium to coarse grained, gray and brown, saturated, ice-contact deposit | 78.3 | | 6SS | | 24 |
| 12.5 | | | 6"ø BOREHOLE | 7SS | | 17 |
| 15.0 | | | | 8SS | | 58 |
| 17.5 | | | 2"ø PVC PIPE | | | |
| 20.0 | | | | 9SS | | 75 |
| 22.5 | | | | | | |
| | Same, except soft, fine to medium grained | | | 10SS | | 25 |
| 25.0 | | | | | | |
| 27.5 | | 60.3 | | | | |
| | SP-SAND, very stiff, medium grained, light brown and gray, saturated | 59.3 | | 11SS | | >100 |
| 30.0 | SW/GW-SAND and GRAVEL, medium to coarse grained, light brown and gray, saturated | | BENTONITE PELLET SEAL | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L108)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 2 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | 2"ø PVC PIPE; 6"ø BOREHOLE | | | |
| 37.5 | Same, except gray and brown, saturated | | WELL SCREEN | 12SS | X | 38 |
| 40.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 40.0 FT. BGS | 48.3 | SAND PACK | | | |
| 42.5 | | | | | | |
| 45.0 | | | | | | |
| 47.5 | | | | | | |
| 50.0 | | | | | | |
| 52.5 | | | | | | |
| 55.0 | | | | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

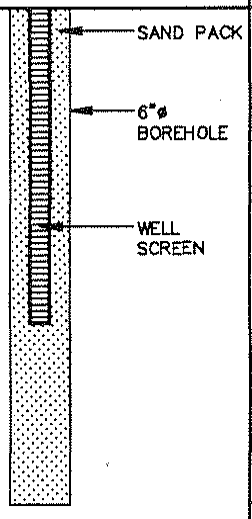
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

(L109)

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 3 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH (ft BGS) | DESCRIPTION OF STRATA | ELEVATION (ft. AMSL) | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY (%) | RQD (%) | WATER RETURN (%) |
|---|---|---|---|---|---|---|---|---|
| | Overburden | |  | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | BEDROCK(Gneiss); metasedimentary, crystalline, fine grained, black and green, some white quartz bands, fractured, with weathered chlorite along fractures | 48.3 | | | 1 | 98 | 0.0 | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | 2 | 98 | 0.0 | |
| 47.5 | END OF HOLE @ 47.5 FT. BGS | 40.8 | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval: 33.0 to 43.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval: 31.0 to 47.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

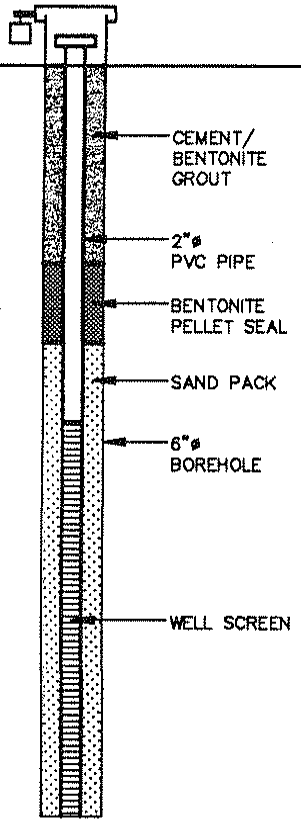
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L110)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66S
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | *90.15*<br>*88.4* | | | | |
| | For stratigraphy see log GW-66D | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| | END OF HOLE @ 19.0 FT. BGS | *69.4* | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |




SCREEN DETAILS:
Screened Interval:
9.0 to 19.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
7.0 to 19.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 1 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Tap of Riser) | 100.39 | | | | |
| | GROUND SURFACE | 98.2 | | | | |
| | OL-TOPSOIL, trace gravel, dark brown | 97.7 | | | | |
| | SW-SAND, little gravel, little silt, very dense, tan and white, dry | | | 1SS | | 50 |
| 2.5 | | | | 2SS | | 60 |
| 5.0 | | | | 3SS | | >100 |
| 7.5 | | | | | | |
| | | | CEMENT/ BENTONITE GROUT | 4SS | | 36 |
| 10.0 | | | | 5SS | | 35 |
| | | | 5"ø BOREHOLE | | | |
| 12.5 | Same, except trace gravel, medium dense, medium to coarse grained, tan, moist, some iron staining | | | 6SS | | 27 |
| 15.0 | | | 2"ø PVC PIPE | 7SS | | 15 |
| | SP-SAND, trace gravel, medium dense, fine grained, ton, moist, same iran staining | 82.7 | | | | |
| 17.5 | Same, except medium grained, saturated | | | 8SS | | 14 |
| | | | | 9SS | | 9 |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | 10SS | | 17 |
| | | | NATIVE MATERIAL | | | |
| 27.5 | | | | | | |
| 30.0 | | | | 11SS | | 22 |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 2 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | 12SS | X | 20 |
| 37.5 | | | | | | |
| | Same faint bedding | | | | | |
| 40.0 | | | | 13SS | X | 24 |
| 42.5 | | | 5"ø BOREHOLE | | | |
| | Some faint bedding | | | | | |
| 45.0 | | | | 14SS | X | 26 |
| 47.5 | | | NATIVE MATERIAL | | | |
| | Some faint bedding | | | | | |
| 50.0 | | | | 15SS | X | 26 |
| 52.5 | | | 2"ø PVC PIPE | | | |
| | Same, except fine to medium grained | | | | | |
| 55.0 | | | | 16SS | X | 28 |
| 57.5 | | | | | | |
| | Same, with some silty layers, iron staining | | | | | |
| 60.0 | | | | 17SS | X | 26 |
| 62.5 | | | | | | |
| 65.0 | | | | 18SS | X | 47 |
| | Fractured and weathered rock (@ 66.0 ft BGS) | | BENTONITE PELLET SEAL | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 3 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 67.5 | | | BENTONITE PELLET SEAL | | | |
| 70.0 | | | 2"ø PVC PIPE; SAND PACK | | | |
| 72.5 | | | | | | |
| 75.0 | Same with trace clay and silt | | 5"ø BOREHOLE | 19SS | | 61 |
| | SW-SAND(TILL), some clay, trace gravel and weathered rock, hard, medium to coarse grained, tan and gray | 22.7 | | | | |
| 77.5 | | | | | | |
| 80.0 | | | WELL SCREEN | 20SS | | >100 |
| | FRACTURED BEDROCK | 17.2 | | | | |
| 82.5 | | | | | | |
| | BEDROCK | 15.2 | | | | |
| | END OF OVERBURDEN HOLE @ 83.0 FT. BGS | | 4"ø HQ COREHOLE | | | |
| 85.0 | | | | | | |
| 87.5 | | | | | | |
| 90.0 | | | | | | |
| 92.5 | | | | | | |
| 95.0 | | | | | | |
| 97.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

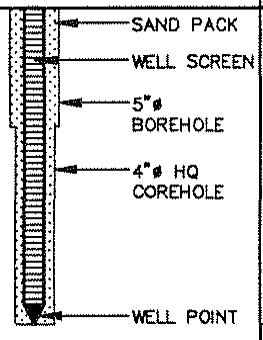
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L126)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 4 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 82.5 | | -83.0 | | | | | | |
| | BEDROCK(Gneiss): black, fine grained, irregular white and green veins (1-5mm), weakly fractured | | | | 1 | 75 | 100.0 | |
| 85.0 | | | | | | | | |
| | | | | | 2 | 75 | 100.0 | |
| 87.5 | | -88.0 | | | | | | |
| | END OF HOLE @ 88 FT. BGS | | | | | | | |
| 90.0 | | | | | | | | |
| 92.5 | | | | | | | | |
| 95.0 | | | | | | | | |
| 97.5 | | | | | | | | |
| 100.0 | | | | | | | | |
| 102.5 | | | | | | | | |
| 105.0 | | | | | | | | |
| 107.5 | | | | | | | | |
| 110.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
72.5 to 87.5' BGS
Length -15.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
68.0 to 83.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

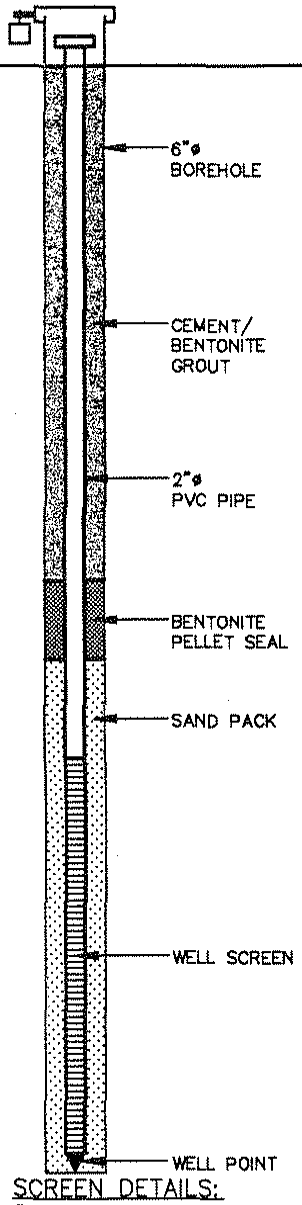
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L127)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67S
DATE COMPLETED: NOVEMBER 2, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 100.61<br>98.4 | | | | |
| | For stratigraphy see log GW-67D | | | | | |
| 2.5 | | | 6"ø BOREHOLE | | | |
| 5.0 | | | | | | |
| 7.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 10.0 | | | 2"ø PVC PIPE | | | |
| 12.5 | | | | | | |
| 15.0 | | | BENTONITE PELLET SEAL | | | |
| 17.5 | | | SAND PACK | | | |
| 20.0 | | | | | | |
| 22.5 | | | WELL SCREEN | | | |
| 25.0 | | | | | | |
| 27.5 | | | WELL POINT | | | |
| | END OF HOLE @ 28.0 FT. BGS | 70.4 | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened interval:
17.5 to 27.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
15.0 to 28.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

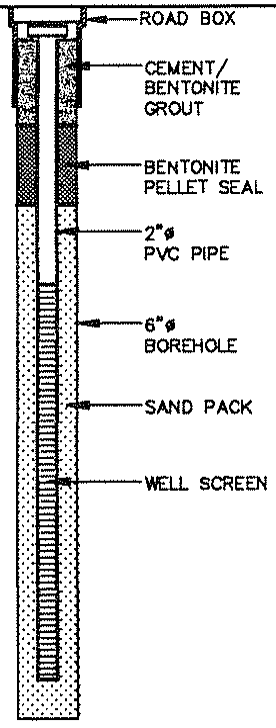
(L111)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68D (Page 1 of 2)
DATE COMPLETED: JULY 23, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL |
|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 90.16 |
| | GROUND SURFACE | 90.3 |
| | Asphalt and road base | 89.7 |
| | SP-SAND(FILL), some silt, trace gravel, very stiff, light brown | |
| 2.5 | Same, except some gravel, little silt and clay, very stiff, gray | |
| 5.0 | | |
| | SP-SAND, some silt, some clay, trace gravel, same organic matter, very stiff, dark brown and gray | |
| 7.5 | | 82.3 |
| | SW-SAND, some clay, some gravel, very stiff to hard, medium to coarse grained, brown and gray, moist | |
| 10.0 | Same, except saturated | |
| | BEDROCK | 79.3 |
| 12.5 | END OF OVERBURDEN HOLE @ 11.0 FT. BGS | |
| 15.0 | | |
| 17.5 | | |
| 20.0 | | |
| 22.5 | | |
| 25.0 | | |
| 27.5 | | |
| 30.0 | | |
| 32.5 | | |

MONITOR INSTALLATION




| SAMPLE NUMBER | STATE | 'N' VALUE |
|---|---|---|
| 1SS | | 42 |
| 2SS | | 63 |
| 3SS | | 50 |
| 4SS | | 88 |
| 5SS | | >100 |
| 6SS | | >100 |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

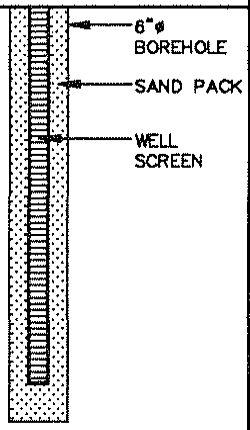
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L112)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68D (Page 2 of 2)
DATE COMPLETED: JULY 23, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 10.0 | | | | | | | | |
| 12.5 | BEDROCK(Gneiss): black and green, fine grained, 3" white and gray quartz bands, medium grained, fractured, iron staining along fractures | 79.3 | | | 1 | 60 | 0.0 | 0 |
| 15.0 | BEDROCK(Gneiss): black and gray, medium grained, quartz banding, some mica | 76.3 | | | 2 | | 0.0 | 0 |
| 17.5 | | | | | | | | |
| | END OF HOLE @ 18 FT. BGS | 72.3 | | | | | | |
| 20.0 | | | | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | | | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
7.0 to 17.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
5.0 to 18.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

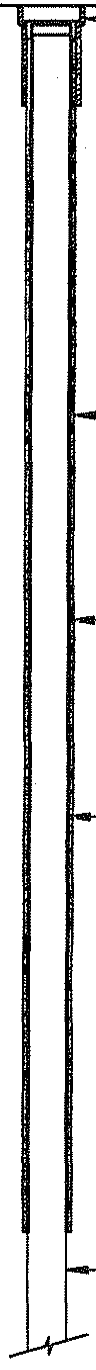
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L128)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR
(Page 1 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE N VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 89.83 | | | | |
| | GROUND SURFACE | 90.2 | | | | |
| | For overburden stratigraphy see log GW-68D | | ROAD BOX | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | 5"ø BOREHOLE | | | |
| 12.5 | | | | | | |
| 15.0 | | | CEMENT/ BENTONITE GROUT | | | |
| 17.5 | | | | | | |
| 20.0 | | | 4"ø PVC PIPE | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| | BEDRDCK | 59.2 | | | | |
| 32.5 | END OF OVERBURDEN HOLE @ 31.0 FT. BGS | | 4"ø HQ COREHOLE | | | |



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L129)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR (Page 2 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BIENDTRECORCVKAL | RNUUNMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | | 4"ø PVC PIPE; CEMENT/ BENTONITE GROUT | | | | | |
| 30.0 | | 59.2 | 5"ø BOREHOLE | | | | | |
| | BEDROCK – for stratigraphy see log GW-68D | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | 4"ø HQ COREHOLE | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L129)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR (Page 3 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | 4"ø HQ COREHOLE | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| | END OF HOLE @ 76 FT. BGS | 14.2 | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |
| 87.5 | | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L115)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69S
DATE COMPLETED: JULY 27, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 92.28<br>90.9 | | | | |
| | For stratigraphy see log GW-69D | | | | | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 5.0 | | | 2"ø PVC PIPE | | | |
| 7.5 | | | BENTONITE PELLET SEAL | | | |
| 10.0 | | | SAND PACK | | | |
| 12.5 | | | 6"ø BOREHOLE | | | |
| 15.0 | | | | | | |
| 17.5 | | | WELL SCREEN | | | |
| 20.0 | | | | | | |
| 22.5 | END OF HOLE @ 23.0 FT. BGS | 67.9 | | | | |
| 25.0 | | | SCREEN DETAILS:<br>Screened Interval:<br>13.0 to 23.0' BGS<br>Length -10.0'<br>Diameter -2.0"<br>Slot # 10<br>Material -PVC<br>Sand pack interval:<br>8.5 to 23.0' BGS<br>Material -# 2 Sand | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

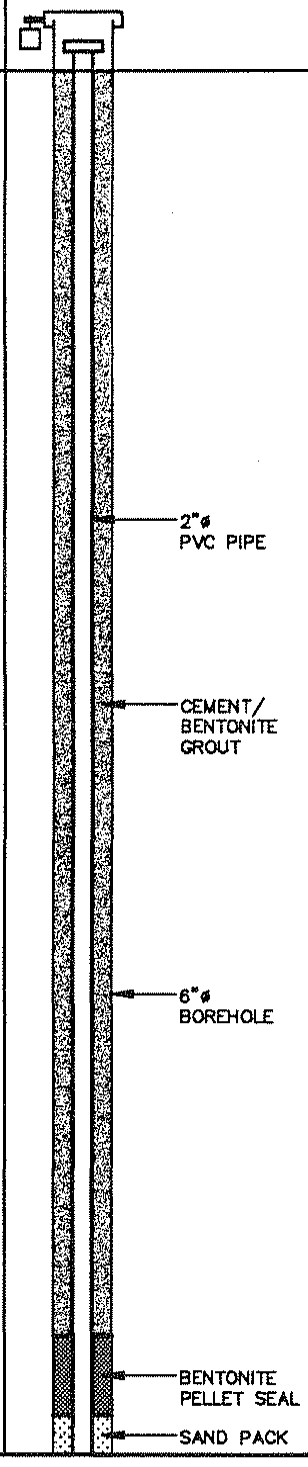
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L113)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 1 of 3)
DATE COMPLETED: JULY 27, 1992
DRILLING METHDD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | SAMPLE NUMBER | STATE | 'N' VALUE |
|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) 93.05<br>GROUND SURFACE 91.1 | | | | |
| | OL—TOPSOIL | 90.8 | | | |
| | SP—SAND, little gravel, stiff, medium to coarse grained, light brown and tan dry | | 1SS | X | 18 |
| 2.5 | | | 2SS | X | 37 |
| | Same, with some iron staining | | | | |
| 5.0 | Same, with some silt, some clay, fine to medium grained, white, dry | | 3SS | X | 87 |
| | SW—SAND, little gravel, stiff, fine to coarse grained, light brown and tan, dry | 85.1 | 4SS | X | 41 |
| 7.5 | | | | | |
| | ML—SILT, some sand, trace gravel, very stiff, tan to white, dry | 83.1<br>82.4 | 5SS | X | 55 |
| 10.0 | SW—SAND, trace gravel, stiff, medium to coarse grained, light brown and tan, dry, some iron staining | | 6SS | X | 10 |
| | Same, except moist | | | | |
| 12.5 | Same, except saturated, increased iron staining | | 7SS | X | 15 |
| 15.0 | Same, except fine grained, tan | | 8SS | X | 11 |
| | SW—SAND, trace gravel, medium to coarse grained with some fine to medium layers, tan with iron staining | | 9SS | X | 21 |
| 17.5 | | | | | |
| | | | 10SS | X | 21 |
| 20.0 | | | | | |
| | | | 11SS | X | 14 |
| 22.5 | | | 12SS | X | 20 |
| 25.0 | | | 13SS | X | 8 |
| 27.5 | | | 14SS | X | 27 |
| | | | 15SS | X | 24 |
| 30.0 | | | | | |
| | | | 16SS | X | 21 |
| 32.5 | | | 17SS | X | 31 |




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

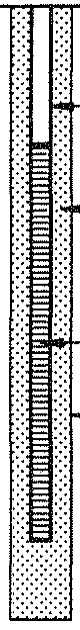
# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L113)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 2 of 3)
DATE COMPLETED: JULY 27, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | 2"ø PVC PIPE | 18SS | X | 24 |
| 37.5 | Same, with increased iron staining, product odor | | SAND PACK | 19SS | X | 20 |
| 40.0 | | | WELL SCREEN | | | |
| 42.5 | WEATHERED BEDROCK, some clay infilling, gray, product odor | 48.1 | 6"ø BOREHOLE | 20SS | X | >100 |
| 45.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 45.0 FT. BGS | 46.1 | | | | |
| 47.5 | | | | | | |
| 50.0 | | | | | | |
| 52.5 | | | | | | |
| 55.0 | | | | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |



SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

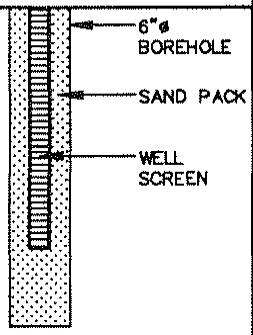
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L114)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 3 of 3)
DATE COMPLETED: JULY 24, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |   | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | BEDROCK(Gneiss): black and green, fine grained, fractured | 46.1 | | | 1 | 15 | 0.0 | 0 |
| 47.5 | END OF HOLE @ 48 FT. BGS | 43.1 | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |

SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

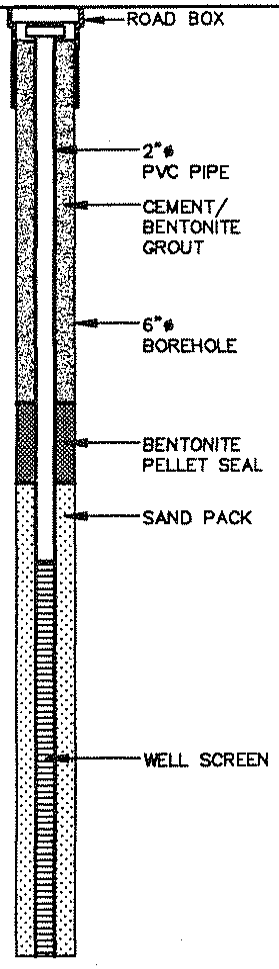
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L118)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70S
DATE COMPLETED: JULY 28, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser)<br>GROUND SURFACE | 91.99<br>92.2 | | | | |
| | For stratigraphy see log GW-70D | |  | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| | END OF HOLE @ 24.0 FT. BGS | 68.2 | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
14.0 to 24.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
12.0 to 24.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L116)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 1 of 2)
DATE COMPLETED: JULY 28, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE ELEVATION (Top of Riser) | 92.10 | | | | |
| | GROUND SURFACE | 92.3 | | | | |
| | OL-TOPSOIL | 91.8 | ROAD BOX | | | |
| | SP-SAND, some silt, little clay, trace gravel, some organic material, light brown | | | 1SS | | 20 |
| 2.5 | SP-SAND, fine grained, tan | | | 2SS | | 25 |
| 5.0 | | | | 3SS | | 15 |
| | Same, with some silt, dark tan | | | 4SS | | 26 |
| 7.5 | | | | 5SS | | |
| 10.0 | | | | 6SS | | |
| | | | 2"ø PVC PIPE | | | |
| 12.5 | SW-SAND, some gravel, medium to coarse grained, light brown, saturated | 80.3 | | 7SS | | 30 |
| 15.0 | | | | 8SS | | 29 |
| | SW/GW-SAND and GRAVEL, medium to coarse grained, light brown | 76.3 | | 9SS | | 40 |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 20.0 | | | | 10SS | | 45 |
| 22.5 | | | | 11SS | | 37 |
| | | | 6"ø BOREHOLE | 12SS | | 36 |
| 25.0 | | | | 13SS | | 26 |
| 27.5 | SW-SAND, some gravel, medium to coarse grained | 64.8 | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L116)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 2 of 2)
DATE COMPLETED: JULY 28, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | 14SS | X | 37 |
| 42.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 45.0 | SW-SAND(TILL), little gravel, brown | 48.3 | | 15SS | X | 40 |
| 47.5 | | | 2"ø PVC PIPE | | | |
| 50.0 | Same, with some iron staining | | BENTONITE PELLET SEAL | 16SS | X | 68 |
| 52.5 | | | 6"ø BOREHOLE | | | |
| 55.0 | | | SAND PACK | | | |
| 57.5 | BEDROCK<br>END OF OVERBURDEN HOLE @ 57.0 FT. BGS | 35.3 | WELL SCREEN | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

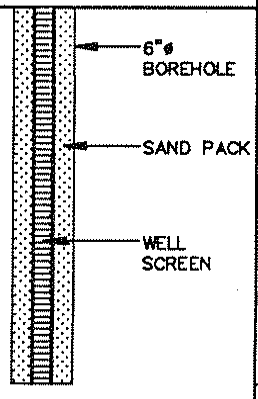
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L117)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 3 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | BEDROCK(Gneiss): black and gray, medium to coarse grained, fractured | 35.3 | | | | | | |
| 60.0 | | | | | 1 | 80 | 0.0 | 0 |
| 62.5 | END OF HOLE @ 62 FT. BGS | 30.3 | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
52.0 to 62.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
50.0 to 62.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L130)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 1 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 96.65 | | | | |
| | GROUND SURFACE | 94.4 | | | | |
| | TOPSOIL, organic rich, black | 94.2 | | | | |
| | SW-SAND(FILL), trace gravel, loose, medium grained, tan, dry | 92.4 | | 1SS | | 6 |
| 2.5 | SM-SAND, some silt, loose, fine grained, tan, dry | | | 2SS | | 5 |
| | Same, except medium dense, tan and black | | | | | |
| 5.0 | | | | 3SS | | 12 |
| | Same, with trace gravel | | | | | |
| 7.5 | | | CEMENT/ BENTONITE GROUT | 4SS | | 18 |
| | | | | 5SS | | 16 |
| 10.0 | SP-SAND, trace silt, medium dense, fine grained, tan, dry | 84.4 | | 6SS | | 12 |
| | Same, except moist | | 5"ø BOREHOLE | 7SS | | >100 |
| 12.5 | | | | | | |
| | SW-SAND, little gravel, trace clay, medium to coarse grained, tan, saturated | 80.4 | | | | |
| 15.0 | | | | 8SS | | >100 |
| | Same, except trace gravel, no clay, very dense | | | | | |
| 17.5 | | | 2"ø PVC PIPE | | | |
| 20.0 | | | | 9SS | | 44 |
| 22.5 | | | | | | |
| | Same, with increased gravel content | | | | | |
| 25.0 | Same, but very hard | | NATIVE MATERIAL | 10SS | | 69 |
| 27.5 | | | | | | |
| 30.0 | | | | 11SS | | 83 |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

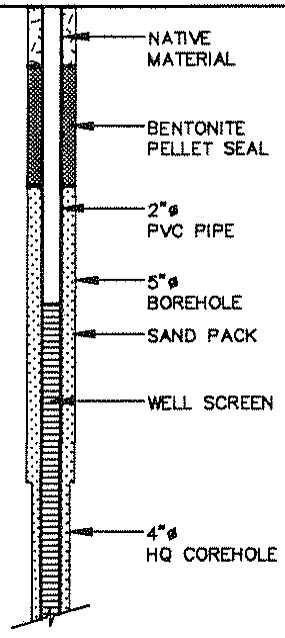
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L130)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 2 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | SP-SAND, trace silt, very dense, fine grained, tan | 60.4 | | 12SS | X | 52 |
| 35.0 | | | | | | |
| 37.5 | | | | | | |
| 40.0 | | | | | | |
| 42.5 | | | | | | |
| 45.0 | BEDROCK<br>END OF OVERBURDEN HOLE @ 44.5 FT. BGS | 49.9 | | | | |
| 47.5 | | | | | | |
| 50.0 | | | | | | |
| 52.5 | | | | | | |
| 55.0 | | | | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

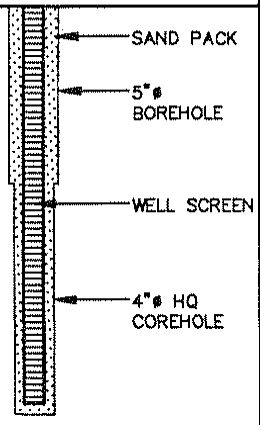
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L131)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 3 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | BEDROCK(Gneiss): black and gray, fine grained, white quartz veins (1-5mm), few fractures, green mineral visible along fractures | 49.9 | | | 1 | 90 | 100.0 | |
| 47.5 | | | | | 2 | 90 | 100.0 | |
| 50.0 | END OF HOLE @ 50.3 FT. BGS | 44.2 | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
40.0 to 50.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
37.0 to 44.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

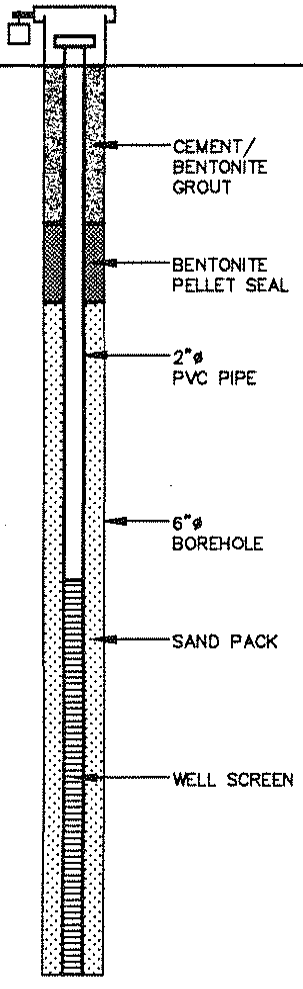
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L132)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71S
DATE COMPLETED: NOVEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 95.60 | | | | |
| | GROUND SURFACE | 93.9 | | | | |
| | For stratigraphy see log GW-71D | | | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| | END OF HOLE @ 23.0 FT. BGS | 70.9 | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |




SCREEN DETAILS:
Screened interval:
13.0 to 23.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
6.0 to 23.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

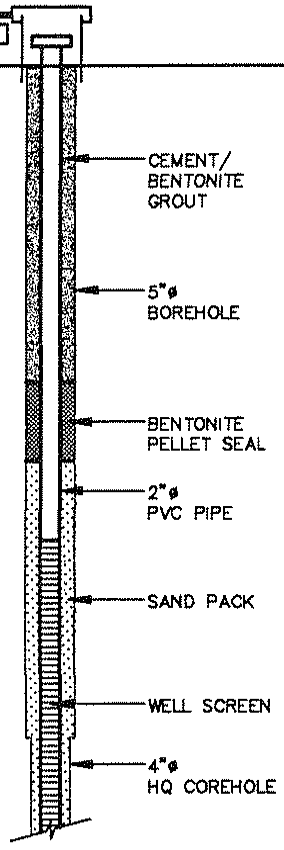
# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L133)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-72D (Page 1 of 2)
DATE COMPLETED: NOVEMBER 5, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 88.19 | | | | |
| | GROUND SURFACE | 86.0 | | | | |
| | SW-SAND(FILL), trace gravel, medium to coarse grained, black | | | 1SS | | 8 |
| | Same, except loose, tan, dry, some iron staining | | | | | |
| 2.5 | Same, except medium dense | | | 2SS | | 18 |
| | Same, except dense, no iron staining | | | | | |
| 5.0 | | | | 3SS | | 42 |
| | Same, except very dense | | | | | |
| 7.5 | | | | 4SS | | 64 |
| | Same, except moist | | | 5SS | | 29 |
| 10.0 | SW-SAND(TILL), little gravel, trace clay, hard, medium to coarse grained, gray, saturated | 76.0 | | 6SS | | 70 |
| | Same, except little clay | | | | | |
| 12.5 | | | | 7SS | | 43 |
| | BEDROCK | 72.0 | | | | |
| 15.0 | | | | | | |
| 17.5 | END OF OVERBURDEN HOLE @ 17.0 FT. BGS | 69.0 | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |




NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

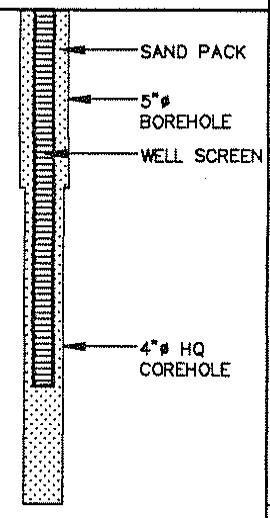
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L134)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-72D (Page 2 of 2)
DATE COMPLETED: NOVEMBER 5, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburen | |  | | | | | |
| 15.0 | | | | | | | | |
| 17.5 | BEDROCK(Gneiss): black and green, medium grained, white medium to coarse grained quartz veins (2-20mm) | 69.0 | | | 1 | 80 | 100.0 | |
| 20.0 | | | | | | | | |
| 22.5 | | | | | 2 | 90 | 100.0 | |
| 25.0 | END OF HOLE @ 25 FT. BGS | 61.0 | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | | | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
10.0 to 17.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

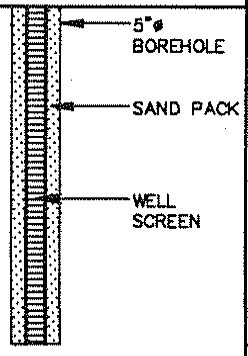
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (BEDROCK)

(L148)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 3 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 40.0 | | | | | | | | |
| | BEDROCK(Gneiss): fine grained to medium grained, sedimentary, weakly to moderately fractured | 40.4 | | | 1 | 90 | 80.0 | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| | END OF HOLE @ 46 FT. BGS | 35.4 | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |
| 52.5 | | | | | | | | |
| 55.0 | | | | | | | | |
| 57.5 | | | | | | | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | | | | | | | | |
| 67.5 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# APPENDIX F

# APPENDIX F

# HYDRAULIC CONDUCTIVITY DATA

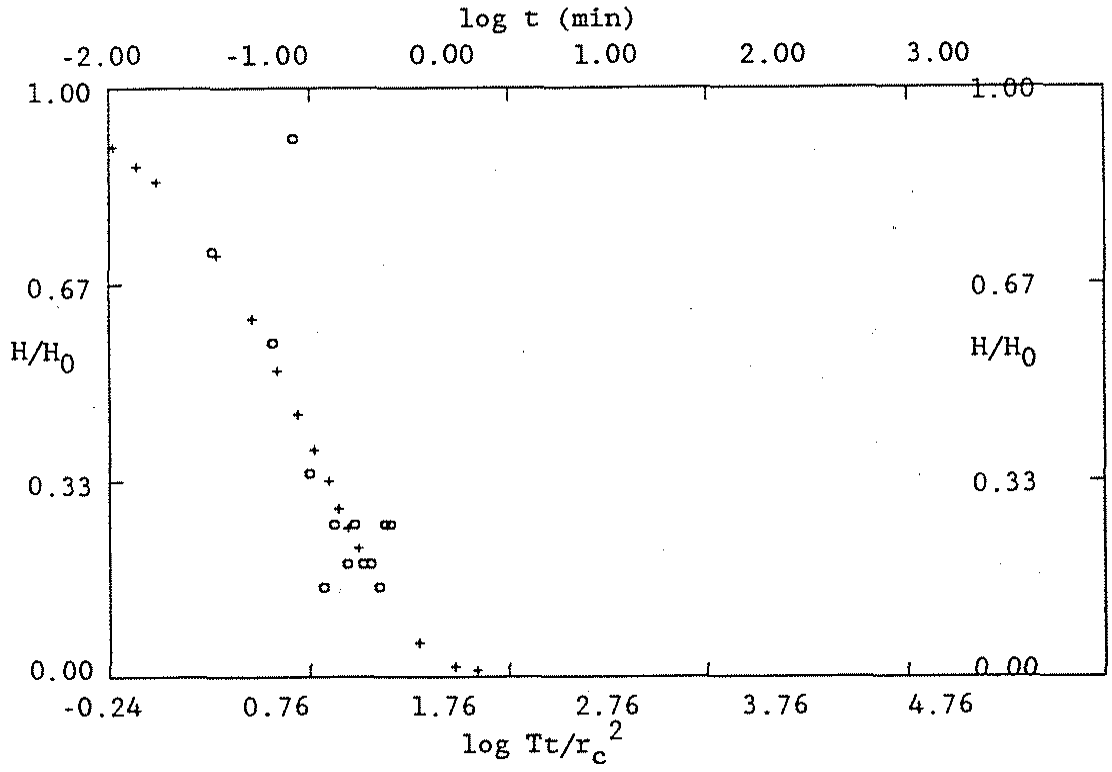
# SLUG TEST HYDRAULIC CONDUCTIVITY DATA

Data for Slug Injection/Withdrawal Test

Well Name: 43DR Date of Test: 9/91
Aquifer Thickness (b): 22.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.460 | 0.460 | 1.000 |
| 3 | 0.033 | 0.330 | 0.330 | 0.717 |
| 4 | 0.067 | 0.260 | 0.260 | 0.565 |
| 5 | 0.083 | 0.420 | 0.420 | 0.913 |
| 6 | 0.100 | 0.160 | 0.160 | 0.348 |
| 7 | 0.117 | 0.070 | 0.070 | 0.152 |
| 8 | 0.133 | 0.120 | 0.120 | 0.261 |
| 9 | 0.150 | 0.090 | 0.090 | 0.196 |
| 10 | 0.167 | 0.120 | 0.120 | 0.261 |
| 11 | 0.183 | 0.090 | 0.090 | 0.196 |
| 12 | 0.200 | 0.090 | 0.090 | 0.196 |
| 13 | 0.217 | 0.070 | 0.070 | 0.152 |
| 14 | 0.233 | 0.120 | 0.120 | 0.261 |
| 15 | 0.250 | 0.120 | 0.120 | 0.261 |

GW43D RISING




o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

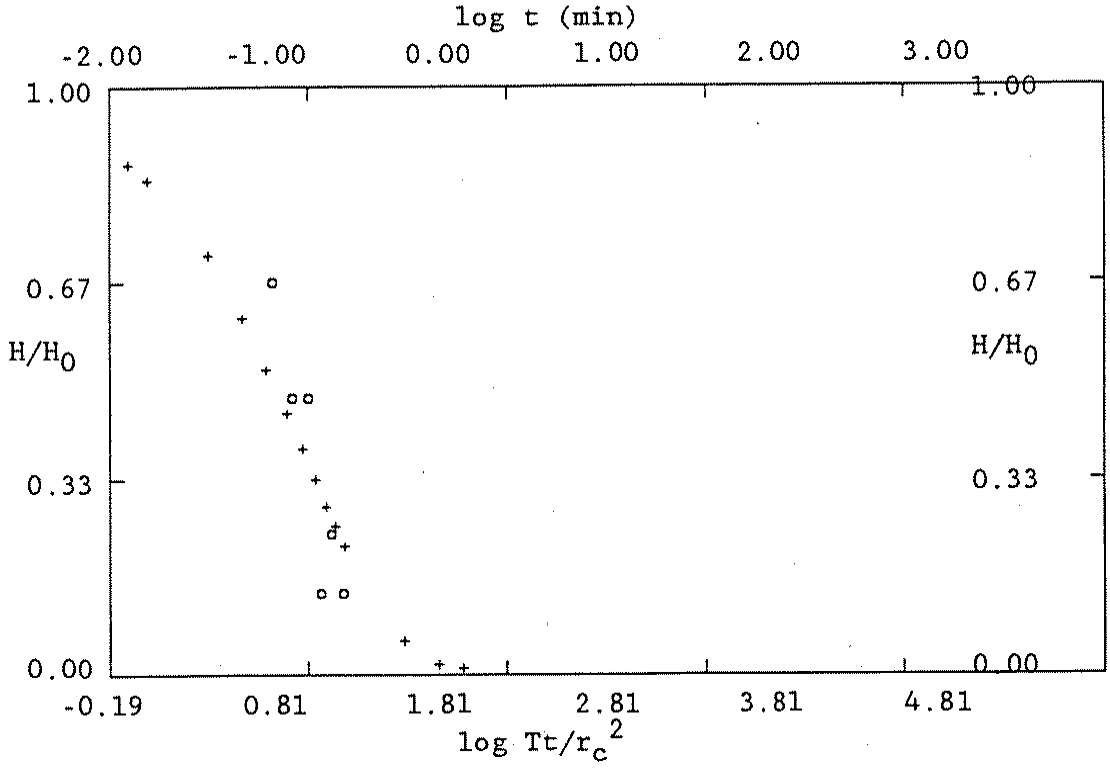
Transmissivity = 3.996E-0001 sq ft/min
Aquifer Thick. = 2.200E+0001 ft
Hydraulic Cond.= 1.816E-0002 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 43DF Date of Test: 9/91
Aquifer Thickness (b): 22.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.210 | 0.210 | 1.000 |
| 3 | 0.033 | 0.470 | 0.470 | 2.238 |
| 4 | 0.050 | 0.440 | 0.440 | 2.095 |
| 5 | 0.067 | 0.140 | 0.140 | 0.667 |
| 6 | 0.083 | 0.100 | 0.100 | 0.476 |
| 7 | 0.100 | 0.100 | 0.100 | 0.476 |
| 8 | 0.117 | 0.030 | 0.030 | 0.143 |
| 9 | 0.133 | 0.050 | 0.050 | 0.238 |
| 10 | 0.150 | 0.030 | 0.030 | 0.143 |
| 11 | 0.167 | 0.000 | 0.000 | 0.000 |

GW43D FALLING




o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

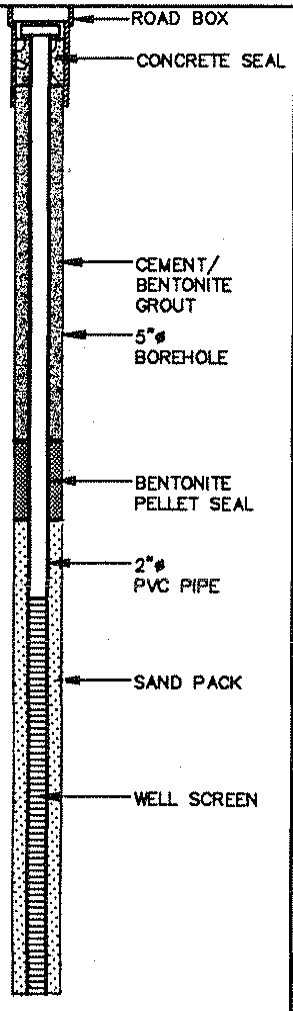
Transmissivity = 4.484E-0001 sq ft/min
Aquifer Thick. = 2.200E+0001 ft
Hydraulic Cond.= 2.038E-0002 ft/min
Storativity = 1.000E-0010

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L142)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73S
DATE COMPLETED: APRIL 19, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 83.39<br>83.4 | | | | |
| | For straigraphy see GW-73D | |  | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | | | | | | |
| 22.5 | | | | | | |
| 25.0 | END OF HOLE @ 25.0 FT. BGS | 58.4 | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
15.0 to 25.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
13.0 to 25.0' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

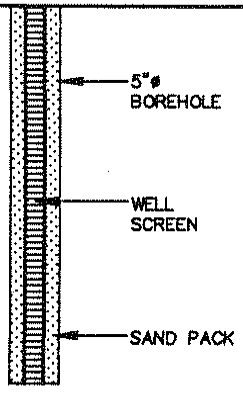
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L141)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73D (Page 3 of 3)
DATE COMPLETED: APRIL 14, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 57.5 | | 25.8 | | | | | | |
| | BEDROCK(Gneiss): heavily fractured, highly weathered | | | | 1 | 50 | | |
| 60.0 | | | | | | | | |
| 62.5 | | | | | | | | |
| 65.0 | END OF HOLE @ 64.5 FT. BGS | 19.3 | | | | | | |
| 67.5 | | | | | | | | |
| 70.0 | | | | | | | | |
| 72.5 | | | | | | | | |
| 75.0 | | | | | | | | |
| 77.5 | | | | | | | | |
| 80.0 | | | | | | | | |
| 82.5 | | | | | | | | |
| 85.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
54.5 to 64.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
52.0 to 64.5' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

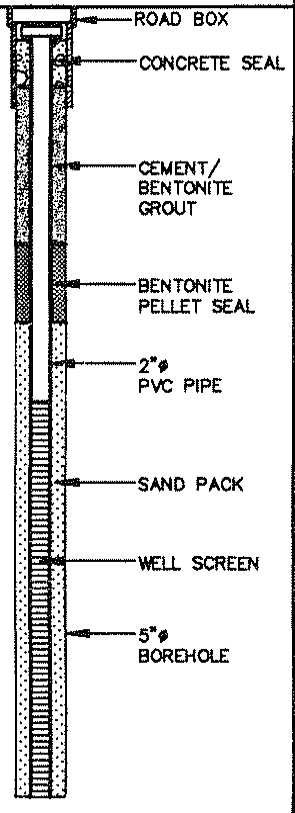
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L143)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-74S
DATE COMPLETED: MARCH 25, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 77.43 | | | | |
| | GROUND SURFACE | 77.7 | | | | |
| | For stratigraphy see GW-74D | |  | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 57.7 | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
8.0 to 20.0' BGS
Length -12.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L144)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-74D (Page 1 of 2)
DATE COMPLETED: MARCH 25, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 77.22 | | | | |
| | GROUND SURFACE | 77.7 | | | | |
| | ASPHALT | 77.0 | ROAD BOX | | | |
| | SW-SAND(FILL), some gravel, brown, moist | | CONCRETE SEAL | 1SS | X | 12 |
| 2.5 | | | | 2SS | X | 17 |
| 5.0 | | | | 3SS | X | 15 |
| | – saturated | | | 4SS | X | 30 |
| 7.5 | | | | | | |
| | SW-SAND, some gravel, medium to coarse grained, brown, outwash | 68.7 | CEMENT/ BENTONITE GROUT | | | |
| 10.0 | | | | 5SS | X | 43 |
| 12.5 | | | | 6SS | X | 20 |
| 15.0 | | | 2"ø PVC PIPE | 7SS | X | 42 |
| 17.5 | | | BENTONITE PELLET SEAL | | | |
| 20.0 | | | 5"ø BOREHOLE | | | |
| 22.5 | | | SAND PACK | 8SS | X | 32 |
| 25.0 | BEDROCK – Gneiss, fine grained, weakly fractured | 52.7 | WELL SCREEN | 9SS | X | >100 |
| | END OF OVERBURDEN HOLE @ 25.0 FT. BGS | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

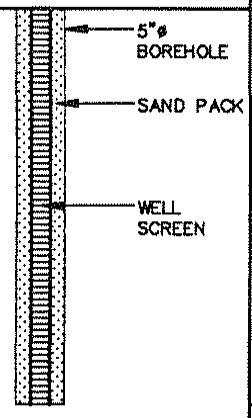
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L145)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-74D (Page 2 of 2)
DATE COMPLETED: MARCH 25, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH | DESCRIPTION OF STRATA | ELEVATION | MONITOR INSTALLATION | BEDROCK INTERVAL | RUN NUMBER | CORE RECOVERY | RQD | WATER RETURN |
|---|---|---|---|---|---|---|---|---|
| ft BGS | | ft. AMSL | | | | % | % | % |
| | Overburden | |  | | | | | |
| 22.5 | | | | | | | | |
| 25.0 | BEDROCK(Gneiss): fine grained, weakly fractured | 52.7 | | | | | | |
| 27.5 | | | | | | | | |
| 30.0 | END OF HOLE @ 30 FT. BGS | 47.7 | | | | | | |
| 32.5 | | | | | | | | |
| 35.0 | | | | | | | | |
| 37.5 | | | | | | | | |
| 40.0 | | | | | | | | |
| 42.5 | | | | | | | | |
| 45.0 | | | | | | | | |
| 47.5 | | | | | | | | |
| 50.0 | | | | | | | | |



SCREEN DETAILS:
Screened Interval:
20.0 to 30.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
18.0 to 30.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

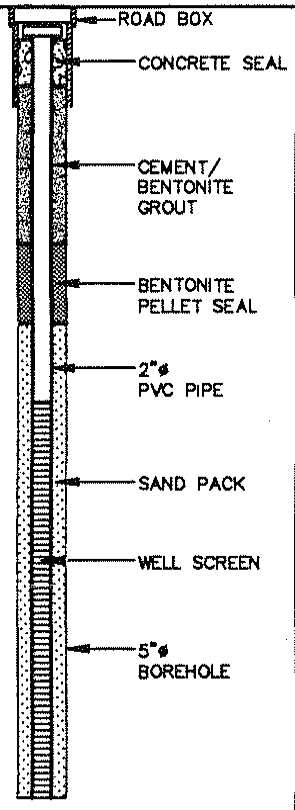
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L146)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75S
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser)<br>GROUND SURFACE | 83.28<br>81.1 | | | | |
| | For stratigraphy see GW-75D | |  | | | |
| 2.5 | | | | | | |
| 5.0 | | | | | | |
| 7.5 | | | | | | |
| 10.0 | | | | | | |
| 12.5 | | | | | | |
| 15.0 | | | | | | |
| 17.5 | | | | | | |
| 20.0 | END OF HOLE @ 20.0 FT. BGS | 61.1 | | | | |
| 22.5 | | | | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | | | |
| 32.5 | | | | | | |



SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L147)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 1 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| | REFERENCE POINT (Top of Riser) | 83.49 | | | | |
| | GROUND SURFACE | 81.4 | | | | |
| | SW-SAND, fine to coarse grained, brown, outwash<br>– saturated | | ROAD BOX<br>CONCRETE SEAL | 1SS | | 19 |
| 2.5 | | | | 2SS | | 22 |
| 5.0 | | | 2"ø PVC PIPE | 3SS | | 16 |
| 7.5 | | | | 4SS | | 25 |
| 10.0 | SP/SW-SAND, interbeds, poorly graded and well graded, medium to coarse grained, brown ice contact deposits | 71.4 | | 5SS | | 17 |
| 12.5 | | | | | | |
| 15.0 | | | | 6SS | | 40 |
| 17.5 | | | CEMENT/ BENTONITE GROUT | | | |
| 20.0 | SW-SAND, medium to coarse grained, brown | 62.2 | | | | |
| 22.5 | | | | 8SS | | 32 |
| | | | 5"ø BOREHOLE | | | |
| 25.0 | | | | | | |
| 27.5 | | | | | | |
| 30.0 | | | | 9SS | | 24 |
| 32.5 | | | BENTONITE PELLET SEAL | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L147)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 2 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE |
|---|---|---|---|---|---|---|
| 35.0 | | | BENTONITE PELLET SEAL; 2"ø PVC PIPE; SAND PACK | 10SS | X | 40 |
| 37.5 | | | | | | |
| 40.0 | | | | 11SS | X | >100 |
| | BEDROCK – refusal | 40.4 | WELL SCREEN | | | |
| 42.5 | END OF OVERBURDEN HOLE @ 41.0 FT. BGS | | 5"ø BOREHOLE | | | |
| 45.0 | | | | | | |
| 47.5 | | | | | | |
| 50.0 | | | | | | |
| 52.5 | | | | | | |
| 55.0 | | | | | | |
| 57.5 | | | | | | |
| 60.0 | | | | | | |
| 62.5 | | | | | | |
| 65.0 | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

Data for Slug Injection/Withdrawal Test

Well Name: 51DR Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.550 | 0.550 | 1.000 |
| 3 | 0.033 | 0.500 | 0.500 | 0.909 |
| 4 | 0.050 | 0.550 | 0.550 | 1.000 |
| 5 | 0.067 | 0.480 | 0.480 | 0.873 |
| 6 | 0.083 | 0.500 | 0.500 | 0.909 |
| 7 | 0.100 | 0.460 | 0.460 | 0.836 |
| 8 | 0.117 | 0.480 | 0.480 | 0.873 |
| 9 | 0.133 | 0.440 | 0.440 | 0.800 |
| 10 | 0.150 | 0.480 | 0.480 | 0.873 |
| 11 | 0.167 | 0.410 | 0.410 | 0.745 |
| 12 | 0.183 | 0.460 | 0.460 | 0.836 |
| 13 | 0.200 | 0.410 | 0.410 | 0.745 |
| 14 | 0.217 | 0.440 | 0.440 | 0.800 |
| 15 | 0.233 | 0.390 | 0.390 | 0.709 |
| 16 | 0.250 | 0.440 | 0.440 | 0.800 |
| 17 | 0.267 | 0.410 | 0.410 | 0.745 |
| 18 | 0.283 | 0.370 | 0.370 | 0.673 |
| 19 | 0.300 | 0.390 | 0.390 | 0.709 |
| 20 | 0.317 | 0.370 | 0.370 | 0.673 |
| 21 | 0.333 | 0.370 | 0.370 | 0.673 |
| 22 | 0.350 | 0.370 | 0.370 | 0.673 |
| 23 | 0.367 | 0.370 | 0.370 | 0.673 |
| 24 | 0.383 | 0.340 | 0.340 | 0.618 |
| 25 | 0.400 | 0.340 | 0.340 | 0.618 |
| 26 | 0.417 | 0.340 | 0.340 | 0.618 |
| 27 | 0.433 | 0.340 | 0.340 | 0.618 |
| 28 | 0.450 | 0.320 | 0.320 | 0.582 |
| 29 | 0.467 | 0.320 | 0.320 | 0.582 |
| 30 | 0.483 | 0.300 | 0.300 | 0.545 |
| 31 | 0.500 | 0.340 | 0.340 | 0.618 |
| 32 | 0.517 | 0.300 | 0.300 | 0.545 |
| 33 | 0.533 | 0.320 | 0.320 | 0.582 |
| 34 | 0.550 | 0.270 | 0.270 | 0.491 |
| 35 | 0.567 | 0.320 | 0.320 | 0.582 |
| 36 | 0.583 | 0.270 | 0.270 | 0.491 |
| 37 | 0.600 | 0.320 | 0.320 | 0.582 |
| 38 | 0.617 | 0.250 | 0.250 | 0.455 |
| 39 | 0.633 | 0.270 | 0.270 | 0.491 |
| 40 | 0.650 | 0.270 | 0.270 | 0.491 |
| 41 | 0.667 | 0.250 | 0.250 | 0.455 |

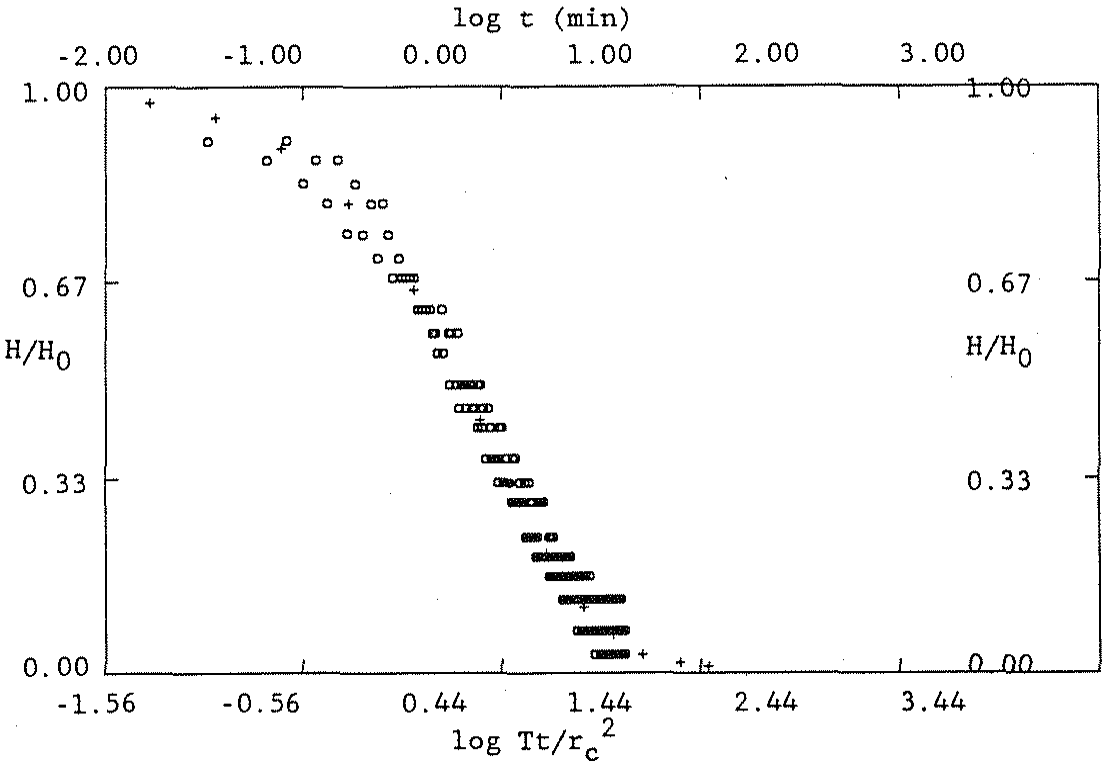
| | | | | |
|---|---|---|---|---|
| 42 | 0.683 | 0.270 | 0.270 | 0.491 |
| 43 | 0.700 | 0.250 | 0.250 | 0.455 |
| 44 | 0.717 | 0.270 | 0.270 | 0.491 |
| 45 | 0.733 | 0.250 | 0.250 | 0.455 |
| 46 | 0.750 | 0.270 | 0.270 | 0.491 |
| 47 | 0.767 | 0.230 | 0.230 | 0.418 |
| 48 | 0.783 | 0.270 | 0.270 | 0.491 |
| 49 | 0.800 | 0.230 | 0.230 | 0.418 |
| 50 | 0.817 | 0.250 | 0.250 | 0.455 |
| 51 | 0.833 | 0.200 | 0.200 | 0.364 |
| 52 | 0.850 | 0.250 | 0.250 | 0.455 |
| 53 | 0.867 | 0.230 | 0.230 | 0.418 |
| 54 | 0.883 | 0.200 | 0.200 | 0.364 |
| 55 | 0.900 | 0.230 | 0.230 | 0.418 |
| 56 | 0.917 | 0.200 | 0.200 | 0.364 |
| 57 | 0.933 | 0.200 | 0.200 | 0.364 |
| 58 | 0.950 | 0.200 | 0.200 | 0.364 |
| 59 | 0.967 | 0.230 | 0.230 | 0.418 |
| 60 | 0.983 | 0.180 | 0.180 | 0.327 |
| 61 | 1.000 | 0.230 | 0.230 | 0.418 |
| 62 | 1.017 | 0.180 | 0.180 | 0.327 |
| 63 | 1.033 | 0.180 | 0.180 | 0.327 |
| 64 | 1.050 | 0.200 | 0.200 | 0.364 |
| 65 | 1.067 | 0.180 | 0.180 | 0.327 |
| 66 | 1.083 | 0.200 | 0.200 | 0.364 |
| 67 | 1.100 | 0.180 | 0.180 | 0.327 |
| 68 | 1.117 | 0.200 | 0.200 | 0.364 |
| 69 | 1.133 | 0.160 | 0.160 | 0.291 |
| 70 | 1.150 | 0.200 | 0.200 | 0.364 |
| 71 | 1.167 | 0.160 | 0.160 | 0.291 |
| 72 | 1.183 | 0.200 | 0.200 | 0.364 |
| 73 | 1.200 | 0.160 | 0.160 | 0.291 |
| 74 | 1.217 | 0.160 | 0.160 | 0.291 |
| 75 | 1.233 | 0.180 | 0.180 | 0.327 |
| 76 | 1.250 | 0.160 | 0.160 | 0.291 |
| 77 | 1.267 | 0.160 | 0.160 | 0.291 |
| 78 | 1.283 | 0.160 | 0.160 | 0.291 |
| 79 | 1.300 | 0.160 | 0.160 | 0.291 |
| 80 | 1.317 | 0.130 | 0.130 | 0.236 |
| 81 | 1.333 | 0.180 | 0.180 | 0.327 |
| 82 | 1.350 | 0.130 | 0.130 | 0.236 |
| 83 | 1.367 | 0.180 | 0.180 | 0.327 |
| 84 | 1.383 | 0.130 | 0.130 | 0.236 |
| 85 | 1.400 | 0.160 | 0.160 | 0.291 |
| 86 | 1.417 | 0.130 | 0.130 | 0.236 |
| 87 | 1.433 | 0.160 | 0.160 | 0.291 |
| 88 | 1.450 | 0.130 | 0.130 | 0.236 |
| 89 | 1.467 | 0.110 | 0.110 | 0.200 |
| 90 | 1.483 | 0.130 | 0.130 | 0.236 |
| 91 | 1.500 | 0.130 | 0.130 | 0.236 |
| 92 | 1.517 | 0.130 | 0.130 | 0.236 |
| 93 | 1.533 | 0.110 | 0.110 | 0.200 |
| 94 | 1.550 | 0.160 | 0.160 | 0.291 |
| 95 | 1.567 | 0.110 | 0.110 | 0.200 |
| 96 | 1.583 | 0.160 | 0.160 | 0.291 |
| 97 | 1.600 | 0.110 | 0.110 | 0.200 |
| 98 | 1.617 | 0.160 | 0.160 | 0.291 |
| 99 | 1.633 | 0.110 | 0.110 | 0.200 |
| 100 | 1.650 | 0.110 | 0.110 | 0.200 |
| 101 | 1.667 | 0.110 | 0.110 | 0.200 |

| | | | | |
|---|---|---|---|---|
| 102 | 1.683 | 0.110 | 0.110 | 0.200 |
| 103 | 1.700 | 0.110 | 0.110 | 0.200 |
| 104 | 1.717 | 0.110 | 0.110 | 0.200 |
| 105 | 1.733 | 0.130 | 0.130 | 0.236 |
| 106 | 1.750 | 0.090 | 0.090 | 0.164 |
| 107 | 1.767 | 0.130 | 0.130 | 0.236 |
| 108 | 1.783 | 0.090 | 0.090 | 0.164 |
| 109 | 1.800 | 0.130 | 0.130 | 0.236 |
| 110 | 1.817 | 0.110 | 0.110 | 0.200 |
| 111 | 1.833 | 0.090 | 0.090 | 0.164 |
| 112 | 1.850 | 0.110 | 0.110 | 0.200 |
| 113 | 1.867 | 0.090 | 0.090 | 0.164 |
| 114 | 1.883 | 0.110 | 0.110 | 0.200 |
| 115 | 1.900 | 0.090 | 0.090 | 0.164 |
| 116 | 1.917 | 0.110 | 0.110 | 0.200 |
| 117 | 1.933 | 0.090 | 0.090 | 0.164 |
| 118 | 1.950 | 0.090 | 0.090 | 0.164 |
| 119 | 1.967 | 0.110 | 0.110 | 0.200 |
| 120 | 1.983 | 0.090 | 0.090 | 0.164 |
| 121 | 2.000 | 0.090 | 0.090 | 0.164 |
| 122 | 2.017 | 0.090 | 0.090 | 0.164 |
| 123 | 2.033 | 0.090 | 0.090 | 0.164 |
| 124 | 2.050 | 0.070 | 0.070 | 0.127 |
| 125 | 2.067 | 0.110 | 0.110 | 0.200 |
| 126 | 2.083 | 0.070 | 0.070 | 0.127 |
| 127 | 2.100 | 0.110 | 0.110 | 0.200 |
| 128 | 2.117 | 0.070 | 0.070 | 0.127 |
| 129 | 2.133 | 0.110 | 0.110 | 0.200 |
| 130 | 2.150 | 0.070 | 0.070 | 0.127 |
| 131 | 2.167 | 0.070 | 0.070 | 0.127 |
| 132 | 2.183 | 0.090 | 0.090 | 0.164 |
| 133 | 2.200 | 0.070 | 0.070 | 0.127 |
| 134 | 2.217 | 0.090 | 0.090 | 0.164 |
| 135 | 2.233 | 0.070 | 0.070 | 0.127 |
| 136 | 2.250 | 0.110 | 0.110 | 0.200 |
| 137 | 2.267 | 0.070 | 0.070 | 0.127 |
| 138 | 2.283 | 0.090 | 0.090 | 0.164 |
| 139 | 2.300 | 0.070 | 0.070 | 0.127 |
| 140 | 2.317 | 0.090 | 0.090 | 0.164 |
| 141 | 2.333 | 0.090 | 0.090 | 0.164 |
| 142 | 2.350 | 0.070 | 0.070 | 0.127 |
| 143 | 2.367 | 0.070 | 0.070 | 0.127 |
| 144 | 2.383 | 0.070 | 0.070 | 0.127 |
| 145 | 2.400 | 0.070 | 0.070 | 0.127 |
| 146 | 2.417 | 0.040 | 0.040 | 0.073 |
| 147 | 2.433 | 0.090 | 0.090 | 0.164 |
| 148 | 2.450 | 0.090 | 0.090 | 0.164 |
| 149 | 2.467 | 0.090 | 0.090 | 0.164 |
| 150 | 2.483 | 0.040 | 0.040 | 0.073 |
| 151 | 2.500 | 0.040 | 0.040 | 0.073 |
| 152 | 2.517 | 0.070 | 0.070 | 0.127 |
| 153 | 2.533 | 0.040 | 0.040 | 0.073 |
| 154 | 2.550 | 0.070 | 0.070 | 0.127 |
| 155 | 2.567 | 0.040 | 0.040 | 0.073 |
| 156 | 2.583 | 0.090 | 0.090 | 0.164 |
| 157 | 2.600 | 0.040 | 0.040 | 0.073 |
| 158 | 2.617 | 0.090 | 0.090 | 0.164 |
| 159 | 2.633 | 0.070 | 0.070 | 0.127 |
| 160 | 2.650 | 0.040 | 0.040 | 0.073 |
| 161 | 2.667 | 0.070 | 0.070 | 0.127 |

| | | | | |
|---|---|---|---|---|
| 162 | 2.683 | 0.040 | 0.040 | 0.073 |
| 163 | 2.700 | 0.070 | 0.070 | 0.127 |
| 164 | 2.717 | 0.040 | 0.040 | 0.073 |
| 165 | 2.733 | 0.090 | 0.090 | 0.164 |
| 166 | 2.750 | 0.040 | 0.040 | 0.073 |
| 167 | 2.767 | 0.040 | 0.040 | 0.073 |
| 168 | 2.783 | 0.070 | 0.070 | 0.127 |
| 169 | 2.800 | 0.040 | 0.040 | 0.073 |
| 170 | 2.817 | 0.070 | 0.070 | 0.127 |
| 171 | 2.833 | 0.040 | 0.040 | 0.073 |
| 172 | 2.850 | 0.070 | 0.070 | 0.127 |
| 173 | 2.867 | 0.040 | 0.040 | 0.073 |
| 174 | 2.883 | 0.040 | 0.040 | 0.073 |
| 175 | 2.900 | 0.070 | 0.070 | 0.127 |
| 176 | 2.917 | 0.040 | 0.040 | 0.073 |
| 177 | 2.933 | 0.070 | 0.070 | 0.127 |
| 178 | 2.950 | 0.020 | 0.020 | 0.036 |
| 179 | 2.967 | 0.070 | 0.070 | 0.127 |
| 180 | 2.983 | 0.040 | 0.040 | 0.073 |
| 181 | 3.000 | 0.040 | 0.040 | 0.073 |
| 182 | 3.017 | 0.070 | 0.070 | 0.127 |
| 183 | 3.033 | 0.040 | 0.040 | 0.073 |
| 184 | 3.050 | 0.070 | 0.070 | 0.127 |
| 185 | 3.067 | 0.020 | 0.020 | 0.036 |
| 186 | 3.083 | 0.070 | 0.070 | 0.127 |
| 187 | 3.100 | 0.020 | 0.020 | 0.036 |
| 188 | 3.117 | 0.020 | 0.020 | 0.036 |
| 189 | 3.133 | 0.040 | 0.040 | 0.073 |
| 190 | 3.150 | 0.040 | 0.040 | 0.073 |
| 191 | 3.167 | 0.070 | 0.070 | 0.127 |
| 192 | 3.183 | 0.020 | 0.020 | 0.036 |
| 193 | 3.200 | 0.070 | 0.070 | 0.127 |
| 194 | 3.217 | 0.040 | 0.040 | 0.073 |
| 195 | 3.233 | 0.020 | 0.020 | 0.036 |
| 196 | 3.250 | 0.040 | 0.040 | 0.073 |
| 197 | 3.267 | 0.020 | 0.020 | 0.036 |
| 198 | 3.283 | 0.070 | 0.070 | 0.127 |
| 199 | 3.300 | 0.020 | 0.020 | 0.036 |
| 200 | 3.317 | 0.070 | 0.070 | 0.127 |
| 201 | 3.333 | 0.040 | 0.040 | 0.073 |
| 202 | 3.350 | 0.020 | 0.020 | 0.036 |
| 203 | 3.367 | 0.040 | 0.040 | 0.073 |
| 204 | 3.383 | 0.020 | 0.020 | 0.036 |
| 205 | 3.400 | 0.070 | 0.070 | 0.127 |
| 206 | 3.417 | 0.020 | 0.020 | 0.036 |
| 207 | 3.433 | 0.020 | 0.020 | 0.036 |
| 208 | 3.450 | 0.040 | 0.040 | 0.073 |
| 209 | 3.467 | 0.040 | 0.040 | 0.073 |
| 210 | 3.483 | 0.040 | 0.040 | 0.073 |
| 211 | 3.500 | 0.020 | 0.020 | 0.036 |
| 212 | 3.517 | 0.070 | 0.070 | 0.127 |
| 213 | 3.533 | 0.020 | 0.020 | 0.036 |
| 214 | 3.550 | 0.070 | 0.070 | 0.127 |
| 215 | 3.567 | 0.040 | 0.040 | 0.073 |
| 216 | 3.583 | 0.020 | 0.020 | 0.036 |
| 217 | 3.600 | 0.040 | 0.040 | 0.073 |
| 218 | 3.617 | 0.020 | 0.020 | 0.036 |
| 219 | 3.633 | 0.070 | 0.070 | 0.127 |
| 220 | 3.650 | 0.020 | 0.020 | 0.036 |
| 221 | 3.667 | 0.070 | 0.070 | 0.127 |

| | | | | |
|---|---|---|---|---|
| 222 | 3.683 | 0.020 | 0.020 | 0.036 |
| 223 | 3.700 | 0.020 | 0.020 | 0.036 |
| 224 | 3.717 | 0.040 | 0.040 | 0.073 |
| 225 | 3.733 | 0.020 | 0.020 | 0.036 |
| 226 | 3.750 | 0.070 | 0.070 | 0.127 |
| 227 | 3.767 | 0.020 | 0.020 | 0.036 |
| 228 | 3.783 | 0.070 | 0.070 | 0.127 |
| 229 | 3.800 | 0.040 | 0.040 | 0.073 |
| 230 | 3.817 | 0.020 | 0.020 | 0.036 |
| 231 | 3.833 | 0.040 | 0.040 | 0.073 |
| 232 | 3.850 | 0.020 | 0.020 | 0.036 |
| 233 | 3.867 | 0.070 | 0.070 | 0.127 |
| 234 | 3.883 | 0.020 | 0.020 | 0.036 |
| 235 | 3.900 | 0.070 | 0.070 | 0.127 |
| 236 | 3.917 | 0.040 | 0.040 | 0.073 |
| 237 | 3.933 | 0.020 | 0.020 | 0.036 |
| 238 | 3.950 | 0.020 | 0.020 | 0.036 |
| 239 | 3.967 | 0.020 | 0.020 | 0.036 |
| 240 | 3.983 | 0.040 | 0.040 | 0.073 |
| 241 | 4.000 | 0.020 | 0.020 | 0.036 |
| 242 | 4.017 | 0.070 | 0.070 | 0.127 |
| 243 | 4.033 | 0.020 | 0.020 | 0.036 |
| 244 | 4.050 | 0.020 | 0.020 | 0.036 |
| 245 | 4.067 | 0.020 | 0.020 | 0.036 |
| 246 | 4.083 | 0.020 | 0.020 | 0.036 |
| 247 | 4.100 | 0.040 | 0.040 | 0.073 |
| 248 | 4.117 | 0.020 | 0.020 | 0.036 |
| 249 | 4.133 | 0.040 | 0.040 | 0.073 |
| 250 | 4.150 | 0.020 | 0.020 | 0.036 |
| 251 | 4.167 | 0.020 | 0.020 | 0.036 |
| 252 | 4.183 | 0.020 | 0.020 | 0.036 |
| 253 | 4.200 | 0.020 | 0.020 | 0.036 |
| 254 | 4.217 | 0.040 | 0.040 | 0.073 |
| 255 | 4.233 | 0.000 | 0.000 | 0.000 |

GW51D RISING




o - Data

+ - Type Curve
Slug Test: alpha = -4.0

SOLUTION

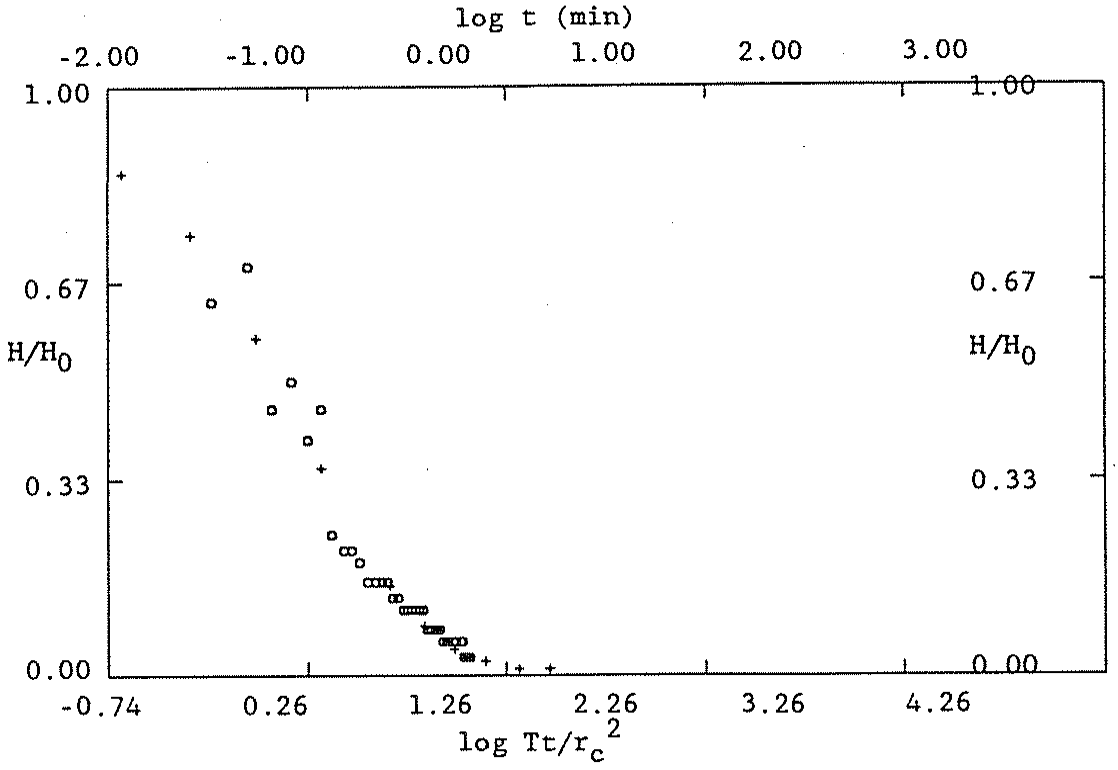
Transmissivity = 1.913E-0002 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 1.913E-0003 ft/min
Storativity = 1.000E-0004

Data for Slug Injection/Withdrawal Test

Well Name: 54DF Date of Test: 9/91
Aquifer Thickness (b): 12.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/H0 |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.880 | 0.880 | 1.000 |
| 3 | 0.033 | 0.560 | 0.560 | 0.636 |
| 4 | 0.050 | 0.610 | 0.610 | 0.693 |
| 5 | 0.067 | 0.400 | 0.400 | 0.455 |
| 6 | 0.083 | 0.440 | 0.440 | 0.500 |
| 7 | 0.100 | 0.350 | 0.350 | 0.398 |
| 8 | 0.117 | 0.400 | 0.400 | 0.455 |
| 9 | 0.133 | 0.210 | 0.210 | 0.239 |
| 10 | 0.150 | 0.190 | 0.190 | 0.216 |
| 11 | 0.167 | 0.190 | 0.190 | 0.216 |
| 12 | 0.183 | 0.170 | 0.170 | 0.193 |
| 13 | 0.200 | 0.140 | 0.140 | 0.159 |
| 14 | 0.217 | 0.140 | 0.140 | 0.159 |
| 15 | 0.233 | 0.140 | 0.140 | 0.159 |
| 16 | 0.250 | 0.140 | 0.140 | 0.159 |
| 17 | 0.267 | 0.120 | 0.120 | 0.136 |
| 18 | 0.283 | 0.120 | 0.120 | 0.136 |
| 19 | 0.300 | 0.100 | 0.100 | 0.114 |
| 20 | 0.317 | 0.100 | 0.100 | 0.114 |
| 21 | 0.333 | 0.100 | 0.100 | 0.114 |
| 22 | 0.350 | 0.100 | 0.100 | 0.114 |
| 23 | 0.367 | 0.100 | 0.100 | 0.114 |
| 24 | 0.383 | 0.100 | 0.100 | 0.114 |
| 25 | 0.400 | 0.070 | 0.070 | 0.080 |
| 26 | 0.417 | 0.070 | 0.070 | 0.080 |
| 27 | 0.433 | 0.070 | 0.070 | 0.080 |
| 28 | 0.450 | 0.070 | 0.070 | 0.080 |
| 29 | 0.467 | 0.070 | 0.070 | 0.080 |
| 30 | 0.483 | 0.050 | 0.050 | 0.057 |
| 31 | 0.500 | 0.050 | 0.050 | 0.057 |
| 32 | 0.517 | 0.050 | 0.050 | 0.057 |
| 33 | 0.533 | 0.050 | 0.050 | 0.057 |
| 34 | 0.550 | 0.050 | 0.050 | 0.057 |
| 35 | 0.567 | 0.050 | 0.050 | 0.057 |
| 36 | 0.583 | 0.050 | 0.050 | 0.057 |
| 37 | 0.600 | 0.050 | 0.050 | 0.057 |
| 38 | 0.617 | 0.030 | 0.030 | 0.034 |
| 39 | 0.633 | 0.030 | 0.030 | 0.034 |
| 40 | 0.650 | 0.030 | 0.030 | 0.034 |
| 41 | 0.667 | 0.030 | 0.030 | 0.034 |

GW54D FALLING




o - Data

+ - Type Curve
Slug Test: alpha = -3.0

SOLUTION

Transmissivity = 1.264E-0001 sq ft/min
Aquifer Thick. = 1.200E+0001 ft
Hydraulic Cond.= 1.053E-0002 ft/min
Storativity = 1.000E-0003

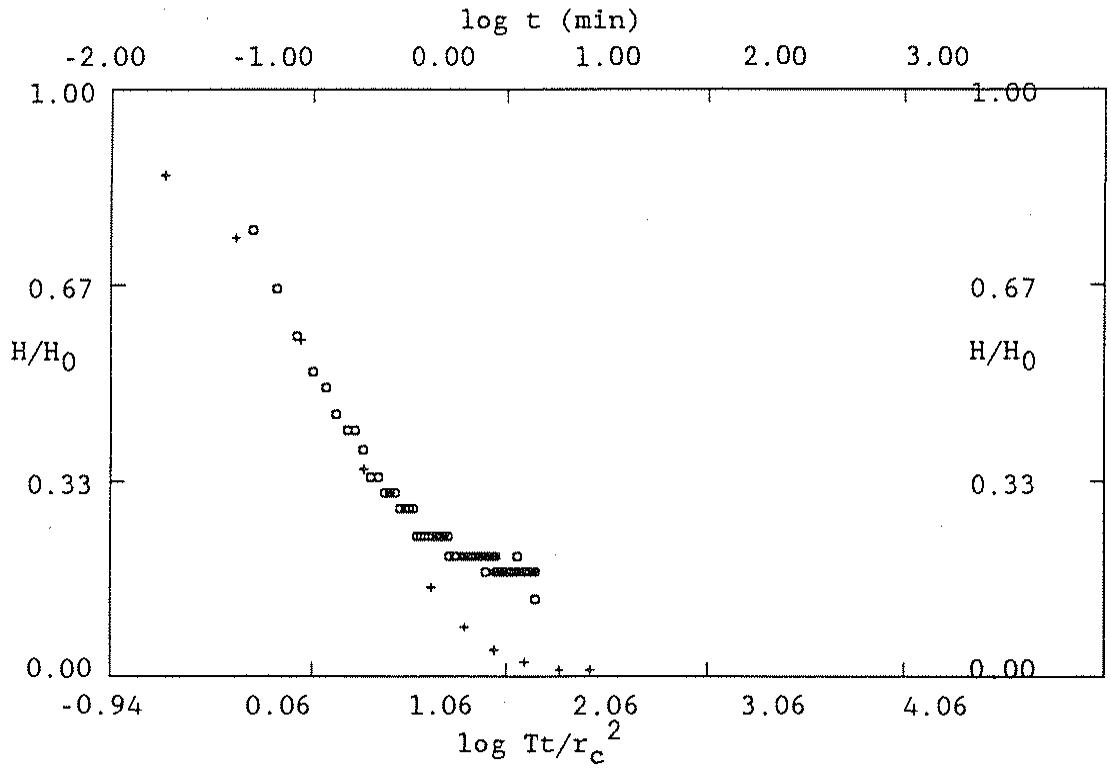
Data for Slug Injection/Withdrawal Test

Well Name: 54DR Date of Test: 9/91
Aquifer Thickness (b): 12.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.670 | 0.670 | 1.000 |
| 3 | 0.033 | 0.700 | 0.700 | 1.045 |
| 4 | 0.050 | 0.510 | 0.510 | 0.761 |
| 5 | 0.067 | 0.440 | 0.440 | 0.657 |
| 6 | 0.083 | 0.390 | 0.390 | 0.582 |
| 7 | 0.100 | 0.350 | 0.350 | 0.522 |
| 8 | 0.117 | 0.330 | 0.330 | 0.493 |
| 9 | 0.133 | 0.300 | 0.300 | 0.448 |
| 10 | 0.150 | 0.280 | 0.280 | 0.418 |
| 11 | 0.167 | 0.280 | 0.280 | 0.418 |
| 12 | 0.183 | 0.260 | 0.260 | 0.388 |
| 13 | 0.200 | 0.230 | 0.230 | 0.343 |
| 14 | 0.217 | 0.230 | 0.230 | 0.343 |
| 15 | 0.233 | 0.210 | 0.210 | 0.313 |
| 16 | 0.250 | 0.210 | 0.210 | 0.313 |
| 17 | 0.267 | 0.210 | 0.210 | 0.313 |
| 18 | 0.283 | 0.190 | 0.190 | 0.284 |
| 19 | 0.300 | 0.190 | 0.190 | 0.284 |
| 20 | 0.317 | 0.190 | 0.190 | 0.284 |
| 21 | 0.333 | 0.190 | 0.190 | 0.284 |
| 22 | 0.350 | 0.160 | 0.160 | 0.239 |
| 23 | 0.367 | 0.160 | 0.160 | 0.239 |
| 24 | 0.383 | 0.160 | 0.160 | 0.239 |
| 25 | 0.400 | 0.160 | 0.160 | 0.239 |
| 26 | 0.417 | 0.160 | 0.160 | 0.239 |
| 27 | 0.433 | 0.160 | 0.160 | 0.239 |
| 28 | 0.450 | 0.160 | 0.160 | 0.239 |
| 29 | 0.467 | 0.160 | 0.160 | 0.239 |
| 30 | 0.483 | 0.160 | 0.160 | 0.239 |
| 31 | 0.500 | 0.160 | 0.160 | 0.239 |
| 32 | 0.517 | 0.140 | 0.140 | 0.209 |
| 33 | 0.533 | 0.140 | 0.140 | 0.209 |
| 34 | 0.550 | 0.140 | 0.140 | 0.209 |
| 35 | 0.567 | 0.140 | 0.140 | 0.209 |
| 36 | 0.583 | 0.140 | 0.140 | 0.209 |
| 37 | 0.600 | 0.140 | 0.140 | 0.209 |
| 38 | 0.617 | 0.140 | 0.140 | 0.209 |
| 39 | 0.633 | 0.140 | 0.140 | 0.209 |
| 40 | 0.650 | 0.140 | 0.140 | 0.209 |
| 41 | 0.667 | 0.140 | 0.140 | 0.209 |

| | | | | |
|---|---|---|---|---|
| 42 | 0.683 | 0.140 | 0.140 | 0.209 |
| 43 | 0.700 | 0.140 | 0.140 | 0.209 |
| 44 | 0.717 | 0.140 | 0.140 | 0.209 |
| 45 | 0.733 | 0.140 | 0.140 | 0.209 |
| 46 | 0.750 | 0.140 | 0.140 | 0.209 |
| 47 | 0.767 | 0.140 | 0.140 | 0.209 |
| 48 | 0.783 | 0.120 | 0.120 | 0.179 |
| 49 | 0.800 | 0.140 | 0.140 | 0.209 |
| 50 | 0.817 | 0.140 | 0.140 | 0.209 |
| 51 | 0.833 | 0.140 | 0.140 | 0.209 |
| 52 | 0.850 | 0.140 | 0.140 | 0.209 |
| 53 | 0.867 | 0.140 | 0.140 | 0.209 |
| 54 | 0.883 | 0.140 | 0.140 | 0.209 |
| 55 | 0.900 | 0.120 | 0.120 | 0.179 |
| 56 | 0.917 | 0.120 | 0.120 | 0.179 |
| 57 | 0.933 | 0.120 | 0.120 | 0.179 |
| 58 | 0.950 | 0.120 | 0.120 | 0.179 |
| 59 | 0.967 | 0.120 | 0.120 | 0.179 |
| 60 | 0.983 | 0.120 | 0.120 | 0.179 |
| 61 | 1.000 | 0.120 | 0.120 | 0.179 |
| 62 | 1.017 | 0.120 | 0.120 | 0.179 |
| 63 | 1.033 | 0.120 | 0.120 | 0.179 |
| 64 | 1.050 | 0.120 | 0.120 | 0.179 |
| 65 | 1.067 | 0.120 | 0.120 | 0.179 |
| 66 | 1.083 | 0.120 | 0.120 | 0.179 |
| 67 | 1.100 | 0.120 | 0.120 | 0.179 |
| 68 | 1.117 | 0.120 | 0.120 | 0.179 |
| 69 | 1.133 | 0.140 | 0.140 | 0.209 |
| 70 | 1.150 | 0.120 | 0.120 | 0.179 |
| 71 | 1.167 | 0.120 | 0.120 | 0.179 |
| 72 | 1.183 | 0.120 | 0.120 | 0.179 |
| 73 | 1.200 | 0.120 | 0.120 | 0.179 |
| 74 | 1.217 | 0.120 | 0.120 | 0.179 |
| 75 | 1.233 | 0.120 | 0.120 | 0.179 |
| 76 | 1.250 | 0.120 | 0.120 | 0.179 |
| 77 | 1.267 | 0.120 | 0.120 | 0.179 |
| 78 | 1.283 | 0.120 | 0.120 | 0.179 |
| 79 | 1.300 | 0.120 | 0.120 | 0.179 |
| 80 | 1.317 | 0.120 | 0.120 | 0.179 |
| 81 | 1.333 | 0.120 | 0.120 | 0.179 |
| 82 | 1.350 | 0.120 | 0.120 | 0.179 |
| 83 | 1.367 | 0.120 | 0.120 | 0.179 |
| 84 | 1.383 | 0.120 | 0.120 | 0.179 |
| 85 | 1.400 | 0.120 | 0.120 | 0.179 |
| 86 | 1.417 | 0.090 | 0.090 | 0.134 |

GW54D RISING




o - Data

+ - Type Curve
Slug Test: alpha = -3.0

SOLUTION

Transmissivity = 7.973E-0002 sq ft/min
Aquifer Thick. = 1.200E+0001 ft
Hydraulic Cond.= 6.644E-0003 ft/min
Storativity = 1.000E-0003

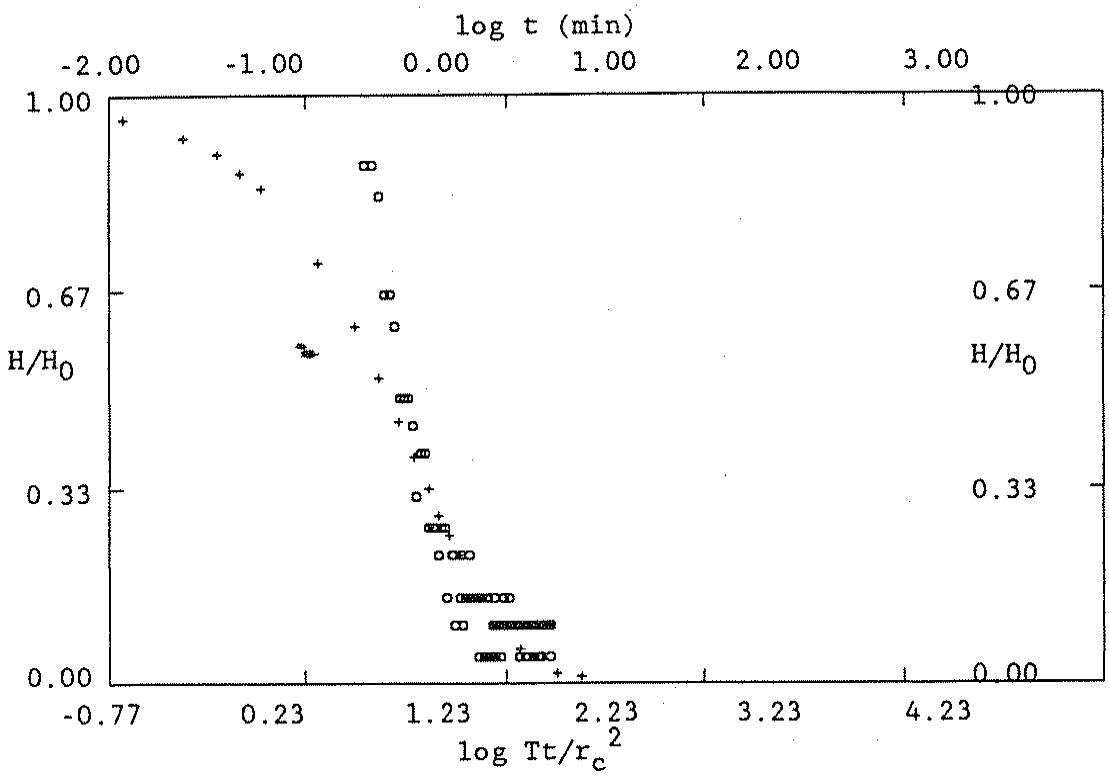
Data for Slug Injection/Withdrawal Test

Well Name: 55DF Date of Test: 9/91
Aquifer Thickness (b): 14.000 ft
Change in Vol.of Water = 0.009 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.410 | 0.410 | 1.000 |
| 3 | 0.033 | 1.200 | 1.200 | 2.927 |
| 4 | 0.050 | 1.380 | 1.380 | 3.366 |
| 5 | 0.067 | 1.030 | 1.030 | 2.512 |
| 6 | 0.083 | 0.570 | 0.570 | 1.390 |
| 7 | 0.100 | 0.670 | 0.670 | 1.634 |
| 8 | 0.117 | 0.600 | 0.600 | 1.463 |
| 9 | 0.133 | 0.570 | 0.570 | 1.390 |
| 10 | 0.150 | 0.500 | 0.500 | 1.220 |
| 11 | 0.167 | 0.480 | 0.480 | 1.171 |
| 12 | 0.183 | 0.430 | 0.430 | 1.049 |
| 13 | 0.200 | 0.360 | 0.360 | 0.878 |
| 14 | 0.217 | 0.360 | 0.360 | 0.878 |
| 15 | 0.233 | 0.340 | 0.340 | 0.829 |
| 16 | 0.250 | 0.270 | 0.270 | 0.659 |
| 17 | 0.267 | 0.270 | 0.270 | 0.659 |
| 18 | 0.283 | 0.250 | 0.250 | 0.610 |
| 19 | 0.300 | 0.200 | 0.200 | 0.488 |
| 20 | 0.317 | 0.200 | 0.200 | 0.488 |
| 21 | 0.333 | 0.200 | 0.200 | 0.488 |
| 22 | 0.350 | 0.180 | 0.180 | 0.439 |
| 23 | 0.367 | 0.130 | 0.130 | 0.317 |
| 24 | 0.383 | 0.160 | 0.160 | 0.390 |
| 25 | 0.400 | 0.160 | 0.160 | 0.390 |
| 26 | 0.417 | 0.110 | 0.110 | 0.268 |
| 27 | 0.433 | 0.110 | 0.110 | 0.268 |
| 28 | 0.450 | 0.110 | 0.110 | 0.268 |
| 29 | 0.467 | 0.090 | 0.090 | 0.220 |
| 30 | 0.483 | 0.110 | 0.110 | 0.268 |
| 31 | 0.500 | 0.110 | 0.110 | 0.268 |
| 32 | 0.517 | 0.060 | 0.060 | 0.146 |
| 33 | 0.533 | 0.090 | 0.090 | 0.220 |
| 34 | 0.550 | 0.090 | 0.090 | 0.220 |
| 35 | 0.567 | 0.040 | 0.040 | 0.098 |
| 36 | 0.583 | 0.060 | 0.060 | 0.146 |
| 37 | 0.600 | 0.090 | 0.090 | 0.220 |
| 38 | 0.617 | 0.040 | 0.040 | 0.098 |
| 39 | 0.633 | 0.060 | 0.060 | 0.146 |
| 40 | 0.650 | 0.060 | 0.060 | 0.146 |
| 41 | 0.667 | 0.090 | 0.090 | 0.220 |

| | | | | |
|---|---|---|---|---|
| 42 | 0.683 | 0.060 | 0.060 | 0.146 |
| 43 | 0.700 | 0.060 | 0.060 | 0.146 |
| 44 | 0.717 | 0.060 | 0.060 | 0.146 |
| 45 | 0.733 | 0.020 | 0.020 | 0.049 |
| 46 | 0.750 | 0.060 | 0.060 | 0.146 |
| 47 | 0.767 | 0.060 | 0.060 | 0.146 |
| 48 | 0.783 | 0.020 | 0.020 | 0.049 |
| 49 | 0.800 | 0.060 | 0.060 | 0.146 |
| 50 | 0.817 | 0.060 | 0.060 | 0.146 |
| 51 | 0.833 | 0.020 | 0.020 | 0.049 |
| 52 | 0.850 | 0.040 | 0.040 | 0.098 |
| 53 | 0.867 | 0.060 | 0.060 | 0.146 |
| 54 | 0.883 | 0.020 | 0.020 | 0.049 |
| 55 | 0.900 | 0.040 | 0.040 | 0.098 |
| 56 | 0.917 | 0.040 | 0.040 | 0.098 |
| 57 | 0.933 | 0.020 | 0.020 | 0.049 |
| 58 | 0.950 | 0.040 | 0.040 | 0.098 |
| 59 | 0.967 | 0.040 | 0.040 | 0.098 |
| 60 | 0.983 | 0.060 | 0.060 | 0.146 |
| 61 | 1.000 | 0.040 | 0.040 | 0.098 |
| 62 | 1.017 | 0.040 | 0.040 | 0.098 |
| 63 | 1.033 | 0.060 | 0.060 | 0.146 |
| 64 | 1.050 | 0.040 | 0.040 | 0.098 |
| 65 | 1.067 | 0.040 | 0.040 | 0.098 |
| 66 | 1.083 | 0.040 | 0.040 | 0.098 |
| 67 | 1.100 | 0.040 | 0.040 | 0.098 |
| 68 | 1.117 | 0.040 | 0.040 | 0.098 |
| 69 | 1.133 | 0.040 | 0.040 | 0.098 |
| 70 | 1.150 | 0.040 | 0.040 | 0.098 |
| 71 | 1.167 | 0.040 | 0.040 | 0.098 |
| 72 | 1.183 | 0.020 | 0.020 | 0.049 |
| 73 | 1.200 | 0.040 | 0.040 | 0.098 |
| 74 | 1.217 | 0.040 | 0.040 | 0.098 |
| 75 | 1.233 | 0.020 | 0.020 | 0.049 |
| 76 | 1.250 | 0.040 | 0.040 | 0.098 |
| 77 | 1.267 | 0.040 | 0.040 | 0.098 |
| 78 | 1.283 | 0.020 | 0.020 | 0.049 |
| 79 | 1.300 | 0.040 | 0.040 | 0.098 |
| 80 | 1.317 | 0.040 | 0.040 | 0.098 |
| 81 | 1.333 | 0.000 | 0.000 | 0.000 |
| 82 | 1.350 | 0.040 | 0.040 | 0.098 |
| 83 | 1.367 | 0.040 | 0.040 | 0.098 |
| 84 | 1.383 | 0.020 | 0.020 | 0.049 |
| 85 | 1.400 | 0.040 | 0.040 | 0.098 |
| 86 | 1.417 | 0.040 | 0.040 | 0.098 |
| 87 | 1.433 | 0.020 | 0.020 | 0.049 |
| 88 | 1.450 | 0.040 | 0.040 | 0.098 |
| 89 | 1.467 | 0.040 | 0.040 | 0.098 |
| 90 | 1.483 | 0.020 | 0.020 | 0.049 |
| 91 | 1.500 | 0.040 | 0.040 | 0.098 |
| 92 | 1.517 | 0.040 | 0.040 | 0.098 |
| 93 | 1.533 | 0.000 | 0.000 | 0.000 |
| 94 | 1.550 | 0.040 | 0.040 | 0.098 |
| 95 | 1.567 | 0.040 | 0.040 | 0.098 |
| 96 | 1.583 | 0.040 | 0.040 | 0.098 |
| 97 | 1.600 | 0.040 | 0.040 | 0.098 |
| 98 | 1.617 | 0.040 | 0.040 | 0.098 |
| 99 | 1.633 | 0.040 | 0.040 | 0.098 |
| 100 | 1.650 | 0.040 | 0.040 | 0.098 |
| 101 | 1.667 | 0.020 | 0.020 | 0.049 |

GW55D FALLING




o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

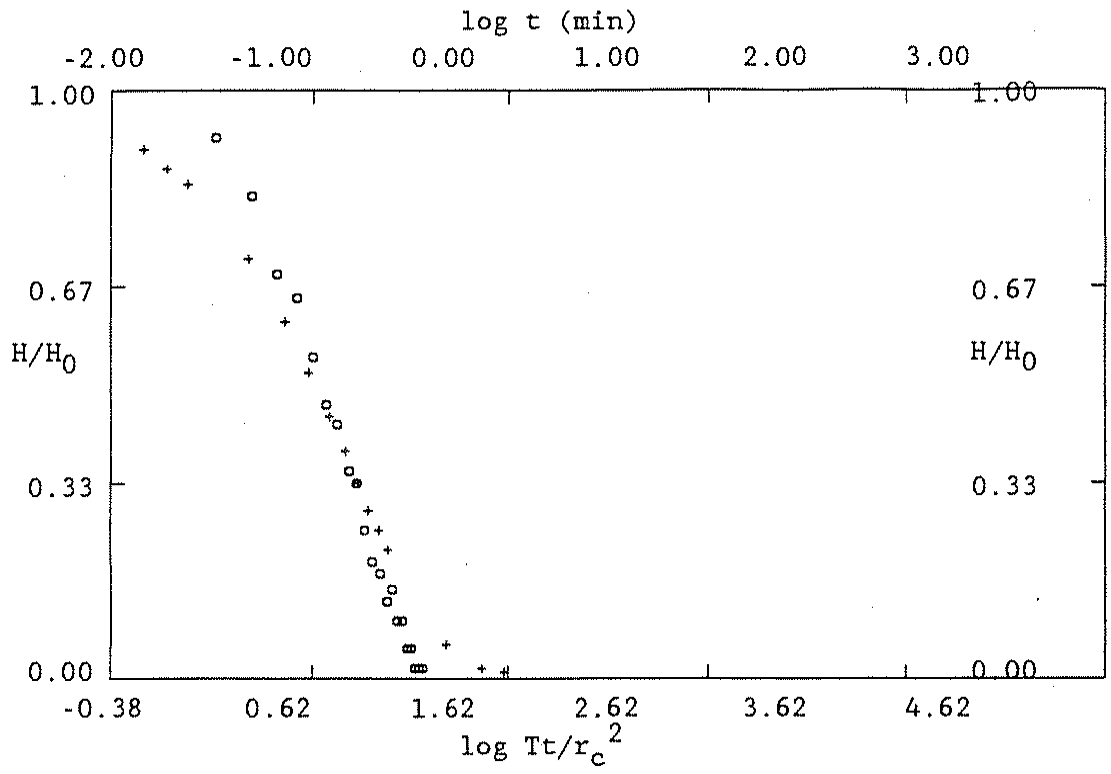
Transmissivity = 1.179E-0001 sq ft/min
Aquifer Thick. = 1.400E+0001 ft
Hydraulic Cond.= 8.424E-0003 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 55DR Date of Test: 9/91
Aquifer Thickness (b): 14.000 ft
Change in Vol.of Water = 0.009 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.900 | 0.900 | 1.000 |
| 3 | 0.033 | 0.830 | 0.830 | 0.922 |
| 4 | 0.050 | 0.740 | 0.740 | 0.822 |
| 5 | 0.067 | 0.620 | 0.620 | 0.689 |
| 6 | 0.083 | 0.580 | 0.580 | 0.644 |
| 7 | 0.100 | 0.490 | 0.490 | 0.544 |
| 8 | 0.117 | 0.420 | 0.420 | 0.467 |
| 9 | 0.133 | 0.390 | 0.390 | 0.433 |
| 10 | 0.150 | 0.320 | 0.320 | 0.356 |
| 11 | 0.167 | 0.300 | 0.300 | 0.333 |
| 12 | 0.183 | 0.230 | 0.230 | 0.256 |
| 13 | 0.200 | 0.180 | 0.180 | 0.200 |
| 14 | 0.217 | 0.160 | 0.160 | 0.178 |
| 15 | 0.233 | 0.120 | 0.120 | 0.133 |
| 16 | 0.250 | 0.140 | 0.140 | 0.156 |
| 17 | 0.267 | 0.090 | 0.090 | 0.100 |
| 18 | 0.283 | 0.090 | 0.090 | 0.100 |
| 19 | 0.300 | 0.050 | 0.050 | 0.056 |
| 20 | 0.317 | 0.050 | 0.050 | 0.056 |
| 21 | 0.333 | 0.020 | 0.020 | 0.022 |
| 22 | 0.350 | 0.020 | 0.020 | 0.022 |
| 23 | 0.367 | -0.020 | 0.020 | 0.022 |
| 24 | 0.383 | 0.000 | 0.000 | 0.000 |

GW55D RISING




o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

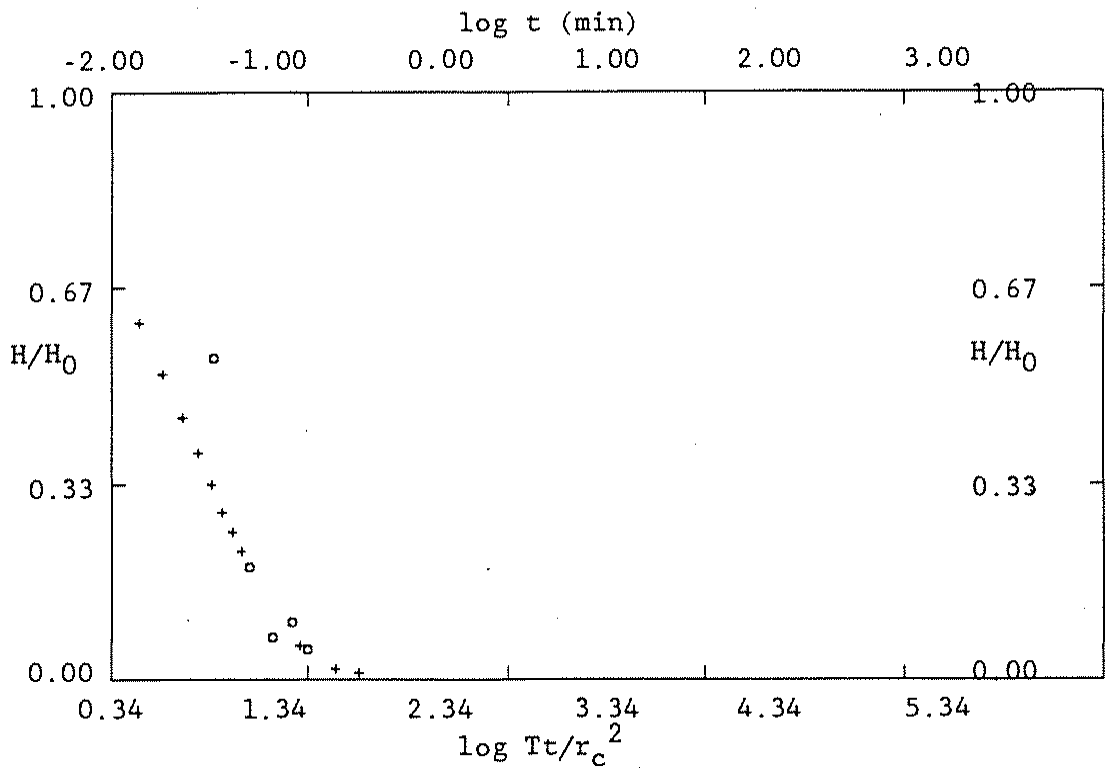
Transmissivity = 2.895E-0001 sq ft/min
Aquifer Thick. = 1.400E+0001 ft
Hydraulic Cond.= 2.068E-0002 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 56DF Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/H0 |
|---|---|---|---|---|
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.970 | 0.970 | 1.000 |
| 3 | 0.033 | 0.530 | 0.530 | 0.546 |
| 4 | 0.050 | 0.190 | 0.190 | 0.196 |
| 5 | 0.067 | 0.070 | 0.070 | 0.072 |
| 6 | 0.083 | 0.100 | 0.100 | 0.103 |
| 7 | 0.100 | 0.050 | 0.050 | 0.052 |
| 8 | 0.117 | 0.000 | 0.000 | 0.000 |

GW56D FALLING




o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

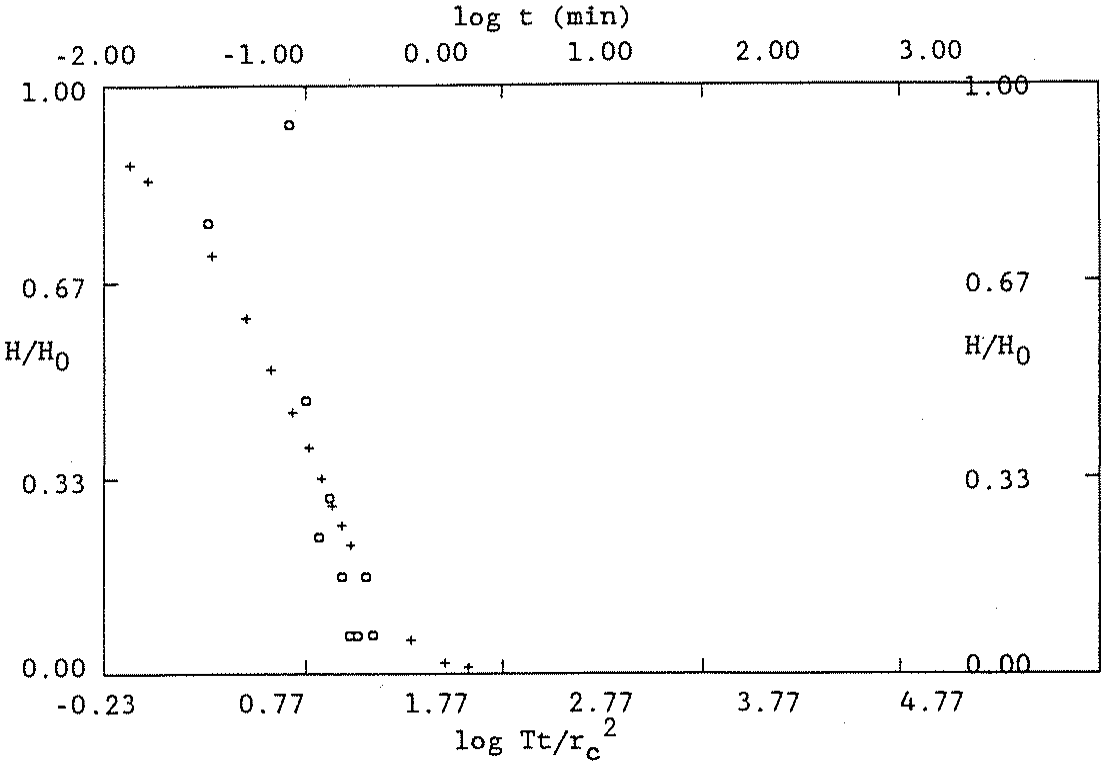
Transmissivity = 1.519E+0000 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 1.519E-0001 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 56DR Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

| Entry No. | Time(t) (min) | Head (ft) | H (ft) | H/HO |
|---|---|---|---|---|
| ******** | ********** | ********** | ********** | ********** |
| 1 | 0.000 | 0.000 | | |
| 2 | 0.017 | 0.300 | 0.300 | 1.000 |
| 3 | 0.033 | 0.230 | 0.230 | 0.767 |
| 4 | 0.050 | 0.460 | 0.460 | 1.533 |
| 5 | 0.067 | 0.620 | 0.620 | 2.067 |
| 6 | 0.083 | 0.280 | 0.280 | 0.933 |
| 7 | 0.100 | 0.140 | 0.140 | 0.467 |
| 8 | 0.117 | 0.070 | 0.070 | 0.233 |
| 9 | 0.133 | 0.090 | 0.090 | 0.300 |
| 10 | 0.150 | 0.050 | 0.050 | 0.167 |
| 11 | 0.167 | 0.020 | 0.020 | 0.067 |
| 12 | 0.183 | 0.020 | 0.020 | 0.067 |
| 13 | 0.200 | 0.050 | 0.050 | 0.167 |
| 14 | 0.217 | 0.020 | 0.020 | 0.067 |
| 15 | 0.233 | 0.000 | 0.000 | 0.000 |

GW56D RISING




o - Data

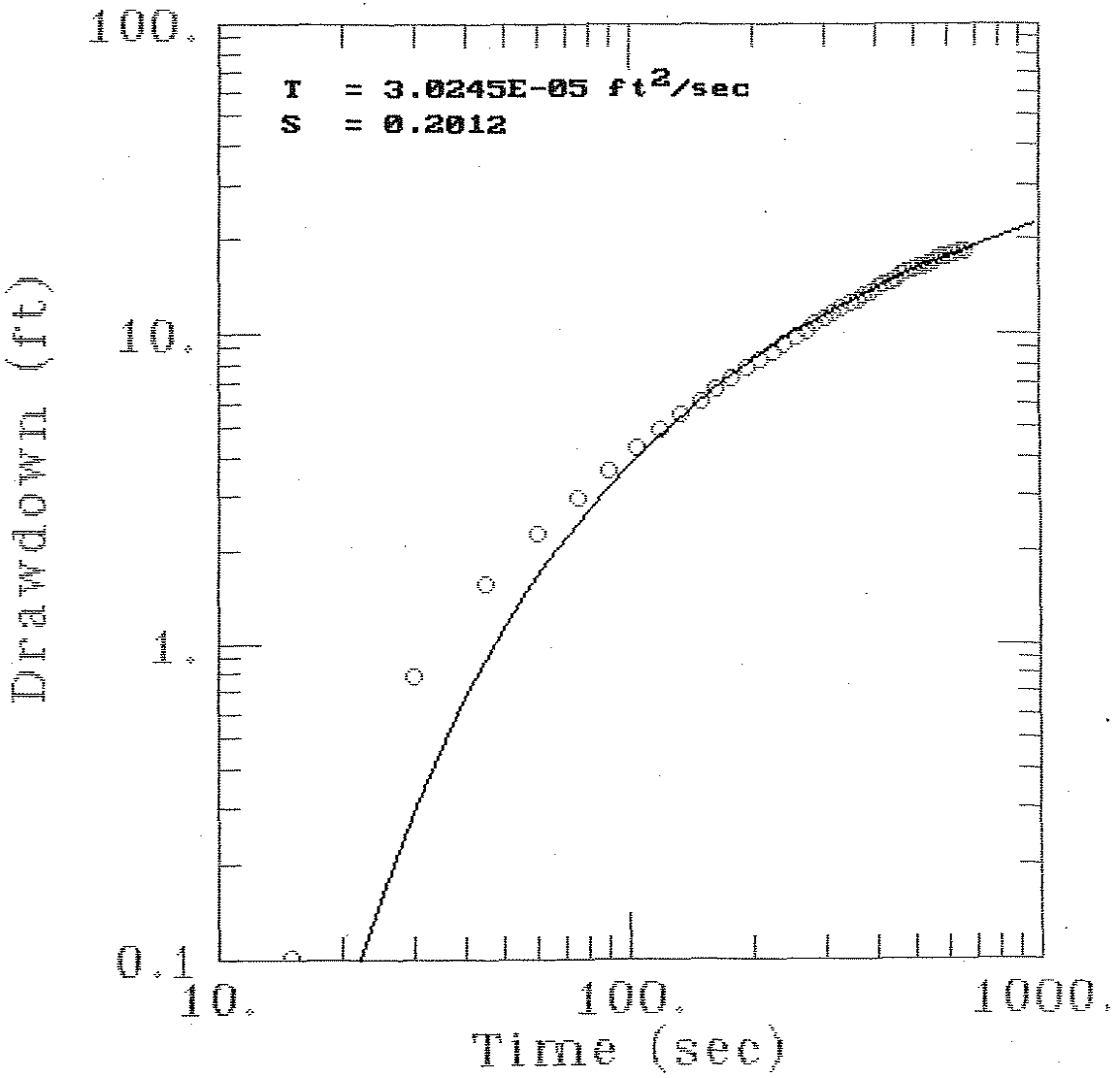
+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

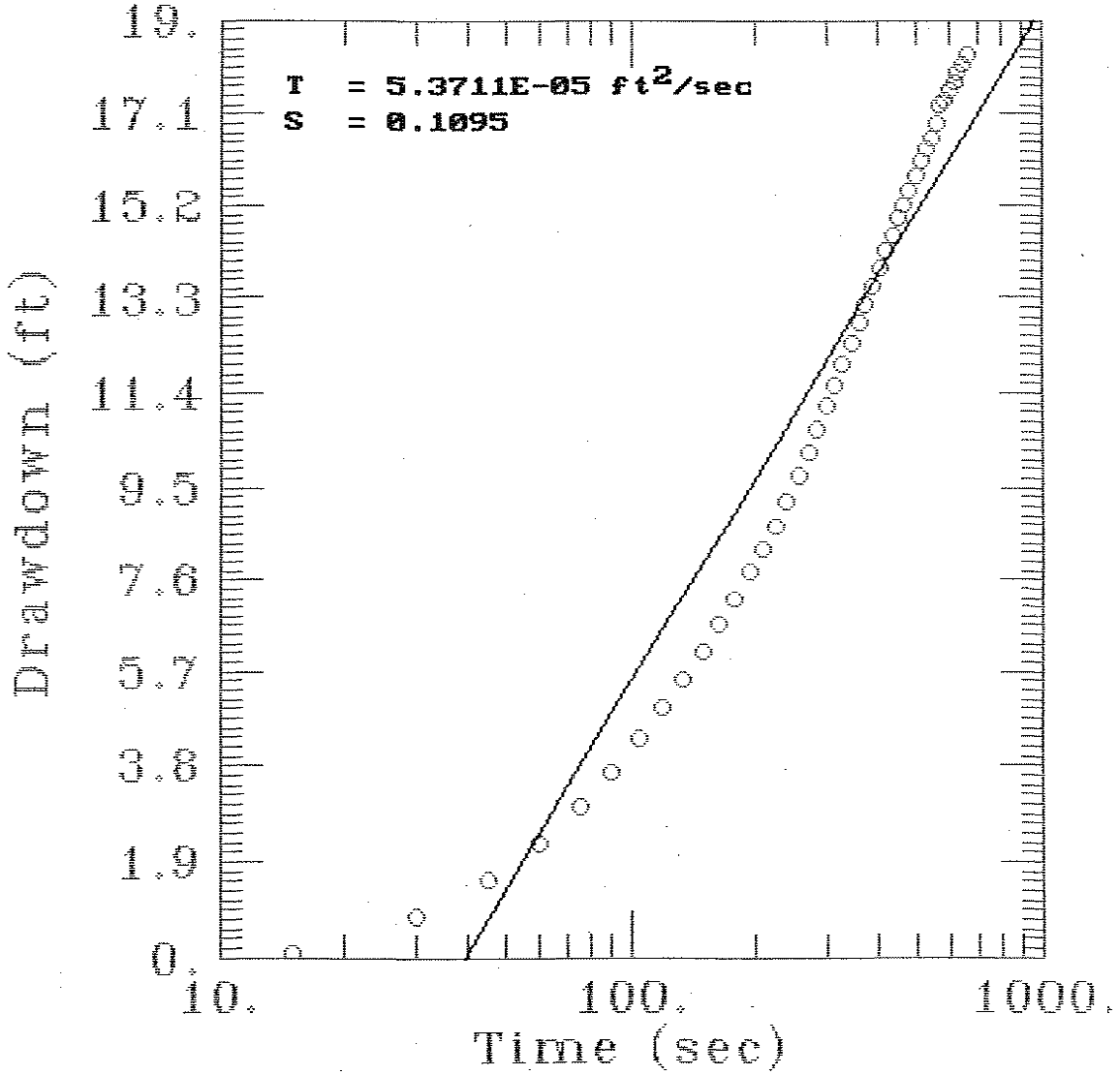
Transmissivity = 4.089E-0001 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 4.089E-0002 ft/min
Storativity = 1.000E-0010

# PUMPING TEST
# HYDRAULIC CONDUCTIVITY DATA

# GW-62BR DRAWDOWN CURVE



# GW-62BR DRAWDOWN CURVE



MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002

Time at Recorder: 01/21/93 15:32:39 Last Update: 12/02/92 10:32:22

Signal process: Not Applicable

Values being saved: averages

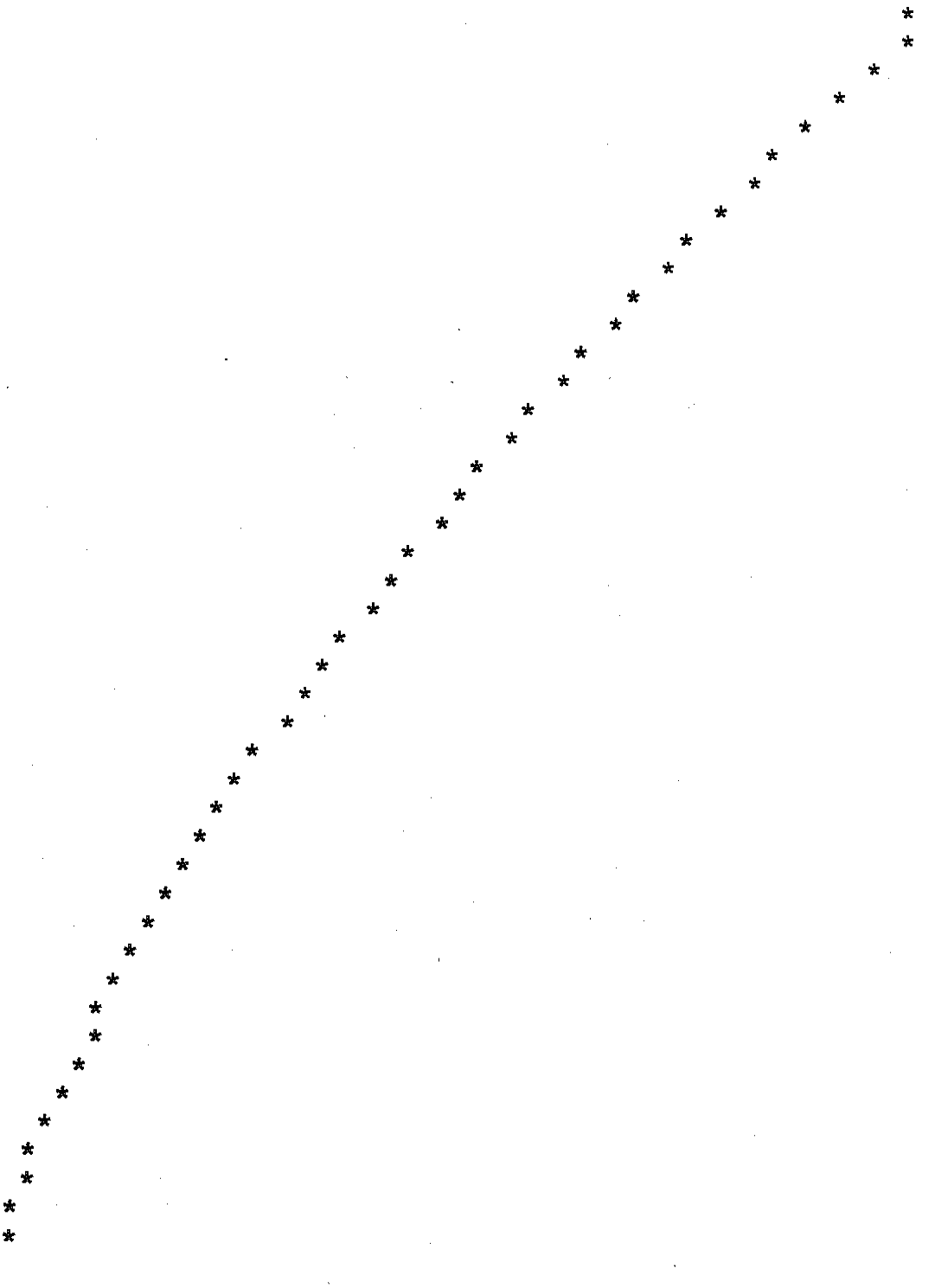
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:15 Amount of data recorded: 00:11:30

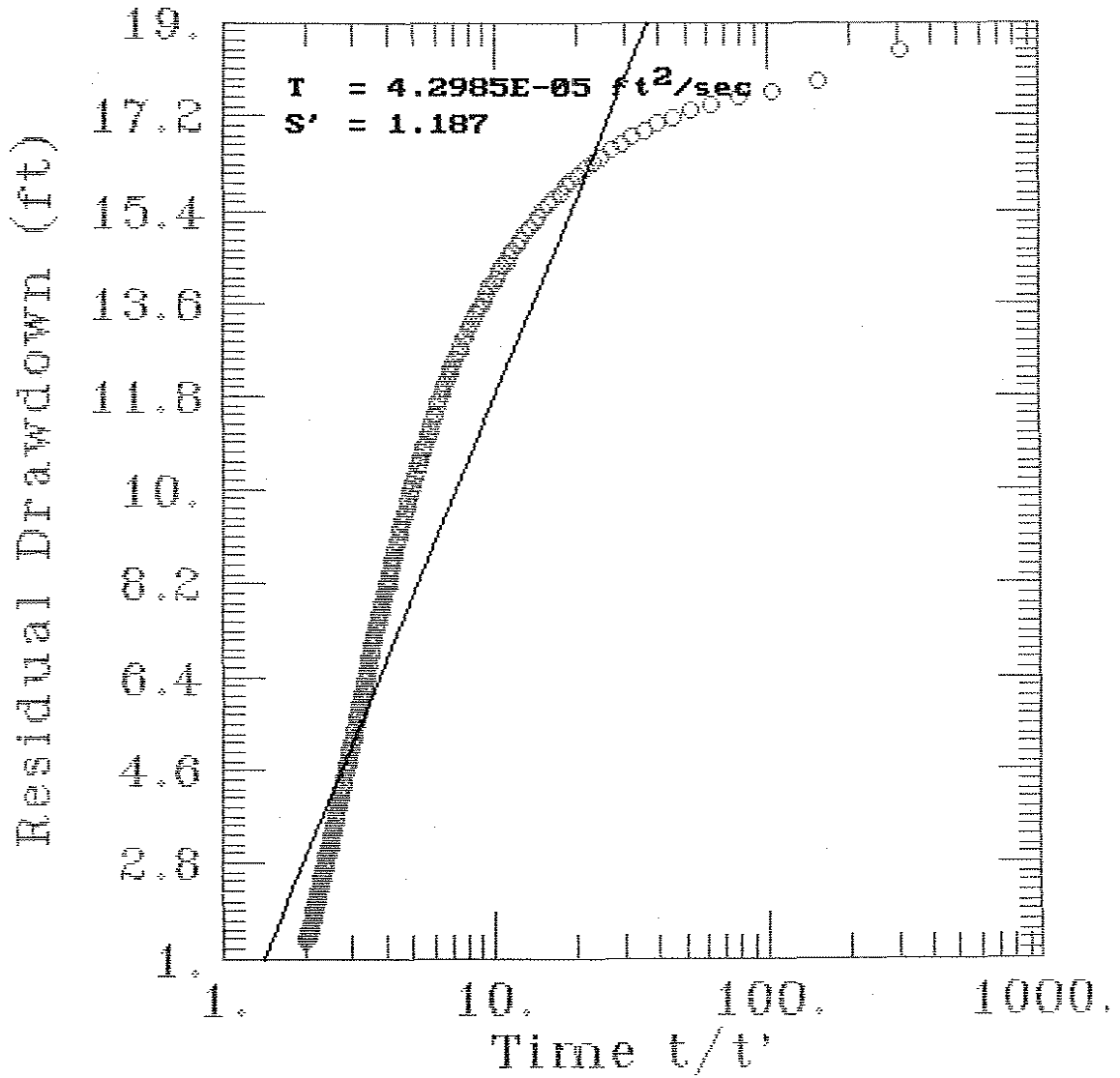
Storage Capacity: 6512 values records: 1 day 03:08:00

Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 15:21:05 | 22.89 |
| 01/21/93 | 15:21:20 | 22.79 |
| 01/21/93 | 15:21:35 | 22.10 |
| 01/21/93 | 15:21:50 | 21.32 |
| 01/21/93 | 15:22:05 | 20.58 |
| 01/21/93 | 15:22:20 | 19.86 |
| 01/21/93 | 15:22:35 | 19.15 |
| 01/21/93 | 15:22:50 | 18.43 |
| 01/21/93 | 15:23:05 | 17.76 |
| 01/21/93 | 15:23:20 | 17.12 |
| 01/21/93 | 15:23:35 | 16.50 |
| 01/21/93 | 15:23:50 | 15.90 |
| 01/21/93 | 15:24:05 | 15.30 |
| 01/21/93 | 15:24:20 | 14.70 |
| 01/21/93 | 15:24:35 | 14.14 |
| 01/21/93 | 15:24:50 | 13.61 |
| 01/21/93 | 15:25:05 | 13.03 |
| 01/21/93 | 15:25:20 | 12.46 |
| 01/21/93 | 15:25:35 | 11.90 |
| 01/21/93 | 15:25:50 | 11.35 |
| 01/21/93 | 15:26:05 | 10.82 |
| 01/21/93 | 15:26:20 | 10.29 |
| 01/21/93 | 15:26:35 | 9.78 |
| 01/21/93 | 15:26:50 | 9.30 |
| 01/21/93 | 15:27:05 | 8.81 |
| 01/21/93 | 15:27:20 | 8.33 |
| 01/21/93 | 15:27:35 | 7.87 |
| 01/21/93 | 15:27:50 | 7.43 |
| 01/21/93 | 15:28:05 | 6.99 |
| 01/21/93 | 15:28:20 | 6.57 |
| 01/21/93 | 15:28:35 | 6.16 |
| 01/21/93 | 15:28:50 | 5.77 |
| 01/21/93 | 15:29:05 | 5.38 |
| 01/21/93 | 15:29:20 | 4.98 |
| 01/21/93 | 15:29:35 | 4.61 |
| 01/21/93 | 15:29:50 | 4.27 |
| 01/21/93 | 15:30:05 | 3.92 |
| 01/21/93 | 15:30:20 | 3.58 |
| 01/21/93 | 15:30:35 | 3.25 |
| 01/21/93 | 15:30:50 | 2.95 |
| 01/21/93 | 15:31:05 | 2.65 |
| 01/21/93 | 15:31:20 | 2.40 |
| 01/21/93 | 15:31:35 | 2.15 |
| 01/21/93 | 15:31:50 | 1.94 |
| 01/21/93 | 15:32:05 | 1.68 |



# GW-62BRD RECOVERY CURVE



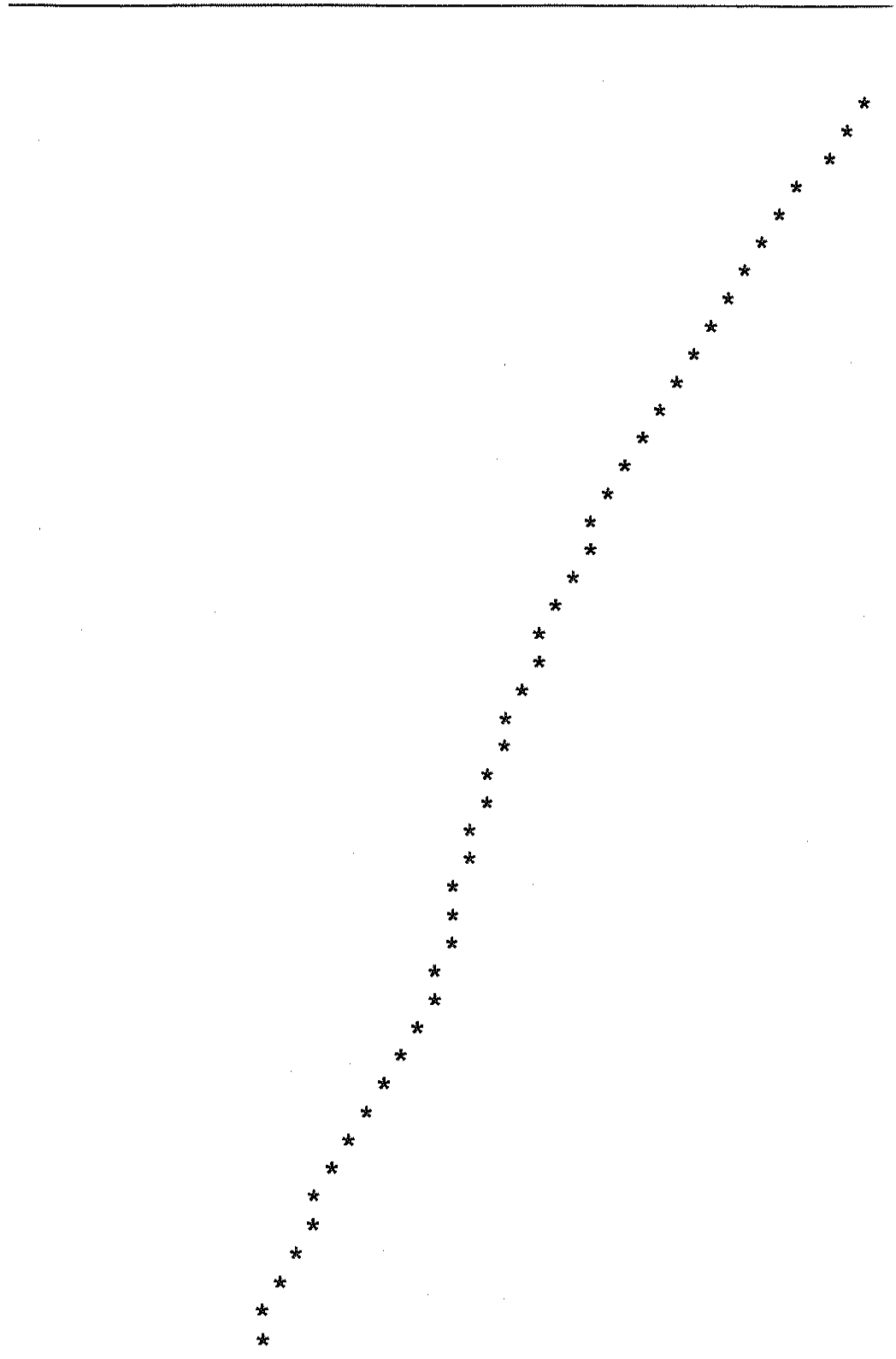
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 15:10:23 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

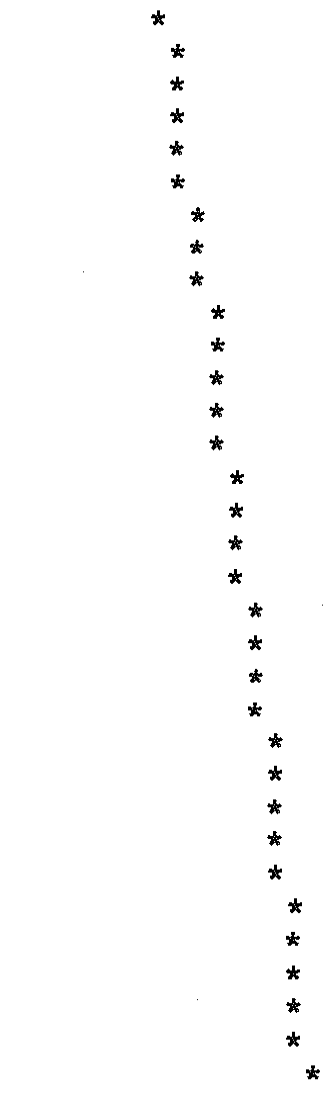
Averaging period: 00:00:15 Amount of data recorded: 01:33:15
Storage Capacity: 6512 values records: 1 day 03:08:00
Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 13:36:54 | 22.72 |
| 01/21/93 | 13:37:09 | 22.59 |
| 01/21/93 | 13:37:24 | 22.03 |
| 01/21/93 | 13:37:39 | 21.48 |
| 01/21/93 | 13:37:54 | 20.99 |
| 01/21/93 | 13:38:09 | 20.53 |
| 01/21/93 | 13:38:24 | 20.07 |
| 01/21/93 | 13:38:39 | 19.63 |
| 01/21/93 | 13:38:54 | 19.19 |
| 01/21/93 | 13:39:09 | 18.80 |
| 01/21/93 | 13:39:24 | 18.36 |
| 01/21/93 | 13:39:39 | 17.99 |
| 01/21/93 | 13:39:54 | 17.65 |
| 01/21/93 | 13:40:09 | 17.28 |
| 01/21/93 | 13:40:24 | 16.93 |
| 01/21/93 | 13:40:39 | 16.61 |
| 01/21/93 | 13:40:54 | 16.26 |
| 01/21/93 | 13:41:09 | 15.92 |
| 01/21/93 | 13:41:24 | 15.62 |
| 01/21/93 | 13:41:39 | 15.32 |
| 01/21/93 | 13:41:54 | 15.02 |
| 01/21/93 | 13:42:09 | 14.72 |
| 01/21/93 | 13:42:24 | 14.46 |
| 01/21/93 | 13:42:39 | 14.21 |
| 01/21/93 | 13:42:54 | 13.98 |
| 01/21/93 | 13:43:09 | 13.75 |
| 01/21/93 | 13:43:24 | 13.54 |
| 01/21/93 | 13:43:39 | 13.33 |
| 01/21/93 | 13:43:54 | 13.13 |
| 01/21/93 | 13:44:09 | 12.94 |
| 01/21/93 | 13:44:24 | 12.78 |
| 01/21/93 | 13:44:39 | 12.62 |
| 01/21/93 | 13:44:54 | 12.48 |
| 01/21/93 | 13:45:09 | 12.39 |
| 01/21/93 | 13:45:24 | 12.13 |
| 01/21/93 | 13:45:39 | 11.77 |
| 01/21/93 | 13:45:54 | 11.37 |
| 01/21/93 | 13:46:09 | 11.00 |
| 01/21/93 | 13:46:24 | 10.66 |
| 01/21/93 | 13:46:39 | 10.34 |
| 01/21/93 | 13:46:54 | 10.01 |
| 01/21/93 | 13:47:09 | 9.69 |
| 01/21/93 | 13:47:24 | 9.39 |
| 01/21/93 | 13:47:39 | 9.09 |
| 01/21/93 | 13:47:54 | 8.81 |
| 01/21/93 | 13:48:09 | 8.54 |
| 01/21/93 | 13:48:24 | 8.28 |

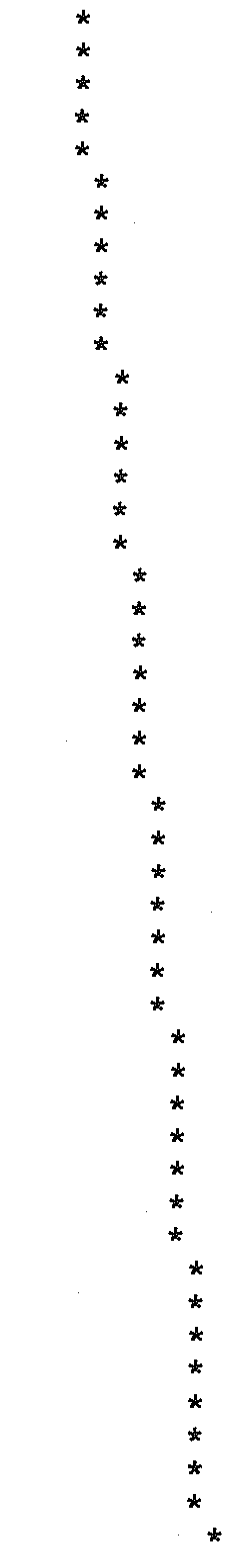


| | | |
|---|---|---|
| 01/21/93 | 13:48:39 | 8.03 |
| 01/21/93 | 13:48:54 | 7.80 |
| 01/21/93 | 13:49:09 | 7.57 |
| 01/21/93 | 13:49:24 | 7.34 |
| 01/21/93 | 13:49:39 | 7.13 |
| 01/21/93 | 13:49:54 | 6.78 |
| 01/21/93 | 13:50:09 | 6.44 |
| 01/21/93 | 13:50:24 | 6.07 |
| 01/21/93 | 13:50:39 | 5.74 |
| 01/21/93 | 13:50:54 | 5.40 |
| 01/21/93 | 13:51:09 | 5.08 |
| 01/21/93 | 13:51:24 | 4.75 |
| 01/21/93 | 13:51:39 | 4.45 |
| 01/21/93 | 13:51:54 | 4.15 |
| 01/21/93 | 13:52:09 | 3.90 |
| 01/21/93 | 13:52:24 | 3.60 |
| 01/21/93 | 13:52:39 | 3.35 |
| 01/21/93 | 13:52:54 | 3.09 |
| 01/21/93 | 13:53:09 | 2.84 |
| 01/21/93 | 13:53:24 | 2.61 |
| 01/21/93 | 13:53:39 | 2.38 |
| 01/21/93 | 13:53:54 | 2.17 |
| 01/21/93 | 13:54:09 | 2.24 |
| 01/21/93 | 13:54:24 | 2.95 |
| 01/21/93 | 13:54:39 | 3.21 |
| 01/21/93 | 13:54:54 | 3.37 |
| 01/21/93 | 13:55:09 | 3.53 |
| 01/21/93 | 13:55:24 | 3.67 |
| 01/21/93 | 13:55:39 | 3.83 |
| 01/21/93 | 13:55:54 | 3.97 |
| 01/21/93 | 13:56:09 | 4.13 |
| 01/21/93 | 13:56:24 | 4.27 |
| 01/21/93 | 13:56:39 | 4.41 |
| 01/21/93 | 13:56:54 | 4.54 |
| 01/21/93 | 13:57:09 | 4.71 |
| 01/21/93 | 13:57:24 | 4.84 |
| 01/21/93 | 13:57:39 | 4.98 |
| 01/21/93 | 13:57:54 | 5.12 |
| 01/21/93 | 13:58:09 | 5.24 |
| 01/21/93 | 13:58:24 | 5.40 |
| 01/21/93 | 13:58:39 | 5.56 |
| 01/21/93 | 13:58:54 | 5.65 |
| 01/21/93 | 13:59:09 | 5.79 |
| 01/21/93 | 13:59:24 | 5.93 |
| 01/21/93 | 13:59:39 | 6.07 |
| 01/21/93 | 13:59:54 | 6.18 |
| 01/21/93 | 14:00:09 | 6.32 |
| 01/21/93 | 14:00:24 | 6.46 |
| 01/21/93 | 14:00:39 | 6.60 |
| 01/21/93 | 14:00:54 | 6.71 |
| 01/21/93 | 14:01:09 | 6.83 |
| 01/21/93 | 14:01:24 | 6.94 |
| 01/21/93 | 14:01:39 | 7.11 |
| 01/21/93 | 14:01:54 | 7.20 |
| 01/21/93 | 14:02:09 | 7.31 |
| 01/21/93 | 14:02:24 | 7.47 |
| 01/21/93 | 14:02:39 | 7.61 |
| 01/21/93 | 14:02:54 | 7.68 |
| 01/21/93 | 14:03:09 | 7.80 |
| 01/21/93 | 14:03:24 | 7.98 |

| | | |
|---|---|---|
| 01/21/93 | 14:03:39 | 8.10 |
| 01/21/93 | 14:03:54 | 8.17 |
| 01/21/93 | 14:04:09 | 8.28 |
| 01/21/93 | 14:04:24 | 8.40 |
| 01/21/93 | 14:04:39 | 8.51 |
| 01/21/93 | 14:04:54 | 8.65 |
| 01/21/93 | 14:05:09 | 8.77 |
| 01/21/93 | 14:05:24 | 8.88 |
| 01/21/93 | 14:05:39 | 9.00 |
| 01/21/93 | 14:05:54 | 9.11 |
| 01/21/93 | 14:06:09 | 9.20 |
| 01/21/93 | 14:06:24 | 9.32 |
| 01/21/93 | 14:06:39 | 9.44 |
| 01/21/93 | 14:06:54 | 9.55 |
| 01/21/93 | 14:07:09 | 9.67 |
| 01/21/93 | 14:07:24 | 9.76 |
| 01/21/93 | 14:07:39 | 9.87 |
| 01/21/93 | 14:07:54 | 9.99 |
| 01/21/93 | 14:08:09 | 10.08 |
| 01/21/93 | 14:08:24 | 10.20 |
| 01/21/93 | 14:08:39 | 10.29 |
| 01/21/93 | 14:08:54 | 10.40 |
| 01/21/93 | 14:09:09 | 10.52 |
| 01/21/93 | 14:09:24 | 10.61 |
| 01/21/93 | 14:09:39 | 10.70 |
| 01/21/93 | 14:09:54 | 10.80 |
| 01/21/93 | 14:10:09 | 10.91 |
| 01/21/93 | 14:10:24 | 11.00 |
| 01/21/93 | 14:10:39 | 11.10 |
| 01/21/93 | 14:10:54 | 11.19 |
| 01/21/93 | 14:11:09 | 11.28 |
| 01/21/93 | 14:11:24 | 11.40 |
| 01/21/93 | 14:11:39 | 11.49 |
| 01/21/93 | 14:11:54 | 11.58 |
| 01/21/93 | 14:12:09 | 11.67 |
| 01/21/93 | 14:12:24 | 11.77 |
| 01/21/93 | 14:12:39 | 11.86 |
| 01/21/93 | 14:12:54 | 11.95 |
| 01/21/93 | 14:13:09 | 12.04 |
| 01/21/93 | 14:13:24 | 12.13 |
| 01/21/93 | 14:13:39 | 12.23 |
| 01/21/93 | 14:13:54 | 12.32 |
| 01/21/93 | 14:14:09 | 12.41 |
| 01/21/93 | 14:14:24 | 12.50 |
| 01/21/93 | 14:14:39 | 12.57 |
| 01/21/93 | 14:14:54 | 12.67 |
| 01/21/93 | 14:15:09 | 12.76 |
| 01/21/93 | 14:15:24 | 12.85 |
| 01/21/93 | 14:15:39 | 12.92 |
| 01/21/93 | 14:15:54 | 13.01 |
| 01/21/93 | 14:16:09 | 13.08 |
| 01/21/93 | 14:16:24 | 13.17 |
| 01/21/93 | 14:16:39 | 13.27 |
| 01/21/93 | 14:16:54 | 13.36 |
| 01/21/93 | 14:17:09 | 13.43 |
| 01/21/93 | 14:17:24 | 13.52 |
| 01/21/93 | 14:17:39 | 13.59 |
| 01/21/93 | 14:17:54 | 13.66 |
| 01/21/93 | 14:18:09 | 13.73 |
| 01/21/93 | 14:18:24 | 13.82 |



| | | |
|---|---|---|
| 01/21/93 | 14:18:39 | 13.89 |
| 01/21/93 | 14:18:54 | 13.96 |
| 01/21/93 | 14:19:09 | 14.05 |
| 01/21/93 | 14:19:24 | 14.14 |
| 01/21/93 | 14:19:39 | 14.19 |
| 01/21/93 | 14:19:54 | 14.26 |
| 01/21/93 | 14:20:09 | 14.35 |
| 01/21/93 | 14:20:24 | 14.44 |
| 01/21/93 | 14:20:39 | 14.49 |
| 01/21/93 | 14:20:54 | 14.58 |
| 01/21/93 | 14:21:09 | 14.65 |
| 01/21/93 | 14:21:24 | 14.72 |
| 01/21/93 | 14:21:39 | 14.79 |
| 01/21/93 | 14:21:54 | 14.86 |
| 01/21/93 | 14:22:09 | 14.93 |
| 01/21/93 | 14:22:24 | 15.00 |
| 01/21/93 | 14:22:39 | 15.06 |
| 01/21/93 | 14:22:54 | 15.13 |
| 01/21/93 | 14:23:09 | 15.20 |
| 01/21/93 | 14:23:24 | 15.27 |
| 01/21/93 | 14:23:39 | 15.32 |
| 01/21/93 | 14:23:54 | 15.39 |
| 01/21/93 | 14:24:09 | 15.46 |
| 01/21/93 | 14:24:24 | 15.53 |
| 01/21/93 | 14:24:39 | 15.57 |
| 01/21/93 | 14:24:54 | 15.66 |
| 01/21/93 | 14:25:09 | 15.71 |
| 01/21/93 | 14:25:24 | 15.78 |
| 01/21/93 | 14:25:39 | 15.85 |
| 01/21/93 | 14:25:54 | 15.87 |
| 01/21/93 | 14:26:09 | 15.94 |
| 01/21/93 | 14:26:24 | 16.03 |
| 01/21/93 | 14:26:39 | 16.06 |
| 01/21/93 | 14:26:54 | 16.13 |
| 01/21/93 | 14:27:09 | 16.17 |
| 01/21/93 | 14:27:24 | 16.29 |
| 01/21/93 | 14:27:39 | 16.29 |
| 01/21/93 | 14:27:54 | 16.40 |
| 01/21/93 | 14:28:09 | 16.45 |
| 01/21/93 | 14:28:24 | 16.47 |
| 01/21/93 | 14:28:39 | 16.52 |
| 01/21/93 | 14:28:54 | 16.59 |
| 01/21/93 | 14:29:09 | 16.63 |
| 01/21/93 | 14:29:24 | 16.68 |
| 01/21/93 | 14:29:39 | 16.79 |
| 01/21/93 | 14:29:54 | 16.84 |
| 01/21/93 | 14:30:09 | 16.89 |
| 01/21/93 | 14:30:24 | 16.96 |
| 01/21/93 | 14:30:39 | 16.96 |
| 01/21/93 | 14:30:54 | 17.05 |
| 01/21/93 | 14:31:09 | 17.07 |
| 01/21/93 | 14:31:24 | 17.16 |
| 01/21/93 | 14:31:39 | 17.16 |
| 01/21/93 | 14:31:54 | 17.21 |
| 01/21/93 | 14:32:09 | 17.30 |
| 01/21/93 | 14:32:24 | 17.35 |
| 01/21/93 | 14:32:39 | 17.42 |
| 01/21/93 | 14:32:54 | 17.44 |
| 01/21/93 | 14:33:09 | 17.46 |
| 01/21/93 | 14:33:24 | 17.56 |

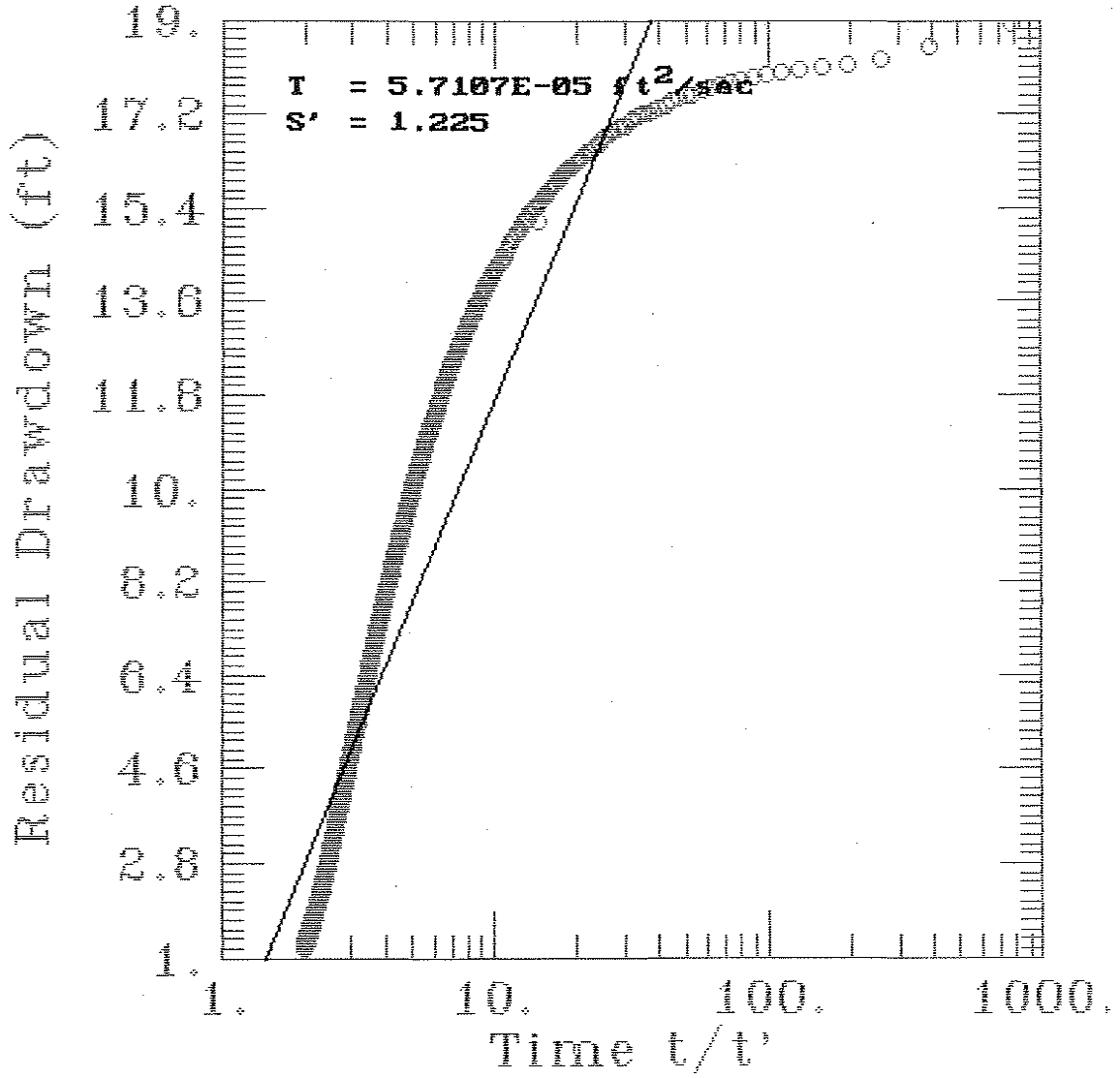


| | | |
|---|---|---|
| 01/21/93 | 14:33:39 | 17.56 |
| 01/21/93 | 14:33:54 | 17.60 |
| 01/21/93 | 14:34:09 | 17.65 |
| 01/21/93 | 14:34:24 | 17.74 |
| 01/21/93 | 14:34:39 | 17.74 |
| 01/21/93 | 14:34:54 | 17.83 |
| 01/21/93 | 14:35:09 | 17.88 |
| 01/21/93 | 14:35:24 | 17.88 |
| 01/21/93 | 14:35:39 | 17.93 |
| 01/21/93 | 14:35:54 | 18.02 |
| 01/21/93 | 14:36:09 | 18.02 |
| 01/21/93 | 14:36:24 | 18.06 |
| 01/21/93 | 14:36:39 | 18.16 |
| 01/21/93 | 14:36:54 | 18.16 |
| 01/21/93 | 14:37:09 | 18.23 |
| 01/21/93 | 14:37:24 | 18.23 |
| 01/21/93 | 14:37:39 | 18.27 |
| 01/21/93 | 14:37:54 | 18.36 |
| 01/21/93 | 14:38:09 | 18.39 |
| 01/21/93 | 14:38:24 | 18.43 |
| 01/21/93 | 14:38:39 | 18.43 |
| 01/21/93 | 14:38:54 | 18.53 |
| 01/21/93 | 14:39:09 | 18.53 |
| 01/21/93 | 14:39:24 | 18.55 |
| 01/21/93 | 14:39:39 | 18.59 |
| 01/21/93 | 14:39:54 | 18.66 |
| 01/21/93 | 14:40:09 | 18.71 |
| 01/21/93 | 14:40:24 | 18.71 |
| 01/21/93 | 14:40:39 | 18.73 |
| 01/21/93 | 14:40:54 | 18.78 |
| 01/21/93 | 14:41:09 | 18.85 |
| 01/21/93 | 14:41:24 | 18.85 |
| 01/21/93 | 14:41:39 | 18.89 |
| 01/21/93 | 14:41:54 | 18.96 |
| 01/21/93 | 14:42:09 | 18.99 |
| 01/21/93 | 14:42:24 | 19.03 |
| 01/21/93 | 14:42:39 | 19.06 |
| 01/21/93 | 14:42:54 | 19.10 |
| 01/21/93 | 14:43:09 | 19.15 |
| 01/21/93 | 14:43:24 | 19.19 |
| 01/21/93 | 14:43:39 | 19.17 |
| 01/21/93 | 14:43:54 | 19.24 |
| 01/21/93 | 14:44:09 | 19.29 |
| 01/21/93 | 14:44:24 | 19.26 |
| 01/21/93 | 14:44:39 | 19.31 |
| 01/21/93 | 14:44:54 | 19.38 |
| 01/21/93 | 14:45:09 | 19.40 |
| 01/21/93 | 14:45:24 | 19.40 |
| 01/21/93 | 14:45:39 | 19.47 |
| 01/21/93 | 14:45:54 | 19.49 |
| 01/21/93 | 14:46:09 | 19.52 |
| 01/21/93 | 14:46:24 | 19.56 |
| 01/21/93 | 14:46:39 | 19.56 |
| 01/21/93 | 14:46:54 | 19.56 |
| 01/21/93 | 14:47:09 | 19.61 |
| 01/21/93 | 14:47:24 | 19.66 |
| 01/21/93 | 14:47:39 | 19.70 |
| 01/21/93 | 14:47:54 | 19.72 |
| 01/21/93 | 14:48:09 | 19.70 |
| 01/21/93 | 14:48:24 | 19.75 |

| | | |
|---|---|---|
| 01/21/93 | 14:48:39 | 19.82 |
| 01/21/93 | 14:48:54 | 19.84 |
| 01/21/93 | 14:49:09 | 19.82 |
| 01/21/93 | 14:49:24 | 19.86 |
| 01/21/93 | 14:49:39 | 19.89 |
| 01/21/93 | 14:49:54 | 19.91 |
| 01/21/93 | 14:50:09 | 19.93 |
| 01/21/93 | 14:50:24 | 20.00 |
| 01/21/93 | 14:50:39 | 19.98 |
| 01/21/93 | 14:50:54 | 20.00 |
| 01/21/93 | 14:51:09 | 20.07 |
| 01/21/93 | 14:51:24 | 20.12 |
| 01/21/93 | 14:51:39 | 20.09 |
| 01/21/93 | 14:51:54 | 20.12 |
| 01/21/93 | 14:52:09 | 20.19 |
| 01/21/93 | 14:52:24 | 20.16 |
| 01/21/93 | 14:52:39 | 20.19 |
| 01/21/93 | 14:52:54 | 20.21 |
| 01/21/93 | 14:53:09 | 20.28 |
| 01/21/93 | 14:53:24 | 20.30 |
| 01/21/93 | 14:53:39 | 20.32 |
| 01/21/93 | 14:53:54 | 20.30 |
| 01/21/93 | 14:54:09 | 20.32 |
| 01/21/93 | 14:54:24 | 20.39 |
| 01/21/93 | 14:54:39 | 20.37 |
| 01/21/93 | 14:54:54 | 20.39 |
| 01/21/93 | 14:55:09 | 20.44 |
| 01/21/93 | 14:55:24 | 20.49 |
| 01/21/93 | 14:55:39 | 20.44 |
| 01/21/93 | 14:55:54 | 20.51 |
| 01/21/93 | 14:56:09 | 20.49 |
| 01/21/93 | 14:56:24 | 20.51 |
| 01/21/93 | 14:56:39 | 20.58 |
| 01/21/93 | 14:56:54 | 20.56 |
| 01/21/93 | 14:57:09 | 20.62 |
| 01/21/93 | 14:57:24 | 20.65 |
| 01/21/93 | 14:57:39 | 20.62 |
| 01/21/93 | 14:57:54 | 20.67 |
| 01/21/93 | 14:58:09 | 20.69 |
| 01/21/93 | 14:58:24 | 20.72 |
| 01/21/93 | 14:58:39 | 20.72 |
| 01/21/93 | 14:58:54 | 20.72 |
| 01/21/93 | 14:59:09 | 20.74 |
| 01/21/93 | 14:59:24 | 20.76 |
| 01/21/93 | 14:59:39 | 20.81 |
| 01/21/93 | 14:59:54 | 20.81 |
| 01/21/93 | 15:00:09 | 20.83 |
| 01/21/93 | 15:00:24 | 20.86 |
| 01/21/93 | 15:00:39 | 20.88 |
| 01/21/93 | 15:00:54 | 20.88 |
| 01/21/93 | 15:01:09 | 20.90 |
| 01/21/93 | 15:01:24 | 20.92 |
| 01/21/93 | 15:01:39 | 20.95 |
| 01/21/93 | 15:01:54 | 20.95 |
| 01/21/93 | 15:02:09 | 20.97 |
| 01/21/93 | 15:02:24 | 20.99 |
| 01/21/93 | 15:02:39 | 21.02 |
| 01/21/93 | 15:02:54 | 21.04 |
| 01/21/93 | 15:03:09 | 21.04 |
| 01/21/93 | 15:03:24 | 21.06 |

| | | | |
|---|---|---|---|
| 01/21/93 | 15:03:39 | 21.06 | * |
| 01/21/93 | 15:03:54 | 21.09 | * |
| 01/21/93 | 15:04:09 | 21.11 | * |
| 01/21/93 | 15:04:24 | 21.11 | * |
| 01/21/93 | 15:04:39 | 21.13 | * |
| 01/21/93 | 15:04:54 | 21.16 | * |
| 01/21/93 | 15:05:09 | 21.16 | * |
| 01/21/93 | 15:05:24 | 21.18 | * |
| 01/21/93 | 15:05:39 | 21.18 | * |
| 01/21/93 | 15:05:54 | 21.20 | * |
| 01/21/93 | 15:06:09 | 21.22 | * |
| 01/21/93 | 15:06:24 | 21.22 | * |
| 01/21/93 | 15:06:39 | 21.25 | * |
| 01/21/93 | 15:06:54 | 21.25 | * |
| 01/21/93 | 15:07:09 | 21.27 | * |
| 01/21/93 | 15:07:24 | 21.29 | * |
| 01/21/93 | 15:07:39 | 21.29 | * |
| 01/21/93 | 15:07:54 | 21.32 | * |
| 01/21/93 | 15:08:09 | 21.32 | * |
| 01/21/93 | 15:08:24 | 21.32 | * |
| 01/21/93 | 15:08:39 | 21.34 | * |
| 01/21/93 | 15:08:54 | 21.36 | * |
| 01/21/93 | 15:09:09 | 21.36 | * |
| 01/21/93 | 15:09:24 | 21.41 | * |
| 01/21/93 | 15:09:39 | 21.41 | * |

# GW-62BR RECOVERY CURVE



MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 18:48:42 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:15 Amount of data recorded: 03:15:15
Storage Capacity: 6512 values records: 1 day 03:08:00
Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 15:33:14 | 0.81 |
| 01/21/93 | 15:33:29 | 0.74 |
| 01/21/93 | 15:33:44 | 1.41 |
| 01/21/93 | 15:33:59 | 1.75 |
| 01/21/93 | 15:34:14 | 1.85 |
| 01/21/93 | 15:34:29 | 1.94 |
| 01/21/93 | 15:34:44 | 1.98 |
| 01/21/93 | 15:34:59 | 2.08 |
| 01/21/93 | 15:35:14 | 2.15 |
| 01/21/93 | 15:35:29 | 2.21 |
| 01/21/93 | 15:35:44 | 2.28 |
| 01/21/93 | 15:35:59 | 2.33 |
| 01/21/93 | 15:36:14 | 2.38 |
| 01/21/93 | 15:36:29 | 2.47 |
| 01/21/93 | 15:36:44 | 2.56 |
| 01/21/93 | 15:36:59 | 2.65 |
| 01/21/93 | 15:37:14 | 2.70 |
| 01/21/93 | 15:37:29 | 2.77 |
| 01/21/93 | 15:37:44 | 2.84 |
| 01/21/93 | 15:37:59 | 2.91 |
| 01/21/93 | 15:38:14 | 3.00 |
| 01/21/93 | 15:38:29 | 3.05 |
| 01/21/93 | 15:38:44 | 3.11 |
| 01/21/93 | 15:38:59 | 3.16 |
| 01/21/93 | 15:39:14 | 3.21 |
| 01/21/93 | 15:39:29 | 3.28 |
| 01/21/93 | 15:39:44 | 3.35 |
| 01/21/93 | 15:39:59 | 3.46 |
| 01/21/93 | 15:40:14 | 3.48 |
| 01/21/93 | 15:40:29 | 3.55 |
| 01/21/93 | 15:40:44 | 3.62 |
| 01/21/93 | 15:40:59 | 3.69 |
| 01/21/93 | 15:41:14 | 3.76 |
| 01/21/93 | 15:41:29 | 3.83 |
| 01/21/93 | 15:41:44 | 3.90 |
| 01/21/93 | 15:41:59 | 3.97 |
| 01/21/93 | 15:42:14 | 4.04 |
| 01/21/93 | 15:42:29 | 4.11 |
| 01/21/93 | 15:42:44 | 4.15 |
| 01/21/93 | 15:42:59 | 4.22 |
| 01/21/93 | 15:43:14 | 4.29 |
| 01/21/93 | 15:43:29 | 4.36 |
| 01/21/93 | 15:43:44 | 4.43 |
| 01/21/93 | 15:43:59 | 4.50 |
| 01/21/93 | 15:44:14 | 4.54 |
| 01/21/93 | 15:44:29 | 4.59 |
| 01/21/93 | 15:44:44 | 4.64 |

| | | |
|---|---|---|
| 01/21/93 | 15:44:59 | 4.71 |
| 01/21/93 | 15:45:14 | 4.75 |
| 01/21/93 | 15:45:29 | 4.82 |
| 01/21/93 | 15:45:44 | 4.89 |
| 01/21/93 | 15:45:59 | 4.96 |
| 01/21/93 | 15:46:14 | 5.03 |
| 01/21/93 | 15:46:29 | 5.08 |
| 01/21/93 | 15:46:44 | 5.14 |
| 01/21/93 | 15:46:59 | 5.21 |
| 01/21/93 | 15:47:14 | 5.26 |
| 01/21/93 | 15:47:29 | 5.33 |
| 01/21/93 | 15:47:44 | 5.38 |
| 01/21/93 | 15:47:59 | 5.44 |
| 01/21/93 | 15:48:14 | 5.51 |
| 01/21/93 | 15:48:29 | 5.56 |
| 01/21/93 | 15:48:44 | 5.63 |
| 01/21/93 | 15:48:59 | 5.68 |
| 01/21/93 | 15:49:14 | 5.77 |
| 01/21/93 | 15:49:29 | 5.79 |
| 01/21/93 | 15:49:44 | 5.86 |
| 01/21/93 | 15:49:59 | 5.93 |
| 01/21/93 | 15:50:14 | 6.02 |
| 01/21/93 | 15:50:29 | 6.04 |
| 01/21/93 | 15:50:44 | 6.09 |
| 01/21/93 | 15:50:59 | 6.16 |
| 01/21/93 | 15:51:14 | 6.21 |
| 01/21/93 | 15:51:29 | 6.28 |
| 01/21/93 | 15:51:44 | 6.32 |
| 01/21/93 | 15:51:59 | 6.44 |
| 01/21/93 | 15:52:14 | 6.44 |
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| 01/21/93 | 15:52:44 | 6.55 |
| 01/21/93 | 15:52:59 | 6.62 |
| 01/21/93 | 15:53:14 | 6.71 |
| 01/21/93 | 15:53:29 | 6.78 |
| 01/21/93 | 15:53:44 | 6.83 |
| 01/21/93 | 15:53:59 | 6.87 |
| 01/21/93 | 15:54:14 | 6.90 |
| 01/21/93 | 15:54:29 | 6.97 |
| 01/21/93 | 15:54:44 | 7.01 |
| 01/21/93 | 15:54:59 | 7.06 |
| 01/21/93 | 15:55:14 | 7.13 |
| 01/21/93 | 15:55:29 | 7.17 |
| 01/21/93 | 15:55:44 | 7.24 |
| 01/21/93 | 15:55:59 | 7.29 |
| 01/21/93 | 15:56:14 | 7.34 |
| 01/21/93 | 15:56:29 | 7.38 |
| 01/21/93 | 15:56:44 | 7.45 |
| 01/21/93 | 15:56:59 | 7.50 |
| 01/21/93 | 15:57:14 | 7.54 |
| 01/21/93 | 15:57:29 | 7.61 |
| 01/21/93 | 15:57:44 | 7.66 |
| 01/21/93 | 15:57:59 | 7.71 |
| 01/21/93 | 15:58:14 | 7.77 |
| 01/21/93 | 15:58:29 | 7.82 |
| 01/21/93 | 15:58:44 | 7.87 |
| 01/21/93 | 15:58:59 | 7.91 |
| 01/21/93 | 15:59:14 | 7.98 |
| 01/21/93 | 15:59:29 | 8.03 |
| 01/21/93 | 15:59:44 | 8.07 |

| | | |
|---|---|---|
| 01/21/93 | 15:59:59 | 8.12 |
| 01/21/93 | 16:00:14 | 8.19 |
| 01/21/93 | 16:00:29 | 8.24 |
| 01/21/93 | 16:00:44 | 8.28 |
| 01/21/93 | 16:00:59 | 8.33 |
| 01/21/93 | 16:01:14 | 8.40 |
| 01/21/93 | 16:01:29 | 8.44 |
| 01/21/93 | 16:01:44 | 8.49 |
| 01/21/93 | 16:01:59 | 8.54 |
| 01/21/93 | 16:02:14 | 8.58 |
| 01/21/93 | 16:02:29 | 8.63 |
| 01/21/93 | 16:02:44 | 8.70 |
| 01/21/93 | 16:02:59 | 8.74 |
| 01/21/93 | 16:03:14 | 8.79 |
| 01/21/93 | 16:03:29 | 8.84 |
| 01/21/93 | 16:03:44 | 8.88 |
| 01/21/93 | 16:03:59 | 8.95 |
| 01/21/93 | 16:04:14 | 8.97 |
| 01/21/93 | 16:04:29 | 9.04 |
| 01/21/93 | 16:04:44 | 9.09 |
| 01/21/93 | 16:04:59 | 9.14 |
| 01/21/93 | 16:05:14 | 9.18 |
| 01/21/93 | 16:05:29 | 9.23 |
| 01/21/93 | 16:05:44 | 9.27 |
| 01/21/93 | 16:05:59 | 9.32 |
| 01/21/93 | 16:06:14 | 9.37 |
| 01/21/93 | 16:06:29 | 9.41 |
| 01/21/93 | 16:06:44 | 9.46 |
| 01/21/93 | 16:06:59 | 9.50 |
| 01/21/93 | 16:07:14 | 9.57 |
| 01/21/93 | 16:07:29 | 9.62 |
| 01/21/93 | 16:07:44 | 9.64 |
| 01/21/93 | 16:07:59 | 9.69 |
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| 01/21/93 | 16:08:29 | 9.78 |
| 01/21/93 | 16:08:44 | 9.85 |
| 01/21/93 | 16:08:59 | 9.90 |
| 01/21/93 | 16:09:14 | 9.94 |
| 01/21/93 | 16:09:29 | 9.99 |
| 01/21/93 | 16:09:44 | 10.04 |
| 01/21/93 | 16:09:59 | 10.08 |
| 01/21/93 | 16:10:14 | 10.13 |
| 01/21/93 | 16:10:29 | 10.15 |
| 01/21/93 | 16:10:44 | 10.20 |
| 01/21/93 | 16:10:59 | 10.24 |
| 01/21/93 | 16:11:14 | 10.31 |
| 01/21/93 | 16:11:29 | 10.34 |
| 01/21/93 | 16:11:44 | 10.40 |
| 01/21/93 | 16:11:59 | 10.43 |
| 01/21/93 | 16:12:14 | 10.47 |
| 01/21/93 | 16:12:29 | 10.52 |
| 01/21/93 | 16:12:44 | 10.57 |
| 01/21/93 | 16:12:59 | 10.61 |
| 01/21/93 | 16:13:14 | 10.66 |
| 01/21/93 | 16:13:29 | 10.70 |
| 01/21/93 | 16:13:44 | 10.73 |
| 01/21/93 | 16:13:59 | 10.77 |
| 01/21/93 | 16:14:14 | 10.82 |
| 01/21/93 | 16:14:29 | 10.87 |
| 01/21/93 | 16:14:44 | 10.91 |

| | | |
|---|---|---|
| 01/21/93 | 16:14:59 | 10.96 |
| 01/21/93 | 16:15:14 | 11.00 |
| 01/21/93 | 16:15:29 | 11.03 |
| 01/21/93 | 16:15:44 | 11.07 |
| 01/21/93 | 16:15:59 | 11.12 |
| 01/21/93 | 16:16:14 | 11.17 |
| 01/21/93 | 16:16:29 | 11.21 |
| 01/21/93 | 16:16:44 | 11.26 |
| 01/21/93 | 16:16:59 | 11.28 |
| 01/21/93 | 16:17:14 | 11.35 |
| 01/21/93 | 16:17:29 | 11.37 |
| 01/21/93 | 16:17:44 | 11.42 |
| 01/21/93 | 16:17:59 | 11.47 |
| 01/21/93 | 16:18:14 | 11.49 |
| 01/21/93 | 16:18:29 | 11.53 |
| 01/21/93 | 16:18:44 | 11.58 |
| 01/21/93 | 16:18:59 | 11.63 |
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| 01/21/93 | 16:19:59 | 11.79 |
| 01/21/93 | 16:20:14 | 11.83 |
| 01/21/93 | 16:20:29 | 11.88 |
| 01/21/93 | 16:20:44 | 11.90 |
| 01/21/93 | 16:20:59 | 11.95 |
| 01/21/93 | 16:21:14 | 12.00 |
| 01/21/93 | 16:21:29 | 12.02 |
| 01/21/93 | 16:21:44 | 12.07 |
| 01/21/93 | 16:21:59 | 12.11 |
| 01/21/93 | 16:22:14 | 12.16 |
| 01/21/93 | 16:22:29 | 12.18 |
| 01/21/93 | 16:22:44 | 12.23 |
| 01/21/93 | 16:22:59 | 12.27 |
| 01/21/93 | 16:23:14 | 12.30 |
| 01/21/93 | 16:23:29 | 12.34 |
| 01/21/93 | 16:23:44 | 12.39 |
| 01/21/93 | 16:23:59 | 12.41 |
| 01/21/93 | 16:24:14 | 12.46 |
| 01/21/93 | 16:24:29 | 12.50 |
| 01/21/93 | 16:24:44 | 12.53 |
| 01/21/93 | 16:24:59 | 12.57 |
| 01/21/93 | 16:25:14 | 12.60 |
| 01/21/93 | 16:25:29 | 12.64 |
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| 01/21/93 | 16:28:14 | 13.03 |
| 01/21/93 | 16:28:29 | 13.08 |
| 01/21/93 | 16:28:44 | 13.10 |
| 01/21/93 | 16:28:59 | 13.15 |
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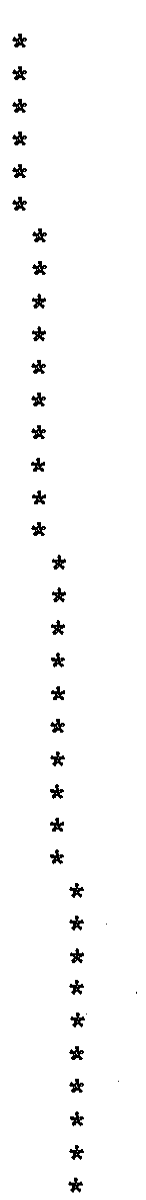
| 01/21/93 | 16:29:44 | 13.27 |



| | | | |
|---|---|---|---|
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| 01/21/93 | 16:30:29 | 13.38 | * |
| 01/21/93 | 16:30:44 | 13.40 | * |
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| 01/21/93 | 16:31:14 | 13.47 | * |
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| 01/21/93 | 16:31:44 | 13.54 | * |
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| 01/21/93 | 16:32:14 | 13.61 | * |
| 01/21/93 | 16:32:29 | 13.66 | * |
| 01/21/93 | 16:32:44 | 13.68 | * |
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| 01/21/93 | 16:33:14 | 13.75 | * |
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| 01/21/93 | 16:33:44 | 13.82 | * |
| 01/21/93 | 16:33:59 | 13.84 | * |
| 01/21/93 | 16:34:14 | 13.87 | * |
| 01/21/93 | 16:34:29 | 13.91 | * |
| 01/21/93 | 16:34:44 | 13.96 | * |
| 01/21/93 | 16:34:59 | 13.98 | * |
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| 01/21/93 | 16:35:29 | 14.05 | * |
| 01/21/93 | 16:35:44 | 14.07 | * |
| 01/21/93 | 16:35:59 | 14.12 | * |
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| 01/21/93 | 16:36:29 | 14.16 | * |
| 01/21/93 | 16:36:44 | 14.21 | * |
| 01/21/93 | 16:36:59 | 14.23 | * |
| 01/21/93 | 16:37:14 | 14.28 | * |
| 01/21/93 | 16:37:29 | 14.30 | * |
| 01/21/93 | 16:37:44 | 14.35 | * |
| 01/21/93 | 16:37:59 | 14.37 | * |
| 01/21/93 | 16:38:14 | 14.40 | * |
| 01/21/93 | 16:38:29 | 14.42 | * |
| 01/21/93 | 16:38:44 | 14.46 | * |
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| 01/21/93 | 16:39:14 | 14.53 | * |
| 01/21/93 | 16:39:29 | 14.56 | * |
| 01/21/93 | 16:39:44 | 14.60 | * |
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| 01/21/93 | 16:40:59 | 14.76 | * |
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| 01/21/93 | 16:41:59 | 14.86 | * |
| 01/21/93 | 16:42:14 | 14.90 | * |
| 01/21/93 | 16:42:29 | 14.93 | * |
| 01/21/93 | 16:42:44 | 14.95 | * |
| 01/21/93 | 16:42:59 | 14.97 | * |
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| 01/21/93 | 16:43:29 | 15.04 | * |
| 01/21/93 | 16:43:44 | 15.06 | * |
| 01/21/93 | 16:43:59 | 15.09 | * |
| 01/21/93 | 16:44:14 | 15.13 | * |
| 01/21/93 | 16:44:29 | 15.16 | * |
| 01/21/93 | 16:44:44 | 15.18 | * |

| | | |
|---|---|---|
| 01/21/93 | 16:44:59 | 15.20 |
| 01/21/93 | 16:45:14 | 15.23 |
| 01/21/93 | 16:45:29 | 15.27 |
| 01/21/93 | 16:45:44 | 15.30 |
| 01/21/93 | 16:45:59 | 15.32 |
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| 01/21/93 | 16:46:59 | 15.43 |
| 01/21/93 | 16:47:14 | 15.46 |
| 01/21/93 | 16:47:29 | 15.50 |
| 01/21/93 | 16:47:44 | 15.53 |
| 01/21/93 | 16:47:59 | 15.57 |
| 01/21/93 | 16:48:14 | 15.60 |
| 01/21/93 | 16:48:29 | 15.62 |
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| 01/21/93 | 16:48:59 | 15.66 |
| 01/21/93 | 16:49:14 | 15.69 |
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| 01/21/93 | 16:49:44 | 15.76 |
| 01/21/93 | 16:49:59 | 15.78 |
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| 01/21/93 | 16:50:29 | 15.83 |
| 01/21/93 | 16:50:44 | 15.87 |
| 01/21/93 | 16:50:59 | 15.90 |
| 01/21/93 | 16:51:14 | 15.92 |
| 01/21/93 | 16:51:29 | 15.94 |
| 01/21/93 | 16:51:44 | 15.96 |
| 01/21/93 | 16:51:59 | 15.99 |
| 01/21/93 | 16:52:14 | 16.01 |
| 01/21/93 | 16:52:29 | 16.03 |
| 01/21/93 | 16:52:44 | 16.06 |
| 01/21/93 | 16:52:59 | 16.10 |
| 01/21/93 | 16:53:14 | 16.13 |
| 01/21/93 | 16:53:29 | 16.15 |
| 01/21/93 | 16:53:44 | 16.17 |
| 01/21/93 | 16:53:59 | 16.20 |
| 01/21/93 | 16:54:14 | 16.24 |
| 01/21/93 | 16:54:29 | 16.24 |
| 01/21/93 | 16:54:44 | 16.29 |
| 01/21/93 | 16:54:59 | 16.31 |
| 01/21/93 | 16:55:14 | 16.33 |
| 01/21/93 | 16:55:29 | 16.36 |
| 01/21/93 | 16:55:44 | 16.38 |
| 01/21/93 | 16:55:59 | 16.40 |
| 01/21/93 | 16:56:14 | 16.43 |
| 01/21/93 | 16:56:29 | 16.45 |
| 01/21/93 | 16:56:44 | 16.50 |
| 01/21/93 | 16:56:59 | 16.52 |
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| 01/21/93 | 16:57:29 | 16.54 |
| 01/21/93 | 16:57:44 | 16.56 |
| 01/21/93 | 16:57:59 | 16.61 |
| 01/21/93 | 16:58:14 | 16.61 |
| 01/21/93 | 16:58:29 | 16.63 |
| 01/21/93 | 16:58:44 | 16.68 |
| 01/21/93 | 16:58:59 | 16.70 |
| 01/21/93 | 16:59:14 | 16.73 |
| 01/21/93 | 16:59:29 | 16.75 |
| 01/21/93 | 16:59:44 | 16.77 |

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| 01/21/93 | 17:00:29 | 16.84 |
| 01/21/93 | 17:00:44 | 16.86 |
| 01/21/93 | 17:00:59 | 16.89 |
| 01/21/93 | 17:01:14 | 16.91 |
| 01/21/93 | 17:01:29 | 16.93 |
| 01/21/93 | 17:01:44 | 16.96 |
| 01/21/93 | 17:01:59 | 16.98 |
| 01/21/93 | 17:02:14 | 17.00 |
| 01/21/93 | 17:02:29 | 17.03 |
| 01/21/93 | 17:02:44 | 17.05 |
| 01/21/93 | 17:02:59 | 17.07 |
| 01/21/93 | 17:03:14 | 17.09 |
| 01/21/93 | 17:03:29 | 17.12 |
| 01/21/93 | 17:03:44 | 17.14 |
| 01/21/93 | 17:03:59 | 17.16 |
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| 01/21/93 | 17:04:44 | 17.23 |
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| 01/21/93 | 17:06:29 | 17.37 |
| 01/21/93 | 17:06:44 | 17.39 |
| 01/21/93 | 17:06:59 | 17.42 |
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| 01/21/93 | 17:07:29 | 17.46 |
| 01/21/93 | 17:07:44 | 17.49 |
| 01/21/93 | 17:07:59 | 17.51 |
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| 01/21/93 | 17:08:29 | 17.53 |
| 01/21/93 | 17:08:44 | 17.56 |
| 01/21/93 | 17:08:59 | 17.58 |
| 01/21/93 | 17:09:14 | 17.60 |
| 01/21/93 | 17:09:29 | 17.63 |
| 01/21/93 | 17:09:44 | 17.65 |
| 01/21/93 | 17:09:59 | 17.67 |
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| 01/21/93 | 17:10:29 | 17.72 |
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| 01/21/93 | 17:11:29 | 17.81 |
| 01/21/93 | 17:11:44 | 17.81 |
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| 01/21/93 | 17:12:14 | 17.86 |
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| 01/21/93 | 17:14:29 | 18.04 |
| 01/21/93 | 17:14:44 | 18.04 |

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| 01/21/93 | 17:16:14 | 18.18 | * |
| 01/21/93 | 17:16:29 | 18.20 | * |
| 01/21/93 | 17:16:44 | 18.18 | * |
| 01/21/93 | 17:16:59 | 18.20 | * |
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| 01/21/93 | 17:17:29 | 18.27 | * |
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| 01/21/93 | 17:28:44 | 18.96 | * |
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| 01/21/93 | 17:29:29 | 19.01 | * |
| 01/21/93 | 17:29:44 | 19.08 | * |

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| 01/21/93 | 17:31:59 | 19.19 | * |
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| 01/21/93 | 17:32:29 | 19.22 | * |
| 01/21/93 | 17:32:44 | 19.24 | * |
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| 01/21/93 | 17:35:29 | 19.40 | * |
| 01/21/93 | 17:35:44 | 19.42 | * |
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| 01/21/93 | 17:36:29 | 19.47 | * |
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| 01/21/93 | 17:38:59 | 19.59 | * |
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| 01/21/93 | 17:43:44 | 19.84 | * |
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| 01/21/93 | 17:44:29 | 19.86 | * |
| 01/21/93 | 17:44:44 | 19.89 | * |

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| 01/21/93 | 17:48:29 | 20.05 | * |
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| 01/21/93 | 17:49:29 | 20.12 | * |
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| 01/21/93 | 17:49:59 | 20.14 | * |
| 01/21/93 | 17:50:14 | 20.12 | * |
| 01/21/93 | 17:50:29 | 20.14 | * |
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| 01/21/93 | 17:50:59 | 20.16 | * |
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| 01/21/93 | 17:52:44 | 20.23 | * |
| 01/21/93 | 17:52:59 | 20.26 | * |
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| 01/21/93 | 17:56:44 | 20.39 | * |
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| 01/21/93 | 17:57:29 | 20.44 | * |
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| 01/21/93 | 17:57:59 | 20.44 | * |
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| 01/21/93 | 17:58:44 | 20.49 | * |
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| 01/21/93 | 17:59:29 | 20.51 | * |
| 01/21/93 | 17:59:44 | 20.51 | * |

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| 01/21/93 | 18:29:44 | 21.34 | * |

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| 01/21/93 | 18:31:14 | 21.36 | * |
| 01/21/93 | 18:31:29 | 21.41 | * |
| 01/21/93 | 18:31:44 | 21.41 | * |
| 01/21/93 | 18:31:59 | 21.36 | * |
| 01/21/93 | 18:32:14 | 21.43 | * |
| 01/21/93 | 18:32:29 | 21.39 | * |
| 01/21/93 | 18:32:44 | 21.39 | * |
| 01/21/93 | 18:32:59 | 21.41 | * |
| 01/21/93 | 18:33:14 | 21.46 | * |
| 01/21/93 | 18:33:29 | 21.46 | * |
| 01/21/93 | 18:33:44 | 21.41 | * |
| 01/21/93 | 18:33:59 | 21.41 | * |
| 01/21/93 | 18:34:14 | 21.46 | * |
| 01/21/93 | 18:34:29 | 21.48 | * |
| 01/21/93 | 18:34:44 | 21.43 | * |
| 01/21/93 | 18:34:59 | 21.48 | * |
| 01/21/93 | 18:35:14 | 21.50 | |
| 01/21/93 | 18:35:29 | 21.50 | |
| 01/21/93 | 18:35:44 | 21.46 | * |
| 01/21/93 | 18:35:59 | 21.46 | * |
| 01/21/93 | 18:36:14 | 21.46 | * |
| 01/21/93 | 18:36:29 | 21.46 | * |
| 01/21/93 | 18:36:44 | 21.50 | |
| 01/21/93 | 18:36:59 | 21.52 | |
| 01/21/93 | 18:37:14 | 21.48 | * |
| 01/21/93 | 18:37:29 | 21.52 | |
| 01/21/93 | 18:37:44 | 21.55 | |
| 01/21/93 | 18:37:59 | 21.55 | |
| 01/21/93 | 18:38:14 | 21.55 | |
| 01/21/93 | 18:38:29 | 21.55 | |
| 01/21/93 | 18:38:44 | 21.55 | |
| 01/21/93 | 18:38:59 | 21.50 | |
| 01/21/93 | 18:39:14 | 21.50 | |
| 01/21/93 | 18:39:29 | 21.50 | |
| 01/21/93 | 18:39:44 | 21.57 | |
| 01/21/93 | 18:39:59 | 21.52 | |
| 01/21/93 | 18:40:14 | 21.59 | |
| 01/21/93 | 18:40:29 | 21.52 | |
| 01/21/93 | 18:40:44 | 21.52 | |
| 01/21/93 | 18:40:59 | 21.59 | |
| 01/21/93 | 18:41:14 | 21.59 | |
| 01/21/93 | 18:41:29 | 21.59 | |
| 01/21/93 | 18:41:44 | 21.55 | |
| 01/21/93 | 18:41:59 | 21.59 | |
| 01/21/93 | 18:42:14 | 21.62 | |
| 01/21/93 | 18:42:29 | 21.62 | |
| 01/21/93 | 18:42:44 | 21.57 | |
| 01/21/93 | 18:42:59 | 21.62 | |
| 01/21/93 | 18:43:14 | 21.62 | |
| 01/21/93 | 18:43:29 | 21.59 | |
| 01/21/93 | 18:43:44 | 21.59 | |
| 01/21/93 | 18:43:59 | 21.64 | |
| 01/21/93 | 18:44:14 | 21.64 | |
| 01/21/93 | 18:44:29 | 21.59 | |
| 01/21/93 | 18:44:44 | 21.64 | |

| | | |
|---|---|---|
| 01/21/93 | 18:44:59 | 21.59 |
| 01/21/93 | 18:45:14 | 21.59 |
| 01/21/93 | 18:45:29 | 21.62 |
| 01/21/93 | 18:45:44 | 21.66 |
| 01/21/93 | 18:45:59 | 21.62 |
| 01/21/93 | 18:46:14 | 21.66 |
| 01/21/93 | 18:46:29 | 21.62 |
| 01/21/93 | 18:46:44 | 21.62 |
| 01/21/93 | 18:46:59 | 21.69 |
| 01/21/93 | 18:47:14 | 21.66 |
| 01/21/93 | 18:47:29 | 21.66 |
| 01/21/93 | 18:47:44 | 21.66 |
| 01/21/93 | 18:47:59 | 21.66 |

MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 12:19:17 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:10 Amount of data recorded: 00:04:50
Storage Capacity: 6512 values records: 18:05:20
Output compressed by a factor of 1

| Date | Time | Avg | |
|---|---|---|---|
| 01/21/93 | 12:14:24 | 9.46 | * |
| 01/21/93 | 12:14:34 | 9.46 | * |
| 01/21/93 | 12:14:44 | 9.46 | * |
| 01/21/93 | 12:14:54 | 9.46 | * |
| 01/21/93 | 12:15:04 | 9.46 | * |
| 01/21/93 | 12:15:14 | 9.46 | * |
| 01/21/93 | 12:15:24 | 9.46 | * |
| 01/21/93 | 12:15:34 | 9.46 | * |
| 01/21/93 | 12:15:44 | 9.44 | * |
| 01/21/93 | 12:15:54 | 9.46 | * |
| 01/21/93 | 12:16:04 | 9.46 | * |
| 01/21/93 | 12:16:14 | 9.46 | * |
| 01/21/93 | 12:16:24 | 9.46 | * |
| 01/21/93 | 12:16:34 | 9.46 | * |
| 01/21/93 | 12:16:44 | 9.44 | * |
| 01/21/93 | 12:16:54 | 9.14 | * |
| 01/21/93 | 12:17:04 | 8.86 | * |
| 01/21/93 | 12:17:14 | 8.81 | * |
| 01/21/93 | 12:17:24 | 8.86 | * |
| 01/21/93 | 12:17:34 | 8.86 | * |
| 01/21/93 | 12:17:44 | 8.88 | * |
| 01/21/93 | 12:17:54 | 8.86 | * |
| 01/21/93 | 12:18:04 | 8.86 | * |
| 01/21/93 | 12:18:14 | 8.86 | * |
| 01/21/93 | 12:18:24 | 8.86 | * |
| 01/21/93 | 12:18:34 | 8.86 | * |
| 01/21/93 | 12:18:44 | 8.86 | * |
| 01/21/93 | 12:18:54 | 8.86 | * |

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 13:03:59 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:02:00 Amount of data recorded: 00:38:00
Storage Capacity: 6512 values records: 9 days 01:04:00
Output compressed by a factor of 1

| Date | Time | Avg | |
|---|---|---|---|
| 01/21/93 | 12:25:02 | 8.86 | * |
| 01/21/93 | 12:27:02 | 8.88 | * |
| 01/21/93 | 12:29:02 | 8.86 | * |
| 01/21/93 | 12:31:02 | 8.86 | * |
| 01/21/93 | 12:33:02 | 8.88 | * |
| 01/21/93 | 12:35:02 | 8.86 | * |
| 01/21/93 | 12:37:02 | 8.86 | * |
| 01/21/93 | 12:39:02 | 8.86 | * |
| 01/21/93 | 12:41:02 | 8.86 | * |
| 01/21/93 | 12:43:02 | 8.84 | * |
| 01/21/93 | 12:45:02 | 8.84 | * |
| 01/21/93 | 12:47:02 | 8.84 | * |
| 01/21/93 | 12:49:02 | 8.86 | * |
| 01/21/93 | 12:51:02 | 8.88 | * |
| 01/21/93 | 12:53:02 | 8.86 | * |
| 01/21/93 | 12:55:02 | 8.88 | * |
| 01/21/93 | 12:57:02 | 8.84 | * |
| 01/21/93 | 12:59:02 | 8.86 | * |

GW-62M - REC
MONITORING DATA

# Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ~~ID: 0002~~
Time at Recorder: 01/21/93 13:12:45 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:01 Amount of data recorded: 00:00:50
Storage Capacity: 6512 values records: 01:48:32
Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 13:11:55 | 8.79 |
| 01/21/93 | 13:11:56 | 8.88 |
| 01/21/93 | 13:11:57 | 8.74 |
| 01/21/93 | 13:11:58 | 8.84 |
| 01/21/93 | 13:11:59 | 8.79 |
| 01/21/93 | 13:12:00 | 8.95 |
| 01/21/93 | 13:12:01 | 8.81 |
| 01/21/93 | 13:12:02 | 8.79 |
| 01/21/93 | 13:12:03 | 8.93 |
| 01/21/93 | 13:12:04 | 8.86 |
| 01/21/93 | 13:12:05 | 8.88 |
| 01/21/93 | 13:12:06 | 8.79 |
| 01/21/93 | 13:12:07 | 8.88 |
| 01/21/93 | 13:12:08 | 8.70 |
| 01/21/93 | 13:12:09 | 8.91 |
| 01/21/93 | 13:12:10 | 8.91 |
| 01/21/93 | 13:12:11 | 9.09 |
| 01/21/93 | 13:12:12 | 9.41 |
| 01/21/93 | 13:12:13 | 9.55 |
| 01/21/93 | 13:12:14 | 9.60 |
| 01/21/93 | 13:12:15 | 9.60 |
| 01/21/93 | 13:12:16 | 9.48 |
| 01/21/93 | 13:12:17 | 9.44 |
| 01/21/93 | 13:12:18 | 9.50 |
| 01/21/93 | 13:12:19 | 9.48 |
| 01/21/93 | 13:12:20 | 9.48 |
| 01/21/93 | 13:12:21 | 9.53 |
| 01/21/93 | 13:12:22 | 9.55 |
| 01/21/93 | 13:12:23 | 9.50 |
| 01/21/93 | 13:12:24 | 9.48 |
| 01/21/93 | 13:12:25 | 9.53 |
| 01/21/93 | 13:12:26 | 9.50 |
| 01/21/93 | 13:12:27 | 9.46 |
| 01/21/93 | 13:12:28 | 9.44 |
| 01/21/93 | 13:12:29 | 9.46 |
| 01/21/93 | 13:12:30 | 9.46 |
| 01/21/93 | 13:12:31 | 9.48 |
| 01/21/93 | 13:12:32 | 9.46 |
| 01/21/93 | 13:12:33 | 9.44 |
| 01/21/93 | 13:12:34 | 9.44 |
| 01/21/93 | 13:12:35 | 9.48 |
| 01/21/93 | 13:12:36 | 9.48 |
| 01/21/93 | 13:12:37 | 9.48 |
| 01/21/93 | 13:12:38 | 9.44 |
| 01/21/93 | 13:12:39 | 9.44 |
| 01/21/93 | 13:12:40 | 9.44 |
| 01/21/93 | 13:12:41 | 9.44 |

```
01/21/93 13:12:42   9.44                                    *
01/21/93 13:12:43   9.48                                      *
```

MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 11:58:11 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:30 Amount of data recorded: 02:18:30
Storage Capacity: 6512 values records: 2 days 06:16:00
Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 09:39:32 | 12.62 |
| 01/21/93 | 09:40:02 | 12.62 |
| 01/21/93 | 09:40:32 | 12.62 |
| 01/21/93 | 09:41:02 | 12.09 |
| 01/21/93 | 09:41:32 | 11.81 |
| 01/21/93 | 09:42:02 | 11.79 |
| 01/21/93 | 09:42:32 | 11.79 |
| 01/21/93 | 09:43:02 | 11.79 |
| 01/21/93 | 09:43:32 | 11.83 |
| 01/21/93 | 09:44:02 | 11.79 |
| 01/21/93 | 09:44:32 | 11.79 |
| 01/21/93 | 09:45:02 | 11.81 |
| 01/21/93 | 09:45:32 | 11.77 |
| 01/21/93 | 09:46:02 | 11.83 |
| 01/21/93 | 09:46:32 | 11.81 |
| 01/21/93 | 09:47:02 | 11.81 |
| 01/21/93 | 09:47:32 | 11.81 |
| 01/21/93 | 09:48:02 | 11.79 |
| 01/21/93 | 09:48:32 | 11.79 |
| 01/21/93 | 09:49:02 | 11.79 |
| 01/21/93 | 09:49:32 | 11.79 |
| 01/21/93 | 09:50:02 | 11.79 |
| 01/21/93 | 09:50:32 | 11.81 |
| 01/21/93 | 09:51:02 | 11.79 |
| 01/21/93 | 09:51:32 | 11.79 |
| 01/21/93 | 09:52:02 | 11.81 |
| 01/21/93 | 09:52:32 | 11.79 |
| 01/21/93 | 09:53:02 | 11.77 |
| 01/21/93 | 09:53:32 | 11.79 |
| 01/21/93 | 09:54:02 | 11.79 |
| 01/21/93 | 09:54:32 | 11.81 |
| 01/21/93 | 09:55:02 | 11.81 |
| 01/21/93 | 09:55:32 | 11.81 |
| 01/21/93 | 09:56:02 | 11.81 |
| 01/21/93 | 09:56:32 | 11.79 |
| 01/21/93 | 09:57:02 | 11.79 |
| 01/21/93 | 09:57:32 | 11.83 |
| 01/21/93 | 09:58:02 | 11.79 |
| 01/21/93 | 09:58:32 | 11.77 |
| 01/21/93 | 09:59:02 | 11.81 |
| 01/21/93 | 09:59:32 | 11.79 |
| 01/21/93 | 10:00:02 | 11.79 |
| 01/21/93 | 10:00:32 | 11.79 |
| 01/21/93 | 10:01:02 | 11.83 |
| 01/21/93 | 10:01:32 | 11.79 |
| 01/21/93 | 10:02:02 | 11.83 |
| 01/21/93 | 10:02:32 | 11.79 |

| | | | |
|---|---|---|---|
| 01/21/93 | 10:03:02 | 11.81 | * |
| 01/21/93 | 10:03:32 | 11.81 | * |
| 01/21/93 | 10:04:02 | 11.79 | * |
| 01/21/93 | 10:04:32 | 11.81 | * |
| 01/21/93 | 10:05:02 | 11.79 | * |
| 01/21/93 | 10:05:32 | 11.83 | * |
| 01/21/93 | 10:06:02 | 11.79 | * |
| 01/21/93 | 10:06:32 | 11.83 | * |
| 01/21/93 | 10:07:02 | 11.77 | * |
| 01/21/93 | 10:07:32 | 11.81 | * |
| 01/21/93 | 10:08:02 | 11.83 | * |
| 01/21/93 | 10:08:32 | 11.79 | * |
| 01/21/93 | 10:09:02 | 11.81 | * |
| 01/21/93 | 10:09:32 | 11.81 | * |
| 01/21/93 | 10:10:02 | 11.81 | * |
| 01/21/93 | 10:10:32 | 11.79 | * |
| 01/21/93 | 10:11:02 | 11.79 | * |
| 01/21/93 | 10:11:32 | 11.77 | * |
| 01/21/93 | 10:12:02 | 11.79 | * |
| 01/21/93 | 10:12:32 | 11.77 | * |
| 01/21/93 | 10:13:02 | 11.79 | * |
| 01/21/93 | 10:13:32 | 11.81 | * |
| 01/21/93 | 10:14:02 | 11.79 | * |
| 01/21/93 | 10:14:32 | 11.79 | * |
| 01/21/93 | 10:15:02 | 11.81 | * |
| 01/21/93 | 10:15:32 | 11.79 | * |
| 01/21/93 | 10:16:02 | 11.79 | * |
| 01/21/93 | 10:16:32 | 11.83 | * |
| 01/21/93 | 10:17:02 | 11.81 | * |
| 01/21/93 | 10:17:32 | 11.81 | * |
| 01/21/93 | 10:18:02 | 11.81 | * |
| 01/21/93 | 10:18:32 | 11.81 | * |
| 01/21/93 | 10:19:02 | 11.81 | * |
| 01/21/93 | 10:19:32 | 11.79 | * |
| 01/21/93 | 10:20:02 | 11.83 | * |
| 01/21/93 | 10:20:32 | 11.74 | * |
| 01/21/93 | 10:21:02 | 11.81 | * |
| 01/21/93 | 10:21:32 | 11.81 | * |
| 01/21/93 | 10:22:02 | 11.79 | * |
| 01/21/93 | 10:22:32 | 11.81 | * |
| 01/21/93 | 10:23:02 | 11.81 | * |
| 01/21/93 | 10:23:32 | 11.79 | * |
| 01/21/93 | 10:24:02 | 11.79 | * |
| 01/21/93 | 10:24:32 | 11.79 | * |
| 01/21/93 | 10:25:02 | 11.81 | * |
| 01/21/93 | 10:25:32 | 11.81 | * |
| 01/21/93 | 10:26:02 | 11.81 | * |
| 01/21/93 | 10:26:32 | 11.83 | * |
| 01/21/93 | 10:27:02 | 11.81 | * |
| 01/21/93 | 10:27:32 | 11.79 | * |
| 01/21/93 | 10:28:02 | 11.81 | * |
| 01/21/93 | 10:28:32 | 11.81 | * |
| 01/21/93 | 10:29:02 | 11.86 | * |
| 01/21/93 | 10:29:32 | 11.81 | * |
| 01/21/93 | 10:30:02 | 11.83 | * |
| 01/21/93 | 10:30:32 | 11.81 | * |
| 01/21/93 | 10:31:02 | 11.81 | * |
| 01/21/93 | 10:31:32 | 11.79 | * |
| 01/21/93 | 10:32:02 | 11.83 | * |
| 01/21/93 | 10:32:32 | 11.81 | * |

| | | | |
|---|---|---|---|
| 01/21/93 | 10:33:02 | 11.83 | * |
| 01/21/93 | 10:33:32 | 11.79 | * |
| 01/21/93 | 10:34:02 | 11.86 | * |
| 01/21/93 | 10:34:32 | 11.81 | * |
| 01/21/93 | 10:35:02 | 11.79 | * |
| 01/21/93 | 10:35:32 | 11.81 | * |
| 01/21/93 | 10:36:02 | 11.83 | * |
| 01/21/93 | 10:36:32 | 11.79 | * |
| 01/21/93 | 10:37:02 | 11.81 | * |
| 01/21/93 | 10:37:32 | 11.81 | * |
| 01/21/93 | 10:38:02 | 11.79 | * |
| 01/21/93 | 10:38:32 | 11.79 | * |
| 01/21/93 | 10:39:02 | 11.79 | * |
| 01/21/93 | 10:39:32 | 11.83 | * |
| 01/21/93 | 10:40:02 | 11.81 | * |
| 01/21/93 | 10:40:32 | 11.79 | * |
| 01/21/93 | 10:41:02 | 11.83 | * |
| 01/21/93 | 10:41:32 | 11.81 | * |
| 01/21/93 | 10:42:02 | 11.81 | * |
| 01/21/93 | 10:42:32 | 11.79 | * |
| 01/21/93 | 10:43:02 | 11.81 | * |
| 01/21/93 | 10:43:32 | 11.79 | * |
| 01/21/93 | 10:44:02 | 11.81 | * |
| 01/21/93 | 10:44:32 | 11.81 | * |
| 01/21/93 | 10:45:02 | 11.83 | * |
| 01/21/93 | 10:45:32 | 11.83 | * |
| 01/21/93 | 10:46:02 | 11.81 | * |
| 01/21/93 | 10:46:32 | 11.81 | * |
| 01/21/93 | 10:47:02 | 11.81 | * |
| 01/21/93 | 10:47:32 | 11.83 | * |
| 01/21/93 | 10:48:02 | 11.81 | * |
| 01/21/93 | 10:48:32 | 11.79 | * |
| 01/21/93 | 10:49:02 | 11.86 | * |
| 01/21/93 | 10:49:32 | 11.81 | * |
| 01/21/93 | 10:50:02 | 11.83 | * |
| 01/21/93 | 10:50:32 | 11.81 | * |
| 01/21/93 | 10:51:02 | 11.86 | * |
| 01/21/93 | 10:51:32 | 11.83 | * |
| 01/21/93 | 10:52:02 | 11.86 | * |
| 01/21/93 | 10:52:32 | 11.83 | * |
| 01/21/93 | 10:53:02 | 11.81 | * |
| 01/21/93 | 10:53:32 | 11.81 | * |
| 01/21/93 | 10:54:02 | 11.83 | * |
| 01/21/93 | 10:54:32 | 11.83 | * |
| 01/21/93 | 10:55:02 | 11.83 | * |
| 01/21/93 | 10:55:32 | 11.86 | * |
| 01/21/93 | 10:56:02 | 11.86 | * |
| 01/21/93 | 10:56:32 | 11.83 | * |
| 01/21/93 | 10:57:02 | 11.86 | * |
| 01/21/93 | 10:57:32 | 11.81 | * |
| 01/21/93 | 10:58:02 | 11.86 | * |
| 01/21/93 | 10:58:32 | 11.83 | * |
| 01/21/93 | 10:59:02 | 11.83 | * |
| 01/21/93 | 10:59:32 | 11.88 | * |
| 01/21/93 | 11:00:02 | 11.83 | * |
| 01/21/93 | 11:00:32 | 11.88 | * |
| 01/21/93 | 11:01:02 | 11.88 | * |
| 01/21/93 | 11:01:32 | 11.81 | * |
| 01/21/93 | 11:02:02 | 11.83 | * |
| 01/21/93 | 11:02:32 | 11.81 | * |

```
01/21/93 11:03:02 11.88          *
01/21/93 11:03:32 11.83        *
01/21/93 11:04:02 11.83        *
01/21/93 11:04:32 11.86         *
01/21/93 11:05:02 11.81       *
01/21/93 11:05:32 11.77     *
01/21/93 11:06:02 11.86         *
01/21/93 11:06:32 11.88          *
01/21/93 11:07:02 11.79      *
01/21/93 11:07:32 11.86         *
01/21/93 11:08:02 11.86         *
01/21/93 11:08:32 11.81       *
01/21/93 11:09:02 11.81       *
01/21/93 11:09:32 11.81       *
01/21/93 11:10:02 11.81       *
01/21/93 11:10:32 11.83        *
01/21/93 11:11:02 11.83        *
01/21/93 11:11:32 11.86         *
01/21/93 11:12:02 11.81       *
01/21/93 11:12:32 11.86         *
01/21/93 11:13:02 11.83        *
01/21/93 11:13:32 11.79      *
01/21/93 11:14:02 11.83        *
01/21/93 11:14:32 11.81       *
01/21/93 11:15:02 11.81       *
01/21/93 11:15:32 11.88          *
01/21/93 11:16:02 11.88          *
01/21/93 11:16:32 11.79      *
01/21/93 11:17:02 11.86         *
01/21/93 11:17:32 11.83        *
01/21/93 11:18:02 11.88          *
01/21/93 11:18:32 11.83        *
01/21/93 11:19:02 11.74    *
01/21/93 11:19:32 11.93             *
01/21/93 11:20:02 11.79      *
01/21/93 11:20:32 11.83        *
01/21/93 11:21:02 11.77     *
01/21/93 11:21:32 11.81       *
01/21/93 11:22:02 11.90           *
01/21/93 11:22:32 11.88          *
01/21/93 11:23:02 11.81       *
01/21/93 11:23:32 11.77     *
01/21/93 11:24:02 11.93             *
01/21/93 11:24:32 11.79      *
01/21/93 11:25:02 11.86         *
01/21/93 11:25:32 11.83        *
01/21/93 11:26:02 11.79      *
01/21/93 11:26:32 11.86         *
01/21/93 11:27:02 11.79      *
01/21/93 11:27:32 11.81       *
01/21/93 11:28:02 11.79      *
01/21/93 11:28:32 11.83        *
01/21/93 11:29:02 11.81       *
01/21/93 11:29:32 11.90           *
01/21/93 11:30:02 11.86         *
01/21/93 11:30:32 11.93             *
01/21/93 11:31:02 11.79      *
01/21/93 11:31:32 11.70 *
01/21/93 11:32:02 11.81       *
01/21/93 11:32:32 11.88          *
```

| | | | |
|---|---|---|---|
| 01/21/93 | 11:33:02 | 11.86 | * |
| 01/21/93 | 11:33:32 | 11.88 | * |
| 01/21/93 | 11:34:02 | 11.88 | * |
| 01/21/93 | 11:34:32 | 11.79 | * |
| 01/21/93 | 11:35:02 | 11.74 | * |
| 01/21/93 | 11:35:32 | 11.95 | * |
| 01/21/93 | 11:36:02 | 11.86 | * |
| 01/21/93 | 11:36:32 | 11.74 | * |
| 01/21/93 | 11:37:02 | 11.79 | * |
| 01/21/93 | 11:37:32 | 11.86 | * |
| 01/21/93 | 11:38:02 | 11.93 | * |
| 01/21/93 | 11:38:32 | 11.72 | * |
| 01/21/93 | 11:39:02 | 11.81 | * |
| 01/21/93 | 11:39:32 | 12.00 | * |
| 01/21/93 | 11:40:02 | 11.70 | * |
| 01/21/93 | 11:40:32 | 11.83 | * |
| 01/21/93 | 11:41:02 | 11.88 | * |
| 01/21/93 | 11:41:32 | 11.81 | * |
| 01/21/93 | 11:42:02 | 11.81 | * |
| 01/21/93 | 11:42:32 | 11.90 | * |
| 01/21/93 | 11:43:02 | 11.77 | * |
| 01/21/93 | 11:43:32 | 11.86 | * |
| 01/21/93 | 11:44:02 | 11.72 | * |
| 01/21/93 | 11:44:32 | 11.81 | * |
| 01/21/93 | 11:45:02 | 11.83 | * |
| 01/21/93 | 11:45:32 | 11.86 | * |
| 01/21/93 | 11:46:02 | 11.83 | * |
| 01/21/93 | 11:46:32 | 11.86 | * |
| 01/21/93 | 11:47:02 | 11.86 | * |
| 01/21/93 | 11:47:32 | 11.88 | * |
| 01/21/93 | 11:48:02 | 11.86 | * |
| 01/21/93 | 11:48:32 | 11.83 | * |
| 01/21/93 | 11:49:02 | 11.77 | * |
| 01/21/93 | 11:49:32 | 11.86 | * |
| 01/21/93 | 11:50:02 | 11.81 | * |
| 01/21/93 | 11:50:32 | 11.86 | * |
| 01/21/93 | 11:51:02 | 11.86 | * |
| 01/21/93 | 11:51:32 | 11.83 | * |
| 01/21/93 | 11:52:02 | 11.81 | * |
| 01/21/93 | 11:52:32 | 11.86 | * |
| 01/21/93 | 11:53:02 | 11.81 | * |
| 01/21/93 | 11:53:32 | 11.81 | * |
| 01/21/93 | 11:54:02 | 11.83 | * |
| 01/21/93 | 11:54:32 | 11.83 | * |
| 01/21/93 | 11:55:02 | 11.83 | * |
| 01/21/93 | 11:55:32 | 11.86 | * |
| 01/21/93 | 11:56:02 | 11.83 | * |
| 01/21/93 | 11:56:32 | 11.86 | * |
| 01/21/93 | 11:57:02 | 11.81 | * |

GW-62D RK

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 12:07:51 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:30 Amount of data recorded: 02:28:00
Storage Capacity: 6512 values records: 2 days 06:16:00
Output compressed by a factor of 1

| Date | Time | Avg |
|---|---|---|
| 01/21/93 | 09:39:32 | 12.62 |
| 01/21/93 | 09:40:02 | 12.62 |
| 01/21/93 | 09:40:32 | 12.62 |
| 01/21/93 | 09:41:02 | 12.09 |
| 01/21/93 | 09:41:32 | 11.81 |
| 01/21/93 | 09:42:02 | 11.79 |
| 01/21/93 | 09:42:32 | 11.79 |
| 01/21/93 | 09:43:02 | 11.79 |
| 01/21/93 | 09:43:32 | 11.83 |
| 01/21/93 | 09:44:02 | 11.79 |
| 01/21/93 | 09:44:32 | 11.79 |
| 01/21/93 | 09:45:02 | 11.81 |
| 01/21/93 | 09:45:32 | 11.77 |
| 01/21/93 | 09:46:02 | 11.83 |
| 01/21/93 | 09:46:32 | 11.81 |
| 01/21/93 | 09:47:02 | 11.81 |
| 01/21/93 | 09:47:32 | 11.81 |
| 01/21/93 | 09:48:02 | 11.79 |
| 01/21/93 | 09:48:32 | 11.79 |
| 01/21/93 | 09:49:02 | 11.79 |
| 01/21/93 | 09:49:32 | 11.79 |
| 01/21/93 | 09:50:02 | 11.79 |
| 01/21/93 | 09:50:32 | 11.81 |
| 01/21/93 | 09:51:02 | 11.79 |
| 01/21/93 | 09:51:32 | 11.79 |
| 01/21/93 | 09:52:02 | 11.81 |
| 01/21/93 | 09:52:32 | 11.79 |
| 01/21/93 | 09:53:02 | 11.77 |
| 01/21/93 | 09:53:32 | 11.79 |
| 01/21/93 | 09:54:02 | 11.79 |
| 01/21/93 | 09:54:32 | 11.81 |
| 01/21/93 | 09:55:02 | 11.81 |
| 01/21/93 | 09:55:32 | 11.81 |
| 01/21/93 | 09:56:02 | 11.81 |
| 01/21/93 | 09:56:32 | 11.79 |
| 01/21/93 | 09:57:02 | 11.79 |
| 01/21/93 | 09:57:32 | 11.83 |
| 01/21/93 | 09:58:02 | 11.79 |
| 01/21/93 | 09:58:32 | 11.77 |
| 01/21/93 | 09:59:02 | 11.81 |
| 01/21/93 | 09:59:32 | 11.79 |
| 01/21/93 | 10:00:02 | 11.79 |
| 01/21/93 | 10:00:32 | 11.79 |
| 01/21/93 | 10:01:02 | 11.83 |
| 01/21/93 | 10:01:32 | 11.79 |
| 01/21/93 | 10:02:02 | 11.83 |
| 01/21/93 | 10:02:32 | 11.79 |

| | | | |
|---|---|---|---|
| 01/21/93 | 10:03:02 | 11.81 | * |
| 01/21/93 | 10:03:32 | 11.81 | * |
| 01/21/93 | 10:04:02 | 11.79 | * |
| 01/21/93 | 10:04:32 | 11.81 | * |
| 01/21/93 | 10:05:02 | 11.79 | * |
| 01/21/93 | 10:05:32 | 11.83 | * |
| 01/21/93 | 10:06:02 | 11.79 | * |
| 01/21/93 | 10:06:32 | 11.83 | * |
| 01/21/93 | 10:07:02 | 11.77 | * |
| 01/21/93 | 10:07:32 | 11.81 | * |
| 01/21/93 | 10:08:02 | 11.83 | * |
| 01/21/93 | 10:08:32 | 11.79 | * |
| 01/21/93 | 10:09:02 | 11.81 | * |
| 01/21/93 | 10:09:32 | 11.81 | * |
| 01/21/93 | 10:10:02 | 11.81 | * |
| 01/21/93 | 10:10:32 | 11.79 | * |
| 01/21/93 | 10:11:02 | 11.79 | * |
| 01/21/93 | 10:11:32 | 11.77 | * |
| 01/21/93 | 10:12:02 | 11.79 | * |
| 01/21/93 | 10:12:32 | 11.77 | * |
| 01/21/93 | 10:13:02 | 11.79 | * |
| 01/21/93 | 10:13:32 | 11.81 | * |
| 01/21/93 | 10:14:02 | 11.79 | * |
| 01/21/93 | 10:14:32 | 11.79 | * |
| 01/21/93 | 10:15:02 | 11.81 | * |
| 01/21/93 | 10:15:32 | 11.79 | * |
| 01/21/93 | 10:16:02 | 11.79 | * |
| 01/21/93 | 10:16:32 | 11.83 | * |
| 01/21/93 | 10:17:02 | 11.81 | * |
| 01/21/93 | 10:17:32 | 11.81 | * |
| 01/21/93 | 10:18:02 | 11.81 | * |
| 01/21/93 | 10:18:32 | 11.81 | * |
| 01/21/93 | 10:19:02 | 11.81 | * |
| 01/21/93 | 10:19:32 | 11.79 | * |
| 01/21/93 | 10:20:02 | 11.83 | * |
| 01/21/93 | 10:20:32 | 11.74 | * |
| 01/21/93 | 10:21:02 | 11.81 | * |
| 01/21/93 | 10:21:32 | 11.81 | * |
| 01/21/93 | 10:22:02 | 11.79 | * |
| 01/21/93 | 10:22:32 | 11.81 | * |
| 01/21/93 | 10:23:02 | 11.81 | * |
| 01/21/93 | 10:23:32 | 11.79 | * |
| 01/21/93 | 10:24:02 | 11.79 | * |
| 01/21/93 | 10:24:32 | 11.79 | * |
| 01/21/93 | 10:25:02 | 11.81 | * |
| 01/21/93 | 10:25:32 | 11.81 | * |
| 01/21/93 | 10:26:02 | 11.81 | * |
| 01/21/93 | 10:26:32 | 11.83 | * |
| 01/21/93 | 10:27:02 | 11.81 | * |
| 01/21/93 | 10:27:32 | 11.79 | * |
| 01/21/93 | 10:28:02 | 11.81 | * |
| 01/21/93 | 10:28:32 | 11.81 | * |
| 01/21/93 | 10:29:02 | 11.86 | * |
| 01/21/93 | 10:29:32 | 11.81 | * |
| 01/21/93 | 10:30:02 | 11.83 | * |
| 01/21/93 | 10:30:32 | 11.81 | * |
| 01/21/93 | 10:31:02 | 11.81 | * |
| 01/21/93 | 10:31:32 | 11.79 | * |
| 01/21/93 | 10:32:02 | 11.83 | * |
| 01/21/93 | 10:32:32 | 11.81 | * |

| | | | |
|---|---|---|---|
| 01/21/93 | 10:33:02 | 11.83 | * |
| 01/21/93 | 10:33:32 | 11.79 | * |
| 01/21/93 | 10:34:02 | 11.86 | * |
| 01/21/93 | 10:34:32 | 11.81 | * |
| 01/21/93 | 10:35:02 | 11.79 | * |
| 01/21/93 | 10:35:32 | 11.81 | * |
| 01/21/93 | 10:36:02 | 11.83 | * |
| 01/21/93 | 10:36:32 | 11.79 | * |
| 01/21/93 | 10:37:02 | 11.81 | * |
| 01/21/93 | 10:37:32 | 11.81 | * |
| 01/21/93 | 10:38:02 | 11.79 | * |
| 01/21/93 | 10:38:32 | 11.79 | * |
| 01/21/93 | 10:39:02 | 11.79 | * |
| 01/21/93 | 10:39:32 | 11.83 | * |
| 01/21/93 | 10:40:02 | 11.81 | * |
| 01/21/93 | 10:40:32 | 11.79 | * |
| 01/21/93 | 10:41:02 | 11.83 | * |
| 01/21/93 | 10:41:32 | 11.81 | * |
| 01/21/93 | 10:42:02 | 11.81 | * |
| 01/21/93 | 10:42:32 | 11.79 | * |
| 01/21/93 | 10:43:02 | 11.81 | * |
| 01/21/93 | 10:43:32 | 11.79 | * |
| 01/21/93 | 10:44:02 | 11.81 | * |
| 01/21/93 | 10:44:32 | 11.81 | * |
| 01/21/93 | 10:45:02 | 11.83 | * |
| 01/21/93 | 10:45:32 | 11.83 | * |
| 01/21/93 | 10:46:02 | 11.81 | * |
| 01/21/93 | 10:46:32 | 11.81 | * |
| 01/21/93 | 10:47:02 | 11.81 | * |
| 01/21/93 | 10:47:32 | 11.83 | * |
| 01/21/93 | 10:48:02 | 11.81 | * |
| 01/21/93 | 10:48:32 | 11.79 | * |
| 01/21/93 | 10:49:02 | 11.86 | * |
| 01/21/93 | 10:49:32 | 11.81 | * |
| 01/21/93 | 10:50:02 | 11.83 | * |
| 01/21/93 | 10:50:32 | 11.81 | * |
| 01/21/93 | 10:51:02 | 11.86 | * |
| 01/21/93 | 10:51:32 | 11.83 | * |
| 01/21/93 | 10:52:02 | 11.86 | * |
| 01/21/93 | 10:52:32 | 11.83 | * |
| 01/21/93 | 10:53:02 | 11.81 | * |
| 01/21/93 | 10:53:32 | 11.81 | * |
| 01/21/93 | 10:54:02 | 11.83 | * |
| 01/21/93 | 10:54:32 | 11.83 | * |
| 01/21/93 | 10:55:02 | 11.83 | * |
| 01/21/93 | 10:55:32 | 11.86 | * |
| 01/21/93 | 10:56:02 | 11.86 | * |
| 01/21/93 | 10:56:32 | 11.83 | * |
| 01/21/93 | 10:57:02 | 11.86 | * |
| 01/21/93 | 10:57:32 | 11.81 | * |
| 01/21/93 | 10:58:02 | 11.86 | * |
| 01/21/93 | 10:58:32 | 11.83 | * |
| 01/21/93 | 10:59:02 | 11.83 | * |
| 01/21/93 | 10:59:32 | 11.88 | * |
| 01/21/93 | 11:00:02 | 11.83 | * |
| 01/21/93 | 11:00:32 | 11.88 | * |
| 01/21/93 | 11:01:02 | 11.88 | * |
| 01/21/93 | 11:01:32 | 11.81 | * |
| 01/21/93 | 11:02:02 | 11.83 | * |
| 01/21/93 | 11:02:32 | 11.81 | * |

| | | | |
|---|---|---|---|
| 01/21/93 | 11:03:02 | 11.88 | * |
| 01/21/93 | 11:03:32 | 11.83 | * |
| 01/21/93 | 11:04:02 | 11.83 | * |
| 01/21/93 | 11:04:32 | 11.86 | * |
| 01/21/93 | 11:05:02 | 11.81 | * |
| 01/21/93 | 11:05:32 | 11.77 | * |
| 01/21/93 | 11:06:02 | 11.86 | * |
| 01/21/93 | 11:06:32 | 11.88 | * |
| 01/21/93 | 11:07:02 | 11.79 | * |
| 01/21/93 | 11:07:32 | 11.86 | * |
| 01/21/93 | 11:08:02 | 11.86 | * |
| 01/21/93 | 11:08:32 | 11.81 | * |
| 01/21/93 | 11:09:02 | 11.81 | * |
| 01/21/93 | 11:09:32 | 11.81 | * |
| 01/21/93 | 11:10:02 | 11.81 | * |
| 01/21/93 | 11:10:32 | 11.83 | * |
| 01/21/93 | 11:11:02 | 11.83 | * |
| 01/21/93 | 11:11:32 | 11.86 | * |
| 01/21/93 | 11:12:02 | 11.81 | * |
| 01/21/93 | 11:12:32 | 11.86 | * |
| 01/21/93 | 11:13:02 | 11.83 | * |
| 01/21/93 | 11:13:32 | 11.79 | * |
| 01/21/93 | 11:14:02 | 11.83 | * |
| 01/21/93 | 11:14:32 | 11.81 | * |
| 01/21/93 | 11:15:02 | 11.81 | * |
| 01/21/93 | 11:15:32 | 11.88 | * |
| 01/21/93 | 11:16:02 | 11.88 | * |
| 01/21/93 | 11:16:32 | 11.79 | * |
| 01/21/93 | 11:17:02 | 11.86 | * |
| 01/21/93 | 11:17:32 | 11.83 | * |
| 01/21/93 | 11:18:02 | 11.88 | * |
| 01/21/93 | 11:18:32 | 11.83 | * |
| 01/21/93 | 11:19:02 | 11.74 | * |
| 01/21/93 | 11:19:32 | 11.93 | * |
| 01/21/93 | 11:20:02 | 11.79 | * |
| 01/21/93 | 11:20:32 | 11.83 | * |
| 01/21/93 | 11:21:02 | 11.77 | * |
| 01/21/93 | 11:21:32 | 11.81 | * |
| 01/21/93 | 11:22:02 | 11.90 | * |
| 01/21/93 | 11:22:32 | 11.88 | * |
| 01/21/93 | 11:23:02 | 11.81 | * |
| 01/21/93 | 11:23:32 | 11.77 | * |
| 01/21/93 | 11:24:02 | 11.93 | * |
| 01/21/93 | 11:24:32 | 11.79 | * |
| 01/21/93 | 11:25:02 | 11.86 | * |
| 01/21/93 | 11:25:32 | 11.83 | * |
| 01/21/93 | 11:26:02 | 11.79 | * |
| 01/21/93 | 11:26:32 | 11.86 | * |
| 01/21/93 | 11:27:02 | 11.79 | * |
| 01/21/93 | 11:27:32 | 11.81 | * |
| 01/21/93 | 11:28:02 | 11.79 | * |
| 01/21/93 | 11:28:32 | 11.83 | * |
| 01/21/93 | 11:29:02 | 11.81 | * |
| 01/21/93 | 11:29:32 | 11.90 | * |
| 01/21/93 | 11:30:02 | 11.86 | * |
| 01/21/93 | 11:30:32 | 11.93 | * |
| 01/21/93 | 11:31:02 | 11.79 | * |
| 01/21/93 | 11:31:32 | 11.70 | * |
| 01/21/93 | 11:32:02 | 11.81 | * |
| 01/21/93 | 11:32:32 | 11.88 | * |

| | | | |
|---|---|---|---|
| 01/21/93 | 11:33:02 | 11.86 | * |
| 01/21/93 | 11:33:32 | 11.88 | * |
| 01/21/93 | 11:34:02 | 11.88 | * |
| 01/21/93 | 11:34:32 | 11.79 | * |
| 01/21/93 | 11:35:02 | 11.74 | * |
| 01/21/93 | 11:35:32 | 11.95 | * |
| 01/21/93 | 11:36:02 | 11.86 | * |
| 01/21/93 | 11:36:32 | 11.74 | * |
| 01/21/93 | 11:37:02 | 11.79 | * |
| 01/21/93 | 11:37:32 | 11.86 | * |
| 01/21/93 | 11:38:02 | 11.93 | * |
| 01/21/93 | 11:38:32 | 11.72 | * |
| 01/21/93 | 11:39:02 | 11.81 | * |
| 01/21/93 | 11:39:32 | 12.00 | * |
| 01/21/93 | 11:40:02 | 11.70 | * |
| 01/21/93 | 11:40:32 | 11.83 | * |
| 01/21/93 | 11:41:02 | 11.88 | * |
| 01/21/93 | 11:41:32 | 11.81 | * |
| 01/21/93 | 11:42:02 | 11.81 | * |
| 01/21/93 | 11:42:32 | 11.90 | * |
| 01/21/93 | 11:43:02 | 11.77 | * |
| 01/21/93 | 11:43:32 | 11.86 | * |
| 01/21/93 | 11:44:02 | 11.72 | * |
| 01/21/93 | 11:44:32 | 11.81 | * |
| 01/21/93 | 11:45:02 | 11.83 | * |
| 01/21/93 | 11:45:32 | 11.86 | * |
| 01/21/93 | 11:46:02 | 11.83 | * |
| 01/21/93 | 11:46:32 | 11.86 | * |
| 01/21/93 | 11:47:02 | 11.86 | * |
| 01/21/93 | 11:47:32 | 11.88 | * |
| 01/21/93 | 11:48:02 | 11.86 | * |
| 01/21/93 | 11:48:32 | 11.83 | * |
| 01/21/93 | 11:49:02 | 11.77 | * |
| 01/21/93 | 11:49:32 | 11.86 | * |
| 01/21/93 | 11:50:02 | 11.81 | * |
| 01/21/93 | 11:50:32 | 11.86 | * |
| 01/21/93 | 11:51:02 | 11.86 | * |
| 01/21/93 | 11:51:32 | 11.83 | * |
| 01/21/93 | 11:52:02 | 11.81 | * |
| 01/21/93 | 11:52:32 | 11.86 | * |
| 01/21/93 | 11:53:02 | 11.81 | * |
| 01/21/93 | 11:53:32 | 11.81 | * |
| 01/21/93 | 11:54:02 | 11.83 | * |
| 01/21/93 | 11:54:32 | 11.83 | * |
| 01/21/93 | 11:55:02 | 11.83 | * |
| 01/21/93 | 11:55:32 | 11.86 | * |
| 01/21/93 | 11:56:02 | 11.83 | * |
| 01/21/93 | 11:56:32 | 11.86 | * |
| 01/21/93 | 11:57:02 | 11.81 | * |
| 01/21/93 | 11:57:32 | 11.83 | * |
| 01/21/93 | 11:58:02 | 11.81 | * |
| 01/21/93 | 11:58:32 | 11.86 | * |
| 01/21/93 | 11:59:02 | 11.86 | * |
| 01/21/93 | 11:59:32 | 11.83 | * |
| 01/21/93 | 12:00:02 | 11.83 | * |
| 01/21/93 | 12:00:32 | 11.86 | * |
| 01/21/93 | 12:01:02 | 11.86 | * |
| 01/21/93 | 12:01:32 | 11.83 | * |
| 01/21/93 | 12:02:02 | 11.86 | * |
| 01/21/93 | 12:02:32 | 11.83 | * |

```
01/21/93 12:03:02 11.83        *
01/21/93 12:03:32 11.86         *
01/21/93 12:04:02 11.86         *
01/21/93 12:04:32 11.86         *
01/21/93 12:05:02 12.55                                    *
01/21/93 12:05:32 12.64                                         *
01/21/93 12:06:02 12.64                                         *
01/21/93 12:06:32 12.67                                          *
01/21/93 12:07:02 12.67                                          *
```

# APPENDIX G

# APPENDIX G

# HAGER-RICHTER EM/TEMPERATURE LOGGING REPORTS

# BOREHOLE GEOPHYSICAL SURVEY II
# OLIN CORPORATION SITE
# WILMINGTON, MASSACHUSETTS

HAGER-RICHTER
GEOSCIENCE, INC.

**Consultants in Geology & Geophysics**

HAGER-RICHTER
GEOSCIENCE, INC.

# BOREHOLE GEOPHYSICAL SURVEY II
# OLIN CORPORATION SITE
# WILMINGTON, MASSACHUSETTS

*Prepared for:*

Conestoga-Rovers & Associates, Inc.
1801 Old Highway 8
St. Paul, MN 55112

*Prepared by:*

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 92G29-A
January, 1993

## 0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. conducted borehole geophysical logging in seven monitoring wells in the vicinity of the Olin Corporation Site, Wilmington, Massachusetts in December, 1992 and January, 1993 for Conestoga-Rovers & Associates, Inc. The current logging is an extension of a borehole geophysical survey conducted near the Site by H-R for CRA in August, 1992. The objectives of the borehole logging program were to provide data on: (1) the location and depth of a conductive plume known to be present in the vicinity of the Site, and (2) the depth intervals of productive fractures intersected in three bedrock wells. Conductivity (EM39) logs were obtained for five wells, and dual temperature logs were obtained in three wells drilled into bedrock.

The results of the survey may be summarized as follows:

1. None of the five wells for which conductivity was measured for this Report exhibits zones of elevated conductivity (approximately 360 mmho/m) as were measured in the August, 1992 series and were interpreted to be within the main part of the conductive plume.

2. The conductivity data for the five wells serve to constrain better the location of the plume. Four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) exhibit zones of slightly elevated conductivity (10 to 25 mmho/m), and are interpreted to be located at the fringes of the conductive plume. The fifth well (GW-69D) exhibits a maximum conductivity of about 115 mmho/m at the bottom of the hole, and is located nearer the central part of the conductive plume.

3. The dual temperature logs indicate that water enters GW-62BR at or near the seal at the bottom of the PVC casing, enters GW-68BR at the bottom of the hole, and are inconclusive about where water enters GW-62BRD.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

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## FIGURES


1. Site location
2. Principle of the induction log
3. Productive fracture location with dual temperature logs


## PLATES


1. Site Plan
2. Conductivity logs superimposed on Site Plan


## APPENDIX


Borehole Logs - in pocket

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

# 1. INTRODUCTION

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. of St. Paul, Minnesota to log seven monitoring wells located in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts. The Site is an inactive chemical plant located in a suburban industrial district. The location of the Site is shown in Figure 1.

The borehole logging program is part of a larger hydrogeologic investigation being conducted by CRA. The present survey is an extension of borehole geophysical logging of ten wells conducted at the Site by H-R for CRA in August, 1992.[1]

The wells and types of logs included in the present survey were:

| Well # | Log Type |
|---|---|
| GW-61BR | Conductivity[2] |
| GW-62BR | Dual Temp (Conductivity in August '92 data set) |
| GW-62BRD | Dual Temp |
| GW-67D | Conductivity |
| GW-68BR | Conductivity + Dual Temp |
| GW-69D | Conductivity |
| GW-71D | Conductivity |

The locations of the subject monitoring wells and the wells included in the August survey are shown on the Site Plan (Plate 1). None of the subject monitoring wells is located on the Olin Corporation property.

The objectives of the borehole logging program were to provide data on: (1) the location and depth of a conductive plume known to be present downgradient from the Olin property, and (2) the depth intervals of productive fractures intersected by three bedrock wells. Conductivity logs were obtained for five of the wells. Three of the wells were drilled into bedrock, and dual temperature logs were obtained for those wells.

---

[1] Reference: "Borehole Geophysical Survey, Olin Corporation Site, Wilmington, Massachusetts," H-R report to CRA dated August, 1992.

[2] Dual temperature logs were not run in this well because it was not accessible to the logging truck at the time of temperature logging.

Jeffrey Mann of Hager-Richter conducted the conductivity logging on December 15-17, 1992 and conducted the temperature logging on January 20, 1993. The fieldwork was coordinated with, and observed in part, by Mr. Jon Michels of CRA. Mr. Mark Jeffrey of CRA also observed a portion of the field operations. All fieldwork was conducted under Level D personal protection. Data analysis and interpretation were completed at the Hager-Richter offices. Original data and field notes reside in the Hager-Richter files and will be retained for a minimum of three years.

## 2. PRINCIPLES, EQUIPMENT & PROCEDURES

### 2.1 Conductivity Logs

*2.1.1 General.* The principle of the conductivity log, sometimes referred to as the electromagnetic induction log, is illustrated in Figure 2. An electric current, called an eddy current, is induced in the formation by an electric current in the transmitter coil (Tx), also called a primary coil, located near the top of the probe. The induced current produces a secondary electromagnetic field and a voltage in the receiver coil (Rx), also called a secondary or measuring coil, located near the bottom of the probe. The design of the system, including the geometry and coil characteristics, is such that the voltage in the receiver coil is proportional to the formation conductivity. In addition, the system is so designed and calibrated that the output, after processing, is the conductivity of the formation in units of millimhos per meter, mmho/m (numerically equivalent to the SI units, milliSiemens per meter, or mS/m).

The maximum distance outward from the tool to which the conductivity of the borehole material is measured is about 2 feet. The tool does not need to be immersed in water to obtain accurate data, but it cannot be used in a steel-cased hole.

*2.1.2 Site Specific.* All data were obtained with a Geonics EM39 logging system. This compact, portable system has a winch with a maximum depth capability of 100 meters. The electronics are battery powered. All data were recorded at intervals of 0.1 meter (approximately 4 inches) while the tool was being pulled out of the monitoring well at a rate of about 2 to 3 feet per minute. The data were recorded in digital form with a data logger, transferred to a portable computer in the field, processed in the office, and then plotted using commercially available software.

As recommended in the report for the August, 1992 data set, the conductivity logs for the current data set were run without purging the wells. One well (GW-45D) that had been logged in the August series was re-logged during the present series to ensure reproducibility. The two logs were essentially identical.

After each log was being run, the equipment was decontaminated by washing the downhole portion of the cable and the tool with Alconox soap and rinsing with distilled water.

## 2.2 Dual Temperature Logs

*2.2.1 General.* The principal of the dual temperature log is illustrated in Figure 3. Two temperature logs are run for each well to identify those fractures, or zones, that are productive. The temperature log is the first log run in each well. Water is then removed from the well, either by pumping or bailing. The amount removed depends on the diameter of the well and, to some extent, on the depth. The concept is to remove enough water to lower the water level approximately 30 to 50 feet if there is no inflow. Most wells produce at least some water during the time required to remove the water and set up the equipment to run the second temperature log. Therefore, at the time of running the second temperature log, the actual displacement of the water column is somewhat less than the 30 to 50 feet. Many wells recover completely, and the static water level is about the same for the two temperature logs. The vertical movement of water in the well causes the temperature of the water at most depths to differ from the formation temperature. Because this difference will decrease with time, the temperature should be logged again within an hour. Comparison of the two temperature logs shows where water enters the well.

*2.2.2 Site Specific.* The borehole logging system was a Mount Sopris Series III logging system with a depth capability of 4500 feet. The equipment is mounted in a four wheel drive pickup truck. Data are recorded in both digital and analogue form. The digital data, recorded in the field in a portable computer, were processed in the office using proprietary software and then plotted using commercially available software.

The digital temperature probe of the Series III logging system measures temperature to 0.02 °C precision. For each well, the temperatures were logged at an interval of 0.1 foot from the static water level to the bottom of the well for each well, at a logging speed of about 20 feet/minute.

After each log was completed at the Site, the equipment was decontaminated with the following procedure: each tool and the downhole portion of the cable were washed

using Alconox soap and natural sponges or cotton rags, and rinsed with distilled water.

The pumping schedule between the first and second temperature logs for each of the three bedrock wells at the Olin Site is the following:

Temperature log #1 run.
Well pumped to remove the volume of water equivalent to a column of approximately 50 feet.
Temperature log #2 run.

*Monitoring well GW-62BR.* The schedule for the dual temperature log was the following, where $T_0$ is the time of starting the pump.

| TIME (min) | WATER LEVEL (feet) | COMMENT |
|---|---|---|
| $< T_0$ | | Run 1st temp log |
| $T_0$ | 4.5 | Start pump |
| $T_0 + 25$ | 32.4 | Stop pump |
| $T_0 + 35$ | 29.5 | |
| $T_0 + 80$ | 18.9 | |
| $T_0 + 173$ | 8.3 | |
| $T_0 + 187$ | 8.0 | Run 2nd temp log |

The pump was set at approximately 50 feet depth. A total of 25 gallons of water was pumped from the well, equivalent to a column of about 35 to 40 feet of water.

*Monitoring well GW-62BRD.* The schedule for the dual temperature log was the following, where $T_0$ is the time of starting the pump.

| TIME (min) | WATER LEVEL (feet) | COMMENT |
|---|---|---|
| $< T_0$ | | Run 1st temp log |
| $T_0$ | 4.6 | Start pump |
| $T_0 + 13$ | 48.8 | Stop pump |
| $T_0 + 93$ | 8.1 | |
| $T_0 + 125$ | 7.8 | Run 2nd temp log |

The pump was set at approximately 50 feet depth. A total of 35 gallons of water was pumped from the well, equivalent to a column of about 50 feet of water.

*Monitoring well GW-68BR.* The schedule for the dual emperature log was the following, where $T_0$ is the time of starting the pump.

| TIME (min) | WATER LEVEL (feet) | COMMENT |
|---|---|---|
| $< T_0$ | | Run 1st temp log |
| $T_0$ | 8.1 | Start pumping |
| $T_0 + 60$ | 29.1 | Stop pumping |
| $T_0 + 140$ | 13.4 | Run 2nd temp log |

The pump was set at approximately 30 feet depth. A total of approximately 16 gallons of water was pumped from the well, equivalent to a column of about 25 feet of water.

## 3. RESULTS AND DISCUSSION

### 3.1 General

A copy of each log is located in the Appendix (in pocket) but is not described in detail in the text. All depths are in units of feet and referenced to depth below the ground surface.

### 3.2 Conductivity Logs

The conductivity measured for four (GW-61BR, GW-67D, GW-68BR, and GW-71D) of the five wells included in the present data set varies from about 0 mmho/m to 25 mmho/m. The conductivity measured in the fifth well (GW-69D) was less than 10 mmho/m except for the bottom of the well, where a peak conductivity of 115 mmho/m was measured.

In Plate 2, conductivity logs for the present data set plus the August, 1992 data set are superimposed on a plan of the Olin Corp. Site to show the relationship of each well location to the conductivity profile measured in the well. None of the five wells of the

current data set exhibits as high conductivity measured six wells in the August, 1992 data set (maximum 360 mmho/m). The wells included in the current data set are located north and south of the wells included in the August, 1992 data set, and on the basis of the conductivities measured, we conclude that four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) are located on the fringes of the conductive plume at the Olin Corporation Site. Well GW-69D appears to be located on the flanks of the plume. We conclude, then, that the conductivity measurements of the current data set help constrain the location of the conductive plume near the Olin Corporation Site.

### 3.2 Dual Temperature Logs

Dual temperature logs were obtained in three wells (GW-62BR, GW-62BRD, and GW-68BR). The length of open hole in each bedrock well is limited, and the bedrock is relatively competent, evidenced by the slow rate of recharge after pumping.

For GW-62BR, the open portion of the borehole is from about 77 feet to the bottom at 110 feet. Our interpretation of the dual temperature log is that water is enters the well at 77 feet, the depth of the PVC/bedrock seal. Small amounts of water might be entering the well at about 91 and 97 feet.

For GW-62BRD, the open portion of the borehole is from 105 feet to the bottom of the well at 146 feet. The near-zero geothermal gradient measured between 85 feet and the total depth precludes using the dual temperature logging technique to obtain data on the depth of water entry. This well exhibited a very slow rate of recharge, indicating that bedrock contains no relatively large conductive fracture.

For GW-68BR, the open portion of the borehole is from 25 feet to the bottom of the well at 76 feet. Our interpretation of the dual temperature log for GW-68BR is that water entry is located at or near the bottom of the well.

## 4. CONCLUSIONS

On the basis of the borehole geophysical logs obtained in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts during December, 1992 and January, 1993, we conclude the following:

1. None of the five wells for which conductivity was measured for this Report exhibits zones of elevated conductivity (approximately 360 mmho/m) as were measured in the August, 1992 series and were interpreted to be within the main part of the conductive plume.

2. The conductivity data for the five wells serve to constrain better the location of the plume. Four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) exhibit zones of slightly elevated conductivity (10 to 25 mmho/m), and are interpreted to be located at the fringes of the conductive plume. The fifth well (GW-69D) exhibits a maximum conductivity of about 115 mmho/m at the bottom of the hole, and is located nearer the central part of the conductive plume.

3. The dual temperature logs indicate that water enters GW-62BR at or near the seal at the bottom of the PVC casing, enters GW-68BR at the bottom of the hole, and are inconclusive about where water enters GW-62BRD.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

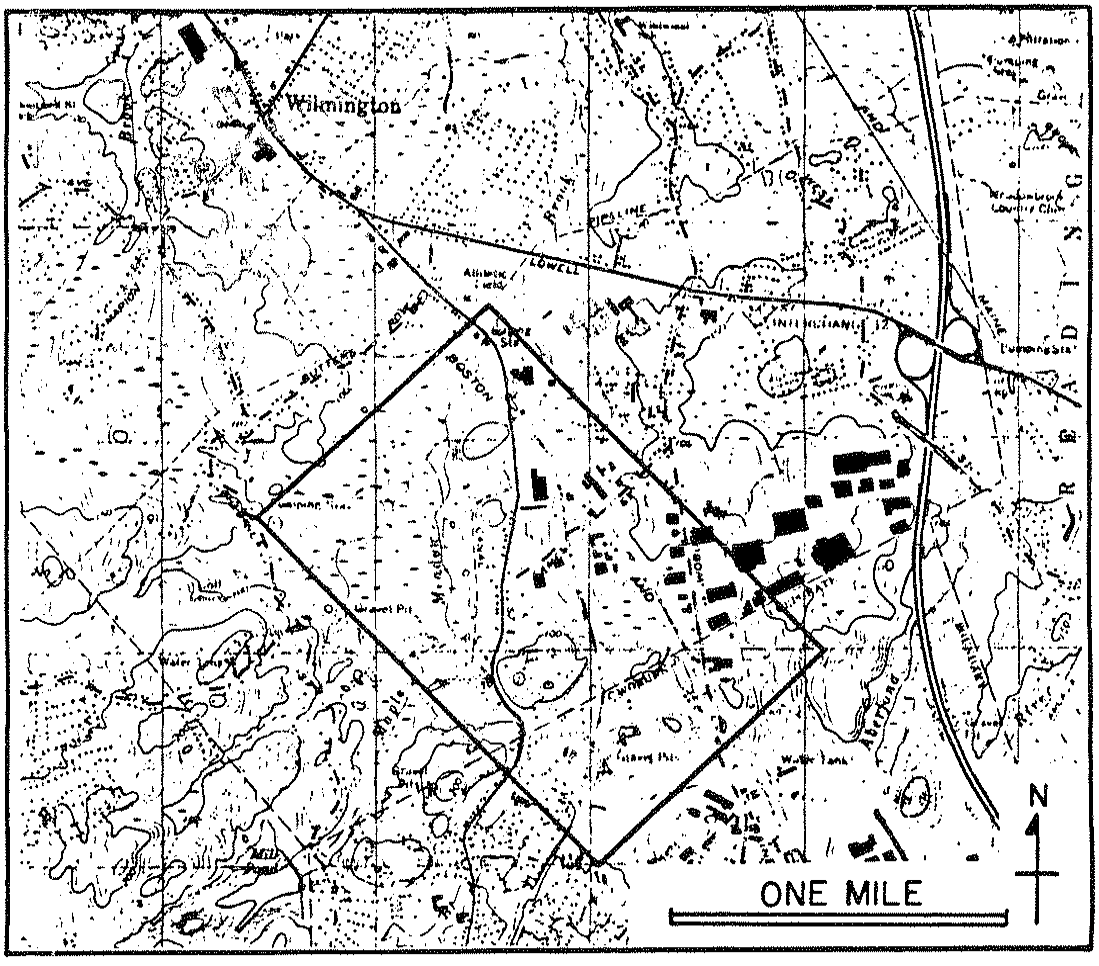


**Figure 1.** Site location. The box outlines the area shown in Plate 1, the Site Plan. Base map Wilmington, Mass. 7 1/2" USGS topographic quadrangle.

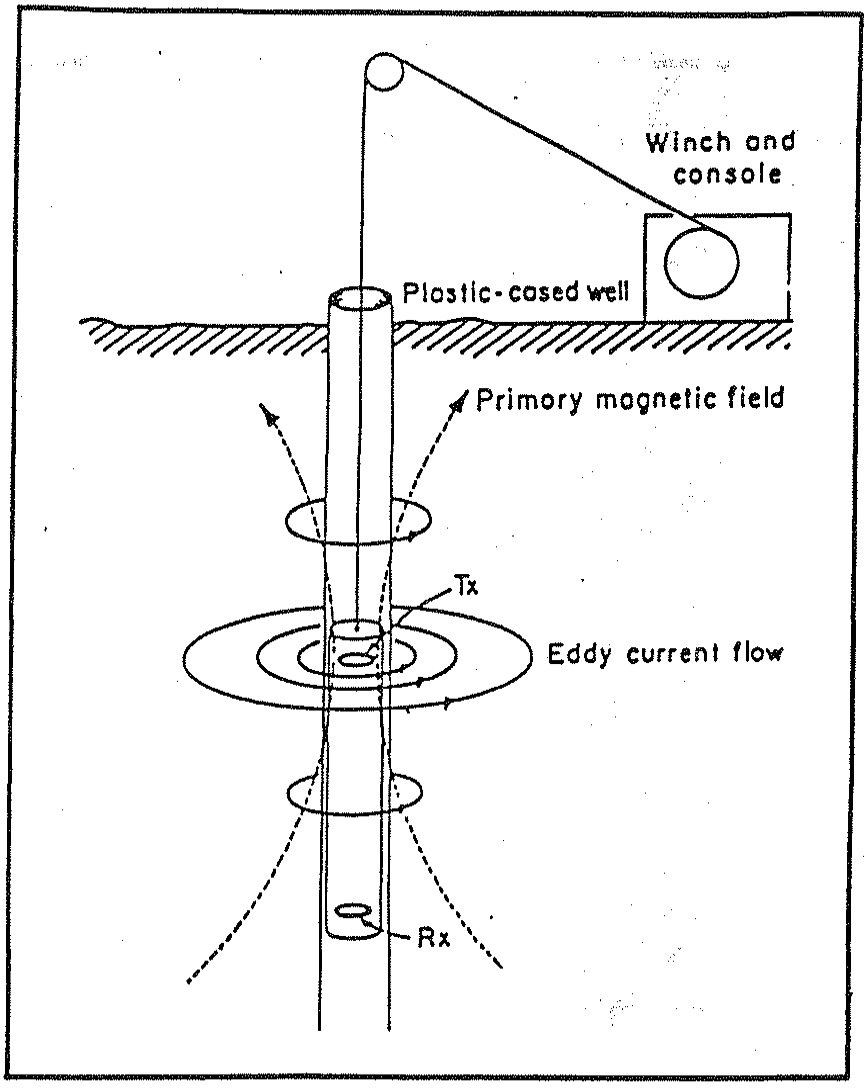


**Figure 2.** Principle of the induction log. Sketch by Geonics.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92[illegible] January, 1993

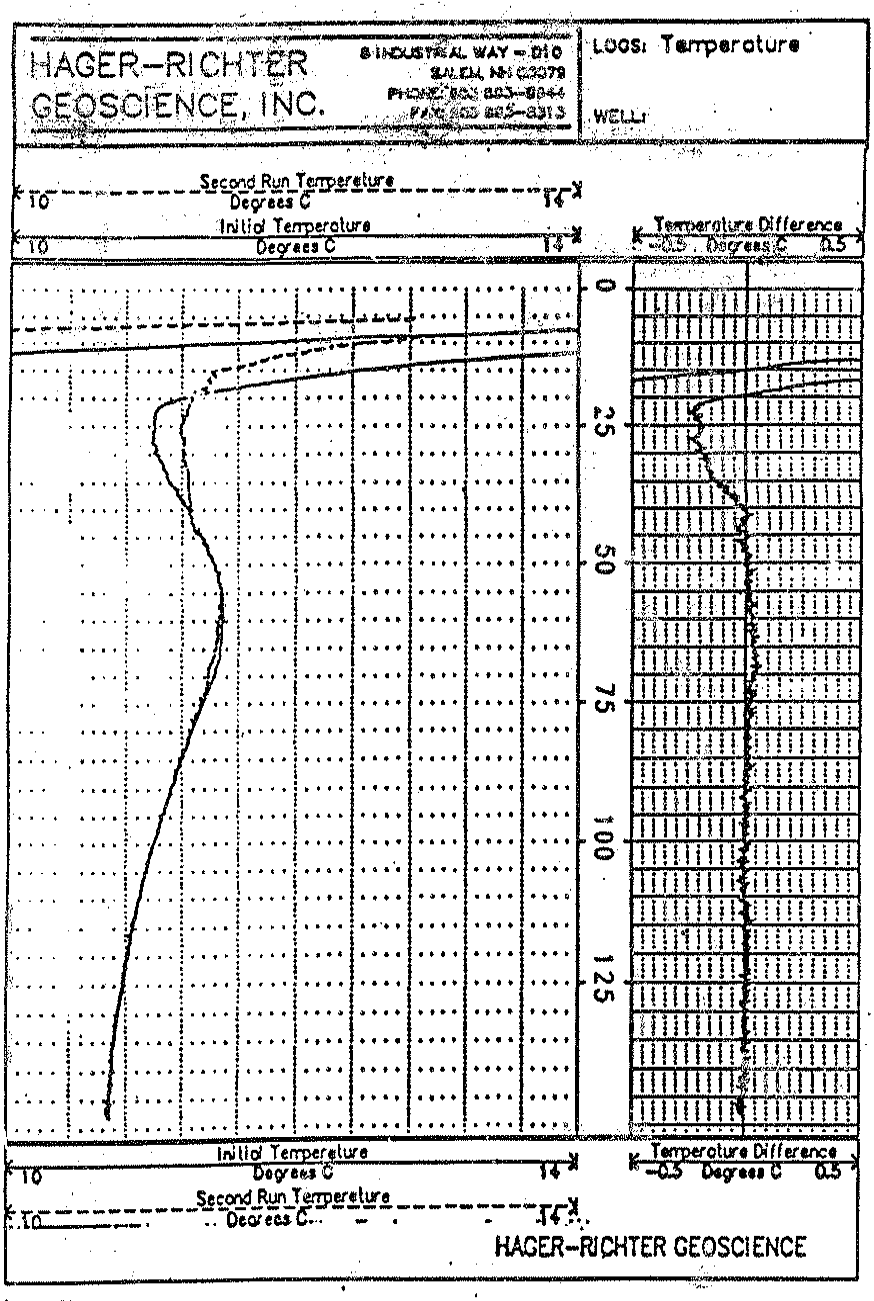


**Figure 3.** Productive fracture location with dual temperature logs. After running the first log, sufficient water is bailed from the well to lower the water level about 30 feet if no water entered the well. The second log was run about 30 minutes later, and the well had fully recharged. The difference log shows that most water entered the well at about 40 feet depth, and about 5 to 10% of the water entered at about 71 feet. Note that the water that entered at 40 feet was warmer than the water being displaced, and the water entering at 71 feet was colder.

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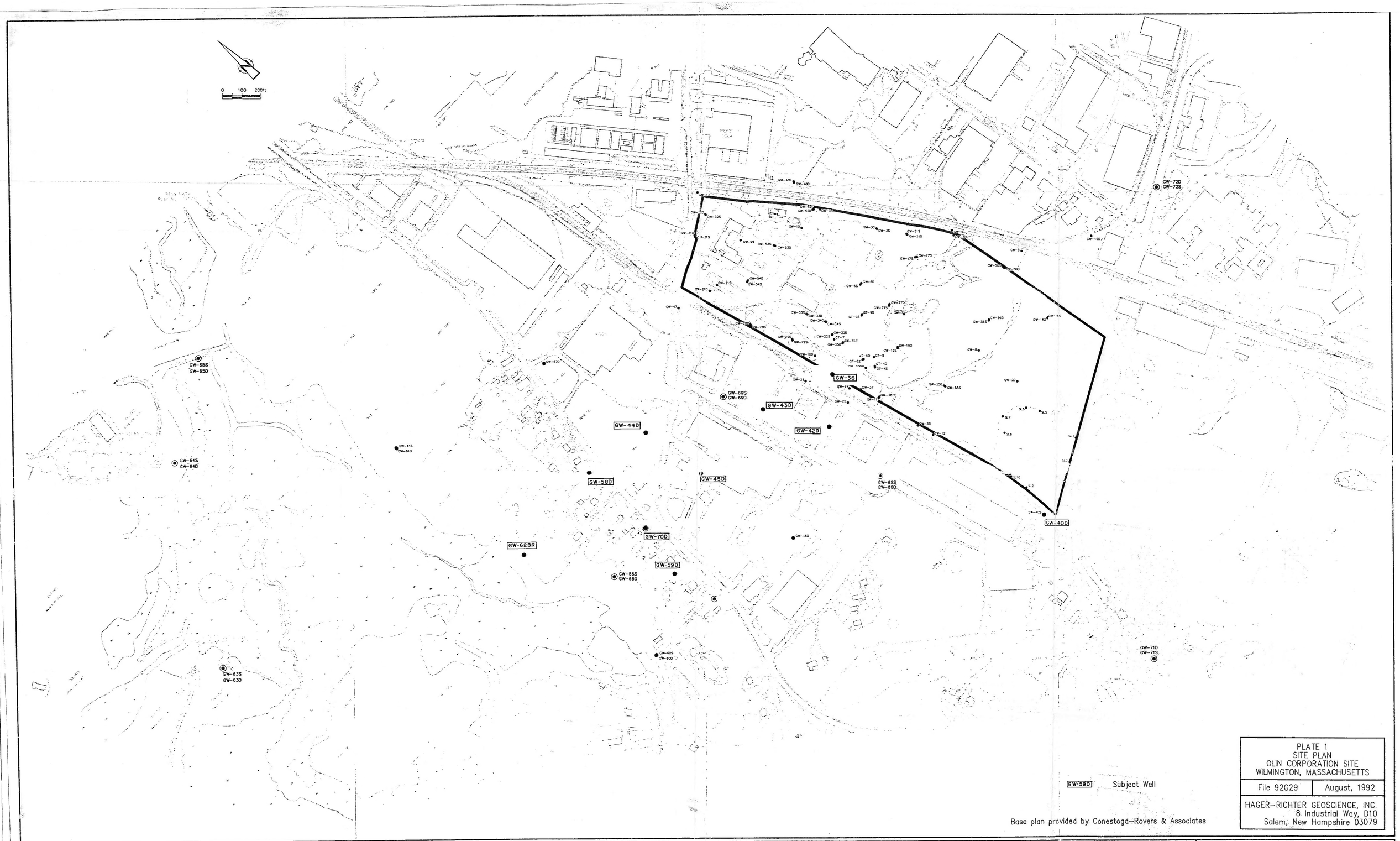



Base plan provided by Conestoga-Rovers & Associates

PLATE 1
SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

| File 92G29 | August, 1992 |
|---|---|

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, New Hampshire 03079

LEGEND

- RAILWAY
- FENCE
- FACILITY BOUNDARY
- GW-570 EXISTING WELL LOCATION
- GW-63S PROPOSED WELL LOCATION

| No. | Revision | Date | Initial |
|---|---|---|---|

Approved

OLIN CORPORATION

WILMINGTON FACILITY

PROPOSED WELL LOCATIONS

**CRA**
**CONESTOGA-ROVERS & ASSOCIATES**

| Drawn by: DKC | Scale: 1" = 200' | Date: JULY 1992 | File No.: 45 (P-50) | Rev.No.: – |
|---|---|---|---|---|
| Designed by: MJ | Field book: | Project No.: 3683 | Drawing No.: 2 | |
| Checked by: MJ | | | | |

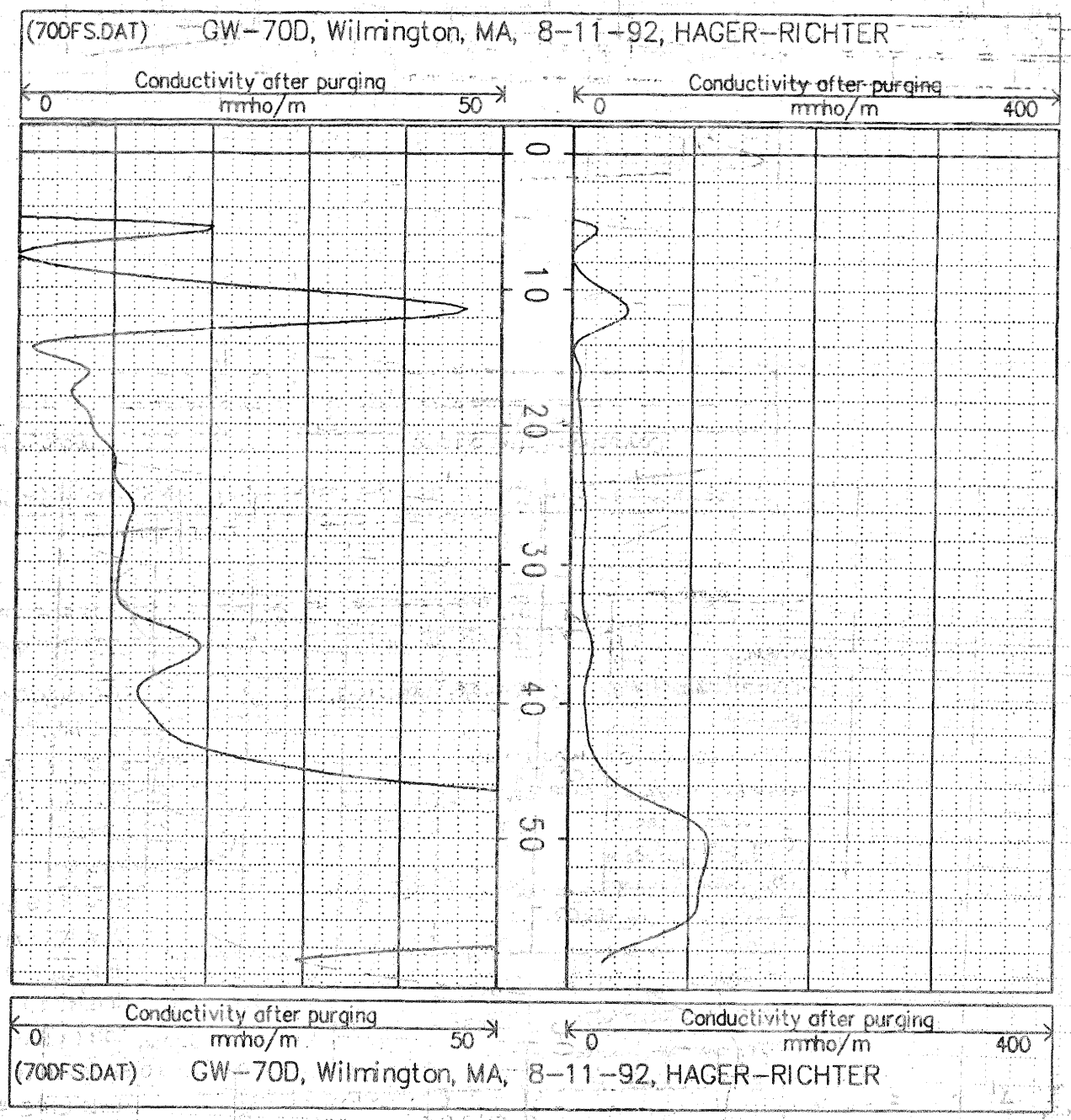
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-70D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 92.3 feet
LOG DATUM: Ground Level
CLIENT TD: 62 feet
H-R TD: 61.08 feet
STATIC WATER LEVEL: 11.74 feet
DEPTH TO BEDROCK: approx. 57 feet



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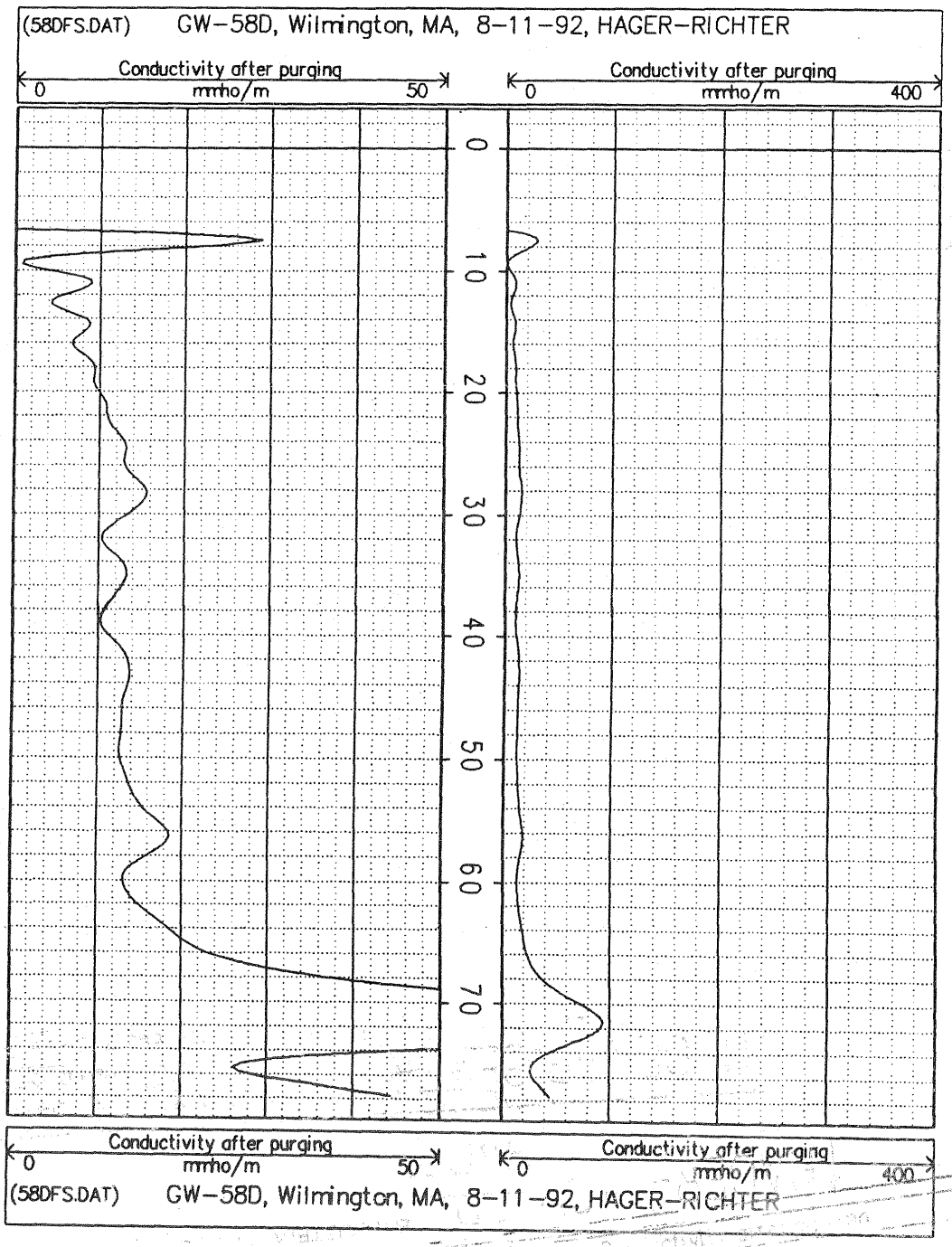
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-58D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

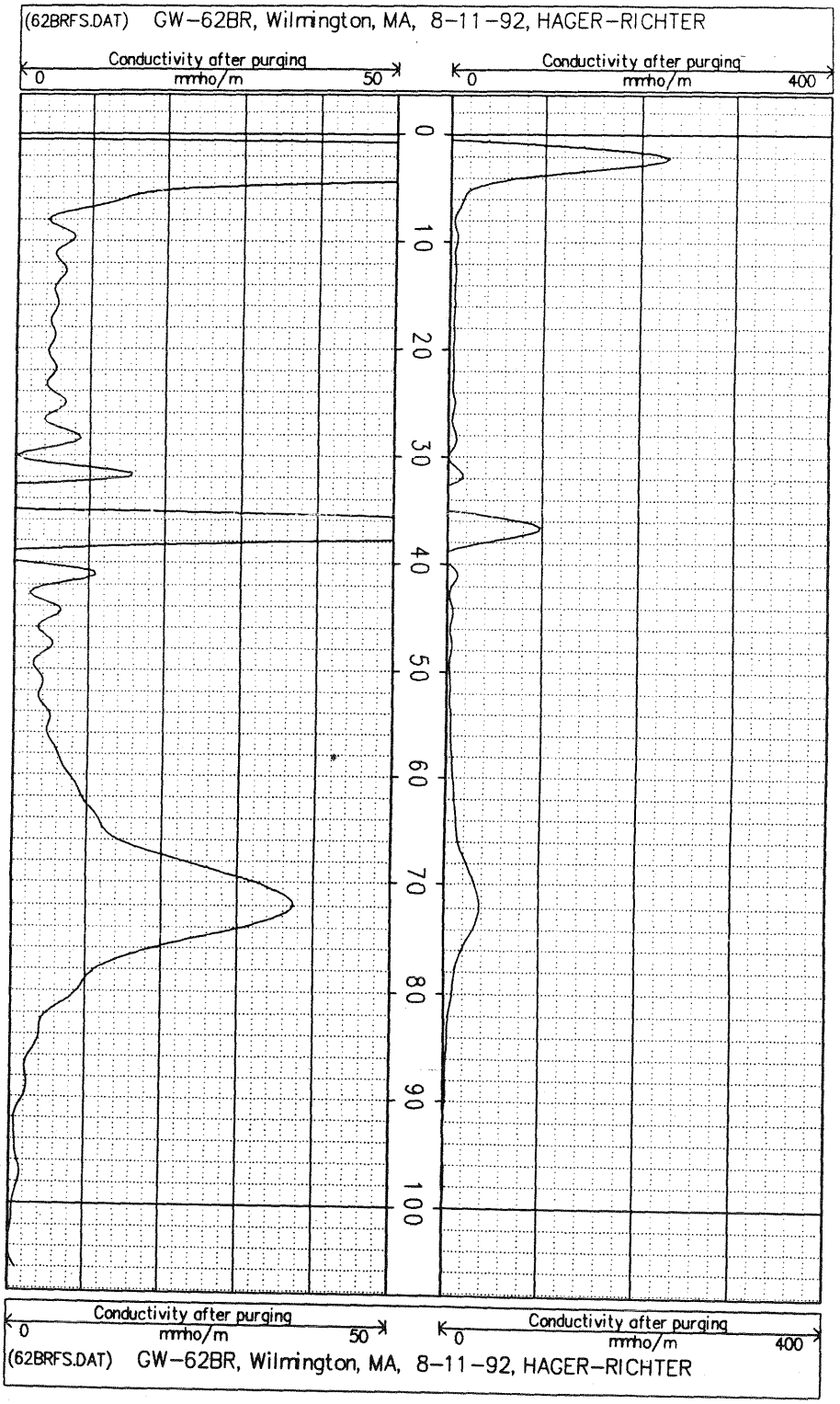
DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 80 feet
H-R TD: 79.91 feet
STATIC WATER LEVEL: 17.9 feet
DEPTH TO BEDROCK: approx. 74 feet



| HAGER-RICHTER GEOSCIENCE, INC. | 8 INDUSTRIAL WAY, UNIT D-10<br>SALEM, NH 03079<br>PHONE: 603 893-9944<br>FAX: 603 893-8313 | CONDUCTIVITY<br><br>WELL: GW-62BR |
|---|---|---|

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 105 feet
H-R TD: 108.19 feet
STATIC WATER LEVEL: 3.84 feet
DEPTH TO BEDROCK: approx. 80 feet



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SALEM, NH 03079
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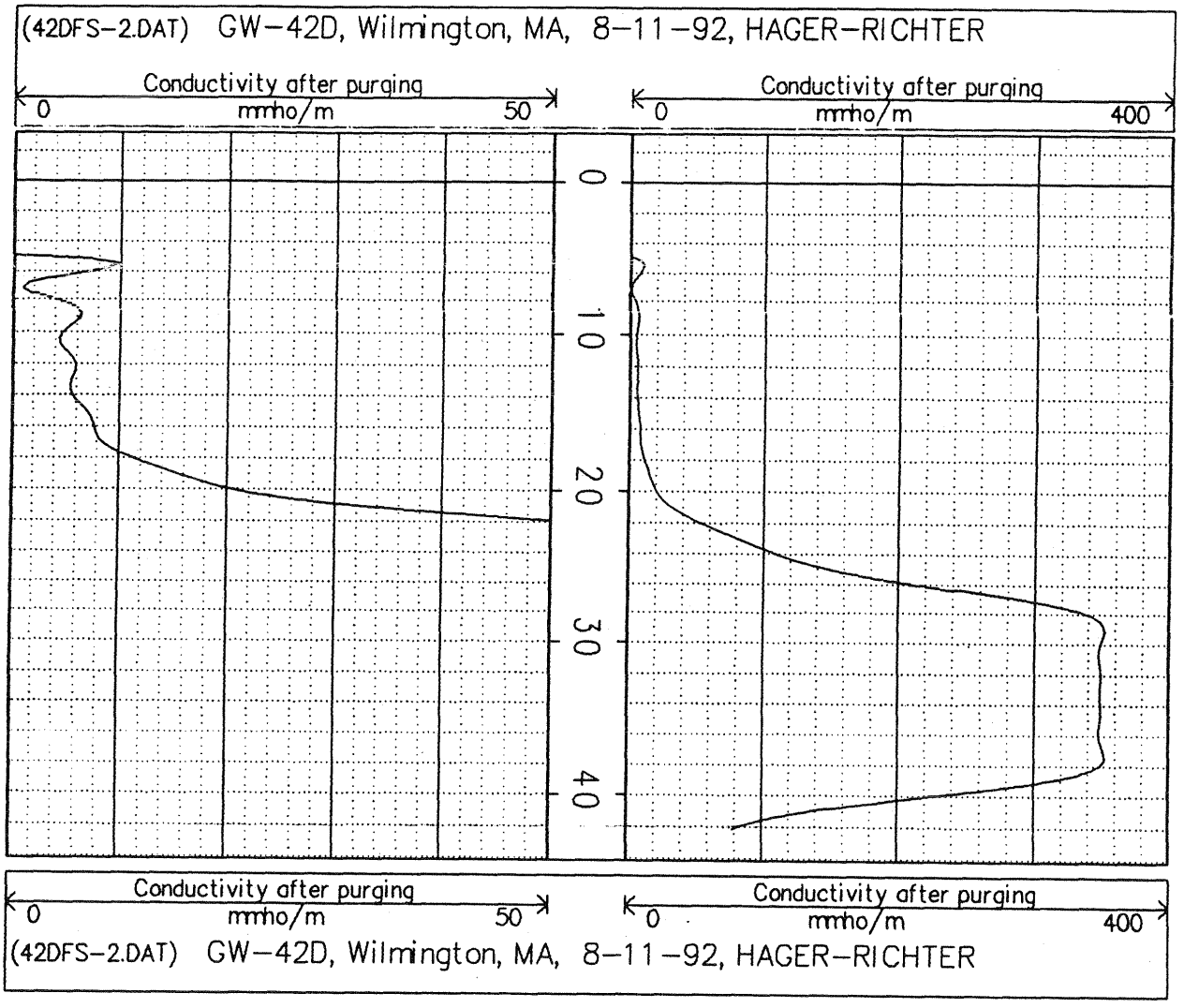
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Monn
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



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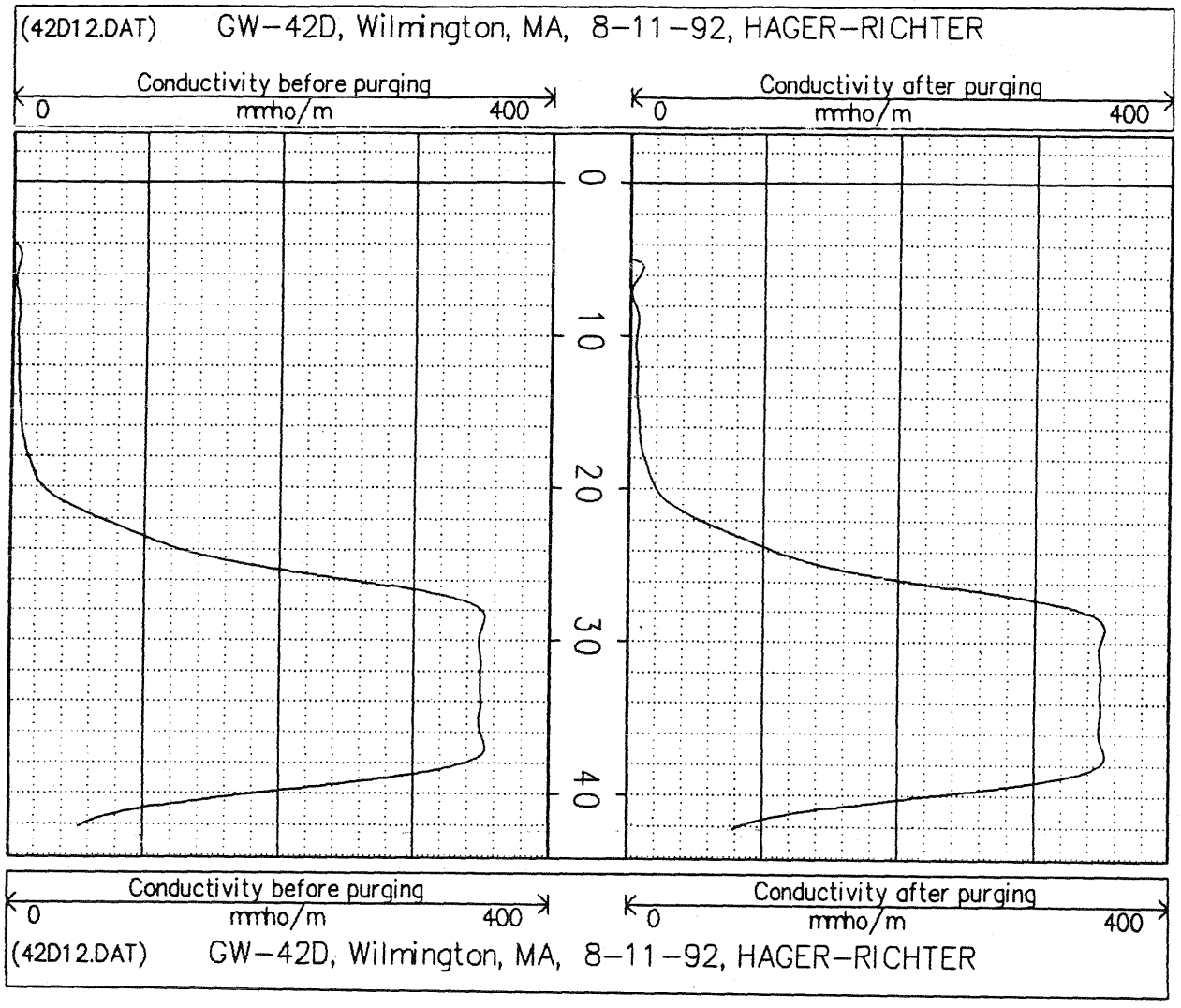
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



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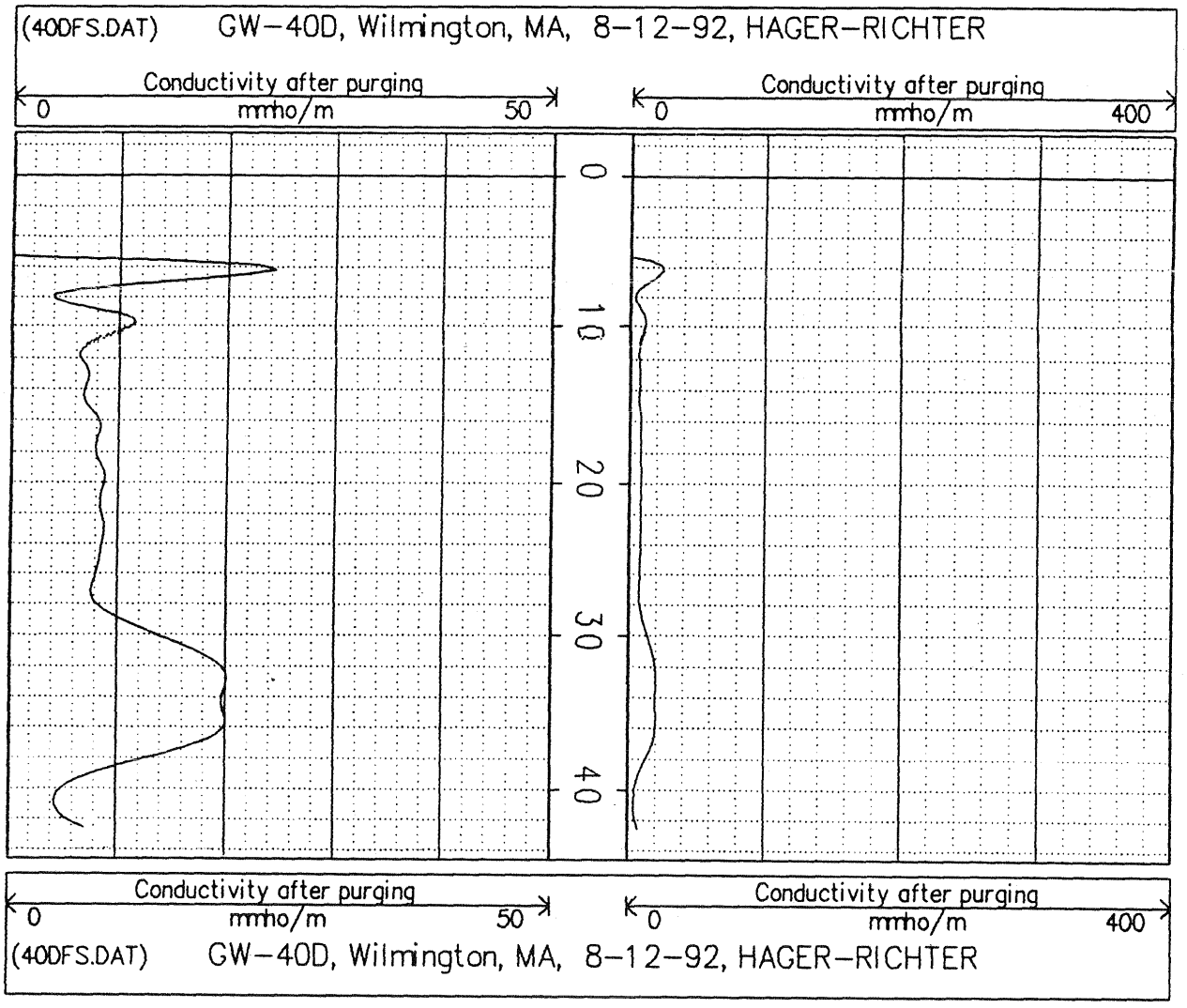
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-40D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 86.4 feet
LOG DATUM: Ground Level
CLIENT TD: 45 feet
H-R TD: 44.73 feet
STATIC WATER LEVEL: 10.6 feet
DEPTH TO BEDROCK: 39.0 feet



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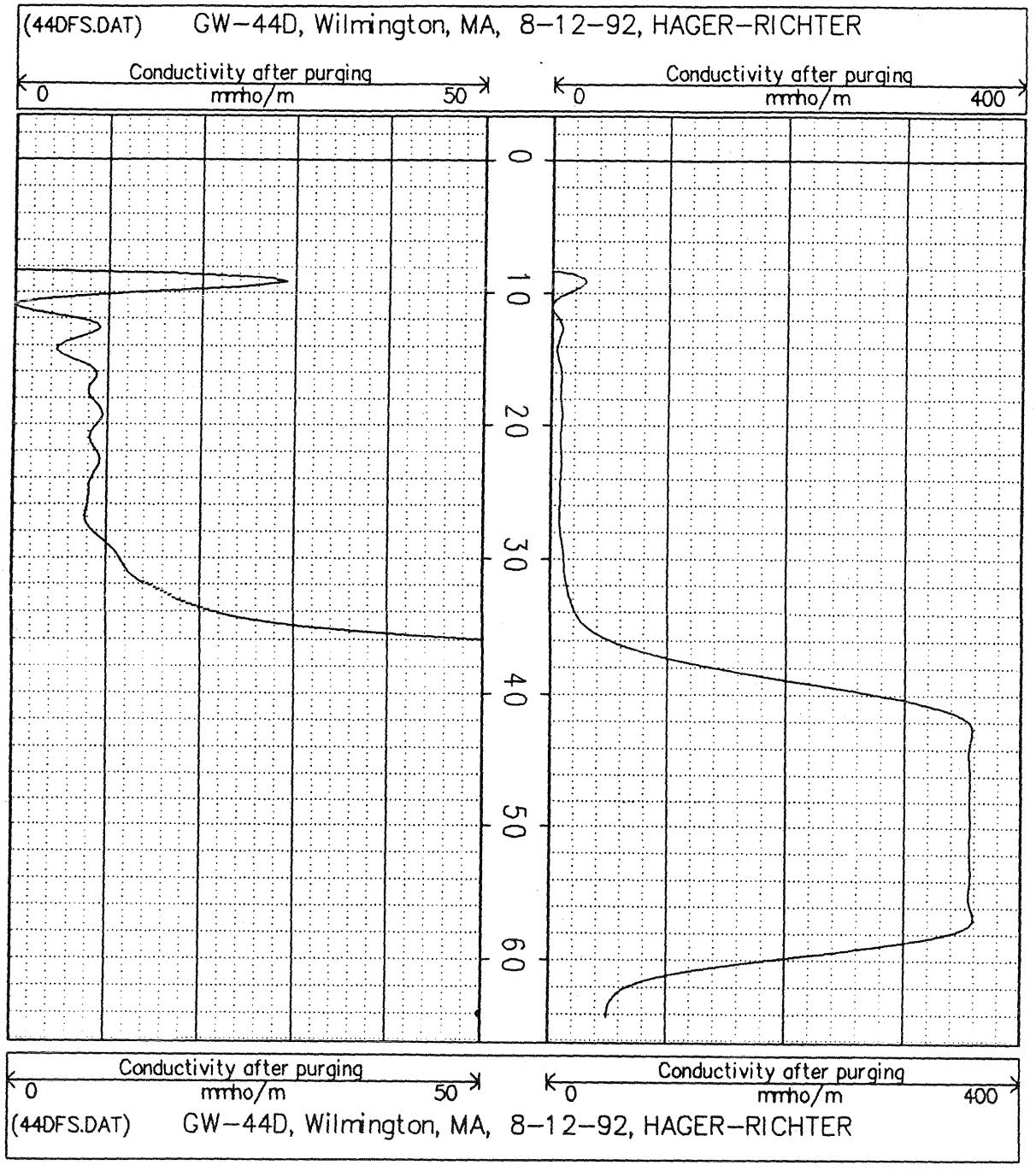
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-44D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 83.5 feet
LOG DATUM: Ground Level
CLIENT TD: 67 feet
H-R TD: 66.38 feet
STATIC WATER LEVEL: 5.94 feet
DEPTH TO BEDROCK: approx. 67 feet



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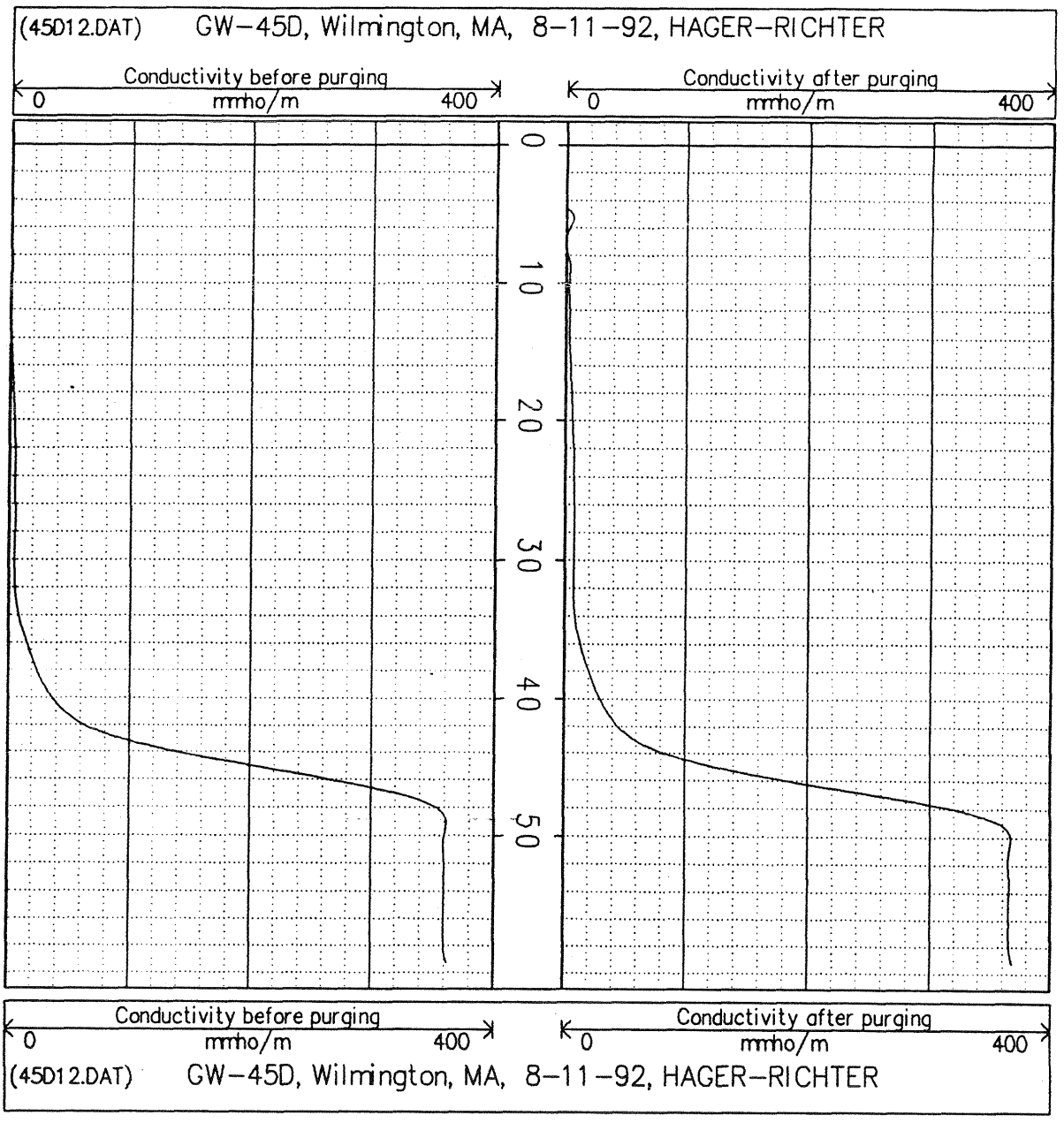
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



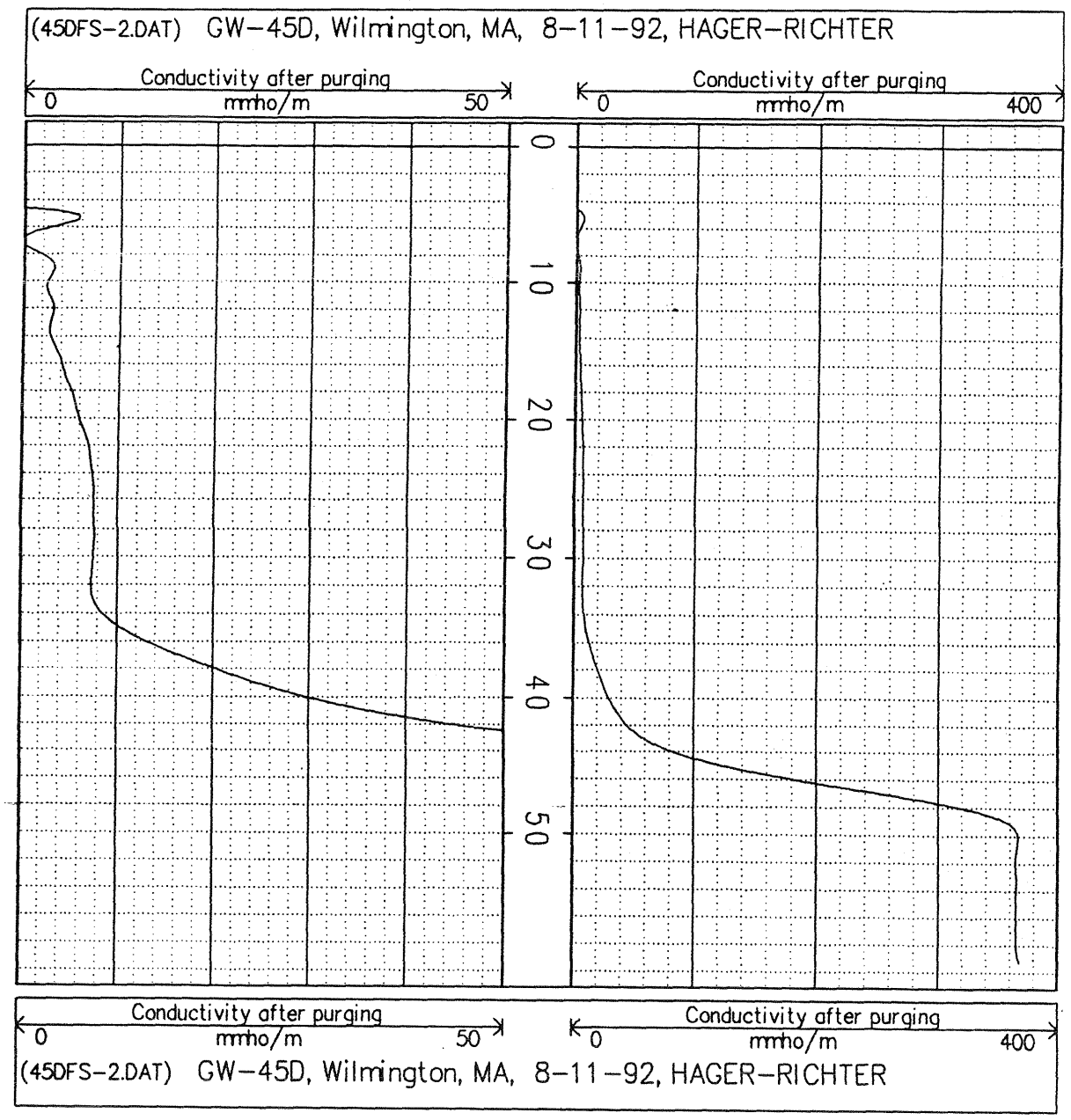
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



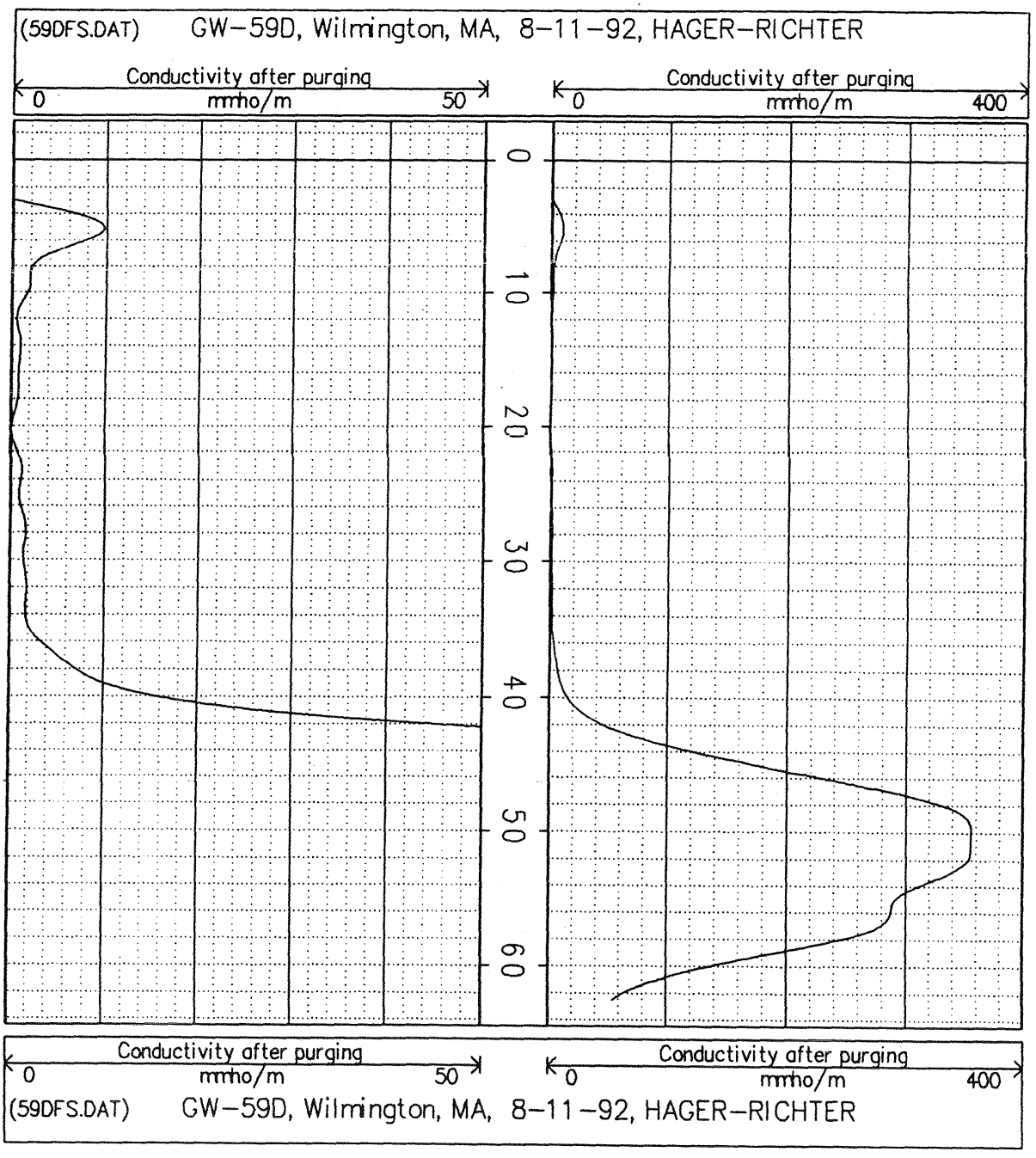
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-59D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.2 feet
LOG DATUM: Ground Level
CLIENT TD: 65 feet
H-R TD: 64.69 feet
STATIC WATER LEVEL: 4.57 feet
DEPTH TO BEDROCK: approx. 60 feet



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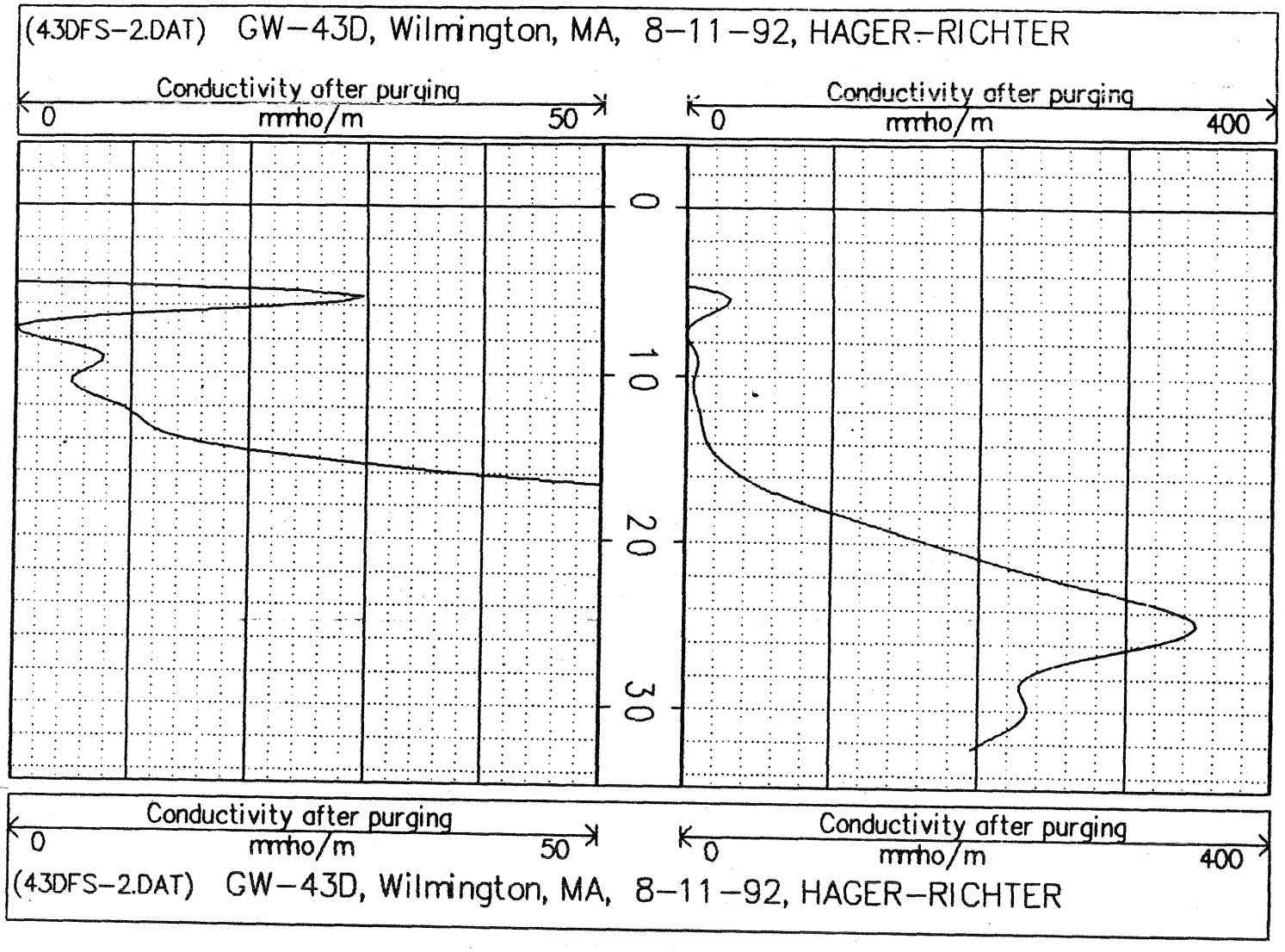
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet



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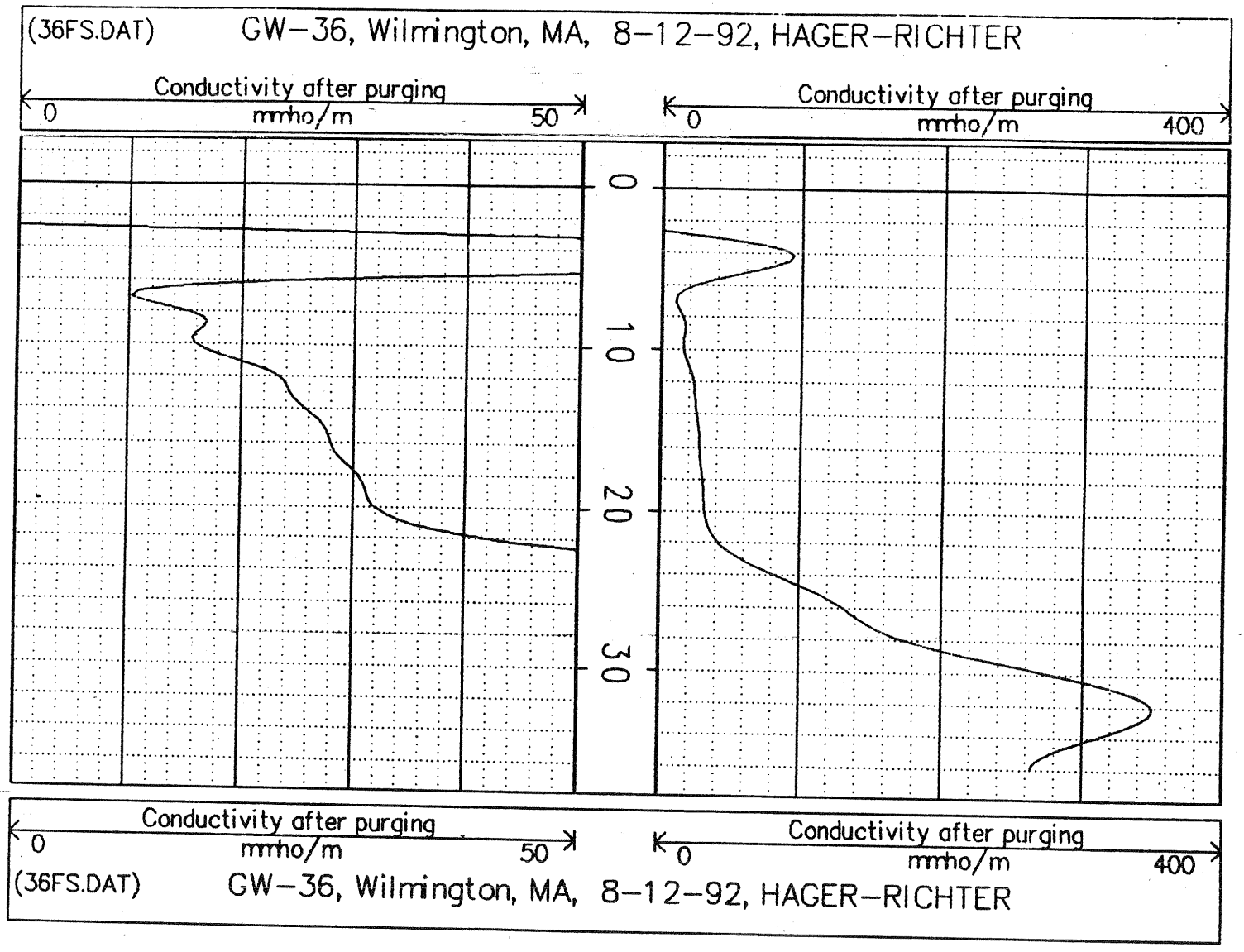
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-36

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 84.3 feet
LOG DATUM: Ground Level
CLIENT TD: 37 feet
H-R TD: 38.09 feet
STATIC WATER LEVEL: 5.4 feet
DEPTH TO BEDROCK: 36.5 feet



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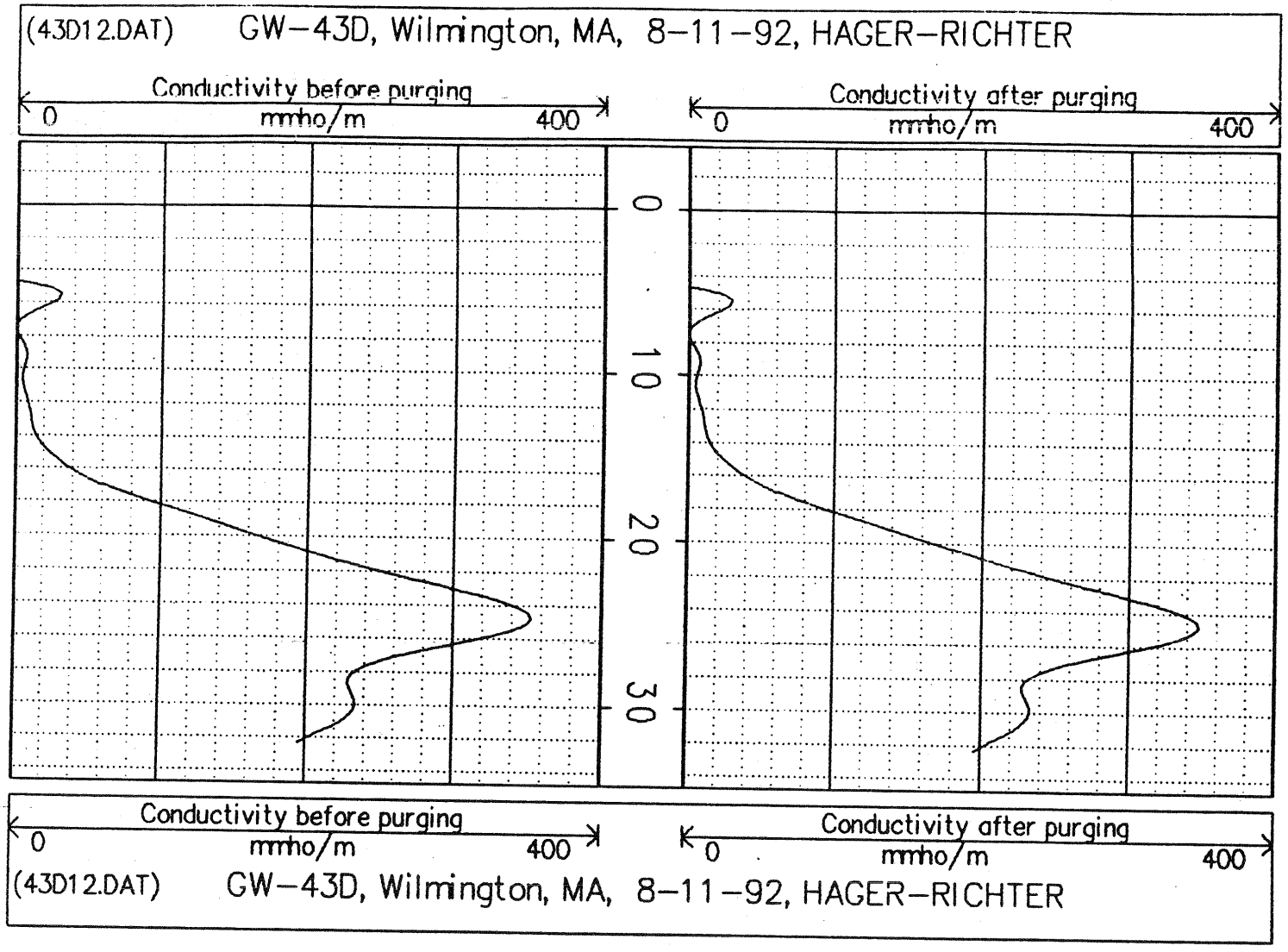
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

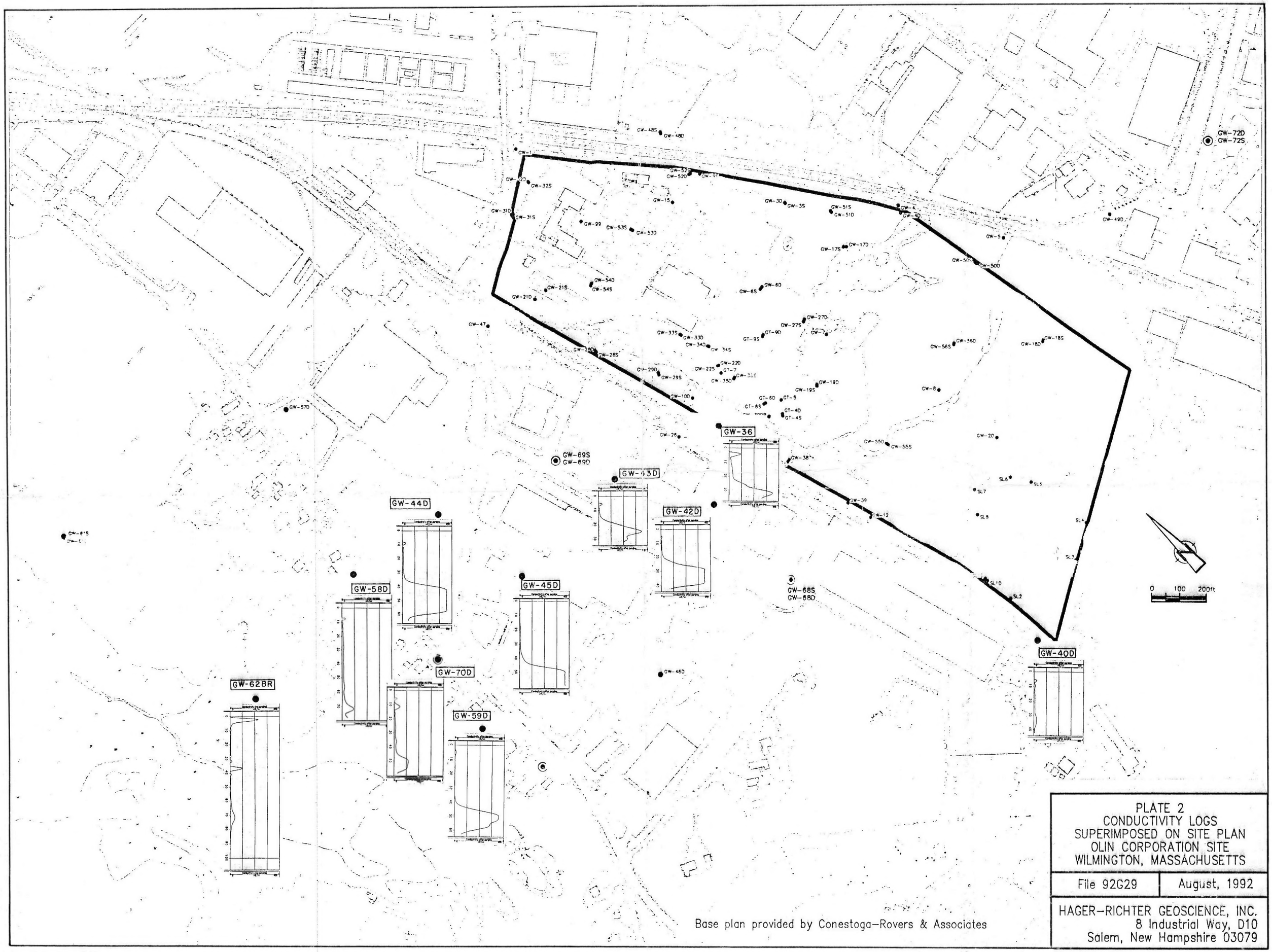
# CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet






Base plan provided by Conestoga-Rovers & Associates

PLATE 2
CONDUCTIVITY LOGS
SUPERIMPOSED ON SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

| File 92G29 | August, 1992 |
|---|---|

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, New Hampshire 03079

# BOREHOLE GEOPHYSICAL SURVEY
# OLIN CORPORATION SITE
# WILMINGTON, MASSACHUSETTS

HAGER-RICHTER
GEOSCIENCE, INC.

Consultants in Geology & Geophysics

HAGER-RICHTER
GEOSCIENCE, INC.

# BOREHOLE GEOPHYSICAL SURVEY
# OLIN CORPORATION SITE
# WILMINGTON, MASSACHUSETTS

*Prepared for:*

Conestoga-Rovers & Associates, Inc.
1801 Old Highway 8
St. Paul, MN 55112

*Prepared by:*

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 92G29
August, 1992

## 0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. to log ten monitoring wells in the vicinity of the Olin Corporation Site, Wilmington, Massachusetts in August, 1992. The objective of the borehole logging program was to provide data on the location and depth of a conductive plume known to be present in the vicinity of the Site. Conductivity (EM39) logs were obtained for each well.

The results of the survey may be summarized as follows:

1. Six of the ten wells exhibit well defined zones of sharply elevated conductivity (uniformly about 360 mmho/m), and are interpreted to be within the main part of the conductive plume.

2. The top of the conductive plume is located at increasing depths below ground surface with increasing distance from the Site.

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

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## FIGURES


1. Site location
2. Principle of the induction log
3. Conductivity profile


## PLATES


1. Site Plan
2. Conductivity logs superimposed on Site Plan


## APPENDIX


Borehole Logs - in pocket

## 1. INTRODUCTION

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. of St. Paul, Minnesota to log ten monitoring wells located in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts. The Site is an inactive chemical plant located in a suburban industrial district. The location of the Site is shown in Figure 1.

The locations of the subject monitoring wells are shown on the Site Plan (Plate 1). Nine of the ten subject monitoring wells are located off the Olin Corporation property.

The objective of the borehole logging program was to provide data on the location and depth of a conductive plume known to be present down-gradient from the Olin property. The borehole logging program is part of a larger hydrogeologic investigation being conducted by CRA.

Jeffrey Mann of Hager-Richter conducted the fieldwork on August 11 and 12, 1992. The fieldwork was coordinated with and observed in part by Mr. Jon Michels of CRA. All fieldwork was conducted under Level D personal protection. Data analysis and interpretation were completed at the Hager-Richter offices. Original data and field notes reside in the Hager-Richter files and will be retained for a minimum of three years.

# 2. PRINCIPLES, EQUIPMENT & PROCEDURES

## 2.1 Conductivity Logs

The principle of the conductivity log, sometimes referred to as the electromagnetic induction log, is illustrated in Figure 2. An electric current, called an eddy current, is induced in the formation by an electric current in the transmitter coil (Tx), also called a primary coil, located near the top of the probe. The induced current produces a secondary electromagnetic field and a voltage in the receiver coil (Rx), also called a secondary or measuring coil, located near the bottom of the probe. The design of the system, including the geometry and coil characteristics, is such that the voltage in the receiver coil is proportional to the formation conductivity. In addition, the system is so designed and calibrated that the output, after processing, is the conductivity of the formation in units of millimhos per meter, mmho/m (numerically equivalent to the SI units, milliSiemens per meter, or mS/m).

The maximum distance outward from the tool to which the conductivity of the borehole material is measured is about 2 feet. The tool does not need to be immersed in water to obtain accurate data, but it cannot be used in a steel-cased hole.

## 2.2 Site Specific

All data were obtained with a Geonics EM39 logging system. This compact, portable system has a winch with a maximum depth capability of 100 meters. The electronics are battery powered. All data were recorded at intervals of 0.1 meter (approximately 4 inches) while the tool was being pulled out of the monitoring well at a rate of about 2 to 3 feet per minute.

The data were recorded in digital form with a data logger, transferred to a portable computer in the field, processed in the office, and then plotted using commercially available software.

Several logs were run more than once to ensure reproducibility. Three wells (GW-42, GW-43, and GW-45) were logged twice -- prior to and after purging the well with fresh tap water to displace possibly contaminated (more conductive) water that entered the well at

the screened interval at the bottom of the hole. Comparison of the conductivity logs run prior to and after purging the boreholes with clean tap water shows no significant difference in the data (see Appendix). The conductivity logs for the seven other wells were run after purging; however, we conclude that the purging is unnecessary and we recommend that the purging step be eliminated if additional wells are logged in the future.

As each log was being run, the equipment was decontaminated by washing the downhole portion of the cable and the tool with Alconox soap and rinsing with distilled water. After completing the logging at each well, the wash and rinse water was disposed of at the decontamination pad.

## 3. RESULTS AND DISCUSSION

### 3.1 General

A copy of each log is located in the Appendix (in pocket) but is not described in detail in the text. All depths are in units of feet and referenced to depth below the ground surface.

### 3.2 Conductivity Logs

The conductivity measured for the ten subject wells varies from about 0 mmho/m to 360 mmho/m in distinct zones related to the location of the wells to the Site. In Plate 2, the conductivity logs are superimposed on a plan of the Olin Corp. Site to show the relationship of well location to the conductivity measured.

Generally, the conductivity of the unsaturated zone and the "fresh" water zones for each of the monitoring wells is less than about 10 mmho/m. The conductivity of natural, fresh ground water in New England is generally a few mmho/m.

In six of the ten wells (GW-36, GW-42D, GW-43D, GW-44D, GW-45D, and GW-59D) the conductivity reaches a uniform maximum of 350-360 mmho/m for well-defined depth intervals (shown in Figure 3). The top of the zones of the highly anomalous conductivity varies in depth below ground surface from 25-32 feet near the Site to about 49

feet farther from the Site. Well GW-70D, located at a similar distance from the Site as GW59D, also exhibits a zone of elevated conductivity at a depth of about 49 feet, but the maximum conductivity measured is only 120 mmho/m, possibly indicating that the well is located off the axis of the plume.

Wells GW-58D and GW-62BR are located slightly north of the six wells with the very high conductivity, and each exhibits a narrow band of elevated conductivity (maximum 95 and 40 mmho/m, respectively) at a depth of about 72 feet below ground surface. There is an elevation change between the two wells, however, with GW-62BR at a lower elevation. Interestingly, the increase in conductivity in GW-62BR occurs at the overburden/bedrock interface. GW-62BR also shows a zone of fluctuating conductivity values between depths of about 32 and 40 feet where the values vary between -20 mmho/m and about 100 mmho/m. Such variable values and negative values over a short distance are generally attributed to the presence of metal objects, although the CRA representative indicated that no steel was left in the borehole. (The negative values for conductivity for the top few feet of each log are due to the steel in the wellhead.)

Well GW-40D, located south of the other nine wells, contains a zone of slightly elevated conductivity (approximately 20 mmho/m) between depths of about 31 and 37 feet. It appears to be located outside the main part of the conductive plume.

## 4. CONCLUSIONS

On the basis of the borehole geophysical logs obtained at the Olin Corporation Site in Wilmington, Massachusetts, we conclude the following:

1. Six of the ten wells exhibit well defined zones of sharply elevated conductivity (uniformly about 360 mmho/m), and are interpreted to be within the main part of the conductive plume.

2. The top of the conductive plume is located at increasing depths below ground surface with increasing distance from the Site.

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

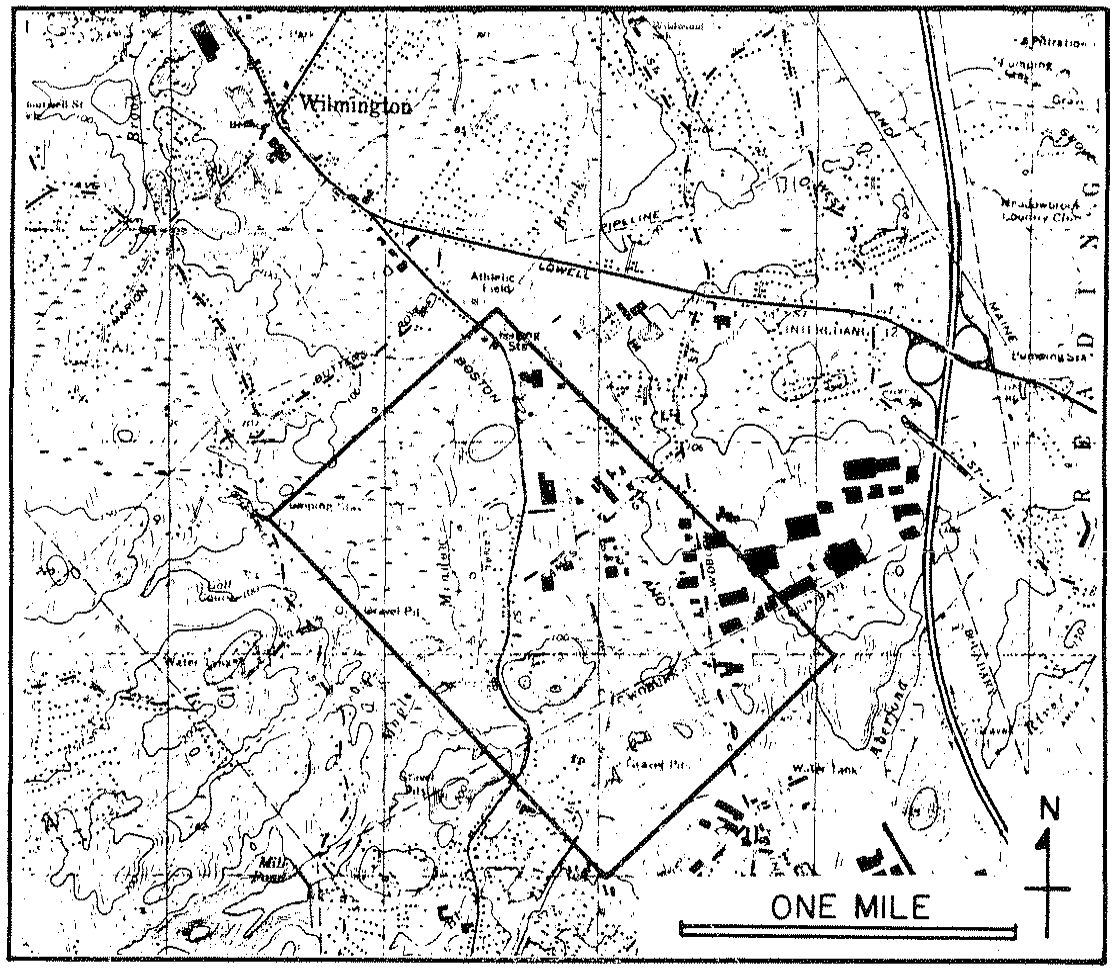



**Figure 1.** Site location. The box outlines the area shown in Plate 1, the Site Plan. Base map Wilmington, Mass. 7 1/2" USGS topographic quadrangle.

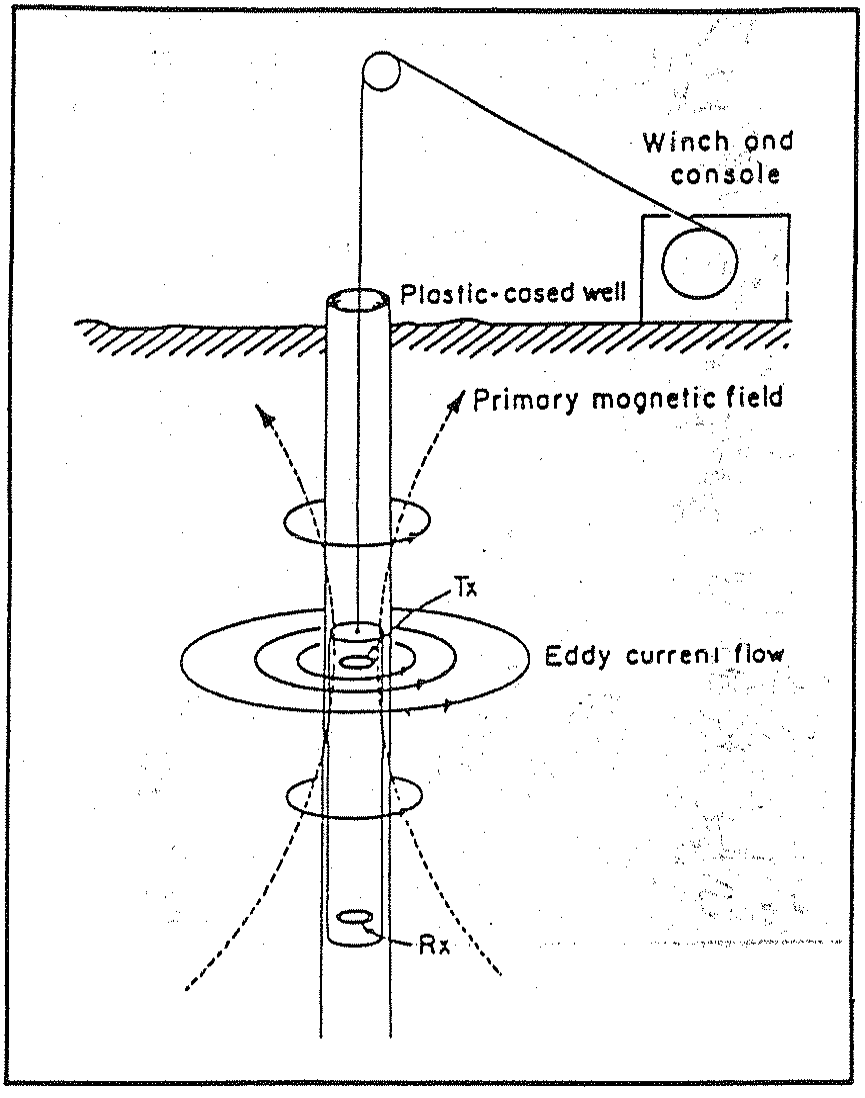



**Figure 2.** Principle of the induction log. Sketch provided by Geonics.

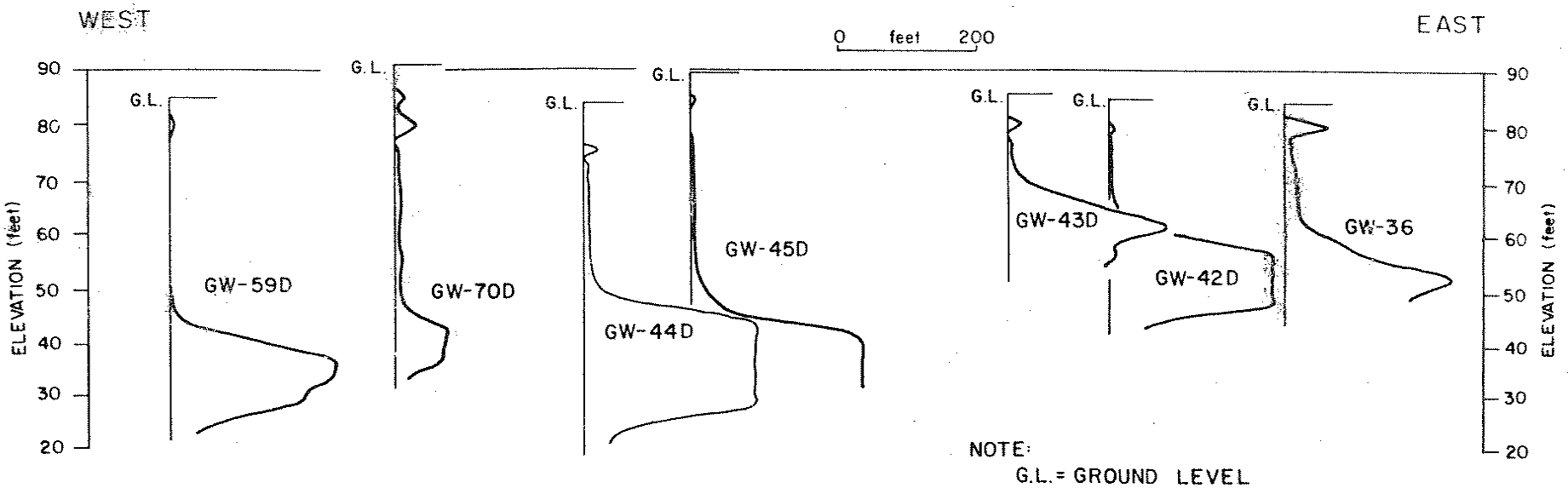
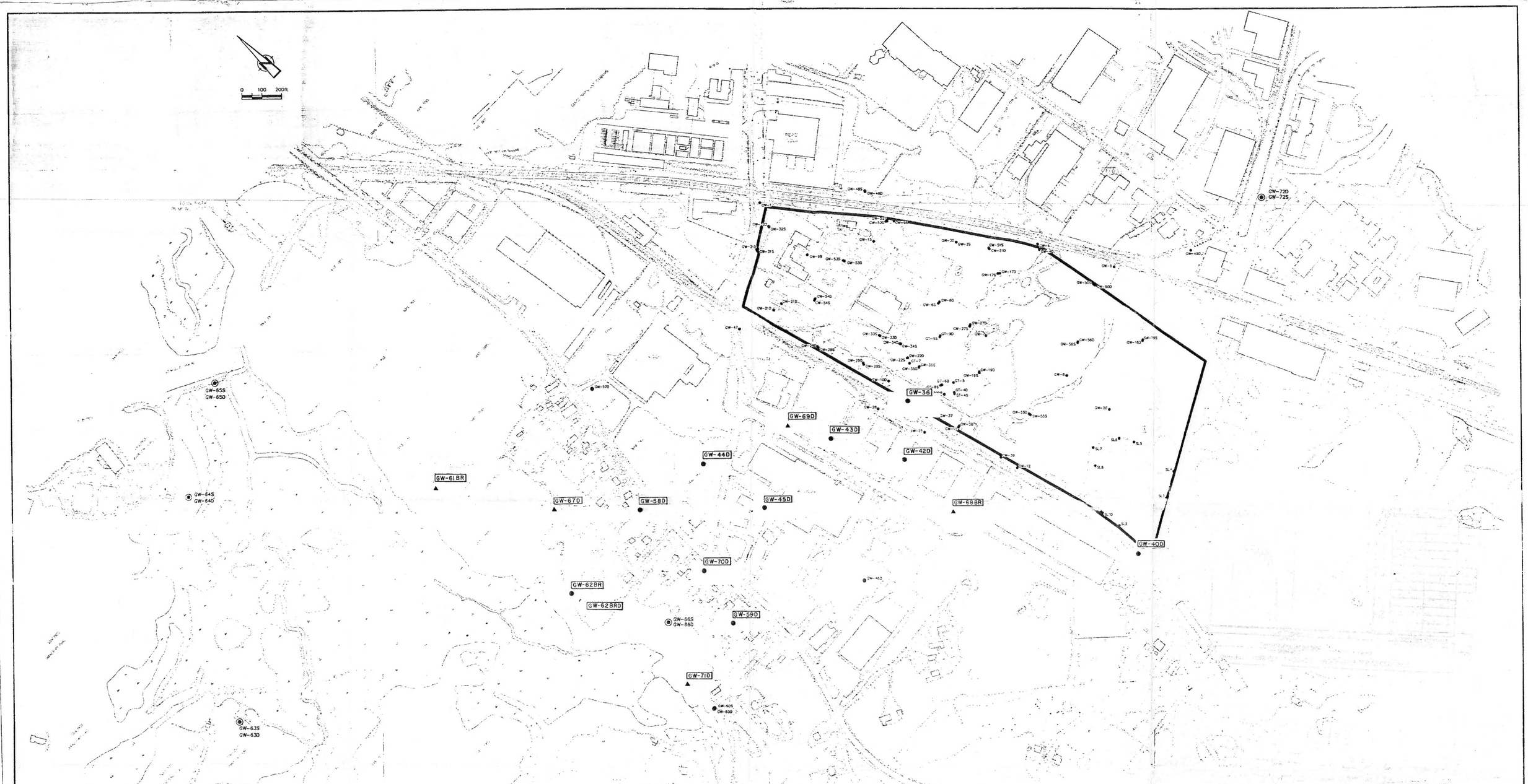



**Figure 3.** Conductivity profile.




GW-67D — Well measured for this Report

GW-59D — Well measured by Hager–Richter (8/92)

Base plan provided by Conestoga–Rovers & Associates

PLATE 1
SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

File 92G29A | January, 1993

HAGER–RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, NH 03079

LEGEND

- RAILWAY
- FENCE
- FACILITY BOUNDARY
- GW-3JD — EXISTING WELL LOCATION
- GW-63S — PROPOSED WELL LOCATION

| Nº | Revision | Date | Initial |
|---|---|---|---|

Approved

OLIN CORPORATION

WILMINGTON FACILITY

PROPOSED WELL LOCATIONS

**CRA**
**CONESTOGA-ROVERS & ASSOCIATES**

| Drawn by: DKC | Scale: 1" = 200' | Date: JULY 1992 | File Nº: 45 (P-50) | Rev.Nº: – |
|---|---|---|---|---|
| Designed by: MJ | | | | |
| Checked by: MJ | Field book: | Project Nº: 3683 | Drawing Nº: 2 | |

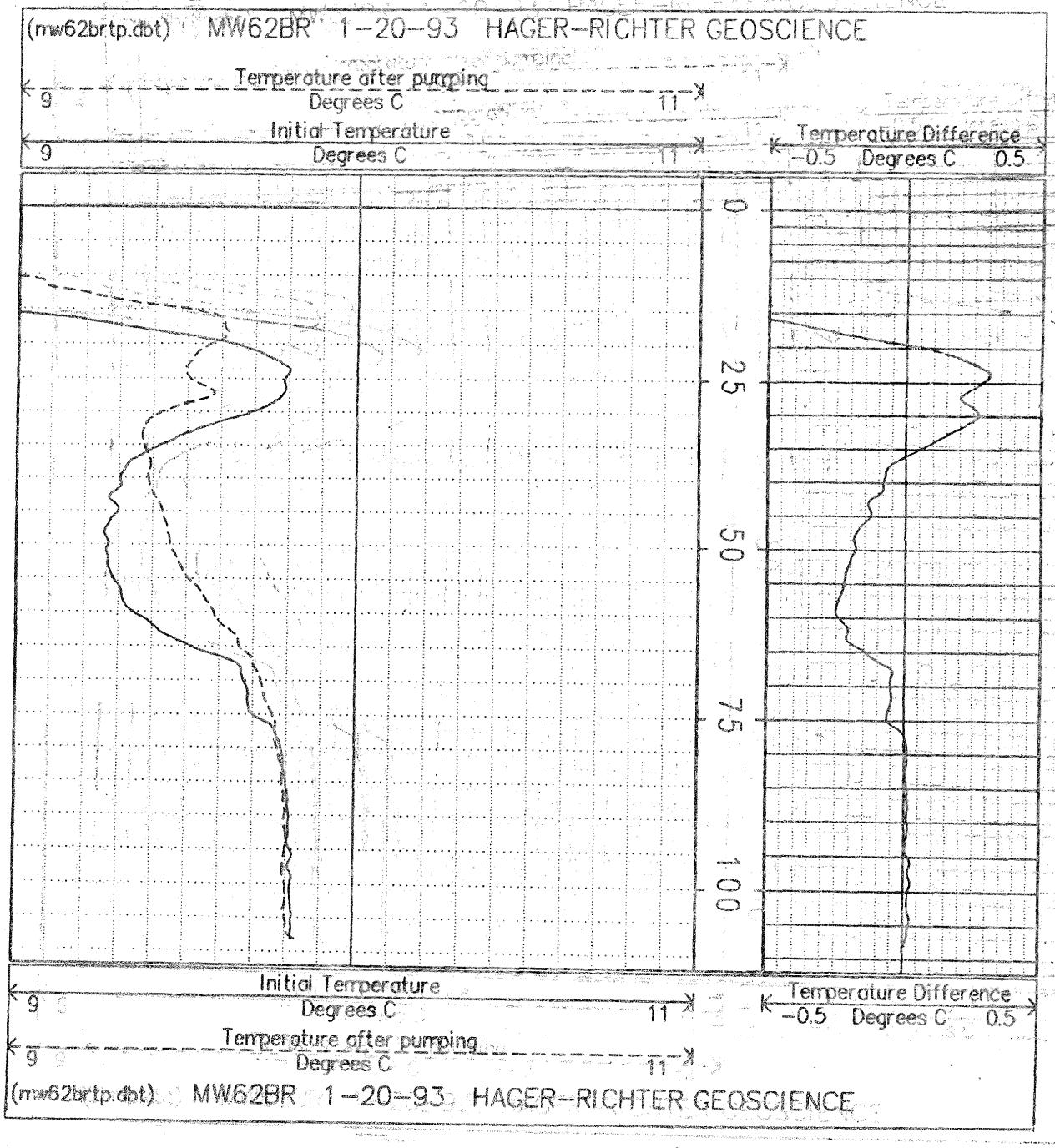
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW62BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 80 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 110.3 feet
STATIC WATER LEVEL: 2.1 feet
DEPTH TO BEDROCK: 75 feet



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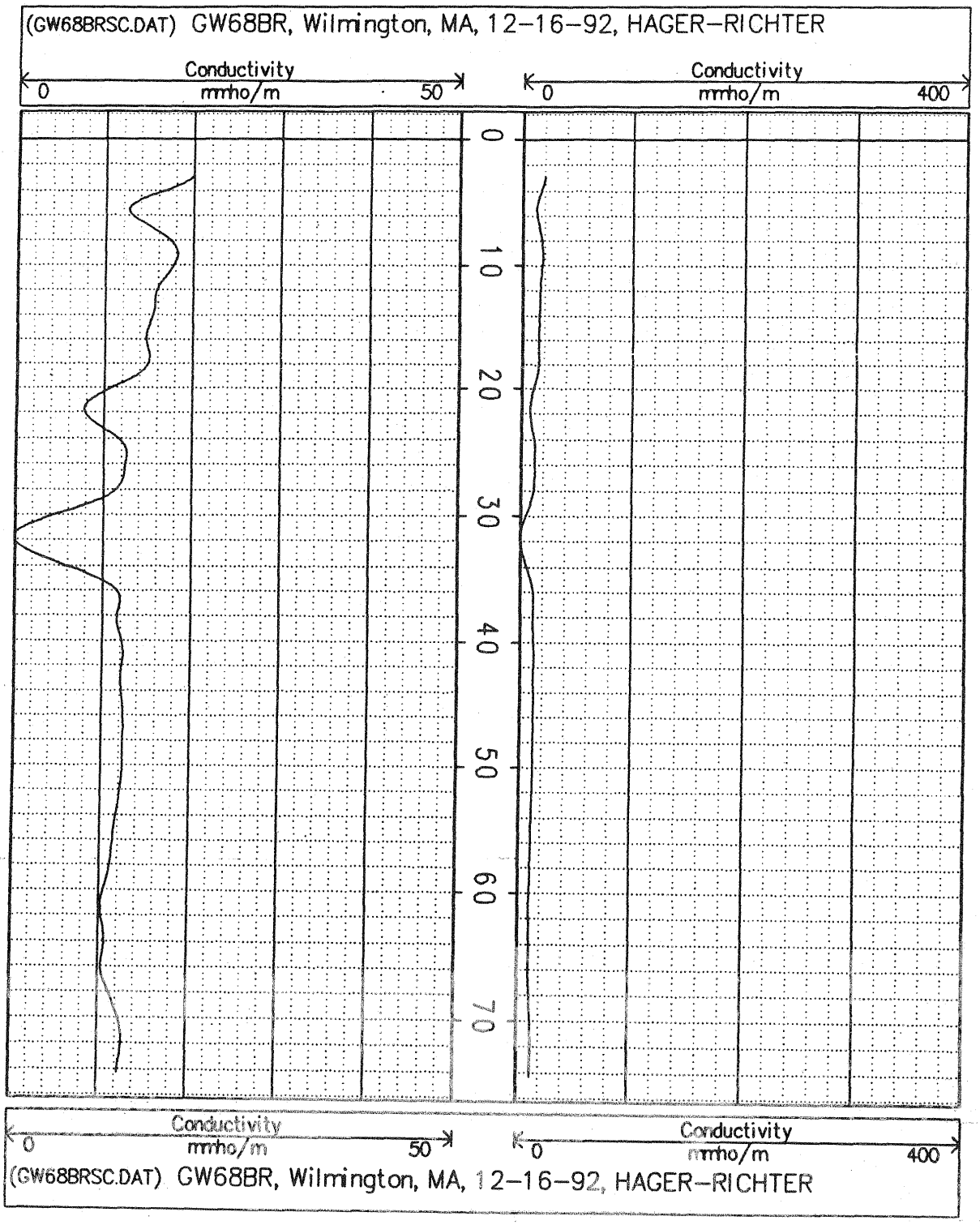
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 76.5 feet
STATIC WATER LEVEL: 18.6 feet
DEPTH TO BEDROCK: 21 feet



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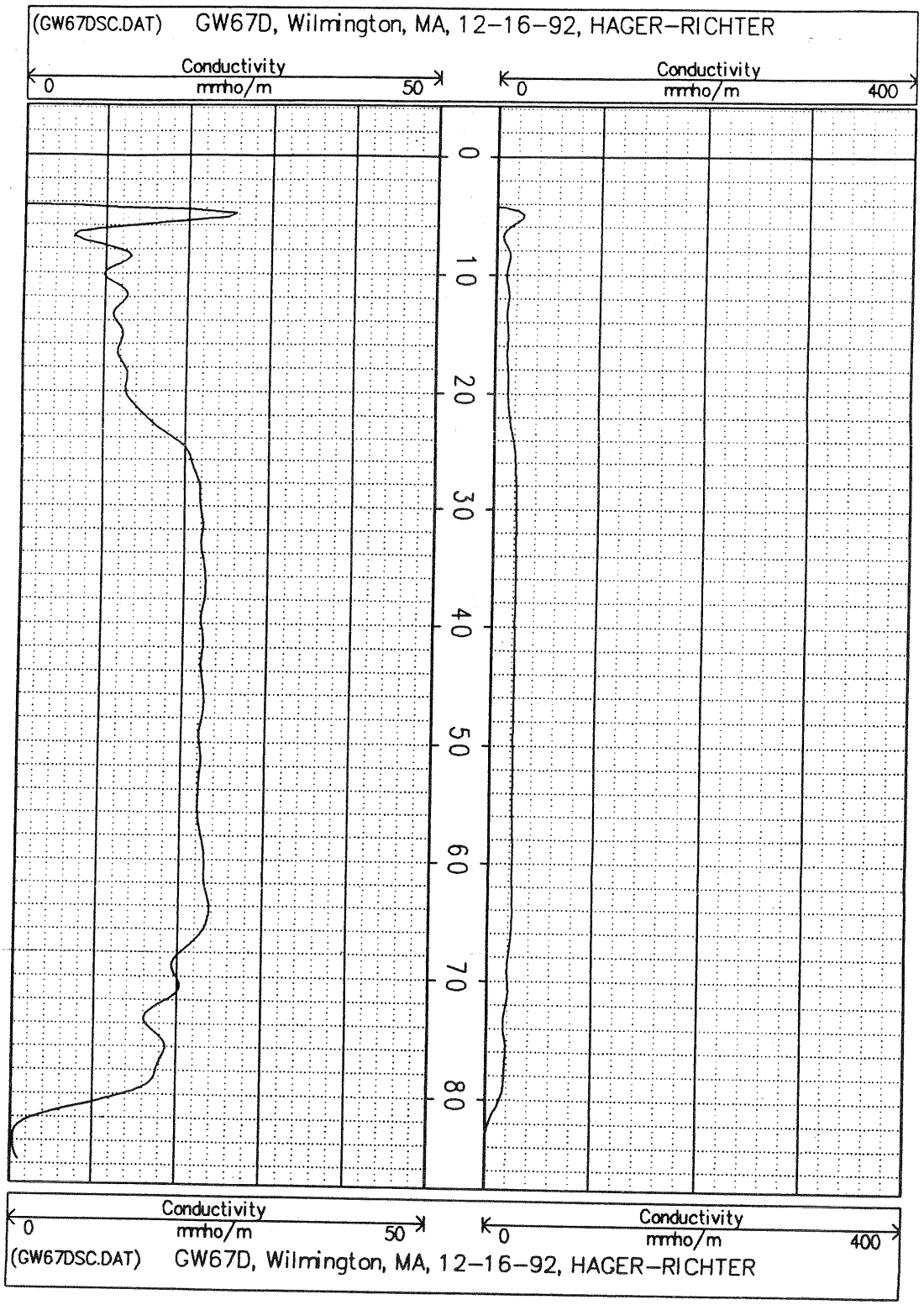
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW67D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 87.8 feet
STATIC WATER LEVEL: 17.3 feet
DEPTH TO BEDROCK:



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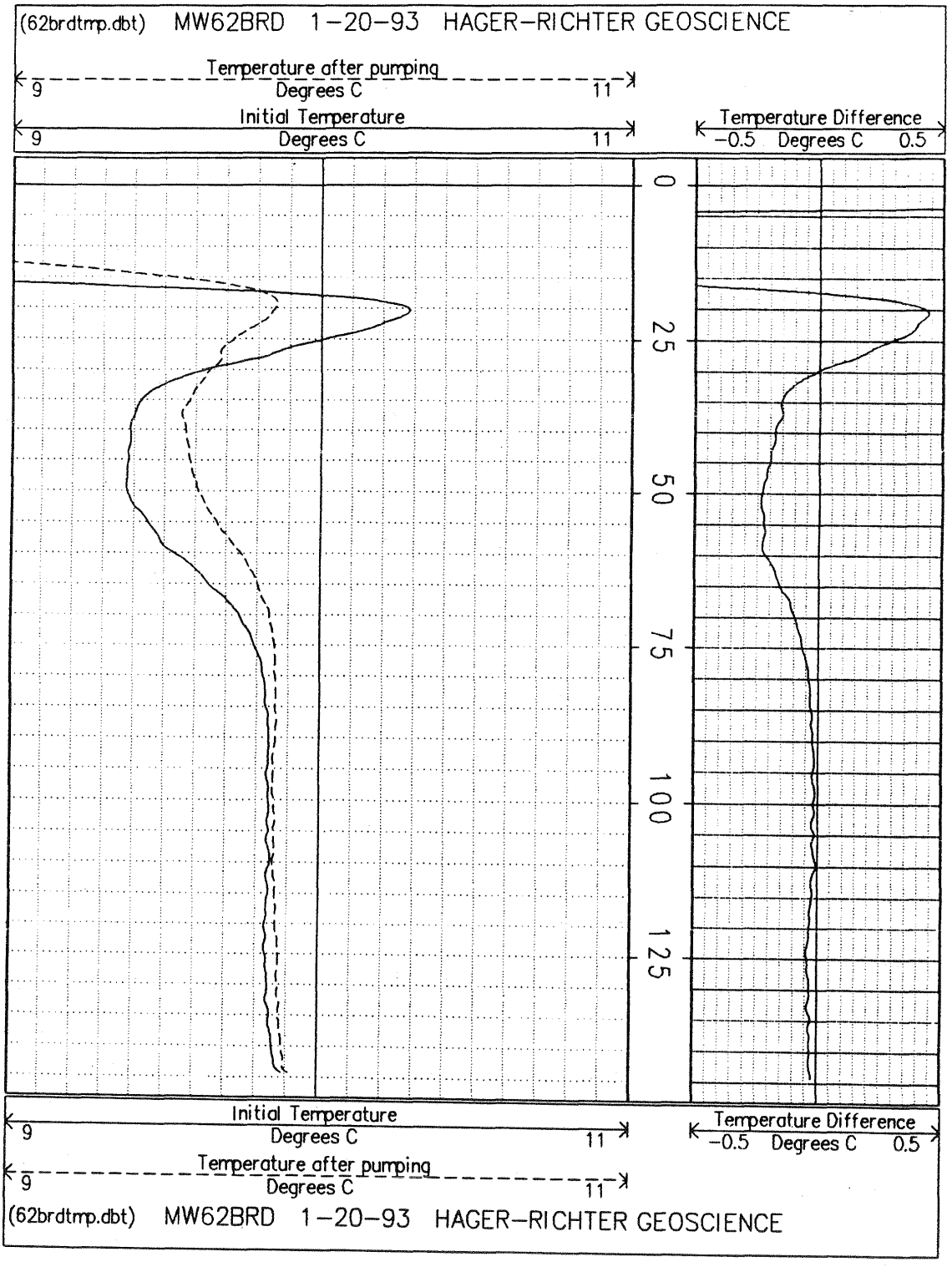
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW62BRD

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 105 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 145.9 feet
STATIC WATER LEVEL: 2.7 feet
DEPTH TO BEDROCK: 75 feet



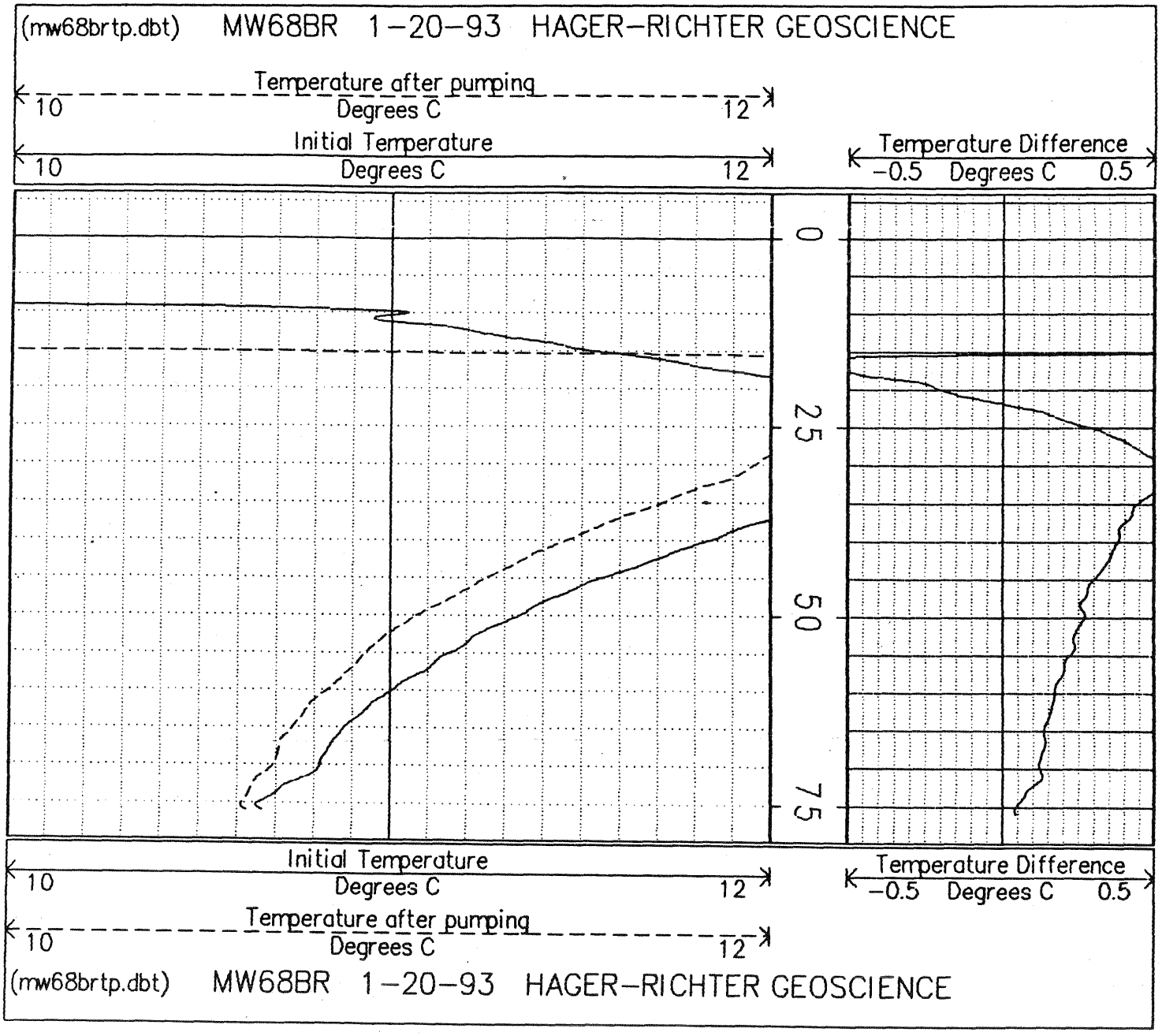
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 26 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 75.7 feet
STATIC WATER LEVEL: 8.1 feet
DEPTH TO BEDROCK: 21 feet



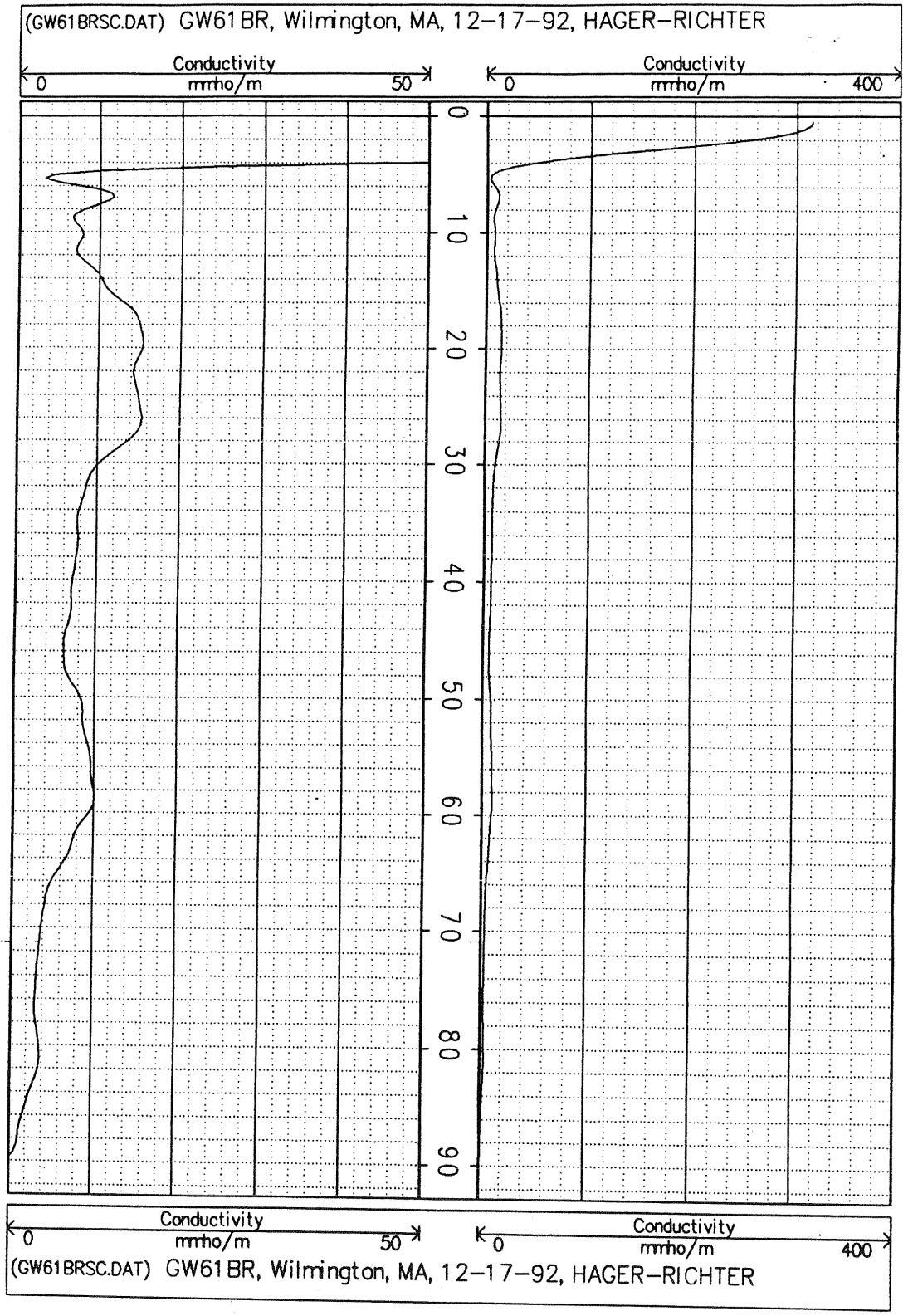
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW61BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 17, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 91.8 feet
STATIC WATER LEVEL: 4.7 feet
DEPTH TO BEDROCK:



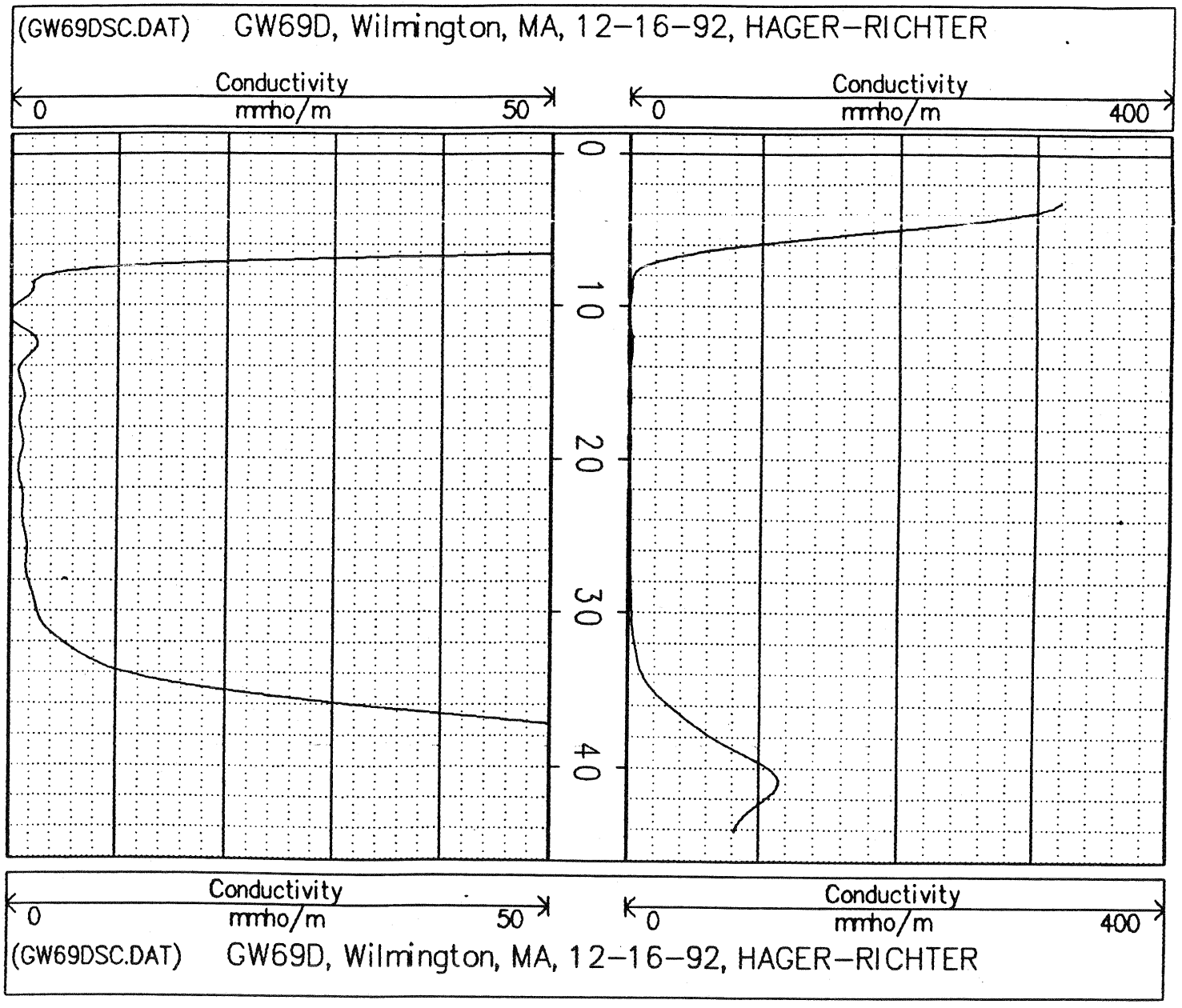
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW69D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 46.3 feet
STATIC WATER LEVEL: 10.0 feet
DEPTH TO BEDROCK:



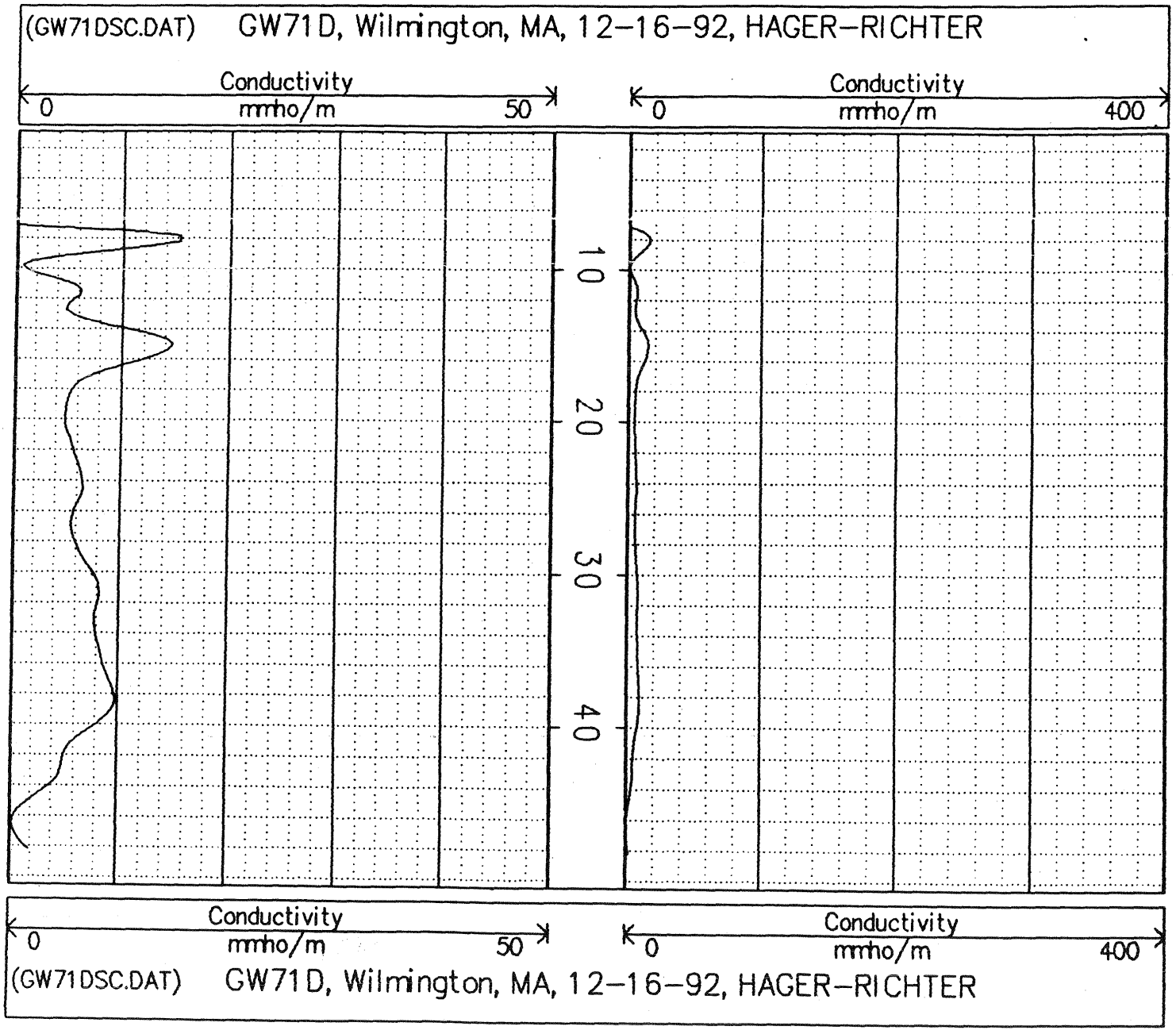
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-71D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 50.3 feet
STATIC WATER LEVEL: 12.8 feet
DEPTH TO BEDROCK:



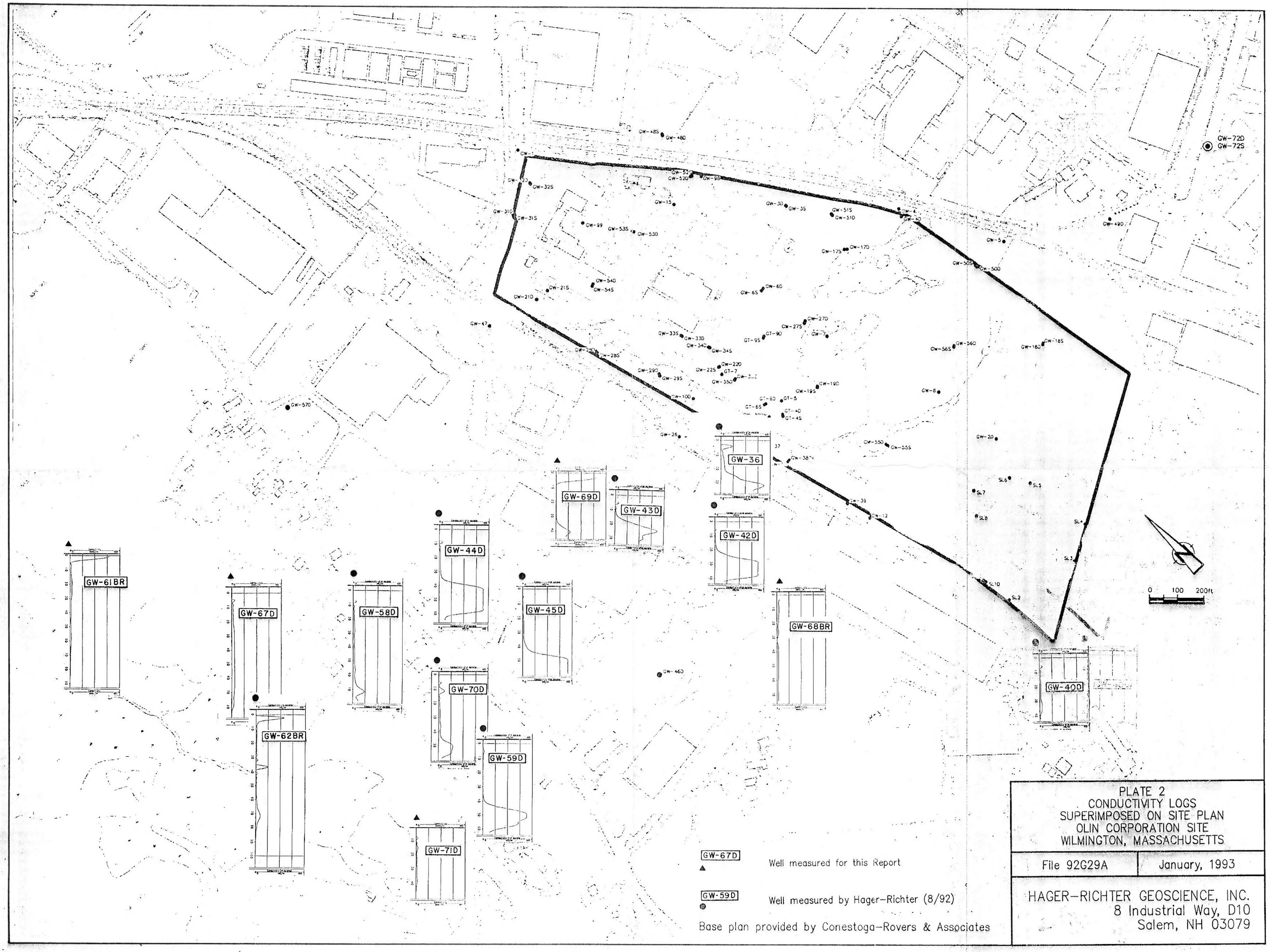



PLATE 2
CONDUCTIVITY LOGS
SUPERIMPOSED ON SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

| File 92G29A | January, 1993 |
|---|---|

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, NH 03079

# APPENDIX H

# APPENDIX H

# QUALITATIVE BIOTA SURVEY/
# WETLANDS DELINEATION

WETLANDS PRESERVATION INC.

# Site Habitat Characterization

Olin Wilmington Facility
51 Eames Street
Wilmington, Massachusetts 01887

March 3, 1993

Revised June 11, 1993

Prepared for

OLIN CHEMICALS
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Charleston, Tennessee 37310

By

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Site Habitat Characterization
Olin Wilmington Facility
51 Eames Street
Wilmington, MA

## 1.0 Introduction

This report provides a detailed evaluation of the location and characteristics of the various upland and wetland habitat areas on and immediately adjacent to the property located on Eames Street in Wilmington, Massachusetts.

For the purpose of this report, the area of study includes all contiguous property at the Eames Street facility, the offsite West Ditch System located immediately to the west of the site, and a similar stream and ditch system located to the east and adjacent to the MBTA railroad track which is referred to as the East Ditch System.

Within the study area, both upland and wetland habitat classes were identified and distinct areas of upland and wetland composed of one or more habitat classes are discussed relative to their vegetative cover, hydrology, soils, wildlife use and other pertinent characteristics. The location of each of the upland and wetland areas is identified on Figure 1, Habitat Location Plan.

## 2.0 Site Overview

The property exhibits several past and present land use patterns which have had an impact on shaping the current condition of the site. The north portion of the site, including approximately one-third of the property area, is currently developed and contains the offices, parking area, several warehouse buildings,

industrial structures such as loading platforms, above ground holding tanks and a water treatment facility. Several concrete pads remain intact from razed process buildings. In general, this portion of the site is highly developed, however, daily activities on this portion are currently limited to facility maintenance and groundwater investigation and monitoring activities.

The central portion of the property is a wetland area which has been highly disturbed during previous tree cutting, soil excavation and stream channelization activities. Several gravel spoil piles and berms remain around a small pond and along the banks of the streams in this portion of the site. The central wetland area on the site is listed as Zone B according to the Flood Insurance Rate Map (FIRM) for Wilmington, Massachusetts, Middlesex County dated June 15, 1982. (Community Panel Numbers 250227-0002 B and 250227-0004 B). Figure 2 illustrates the FIRM for the site.

The southwest corner of the property contains a gypsum landfill which has been capped and is currently mowed periodically to restrict tree and shrub development.

The remaining south central and southeast portion of the site is mixed forested wetland and forested upland. Several old ditches, stone piles and an old foundation indicate the historic farming activities on this portion of the site. The average diameter of the forest trees in this area is 12 to 14 inches dbh (diameter at breast height). The presence of the mature red oak/white pine forest canopy indicates this portion of the site has most likely remained relatively undisturbed for 60 or more years.

## 3.0 Upland Habitat Evaluation

### 3.1 Upland Area Classification

The upland component of the property currently consists of several types of areas which are best classified according to their respective land use and vegetation cover patterns. While no one formal habitat classification system is available for disturbed sites such as this, the following descriptions best identify the current conditions of the upland habitats on the site.

- Heavily maintained/industrial - This class includes all upland areas currently or previously developed which continue to be maintained as part of an industrial facility. Characteristics of this class include all office, factory and storage buildings on the site, paved parking and driveway areas, industrial facilities such as fuel tanks, railroad tracks, concrete pads and loading platforms.
- Heavily maintained/open field - This class consists of areas on the site which have been previously altered and were heavily utilized in the past but are currently mowed periodically and maintained as open field. Included in this class are areas due south of the factory buildings on the site known as the former lagoon area and the area of the capped gypsum landfill in the southwest corner of the property.
- Upland Forest (white pine/Northern red oak/white ash stand type) - This class includes all the upland forested portions of the property. The stand type is white pine/Northern red oak/white ash according to Forest Cover Types of North America, Society of American Foresters, 1954. Variations and subtypes in species composition exist in specific areas on the site due to manmade or natural disturbances. Portions of the forested upland area are in various stages of secondary succession,

however, in general, the majority of the forested area was found to be consistent in species composition with this stand type. The primary species in the type are Eastern white pine, Northern red oak and white ash. Red maple is the chief associate while various other species may also be present in specific areas.

## 3.2 Upland Area Characterization

### 3.2.1 Upland Area A

Upland Area A is the front or north portion of the site and extends from the entrance along Eames Street to the south of the existing or former building and tank facilities. This area of the site is highly developed and contains offices, associated landscaping, industrial structures and several mature trees standing along the perimeter of the maintained area. Much of this area is paved. Upland grasses and forbs generally dominate the non-paved portions of the site here. Drainage from this area generally sheds toward the west toward Drainage Area BB and to the south toward Drainage Area AA.

The soils of Upland Area A have been obscured by impervious surfaces and building construction. These soils are classified as Urban Land and include areas of Udorthents which are heavily disturbed by cultural activities which include excavating, regrading, filling and continued maintenance. Due to the highly developed condition of this portion of the site, quantitative vegetation sampling and soil sampling was not conducted. Although this area of the site was in active chemical manufacturing for many years, current activities are limited primarily to facility maintenance and groundwater interception system.

### 3.2.2 Upland Area B

Upland Area B is located south of the buildings and industrial facilities on the site and is an area of open mowed field which once contained open lagoons or settling ponds. These structures have been removed, the area has been regraded and is now mowed periodically. This area is best characterized as heavily maintained/open field.

The soils of this area are heavily disturbed by historic grading activities which include excavating, regrading, filling and continued maintenance. These soils are classified as Udorthents. They are variable in composition and drainage class because soil morphology has been altered by the development activities. Additional onsite investigation would be necessary to determine the suitability of these soils for future use. The periodic mowing of this area restricts tree, sapling and shrub development and limits the plant community to grasses and forbs. Due to the season of observation, definitive identification of the herbaceous species in this area was not feasible. The past disturbances and the present maintenance schedule in this area restricts further succession toward a more natural and diverse plant community.

### 3.2.3 Upland Area C

Upland Area C is a capped gypsum landfill in the southwest corner of the site. This area is periodically mowed and is maintained as open field with only an herbaceous stratum with a variety of upland grasses and forbs present. Due to the season of observation, definitive identification of species in this area was not feasible. The past disturbances and the present maintenance schedule in this area restricts further succession toward more natural communities. Therefore, this area is best characterized as heavily maintained/open field. Due to the season of

observation along with the closely mowed condition of the herbaceous stratum, quantitative vegetation sampling was not conducted in this area. Similarly, due to the present land use of this area and disturbed nature of the area, soil sampling was also not conducted.

### 3.2.4 Upland Area D

The remaining portion of the property, including the area south of the central wetland area, an upland island centrally located on the site, and several small peripheral areas are typically forested upland. These areas are best described as successional mixed hardwood/white pine and generally corresponds to the white pine/Northern red oak/white ash stand type as described in the Forest Cover Types of North America published by the Society of American Foresters. The forest canopy is well stratified with an average tree diameter of 12" dbh. This portion of the property is relatively undisturbed. Evidence of past farming activities is found in several old foundations, stone piles and old cart paths.

The predominant soils in Upland Area D are deep, well to somewhat excessively drained gravelly loamy sand and coarse sand textures. They are deep to water table and bedrock. These soils are derived from coarse sandy glacial till parent materials. These parent materials were deposited by glacial ice with minimal transportation by water. The soils of Upland Area D are relatively undisturbed as compared to other areas of the site. These soils most closely resemble Canton series soils. Canton soils have more sand in the substratum and are less firm in the substratum than other till soils with dense basal deposits.

While glacial till materials are generally unstratified and heterogeneous in the forested upland area, the largest portion of the forested area, closest to the

town line with Woburn, does exhibit some signs of stratification and likely experienced influence from glacial meltwater. Conversely, the soils on the upland island generally possess finer textures and do not exhibit stratification. By virtue of its landscape position, the island is only moderately well to well drained as are the portions of Upland Area D to the east and west of the pond. The condition of most of the area indicates that this area has received minimal disturbance in the last 60+ years. Recent disturbance in this area appears limited to periodic use of several cart paths to access groundwater monitoring wells and the area disturbed to erect the chain link fence at the perimeter of the property.

The tree stratum in the forested areas is made up of red oak (*Quercus rubra*), black cherry (*Prunus serotina*), white oak (*Quercus alba*), red maple (*Acer rubrum*), gray birch (*Betula populifolia*), white pine (*Pinus strobus*) and pitch pine (*Pinus rigida*). The sapling stratum typically contains red oak, red maple, gray birch and white pine. The shrub stratum density is variable through much of the area with shadbush (*Amelanchier canadensis*), highbush blueberry (*Vaccinium corymbosum*), white pine, beaked hazelnut (*Corylus cornuta*), common red raspberry (*Rubus idaeus*), blackberry (*Rubus* sp.), black chokeberry (*Aronia melanocarpa*) and multiflora rose (*Rosa multiflora*) occasionally present. The herbaceous stratum typically consists of cinnamon fern (*Osmunda cinnamomea*), teaberry (*Gaultheria procumbens*), partridge berry (*Mitchella repens*), clubmoss (*Lycopodium complanatum*), common raspberry (*Rubus* sp.) and poison ivy (*Toxicodendron radicans*). Additional herbaceous species were present but unidentifiable due to the season of observation. The liana stratum is typically sparse with poison ivy, bittersweet (*Celastrus scandens*) and grape (*Vitis* sp.) present. Table 1 portrays the plant community characteristics of the forested upland island in the central

portion of this area. Figure 3 illustrates the moderately stratified nature of this forested upland and the dominance of the tree and shrub communities. Table 2 provides the plant community characteristics of the forested upland area in the southeastern corner of the property. Figure 4 illustrates the high vertical stratification of this portion of the forested upland. The generally mature even aged nature of the forest cover along with the high degree of stratification in the forest indicates that these areas have been relatively undisturbed for 60 or more years. The high degree of vertical stratification in these areas generally increases the overall wildlife habitat value of the forest.

## 4.0 Wetland Habitat Evaluation

### 4.1 Wetland Regulatory Jurisdiction and Delineation

#### 4.1.1 Jurisdictional Wetland Regulations

The site is subject to the following wetland protection regulations: Massachusetts Wetland Protection Regulations (MWPR) 310 CMR 10.00 and the Federal Clean Water Act, Sections 401 and 404. The site currently contains wetland resource areas which are jurisdictional under all of these regulations. Jurisdictional state wetlands include Bank (310 CMR 10.54) associated with perennial and intermittent streams on the site, Land Under Water (310 CMR 10.56) associated with a pond and perennial stream on the site, and Bordering Vegetated Wetlands (BVW) (310 CMR 10.55). While these resource types are included in the state jurisdiction, all wetland areas on the site also represent federal wetland areas and fall under the jurisdiction of the Army Corps of Engineers (ACOE) under the Clean Water Act, Sections 401 and 404.

According to the FIRM for the Town of Wilmington, Massachusetts, Middlesex County, dated June 15, 1982, the property contains an area of Zone B* floodplain throughout the central portion of the site. No Zone A floodplain occurs on the site. Based on the vegetative, topographical and hydrological conditions on the site, it is anticipated that any areas of 100 year floodplain which may occur in Zone B will fall within the jurisdictional BVW boundaries and thus no jurisdictional Bordering Land Subject to Flooding (BLSF) as identified in MWPR 310 CMR 10.57 occurs on the property. Figure 2 illustrates the floodplain area designated on the Community Panel Numbers 250227-0002 B and 250227 0004 B of the FIRM for the Town of Wilmington, Massachusetts.

All upland portions of the site falling within 100 feet of the onsite or adjacent wetland boundary when the boundary delineates the edge of BVW or Bank are considered jurisdictional buffer zone area subject to regulation under the MWPR. No buffer zone is dictated for the small isolated wetland, Area DD, by state regulation.

### 4.1.2 Wetland Boundary Delineation

Due to the nature of the site, only slight variations were observed in the jurisdictional boundaries of the wetland areas using the respective delineation approaches in the state and federal regulations. As a result, one wetland boundary was established which encompasses the state and federal wetland jurisdictional boundary for each area. The wetland delineation placed in the

* Zone B is defined as: "Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood."

field represents the upper limit of either the state wetland boundary based on the predominance (50% or more) of wetland indicator species, or a federal wetland boundary based on the three parameter approach as defined by the 1987 Federal Manual for Delineating Jurisdictional Wetland Areas.

The field delineation was conducted by placing consecutively numbered solid pink flags at intervals along the wetland boundary. The interval between flags is determined by the configuration of the boundary and density of vegetation. The wetland flags series used to complete the delineation are: A1-A60, B1-B23, C1-C53, D1-D118, E1-E16, F1-F6, G1-G16, H1-H20, J1-J18, S1-S16, U1-U58, V1-V13, W1-W34, X1-X28, Y1-Y29, and Z1-Z22 respectively.

Wetland flags were placed in the field according to the criteria for delineation provided in the MWPR. The flags identify the limit where 50 percent or more of the vegetation cover by stratum (tree, sapling, shrub, liana (vine) and herbaceous) is made up of wetland indicator species or according to the multi-disciplinary technical criteria utilized by the federal government for wetland delineation, whichever location was higher on the topography.

In utilizing the federal methodology, the wetland flags identify areas which exhibit evidence of hydrophytic vegetation, hydric soils and wetland hydrology.

Circular plots were utilized for the vegetation and soil sampling and plot size for each respective stratum was adjusted according to site conditions. In general, vegetation plot sizes for each stratum are as follows: tree and liana - 30 foot radius, sapling and shrub - 15 foot radius, and herbaceous 5 foot radius. Trees were sampled by measuring the dbh of each stem in the plot and the

corresponding value was then recorded on the data form. Sapling, shrub, herbaceous and liana species were sampled by calculating the percent aerial coverage of each species in the stratum. The status of plant species as wetland indicator plants was determined using the National List of Wetland Plants for Massachusetts dated May 1988.

Soil observation holes within the plot area were dug by hand using tile spade and/or dutch auger. The point of measurement of the soil surface does not include the forest duff (recognizable plant remains/fibric non-soil material per USDA format) for mineral soils. For organic soils and mineral soils with a histic epipedon (thick organic surface layer), the soil surface is the top of the uppermost organic horizon. All soil colors are based on standardized notation and color chips of the Munsell Soil Color Chart (1990 Edition) and a moist condition unless noted otherwise.

Any soil profile descriptions and vernacular are based on currently accepted terminology of the United States Department of Agriculture (USDA)/Soil Conservation Service (SCS). Color, texture, structure, consistence and other physical soil properties are based on field estimations; no laboratory tests were performed.

Hydric soil determinations are based on actual field observations of soil morphology as compared to the technical criteria and field indicators listed in the Corps of Engineers Wetlands Delineation Manual dated 1987. For hydric soil determinations, the control section is 20 inches (50 centimeters) minimally, from the soil surface. Soil drainage class determinations are based on actual field observations of soil morphology as compared to the U.S. Army Corps of Engineers -

New England Division, Guidelines For Soil Drainage Class Determination, dated 02/27/91. Soil taxonomy determinations are based on actual field observations as compared to the Keys to Taxonomic Classification of New England Soils by M.R. Cuomo and S.A.L. Pilgrim. January 1991.

## 4.2 Wetland Area Characterization

### 4.2.1 Wetland Classification

For the purpose of evaluation, the wetlands on the site were segregated into 6 drainage areas based on the overriding hydrologic characteristics. Each of these areas include one or more wetland classes based on their plant community composition and structural components. Each wetland class has been identified in the field through visual observations of hydrologic and plant community characteristics. Detailed descriptions of the wetland classes within the various drainage areas were documented at strategic observation points which provided representative samples of the wetland types present. Classification of wetland areas on the site is from Classification of Wetlands and Deep Water Habitats of the United States by Lewis M. Cowardin et. al., United States Fish and Wildlife Service.

The various wetland areas found on the site have been classified into the following wetland types:

- Forested wetland - This wetland class is characterized by woody vegetation and normally possesses an overstory of trees, and understory of young trees and shrubs and a low understory of herbaceous species. The forested wetlands on the site are considered broad leaved deciduous and, in general, red maple is the dominant tree species.
- Scrub-shrub wetland - This wetland class is dominated by woody vegetation less than 20 feet tall and includes true shrubs, young trees

and other normally taller shrubs and trees stunted due to environmental conditions, i.e. ice damage, wind damage, frequent flooding or browsing. The scrub-shrub wetlands on the site are considered broad leaved deciduous and are generally dominated by silky dogwood (*Cornus amomum*), highbush blueberry, sweet pepperbush (*Clethra alnifolia*) and glossy buckthorn (*Rhamnus frangula*).

- Emergent wetland - This wetland class is characterized by erect herbaceous species well suited for survival in very wet or inundated soil conditions. In general, the species are most commonly perennial well rooted hydrophytes. The emergent wetlands on the site are considered Palustrine persistent emergent wetlands dominated by such species as cattail (*Typha latifolia*), woolgrass (*Scirpus cyperinus*), purple loosestrife (*Lythrum salicaria*), sedge (*Carex* spp.) and reed (*Phragmites* spp.).
- Unconsolidated bottom - This wetland class includes wetland and standing water areas with at least 25% of the bottom substrate covered by particles smaller than stones (rock fragments larger than 25.4 cm (10 inches) but less than 60.4 cm (24 inches)) and <30% vegetative cover. The small pond on the site fits this description and therefore has been included under this class.
- Streambed - This class includes all the intermittent and perennial drainage channels on the site. Substrate within each streambed can vary greatly depending on local conditions. Streambeds may be scoured and unvegetated or may contain occasional pioneering annuals or perennial emergents and shrubs. The vegetation cover, however, must be too sparse to classify the area as either emergent wetland or scrub-shrub.

### 4.2.2 Drainage Area Descriptions

#### 4.2.2.1 Drainage Area AA

Area AA is the primary drainage path through the property. It includes the "West Ditch" "South Ditch" and portions of the "East Ditch" systems. Area AA is considered to begin in the three distinct channels of the offsite West Ditch area and flows easterly under the abandoned railroad at a stone box culvert and onto the property. The three offsite drainage ditches generally collect water from a drainage basin which is in predominantly commercial and light industrial use. The ditch system receives water from a detention pond located west of Jewel Drive, several roof and parking lot drainages, surface runoff and from groundwater discharges. The West Ditch system is entirely manmade with flow channels along lot lines and along the adjacent railroad line. The West Ditch System flows largely in response to precipitation runoff with significant flows occurring during and immediately following storm conditions. Between storms the principle hydrologic input is groundwater which appears to maintain a small relatively constant flow within the channel once it enters the property. Water collected in the West Ditch system flows under the railroad track via a box culvert and east through the property within a well defined channel (referred to as the South Ditch System).

The West Ditch system is a principal source of surface discharge of site groundwater. The resulting interaction with surface water conditions results in formation of relatively insoluble compounds which form a low density flocculent which drifts with the stream flow and settles throughout the stream bottom in the West Ditch as well as in the remainder of Drainage Area AA. Plans to control the flocculent on the site property have been the focus of considerable study. A detailed evaluation of existing conditions of the West Ditch system was provided

in Wetlands Preservation, Inc.'s Existing Wetland Conditions, Interim Action Plan, West Ditch Precipitate report dated November 2, 1992. This report may be referred to for additional information on the emergent wetland areas within the West Ditch.

The soils within the West Ditch area are heavily disturbed by development activities along Jewell Drive and appear to have been filled and regraded. These soils are classified as Udorthents and have a wet substratum. These soils are considered hydric and most closely resemble poorly drained mineral soils. The stream channels in the lower end of the ditch are also frequently covered with flocculent from the contaminated groundwater release. This flocculent tends to readily resuspend during high runoff periods and the degree of flocculent percent is dependent upon several factors including water flow, water levels and groundwater levels.

Vegetation patterns within the West Ditch System reflect the historically disturbed nature of the area resulting from railroad and industrial development. Vegetation in the ditch system is highly variable with vegetative cover generally dominated by plant species which can tolerate a wide range of hydrologic conditions. Predominant species are purple loosestrife, cattail, Canada rush (*Juncus canadensis*), soft rush (*Juncus effusus*), sedge, common reed, glossy buckthorn and red maple. Vegetation is patchy in distribution, apparently a result of the variations in soil and hydrologic conditions. The vegetation is dominated by an herbaceous stratum throughout the central portion of each ditch with a relatively dense shrub stratum occurring along the bank. The frequency of flooding in this area limits the development of tree and shrub strata throughout most of the central portion of the ditches. The herbaceous plant community will most likely remain dominant with little change within the flooded basin. Table 3

provides details of the current plant community in a typical section of the emergent wetland in the West Ditch. The dominant herbaceous stratum throughout the central portion of this area along with the species composition identifies this area as emergent wetland. Figure 5 illustrates the percent cover by vegetation stratum and the dominance of the herbaceous stratum in the emergent wetland area.

Once on the site property, the stream, now referred to as the South Ditch, receives flow from Area BB and generally deepens and flows easterly across the site. Near the center of the property, the stream flows adjacent to a small manmade pond. A small break in the berm of the pond provides a hydrologic connection with the stream. The direction of flows to and from the pond from the stream are dependent on relative hydrostatic head in each area. The stream continues southeastward past the pond eventually merging with the third major drainage stream (Drainage Area CC) on the site near the fence along the eastern property line. Following the confluence with the flow from Area CC, the stream flows off the property into the railroad ditch along the west side of the MBTA tracks where there is a confluence with flows from Drainage Area EE, also referred to as the East Ditch. The combined flows discharge south to a 24" CMP where it continues through a series of surface and subsurface drainages along the west side of the MBTA railroad tracks to its eventual confluence with Halls Brook just west of the inlet of Halls Brook at Mishawum Lake in Woburn. Halls Brook in this area is highly degraded as a result of industrial urbanization, however, the Halls Brook system does support populations of the Mystic Valley Amphipod (*Crangonyx aberrans*), an invertebrate which is state listed as a Species of Special Concern pursuant to the Massachusetts Endangered Species Act (MGL c. 131A).

The soils in the South Ditch section of Drainage Area AA are heavily disturbed by logging, excavating, regrading and filling, especially at the margins of the current wetland boundary. These soils are classified as Udorthents and have a wet substratum.

The predominant soils inside the wetland boundary are considered hydric and closely resemble very poorly drained mineral soils. The eastern portion of Drainage Area AA, within the confines of the fence line around the parcel, is periodically inundated or ponded during cycles of high groundwater table.

A profile description (typical) for predominant soils within the wetland area reads as follows:

| | |
|---|---|
| 0" | Black (10YR 2/0), fibric plant remains, mucky peat, saturated |
| 6" | Black (10YR 2/0), loam |
| 12" | Gray (10YR 6/1), coarse sandy loam (gleyed) |
| 36" | terminated, refusal (stones) |

This description most closely corresponds to Scarboro series soils.

Several wetland community types exist within the South Ditch area, including emergent wetlands, scrub-shrub wetlands, a stream, a pond and wooded wetlands. Most of the stream channel has been dredged and the banks and portions of the streambed have revegetated with emergent wetland vegetation and wetland shrub species. Typically there is manna grass (*Glyceria obtusa*), woolgrass, soft rush and sedges in the herbaceous stratum. There is glossy buckthorn, gray birch and sweet pepperbush in the shrub stratum. Occasionally there is red maple, gray birch, red oak, shadbush and swamp white oak (*Quercus bicolor*) in the tree stratum along the edge of the stream.

The manmade pond is approximately 150′ by 50′ and is located centrally in the property. The pond is hydrologically connected with the stream via a small break in the berm at the southwest corner. The area immediately to the northeast and west of the pond is highly disturbed and contains several gravel berms and piles, most of which have revegetated with upland trees, shrubs and herbaceous species. The pond is well vegetated along the north edge with dense overhanging shrubs and small trees including gray birch and red maple in the tree stratum and glossy buckthorn and red chokeberry (*Aronia arbutifolia*) in the shrub stratum. There are several small open areas along the pond edges vegetated with soft rush, goldenrod (*Solidago* sp.), swamp dewberry (*Rubus hispidus*) and little bluestem (*Andropogon scoparius*) in the herbaceous stratum. Initial investigations indicate the pond as unconsolidated bottom with a mud bottom substrate. Most of the pond bottom has been subject to significant deposition of flocculent material from contaminated groundwater discharges. The pond has a vegetative cover of less than 30% and is permanently flooded. Observations during the summer of 1992 indicate extremely sparse submerged aquatic vegetation exists within the pond area. The edges of the pond are vegetated with an approximate equal percentage of species in the shrub and herbaceous strata with tree, sapling and liana strata generally nonexistent. Table 4 provides details on the plant community of the area immediately along the pond edges. Figure 6 illustrates the dominance of the shrub and herbaceous strata along the pond edge and the general absence of the tree, sapling and liana strata. The dominant species within the herbaceous and shrub strata indicate that this area, while once highly disturbed, is currently in an early successional stage of revegetation.

There is a large scrub-shrub wetland area to the north and northeast of the pond area. In this area, groundwater breakout occurs and generally flows are from the former lagoon area in a southeasterly direction to the South Ditch. There are also several small depressional areas within this scrub-shrub wetland which occasionally pond water. Typically this area contains heavily vegetated shrub thickets with many open clearings interspersed throughout. The clearings are dominated by a dense herbaceous stratum.

Historical data from aerial photography and recent field observations of remnant stumps and downed logs indicate the area east of the old lagoon area and north of the pond area was once forested but has undergone a significant change in vegetation cover. There are rotting tree stumps throughout this scrub-shrub area which show evidence of past cutting activities. While an indepth investigation has not been done, it appears the earlier forest canopy in this area died back within a relatively short period of time. The standing dead trees were subsequently cut and removed from the area. The present scrub-shrub community has become well established in the cleared or open area. Evidence of this mortality has been observed on aerial photographs dated April 13, 1981 and may be related to a variety of factors, including air or water borne contaminants from the old lagoon structure, human induced surface and ground hydrology changes, or natural causes such as gypsy moth defoliation, disease, etc. In general, this area is dominated by gray birch with red maple occasionally present in a sparse tree and sapling strata. The shrub stratum is dominated by gray birch and glossy buckthorn with common elderberry (*Sambucus canadensis*) and highbush blueberry occasionally present. The herbaceous stratum ranges from relatively sparse in the dense thicket portion of this scrub-shrub wetland to dense in the open clearings. Goldenrod, woolgrass and unidentified grasses (*Graminae* spp.) are commonly found

throughout this area with pokeweed (*Phytolacca americana*), tussock sedge (*Carex stricta*) and phragmites (*Phragmites australis*) occasionally present. False buckwheat (*Polygonum scandens*) is occasionally present in the liana stratum.

Provided in Table 5 are the results of vegetation sampling conducted within the scrub-shrub wetland area. The species composition of the tree, sapling and shrub strata are dominated by an early successional species typically found on disturbed sites. Figure 7 illustrates the high percentage of species cover in the shrub and herbaceous strata while the tree, sapling and liana strata are relatively sparse.

Also present in Drainage Area AA is a small portion of forested wetland adjacent to the fence at the east property line. This area is typically vegetated with a mature overstory with red maple dominant and white oak, gray birch, black cherry and white pine occasionally present in the tree stratum. Red maple and gray birch are found in the sapling stratum. The shrub stratum is dense at the perimeter of this area and generally sparse toward the center. Glossy buckthorn, red maple and highbush blueberry are found with shadbush occurring occasionally. No species were observed in the liana stratum. The herbaceous stratum consists of glossy buckthorn seedlings and an unidentified fern species. The vegetational composition of this area is generally evenly distributed among the tree, sapling and shrub strata with a sparse herbaceous stratum and no liana stratum present. The plant community composition is typically broad leaved deciduous. Table 6 provides results of vegetation sampling within this forested wetland area. Figure 8 illustrates the approximately equal percent coverages of tree, sapling and shrub strata, a generally sparse herbaceous stratum and a nonexistent liana stratum for the sample. The degree of stratification and dominance of the older tree and sapling species indicates this area has not undergone recent disturbances.

#### 4.2.2.2 Drainage Area BB

Area BB is generally located west of the main site buildings and also includes a small area in the northwest corner of the site. This small drainage area begins in the northwest property corner and is joined by a second small drainage originating from a culvert at the outfall for the water treatment facility on the site. The flows through the culvert are intermittent and depend on water treatment system discharges and runoff on the site. Together, these flows form the main stream which flows south along the west property line. The lower portion of the drainage in Area BB is a dug channel. The flow in the channel continues south to a 36" culvert running under the access road midway along the west side property line on the site. A short distance below the culvert, the drainage merges with the flow in Drainage Area AA.

The soils of Wetland Area BB are heavily disturbed by historic site activities which include excavating, regrading and filling in and around the borders of the wetland. The area also historically received stormwater runoff from roofs and other impervious surfaces located on the developed (northerly) portion of the site. These soils are classified as Udorthents due to the site history.

The predominant soil condition within the wetland represents a very poorly drained organic soil. These soils have a very wet substratum and are considered hydric. A profile description (typical) for the existing unfilled wetland area reads as follows:

| | |
|---|---|
| 0" | Black (10YR 2/0), highly decomposed sapric muck |
| 30" | Brown (7.5YR 5/3), coarse sandy loam |
| 48" | terminated, no refusal |

This description most closely corresponds to Freetown series soils.

Area BB contains several wetland classes associated with the small drainage stream flowing south through the area. The northern portion of Area BB is generally an emergent wetland at the center with a plant community dominated by cattail, meadowsweet (*Spiraea latifolia*), goldenrod and purple loosestrife. Surrounding the open marsh portion is an area of forested wetland dominated by red maple, gray birch and swamp white oak in the tree stratum; red maple in the sapling stratum; highbush blueberry, shadbush and glossy buckthorn in the shrub stratum; and cinnamon fern in the herbaceous stratum.

Associated with the middle portion of the stream in Area BB is a similar open marsh area typically vegetated with cattail, purple loosestrife, meadowsweet and goldenrod. Occasionally there is glossy buckthorn, red maple and gray birch present in the shrub stratum along the side slope/perimeter areas. The vegetation of this area is dominated by the herbaceous and shrub strata with tree, sapling and liana strata generally nonexistent. The majority of this area is an open emergent wetland system with shrub species present along the perimeter. Due to the flooding frequency in the area, the vegetation is not highly stratified and it is unlikely, due to the saturated and occasionally inundated soils, that rapid successional changes in the plant community will occur within the flooded basin. Table 7 provides details on the current plant community composition of the open wetland portion of Area BB. The dominant herbaceous stratum and the subdominant shrub stratum illustrated in Figure 9 identify this area as emergent wetland.

The plant community in the southern most portion of Area BB is typically a forested wetland dominated by gray birch with quaking aspen (*Populus tremula*) with swamp white oak also present. The sapling stratum is dominated by gray birch and the shrub stratum is predominantly glossy buckthorn with gray birch and highbush

blueberry also present. No species were observed in the liana stratum and in the herbaceous stratum there are several fern species (all were unidentified due to the season of the year) and glossy buckthorn dominant with sedges, goldenrod and swamp dewberry also present. Table 8 provides the results of the vegetation sampling in the forested wetland portion of Area BB. The species composition found in this area indicates that this area has undergone a previous disturbance and is in an early forest successional stage. Figure 10 illustrates the relative dominance of the shrub and herbaceous strata.

There is evidence of past cutting activities in this area and several large rotting stumps remain in the area. The main channel of the stream through this area is through a manmade ditch which contains flows directly to the 36" CMP at the access road along the west side property line. The southerly portion of the area also includes a remnant manmade ditch which no longer contains flowing water.

#### 4.2.2.3 Drainage Area CC

Drainage Area CC is located south of Drainage Area AA and surface water from Area CC flows to the east eventually entering Drainage Area AA near the eastern property line. This small drainage stream begins as groundwater breakout in a large, relatively flat scrub-shrub swamp located along the western side of the property. Drainage Area CC contains two wetland types, a scrub-shrub portion along the west side property line directly south and adjacent to the main drainage stream (Drainage Area AA) on the site and a larger forested wetland complex located along the eastern portion of the drainage. Drainage Area CC extends from the west property line through the center portion of the property to the confluence with the main drainage Area AA approximately 25' east of the chain link fence at the east property line.

The predominant soils in Wetland Area CC are very poorly drained mineral soils. The western portions of Drainage Area CC have been exposed to some disturbance during past site investigations but the majority of Area CC soils are in a natural condition. Portions of the area are subject to flooding due to bank overflow from the brook and have a water table that is occasionally above the soil surface. The remainder of time the water table is at or very near the soil surface. The soils in this area most closely resemble Swansea series. Poorly drained mineral soils also constitute a significant portion of the wetland area.

The scrub-shrub area is vegetated with dense shrub thickets with occasional small open grassy areas interspersed throughout. In the thicket section, glossy buckthorn is dominant in the shrub stratum, with sweet pepperbush, gray birch seedlings and highbush blueberry also present. The herbaceous stratum is generally sparse here with cinnamon fern, sensitive fern (*Onoclea sensibilis*) and another unidentified fern species occasionally present.

In the open grassy portions of the scrub-shrub area, gray birch and glossy buckthorn are most commonly found in a sparse to medium shrub stratum with sweet pepperbush and highbush blueberry occasionally present. The herbaceous stratum is made up of little bluestem, soft rush, Canada rush and swamp dewberry, with twig rush (*Cladium marisoides*) and several unidentified grasses occasionally present. This portion of the scrub-shrub area contains several depressional areas which pond water during the winter and spring seasons. This area was disturbed during previous dredging activities in the main stream and several berms and small soil piles remain. The vegetation composition of this area is dominated by portions of dense shrub thickets along with open grassy patches scattered throughout.

Although the area does contain open grassy portions in areas of more recent disturbance, the overall plant community makeup best characterizes the area as scrub-shrub wetland. The majority of the area was relatively recently disturbed and is in an early successional stage with the shrub and herbaceous strata dominant. The tree, sapling and liana strata are generally nonexistent. The hydrologic conditions in this area are similar to the adjacent wooded swamp and this area will most likely develop a tree and sapling overstory over time. Table 9 provides details on the current plant community composition of this wetland area. The occurrence of a dense shrub stratum interspersed with open grassy patches identifies this area as scrub-shrub wetland. Figure 11 illustrates the dominance of the shrub and herbaceous strata in representative portions of the thicket and open meadow areas within the wetland. The species composition and structural characteristics indicate past disturbance to this area and identify the wetland area as being in a relatively early successional stage.

The eastern portion of Area CC is a forested wetland and is typical of red maple swamps in New England. The tree stratum is dominated by red maple with gray birch, swamp white oak, red oak, white oak, black cherry, white pine and pitch pine also occasionally present. The average diameter of trees in the overstory, excepting gray birch, is 12" dbh. The sapling stratum is made up of red maple while the shrub stratum is dominated by glossy buckthorn and red maple with Northern arrow-wood (*Viburnum recognitum)*, highbush blueberry and red chokeberry occasionally present. The predominant observed species in the herbaceous stratum were cinnamon fern and glossy buckthorn seedlings with sphagnum (*Sphagnum* sp.), royal fern (*Osmunda regalis*), wood fern (*Dryopteris* sp.) and an unidentified fern species present but in lesser numbers. No species were observed within the liana stratum during the vegetation sampling. The vegetation composition of this area

is typical of forested wetlands. The tree, shrub and herbaceous strata are the most prevalent, the sapling stratum is sparse and there were no liana observed. The average diameter of the trees is 12 inches dbh.

This gray birch/red maple stand type is typical on abandoned farm land. The birch component is generally short lived, usually dying back in 60 years or less. As is typical of most wooded swamps in New England, this community is a sere, or a step in the successional stage, and will change over time as the vegetation community matures. Table 10 provides the results of the vegetation sampling in the forested wetland portion of Drainage Area CC. The species composition found in this area indicates that the forested wetland is currently in an early to mid successional stage with generally little or no recent disturbances within the forest. Figure 12 illustrates the generally high degree of vertical stratification in the forested wetland.

#### 4.2.2.4 Drainage Area DD

Area DD is an isolated basin which receives surface runoff during storm events from the surrounding area particularly the steep side slopes associated with the offsite landfill located to the southeast. Several hydrology indicators observed in the area including water stains on exposed rocks, rust stains on fence posts along the property line, and water stained leaves confirm that this area is inundated periodically.

The predominant soils in Wetland Area DD are very poorly drained mineral soils which are somewhat disturbed. These soils often are inundated. The soils in this area most closely resemble Swansea series. There are somewhat poorly drained and poorly drained soils found here as well.

The wetland area in Drainage Area DD is an emergent wetland dominated by herbaceous hydrophytic vegetation throughout the center portion with generally sparse tree, sapling and shrub strata along the outer perimeters. The central portion of the area is densely vegetated with purple loosestrife dominant in the herbaceous stratum with goldenrod, jewelweed (*Impatiens capensis*), sedges and soft rush also present. Occasionally there is evening primrose (*Oenothera* sp.) in the stratum. The edge areas are vegetated with black willow (*Salix nigra*) and red maple in a sparse tree stratum. Red maple forms a sparse sapling stratum along the perimeter of the area. Glossy buckthorn and common elderberry are found in the shrub stratum which is also restricted to the perimeter of the basin. There were no species observed in the liana stratum. The vegetational composition of this area is dominated by a dense herbaceous stratum with trees, sapling and shrubs occurring in approximate equal densities around the perimeter. The majority of this isolated area is an emergent wetland. Due to frequent flooding in this area, the vegetation is not highly stratified and it is unlikely due to the hydrologic conditions that rapid change in the plant community structure will occur within the flooded basin. Table 11 provides details on the current vegetation characteristics of this wetland area. Although tree, sapling and shrub strata are present, they occur in a relatively small area along the perimeter of this area. The herbaceous stratum throughout the central portion of this wetland area is composed of dominant species found in emergent wetlands. Figure 13 illustrates the overwhelming dominance of the herbaceous stratum in this area.

#### 4.2.2.5 Drainage Area EE

Area EE has historically been referred to as the East Ditch System and is located to the east of the property along the west side of the MBTA railroad tracks. The drainage begins at a 24" culvert immediately south of the bridge over the railroad

tracks on Eames Street and extends approximately 2,100 feet south to the confluence of the main stream from the AA area which joins the drainage ditch approximately 200 feet north of a 24" culvert. The main discharge from the property continues through the south portion of the drainage ditch along the west side of the tracks and subsequently enters the 24" culvert which discharges in an open ditch approximately 400' to the south. Eventually the drainage ditch discharges into Halls Brook in Woburn.

The soils of Wetland Area EE are heavily disturbed by historic and ongoing activities related to excavation and maintenance for the railroad tracks. These soils are classified as Udorthents. Additionally, the bottom of the excavation has a wet substratum. These soils are considered hydric and most closely resemble poorly drained mineral soils, however, most of the ditch has been covered with a layer of 1" - 2" crushed aggregate.

The ditch is sparsely vegetated along its entire length with the majority of the vegetation being subject to cutting and/or spraying during maintenance of the railroad easement. Small red maple and glossy buckthorn shrub and tree sprouts occur on the west bank of the ditch. Herbaceous species observed include purple loosestrife, sedge, soft rush, several grasses and swamp dewberry. The east bank of the ditch is entirely made up of crushed stone and occasionally contains glossy buckthorn and red maple sprouts. Due to its proximity to the railroad ROW, this area is heavily maintained by vegetative cutting and/or spraying. The heavily maintained nature of this area generally restricts plant community establishment.

The inundated portion of the ditch is unvegetated with a variable sand, mud and cobble-gravel bottom. Sparse herbaceous and shrub strata are present along the

west bank of the ditch. Due to MBTA maintenance schedules, this area is anticipated to remain as a sparsely vegetated ditch and is considered to fall within the Unconsolidated Bottom wetland classification due to the bottom substrate and low percentage of plant species coverage. Table 12 provides details of the limited plant community of this area. The poor substrate and highly disturbed nature of the ditch limit the plant community to a sparse herbaceous and shrub strata. Figure 14 illustrates the dominance of the sparse herbaceous and shrub strata present in this area.

## 5.0 Wildlife Utilization of Site

During the wetland delineation activities and several follow-up site visits, general observations of onsite wildlife habitat characteristics were made within the various wetland upland areas. These observations included plant community composition and structure, occurrence of edge and transition zones, hydrologic characteristics, leaf litter and substrate characteristics, nesting, denning and travel corridor sites as well as actual observations of individual species using the area.

In general, the site contains a diverse mix of wetland and upland habitats. This diversity of habitat can enhance an area's overall ability to support and sustain equally diverse wildlife populations. The mosaic of dense scrub-shrub thickets interspersed among the forested wetland, and the presence of pond and stream corridors increases the available edge habitat important to many small mammals and songbirds. The changes in vertical stratification from dense wooded areas into open wet meadow, marsh and maintained upland fields provides browsing, sunning and feeding areas. During the site visits, observations of Eastern cottontail rabbits (*Sylvilagus floridanus*) and their sign such as tracks, pellets and burrows

confirms a utilization of the site by this species. Several larger animal dens were also observed on the site and may be utilized by woodchuck (*Marmota monax*), opossum (*Didelphis virginiana*) or quite likely fox (*Vulpes fulva*). Fox and raccoon (*Procyon lotor*) tracks as well as travel lanes under the chain link fence along the south property line were observed. During the site evaluation, woodchuck remains were found in Drainage Area AA and a dead opossum was observed in the upland forested area south of Drainage Area CC.

The chain link fence enclosing the entire property, while passable by smaller mammals, restricts usage of the site by larger mammals. The land use patterns of the surrounding area also limit the types of wildlife species in the area, therefore it is unlikely mammals other than those typical to urban areas such as gray squirrel (*Sciurus carolinensis*), raccoon, woodchuck, rabbit, opossum and skunk (*Mephitis mephitis*) frequent the area.

Several significant snags as well as downed hollow trees were observed in both the forested wetland and forested upland portions of the site. Cavities and burrow holes indicated use by birds, however, due to the season of observation, which was generally after the fall migration season, bird sightings were limited. Species observed during the site visits included black capped chickadees (*Parus atricapillus*), blue jays (*Cyanocitta cristata*), sparrows (unidentified) and a downy woodpecker (*Dendrocopus pubescens*). Several small songbird nests were observed in the dense thicket portions of the scrub-shrub wetland areas.

There are many areas on the site which may be important in providing reptile and amphibian habitat. The various perennial and intermittent streams, the pond and intermittently flooded areas, the variability of substrates from soft burrowable

mud to rocky crevice laden stream bottoms, and the occurrence of many downed and rotting logs and stumps in some portions of the site are physical and structural characteristics which contribute to reptile and amphibian habitat. Many of these areas are, however, impacted to varying degrees by past and current human activities on the site including vegetation control, disturbed soil conditions, flocculent sedimentation. As a result, the site appears to provide only marginal habitat for reptiles and amphibians. Various observations of amphibians were made during several visits to the site including Northern leopard frog (*Rana pipiens pipiens*) and bull frog (*Rana catesbeiana*) sightings. Given the nature of the wetland areas on the site, spring peepers (*Hyla crucifer crucifer*) and wood frogs (*Rana sylvatica*) are also likely to occur.

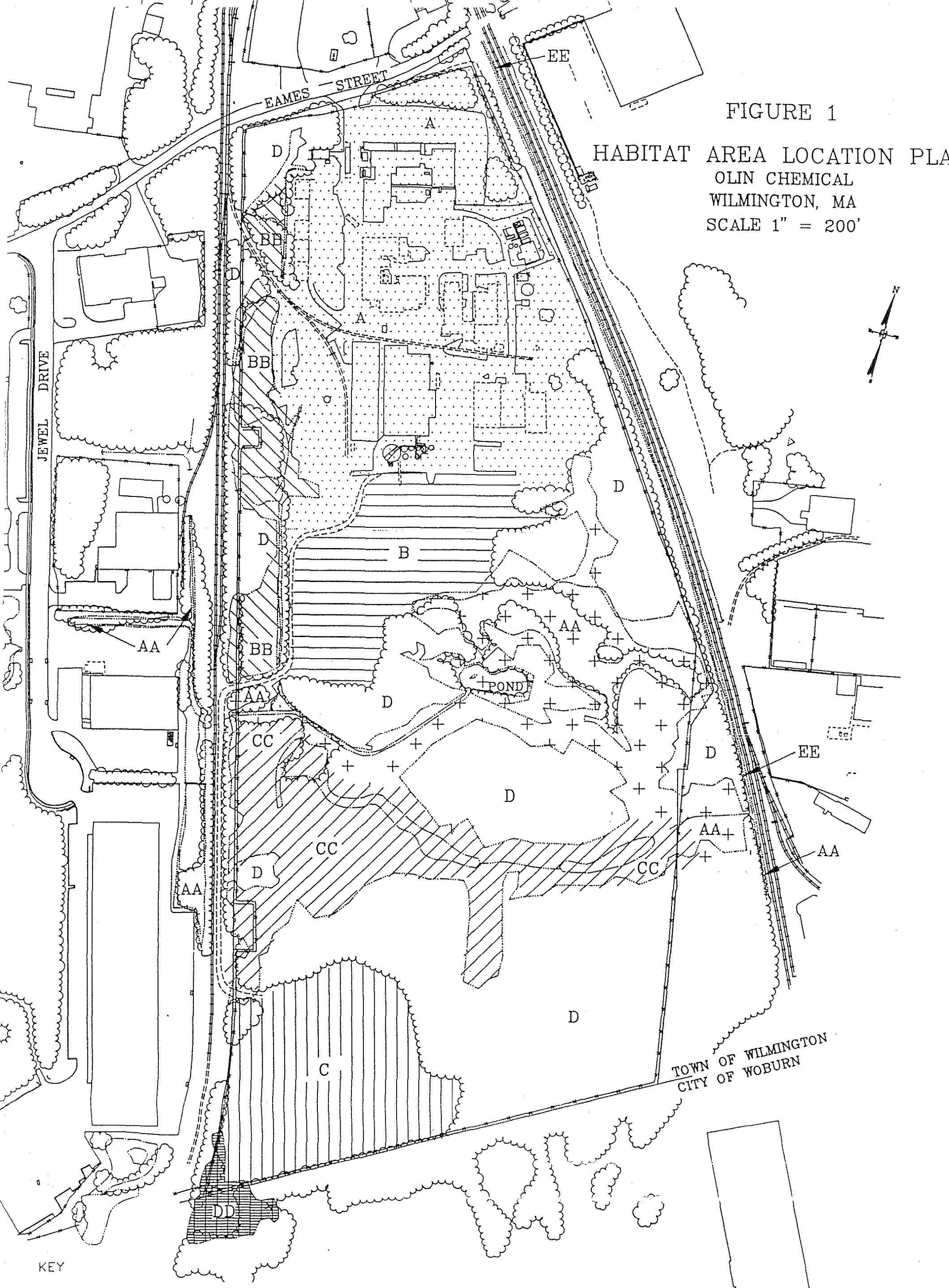
The proximity of unbroken forest cover along the south edge of the central wetland area can provide corridors between the wetland area into and beyond the buffer zone in the upland forest. The cleared forest at the interface between the landfill area and lagoon area and the forested uplands can provide important "edge" essential for a variety of small songbirds, mammals and reptiles which utilize the open field to feed and sun but which need the heavily stratified dense forest canopy cover for shelter and nesting.

Summary Perspective of Wildlife Usage

The site contains a variety of upland and wetland habitats which contain wildlife habitat characteristics such as denning, feeding, sheltering and nesting sites which are useful to a wide variety of birds, small mammals, reptiles and amphibians. The transition areas between the various upland and wetland habitats and the interspersion of individual habitat types within the upland and wetland areas are important in providing edge between the dense cover types and the open meadow and grassy portions of the various habitat areas.

The current contamination of the main drainage stream in the Drainage Area AA reduces the overall water quality of this portion of the site. While the various wetland and upland habitats adjacent to the stream currently contain useful wildlife habitat characteristics, the poor water quality and past human disruption of the area limit the habitat value of this portion of the site.

The current industrial complex on the north portion of the site limits the usefulness of this area to many small mammals and birds which require tracts of undisturbed woodland for seclusion and shelter. The existing chain link security fence erected in 1981 inhibits movement of larger mammals on and off the site thus restricting habitation of the site by these animals as well as the use of adjacent habitat types. The open paved and grassy areas on the north portion of the site may enhance sunning and feeding areas for select birds, small mammals such as rodents, squirrels and rabbits, and reptiles such as snakes.




KEY

| | |
|---|---|
| A | HEAVILY MAINTAINED/INDUSTRIAL |
| B | HEAVILY MAINTAINED/OPEN FIELD – FORMER LAGOON AREA |
| C | HEAVILY MAINTAINED OPEN FIELD – GYPSUM DUMP |
| D | FORESTED UPLAND |
| AA | DRAINAGE AREA AA – UNCONSOLIDATED BOTTOM – POND/SCRUB–SHRUB WETLAND/FORESTED WETLAND – "SOUTH DITC EMERGENT WETLAND – "WEST DITCH" |
| BB | DRAINAGE AREA BB – EMERGENT WETLAND/SCRUB–SHRUB WETLAND/FORESTED WETLAND |
| CC | DRAINAGE AREA CC – SCRUB–SHRUB WETLAND/FORESTED WETLAND |
| DD | DRAINAGE AREA DD – EMERGENT WETLAND – ISOLATED |
| EE | DRAINAGE AREA EE – UNCONSOLIDATED BOTTOM – "EAST DITCH" |

Table 1

Plant Community Composition

Upland Area D

Forested Upland Island Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Dense | | |
| white pine | (*Pinus strobus*) | | D | FACU |
| white oak | (*Quercus alba*) | | D | FACU- |
| black cherry | (*Prunus serotina*) | | C | FACU |
| red maple | (*Acer rubrum*) | | O | FAC |
| Sapling | | Sparse | | |
| black cherry | (*Prunus serotina*) | | O | FACU |
| shadbush | (*Amelanchier canadensis*) | | O | FAC |
| red maple | (*Acer rubrum*) | | O | FAC |
| Shrub | | Medium Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| red maple | (*Acer rubrum*) | | O | FAC |
| black cherry | (*Prunus serotina*) | | O | FACU |
| shadbush | (*Amelanchier canadensis*) | | O | FAC |
| Herbaceous | | Sparse* | | |
| glossy buckthorn | (*Rhamnus frangula*) | | C | FAC |
| clubmoss | (*Lycopodium complanatum*) | | O | FACU |

Liana - none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 2

Plant Community Composition

Upland Area D

Forested Upland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Dense | | |
| white oak | (*Quercus alba*) | | D | FACU- |
| red oak | (*Quercus rubra*) | | C | FACU- |
| black cherry | (*Prunus serotina*) | | O | FACU |
| Sapling | | Medium Dense | | |
| white oak | (*Quercus alba*) | | D | FACU- |
| Shrub | | Medium Dense | | |
| red oak | (*Quercus rubra*) | | C | FACU- |
| black cherry | (*Prunus serotina*) | | C | FACU |
| red maple | (*Acer rubrum*) | | O | FAC |
| highbush blueberry | (*Vaccinium corymbosum*) | | O | FACW- |
| Herbaceous | | Medium Dense* | | |
| sheep laurel | (*Kalmia angustifolia*) | | D | FAC |
| teaberry | (*Gaultheria procumbens*) | | D | FACU |
| clubmoss | (*Lycopodium complanatum*) | | O | FACU |
| black cherry | (*Prunus serotina*) | | O | FACU |

Liana - none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 3

Plant Community Composition

Drainage Area AA

Emergent Wetland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Sparse | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| Sapling | | Sparse | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| Shrub | | Medium Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| Herbaceous | | Very Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| manna grass | (*Glyceria canadensis*) | | C | OBL |
| goldenrod | (*Solidago* sp.) | | O | -- |
| spiraea | (*Spiraea tomentosa*) | | O | FACW |
| unidentified herbaceous | | | O | -- |

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 4

Plant Community Composition

Drainage Area AA

Unconsolidated Bottom Component (Pond)

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Shrub | | Medium Dense | | |
| gray birch | (*Betula populifolia*) | | C | FAC |
| red maple | (*Acer rubrum*) | | C | FAC |
| Herbaceous | | Medium Dense | | |
| little bluestem | (*Andropogon scoparius*) | | C | UPL |
| goldenrod | (*Solidago* sp.) | | C | -- |
| swamp dewberry | (*Rubus hispidus*) | | C | FACW |
| soft rush | (*Juncus effusus*) | | O | FACW+ |

Note: No aquatic vegetation observed due to ice cover on the pond.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 5

Plant Community Composition

Drainage Area AA

Scrub-Shrub Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Sparse | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| red maple | (*Acer rubrum*) | | O | FAC |
| Sapling | | Sparse | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| Shrub | | Dense | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| elderberry | (*Sambucus candensis*) | | O | FACW- |
| highbush blueberry | (*Vaccinium corymbosum*) | | O | FACW- |
| Herbaceous | | Dense | | |
| goldenrod | (*Solidago* sp.) | | D | -- |
| grasses | (*Graminae* spp.) | | C | -- |
| woolgrass | (*Scirpus cyperinus*) | | C | FACW+ |
| pokeweed | (*Phytolaca americana*) | | O | FACU+ |
| phragmites | (*Phragmites* sp.) | | O | FACW |
| tussock sedge | (*Carex stricta*) | | O | OBL |
| Liana | | | | |
| false buckwheat | (*Polygonum scandens*) | | O | FACU+ |

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 6

Plant Community Composition

Drainage Area AA

Forested Wetland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Medium Sparse | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| quaking aspen | (*Populus tremula*) | | C | FACU |
| swamp white oak | (*Quercus bicolor*) | | O | FACW+ |
| Sapling | | Medium Sparse | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| Shrub | | Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| gray birch | (*Betula populifolia*) | | O | FAC |
| highbush blueberry | (*Vaccinium corymbosum*) | | O | FACW- |
| Herbaceous | | Dense | | |
| spinulose wood fern | (*Dryopteris spinulosa*) | | D | FAC+ |
| glossy buckthorn | (*Rhamnus frangula*) | | C | FAC |
| goldenrod | (*Solidago* sp.) | | O | -- |
| sedge | (*Carex* sp.) | | O | -- |
| lady fern | (*Athyrium thelypterioides*) | | O | FAC |
| swamp dewberry | (*Rubus hispidus*) | | O | FACW |

Liana -- none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 7

Plant Community Composition

Drainage Area BB

Emergent Wetland Component

Area along ditch - open marsh

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Shrub | | Medium Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| red maple | (*Acer rubrum*) | | C | FAC |
| gray birch | (*Betula populifolia*) | | O | FAC |
| Herbaceous | | Dense | | |
| cattail | (*Typha latifolia*) | | D | OBL |
| purple loosestrife | (*Lythrum salicaria*) | | D | FACW+ |
| spiraea | (*Spiraea latifolia*) | | C | FAC+ |
| goldenrod | (*Solidago* sp.) | | C | -- |

Tree, Sapling and Liana strata - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 8

Plant Community Composition

Drainage Area BB

Forested Wetland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Medium Dense | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| white oak | (*Quercus alba*) | | O | FACU- |
| gray birch | (*Betula populifolia*) | | O | FAC |
| black cherry | (*Prunus serotina*) | | O | FACU |
| white pine | (*Pinus strobus*) | | trace | FACU |
| Sapling | | Medium Dense | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| gray birch | (*Betula populifolia*) | | O | FAC |
| Shrub | | Medium Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| highbush blueberry | (*Vaccinium corymbosum*) | | C | FACW- |
| red maple | (*Acer rubrum*) | | C | FAC |
| shadbush | (*Amelanchier arbutifolia*) | | trace | FACW |
| Herbaceous | | Sparse | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| fern (unidentified) | | | O | -- |
| Indian pipe | (*Monotropa uniflora*) | | trace | FACU- |

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 9

Plant Community Composition

Drainage Area CC

Scrub-Shrub Component

Thicket Section

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Shrub | | Very Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| sweet pepperbush | (*Clethra alnifolia*) | | C | FAC+ |
| gray birch | (*Betula populifolia*) | | C | FAC |
| highbush blueberry | (*Vaccinium corymbosum*) | | O | FACW- |
| Herbaceous | | Sparse | | |
| cinnamon fern | (*Osmunda cinnamomea*) | | C | FACW |
| fern (unidentified) | | | O | -- |
| sensitive fern | (*Onoclea sensibilis*) | | O | FACW |

Tree, Sapling, and Liana strata - none observed

Open Meadow Section

| | | | | |
|---|---|---|---|---|
| Shrub | | Sparse/ Medium | | |
| gray birch | (*Betula populifolia*) | | D | FAC |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| sweet pepperbush | (*Clethra alnifolia*) | | O | FAC+ |
| highbush blueberry | (*Vaccinium corymbosum*) | | O | FACW- |
| Herbaceous | | Dense | | |
| little bluestem | (*Andropogon scoparius*) | | D | UPL |
| soft rush | (*Juncus effusus*) | | C | FACW+ |
| Canada rush | (*Juncus canadensis*) | | C | OBL |
| swamp dewberry | (*Rubus hispidus*) | | C | FACW |
| twig rush | (*Cladium marisoides*) | | O | OBL |

Tree, Sapling, and Liana strata - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 10

Plant Community Composition

Drainage Area CC

Forested Wetland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Medium Density | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| gray birch | (*Betula populifolia*) | | C | FAC |
| red oak | (*Quercus rubra*) | | O | FACU- |
| pitch pine | (*Pinus rigida*) | | O | FACU |
| white oak | (*Quercus alba*) | | O | FACU- |
| black cherry | (*Prunus serotina*) | | O | FACU |
| white pine | (*Pinus strobus*) | | O | FACU |
| Sapling | | Sparse | | |
| red maple | (*Acer rubrum*) | | D | FAC |
| Shrub | | Medium Dense | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| red maple | (*Acer rubrum*) | | C | FAC |
| Northern arrow-wood | (*Viburnum recognitum*) | | O | FACW+ |
| Herbaceous | | Dense | | |
| cinnamon fern | (*Osmunda cinnamomea*) | | D | FACW |
| sphagnum | (*Sphagnum* sp.) | | C | OBL |
| royal fern | (*Osmunda regalis*) | | C | OBL |
| glossy buckthorn | (*Rhamnus frangula*) | | C | FAC |
| wood fern | (*Dryopteris* sp.) | | O | -- |
| fern (unidentified) | | | O | -- |

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 11

Plant Community Composition

Drainage Area DD

Emergent Wetland Component

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree | | Sparse | | |
| willow | (*Salix* sp.) | | D | FACW+ |
| red maple | (*Acer rubrum*) | | C | FAC |
| Sapling | | Sparse | | |
| red maple | (*Acer rubrum*) | | C | FAC |
| Shrub | | Sparse | | |
| glossy buckthorn | (*Rhamnus frangula*) | | D | FAC |
| elderberry | (*Sambucus canadensis*) | | O | FACW- |
| Herbaceous | | Dense | | |
| purple loosestrife | (*Lythrum salicaria*) | | D | FACW+ |
| goldenrod | (*Solidago* sp.) | | C | -- |
| jewelweed | (*Impatiens capensis*) | | C | FACW |
| sedge | (*Carex* sp.) | | C | -- |
| soft rush | (*Juncus effusus*) | | O | FACW+ |
| evening primrose | (*Oenothera* sp.) | | trace | -- |

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 12

Plant Community Composition

Drainage Area EE

Unconsolidated Bottom Component (Ditch)

| Stratum | Scientific Name | Canopy Closure | Species Dominance | NWI Status |
|---|---|---|---|---|
| Tree and Sapling strata - none observed | | | | |
| Shrub | | Sparse | | |
| red maple | (*Acer rubrum*) | | C | FAC |
| glossy buckthorn | (*Rhamnus frangula*) | | C | FAC |
| Herbaceous | | Medium Sparse | | |
| purple loosestrife | (*Lythrum salicaria*) | | C | FACW+ |
| sedge | (*Carex* sp.) | | C | -- |
| soft rush | (*Juncus effusus*) | | O | FACW+ |
| grasses | (*Graminae* spp.) | | O | -- |
| swamp dewberry | (*Rubus hispidus*) | | O | FACW |
| Liana - none observed | | | | |

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

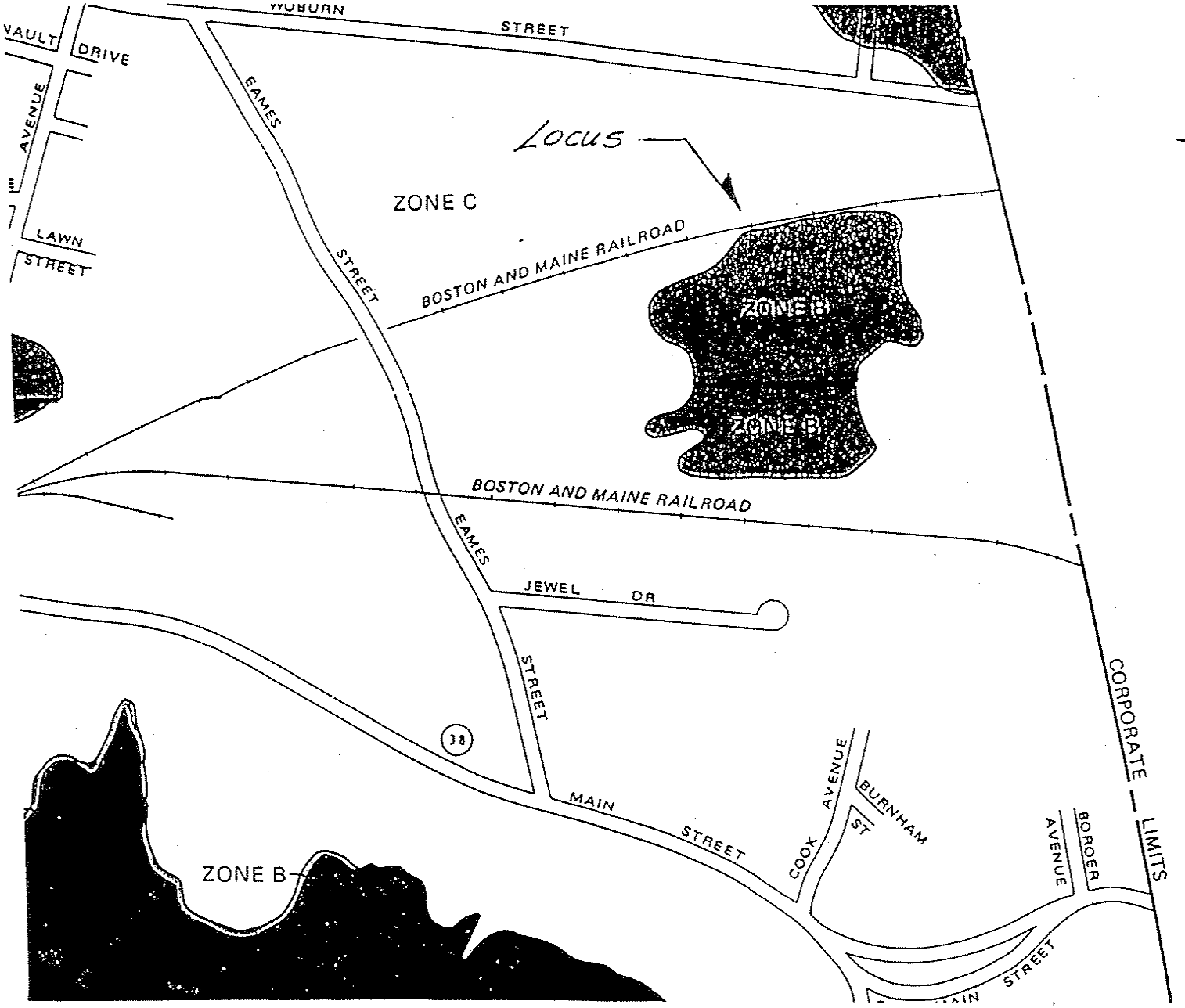



FIGURE 2

# FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
WILMINGTON,
MASSACHUSETTS
MIDDLESEX COUNTY

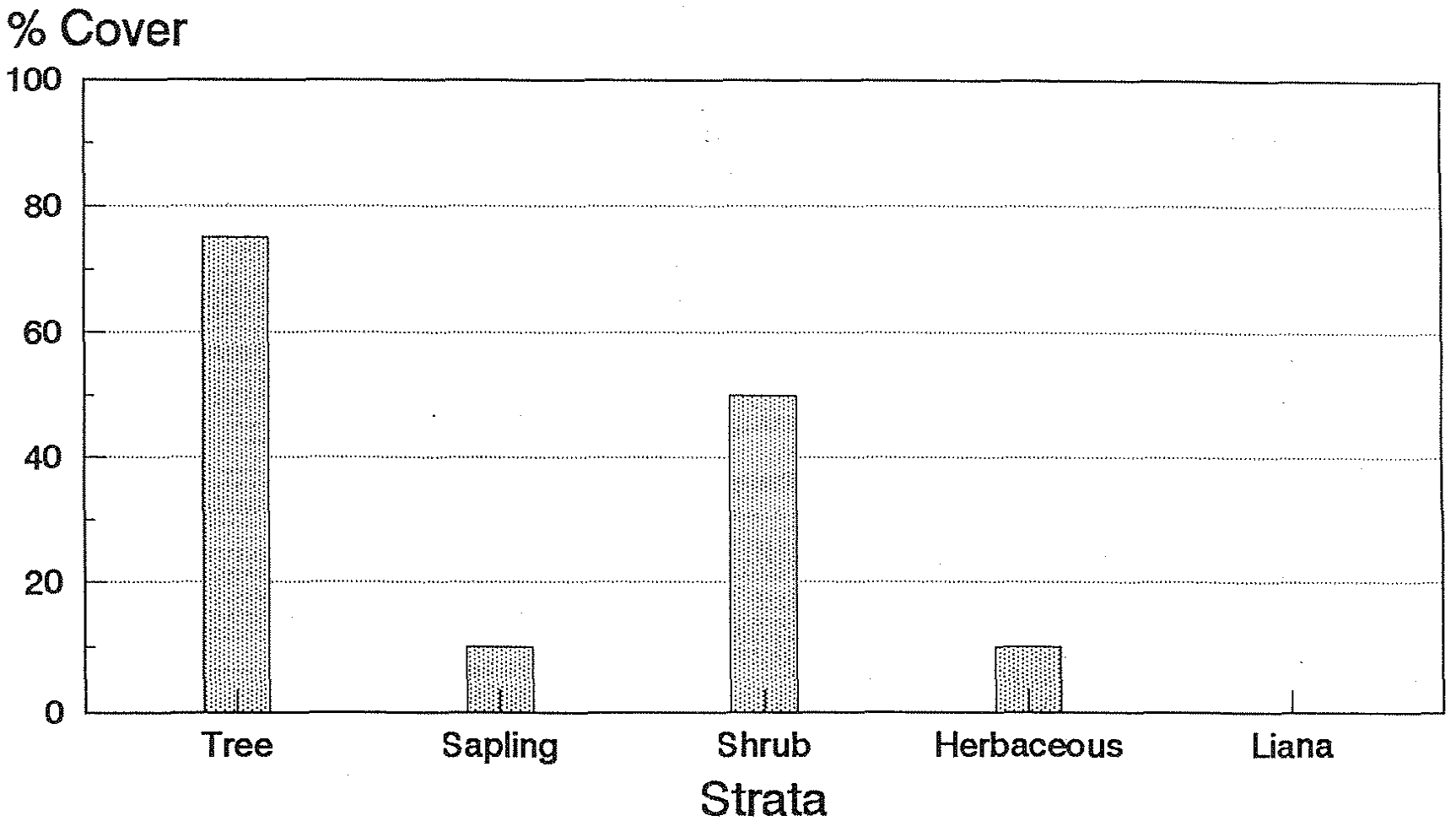
COMMUNITY-PANEL NUMBER
250227 0004 B
EFFECTIVE DATE:
JUNE 15, 1982

COMMUNITY-PANEL NUMBER
250227 0002 B
EFFECTIVE DATE:
JUNE 15, 1982

# Figure 3

**Upland Area D**

**Forested Upland Island Component**

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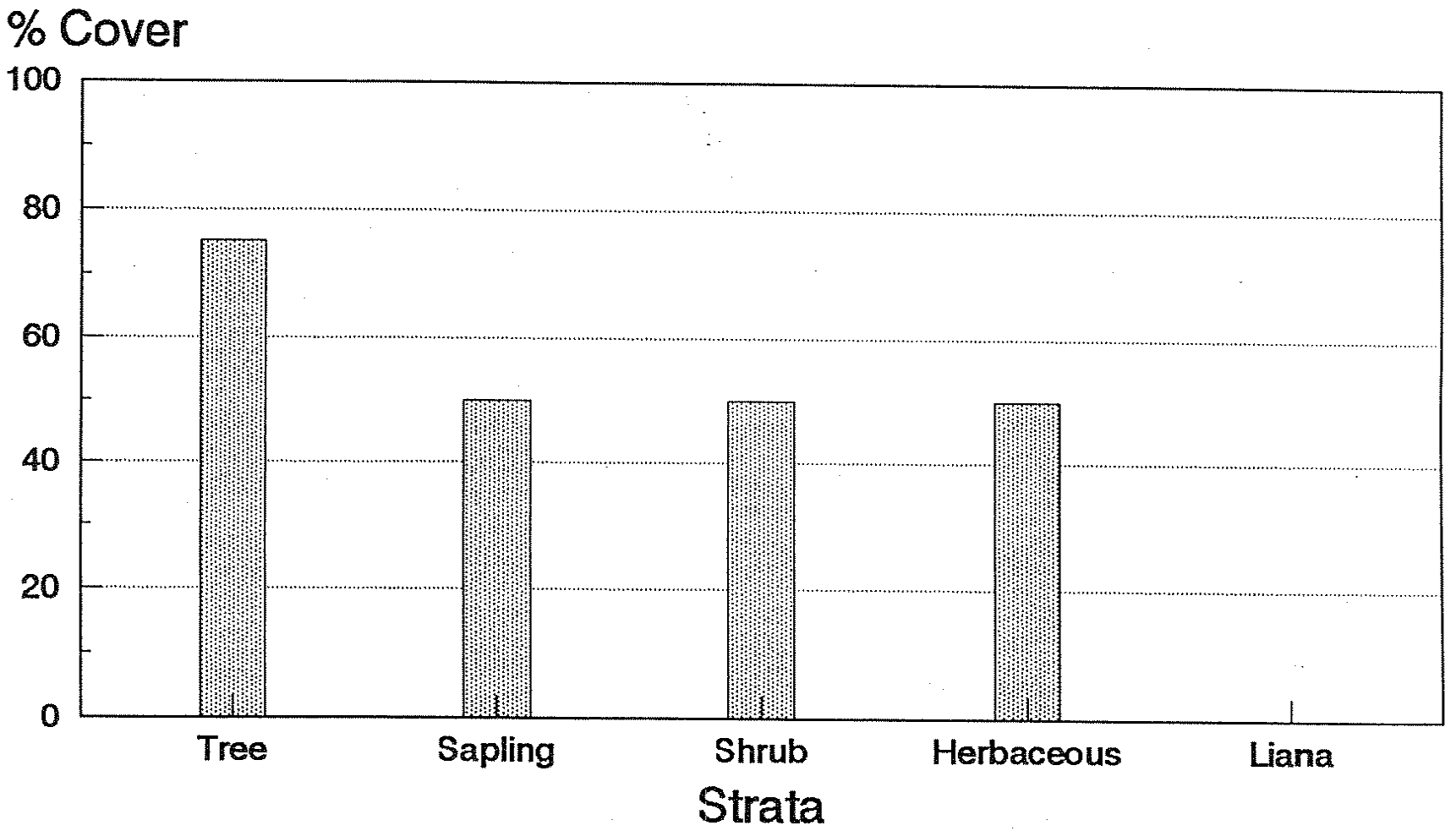
# Figure 4

**Upland Area D**

**Forested Upland Component**

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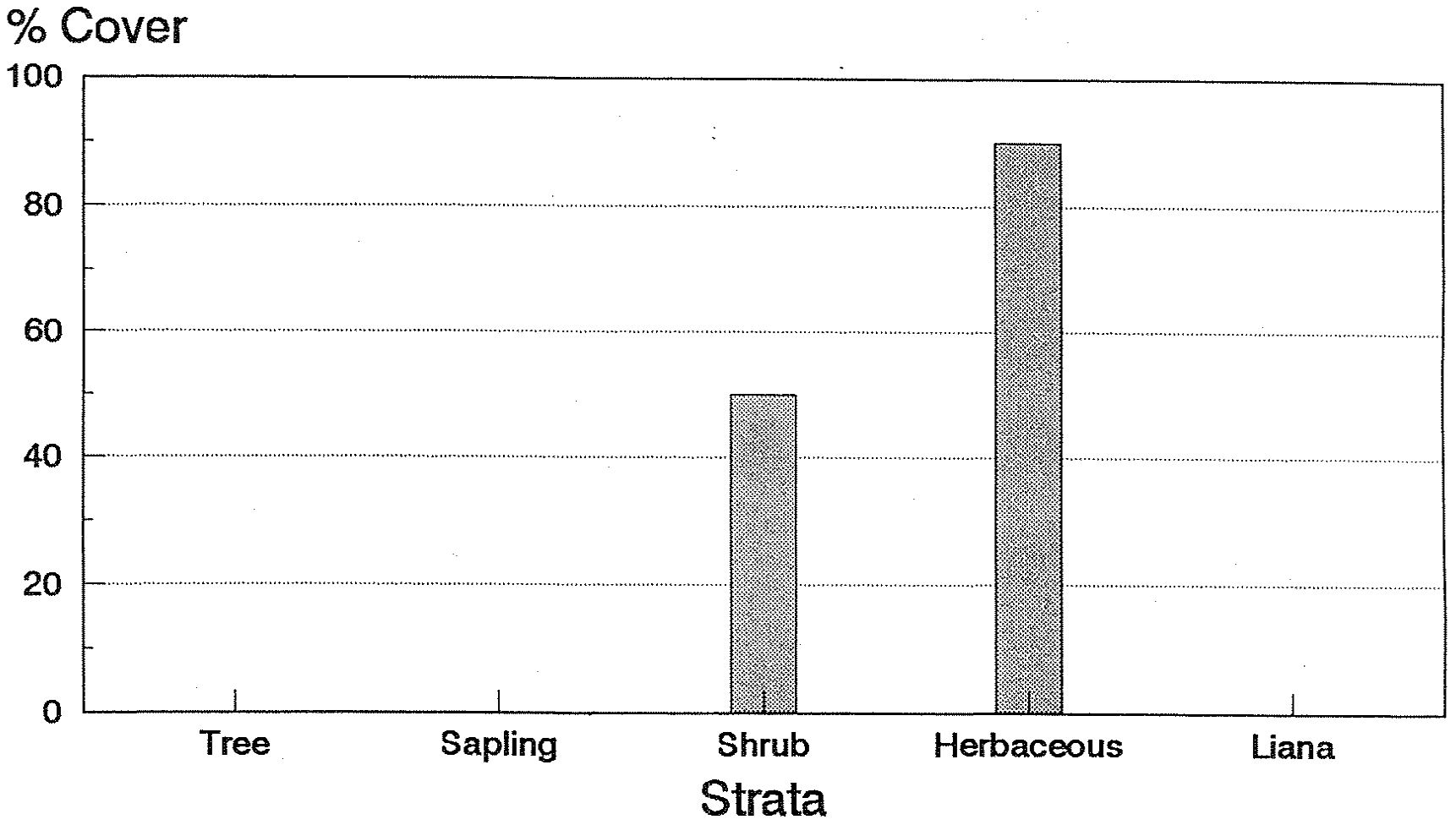
# Figure 5

**Drainage Area AA**

**Emergent Wetland Component**

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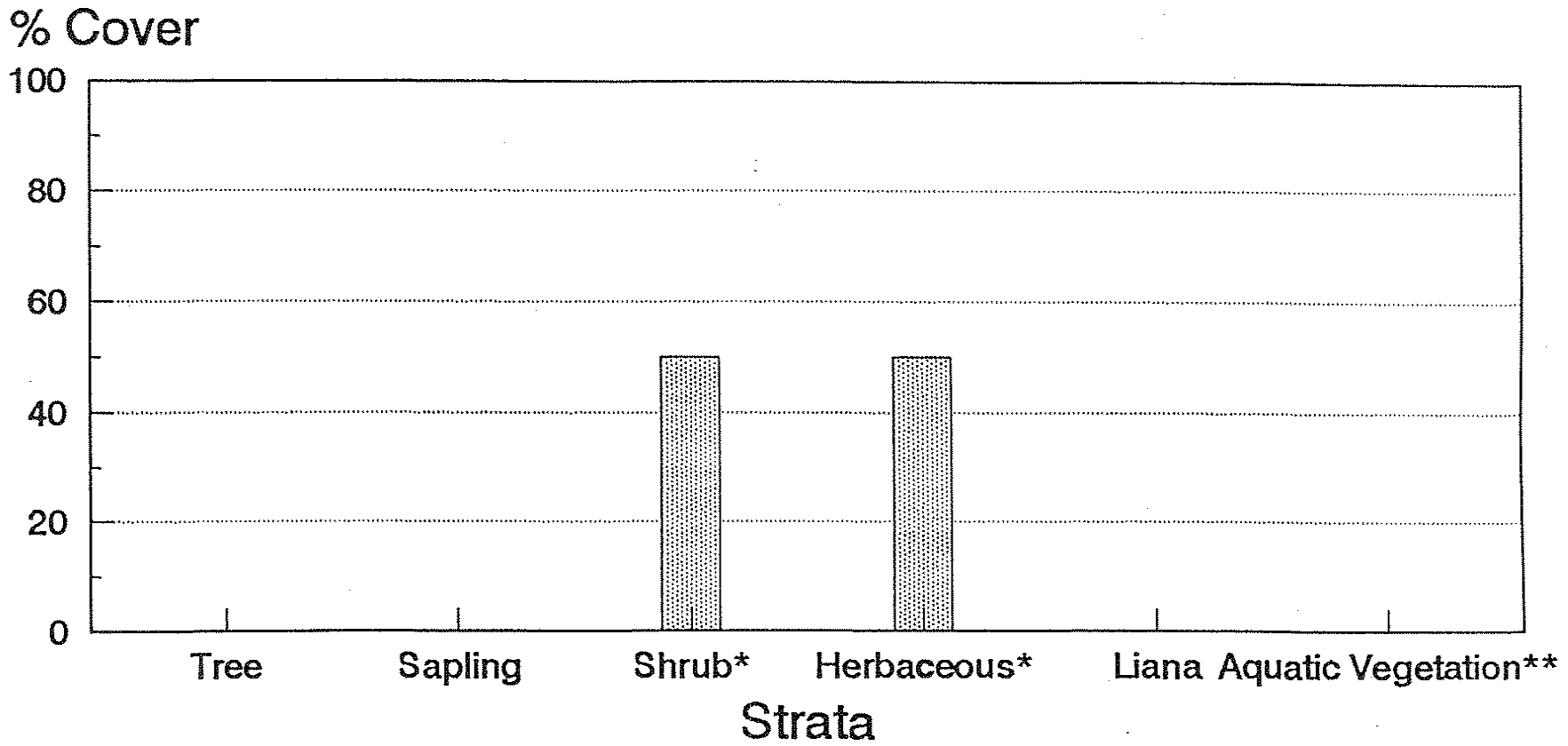
# Figure 6

## Drainage Area AA

## Unconsolidated Bottom Component (Pond)

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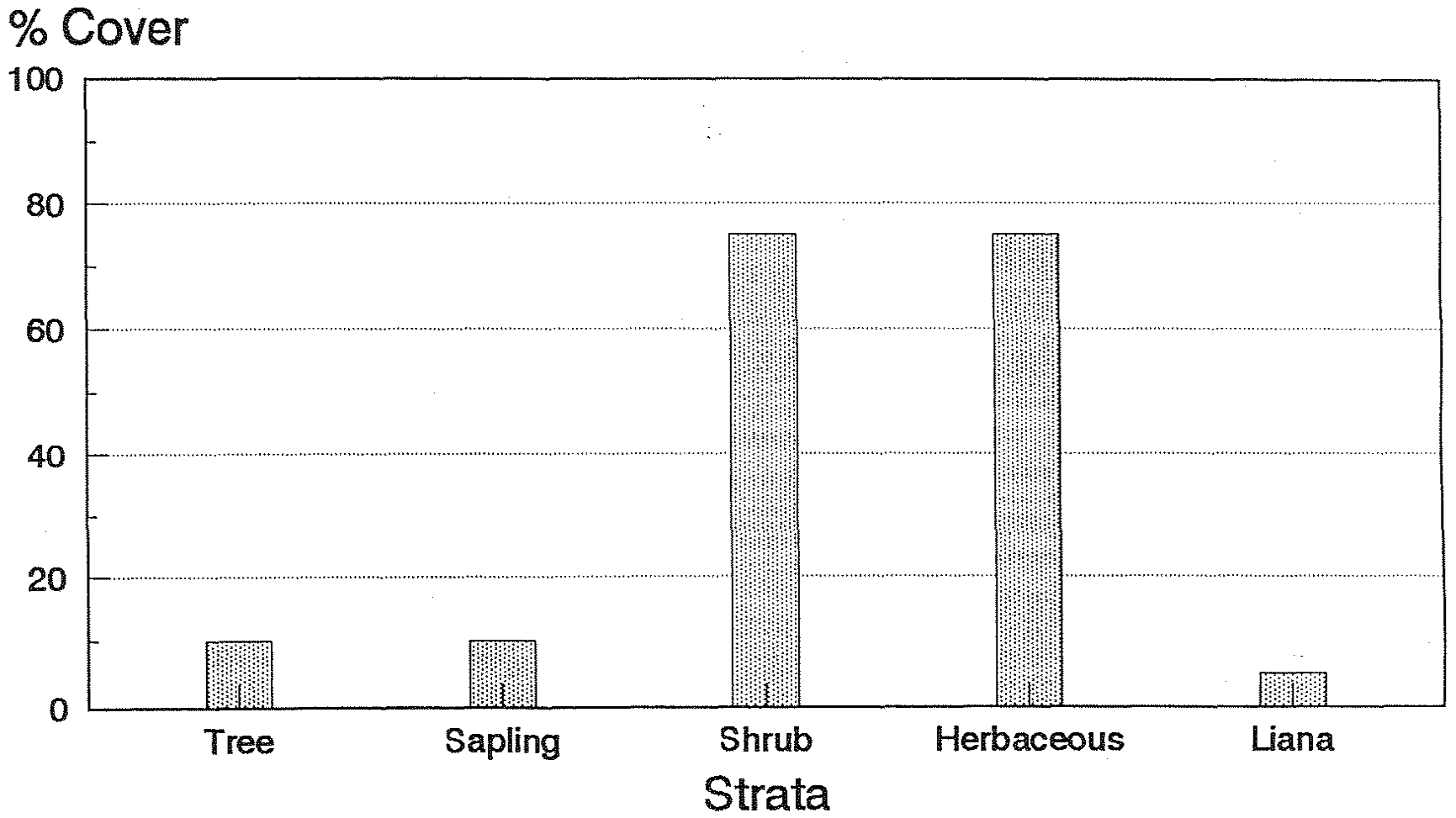
*Note: Located along pond edges only.

**Note: No aquatic vegetation observed during quantitative vegetation sampling due to ice cover on the pond. Previous observations indicated extremely sparse submerged aquatic vegetation.

# Figure 7

**Drainage Area AA**

**Scrub-Shrub Component**

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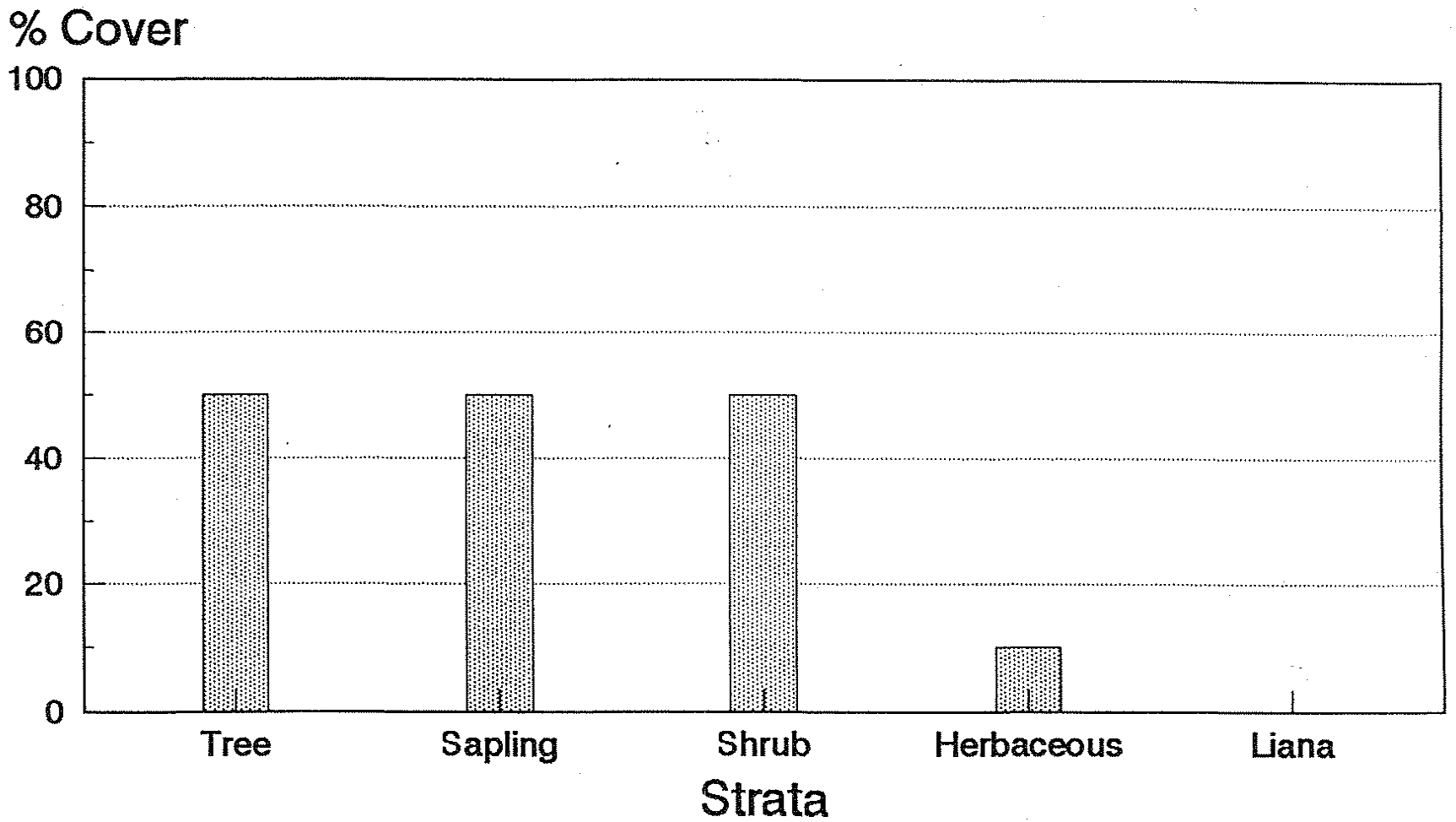
# Figure 8

**Drainage Area AA**

**Forested Wetland Component**

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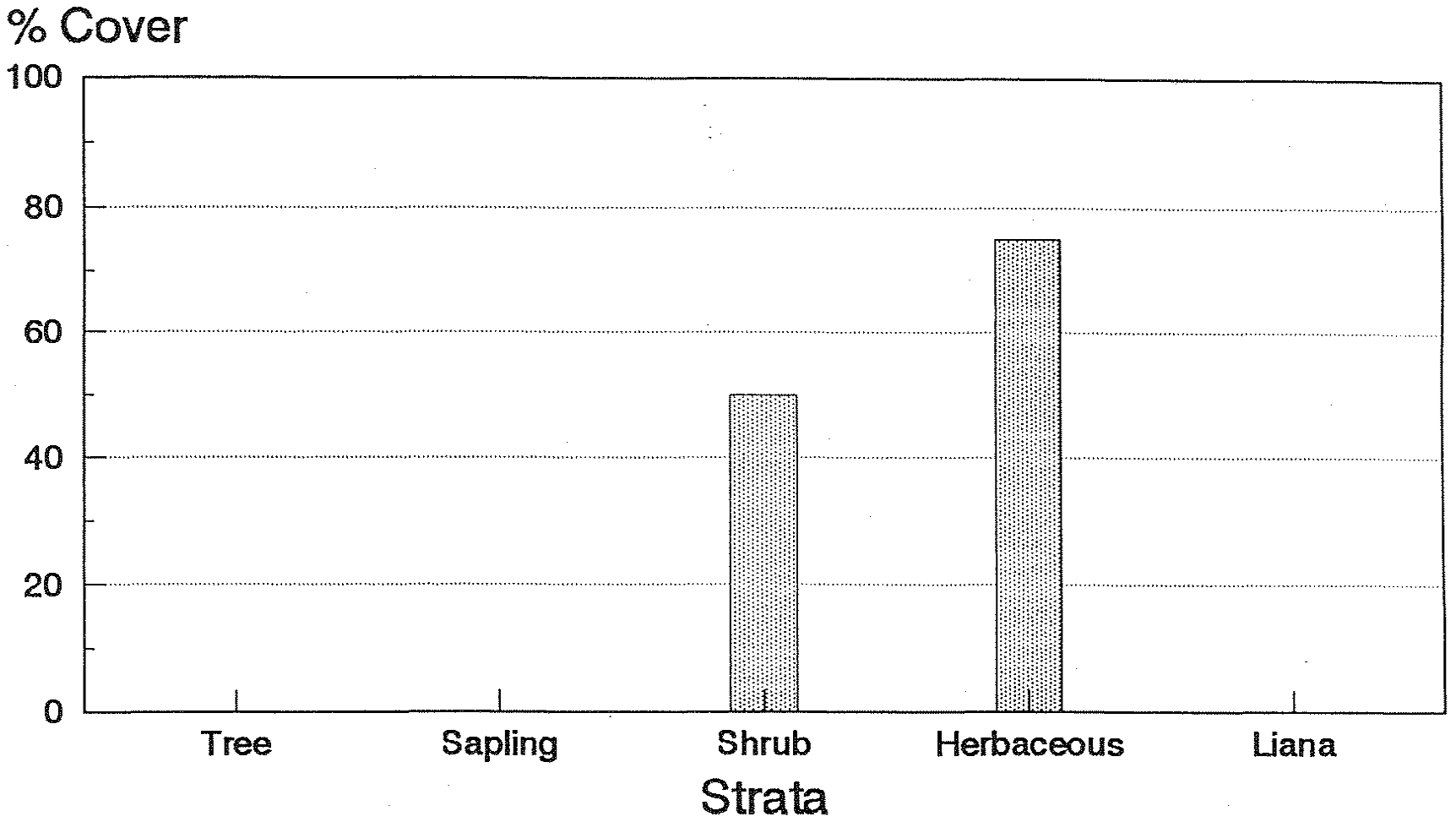
# Figure 9

**Drainage Area BB**

**Emergent Wetland Component**

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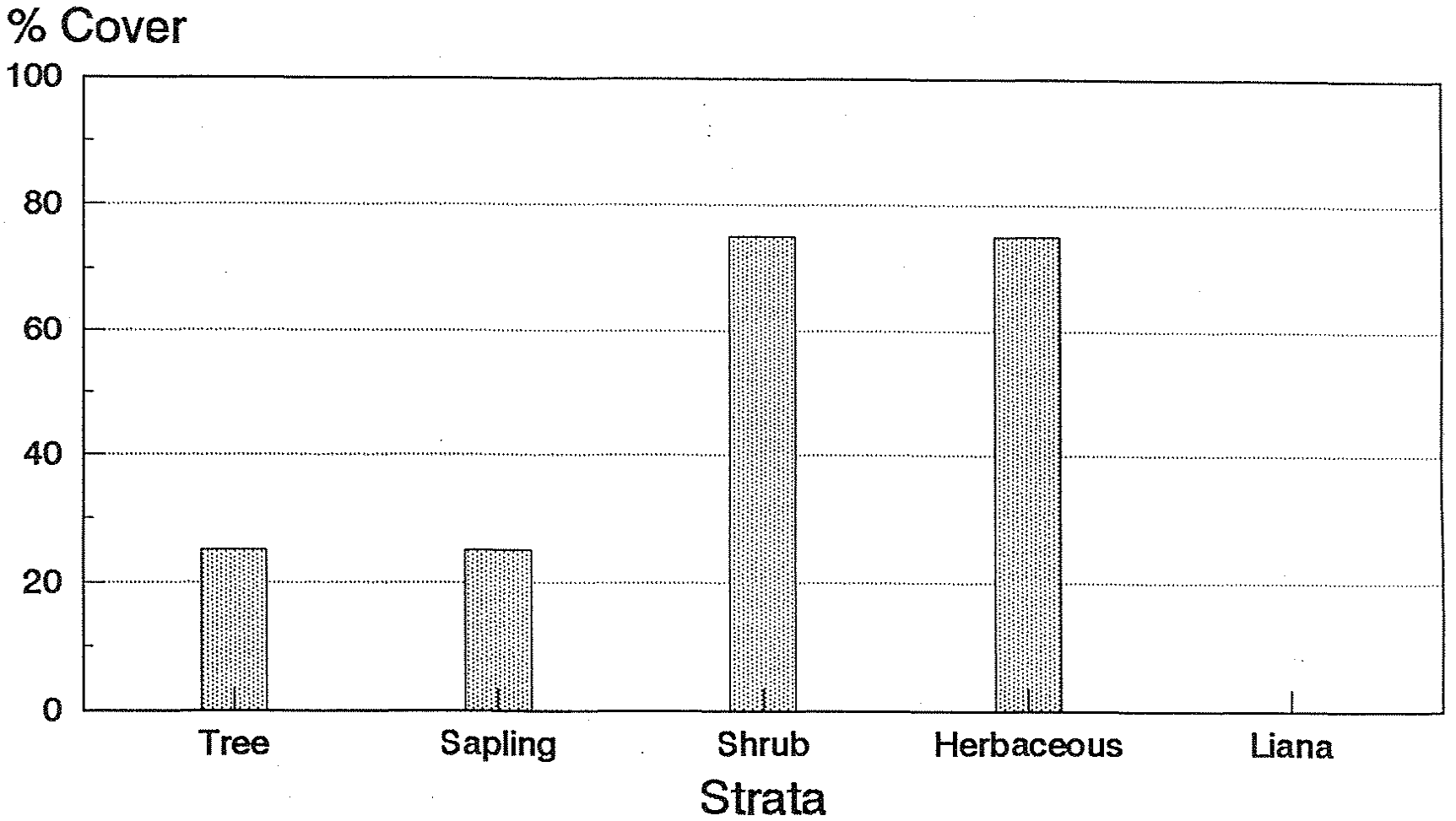
# Figure 10

**Wetland Area BB**

**Forested Wetland Component**

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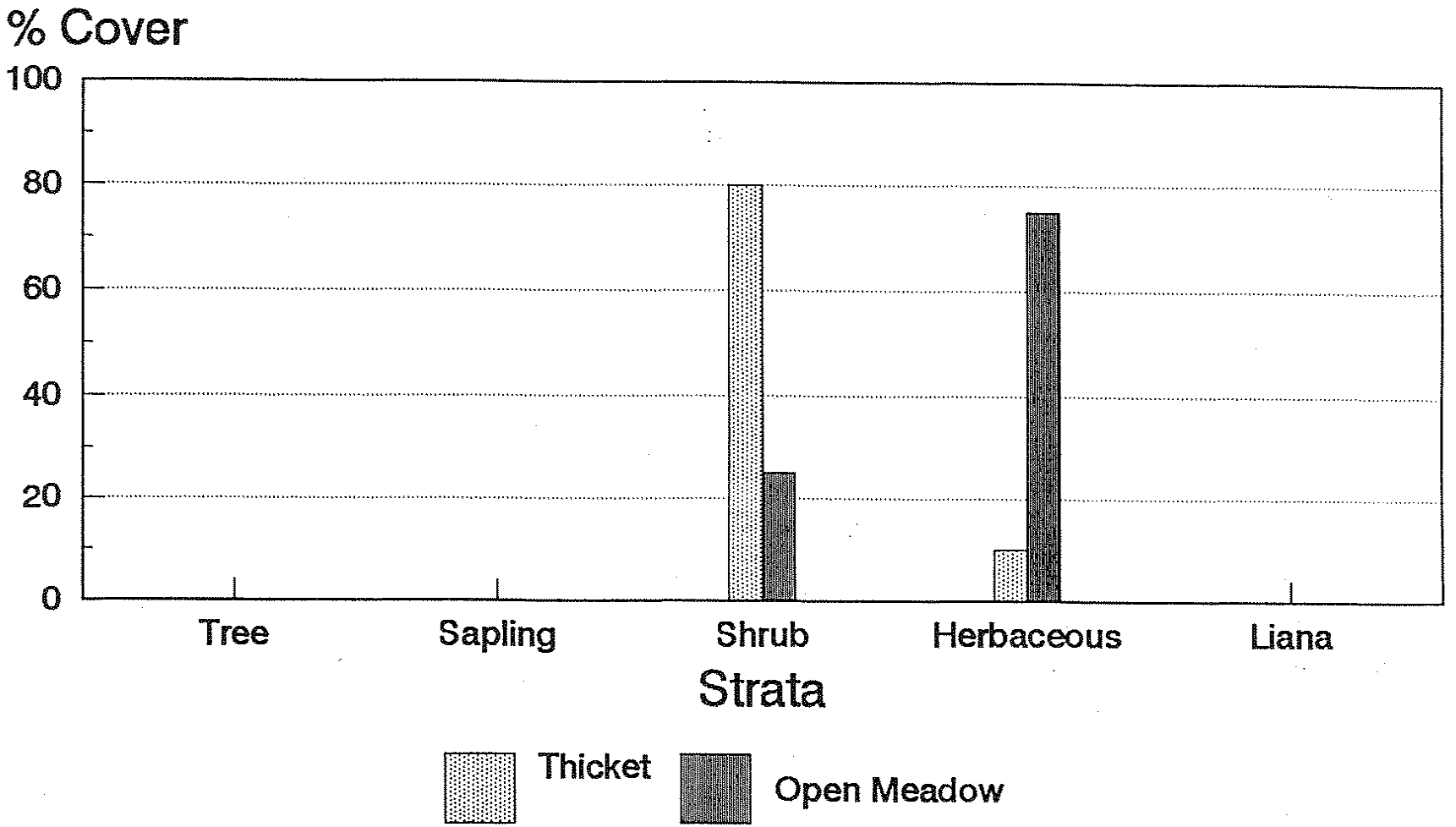
# Figure 11

## Drainage Area CC
## Scrub-Shrub Component

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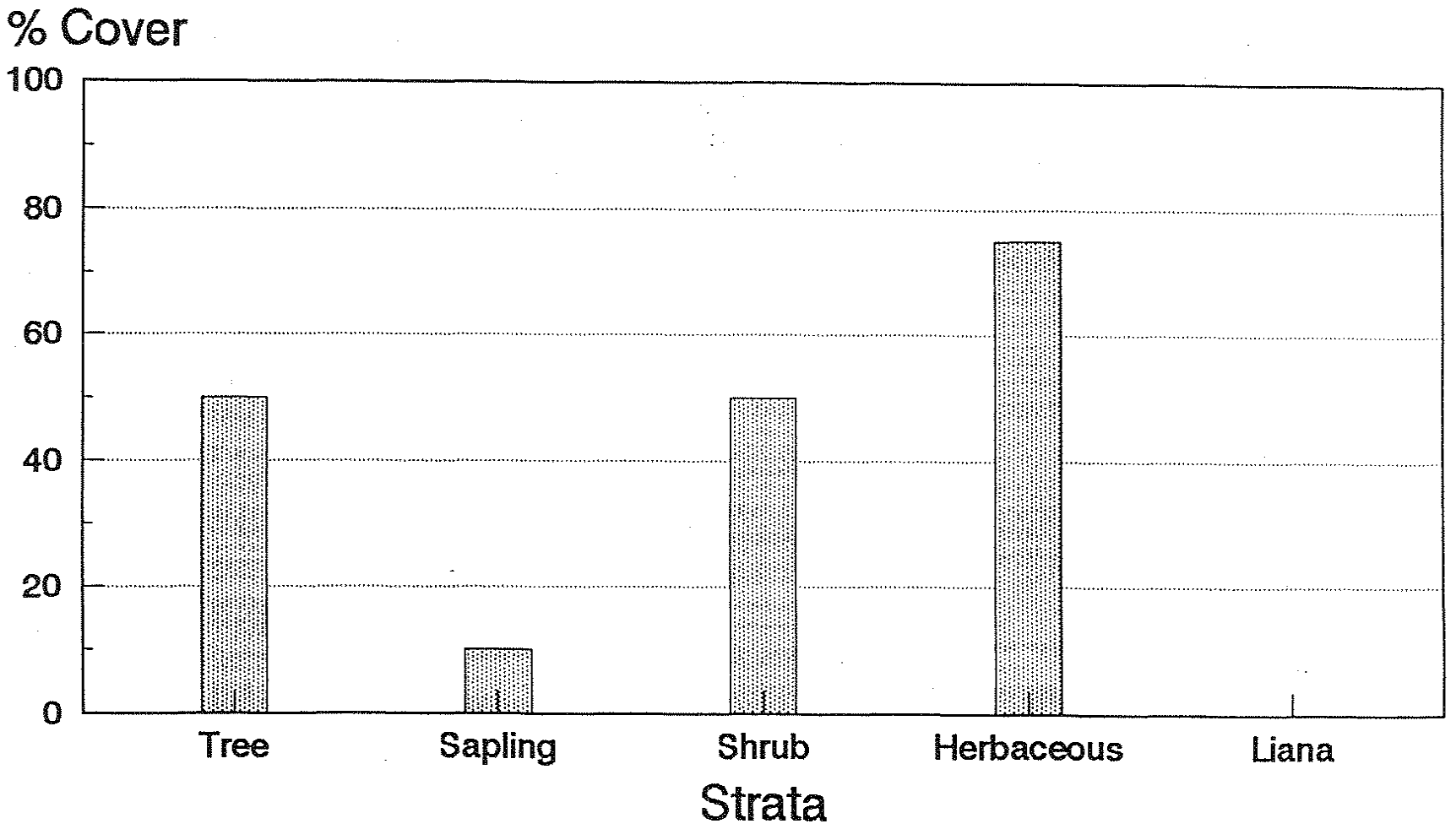
# Figure 12

**Drainage Area CC**
**Forested Wetland Component**

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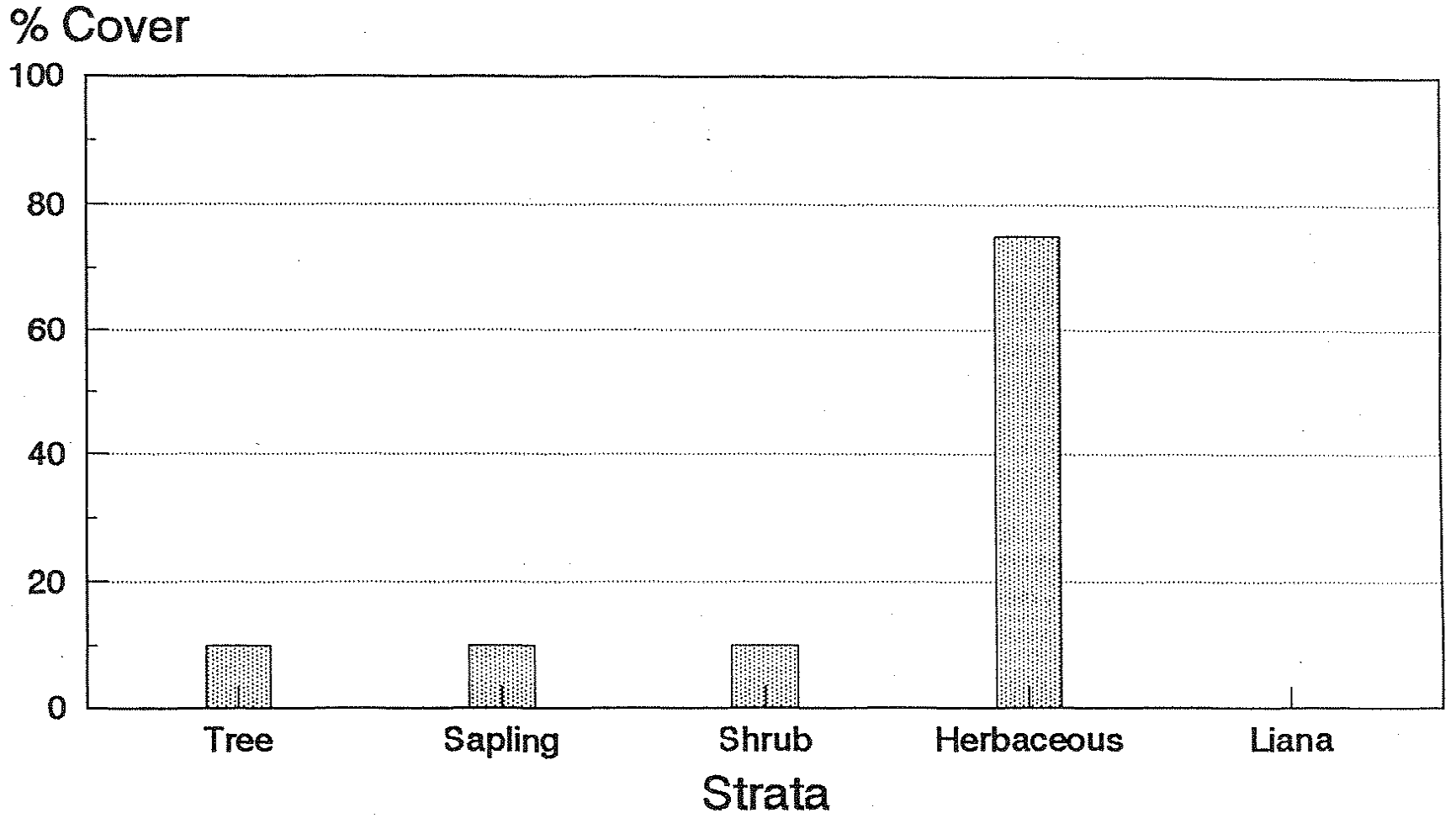
# Figure 13

**Drainage Area DD**

**Emergent Wetland Component**

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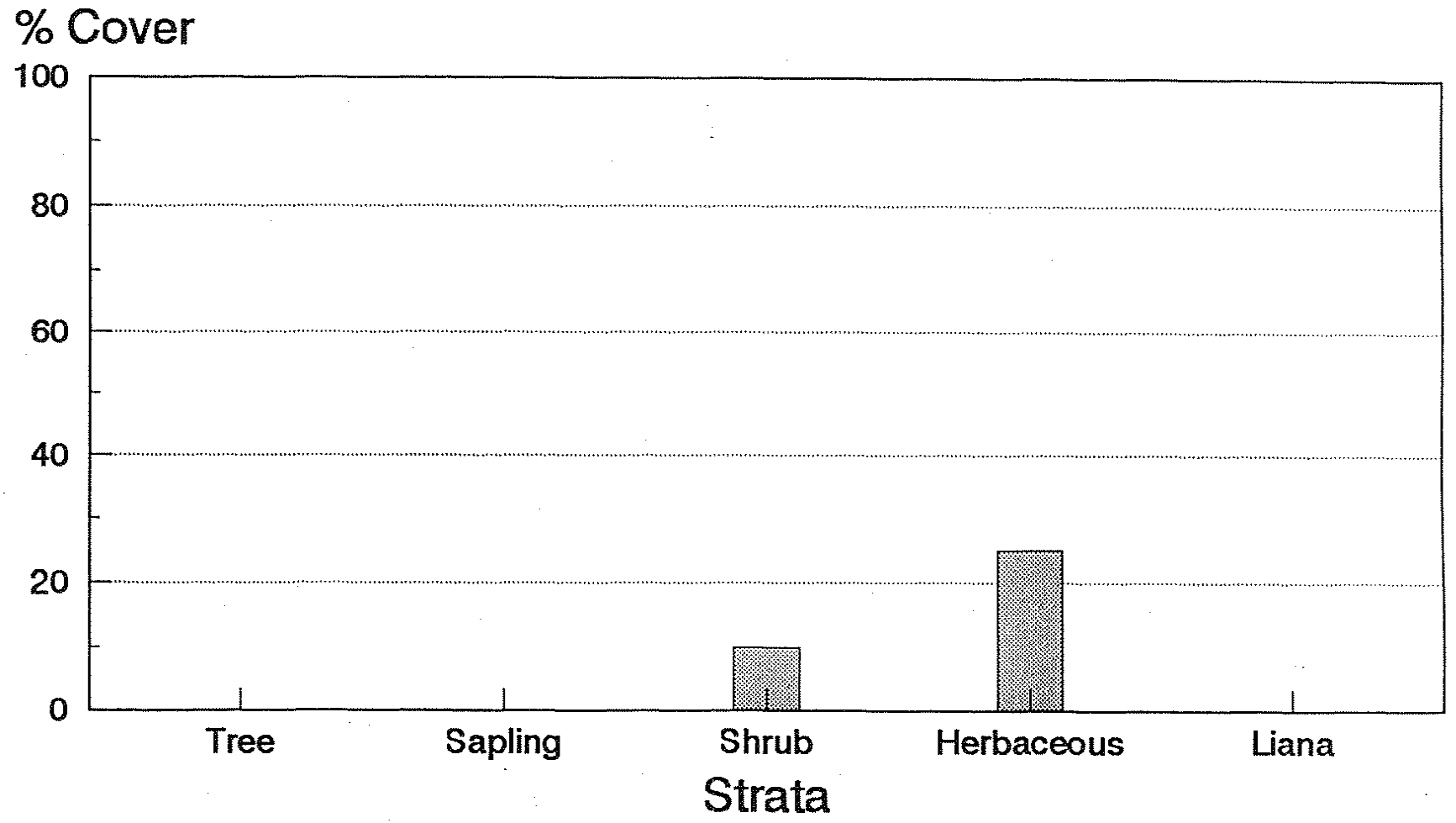
# Figure 14

**Drainage Area EE**

**Unconsolidated Bottom Component (Ditch)**

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# APPENDIX I

# APPENDIX I

# BOREHOLE STRATIGRAPHIC LOGS

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-01)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-1
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.0 | | | | | |
| | SW-SAND(FILL), fine to coarse grained, angular, some silt, brown, dry | | | 1SS | | 32 | 0 |
| 2.5 | | | | 2SS | | 27 | 0 |
| 5.0 | | | 8"ø BOREHOLE | 3SS | | 21 | |
| 7.5 | Same, except medium to coarse grained, trace fine gravel, angular, brownish gray, slighlty moist<br>- 1/2" silt seam, black, product odor | | CEMENT/ BENTONITE GROUT | 4SS | | 45 | 0 |
| 10.0 | | | | 5SS | | 47 | 12 |
| | | | | 6SS | | 65 | 0 |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 73.0 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-02)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-2
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 86.5 | | | | | |
| | SP-SAND(FILL), fine to coarse grained, some silt, trace gravel, brown, dry | | | 1SS | | 35 | 0 |
| 2.5 | | | | 2SS | | 34 | 0 |
| 5.0 | | | | 3SS | | 7 | 0 |
| | Same, except medium grained, no gravel | | 8"ø BOREHOLE | 4SS | | 38 | 0 |
| 7.5 | SP-SAND, medium to coarse grained, brown, dry | | CEMENT/ BENTONITE GROUT | 5SS | | 76 | 0 |
| 10.0 | | | | 6SS | | >100 | 0 |
| | - saturated | | | | | | |
| 12.5 | Same, except fine to coarse grained, angular, gray, saturated | | | 7SS | | >100 | 0 |
| 15.0 | | | | 8SS | | 13 | 0 |
| 17.5 | - black coarse sand, product odor (17.5 ft to 18.0 ft BGS) | 68.5 | | 9SS | | 45 | 0 |
| | END OF HOLE @ 18.0 FT. BGS | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-03)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-3
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 86.2 | | | | | |
| | SP-SAND(FILL), fine to medium grained, some silt, brown, dry | | | 1SS | | 41 | 0 |
| | - trace gravel | | | | | | |
| 2.5 | | | | 2SS | | 26 | 0 |
| | | | 8"ø BOREHOLE | | | | |
| 5.0 | | | | 3SS | | 14 | 0 |
| | | | CEMENT/ BENTONITE GROUT | | | | |
| 7.5 | | | | 4SS | | 42 | 0 |
| | SP-SAND, medium to coarse grained, brown, dry | | | 5SS | | 40 | 0 |
| 10.0 | | | | | | | |
| | - saturated | | | 6SS | | 60 | 0 |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 74.2 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-04)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-4
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 86.2 | | | | | |
| | SP-SAND(FILL), fine to medium grained, some silt, brown, dry | | 8"ø BOREHOLE | 1SS | | 38 | 0 |
| 2.5 | | | | 2SS | | 45 | 0 |
| 5.0 | Same, except medium to coarse grained, trace silt, trace gravel, slightly moist | | CEMENT/ BENTONITE GROUT | 3SS | | 75 | 0 |
| 7.5 | – black organic seam, saturated, no odor (7.8 to 8.4 ft BGS) SW-SAND, coarse grained, angular, gray, saturated | | | 4SS | | 45 | 0 |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 76.2 | | 5SS | | 31 | 0 |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-05)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-5
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.1 | | | | | |
| | SP-SAND(FILL), some silt, trace gravel, brown, dry | | | 1SS | | 56 | 0 |
| 2.5 | | | 8"ø BOREHOLE | 2SS | | 50 | 0 |
| 5.0 | | | CEMENT/ BENTONITE GROUT | 3SS | | 23 | 0 |
| | SP-SAND(FILL), medium to coarse grained, angular, red brown, moist | | | 4SS | | 22 | 0 |
| 7.5 | – some gravel (cobbles), brown gray, saturated | | | 5SS | | >100 | 0 |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 78.1 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-06)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-6
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.3 | | | | | |
| | SP-SAND(FILL), fine to medium grained, some silt, brown, dry | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 37 | 0 |
| 2.5 | | | | 2SS | | 34 | 0 |
| 5.0 | Some, except some gravel, trace silt, moist | | | 3SS | | 32 | 0 |
| | SP-SAND, medium to coarse grained, gray - saturated | | | 4SS | | 30 | 0 |
| 7.5 | END OF HOLE @ 8.0 FT. BGS | 77.3 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-07)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-7
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 84.0 | | | | | |
| | SW-SAND(FILL), fine grained brown, dry | | | 1SS | | 34 | 0 |
| 2.5 | SP-SAND, medium to coarse grained, brown, dry | | 8"ø BOREHOLE<br>CEMENT/ BENTONITE GROUT | 2SS | | 29 | 0 |
| 5.0 | - moist<br>- cobbles, saturated | | | 3SS | | 23 | 0 |
| 7.5 | | | | 4SS | | >100 | 0 |
| | END OF HOLE @ 8.0 FT. BGS | 76.0 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-08)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-8
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 84.7 | | | | | |
| | SW-SAND, fine grained, same silt, brown, dry | | 11"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | X | 21 | 0 |
| 2.5 | | | | 2SS | X | 17 | 0 |
| | Same, except medium grained, gray | | | | | | |
| 5.0 | SP-SAND, coarse grained, angular, some silt, trace gravel (cabbles), maist – saturated | | | 3SS | X | 14 | 0 |
| 7.5 | | | | 4SS | X | >100 | 0 |
| | END OF HOLE @ 8.0 FT. BGS | 76.7 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-09)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-9
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.1 | | | | | |
| | SW-SAND, some silt, trace gravel, brown, dry | | | 1SS | | 14 | 0 |
| 2.5 | | | | 2SS | | 15 | 0 |
| | Same, except medium to coarse grained, no silt | | 8"ø BOREHOLE | | | | |
| 5.0 | Same, except some gravel, cobbles, moist | | CEMENT/ BENTONITE GROUT | 3SS | | 6 | 0 |
| 7.5 | | | | 4SS | | >100 | 0 |
| | – saturated | | | | | | |
| | SW-SAND, medium to coarse grained, some gravel, saturated | | | 5SS | | 23 | 0 |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 78.1 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-10)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-10
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.2 | | | | | |
| | SP-SAND, fine grained, gray brown, dry | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 40 | 0 |
| 2.5 | Same, except medium grained, gray with black stains, moist | | | 2SS | | 30 | 0 |
| 5.0 | | | | 3SS | | 25 | |
| 7.5 | - saturated | | | 4SS | | >100 | |
| | END OF HOLE @ 8.0 FT. BGS | 77.2 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-11)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-11
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.2 | | | | | |
| | ML-SILT(FILL), brown, dry | 86.7 | | 1SS | | 20 | 0 |
| 2.5 | SW-SAND(FILL), medium grained, some gravel, brown, dry | 84.2 | | 2SS | | 17 | 0 |
| 5.0 | GC-GRAVEL(FILL), medium grained, cobbles, black, dry, stringer of product, odor | | 8"ø BOREHOLE; CEMENT/BENTONITE GROUT | 3SS | | >100 | 0 |
| 7.5 | | | | 4SS | | >100 | 0 |
| | | | | 5SS | | >100 | 24 |
| 10.0 | SW-SAND, coarse grained, angular, saturated | 78.2 | | 6SS | | | 8 |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 76.2 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-12)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-12
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.M. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.9 | | | | | |
| | SP-SAND, medium grained, brown, moist | | 11"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 16 | 0 |
| 2.5 | | | | 2SS | | 7 | 5 |
| | SW-SAND, some gravel, hard, black | | | | | | |
| 5.0 | | | | 3SS | | >100 | 2.5 |
| | – saturated | 79.9 | | | | | |
| | END OF HOLE @ 6.0 FT. BGS | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-13)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-13
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 91.5 | | | | | |
| | No recovery | | | 1SS | | 11 | |
| 2.5 | SW-SAND, fine to medium grained, some round gravel, loose, brown dry to moist | 89.5 | | 2SS | | 11 | |
| 5.0 | SP-SAND, medium to coarse grained, some round to subangular gravel, loose, light brown, moist | | 8"ø BOREHOLE; CEMENT/BENTONITE GROUT | 3SS | | >100 | |
| | | | | 4SS | | >100 | |
| 7.5 | | | | 5SS | | >100 | |
| 10.0 | GP-GRAVEL, fine to coarse grained, some medium to coarse sand, trace rock flour, loose, light brown, moist mottling otherwise dry | 83.5 | | 6SS | | 100 | |
| | | | | 7SS | | >100 | |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 79.5 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-14)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-14
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.9 | | | | | |
| | SP-SAND, medium grained, brown, dry | | | 1SS | | 19 | 0 |
| 2.5 | | | 11"ø BOREHOLE | 2SS | | 7 | 0 |
| | - very hard, cobbles | | CEMENT/ BENTONITE GROUT | 3SS | | >100 | 3 |
| 5.0 | | | | | | | |
| | - saturated | | | | | | |
| 7.5 | | | | 4SS | | | 3 |
| | END OF HOLE @ 9.0 FT. BGS | 76.9 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-15)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-15
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 89.0 | | | | | |
| 2.5 | SW-SAND, fine to medium grained, little silt little clay, trace organics, trace gravel, loose, tan brown, dry to moist<br>Same, with no organics, dense, moist | | | 1SS | | 14 | |
| | | | 8"ø BOREHOLE | 2SS | | 34 | |
| 5.0 | SP-SAND, fine to coarse grained, some subrounded to angular gravel, little rock flour, very dense, tan brown, dry to moist | | CEMENT/ BENTONITE GROUT | 3SS | | >100 | |
| | | 83.0 | | | | | |
| 7.5 | GP-GRAVEL, fine to coarse grained, angular to subrounded, little rock flour, little coarse sand, very dense, tan to light brown, dry to moist<br>Same, except medium to coarse grained, round, some coarse sand, dense, tan brown, moist to wet | | | 4SS | | >100 | |
| | | | | 5SS | | 60 | |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 79.0 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-16)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-16
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 86.2 | | | | | |
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | X | 15 | 0 |
| 2.5 | | | | 2SS | X | 16 | 0 |
| 5.0 | – block product (5.5 to 6.0 ft BGS) | | | 3SS | X | 5 | 3 |
| 7.5 | | | | 4SS | X | 41 | |
| | END OF HOLE @ 8.0 FT. BGS | 78.2 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-17)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-17
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 86.7 | | | | | |
| | SW-SAND, fine to medium grained, trace gravel, trace silt, medium dense, light brown, moist | | 8"ø BOREHOLE | 1SS | X | 13 | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | 2SS | X | 14 | |
| | Same, except little silt, dark brown, moist to wet | | | | | | |
| 5.0 | | | | 3SS | X | 4 | |
| | END OF HOLE @ 6.0 FT. BGS | 80.7 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-18)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-18
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 87.0 | | | | | |
| | SP-SAND, medium grained, brown, moist | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | X | 20 | 0 |
| 2.5 | | | | 2SS | X | 22 | |
| | SW-SAND, some gravel, trace silt, brown, red and black, tar like substance, weak product odor | | | | | | |
| 5.0 | | | | 3SS | X | 41 | |
| | END OF HOLE @ 6.0 FT. BGS | 81.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-19)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-19
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.1 | | | | | |
| | Concrete | 87.1 | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | | | | |
| 2.5 | SP-SAND, medium to coarse grained, some gravel, brown, dry | | | 1SS | X | 15 | |
| 5.0 | SW-SAND, medium grained, red brown, moist | | | 2SS | X | 10 | |
| | | | | 3SS | X | 14 | |
| 7.5 | - saturated | | | 4SS | X | 40 | |
| | END OF HOLE @ 9.0 FT. BGS | 79.1 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-20)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-20
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 91.6 | | | | | |
| | Asphalt (3") | | | 1SS | | 40 | |
| 2.5 | SW-SAND, fine to medium grained, little pebbles, medium dense, tan brown, dry to slightly moist | 89.6 | | 2SS | | 35 | |
| 5.0 | SP-SAND, fine to medium grained, some round gravel, dense, tan brown, dry to moist | | 8"ø BOREHOLE | 3SS | | 68 | |
| 7.5 | GP-GRAVEL, medium to coarse, rounded, some medium to coarse grained sand, dense, tan to orange brown, orange rust mottling, dry to moist | 85.6 | CEMENT/ BENTONITE GROUT | 4SS | | >100 | |
| 10.0 | SP-SAND, medium to coarse grained, some round gravel, dense, tan brown, dry to moist | 83.6 | | 5SS | | >100 | |
| | – saturated | | | 6SS | | 85 | |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 79.6 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-21)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-21
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 91.3 | | | | | |
| | ASPHALT | 91.1 | | | | | |
| | SW-SAND, fine to medium grained, trace silt, trace clay, loose, tan brown, dry to moist | | | 1SS | | 20 | |
| 2.5 | - errant round quartz | | | 2SS | | 53 | |
| | SP-SAND, fine to coarse grained, some coarse round gravel, very dense, mottled light tan brown ond brown, dry | | 8"ø BOREHOLE | 3SS | | 76 | |
| 5.0 | Same, except dry to moist | | CEMENT/ BENTONITE GROUT | 4SS | | 100 | |
| 7.5 | SP/GW-SAND and GRAVEL, medium to fine grained, dry to moist | 83.3 | | 5SS | | 44 | |
| 10.0 | - moist | | | | | | |
| | GP/GW-GRAVEL, medium fine to very coarse, dense, brown, saturated, little silt and clay in matrix | 81.3 | | 6SS | | 56 | |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 79.3 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-22)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-22
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 91.0 | | | | | |
| | Asphalt | 90.8 | | | | | |
| | SW-SAND, fine to medium grained, loose, brown, moist | | | 1SS | X | 26 | |
| 2.5 | SP-SAND, fine to coarse grained, some rounded gravel, loose, brown to tan brown, moist | | | 2SS | X | 12 | |
| | SW-SAND, fine to medium grained, some errant raunded gravel, very loose, brown, moist | | 8"ø BOREHOLE | | | | |
| 5.0 | | | | 3SS | X | 5 | |
| | | | CEMENT/ BENTONITE GROUT | | | | |
| 7.5 | | | | 4SS | X | 11 | |
| | | | | 5SS | X | 8 | |
| 10.0 | GW-GRAVEL, fine to medium, little fine sand, little clay and silt in matrix, loose, tan brown, saturated | 81.0 | | 6SS | X | 7 | |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 79.0 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-23)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-23
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.0 | | | | | |
| | SP-SAND, medium grained, dry | | 11"ϕ BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 11 | 0 |
| 2.5 | Same, except red – boulder | | | 2SS | | | 0 |
| | SP-SAND, medium grained, red brown, moist | | | | | | |
| 5.0 | – saturated | | | 3SS | | 95 | |
| | END OF HOLE @ 6.0 FT. BGS | 79.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-24)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-24
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.4 | | | | | |
| | SP-SAND, medium grained, red brown, dry | | 8"ø BOREHOLE | 1SS | X | 10 | |
| 2.5 | | | CEMENT/ BENTONITE GROUT | 2SS | X | 25 | |
| 5.0 | | | | 3SS | X | 57 | |
| | – saturated | 79.4 | | | | | |
| | END OF HOLE @ 6.0 FT. BGS | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-25)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-25
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 85.5 | | | | | |
| | SP-SAND, medium grained, red brown, dry | | 8"ø BOREHOLE | 1SS | X | 7 | 0 |
| 2.5 | | | CEMENT/ BENTONITE GROUT | 2SS | X | 22 | 0 |
| 5.0 | | | | 3SS | X | 58 | 0 |
| | - saturated | 79.5 | | | | | |
| | END OF HOLE @ 6.0 FT. BGS | | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-26)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-26
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 90.6 | | | | | |
| 2.5 | Cement | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | | | | |
| 5.0 | SW-SAND, fine to medium grained, medium dense, white to tan brown, striated lower 8" with tan brown, moist | 85.6 | | 1SS | X | 53 | |
| 7.5 | Same, except moist to wet | | | 2SS | X | 90 | |
| | END OF HOLE @ 9.0 FT. BGS | 81.6 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-27)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-27
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 89.8 | | | | | |
| 2.5 | SW-SAND, fine grained, little organics, loose, tan to light brown, dry<br>Same, except no organics, tan brown with dark mottling, dry to moist | | 8"ø BOREHOLE<br>CEMENT/ BENTONITE GROUT | 1SS | | 12 | |
| 5.0 | SW-SAND, fine to medium grained, little gravel, trace coarse sand in gravel, medium dense, dry to moist | | | 2SS | | 14 | |
| | | | | 3SS | | >100 | |
| | END OF HOLE @ 6.0 FT. BGS | 83.8 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-28)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-28
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 90.6 | | | | | |
| | SW-SAND, medium to fine grained, loose, dark brown and black, dry to moist, chemical like odor | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 19 | |
| 2.5 | Same, except light brown to brown, chemical like odor | | | 2SS | | 16 | |
| | SW-SAND, fine to medium grained, tan brown, moist, chemical like odor | | | | | | |
| 5.0 | Same, slight chemical like odor | | | 3SS | | 30 | |
| | | | | 4SS | | 26 | |
| 7.5 | SP-SAND, fine to medium grained, some silt, some angular gravel, dense, dark gray to tan brown to dark brown, wet, strong chemical like odor | | | 5SS | | >100 | |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 80.6 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L-29)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-29
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 89.6 | | | | | |
| | SP-SAND(FILL), medium grained, red brown, dr | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | X | 20 | 0 |
| 2.5 | | | | 2SS | X | 16 | 0 |
| 5.0 | | | | 3SS | X | 29 | 0 |
| | | | | 4SS | X | >100 | 0 |
| 7.5 | SW-SAND(TILL), fine to medium grained, some silt, some gravel, brown gray, saturated | 82.1 | | 5SS | X | >100 | 0 |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 79.6 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-30)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-30
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 89.5 | | | | | |
| | SW-SAND, fine to medium griained, trace angular gravel, loose, dark brown and black, moist to dry, slight chemical odor | | | 1SS | | 11 | |
| 2.5 | Same, with no gravel, dark orange brown, moist, slight chemical odor | | | 2SS | | 16 | |
| | Same, except medium dense, slight chemical odor | | 8"ø BOREHOLE | | | | |
| 5.0 | | | | 3SS | | 27 | |
| | - slight chemical odor | | CEMENT/ BENTONITE GROUT | | | | |
| 7.5 | | | | 4SS | | 47 | |
| | | | | 5SS | | >100 | |
| 10.0 | | | | | | | |
| 12.5 | END OF HOLE @ 12.0 FT. BGS | 77.5 | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-31)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-31
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.5 | | | | | |
| | Concrete | 87.5 | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | | | | |
| | SP-SAND, medium grained, brown, dry | | | 1SS | X | 40 | |
| 2.5 | | | | | | | |
| | | | | 2SS | X | 12 | |
| 5.0 | – moist | | | | | | |
| | – saturated | | | 3SS | X | 10 | |
| 7.5 | END OF HOLE @ 7.0 FT. BGS | 81.5 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
# (OVERBURDEN)

(L-32)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-32
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.7 | | | | | |
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | X | 11 | 0 |
| 2.5 | | | | 2SS | X | 10 | 0 |
| 5.0 | | | | 3SS | X | 36 | 0 |
| 7.5 | SW-SAND, some silt, brown, wet | | | 4SS | X | 54 | 0 |
| | - saturated | | | 5SS | X | 26 | 0 |
| 10.0 | END OF HOLE @ 10.0 FT. BGS | 78.7 | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-33)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-33
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISDR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.4 | | | | | |
| | SW-SAND, fine to medium grained, errant angular gravel, trace silt, loose, dark brown, dry | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 10 | |
| 2.5 | | | | 2SS | | 7 | |
| | Same, except orange brown, moist | | | | | | |
| 5.0 | | | | 3SS | | 6 | |
| | Same, except dark orange brown, wet | | | | | | |
| 7.5 | | | | 4SS | | 6 | |
| | END OF HOLE @ 8.0 FT. BGS | 80.4 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-34)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-34
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | STATE | 'N' VALUE | PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.0 | | | | | |
| | SW-SAND, fine to medium grained, angular gravel (top 1"), loose, dark orange brown, moist | | 8"ø BOREHOLE; CEMENT/ BENTONITE GROUT | 1SS | | 6 | |
| 2.5 | Same, except orange brown to tan brown | | | 2SS | | 10 | |
| 5.0 | | | | 3SS | | 11 | |
| 7.5 | – moist to wet | | | 4SS | | 12 | |
| | END OF HOLE @ 8.0 FT. BGS | 80.0 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

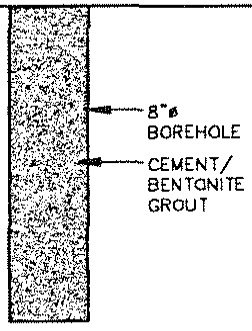
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-35)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-35
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | 88.1 | | | | | |
| | Asphalt | 87.9 |   | | | | |
| 2.5 | SW-SAND, fine to medium grained, trace organics, trace gravel, medium dense, dark brown to black, moist, slight chemical like odor | | | 1SS | X | 24 | |
| | Same, except no gravel or organics, dark tan brown, slight chemical odor | | | 2SS | X | 26 | |
| 5.0 | Same, except light tan brown | | | 3SS | X | 31 | |
| | Same, except tan brown to dark tan brown | | | | | | |
| 7.5 | – trace fine gravel, moist to wet | | | 4SS | X | 48 | |
| | END OF HOLE @ 8.0 FT. BGS | 80.1 | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L135)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-36
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE; CUTTINGS | 1SS | X | | |
| 2.5 | | | | 2SS | X | | |
| 5.0 | – saturated | | | 3SS | X | | |
| | END OF HOLE @ 6.0 FT. BGS | -6.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L136)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-37
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE; CUTTINGS | 1SS | X | | |
| 2.5 | | | | 2SS | X | | |
| 5.0 | – saturated | | | 3SS | X | | |
| | END OF HOLE @ 6.0 FT. BGS | -6.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L137)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-38
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE | 1SS | | | |
| 2.5 | | | CUTTINGS | 2SS | | | |
| | – saturated | | | | | | |
| 5.0 | END OF HOLE @ 5.0 FT. BGS | -5.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L138)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-39
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE; CUTTINGS | 1SS | | | |
| 2.5 | | | | 2SS | | | |
| 5.0 | – saturated | | | 3SS | | | |
| | END OF HOLE @ 6.0 FT. BGS | -6.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# STRATIGRAPHIC AND INSTRUMENTATION LOG
## (OVERBURDEN)

(L139)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-40
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

| DEPTH ft BGS | STRATIGRAPHIC DESCRIPTION & REMARKS | ELEVATION ft AMSL | MONITOR INSTALLATION | SAMPLE NUMBER | SAMPLE STATE | SAMPLE 'N' VALUE | SAMPLE PID (ppm) |
|---|---|---|---|---|---|---|---|
| | SP-SAND, medium grained, brown, dry | | 8"ø BOREHOLE | 1SS | X | | |
| 2.5 | | | CUTTINGS | 2SS | X | | |
| 5.0 | – moist | | | 3SS | X | | |
| | END OF HOLE @ 6.0 FT. BGS | -6.0 | | | | | |
| 7.5 | | | | | | | |
| 10.0 | | | | | | | |
| 12.5 | | | | | | | |
| 15.0 | | | | | | | |
| 17.5 | | | | | | | |
| 20.0 | | | | | | | |
| 22.5 | | | | | | | |
| 25.0 | | | | | | | |
| 27.5 | | | | | | | |
| 30.0 | | | | | | | |
| 32.5 | | | | | | | |

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

# APPENDIX J

# APPENDIX J

# MAIN STREET PRIVATE WELL SAMPLING PROTOCOL AND ANALYTICAL REPORTS

3683

Olin CORPORATION
Environmental
Public
Affairs

# FOR YOUR INFORMATION

**Notes From Wilmington Trip**
9/14/91 - 9/16/91

Home Sampling Program.
Discussions With Local Officials.

S. J. Barbee - New Haven
D. L. Cummings - Charleston
R. J. Horn - Charleston
S. G. Morrow - Charleston
T. P. O'Brien - Easton
A. D. Rheingold - Stamford
D. H. Brewer - Cleveland
L. E. Gaza - Stamford
W. H. Werfelman - Stamford

Curt M. Richards
Environmental Public Affairs

**Recycled Paper -**
*Protecting our resources for the next generation*

WILM

PRIVATE WELL

Notes

Wilmington, MA Trip

9/14/91 - 9/16/91

Story Line:

- Conducting groundwater study.
- Property access problems with Altron.
- Wednesday, received data from well on Harwick property. High readings of chromium, sulfates, chlorides, & ammonia.
- Consultant immediately sought more information on Altron wells (drillers in area). Now has 3 wells with capability of 150 gallons/minute.
- Discovered 1977 Altron found "green water" at 67 feet. At 30 feet water clean.
- Discovered 5 homes not on city water system on Main Street (1000 feet from Site).
- Need to sample private wells to determine if any contamination.
- Expedited analysis - results to be available Friday/Saturday.

**Residences On Private Wells:**

**Gennaro Grasso** (508) 658-4450
885 Main Street

- Emino Cavelle - mother-in-law.
- Sophisticated well water treatment system - adjusts pH, removes iron, filters.
- Tests water couple of times a year. pH has been at 5.5.
- Two wells. Well approximately 30'deep. Well 15 - 20 'deep for outside use.
- Permission to sample Monday 9/16 @ 2:30.
- Sampled kitchen sink and outside faucet.
- Sample 4 & 4A (inside)
- Sample 5 & 5A (outside - 2nd well)

**Charles Spinazola** (508) 658-3296
887 Main Street

- Doesn't use residence well. Well collapsed.
- 2nd well at trailer. Use bottled water for drinking.
- Has 3 monitoring wells on property for 21E test for property transfer. All determined clean by MassEPA.
- Have CRA determine requirements for 21E?? Information on 21E public?? (Mike Bellotti)
- Permission to sample Monday 9/16 @ anytime.
- Sampled outside faucet at trailer.
- Sample 1 & 1A

**Jas Montague** (508) 658-2123
889 Main Street

- Michelle - granddaughter lives at resident with Traci Daston.
- Use bottled water for drinking.
- Permission to sample Monday 9/16 @ 4:00.
- Sampled kitchen sink faucet.
- Sample 6 & 6A

**Michael A. Gatta** (617) 933-7188
911 Main Street

- Attorney - In Trust for family.
- Rental property.
- Bob Cowers / Dave Craigie / Chuck McIssac (M.W. Carr) tenants.
- Use bottled water.
- Permission to sample Monday 9/16 @3:00.
- Sampled outside faucet. Michael Gatta observed sampling.
- Sample 3 & 3A

**Marvin H. Greenberg** (617) 933-7360
919 Main Street

- Attorney.
- Peter Spinazola (617) 935-0041 co-owner (Anchor Body Shop).
- Rental property.
- Diane Cote (508) 658-7450 / Mrs. Camale tenants.
- Use bottled water for drinking/cooking.
- Permission to sample Monday @2:30
- Sampled upstairs kitchen sink faucet.
- Sample 2 & 2A

**Discussions With Town Officials:**

Michael Ciara, Wilmington Town Manager

- Appreciated notification of activities.
- Wondered why we miss homes on first search.
- Concerned about MassDEP communication.
- Offered to help as intermediary with Altron. Had no success.
- Stated no need to communicate with other officials except Health & Conservation at this time.
- Wanted to hear results as soon as available.

Greg Erickson, Director of Health, Town of Wilmington

- Appreciated notification of activities.
- Offered any assistance that he could bring to the situation.
- Provided lead on Michael Gatta.
- Requested sampling analysis when available.

Eileen Chabot, Conservation Administrator, Wilmington Conservation Commission

- Appreciated notification of activities.
- Expressed delight because "Olin now keeps the Conservation Commission informed".
- Stated it was "nice" to work with our contractor because they "did the job right" and "didn't leave the Site looking a mess when they left".

Follow-up:

- Will travel to Wilmington Friday 9/20 to implement communication strategy.
- Have committed to residents that I will provide a verbal communication of the results either Friday evening or Saturday morning.
- Have committed to Town Manager to provide information as soon as available and no later then Friday.
- Have committed to Director of Health and Conservation Administrator to communicate on Friday.
- Have requested that Environmental Remediation communicate with MassDEP about activities.
- Have requested Environmental Remediation investigate Mass 21E.
- Have been told by Legal that TOSCA Notification is not needed.
- Have suggested that Altron response to Town Manager be discussed at Site Team meeting Thursday 9/19.

ABB
ASEA BROWN BOVERI

RECEIVED
SEP 27 1991
MICHAEL J. BELLOTTI
WICM
~~CAA~~ ANALYSIS
ABB

September 26, 1991

Mr. Michael Bellotti
Olin Chemicals
PO Box 248
Lower River Road
Charleston, TN

FILE COPY

Subject: Domestic Well Analysis

Enclosed ar the Reports of Analysis for the six Domestic Wells Sampled on September 16, 1991. During our data review it was noted that the Surrogate Recovery for two wells did not meet our QC criteria. Consequently, we are re-extracting and rerunning these samples. Additionally a computer file corruption has made it impossible to report the surrogate recovery for another sample. This sample will be re-run with the other samples. In all cases no herbicides were detected. We will report the results of these re-runs as soon as they are available.

If you have any questions, please do not hesitate to call me.

Sincerely,

ABB Environmental Services, Inc.

Bill

Willard C. Warren, Director
Analytical Laboratory Services

cc: R. Rozene
D. Cameron

ABB Environmental Services, Inc.

**Analytical Laboratory**
340 County Road
Post Office Box 720
Westbrook, Maine 04092
Telephone (207) 874-2400
Fax (207) 775-4029

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
340 COUNTY ROAD NO. 5
P. O. BOX 720
WESTBROOK, ME 04092
(207)874-2400/FAX(207)775-4029

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963
PAGE 1

| CLIENT SAMPLE ID | DW1 | DW1A | |
|---|---|---|---|
| ABB SAMPLE ID | 91259009 | 91259010 | |
| DATE RECEIVED | 9/16/91 | 9/16/91 | UNITS |
| COLIFORMS, FECAL | < 1 | < 1 | /100 ML |
| COLIFORMS, TOTAL | < 1 | < 1 | /100 ML |
| PH (LABORATORY) | 6.7 | 6.1 | |
| RESIDUE, FILTERABLE (TDS) | 120 | 120 | MG/L |
| SODIUM, TOTAL | 17 | 17 | MG/L |
| BARIUM, TOTAL | < 0.005 | < 0.005 | MG/L |
| IRON, TOTAL | 1.2 | 1.2 | MG/L |
| MANGANESE, TOTAL | 0.72 | 0.72 | MG/L |
| ALUMINUM, TOTAL | < 0.10 | < 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < 0.010 | < 0.010 | MG/L |
| ARSENIC, TOTAL | < 0.005 | < 0.005 | MG/L |
| BERYLLIUM, TOTAL | < 0.015 | < 0.015 | MG/L |
| CADMIUM, TOTAL | < 0.002 | < 0.002 | MG/L |
| CHROMIUM, TOTAL | < 0.015 | < 0.015 | MG/L |
| COPPER, TOTAL | 0.039 | 0.036 | MG/L |
| LEAD, TOTAL | < 0.005 | < 0.005 | MG/L |
| THALLIUM, TOTAL | < 0.005 | < 0.005 | MG/L |
| NICKEL, TOTAL | < 0.040 | < 0.040 | MG/L |
| SILVER, TOTAL | < 0.015 | < 0.015 | MG/L |
| ZINC, TOTAL | < 0.025 | < 0.025 | MG/L |
| ANTIMONY, TOTAL | < 0.005 | < 0.005 | MG/L |
| SELENIUM, TOTAL | < 0.005 | < 0.005 | MG/L |
| MERCURY, TOTAL | < 0.20 | < 0.20 | UG/L |
| CHLORIDE | 21 | 21 | MG/L |
| CYANIDE, TOTAL | < 20 | < 20 | UG/L |
| FLUORIDE | < 0.20 | < 0.20 | MG/L |
| AMMONIA, AS N | < 0.10 | < 0.10 | MG/L |
| NITROGEN, TOTAL KJELDAHL | < 0.10 | 0.18 | MG/L |
| NITRATE, AS N | 0.29 | 0.26 | MG/L |
| SULFATE | 16 | 16 | MG/L |
| ETHYLENE DIBROMIDE | | | |
| ETHYLENE DIBROMIDE | < 0.2 | < 0.2 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | | | |
| 1,2-DIBROMO-3-CHLOROPROPANE | < 0.5 | < 0.5 | UG/L |
| PESTICIDES & PCB'S SURROGATE RECOVERY | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | 140 | 110 | % |
| PRIMARY DRINKING WATER STANDARDS PEST. | | | |
| ENDRIN | < 1 | < 1 | UG/L |
| LINDANE | < 1 | < 1 | UG/L |
| METHOXYCHLOR | < 1 | < 1 | UG/L |

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963
PAGE 2

| CLIENT SAMPLE ID | DW1 | | DW1A | | |
|---|---|---|---|---|---|
| ABB SAMPLE ID | 91259009 | | 91259010 | | |
| DATE RECEIVED | 9/16/91 | | 9/16/91 | | UNITS |
| PRIMARY DRINKING WATER STANDARDS PEST. (CONT) | | | | | |
| TOXAPHENE | < | 1 | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - PEST | | | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 100 | | 95 | % |
| PRIMARY DRINKING WATER STANDARDS HERB. | | | | | |
| 2,4-D | < | 10 | < | 10 | UG/L |
| 2,4,5-TP(SILVEX) | < | 1 | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - HERB | | | | | |
| 2,4-DB | | 26 | | 30 | % |
| DRINKING WATER VOLATILES | | | | | |
| BENZENE | < | 0.08 | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < | 0.1 | < | 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | JB | 0.10 | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 1.2 | B | 0.87 | UG/L |
| NAPHTHALENE | JB | 0.05 | JB | 0.05 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | < | 0.17 | UG/L |

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REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963


| CLIENT SAMPLE ID | DW1 | | DW1A | | |
|---|---|---|---|---|---|
| ABB SAMPLE ID | 91259009 | | 91259010 | | |
| DATE RECEIVED | 9/16/91 | | 9/16/91 | | UNITS |
| DRINKING WATER VOLATILES | | | (CONT) | | |
| TETRACHLOROETHENE | < | 0.04 | < | 0.04 | UG/L |
| TOLUENE | < | 0.13 | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < | 0.11 | < | 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 0.06 | < | 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < | 0.1 | < | 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < | 0.2 | < | 0.2 | UG/L |
| TRICHLOROETHENE | < | 0.1 | < | 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < | 0.13 | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < | 0.18 | < | 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < | 0.08 | < | 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | JB | 0.02 | < | 0.07 | UG/L |
| VINYL CHLORIDE | < | 0.25 | < | 0.25 | UG/L |
| O-XYLENE | < | 0.16 | < | 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < | 0.22 | < | 0.22 | UG/L |
| VOLATILE SURROGATE RECOVERY | | | | | |
| P-BROMOFLUOROBENZENE | | 71 | | 76 | % |
| 1,2-DICHLOROBENZENE-D4 | ** | 44 | ** | 42 | % |
| SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS | | | | | |
| BENZO(B)FLUORANTHENE | < | 10 | < | 10 | UG/L |
| BENZO(K)FLUORANTHENE | < | 10 | < | 10 | UG/L |
| CHRYSENE | < | 10 | < | 10 | UG/L |
| BENZO(A)ANTHRACENE | < | 10 | < | 10 | UG/L |
| ANTHRACENE | < | 10 | < | 10 | UG/L |
| PHENANTHRENE | < | 10 | < | 10 | UG/L |
| ACENAPHTHYLENE | < | 10 | < | 10 | UG/L |
| ACENAPHTHENE | < | 10 | < | 10 | UG/L |
| BENZO(A)PYRENE | < | 10 | < | 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < | 10 | < | 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < | 10 | < | 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < | 10 | < | 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < | 10 | < | 10 | UG/L |
| DIETHYLPHTHALATE | < | 10 | < | 10 | UG/L |
| DIMETHYLPHTHALATE | < | 10 | < | 10 | UG/L |
| FLUORANTHENE | < | 10 | < | 10 | UG/L |
| FLUORENE | < | 10 | < | 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < | 10 | < | 10 | UG/L |
| HEXACHLOROBUTADIENE | < | 10 | < | 10 | UG/L |
| HEXACHLOROETHANE | < | 10 | < | 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < | 10 | < | 10 | UG/L |
| ISOPHORONE | < | 10 | < | 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < | 10 | < | 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < | 10 | < | 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < | 10 | < | 10 | UG/L |
| NITROBENZENE | < | 10 | < | 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < | 10 | < | 10 | UG/L |
| PYRENE | < | 10 | < | 10 | UG/L |
| BENZO(GHI)PERYLENE | < | 10 | < | 10 | UG/L |
| 1,2-DICHLOROBENZENE | < | 10 | < | 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 10 | < | 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < | 10 | < | 10 | UG/L |
| 1,3-DICHLOROBENZENE | < | 10 | < | 10 | UG/L |
| 1,4-DICHLOROBENZENE | < | 10 | < | 10 | UG/L |
| 2-CHLORONAPHTHALENE | < | 10 | < | 10 | UG/L |
| 2-CHLOROPHENOL | < | 10 | < | 10 | UG/L |
| 2-NITROPHENOL | < | 10 | < | 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < | 10 | < | 10 | UG/L |
| 2,4-DICHLOROPHENOL | < | 10 | < | 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < | 10 | < | 10 | UG/L |

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REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963
PAGE 4

| CLIENT SAMPLE ID | DW1 | | DW1A | | |
|---|---|---|---|---|---|
| ABB SAMPLE ID | 91259009 | | 91259010 | | |
| DATE RECEIVED | 9/16/91 | | 9/16/91 | | UNITS |
| SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT) | | | | | |
| 2,4-DINITROTOLUENE | < | 10 | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | < | 50 | UG/L |
| PHENOL | < | 10 | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | < | 10 | UG/L |
| BENZIDINE | < | 50 | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | < | 10 | UG/L |
| SEMIVOLATILE SURROGATE RECOVERY | | | | | |
| 2-FLUOROPHENOL | | 43 | | 37 | % |
| PHENOL-D5 | | 25 | | 22 | % |
| NITROBENZENE-D5 | | 74 | | 72 | % |
| 2-FLUOROBIPHENYL | | 83 | | 80 | % |
| 2,4,6-TRIBROMOPHENOL | | 70 | | 59 | % |
| TERPHENYL-D14 | | 74 | | 78 | % |

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 1

J = Indicates an estimated value. The analyte was detected in the sample at a concentration greater than the measured detection limit but less than the laboratory's Practical Quantitation Level.

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

** Surrogate recovery does not meet internal QC criteria. Insufficient sample remained for reanalysis.

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REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11964
PAGE 1

| CLIENT SAMPLE ID | | DW2 | |
|---|---|---|---|
| ABB SAMPLE ID | | 91259011 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| COLIFORMS, FECAL | | 2 | /100 ML |
| COLIFORMS, TOTAL | | 12 | /100 ML |
| PH (LABORATORY) | | 6.5 | |
| RESIDUE, FILTERABLE (TDS) | | 140 | MG/L |
| SODIUM, TOTAL | | 20 | MG/L |
| BARIUM, TOTAL | | 0.022 | MG/L |
| IRON, TOTAL | | 0.48 | MG/L |
| MANGANESE, TOTAL | | 0.97 | MG/L |
| ALUMINUM, TOTAL | < | 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < | 0.010 | MG/L |
| ARSENIC, TOTAL | < | 0.005 | MG/L |
| BERYLLIUM, TOTAL | < | 0.015 | MG/L |
| CADMIUM, TOTAL | < | 0.002 | MG/L |
| CHROMIUM, TOTAL | < | 0.015 | MG/L |
| COPPER, TOTAL | | 0.040 | MG/L |
| LEAD, TOTAL | < | 0.005 | MG/L |
| THALLIUM, TOTAL | < | 0.005 | MG/L |
| NICKEL, TOTAL | < | 0.040 | MG/L |
| SILVER, TOTAL | < | 0.015 | MG/L |
| ZINC, TOTAL | < | 0.025 | MG/L |
| ANTIMONY, TOTAL | # < | 0.005 | MG/L |
| SELENIUM, TOTAL | < | 0.005 | MG/L |
| MERCURY, TOTAL | < | 0.20 | UG/L |
| CHLORIDE | | 42 | MG/L |
| CYANIDE, TOTAL | < | 20 | UG/L |
| FLUORIDE | < | 0.20 | MG/L |
| AMMONIA, AS N | | 0.32 | MG/L |
| NITROGEN, TOTAL KJELDAHL | | 0.27 | MG/L |
| NITRATE, AS N | * | 0.19 | MG/L |
| SULFATE | | 13 | MG/L |
| ETHYLENE DIBROMIDE | | | |
| ETHYLENE DIBROMIDE | < | 0.2 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | | | |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.5 | UG/L |
| PESTICIDES & PCB'S SURROGATE RECOVERY | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 110 | % |
| PRIMARY DRINKING WATER STANDARDS PEST. | | | |
| ENDRIN | < | 1 | UG/L |
| LINDANE | < | 1 | UG/L |
| METHOXYCHLOR | < | 1 | UG/L |

| CLIENT SAMPLE ID | DW2 | |
|---|---|---|
| ABB SAMPLE ID | 91259011 | |
| DATE RECEIVED | 9/16/91 | UNITS |
| **PRIMARY DRINKING WATER STANDARDS PEST. (CONT)** | | |
| TOXAPHENE | < 1 | UG/L |
| **DRINKING WATER SURROGATE RECOVERY - PEST** | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | 110 | % |
| **PRIMARY DRINKING WATER STANDARDS HERB.** | | |
| 2,4-D | < 10 | UG/L |
| 2,4,5-TP(SILVEX) | < 1 | UG/L |
| **DRINKING WATER SURROGATE RECOVERY - HERB** | | |
| 2,4-DB | 39 | % |
| **DRINKING WATER VOLATILES** | | |
| BENZENE | < 0.08 | UG/L |
| BROMOBENZENE | < 0.05 | UG/L |
| BROMOCHLOROMETHANE | < 0.16 | UG/L |
| BROMODICHLOROMETHANE | < 0.21 | UG/L |
| BROMOFORM | < 0.17 | UG/L |
| BROMOMETHANE | < 0.16 | UG/L |
| N-BUTYLBENZENE | < 0.08 | UG/L |
| SEC-BUTYLBENZENE | < 0.05 | UG/L |
| TERT-BUTYLBENZENE | < 0.06 | UG/L |
| CARBON TETRACHLORIDE | < 0.12 | UG/L |
| CHLOROBENZENE | < 0.05 | UG/L |
| CHLOROETHANE | < 0.13 | UG/L |
| CHLOROFORM | < 0.16 | UG/L |
| CHLOROMETHANE | < 0.18 | UG/L |
| 2-CHLOROTOLUENE | < 0.11 | UG/L |
| 4-CHLOROTOLUENE | < 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < 0.11 | UG/L |
| DIBROMOMETHANE | < 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < 0.11 | UG/L |
| ETHYLBENZENE | < 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < 0.12 | UG/L |
| ISOPROPYLBENZENE | < 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < 0.08 | UG/L |
| METHYLENE CHLORIDE | B 0.44 | UG/L |
| NAPHTHALENE | < 0.21 | UG/L |
| N-PROPYLBENZENE | < 0.07 | UG/L |
| STYRENE | < 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < 0.17 | UG/L |

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REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11964


| CLIENT SAMPLE ID | | DW2 | |
|---|---|---|---|
| ABB SAMPLE ID | | 91259011 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| DRINKING WATER VOLATILES | | | (CONT) |
| TETRACHLOROETHENE | < | 0.04 | UG/L |
| TOLUENE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < | 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < | 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < | 0.2 | UG/L |
| TRICHLOROETHENE | < | 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < | 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < | 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < | 0.07 | UG/L |
| VINYL CHLORIDE | < | 0.25 | UG/L |
| O-XYLENE | < | 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < | 0.22 | UG/L |
| VOLATILE SURROGATE RECOVERY | | | |
| P-BROMOFLUOROBENZENE | | 77 | % |
| 1,2-DICHLOROBENZENE-D4 | | 84 | % |
| SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS | | | |
| BENZO(B)FLUORANTHENE | < | 10 | UG/L |
| BENZO(K)FLUORANTHENE | < | 10 | UG/L |
| CHRYSENE | < | 10 | UG/L |
| BENZO(A)ANTHRACENE | < | 10 | UG/L |
| ANTHRACENE | < | 10 | UG/L |
| PHENANTHRENE | < | 10 | UG/L |
| ACENAPHTHYLENE | < | 10 | UG/L |
| ACENAPHTHENE | < | 10 | UG/L |
| BENZO(A)PYRENE | < | 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < | 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < | 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < | 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < | 10 | UG/L |
| DIETHYLPHTHALATE | < | 10 | UG/L |
| DIMETHYLPHTHALATE | < | 10 | UG/L |
| FLUORANTHENE | < | 10 | UG/L |
| FLUORENE | < | 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < | 10 | UG/L |
| HEXACHLOROBUTADIENE | < | 10 | UG/L |
| HEXACHLOROETHANE | < | 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < | 10 | UG/L |
| ISOPHORONE | < | 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < | 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < | 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < | 10 | UG/L |
| NITROBENZENE | < | 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < | 10 | UG/L |
| PYRENE | < | 10 | UG/L |
| BENZO(GHI)PERYLENE | < | 10 | UG/L |
| 1,2-DICHLOROBENZENE | < | 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < | 10 | UG/L |
| 1,3-DICHLOROBENZENE | < | 10 | UG/L |
| 1,4-DICHLOROBENZENE | < | 10 | UG/L |
| 2-CHLORONAPHTHALENE | < | 10 | UG/L |
| 2-CHLOROPHENOL | < | 10 | UG/L |
| 2-NITROPHENOL | < | 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < | 10 | UG/L |
| 2,4-DICHLOROPHENOL | < | 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < | 10 | UG/L |

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CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11969


| CLIENT SAMPLE ID | TRIP BLK | | |
|---|---|---|---|
| ABB SAMPLE ID | 91259016 | | |
| DATE RECEIVED | 9/16/91 | | UNITS |
| DRINKING WATER VOLATILES | | | |
| BENZENE | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < | 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 0.82 | UG/L |
| NAPHTHALENE | < | 0.21 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | UG/L |

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11969
PAGE 2

| CLIENT SAMPLE ID | TRIP BLK | |
|---|---|---|
| ABB SAMPLE ID | 91259016 | |
| DATE RECEIVED | 9/16/91 | UNITS |
| DRINKING WATER VOLATILES | | (CONT) |
| TETRACHLOROETHENE | < 0.04 | UG/L |
| TOLUENE | 0.14 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < 0.2 | UG/L |
| TRICHLOROETHENE | < 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < 0.07 | UG/L |
| VINYL CHLORIDE | < 0.25 | UG/L |
| O-XYLENE | < 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < 0.22 | UG/L |
| VOLATILE SURROGATE RECOVERY | | |
| P-BROMOFLUOROBENZENE | 92 | % |
| 1,2-DICHLOROBENZENE-D4 | 106 | % |

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 7

detected in the laboratory method blank analyzed
.ly with the samples.

refer to the Quality Control Report for method blank compound
.trations.

# CHAIN OF CUSTODY RECORD



| PROJECT NO. | PROJECT NAME |
|---|---|
| | OLIN CHEMICAL DOMESTIC WELL |

SAMPLERS (SIGNATURE): Kim A. Nelson

| STA. NO. | DATE | TIME | COMP. | GRAB | STATION LOCATION | NO. OF CONTAINERS | 40 ml VOA | 1 l plastic | 500 ml plastic | 1 l Amber | 250 ml plastic | 1 l glass | 250 ml plastic | 100 ml glass | 40 ml VOA | 250 ml plastic | 1 l amber glass | REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9/16/91 | 11:55 | | | DW-1 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 11:55 | | | DW-1A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 14:35 | | | DW-2 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | 2 | 1 | 4 | |
| | | 14:35 | | | DW-2A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:00 | | | DW-3 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:00 | | | DW-3A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:25 | | | DW-4 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:25 | | | DW-4A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:50 | | | DW-5 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:50 | | | DW-5A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 16:15 | | | DW-6 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 16:15 | | | DW-6A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | | | | ~~DW-7~~ | | ~~2~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~4~~ | | ~~2~~ | | ~~1~~ | | NOT NEEDED |
| | | | | | ~~DW-7A~~ | | ~~2~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~4~~ | ~~1~~ | | | ~~1~~ | | |

| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) | RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|---|---|
| Kim A. Nelson | 9/16/91 16:30 | John L. Shields | | | |
| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) | RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) |
| | | | | | |
| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED FOR DISPOSAL BY: (SIGNATURE) | DATE/TIME | REMARKS | |
| | | | | | |

ABB Environmental Services, Inc.

OH-62

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Acidity | 305.1 | 10 mg/L |
| Alkalinity-Manual Titrimetric | 310.1 | 20 mg/L |
| Bicarbonate, Carbonate (see pH & alkalinity) | calc. | mg/L |
| Biochemical Oxygen Demand-Carbonaceous | 405.1 | 6 mg/L |
| Biochemical Oxygen Demand-Total | 405.1 | 6 mg/L |
| Chemical Oxygen Demand-Manual Colorimetric | 410.4 | 15 mg/L |
| Chloride-Automated Ferricyanide | 325.2 | 2 mg/L |
| Chlorine, Total Residual | 330.5 | 0.1 mg/L |
| Coliform, Fecal | APHA 909C | 1/100 mL |
| Coliform, Total | APHA 909A | 1/100 mL |
| Color, True | 110.2 | 5 PTCO |
| Color, Apparent | 110.2 | 5 PTCO |
| Corrosivity-NACE Standard TM-01-69 | 1110 | 10 mpy |
| Cyanide, Total-Spectrophotometric | 335.2 | 20 ug/L |
| Cyanide, Amenable-Spectrophotometric | 335.1 | 20 ug/L |
| Dissolved Oxygen(Laboratory)-Membrane Electrode | 360.1 | 1 mg/L |
| Fluoride, Potentiometric ISE | 340.2 | 0.2 mg/L |
| Fluoride with distillation, Potentiometric ISE | 340.1/340.2 | 0.2 mg/L |
| Hardness, Total-Manual Titrimetric | 130.2 | 5 mg/L |
| Ignitability-Flash Point (closed cup) | 1010 | 25 Degrees Celsius |
| MBAS, Extraction-Colorimetric | 425.1 | 0.04 mg/L |
| Ammonia-Nitrogen-Automated Phenate | 350.1 | 0.1 mg/L |
| Organic Nitrogen-Auto. Block Digest.,Spectro. | 350.1/351.2 | 0.1 mg/L |
| Total Kjeldahl Nitrogen-Auto Block Digest,Spect | 351.2 | 0.1 mg/L |
| Nitrate+Nitrite-Automated Cadmium Reduction | 353.2 | 0.05 mg/L |
| Nitrate-Automated Cadmium Red./Diazotization | 353.2/354.1 | 0.05 mg/L |
| Nitrite-Automated Diazotization | 354.1 | 0.05 mg/L |
| Oil & Grease-Total Recoverable, Gravimetric | 413.1 | 5 mg/L |
| Oil & Grease-Total Recoverable, Infrared | 413.2 | 1.5 mg/L |
| Oil & Grease-Hydrocarbons,Grav./Solvent Extract | APHA 503E | 5 mg/L |
| pH (Laboratory) | 150.1 | — |
| Phenolics, Total Recoverable-Manual 4AAP | 420.1 | 5 ug/L |
| Phosphate,Total-Auto Ascorbic Acid/Block Digestion | 365.4 | 0.1 mg/L |
| Phosphate, Ortho-Auto. Ascorbic Acid | 365.1 | 0.05 mg/L |
| Silica-Manual Molybdosilicate | 370.1 | 1 mg/L |
| Solids-Nonfilterable Residue (TSS) | 160.2 | 4 mg/L |
| Solids-Volatile Nonfilterable Residue (VSS) | 160.2/160.4 | 10 mg/L |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Solids-Filterable Residue (TDS),Gravimetric 180 | 160.1 | 10 mg/L |
| Solids-Volatile Filterable Residue (VDS) | 160.1/160.4 | 10 mg/L |
| Solids-Settleable Solids (SS) | 160.5 | 0.2 mL/L |
| Solids-Total Solids | 160.3 | 10 mg/L |
| Specific Conductance-Wheatstone Bridge | 120.1 | umhos/cm |
| Sulfate-Turbidimetric | 375.4 | 1 mg/L |
| Sulfite-Titrimetric | 377.1 | 3 mg/L |
| Sulfide-Iodometric | 376.1 | 1 mg/L |
| Sulfide-Monier-Williams | 40CFR-425 | 0.5 mg/L |
| Sulfide-Reactive | 7.3.4.1 | |
| Tannin/Lignin-Calorimetric | APHA 513 | 1 mg/L |
| Total Organic Carbon-Oxidation | 415.1 | 1 mg/L |
| Total Inorganic Carbon | 415.1 | 1 mg/L |
| Total Organic Halogen | 9020 | mg/L |
| Total Petroleum Hydrocarbons-Extraction, IR | 418.1 | 1 mg/L |
| Turbidity | 180.1 | 1 NTU |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# ELEMENTAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Aluminum-ICP | 200.7/6010 | 0.100 mg/L |
| Antimony-Furnace AA | 204.2/7041 | 0.005 mg/L |
| Arsenic-Furnace AA | 206.2/7060 | 0.005 mg/L |
| Barium-ICP | 200.7/6010 | 0.005 mg/L |
| Beryllium-ICP | 200.7/6010 | 0.015 mg/L |
| Boron-ICP | 200.7/6010 | 0.025 mg/L |
| Cadmium-Furnace AA | 213.2 | 0.002 mg/L |
| Calcium-ICP | 200.7/6010 | 0.025 mg/L |
| Chromium-ICP | 200.7/6010 | 0.015 mg/L |
| Chromium, Hexavalent-Colorimetric | 7196 | 0.010 mg/L |
| Cobalt-ICP | 200.7/6010 | 0.015 mg/L |
| Copper-ICP | 200.7/6010 | 0.025 mg/L |
| Gold-ICP | 200.7/6010 | 0.100 mg/L |
| Iron-ICP | 200.7/6010 | 0.025 mg/L |
| Lead-ICP | 200.7/6010 | 0.100 mg/L |
| Lead-Furnace AA | 239.2/7421 | 0.005 mg/L |
| Magnesium-ICP | 200.7/6010 | 0.050 mg/L |
| Manganese-ICP | 200.7/6010 | 0.010 mg/L |
| Mercury-CVAA | 245.1/7470 | 0.20 ug/L |
| Molybdenum-ICP | 200.7/6010 | 0.020 mg/L |
| Nickel-ICP | 200.7/6010 | 0.040 mg/L |
| Platinum-Furnace AA | 255.2 | 0.005 mg/L |
| Potassium-Flame AA | 258.1 | 0.025 mg/L |
| Potassium-ICP | 200.7/6010 | 0.500 mg/L |
| Selenium-Furnace AA | 270.2/7740 | 0.005 mg/L |
| Silver-ICP | 200.7/6010 | 0.015 mg/L |
| Sodium-ICP | 200.7/6010 | 0.050 mg/L |
| Thallium-Furnace AA | 279.2/7841 | 0.005 mg/L |
| Tin-ICP | 200.7/6010 | 0.100 mg/L |
| Titanium-ICP | 200.7/6010 | 0.100 mg/L |
| Vanadium-ICP | 200.7/6010 | 0.025 mg/L |
| Zinc-ICP | 200.7/6010 | 0.025 mg/L |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the laboratory PQL as a result of sample matrix and compound concentration.

ICP = Inductively Coupled Plasma

AA = Atomic Absorption

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION

PARAMETER: ETHYLENE DIBROMIDE/1,2-DIBROMO-3-CHLOROPROPANE

METHOD: GC/ECD

MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| Ethylene dibromide | 0.2 |
| 1,2-Dibromo-3-chloropropane | 0.5 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SDWA PESTICIDES
METHOD: 608
MATRIX: AQUEOUS

| *COMPOUND* | *PQL (ug/L)* |
|---|---|
| Endrin | 1 |
| Lindane | 1 |
| Methoxychlor | 1 |
| Toxaphene | 1 |

PARAMETER: SDWA HERBICIDES
METHOD: SM509B
MATRIX: AQUEOUS

| *COMPOUND* | *PQL (ug/L)* |
|---|---|
| 2,4-D | 10 |
| 2,4,5-TP (Silvex) | 1 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# ANALYTICAL METHOD INFORMATION
## PARAMETER: DRINKING WATER VOLATILE ORGANICS
## METHOD: 524.2
## MATRIX: AQUEOUS

| *Compound* | *Minimum Detection Limit (MDL) (ug/L)* |
|---|---|
| Benzene | 0.08 |
| Bromobenzene | 0.05 |
| Bromochloromethane | 0.16 |
| Bromodichloromethane | 0.21 |
| Bromoform | 0.17 |
| Bromomethane | 0.16 |
| n-Butylbenzene | 0.08 |
| sec-Butylbenzene | 0.05 |
| tert-Butylbenzene | 0.06 |
| Carbon tetrachloride | 0.12 |
| Chlorobenzene | 0.05 |
| Chloroethane | 0.13 |
| Chloroform | 0.16 |
| Chloromethane | 0.18 |
| 2-Chlorotoluene | 0.11 |
| 4-Chlorotoluene | 0.10 |
| Dibromochloromethane | 0.19 |
| 1,2-Dibromo-3-chloropropane | 0.85 |
| 1,2-Dibromoethane | 0.11 |
| Dibromomethane | 0.18 |
| 1,2-Dichlorobenzene | 0.10 |
| 1,3-Dichlorobenzene | 0.10 |
| 1,4-Dichlorobenzene | 0.10 |
| Dichlorodifluoromethane | 0.21 |
| 1,1-Dichloroethane | 0.11 |
| 1,2-Dichloroethane | 0.10 |
| 1,1-Dichloroethene | 0.19 |
| cis-1,2-Dichloroethene | 0.22 |
| trans-1,2-Dichloroethene | 0.20 |
| 1,2-Dichloropropane | 0.12 |
| 1,3-Dichloropropane | 0.14 |
| 2,2-Dichloropropane | 0.27 |
| 1,1-Dichloropropene | 0.12 |
| cis-1,3-Dichloropropene | 0.14 |
| trans-1,3-Dichloropropene | 0.11 |
| Ethylbenzene | 0.10 |

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# ANALYTICAL METHOD INFORMATION
# PARAMETER: DRINKING WATER VOLATILE ORGANICS
# METHOD: 524.2
# MATRIX: AQUEOUS

| *Compound* | *Minimum Detection Limit (MDL) (ug/L)* |
|---|---|
| Hexachlorobutadiene | 0.12 |
| Isopropylbenzene | 0.04 |
| 4-Isopropyltoluene | 0.08 |
| Methylene chloride | 0.24 |
| Naphthalene | 0.21 |
| n-Propylbenzene | 0.07 |
| Styrene | 0.12 |
| 1,1,1,2-Tetrachloroethane | 0.11 |
| 1,1,2,2-Tetrachloroethane | 0.17 |
| Tetrachloroethene | 0.04 |
| Toluene | 0.13 |
| 1,2,3-Trichlorobenzene | 0.11 |
| 1,2,4-Trichlorobenzene | 0.06 |
| 1,1,1-Trichloroethane | 0.10 |
| 1,1,2-Trichloroethane | 0.20 |
| Trichloroethene | 0.10 |
| Trichlorofluoromethane | 0.13 |
| 1,2,3-Trichloropropane | 0.18 |
| 1,2,4-Trimethylbenzene | 0.08 |
| 1,3,5-Trimethylbenzene | 0.07 |
| Vinyl chloride | 0.25 |
| o-Xylene | 0.16 |
| m-Xylene | 0.22 |
| p-Xylene | 0.22 |

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# ANALYTICAL METHOD INFORMATION
## PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
## METHOD: 625/8270
## MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| Benzo(B)Fluoranthene | 10 |
| Benzo(K)Fluoranthene | 10 |
| Chrysene | 10 |
| Benzo(A)Anthracene | 10 |
| Anthracene | 10 |
| Phenanthrene | 10 |
| Acenaphthylene | 10 |
| Acenaphthene | 10 |
| Benzo(A)Pyrene | 10 |
| Bis(2-Chloroethyl)Ether | 10 |
| Bis(2-Chloroethoxy)Methane | 10 |
| Bis(2-Chloroisopropyl)Ether | 10 |
| Butyl Benzyl Phthalate | 10 |
| Diethylphthalate | 10 |
| Dimethylphthalate | 10 |
| Fluoranthene | 10 |
| Fluorene | 10 |
| Hexachlorocyclopentadiene | 10 |
| Hexachlorobutadiene | 10 |
| Hexachloroethane | 10 |
| Indeno(1,2,2-CD)Pyrene | 10 |
| Isophorone | 10 |
| N-Nitrosodi-n-Propylamine | 10 |
| N-Nitrosodiphenylamine | 10 |
| N-Nitrosodimethylamine | 10 |
| Nitrobenzene | 10 |
| 4-Chloro-3-methylphenol | 10 |
| Pyrene | 10 |
| Benzo(GHI)perylene | 10 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| 1,2-Dichlorobenzene | 10 |
| 1,2,4-Trichlorobenzene | 10 |
| Dibenzo(A,H)Anthracene | 10 |
| 1,3-Dichlorobenzene | 10 |
| 1,4-Dichlorobenzene | 10 |
| 2-Chloronaphthalene | 10 |
| 2-Chlorophenol | 10 |
| 2-Nitrophenol | 10 |
| Di-n-octylphthalate | 10 |
| 2,4-Dichlorophenol | 10 |
| 2,4-Dimethylphenol | 10 |
| 2,4-Dinitrotoluene | 10 |
| 2,4-Dinitrophenol | 50 |
| 2,4,6-Trichlorophenol | 10 |
| 2,6-Dinitrotoluene | 10 |
| 3,3-Dichlorobenzidine | 20 |
| 4-Bromophenyl Phenyl Ether | 10 |
| 4-Chlorophenyl Phenyl Ether | 10 |
| 4-Nitrophenol | 50 |
| 2-Methyl-4,6-Dinitrophenol | 50 |
| Phenol | 10 |
| Napbthalene | 10 |
| Pentachlorophenol | 50 |
| Bis(2-Ethylhexyl)Phthalate | 10 |
| Di-n-Butylphthalate | 10 |
| Benzidine | 50 |
| Hexachlorobenzene | 10 |
| 1,2-Diphenyldrazine | 10 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

# REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

The attached Report of Analysis summarizes the analytical results for your drinking water sample. The ABB-ES Laboratory reports results using industry-accepted protocols as well as some unique reporting protocols that are designed to present a comprehensive Report of Analysis.

All sample results are reported in concentration units of ug/L (micrograms per liter) or mg/L (milligrams per liter). These units are used to express the concentration of a particular substance in a solution. One milligram per liter (1 mg/L) is equivalent to one thousand micrograms per liter (1000 mg/L); therefore, a solution with a concentration of 5 mg/L is more concentrated than a solution with a concentration of 5 ug/L.

After the Volatile Organic and Semivolatile Organic results, there is a section entitled Volatile Surrogate Recovery and Semivolatile Surrogate Recovery, respectively. Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate. The surrogate compounds act as a means to measure the efficiency of the sample extraction and analysis.

The US Environmental Protection Agency has outlined certain criteria that the ABB-ES Laboratory uses for reporting sample concentrations. These criteria dictate the detection limits that laboratories should use for reporting sample results. The ABB-ES Laboratory conducts Method Detection Limit (MDL) studies and Instrument Detection Limit (IDL) studies on a regular basis. The MDL and IDL studies enable us to determine the limitations of analytical procedures as well as instrumentation. An MDL is defined as:

> "The minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero."

An IDL is defined as:

> "The smallest signal above background noise that an instrument can detect at a 99% confidence level."

Method Detection Limit or Instrument Detection Limit concentrations are then multiplied by a factor of 3 (three) to 10 (ten) to determine what the Practical Quantitation Limit (PQL) is for a particular analysis. A PQL is defined as:

> "The lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions."

## REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

All parameters on this Report of Analysis are reported based upon PQLs except for the Volatile Organic Analysis results. The Volatile Organic Analysis results are reported based upon MDLs so that ABB-ES reporting limits comply with Massachusetts Department of Environmental Protection drinking water limits. If a result is reported with a " < " sign, then the compound was not detected in the sample above the PQL or, in the case of Volatile Organics, the MDL.

As part of the standard operating procedures of the ABB-ES Laboratory, contaminant-free water is analyzed as a sample concurrently with a set of samples. This reagent-free water sample is called a method blank. A "B" notation signifies that the compound reported was also detected in its corresponding method blank. There are certain compounds that occur as common laboratory contaminants that may be detected in the method blank. It is standard policy for the laboratory to reanalyze a sample if a compound that is not a common laboratory contaminant is detected in the method blank.

For Volatile Organic and Semivolatile Organic analyses, it is common for most laboratories to report values that are below the PQL. These values are notated with a "J". The "J" notation signifies that the parameter was detected and that the value reported is an estimated value because it is below the PQL.

The ABB-ES Laboratory will notate other sample results based upon Quality Control criteria to which the laboratory adheres. Non-standard quality control results are notated on the Report of Analysis. This notation will give a brief explanation of the impact of these quality control results on the actual sample results.

ABB

ASEA BROWN BOVERI

# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| Arsenic, total | 0.05 | |
| Barium, total | 1 | |
| Benzene | 0.005 | |
| gamma-BHC (Lindane) | 0.0004 | |
| Bromobenzene | U | |
| Bromochloromethane | U | |
| Bromodichloromethane | * | |
| Bromoform | * | |
| Bromomethane | U | |
| n-Butylbenzene | U | |
| sec-Butylbenzene | U | |
| tert-Butylbenzene | U | |
| Cadmium, total | 0.010 | |
| Carbon tetrachloride | 0.005 | |
| Chloride | U | 250 |
| Chlorobenzene | U | |
| Chloroethane | U | |
| Chloroform | * | |
| Chloromethane | U | |
| 2-Chlorotoluene | U | |
| 4-Chlorotoluene | U | |
| Chromium, total | 0.05 | |
| Chromium, hexavalent | 0.05 | |
| Coliform, fecal | 1/100 mL | |
| Coliform, total | 1/100 mL | |
| Color | | 15 color units |
| Copper, total | | 1 |
| Corrosivity | | noncorrosive |
| 2,4-D | 0.1 | |
| 1,2-Dibromo-3-chloropropane | U | |
| Dibromochloromethane | * | |
| 1,2-Dibromoethane | U | |
| Dibromomethane | U | |
| 1,2-Dichlorobenzene | U | |
| 1,3-Dichlorobenzene | U | |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

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# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| 1,4-Dichlorobenzene | 0.075 | |
| Dichlorodifluoromethane | U | |
| 1,1-Dichloroethane | U | |
| 1,2-Dichloroethane | 0.005 | |
| 1,1-Dichloroethene | 0.007 | |
| cis-1,2-Dichloroethene | U | |
| trans-1,2-Dichloroethene | U | |
| 1,2-Dichloropropane | U | |
| 1,3-Dichloropropane | U | |
| 2,2-Dichloropropane | U | |
| 1,1-Dichloropropene | U | |
| cis-1,3-Dichloropropene | U | |
| trans-1,3-Dichloropropene | U | |
| Endrin | 0.0002 | |
| Ethylbenzene | U | |
| Fluoride, soluble | 4.0 | 2.0 |
| Hexachlorobutadiene | U | |
| Iron, total | U | 0.3 |
| Isopropylbenzene | U | |
| 4-Isopropyltoluene | U | |
| Langelier saturation index | U | |
| Lead, total | 0.05 | |
| Manganese, total | U | 0.05 |
| Mercury, total | 0.002 | |
| Methoxychlor | 0.1 | |
| Methylene chloride | U | |
| Naphthalene | U | |
| Nitrate, (as N) | 10 | |
| Odor | | 3 TON |
| pH | | 6.5-8.5 |
| n-Propylbenzene | U | |
| Radioactivity, total alpha | 15 pCi/L | |
| Radioactivity, total beta | 4 mrem | |
| Radium 226, total | 5 pCi/L | |
| Radium, 228 | 5 pCi/L | |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Aet.

# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| Selenium, total | 0.01 | |
| Silver, total | 0.05 | |
| Sodium, total | 20.0 | |
| Styrene | U | |
| Sulfate (as SO4) | | 250 |
| Surfactants | | 2 |
| 1,1,1,2-Tetrachloroethane | U | |
| 1,1,2,2-Tetrachloroethane | U | |
| Tetrachloroethene | U | |
| Toluene | U | |
| Total dissolved solids (TDS) | | 500 |
| Toxaphene | 0.005 | |
| 2,4,5-TP (Silvex) | 0.01 | |
| 1,2,3-Trichlorobenzene | U | |
| 1,2,4-Trichlorobenzene | U | |
| 1,1,1-Trichloroethane | 0.20 | |
| 1,1,2-Trichloroethane | U | |
| Trichloroethene | 0.005 | |
| Trichlorofluoromethane | U | |
| 1,2,3-Trichloropropane | U | |
| Trihalomethanes (chloroform, bromoform, | 0.10 | |
| bromodichloromethane, dibromochloromethane) * | | |
| 1,2,4-Trimethylbenzene | U | |
| 1,3,5-Trimethylbenzene | U | |
| Turbidity | 1-5 ntu | |
| Vinyl chloride | 0.002 | |
| m-Xylene | U | |
| o-Xylene | U | |
| p-Xylene | U | |
| Zinc, total | | 5 |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Acidity | 305.1 | 10 mg/L |
| Alkalinity-Manual Titrimetric | 310.1 | 20 mg/L |
| Bicarbonate, Carbonate (see pH & alkalinity) | calc. | mg/L |
| Biochemical Oxygen Demand-Carbonaceous | 405.1 | 6 mg/L |
| Biochemical Oxygen Demand-Total | 405.1 | 6 mg/L |
| Chemical Oxygen Demand-Manual Colorimetric | 410.4 | 15 mg/L |
| Chloride-Automated Ferricyanide | 325.2 | 2 mg/L |
| Chlorine, Total Residual | 330.5 | 0.1 mg/L |
| Coliform, Fecal | APHA 909C | 1/100 mL |
| Coliform, Total | APHA 909A | 1/100 mL |
| Color, True | 110.2 | 5 PTCO |
| Color, Apparent | 110.2 | 5 PTCO |
| Corrosivity-NACE Standard TM-01-69 | 1110 | 10 mpy |
| Cyanide, Total-Spectrophotometric | 335.2 | 20 ug/L |
| Cyanide, Amenable-Spectrophotometric | 335.1 | 20 ug/L |
| Dissolved Oxygen(Laboratory)-Membrane Electrode | 360.1 | 1 mg/L |
| Fluoride, Potentiometric ISE | 340.2 | 0.2 mg/L |
| Fluoride with distillation, Potentiometric ISE | 340.1/340.2 | 0.2 mg/L |
| Hardness, Total-Manual Titrimetric | 130.2 | 5 mg/L |
| Ignitability-Flash Point (closed cup) | 1010 | 25 Degrees Celsius |
| MBAS, Extraction-Colorimetric | 425.1 | 0.04 mg/L |
| Ammonia-Nitrogen-Automated Phenate | 350.1 | 0.1 mg/L |
| Organic Nitrogen-Auto. Block Digest., Spectro. | 350.1/351.2 | 0.1 mg/L |
| Total Kjeldahl Nitrogen-Auto Block Digest, Spect | 351.2 | 0.1 mg/L |
| Nitrate+Nitrite-Automated Cadmium Reduction | 353.2 | 0.05 mg/L |
| Nitrate-Automated Cadmium Red./Diazotization | 353.2/354.1 | 0.05 mg/L |
| Nitrite-Automated Diazotization | 354.1 | 0.05 mg/L |
| Oil & Grease-Total Recoverable, Gravimetric | 413.1 | 5 mg/L |
| Oil & Grease-Total Recoverable, Infrared | 413.2 | 1.5 mg/L |
| Oil & Grease-Hydrocarbons, Grav./Solvent Extract | APHA 503E | 5 mg/L |
| pH (Laboratory) | 150.1 | — |
| Phenolics, Total Recoverable-Manual 4AAP | 420.1 | 5 ug/L |
| Phosphate, Total-Auto Ascorbic Acid/Block Digestion | 365.4 | 0.1 mg/L |
| Phosphate, Ortho-Auto. Ascorbic Acid | 365.1 | 0.05 mg/L |
| Silica-Manual Molybdosilicate | 370.1 | 1 mg/L |
| Solids-Nonfilterable Residue (TSS) | 160.2 | 4 mg/L |
| Solids-Volatile Nonfilterable Residue (VSS) | 160.2/160.4 | 10 mg/L |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

# GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Solids-Filterable Residue (TDS),Gravimetric 180 | 160.1 | 10 mg/L |
| Solids-Volatile Filterable Residue (VDS) | 160.1/160.4 | 10 mg/L |
| Solids-Settleable Solids (SS) | 160.5 | 0.2 mL/L |
| Solids-Total Solids | 160.3 | 10 mg/L |
| Specific Conductance-Wheatstone Bridge | 120.1 | umhos/cm |
| Sulfate-Turbidimetric | 375.4 | 1 mg/L |
| Sulfite-Titrimetric | 377.1 | 3 mg/L |
| Sulfide-Iodometric | 376.1 | 1 mg/L |
| Sulfide-Monier-Williams | 40CFR-425 | 0.5 mg/L |
| Sulfide-Reactive | 7.3.4.1 | |
| Tannin/Lignin-Colorimetric | APHA 513 | 1 mg/L |
| Total Organic Carbon-Oxidation | 415.1 | 1 mg/L |
| Total Inorganic Carbon | 415.1 | 1 mg/L |
| Total Organic Halogen | 9020 | mg/L |
| Total Petroleum Hydrocarbons-Extraction, IR | 418.1 | 1 mg/L |
| Turbidity | 180.1 | 1 NTU |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

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# ELEMENTAL ANALYSES - AQUEOUS MATRIX

| *PARAMETER* | *METHOD* | *PQL* |
|---|---|---|
| Aluminum-ICP | 200.7/6010 | 0.100 mg/L |
| Antimony-Furnace AA | 204.2/7041 | 0.005 mg/L |
| Arsenic-Furnace AA | 206.2/7060 | 0.005 mg/L |
| Barium-ICP | 200.7/6010 | 0.005 mg/L |
| Beryllium-ICP | 200.7/6010 | 0.015 mg/L |
| Boron-ICP | 200.7/6010 | 0.025 mg/L |
| Cadmium-Furnace AA | 213.2 | 0.002 mg/L |
| Calcium-ICP | 200.7/6010 | 0.025 mg/L |
| Chromium-ICP | 200.7/6010 | 0.015 mg/L |
| Chromium, Hexavalent-Colorimetric | 7196 | 0.010 mg/L |
| Cobalt-ICP | 200.7/6010 | 0.015 mg/L |
| Copper-ICP | 200.7/6010 | 0.025 mg/L |
| Gold-ICP | 200.7/6010 | 0.100 mg/L |
| Iron-ICP | 200.7/6010 | 0.025 mg/L |
| Lead-ICP | 200.7/6010 | 0.100 mg/L |
| Lead-Furnace AA | 239.2/7421 | 0.005 mg/L |
| Magnesium-ICP | 200.7/6010 | 0.050 mg/L |
| Manganese-ICP | 200.7/6010 | 0.010 mg/L |
| Mercury-CVAA | 245.1/7470 | 0.20 ug/L |
| Molybdenum-ICP | 200.7/6010 | 0.020 mg/L |
| Nickel-ICP | 200.7/6010 | 0.040 mg/L |
| Platinum-Furnace AA | 255.2 | 0.005 mg/L |
| Potassium-Flame AA | 258.1 | 0.025 mg/L |
| Potassium-ICP | 200.7/6010 | 0.500 mg/L |
| Selenium-Furnace AA | 270.2/7740 | 0.005 mg/L |
| Silver-ICP | 200.7/6010 | 0.015 mg/L |
| Sodium-ICP | 200.7/6010 | 0.050 mg/L |
| Thallium-Furnace AA | 279.2/7841 | 0.005 mg/L |
| Tin-ICP | 200.7/6010 | 0.100 mg/L |
| Titanium-ICP | 200.7/6010 | 0.100 mg/L |
| Vanadium-ICP | 200.7/6010 | 0.025 mg/L |
| Zinc-ICP | 200.7/6010 | 0.025 mg/L |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the laboratory PQL as a result of sample matrix and compound concentration.

ICP = Inductively Coupled Plasma

AA = Atomic Absorption

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Westbrook, Maine

ANALYTICAL METHOD INFORMATION

PARAMETER: ETHYLENE DIBROMIDE/1,2-DIBROMO-3-CHLOROPROPANE

METHOD: GC/ECD

MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| Ethylene dibromide | 0.2 |
| 1,2-Dibromo-3-chloropropane | 0.5 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SDWA PESTICIDES
METHOD: 608
MATRIX: AQUEOUS

| *COMPOUND* | *PQL (ug/L)* |
|---|---|
| Endrin | 1 |
| Lindane | 1 |
| Methoxychlor | 1 |
| Toxaphene | 1 |

PARAMETER: SDWA HERBICIDES
METHOD: SM509B
MATRIX: AQUEOUS

| *COMPOUND* | *PQL (ug/L)* |
|---|---|
| 2,4-D | 10 |
| 2,4,5-TP (Silvex) | 1 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

| *Compound* | *Minimum Detection Limit (MDL) (ug/L)* |
|---|---|
| Benzene | 0.08 |
| Bromobenzene | 0.05 |
| Bromochloromethane | 0.16 |
| Bromodichloromethane | 0.21 |
| Bromoform | 0.17 |
| Bromomethane | 0.16 |
| n-Butylbenzene | 0.08 |
| sec-Butylbenzene | 0.05 |
| tert-Butylbenzene | 0.06 |
| Carbon tetrachloride | 0.12 |
| Chlorobenzene | 0.05 |
| Chloroethane | 0.13 |
| Chloroform | 0.16 |
| Chloromethane | 0.18 |
| 2-Chlorotoluene | 0.11 |
| 4-Chlorotoluene | 0.10 |
| Dibromochloromethane | 0.19 |
| 1,2-Dibromo-3-chloropropane | 0.85 |
| 1,2-Dibromoethane | 0.11 |
| Dibromomethane | 0.18 |
| 1,2-Dichlorobenzene | 0.10 |
| 1,3-Dichlorobenzene | 0.10 |
| 1,4-Dichlorobenzene | 0.10 |
| Dichlorodifluoromethane | 0.21 |
| 1,1-Dichloroethane | 0.11 |
| 1,2-Dichloroethane | 0.10 |
| 1,1-Dichloroethene | 0.19 |
| cis-1,2-Dichloroethene | 0.22 |
| trans-1,2-Dichloroethene | 0.20 |
| 1,2-Dichloropropane | 0.12 |
| 1,3-Dichloropropane | 0.14 |
| 2,2-Dichloropropane | 0.27 |
| 1,1-Dichloropropene | 0.12 |
| cis-1,3-Dichloropropene | 0.14 |
| trans-1,3-Dichloropropene | 0.11 |
| Ethylbenzene | 0.10 |

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

| *Compound* | *Minimum Detection Limit (MDL) (ug/L)* |
|---|---|
| Hexachlorobutadiene | 0.12 |
| Isopropylbenzene | 0.04 |
| 4-Isopropyltoluene | 0.08 |
| Methylene chloride | 0.24 |
| Naphthalene | 0.21 |
| n-Propylbenzene | 0.07 |
| Styrene | 0.12 |
| 1,1,1,2-Tetrachloroethane | 0.11 |
| 1,1,2,2-Tetrachloroethane | 0.17 |
| Tetrachloroethene | 0.04 |
| Toluene | 0.13 |
| 1,2,3-Trichlorobenzene | 0.11 |
| 1,2,4-Trichlorobenzene | 0.06 |
| 1,1,1-Trichloroethane | 0.10 |
| 1,1,2-Trichloroethane | 0.20 |
| Trichloroethene | 0.10 |
| Trichlorofluoromethane | 0.13 |
| 1,2,3-Trichloropropane | 0.18 |
| 1,2,4-Trimethylbenzene | 0.08 |
| 1,3,5-Trimethylbenzene | 0.07 |
| Vinyl chloride | 0.25 |
| o-Xylene | 0.16 |
| m-Xylene | 0.22 |
| p-Xylene | 0.22 |

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| Benzo(B)Fluoranthene | 10 |
| Benzo(K)Fluoranthene | 10 |
| Chrysene | 10 |
| Benzo(A)Anthracene | 10 |
| Anthracene | 10 |
| Phenanthrene | 10 |
| Acenaphthylene | 10 |
| Acenaphthene | 10 |
| Benzn(A)Pyrene | 10 |
| Bis(2-Chloroethyl)Ether | 10 |
| Bis(2-Chloroethoxy)Methane | 10 |
| Bis(2-Chloroisopropyl)Ether | 10 |
| Butyl Benzyl Phthalate | 10 |
| Diethylphthalate | 10 |
| Dimethylphthalate | 10 |
| Fluoranthene | 10 |
| Fluorene | 10 |
| Hexachlorocyclopentadiene | 10 |
| Hexachlorobutadiene | 10 |
| Hexachloroethane | 10 |
| Indeno(1,2,2-CD)Pyrene | 10 |
| Isophorone | 10 |
| N-Nitrosodi-n-Propylamine | 10 |
| N-Nitrosodiphenylamine | 10 |
| N-Nitrosodimethylamine | 10 |
| Nitrobenzene | 10 |
| 4-Chloro-3-methylphenol | 10 |
| Pyrene | 10 |
| Benzo(GHI)perylene | 10 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

| *Compound* | *Practical Quantitation Limit (PQL) (ug/L)* |
|---|---|
| 1,2-Dichlorobenzene | 10 |
| 1,2,4-Trichlorobenzene | 10 |
| Dibenzo(A,H)Anthracene | 10 |
| 1,3-Dichlorobenzene | 10 |
| 1,4-Dichlorobenzene | 10 |
| 2-Chloronaphthalene | 10 |
| 2-Chlorophenol | 10 |
| 2-Nitrophenol | 10 |
| Di-n-octylphthalate | 10 |
| 2,4-Dichlorophenol | 10 |
| 2,4-Dimethylphenol | 10 |
| 2,4-Dinitrotoluene | 10 |
| 2,4-Dinitrophenol | 50 |
| 2,4,6-Trichlorophenol | 10 |
| 2,6-Dinitrotoluene | 10 |
| 3,3-Dichlorobenzidine | 20 |
| 4-Bromophenyl Phenyl Ether | 10 |
| 4-Chlorophenyl Phenyl Ether | 10 |
| 4-Nitrophenol | 50 |
| 2-Methyl-4,6-Dinitrophenol | 50 |
| Phenol | 10 |
| Naphthalene | 10 |
| Pentachlorophenol | 50 |
| Bis(2-Ethylhexyl)Phthalate | 10 |
| Di-n-Butylphthalate | 10 |
| Benzidine | 50 |
| Hexachlorobenzene | 10 |
| 1,2-Diphenyldrazine | 10 |

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

# REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

The attached Report of Analysis summarizes the analytical results for your drinking water sample. The ABB-ES Laboratory reports results using industry-accepted protocols as well as some unique reporting protocols that are designed to present a comprehensive Report of Analysis.

All sample results are reported in concentration units of ug/L (micrograms per liter) or mg/L (milligrams per liter). These units are used to express the concentration of a particular substance in a solution. One milligram per liter (1 mg/L) is equivalent to one thousand micrograms per liter (1000 mg/L); therefore, a solution with a concentration of 5 mg/L is more concentrated than a solution with a concentration of 5 ug/L.

After the Volatile Organic and Semivolatile Organic results, there is a section entitled Volatile Surrogate Recovery and Semivolatile Surrogate Recovery, respectively. Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate. The surrogate compounds act as a means to measure the efficiency of the sample extraction and analysis.

The US Environmental Protection Agency has outlined certain criteria that the ABB-ES Laboratory uses for reporting sample concentrations. These criteria dictate the detection limits that laboratories should use for reporting sample results. The ABB-ES Laboratory conducts Method Detection Limit (MDL) studies and Instrument Detection Limit (IDL) studies on a regular basis. The MDL and IDL studies enable us to determine the limitations of analytical procedures as well as instrumentation. An MDL is defined as:

> "The minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero."

An IDL is defined as:

> "The smallest signal above background noise that an instrument can detect at a 99% confidence level."

Method Detection Limit or Instrument Detection Limit concentrations are then multiplied by a factor of 3 (three) to 10 (ten) to determine what the Practical Quantitation Limit (PQL) is for a particular analysis. A PQL is defined as:

> "The lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions."

## REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

All parameters on this Report of Analysis are reported based upon PQLs except for the Volatile Organic Analysis results. The Volatile Organic Analysis results are reported based upon MDLs so that ABB-ES reporting limits comply with Massachusetts Department of Environmental Protection drinking water limits. If a result is reported with a " < " sign, then the compound was not detected in the sample above the PQL or, in the case of Volatile Organics, the MDL.

As part of the standard operating procedures of the ABB-ES Laboratory, contaminant-free water is analyzed as a sample concurrently with a set of samples. This reagent-free water sample is called a method blank. A "B" notation signifies that the compound reported was also detected in its corresponding method blank. There are certain compounds that occur as common laboratory contaminants that may be detected in the method blank. It is standard policy for the laboratory to reanalyze a sample if a compound that is not a common laboratory contaminant is detected in the method blank.

For Volatile Organic and Semivolatile Organic analyses, it is common for most laboratories to report values that are below the PQL. These values are notated with a "J". The "J" notation signifies that the parameter was detected and that the value reported is an estimated value because it is below the PQL.

The ABB-ES Laboratory will notate other sample results based upon Quality Control criteria to which the laboratory adheres. Non-standard quality control results are notated on the Report of Analysis. This notation will give a brief explanation of the impact of these quality control results on the actual sample results.

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# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| Arsenic, total | 0.05 | |
| Barium, total | 1 | |
| Benzene | 0.005 | |
| gamma-BHC (Lindane) | 0.0004 | |
| Bromobenzene | U | |
| Bromochloromethane | U | |
| Bromodichloromethane | * | |
| Bromoform | * | |
| Bromomethane | U | |
| n-Butylbenzene | U | |
| sec-Butylbenzene | U | |
| tert-Butylbenzene | U | |
| Cadmium, total | 0.010 | |
| Carbon tetrachloride | 0.005 | |
| Chloride | U | 250 |
| Chlorobenzene | U | |
| Chloroethane | U | |
| Chloroform | * | |
| Chloromethane | U | |
| 2-Chlorotoluene | U | |
| 4-Chlorotoluene | U | |
| Chromium, total | 0.05 | |
| Chromium, hexavalent | 0.05 | |
| Coliform, fecal | 1/100 mL | |
| Coliform, total | 1/100 mL | |
| Color | | 15 color units |
| Copper, total | | 1 |
| Corrosivity | | noncorrosive |
| 2,4-D | 0.1 | |
| 1,2-Dibromo-3-chloropropane | U | |
| Dibromochloromethane | * | |
| 1,2-Dibromoethane | U | |
| Dibromomethane | U | |
| 1,2-Dichlorobenzene | U | |
| 1,3-Dichlorobenzene | U | |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

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# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| 1,4-Dichlorobenzene | 0.075 | |
| Dichlorodifluoromethane | U | |
| 1,1-Dichloroethane | U | |
| 1,2-Dichloroethane | 0.005 | |
| 1,1-Dichloroethene | 0.007 | |
| cis-1,2-Dichloroethene | U | |
| trans-1,2-Dichloroethene | U | |
| 1,2-Dichloropropane | U | |
| 1,3-Dichloropropane | U | |
| 2,2-Dichloropropane | U | |
| 1,1-Dichloropropene | U | |
| cis-1,3-Dichloropropene | U | |
| trans-1,3-Dichloropropene | U | |
| Endrin | 0.0002 | |
| Ethylbenzene | U | |
| Fluoride, soluble | 4.0 | 2.0 |
| Hexachlorobutadiene | U | |
| Iron, total | U | 0.3 |
| Isopropylbenzene | U | |
| 4-Isopropyltoluene | U | |
| Langelier saturation index | U | |
| Lead, total | 0.05 | |
| Manganese, total | U | 0.05 |
| Mercury, total | 0.002 | |
| Methoxychlor | 0.1 | |
| Methylene chloride | U | |
| Naphthalene | U | |
| Nitrate, (as N) | 10 | |
| Odor | | 3 TON |
| pH | | 6.5-8.5 |
| n-Propylbenzene | U | |
| Radioactivity, total alpha | 15 pCi/L | |
| Radioactivity, total beta | 4 mrem | |
| Radium 226, total | 5 pCi/L | |
| Radium, 228 | 5 pCi/L | |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

# US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

| *PARAMETER* | *PRIMARY MCL (mg/L)* | *SECONDARY MCL (mg/L)* |
|---|---|---|
| Selenium, total | 0.01 | |
| Silver, total | 0.05 | |
| Sodium, total | 20.0 | |
| Styrene | U | |
| Sulfate (as SO4) | | 250 |
| Surfactants | | 2 |
| 1,1,1,2-Tetrachloroethane | U | |
| 1,1,2,2-Tetrachloroethane | U | |
| Tetrachloroethene | U | |
| Toluene | U | |
| Total dissolved solids (TDS) | | 500 |
| Toxaphene | 0.005 | |
| 2,4,5-TP (Silvex) | 0.01 | |
| 1,2,3-Trichlorobenzene | U | |
| 1,2,4-Trichlorobenzene | U | |
| 1,1,1-Trichloroethane | 0.20 | |
| 1,1,2-Trichloroethane | U | |
| Trichloroethene | 0.005 | |
| Trichlorofluoromethane | U | |
| 1,2,3-Trichloropropane | U | |
| Trihalomethanes (chloroform, bromoform, | 0.10 | |
| bromodichloromethane, dibromochloromethane) * | | |
| 1,2,4-Trimethylbenzene | U | |
| 1,3,5-Trimethylbenzene | U | |
| Turbidity | 1-5 ntu | |
| Vinyl chloride | 0.002 | |
| m-Xylene | U | |
| o-Xylene | U | |
| p-Xylene | U | |
| Zinc, total | | 5 |

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

# ANALYSIS REQUEST FORM

Client Information: Name [illegible]

Company [illegible]

Mailing Adddress

Purchase Order/Job Number [illegible]

Where to Send Report ☑ Directly to Client

☐ ABB - Name

Analyses Requested By: Technical Project Professional

Approved By: Project Manager

Date Received [illegible]

Lab Location [illegible]

Results Due [illegible]

Client I.D. No. [illegible]

☐ Solid Waste Data File

☐ Data Documentation Req'd

☐ Entered in Computer

Type of Sample [illegible]

List Any Hazards [illegible]

☐ SPECIAL PROCEDURE

☐ Filtered in Field ☑ Non-Filtered

Additional Information or Special Procedures

[illegible] MADEP

[illegible] parameters [illegible]

[illegible]

[illegible] DUP [illegible]

[illegible] dates

[illegible] Chemistry 041991 [illegible]

[illegible] 041991 [illegible]

| Sample Identification | Lab Numbers | Date Sampled | Sampled By | Analyses Required |
|---|---|---|---|---|
| [illegible] | [illegible] | 091691 | [illegible] | [illegible] |
| | | | | [illegible] VOA [illegible] |
| | | | | [illegible] |
| RUSH | | | | [illegible] pH, TDS, TKN, |
| | | | | [illegible] |
| | | | | [illegible] Cd, Pb, [illegible] Tl |
| | | | | [illegible] Ni, Ag, Zn, |
| | | | | [illegible] Al, Mn |
| | | | | VOA [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | ↓ |
| [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | |
| [illegible] | [illegible] | 091691 | [illegible] | DW VOAs (524.2-MDL) + [illegible] |
| | | | | [illegible] |

[illegible]

OH-62

**ABB Environmental Services, Inc.**

Client: Olin Chemical, Sample Numbers: 91259009-016

# ANALYSIS AND QUALITY CONTROL DOCUMENTATION

Prepared By:

ABB ENVIRONMENTAL
ANALYTICAL LABORATORY SERVICES DIVISION
PORTLAND, MAINE

26-Sep-91

Reviewed and Approved by: Julie Ricardi
Laboratory Quality Assurance: Julie Ricardi

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## MA DEP QC REPORT

MA DEP QC Report documentation consists of the following components for specific types of analyses:

| Section | Type of Documentation |
|---|---|
| INORGANIC ANALYSES FOR METALS | |
| o | METHODS AND CHRONOLOGY OF ANALYSIS |
| o | METHOD BLANK AND LABORATORY CONTROL SAMPLE RESULTS |
| o | DUPLICATE AND MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS |
| o | SUMMARY REPORT |
| INORGANIC ANALYSES FOR NON-METALS | |
| o | METHODS AND CHRONOLOGY OF ANALYSIS |
| o | METHOD BLANK AND LABORATORY CONTROL SAMPLE RESULTS |
| o | DUPLICATE AND MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS |
| o | SUMMARY REPORT |
| ORGANIC ANALYSES BY GC | |
| o | METHODS, CHRONOLOGY OF ANALYSIS AND METHOD BLANK RESULTS |
| o | LABORATORY CONTROL SAMPLE RESULTS |
| o | SAMPLE DUPLICATE RESULTS |
| o | MATRIX SPIKE RESULTS |
| ORGANIC ANALYSES BY GC/MS | |
| o | METHODS, CHRONOLOGY OF ANALYSIS AND METHOD BLANK RESULTS |
| o | LABORATORY CONTROL SAMPLE RESULTS |
| o | SAMPLE DUPLICATE RESULTS |
| o | MATRIX SPIKE RESULTS |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## MA DEP QC REPORT

MA DEP QC Report documentation consists of the following components for specific types of analyses:

| Section | Type of Documentation |
|---|---|
| CHAIN OF CUSTODY | |
| | o ANALYSIS REQUEST FORMS |
| | o CHAIN OF CUSTODY RECORDS |
| | o SAMPLE RECEIVING DOCUMENTATION |
| | o CORRESPONDENCE |

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11964
PAGE 4

| | | |
|---|---|---|
| CLIENT SAMPLE ID | DW2 | |
| ABB SAMPLE ID | 91259011 | |
| DATE RECEIVED | 9/16/91 | UNITS |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

| | | | |
|---|---|---|---|
| 2,4-DINITROTOLUENE | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | UG/L |
| PHENOL | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | UG/L |
| BENZIDINE | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | UG/L |

SEMIVOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| 2-FLUOROPHENOL | 39 | % |
| PHENOL-D5 | 22 | % |
| NITROBENZENE-D5 | 77 | % |
| 2-FLUOROBIPHENYL | 80 | % |
| 2,4,6-TRIBROMOPHENOL | 64 | % |
| TERPHENYL-D14 | 75 | % |

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 2

* The reported value is the mean of two or more replicate analyses of the sample. The precision of the replicate analyses is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

\# Matrix spike recovery is outside the laboratory's specified acceptance range indicating potential sample matrix interference and potential bias of reported value for this parameter.

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
340 COUNTY ROAD NO. 5
P. O. BOX 720
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(207)874-2400/FAX(207)775-4029

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
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CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
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PAGE 1

| CLIENT SAMPLE ID | | DW3 | |
|---|---|---|---|
| ABB SAMPLE ID | | 91259012 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| COLIFORMS, FECAL | < | 1 | /100 ML |
| COLIFORMS, TOTAL | < | 1 | /100 ML |
| PH (LABORATORY) | | 6.2 | |
| RESIDUE, FILTERABLE (TDS) | | 150 | MG/L |
| SODIUM, TOTAL | | 31 | MG/L |
| BARIUM, TOTAL | | 0.007 | MG/L |
| IRON, TOTAL | | 0.64 | MG/L |
| MANGANESE, TOTAL | | 0.16 | MG/L |
| ALUMINUM, TOTAL | < | 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < | 0.010 | MG/L |
| ARSENIC, TOTAL | < | 0.005 | MG/L |
| BERYLLIUM, TOTAL | < | 0.015 | MG/L |
| CADMIUM, TOTAL | < | 0.002 | MG/L |
| CHROMIUM, TOTAL | < | 0.015 | MG/L |
| COPPER, TOTAL | | 0.032 | MG/L |
| LEAD, TOTAL | < | 0.005 | MG/L |
| THALLIUM, TOTAL | < | 0.005 | MG/L |
| NICKEL, TOTAL | < | 0.040 | MG/L |
| SILVER, TOTAL | < | 0.015 | MG/L |
| ZINC, TOTAL | | 0.14 | MG/L |
| ANTIMONY, TOTAL | < | 0.005 | MG/L |
| SELENIUM, TOTAL | < | 0.005 | MG/L |
| MERCURY, TOTAL | < | 0.20 | UG/L |
| CHLORIDE | | 56 | MG/L |
| CYANIDE, TOTAL | < | 20 | UG/L |
| FLUORIDE | < | 0.20 | MG/L |
| AMMONIA, AS N | < | 0.10 | MG/L |
| NITROGEN, TOTAL KJELDAHL | | 0.12 | MG/L |
| NITRATE, AS N | | 0.29 | MG/L |
| SULFATE | | 16 | MG/L |
| ETHYLENE DIBROMIDE | | | |
| ETHYLENE DIBROMIDE | < | 0.2 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | | | |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.5 | UG/L |
| PESTICIDES & PCB'S SURROGATE RECOVERY | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 78 | % |
| PRIMARY DRINKING WATER STANDARDS PEST. | | | |
| ENDRIN | < | 1 | UG/L |
| LINDANE | < | 1 | UG/L |
| METHOXYCHLOR | < | 1 | UG/L |

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| CLIENT SAMPLE ID | DW3 | | |
|---|---|---|---|
| ABB SAMPLE ID | 91259012 | | |
| DATE RECEIVED | 9/16/91 | | UNITS |
| PRIMARY DRINKING WATER STANDARDS PEST. (CONT) | | | |
| TOXAPHENE | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - PEST | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 100 | % |
| PRIMARY DRINKING WATER STANDARDS HERB. | | | |
| 2,4-D | < | 10 | UG/L |
| 2,4,5-TP(SILVEX) | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - HERB | | | |
| 2,4-DB | @ | 14 | % |
| DRINKING WATER VOLATILES | | | |
| BENZENE | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < | 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 0.71 | UG/L |
| NAPHTHALENE | < | 0.21 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | UG/L |

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CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
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| CLIENT SAMPLE ID | DW3 | |
|---|---|---|
| ABB SAMPLE ID | 91259012 | |
| DATE RECEIVED | 9/16/91 | UNITS |

DRINKING WATER VOLATILES (CONT)

| | | | |
|---|---|---|---|
| TETRACHLOROETHENE | < | 0.04 | UG/L |
| TOLUENE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < | 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < | 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < | 0.2 | UG/L |
| TRICHLOROETHENE | < | 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < | 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < | 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < | 0.07 | UG/L |
| VINYL CHLORIDE | < | 0.25 | UG/L |
| O-XYLENE | < | 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < | 0.22 | UG/L |

VOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| P-BROMOFLUOROBENZENE | 90 | % |
| 1,2-DICHLOROBENZENE-D4 | 72 | % |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS

| | | | |
|---|---|---|---|
| BENZO(B)FLUORANTHENE | < | 10 | UG/L |
| BENZO(K)FLUORANTHENE | < | 10 | UG/L |
| CHRYSENE | < | 10 | UG/L |
| BENZO(A)ANTHRACENE | < | 10 | UG/L |
| ANTHRACENE | < | 10 | UG/L |
| PHENANTHRENE | < | 10 | UG/L |
| ACENAPHTHYLENE | < | 10 | UG/L |
| ACENAPHTHENE | < | 10 | UG/L |
| BENZO(A)PYRENE | < | 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < | 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < | 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < | 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < | 10 | UG/L |
| DIETHYLPHTHALATE | < | 10 | UG/L |
| DIMETHYLPHTHALATE | < | 10 | UG/L |
| FLUORANTHENE | < | 10 | UG/L |
| FLUORENE | < | 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < | 10 | UG/L |
| HEXACHLOROBUTADIENE | < | 10 | UG/L |
| HEXACHLOROETHANE | < | 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < | 10 | UG/L |
| ISOPHORONE | < | 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < | 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < | 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < | 10 | UG/L |
| NITROBENZENE | < | 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < | 10 | UG/L |
| PYRENE | < | 10 | UG/L |
| BENZO(GHI)PERYLENE | < | 10 | UG/L |
| 1,2-DICHLOROBENZENE | < | 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < | 10 | UG/L |
| 1,3-DICHLOROBENZENE | < | 10 | UG/L |
| 1,4-DICHLOROBENZENE | < | 10 | UG/L |
| 2-CHLORONAPHTHALENE | < | 10 | UG/L |
| 2-CHLOROPHENOL | < | 10 | UG/L |
| 2-NITROPHENOL | < | 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < | 10 | UG/L |
| 2,4-DICHLOROPHENOL | < | 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < | 10 | UG/L |

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11965
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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | DW3 | | |
| ABR SAMPLE ID | 91259012 | | |
| DATE RECEIVED | 9/16/91 | | UNITS |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

| | | | |
|---|---|---|---|
| 2,4-DINITROTOLUENE | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | UG/L |
| PHENOL | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | UG/L |
| BENZIDINE | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | UG/L |

SEMIVOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| 2-FLUOROPHENOL | 49 | % |
| PHENOL-D5 | 31 | % |
| NITROBENZENE-D5 | 77 | % |
| 2-FLUOROBIPHENYL | 77 | % |
| 2,4,6-TRIBROMOPHENOL | 78 | % |
| TERPHENYL-D14 | 75 | % |

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 3

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

@ Surrogate recovery does not meet internal QC criteria. Sample will be reextracted and reported at a later date.

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
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WESTBROOK, ME 04092
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OLIN CHEMICAL
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CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11966
PAGE 1

| CLIENT SAMPLE ID | DW4 | |
|---|---|---|
| ABB SAMPLE ID | 91259013 | |
| DATE RECEIVED | 9/16/91 | UNITS |
| COLIFORMS, FECAL | < 1 | /100 ML |
| COLIFORMS, TOTAL | < 1 | /100 ML |
| PH (LABORATORY) | 7.3 | |
| RESIDUE, FILTERABLE (TDS) | 140 | MG/L |
| SODIUM, TOTAL | 21 | MG/L |
| BARIUM, TOTAL | 0.006 | MG/L |
| IRON, TOTAL | 0.43 | MG/L |
| MANGANESE, TOTAL | 0.38 | MG/L |
| ALUMINUM, TOTAL | < 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < 0.010 | MG/L |
| ARSENIC, TOTAL | < 0.005 | MG/L |
| BERYLLIUM, TOTAL | < 0.015 | MG/L |
| CADMIUM, TOTAL | < 0.002 | MG/L |
| CHROMIUM, TOTAL | < 0.015 | MG/L |
| COPPER, TOTAL | < 0.025 | MG/L |
| LEAD, TOTAL | 0.005 | MG/L |
| THALLIUM, TOTAL | < 0.005 | MG/L |
| NICKEL, TOTAL | < 0.040 | MG/L |
| SILVER, TOTAL | < 0.015 | MG/L |
| ZINC, TOTAL | < 0.025 | MG/L |
| ANTIMONY, TOTAL | < 0.005 | MG/L |
| SELENIUM, TOTAL | < 0.005 | MG/L |
| MERCURY, TOTAL | < 0.20 | UG/L |
| CHLORIDE | 34 | MG/L |
| CYANIDE, TOTAL | < 20 | UG/L |
| FLUORIDE | < 0.20 | MG/L |
| AMMONIA, AS N | 0.54 | MG/L |
| NITROGEN, TOTAL KJELDAHL | 0.72 | MG/L |
| NITRATE, AS N | 0.22 | MG/L |
| SULFATE | 18 | MG/L |

ETHYLENE DIBROMIDE

| | | |
|---|---|---|
| ETHYLENE DIBROMIDE | < 0.2 | UG/L |

1,2-DIBROMO-3-CHLOROPROPANE

| | | |
|---|---|---|
| 1,2-DIBROMO-3-CHLOROPROPANE | < 0.5 | UG/L |

PESTICIDES & PCB'S SURROGATE RECOVERY

| | | |
|---|---|---|
| 2,4,5,6-TETRACHLORO-META-XYLENE | 140 | % |

PRIMARY DRINKING WATER STANDARDS PEST.

| | | |
|---|---|---|
| ENDRIN | < 1 | UG/L |
| LINDANE | < 1 | UG/L |
| METHOXYCHLOR | < 1 | UG/L |

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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | | DW4 | |
| ABB SAMPLE ID | | 91259013 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| PRIMARY DRINKING WATER STANDARDS PEST. (CONT) | | | |
| TOXAPHENE | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - PEST | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 60 | % |
| PRIMARY DRINKING WATER STANDARDS HERB. | | | |
| 2,4-D | < | 10 | UG/L |
| 2,4,5-TP(SILVEX) | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - HERB | | | |
| 2,4-DB | | *** | % |
| DRINKING WATER VOLATILES | | | |
| BENZENE | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < | 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 0.48 | UG/L |
| NAPHTHALENE | < | 0.21 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | UG/L |

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| CLIENT SAMPLE ID | DW4 | |
|---|---|---|
| ABB SAMPLE ID | 91259013 | |
| DATE RECEIVED | 9/16/91 | UNITS |
| DRINKING WATER VOLATILES | | (CONT) |
| TETRACHLOROETHENE | < 0.04 | UG/L |
| TOLUENE | < 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < 0.2 | UG/L |
| TRICHLOROETHENE | < 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < 0.07 | UG/L |
| VINYL CHLORIDE | < 0.25 | UG/L |
| O-XYLENE | < 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < 0.22 | UG/L |
| VOLATILE SURROGATE RECOVERY | | |
| P-BROMOFLUOROBENZENE | 89 | % |
| 1,2-DICHLOROBENZENE-D4 | 77 | % |
| SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS | | |
| BENZO(B)FLUORANTHENE | < 10 | UG/L |
| BENZO(K)FLUORANTHENE | < 10 | UG/L |
| CHRYSENE | < 10 | UG/L |
| BENZO(A)ANTHRACENE | < 10 | UG/L |
| ANTHRACENE | < 10 | UG/L |
| PHENANTHRENE | < 10 | UG/L |
| ACENAPHTHYLENE | < 10 | UG/L |
| ACENAPHTHENE | < 10 | UG/L |
| BENZO(A)PYRENE | < 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < 10 | UG/L |
| DIETHYLPHTHALATE | < 10 | UG/L |
| DIMETHYLPHTHALATE | < 10 | UG/L |
| FLUORANTHENE | < 10 | UG/L |
| FLUORENE | < 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < 10 | UG/L |
| HEXACHLOROBUTADIENE | < 10 | UG/L |
| HEXACHLOROETHANE | < 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < 10 | UG/L |
| ISOPHORONE | < 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < 10 | UG/L |
| NITROBENZENE | < 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < 10 | UG/L |
| PYRENE | < 10 | UG/L |
| BENZO(GHI)PERYLENE | < 10 | UG/L |
| 1,2-DICHLOROBENZENE | < 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < 10 | UG/L |
| 1,3-DICHLOROBENZENE | < 10 | UG/L |
| 1,4-DICHLOROBENZENE | < 10 | UG/L |
| 2-CHLORONAPHTHALENE | < 10 | UG/L |
| 2-CHLOROPHENOL | < 10 | UG/L |
| 2-NITROPHENOL | < 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < 10 | UG/L |
| 2,4-DICHLOROPHENOL | < 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < 10 | UG/L |

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

| | | | |
|---|---|---|---|
| 2,4-DINITROTOLUENE | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | UG/L |
| PHENOL | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | UG/L |
| BENZIDINE | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | UG/L |

SEMIVOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| 2-FLUOROPHENOL | 40 | % |
| PHENOL-D5 | 28 | % |
| NITROBENZENE-D5 | 77 | % |
| 2-FLUOROBIPHENYL | 85 | % |
| 2,4,6-TRIBROMOPHENOL | 84 | % |
| TERPHENYL-D14 | 85 | % |

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 4

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

*** Unable to calculate surrogate recovery due to computer file corruption; sample will be reanalyzed and reported at a later date.

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
340 COUNTY ROAD NO. 5
P. O. BOX 720
WESTBROOK, ME 04092
(207)874-2400/FAX(207)775-4029

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| CLIENT SAMPLE ID | DW5 | |
|---|---|---|
| ABB SAMPLE ID | 91259014 | |
| DATE RECEIVED | 9/16/91 | UNITS |
| COLIFORMS, FECAL | < 1 | /100 ML |
| COLIFORMS, TOTAL | < 1 | /100 ML |
| PH (LABORATORY) | 6.6 | |
| RESIDUE, FILTERABLE (TDS) | 140 | MG/L |
| SODIUM, TOTAL | 32 | MG/L |
| BARIUM, TOTAL | 0.022 | MG/L |
| IRON, TOTAL | 1.5 | MG/L |
| MANGANESE, TOTAL | 0.84 | MG/L |
| ALUMINUM, TOTAL | < 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < 0.010 | MG/L |
| ARSENIC, TOTAL | < 0.005 | MG/L |
| BERYLLIUM, TOTAL | < 0.015 | MG/L |
| CADMIUM, TOTAL | < 0.002 | MG/L |
| CHROMIUM, TOTAL | < 0.015 | MG/L |
| COPPER, TOTAL | < 0.025 | MG/L |
| LEAD, TOTAL | < 0.005 | MG/L |
| THALLIUM, TOTAL | < 0.005 | MG/L |
| NICKEL, TOTAL | < 0.040 | MG/L |
| SILVER, TOTAL | < 0.015 | MG/L |
| ZINC, TOTAL | 0.054 | MG/L |
| ANTIMONY, TOTAL | < 0.005 | MG/L |
| SELENIUM, TOTAL | < 0.005 | MG/L |
| MERCURY, TOTAL | < 0.20 | UG/L |
| CHLORIDE | 28 | MG/L |
| CYANIDE, TOTAL | < 20 | UG/L |
| FLUORIDE | < 0.20 | MG/L |
| AMMONIA, AS N | 7.6 | MG/L |
| NITROGEN, TOTAL KJELDAHL | 7.6 | MG/L |
| NITRATE, AS N | 1.4 | MG/L |
| SULFATE | 16 | MG/L |
| ETHYLENE DIBROMIDE | | |
| ETHYLENE DIBROMIDE | < 0.2 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | | |
| 1,2-DIBROMO-3-CHLOROPROPANE | < 0.5 | UG/L |
| PESTICIDES & PCB'S SURROGATE RECOVERY | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | 140 | % |
| PRIMARY DRINKING WATER STANDARDS PEST. | | |
| ENDRIN | < 1 | UG/L |
| LINDANE | < 1 | UG/L |
| METHOXYCHLOR | < 1 | UG/L |

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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | | DW5 | |
| ABB SAMPLE ID | | 91259014 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| PRIMARY DRINKING WATER STANDARDS PEST. (CONT) | | | |
| TOXAPHENE | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - PEST | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 110 | % |
| PRIMARY DRINKING WATER STANDARDS HERB. | | | |
| 2,4-D | < | 10 | UG/L |
| 2,4,5-TP(SILVEX) | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - HERB | | | |
| 2,4-DB | | 110 | % |
| DRINKING WATER VOLATILES | | | |
| BENZENE | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | | 0.19 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 0.54 | UG/L |
| NAPHTHALENE | < | 0.21 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | UG/L |

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DRINKING WATER VOLATILES (CONT)

| | | | |
|---|---|---|---|
| TETRACHLOROETHENE | < | 0.04 | UG/L |
| TOLUENE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < | 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < | 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < | 0.2 | UG/L |
| TRICHLOROETHENE | < | 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < | 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < | 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < | 0.07 | UG/L |
| VINYL CHLORIDE | < | 0.25 | UG/L |
| O-XYLENE | < | 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < | 0.22 | UG/L |

VOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| P-BROMOFLUOROBENZENE | 89 | % |
| 1,2-DICHLOROBENZENE-D4 | 79 | % |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS

| | | | |
|---|---|---|---|
| BENZO(B)FLUORANTHENE | < | 10 | UG/L |
| BENZO(K)FLUORANTHENE | < | 10 | UG/L |
| CHRYSENE | < | 10 | UG/L |
| BENZO(A)ANTHRACENE | < | 10 | UG/L |
| ANTHRACENE | < | 10 | UG/L |
| PHENANTHRENE | < | 10 | UG/L |
| ACENAPHTHYLENE | < | 10 | UG/L |
| ACENAPHTHENE | < | 10 | UG/L |
| BENZO(A)PYRENE | < | 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < | 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < | 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < | 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < | 10 | UG/L |
| DIETHYLPHTHALATE | < | 10 | UG/L |
| DIMETHYLPHTHALATE | < | 10 | UG/L |
| FLUORANTHENE | < | 10 | UG/L |
| FLUORENE | < | 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < | 10 | UG/L |
| HEXACHLOROBUTADIENE | < | 10 | UG/L |
| HEXACHLOROETHANE | < | 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < | 10 | UG/L |
| ISOPHORONE | < | 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < | 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < | 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < | 10 | UG/L |
| NITROBENZENE | < | 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < | 10 | UG/L |
| PYRENE | < | 10 | UG/L |
| BENZO(GHI)PERYLENE | < | 10 | UG/L |
| 1,2-DICHLOROBENZENE | < | 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < | 10 | UG/L |
| 1,3-DICHLOROBENZENE | < | 10 | UG/L |
| 1,4-DICHLOROBENZENE | < | 10 | UG/L |
| 2-CHLORONAPHTHALENE | < | 10 | UG/L |
| 2-CHLOROPHENOL | < | 10 | UG/L |
| 2-NITROPHENOL | < | 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < | 10 | UG/L |
| 2,4-DICHLOROPHENOL | < | 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < | 10 | UG/L |

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REPORT OF ANALYSIS 9/26/91
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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | | D#5 | |
| ABB SAMPLE ID | | 91259014 | |
| DATE RECEIVED | | 9/16/91 | UNITS |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

| | | | |
|---|---|---|---|
| 2,4-DINITROTOLUENE | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | UG/L |
| PHENOL | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | UG/L |
| BENZIDINE | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | UG/L |

SEMIVOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| 2-FLUOROPHENOL | 34 | % |
| PHENOL-D5 | 23 | % |
| NITROBENZENE-D5 | 60 | % |
| 2-FLUOROBIPHENYL | 75 | % |
| 2,4,6-TRIBROMOPHENOL | 65 | % |
| TERPHENYL-D14 | 66 | % |

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 5

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
340 COUNTY ROAD NO. 5
P. O. BOX 720
WESTBROOK, ME 04092
(207)874-2400/FAX(207)775-4029

OLIN CHEMICAL
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CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
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PAGE 1

| CLIENT SAMPLE ID | | DW6 | |
|---|---|---|---|
| ABB SAMPLE ID | | 91259015 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| COLIFORMS, FECAL | < | 1 | /100 ML |
| COLIFORMS, TOTAL | < | 1 | /100 ML |
| PH (LABORATORY) | | 6.1 | |
| RESIDUE, FILTERABLE (TDS) | | 120 | MG/L |
| SODIUM, TOTAL | | 20 | MG/L |
| BARIUM, TOTAL | < | 0.005 | MG/L |
| IRON, TOTAL | | 0.52 | MG/L |
| MANGANESE, TOTAL | | 0.19 | MG/L |
| ALUMINUM, TOTAL | < | 0.10 | MG/L |
| CHROMIUM, HEXAVALENT | < | 0.010 | MG/L |
| ARSENIC, TOTAL | < | 0.005 | MG/L |
| BERYLLIUM, TOTAL | < | 0.015 | MG/L |
| CADMIUM, TOTAL | < | 0.002 | MG/L |
| CHROMIUM, TOTAL | < | 0.015 | MG/L |
| COPPER, TOTAL | | 0.042 | MG/L |
| LEAD, TOTAL | < | 0.005 | MG/L |
| THALLIUM, TOTAL | < | 0.005 | MG/L |
| NICKEL, TOTAL | < | 0.040 | MG/L |
| SILVER, TOTAL | < | 0.015 | MG/L |
| ZINC, TOTAL | < | 0.025 | MG/L |
| ANTIMONY, TOTAL | < | 0.005 | MG/L |
| SELENIUM, TOTAL | < | 0.005 | MG/L |
| MERCURY, TOTAL | < | 0.20 | UG/L |
| CHLORIDE | | 38 | MG/L |
| CYANIDE, TOTAL | < | 20 | UG/L |
| FLUORIDE | < | 0.20 | MG/L |
| AMMONIA, AS N | | 0.37 | MG/L |
| NITROGEN, TOTAL KJELDAHL | | 0.41 | MG/L |
| NITRATE, AS N | * | 0.28 | MG/L |
| SULFATE | | 16 | MG/L |
| ETHYLENE DIBROMIDE | | | |
| ETHYLENE DIBROMIDE | < | 0.2 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | | | |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.5 | UG/L |
| PESTICIDES & PCB'S SURROGATE RECOVERY | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 92 | % |
| PRIMARY DRINKING WATER STANDARDS PEST. | | | |
| ENDRIN | < | 1 | UG/L |
| LINDANE | < | 1 | UG/L |
| METHOXYCHLOR | < | 1 | UG/L |

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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | | DW6 | |
| ABB SAMPLE ID | | 91259015 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| PRIMARY DRINKING WATER STANDARDS PEST. (CONT) | | | |
| TOXAPHENE | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - PEST | | | |
| 2,4,5,6-TETRACHLORO-META-XYLENE | | 96 | % |
| PRIMARY DRINKING WATER STANDARDS HERB. | | | |
| 2,4-D | < | 10 | UG/L |
| 2,4,5-TP(SILVEX) | < | 1 | UG/L |
| DRINKING WATER SURROGATE RECOVERY - HERB | | | |
| 2,4-DB | @ | 16 | % |
| DRINKING WATER VOLATILES | | | |
| BENZENE | < | 0.08 | UG/L |
| BROMOBENZENE | < | 0.05 | UG/L |
| BROMOCHLOROMETHANE | < | 0.16 | UG/L |
| BROMODICHLOROMETHANE | < | 0.21 | UG/L |
| BROMOFORM | < | 0.17 | UG/L |
| BROMOMETHANE | < | 0.16 | UG/L |
| N-BUTYLBENZENE | < | 0.08 | UG/L |
| SEC-BUTYLBENZENE | < | 0.05 | UG/L |
| TERT-BUTYLBENZENE | < | 0.06 | UG/L |
| CARBON TETRACHLORIDE | < | 0.12 | UG/L |
| CHLOROBENZENE | < | 0.05 | UG/L |
| CHLOROETHANE | < | 0.13 | UG/L |
| CHLOROFORM | < | 0.16 | UG/L |
| CHLOROMETHANE | < | 0.18 | UG/L |
| 2-CHLOROTOLUENE | < | 0.11 | UG/L |
| 4-CHLOROTOLUENE | < | 0.1 | UG/L |
| DIBROMOCHLOROMETHANE | < | 0.19 | UG/L |
| 1,2-DIBROMO-3-CHLOROPROPANE | < | 0.85 | UG/L |
| 1,2-DIBROMOETHANE | < | 0.11 | UG/L |
| DIBROMOMETHANE | < | 0.18 | UG/L |
| 1,2-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,3-DICHLOROBENZENE | < | 0.1 | UG/L |
| 1,4-DICHLOROBENZENE | < | 0.1 | UG/L |
| DICHLORODIFLUOROMETHANE | < | 0.21 | UG/L |
| 1,1-DICHLOROETHANE | < | 0.11 | UG/L |
| 1,2-DICHLOROETHANE | < | 0.1 | UG/L |
| 1,1-DICHLOROETHENE | < | 0.19 | UG/L |
| CIS-1,2-DICHLOROETHENE | < | 0.22 | UG/L |
| TRANS-1,2-DICHLOROETHENE | < | 0.2 | UG/L |
| 1,2-DICHLOROPROPANE | < | 0.12 | UG/L |
| 1,3-DICHLOROPROPANE | < | 0.14 | UG/L |
| 2,2-DICHLOROPROPANE | < | 0.27 | UG/L |
| 1,1-DICHLOROPROPENE | < | 0.12 | UG/L |
| CIS-1,3-DICHLOROPROPENE | < | 0.14 | UG/L |
| TRANS-1,3-DICHLOROPROPENE | < | 0.11 | UG/L |
| ETHYLBENZENE | < | 0.1 | UG/L |
| HEXACHLOROBUTADIENE | < | 0.12 | UG/L |
| ISOPROPYLBENZENE | < | 0.04 | UG/L |
| 4-ISOPROPYLTOLUENE | < | 0.08 | UG/L |
| METHYLENE CHLORIDE | B | 0.55 | UG/L |
| NAPHTHALENE | < | 0.21 | UG/L |
| N-PROPYLBENZENE | < | 0.07 | UG/L |
| STYRENE | < | 0.12 | UG/L |
| 1,1,1,2-TETRACHLOROETHANE | < | 0.11 | UG/L |
| 1,1,2,2-TETRACHLOROETHANE | < | 0.17 | UG/L |

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| | | | |
|---|---|---|---|
| CLIENT SAMPLE ID | | DW6 | |
| ABB SAMPLE ID | | 91259015 | |
| DATE RECEIVED | | 9/16/91 | UNITS |
| DRINKING WATER VOLATILES | | | (CONT) |
| TETRACHLOROETHENE | < | 0.04 | UG/L |
| TOLUENE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROBENZENE | < | 0.11 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 0.06 | UG/L |
| 1,1,1-TRICHLOROETHANE | < | 0.1 | UG/L |
| 1,1,2-TRICHLOROETHANE | < | 0.2 | UG/L |
| TRICHLOROETHENE | < | 0.1 | UG/L |
| TRICHLOROFLUOROMETHANE | < | 0.13 | UG/L |
| 1,2,3-TRICHLOROPROPANE | < | 0.18 | UG/L |
| 1,2,4-TRIMETHYLBENZENE | < | 0.08 | UG/L |
| 1,3,5-TRIMETHYLBENZENE | < | 0.07 | UG/L |
| VINYL CHLORIDE | < | 0.25 | UG/L |
| O-XYLENE | < | 0.16 | UG/L |
| M-XYLENE / P-XYLENE | < | 0.22 | UG/L |
| VOLATILE SURROGATE RECOVERY | | | |
| P-BROMOFLUOROBENZENE | | 83 | % |
| 1,2-DICHLOROBENZENE-D4 | ** | 60 | % |
| SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS | | | |
| BENZO(B)FLUORANTHENE | < | 10 | UG/L |
| BENZO(K)FLUORANTHENE | < | 10 | UG/L |
| CHRYSENE | < | 10 | UG/L |
| BENZO(A)ANTHRACENE | < | 10 | UG/L |
| ANTHRACENE | < | 10 | UG/L |
| PHENANTHRENE | < | 10 | UG/L |
| ACENAPHTHYLENE | < | 10 | UG/L |
| ACENAPHTHENE | < | 10 | UG/L |
| BENZO(A)PYRENE | < | 10 | UG/L |
| BIS(2-CHLOROETHYL)ETHER | < | 10 | UG/L |
| BIS(2-CHLOROETHOXY)METHANE | < | 10 | UG/L |
| BIS(2-CHLOROISOPROPYL)ETHER | < | 10 | UG/L |
| BUTYL BENZYL PHTHALATE | < | 10 | UG/L |
| DIETHYLPHTHALATE | < | 10 | UG/L |
| DIMETHYLPHTHALATE | < | 10 | UG/L |
| FLUORANTHENE | < | 10 | UG/L |
| FLUORENE | < | 10 | UG/L |
| HEXACHLOROCYCLOPENTADIENE | < | 10 | UG/L |
| HEXACHLOROBUTADIENE | < | 10 | UG/L |
| HEXACHLOROETHANE | < | 10 | UG/L |
| INDENO(1,2,3-CD)PYRENE | < | 10 | UG/L |
| ISOPHORONE | < | 10 | UG/L |
| N-NITROSODI-N-PROPYLAMINE | < | 10 | UG/L |
| N-NITROSODIPHENYLAMINE | < | 10 | UG/L |
| N-NITROSODIMETHYLAMINE | < | 10 | UG/L |
| NITROBENZENE | < | 10 | UG/L |
| 4-CHLORO-3-METHYLPHENOL | < | 10 | UG/L |
| PYRENE | < | 10 | UG/L |
| BENZO(GHI)PERYLENE | < | 10 | UG/L |
| 1,2-DICHLOROBENZENE | < | 10 | UG/L |
| 1,2,4-TRICHLOROBENZENE | < | 10 | UG/L |
| DIBENZO(A,H)ANTHRACENE | < | 10 | UG/L |
| 1,3-DICHLOROBENZENE | < | 10 | UG/L |
| 1,4-DICHLOROBENZENE | < | 10 | UG/L |
| 2-CHLORONAPHTHALENE | < | 10 | UG/L |
| 2-CHLOROPHENOL | < | 10 | UG/L |
| 2-NITROPHENOL | < | 10 | UG/L |
| DI-N-OCTYLPHTHALATE | < | 10 | UG/L |
| 2,4-DICHLOROPHENOL | < | 10 | UG/L |
| 2,4-DIMETHYLPHENOL | < | 10 | UG/L |

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| | | |
|---|---|---|
| CLIENT SAMPLE ID | DW6 | |
| ABB SAMPLE ID | 91259015 | |
| DATE RECEIVED | 9/16/91 | UNITS |

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

| | | | |
|---|---|---|---|
| 2,4-DINITROTOLUENE | < | 10 | UG/L |
| 2,4-DINITROPHENOL | < | 50 | UG/L |
| 2,4,6-TRICHLOROPHENOL | < | 10 | UG/L |
| 2,6-DINITROTOLUENE | < | 10 | UG/L |
| 3,3-DICHLOROBENZIDINE | < | 20 | UG/L |
| 4-BROMOPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-CHLOROPHENYL PHENYL ETHER | < | 10 | UG/L |
| 4-NITROPHENOL | < | 50 | UG/L |
| 2-METHYL-4,6-DINITROPHENOL | < | 50 | UG/L |
| PHENOL | < | 10 | UG/L |
| NAPHTHALENE | < | 10 | UG/L |
| PENTACHLOROPHENOL | < | 50 | UG/L |
| BIS(2-ETHYLHEXYL)PHTHALATE | < | 10 | UG/L |
| DI-N-BUTYLPHTHALATE | < | 10 | UG/L |
| BENZIDINE | < | 50 | UG/L |
| HEXACHLOROBENZENE | < | 10 | UG/L |
| 1,2-DIPHENYLHRAZINE | < | 10 | UG/L |

SEMIVOLATILE SURROGATE RECOVERY

| | | |
|---|---|---|
| 2-FLUOROPHENOL | 41 | % |
| PHENOL-D5 | 28 | % |
| NITROBENZENE-D5 | 74 | % |
| 2-FLUOROBIPHENYL | 82 | % |
| 2,4,6-TRIBROMOPHENOL | 74 | % |
| TERPHENYL-D14 | 78 | % |

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 6

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

* The reported value is the mean of two or more replicate analyses of the sample. The precision of the replicate analyses is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

** Surrogate recovery does not meet internal QC criteria. Insufficient sample remained for reanalysis.

@ Surrogate recovery does not meet internal QC criteria. Sample will be reextracted and reported at a later date.

Client: OLIN CORP.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

*Sample Receiving Documentation*

| ABB Environmental Sample Numbers | Date Sample Received | Sample Matrix Description | Condition Upon Receipt | Chain of Custody Present | Requested Analyses | pH Checked |
|---|---|---|---|---|---|---|
| 91259012 | 09·16·91 | WATER | COOL + INTACT | YES | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, PEST, PCB, HERB | NA |
| 91259013 | | | | | Cr+6 | NA |
| | | | | | NH3 | <2 |
| | | | | | Cl, SO4, NO3, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | ~~TOTAL COLIFORM~~ | — |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, PEST, PCB, HERB | NA |

000052 AS/9 16 91

Client: OLIN CORP

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

*Sample Receiving Documentation*

| ABB Environmental Sample Numbers | Date Sample Received | Sample Matrix Description | Condition Upon Receipt | Chain of Custody Present | Requested Analyses | pH Checked |
|---|---|---|---|---|---|---|
| 91259013 | 09·16·91 | WATER | COOL + INTACT | YES | SVOA, PEST, PCB, HERB | NA |
| ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| 91259014 | | | | | $Cr^{+6}$ | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, PEST, PCB, HERB | NA |
| | | | | | ↓ | ↓ |
| 91259015 | | | | | $Cr^{+6}$ | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| ↓ | ↓ | ↓ | ↓ | ↓ | | |

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9/17/91

Client: OLIN CORP.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

*Sample Receiving Documentation*

| ABB Environmental Sample Numbers | Date Sample Received | Sample Matrix Description | Condition Upon Receipt | Chain of Custody Present | Requested Analyses | pH Checked |
|---|---|---|---|---|---|---|
| 91255015 | 09.16.91 | WATER | COOL + INTACT | YES | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, TEST, PCB, HERB | NA |
| 91259016 | | | | | VOA. | |
| | | | | | VOA | |



9/19/91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| METHODS OF ANALYSIS | | | CHRONOLOGY OF ANALYSES | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Aluminum | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Barium | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Beryllium | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Chromium | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| *METHODS OF ANALYSIS* | | | *CHRONOLOGY OF ANALYSES* | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Copper | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Iron | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Manganese | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Nickel | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| METHODS OF ANALYSIS | | | CHRONOLOGY OF ANALYSES | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Silver | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Sodium | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Zinc | 200.7 | Atomic Emission, Inductively Coupled Plasma | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Antimony | 204.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

*METHODS OF ANALYSIS* | *CHRONOLOGY OF ANALYSES*

| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
|---|---|---|---|---|---|---|---|
| Arsenic | 206.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Cadmium | 213.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Lead | 239.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| Selenium | 270.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| METHODS OF ANALYSIS | | | CHRONOLOGY OF ANALYSES | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Thallium | 279.2 | Atomic Absorption, Graphite Furnace | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| Mercury | 245.1 | Atomic Absorption, Manual Cold Vapor | 91259009 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |

Notes:
Unless otherwise indicated, analytical methods are from (1) "Methods of Chemical Analysis of Water and Wastes," EPA-600/4-79-020, Revised March, 1983, or (2) "Test Methods for Evaluating Solid Wastes," EPA SW-846, Revised November, 1986.

*The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Method Blank and Laboratory Control Sample Results

| | | | *METHOD BLANK RESULTS* | | | | | | *LABORATORY CONTROL SAMPLE RESULTS* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Date of Prep | Date of Analysis | Units | | Concentration Measured in Blank | | Acceptance Range | Practical Quantitation Level* | Units | True Value | Measured Value | Percent Recovered | Acceptance Range (%) | Acceptance Range (mg/kg) |
| Aluminum | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 3.00 | 2.88 | 96.0 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 3.00 | 2.94 | 98.0 | 80-120 | |
| Barium | 17-Sep-91 | 19-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | | | | | | |
| | 17-Sep-91 | 19-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | | | | | | |
| | 17-Sep-91 | 18-Sep-91 | | | | | | | mg/L | 0.300 | 0.294 | 98.0 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | | | | | | | mg/L | 0.300 | 0.295 | 98.3 | 80-120 | |
| Beryllium | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.100 | 0.093 | 93.0 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.100 | 0.095 | 95.0 | 80-120 | |
| Chromium | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.300 | 0.300 | 100 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.300 | 0.309 | 103 | 80-120 | |
| Copper | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.025 | 0.025 | mg/L | 0.300 | 0.285 | 95.0 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.025 | 0.025 | mg/L | 0.300 | 0.296 | 98.7 | 80-120 | |
| Iron | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.050 | 0.025 | mg/L | 12.5 | 12.4 | 99.2 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.050 | 0.025 | mg/L | 12.5 | 12.5 | 100 | 80-120 | |
| Manganese | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.010 | < | 0.010 | 0.010 | mg/L | 0.200 | 0.195 | 97.5 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.010 | < | 0.010 | 0.010 | mg/L | 0.200 | 0.197 | 98.5 | 80-120 | |
| Nickel | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.040 | < | 0.040 | 0.040 | mg/L | 0.300 | 0.296 | 98.7 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.040 | < | 0.040 | 0.040 | mg/L | 0.300 | 0.297 | 99.0 | 80-120 | |
| Silver | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.300 | 0.300 | 100 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.015 | < | 0.015 | 0.015 | mg/L | 0.300 | 0.300 | 100 | 80-120 | |
| Sodium | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.050 | < | 0.200 | 0.050 | mg/L | 2.50 | 2.40 | 96.0 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.050 | < | 0.200 | 0.050 | mg/L | 2.50 | 2.45 | 98.0 | 80-120 | |
| Zinc | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.025 | 0.025 | mg/L | 0.300 | 0.296 | 98.7 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.025 | < | 0.025 | 0.025 | mg/L | 0.300 | 0.299 | 99.7 | 80-120 | |
| Antimony | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.020 | 0.023 | 115 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | | | | | | | mg/L | 0.020 | 0.023 | 115 | 80-120 | |
| Arsenic | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.020 | 0.022 | 110 | 80-120 | |
| | 17-Sep-91 | 19-Sep-91 | | | | | | | mg/L | 0.020 | 0.022 | 110 | 80-120 | |

Client: Olin Chemical

24-Sep-91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Method Blank and Laboratory Control Sample Results

| | | | METHOD BLANK RESULTS | | | | | LABORATORY CONTROL SAMPLE RESULTS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Date of Prep | Date of Analysis | Units | | Concentration Measured in Blank | | Acceptance Range | Practical Quantitation Level* | Units | True Value | Measured Value | Percent Recovered | Acceptance Range (%) | Acceptance Range (mg/kg) |
| Cadmium | 17-Sep-91 | 18-Sep-91 | mg/L | < | 0.002 | < | 0.002 | 0.002 | mg/L | 0.010 | 0.011 | 110 | 80-120 | |
| | 17-Sep-91 | 18-Sep-91 | | | | | | | mg/L | 0.010 | 0.011 | 110 | 80-120 | |
| Lead | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.020 | 0.022 | 110 | 80-120 | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.020 | 0.020 | 100 | 80-120 | |
| Selenium | 17-Sep-91 | 19-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.010 | 0.010 | 100 | 80-120 | |
| | 17-Sep-91 | 19-Sep-91 | | | | | | | mg/L | 0.010 | 0.010 | 100 | 80-120 | |
| Thallium | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.005 | < | 0.005 | 0.005 | mg/L | 0.010 | 0.009 | 90.0 | 80-120 | |
| | 17-Sep-91 | 17-Sep-91 | | | | | | | mg/L | 0.010 | 0.009 | 90.0 | 80-120 | |
| Mercury | 18-Sep-91 | 18-Sep-91 | ug/L | < | 0.20 | < | 0.20 | 0.20 | ug/L | 2.00 | 1.70 | 85.0 | 80-120 | |
| | 18-Sep-91 | 18-Sep-91 | ug/L | < | 0.20 | < | 0.20 | 0.20 | ug/L | 2.00 | 1.65 | 82.5 | 80-120 | |

* Practical quantitation level is the lowest concentration measurable for samples with normal chemical and physical composition during routine laboratory operations.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory and method specified acceptance range except as noted.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

| | | DUPLICATE RESULTS | | | | | | MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ABB | | Sample | | | | Acceptance | | Concentration or Quantity | | | | Matrix Spike Recovery (%) | | | | |
| | Environmental | | Measurement | | Mean | | Range | Units | Sample | Spike | Sample | Sample | Sample | Sample | Acceptance | RPD | Acceptance |
| Parameter | Sample No. | Units | Rep 1 | Rep 2 | Conc | RPD (%) | for RPD (%) | | Only | Added | +Spike Dup 1 | +Spike Dup 2 | +Spike Dup 1 | +Spike Dup 2 | Range (%) | (%) | Range (%) |
| Aluminum | 91259011 | mg/L | <0.100 | <0.100 | <0.100 | NC | 0-20 | mg/L | <0.100 | 3.00 | 2.92 | NA | 97.3 | NA | 80-120 | NA | 0-20 |
| Barium | 91259011 | mg/L | 0.022 | 0.021 | 0.022 | 4.7 | 0-20 | mg/L | 0.022 | 0.300 | 0.319 | NA | 99.0 | NA | 80-120 | NA | 0-20 |
| Beryllium | 91259011 | mg/L | <0.015 | <0.015 | <0.015 | NC | 0-20 | mg/L | <0.015 | 0.100 | 0.091 | NA | 91.0 | NA | 80-120 | NA | 0-20 |
| Chromium | 91259011 | mg/L | <0.015 | <0.015 | <0.015 | NC | 0-20 | mg/L | <0.015 | 0.300 | 0.288 | NA | 96.0 | NA | 80-120 | NA | 0-20 |
| Copper | 91259011 | mg/L | 0.038 | 0.043 | 0.041 | 12 | 0-100 | mg/L | 0.041 | 0.300 | 0.334 | NA | 97.7 | NA | 80-120 | NA | 0-20 |
| Iron | 91259011 | mg/L | 0.483 | 0.478 | 0.481 | 1.0 | 0-20 | mg/L | 0.481 | 12.5 | 12.6 | NA | 97.0 | NA | 80-120 | NA | 0-20 |
| Manganese | 91259011 | mg/L | 0.977 | 0.967 | 0.972 | 1.0 | 0-20 | mg/L | 0.972 | 0.200 | 1.17 | NA | 99.0 | NA | 80-120 | NA | 0-20 |
| Nickel | 91259011 | mg/L | <0.040 | <0.040 | <0.040 | NC | 0-20 | mg/L | <0.040 | 0.300 | 0.303 | NA | 101 | NA | 80-120 | NA | 0-20 |
| Silver | 91259011 | mg/L | <0.015 | <0.015 | <0.015 | NC | 0-20 | mg/L | <0.015 | 0.300 | 0.292 | NA | 97.3 | NA | 80-120 | NA | 0-20 |
| Sodium | 91259011 | mg/L | 20.2 | 20.3 | 20.3 | 0.5 | 0-20 | mg/L | 20.3 | 2.50 | 22.8 | NA | 100 | NA | 80-120 | NA | 0-20 |
| Zinc | 91259011 | mg/L | <0.025 | <0.025 | <0.025 | NC | 0-20 | mg/L | <0.025 | 0.300 | 0.306 | NA | 102 | NA | 80-120 | NA | 0-20 |
| Antimony | 91259011 | mg/L | <0.005 | <0.005 | <0.005 | NC | 0-20 | mg/L | <0.005 | 0.020 | 0.028 | NA | 140 | NA | 80-120 | NA | 0-20 |
| Arsenic | 91259011 | mg/L | <0.005 | <0.005 | <0.005 | NC | 0-20 | mg/L | <0.005 | 0.020 | 0.023 | NA | 115 | NA | 80-120 | NA | 0-20 |
| Cadmium | 91259011 | mg/L | <0.002 | <0.002 | <0.002 | NC | 0-20 | mg/L | <0.002 | 0.010 | 0.011 | NA | 110 | NA | 80-120 | NA | 0-20 |
| Lead | 91259011 | mg/L | <0.005 | <0.005 | <0.005 | NC | 0-20 | mg/L | <0.005 | 0.020 | 0.020 | NA | 100 | NA | 80-120 | NA | 0-20 |
| Selenium | 91259011 | mg/L | <0.005 | <0.005 | <0.005 | NC | 0-20 | mg/L | <0.005 | 0.010 | 0.012 | NA | 120 | NA | 80-120 | NA | 0-20 |
| Thallium | 91259011 | mg/L | <0.005 | <0.005 | <0.005 | NC | 0-20 | mg/L | <0.005 | 0.010 | 0.010 | NA | 100 | NA | 80-120 | NA | 0-20 |
| Mercury | 91259011 | ug/L | <0.20 | <0.20 | <0.20 | NC | 0-20 | ug/L | <0.20 | 2.00 | 1.95 | NA | 97.5 | NA | 80-120 | NA | 0-20 |

RPD = Relative percent difference, which is the absolute value of the difference between two duplicate results divided by the mean concentration then multiplied by 100%.

NA = Not applicable.

NC = Relative percent difference cannot be calculated for sample results less than the PQL.



Because of the large uncertainty (i.e., 33% or greater) associated with measurements made near the detection level, the acceptance range for relative

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

| | | *DUPLICATE RESULTS* | | | | | | *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ABB Environmental | | Sample Measurement | | Mean | | Acceptance Range | | Concentration or Quantity | | | | Matrix Spike Recovery (%) | | | | |
| Parameter | Sample No. | Units | Rep 1 | Rep 2 | Conc | RPD (%) | for RPD (%) | Units | Sample Only | Spike Added | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Acceptance Range (%) | RPD (%) | Acceptance Range (%) |

percent difference for duplicate measurements at such low concentrations is 0-100%.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory or contract specified acceptance range except as noted.

* Matrix spike recovery is outside the laboratory's specified acceptance range indicating potential sample matrix interference and potential bias of reported value for this parameter.

Client: Olin Chemical

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ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

***Summary Report***

## ***Inorganic Laboratory Summary Report***

All sample analyses for elements referenced by this Quality Control Report were routine and were conducted in accordance with appropriate analytical protocols and laboratory standard operating procedures except as noted.

ABB Environmental Sample No. 91259011
Parameter: Antimony
Description of Problem/Summary of Laboratory Actions: The antimony matrix spike recovery for this sample is 140%, which is outside the laboratory's acceptance range of 80%-120%. This may indicate the presence of a sample matrix interference and a potential bias of the reported value for this parameter.

Client: Olin Chemical

24-Sep-91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| METHODS OF ANALYSIS | | | CHRONOLOGY OF ANALYSES | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Chloride | 325.2 | Colorimetric, Automated Ferricyanide | 91259009 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| Coliform, Fecal | ~APHA 909C | Membrane Filter, M-FC medium | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Coliform, Total | ~APHA 909A | Membrane Filter, M-Endo medium | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Chromium, Hexavalent | 7196 | Colorimetric | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| METHODS OF ANALYSIS | | | CHRONOLOGY OF ANALYSES | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
| Cyanide, Total | 335.2 | Spectrophotometric, Manual | 91259009 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 |
| Fluoride | 340.2 | Potentiometric, Ion Selective Electrode | 91259009 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| Ammonia-Nitrogen | 350.1 | Colorimetric, Automated Phenate | 91259009 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 18-Sep-91 | 18-Sep-91 | 1.0 |
| TKN -Total Kjeldahl Nitrogen | 351.2 | Colorimetric, Automated Block Digestor | 91259009 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 18-Sep-91 | 19-Sep-91 | 1.0 |

Client: Olin Chemical

24-Sep-91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| Parameter | METHODS OF ANALYSIS: Method No. | Description | CHRONOLOGY OF ANALYSES: ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
|---|---|---|---|---|---|---|---|
| Nitrate+Nitrite-Nitrogen | 353.2 | Colorimetric, Automated Cadmium Reduction | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| Nitrate-Nitrogen | 353.2/354.1 | Calculation from Nitrate+Nitrite, Nitrite | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| Nitrite-Nitrogen | 354.1 | Colorimetric, Automated | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| pH (Laboratory) | 150.1 | Electrometric | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Methods and Chronology of Analysis

| Parameter | Method No. | Description | ABB Environmental Sample Nos. | Date Sample Received | Date of Sample Chemical Preparation | Date of Instrument Analysis | Dilution Factor * |
|---|---|---|---|---|---|---|---|
| | *METHODS OF ANALYSIS* | | *CHRONOLOGY OF ANALYSES* | | | | |
| TDS -Filterable Residue | 160.1 | Gravimetric, 180C | 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| Sulfate | 375.4 | Turbidimetric | 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259010 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259011 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259012 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259013 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259014 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |
| | | | 91259015 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 |

Notes:
Unless otherwise indicated, analytical methods are from (1) "Methods of Chemical Analysis of Water and Wastes," EPA 600/4-79-020, Revised March, 1983, or (2) "Test Methods for Evaluating Solid Wastes," EPA SW-846, Revised November, 1986.

NA = Not applicable.

~ APHA = Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th edition, 1985.

*The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Method Blank and Laboratory Control Sample Results

| | | | METHOD BLANK RESULTS | | | | | | LABORATORY CONTROL SAMPLE RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Date of Prep* | Date of Analysis* | Units | | Conc. Measured in Blank | | Acceptance Range | Practical Quantitation Level** | Units | True Value | Measured Value | Percent Recovered | Acceptance Range (%) | Acceptance Range (mg/kg) | Acceptance Range (%) |
| Chloride | 18-Sep-91 | 18-Sep-91 | mg/L | < | 2.0 | < | 2.0 | 2.0 | mg/L | 62.5 | 69.8 | 112 | 80-120 | | |
| | 18-Sep-91 | 18-Sep-91 | mg/L | < | 2.0 | < | 2.0 | 2.0 | mg/L | 62.5 | 70.7 | 113 | 80-120 | | |
| Coliform, Fecal | 17-Sep-91 | 18-Sep-91 | col/100 mL | < | 1.0 | < | 1.0 | 1.0 | | | | | | | |
| Coliform, Total | 17-Sep-91 | 18-Sep-91 | col/100 mL | < | 1.0 | < | 1.0 | 1.0 | | | | | | | |
| Chromium, Hexavalent | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.010 | < | 0.010 | 0.010 | mg/L | 0.043 | 0.040 | 93.0 | 80-120 | | |
| Cyanide, Total | 17-Sep-91 | 19-Sep-91 | ug/L | < | 20 | < | 20 | 20 | ug | 10.5 | 9.34 | 89.0 | 80-120 | | |
| Fluoride | 18-Sep-91 | 18-Sep-91 | mg/L | < | 0.20 | < | 0.20 | 0.20 | mg/L | 1.00 | 0.96 | 96.0 | 80-120 | | |
| | 18-Sep-91 | 18-Sep-91 | | | | | | | mg/L | 0.80 | 0.78 | 97.5 | 80-120 | | |
| Ammonia-Nitrogen | 18-Sep-91 | 18-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 1.50 | 1.57 | 105 | 80-120 | | |
| | 18-Sep-91 | 18-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 1.50 | 1.49 | 99.3 | 80-120 | | |
| TKN -Total Kjeldahl Nitrogen | 18-Sep-91 | 19-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 1.25 | 1.29 | 103 | 80-120 | | |
| | 18-Sep-91 | 19-Sep-91 | mg/L | < | 0.10 | < | 0.10 | 0.10 | mg/L | 1.25 | 1.19 | 95.2 | 80-120 | | |
| Nitrate+Nitrite-Nitrogen | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.22 | 102 | 80-120 | | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.26 | 105 | 80-120 | | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.26 | 105 | 80-120 | | |
| Nitrate-Nitrogen | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.22 | 102 | 80-120 | | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.26 | 105 | 80-120 | | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.20 | 1.26 | 105 | 80-120 | | |
| Nitrite-Nitrogen | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.00 | 0.918 | 91.8 | 80-120 | | |
| | 17-Sep-91 | 17-Sep-91 | mg/L | < | 0.050 | < | 0.050 | 0.050 | mg/L | 1.00 | 0.978 | 97.8 | 80-120 | | |
| TDS -Filterable Residue | 17-Sep-91 | 18-Sep-91 | mg/L | < | 10 | < | 10 | 10 | mg/L | 746 | 727 | 97.5 | 80-120 | | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 10 | < | 10 | 10 | | | | | | | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 10 | < | 10 | 10 | | | | | | | |
| | 17-Sep-91 | 18-Sep-91 | mg/L | < | 10 | < | 10 | 10 | | | | | | | |
| Sulfate | 17-Sep-91 | 17-Sep-91 | mg/L | < | 1.0 | < | 1.0 | 1.0 | mg | 1.25 | 1.24 | 99.2 | 80-120 | | |
| | | | | | | | | | mg | 1.25 | 1.21 | 96.8 | 80-120 | | |

* Date is indicated if sample preparation/analysis was performed on more than one day for a parameter. If no date is given, all samples, method blanks and laboratory control samples were prepared and analyzed as indicated on the Chronology Form.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

Method Blank and Laboratory Control Sample Results

| | | | METHOD BLANK RESULTS | | | | LABORATORY CONTROL SAMPLE RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Date of Prep* | Date of Analysis* | Units | Conc. Measured in Blank | Acceptance Range | Practical Quantitation Level** | Units | True Value | Measured Value | Percent Recovered | Acceptance Range (%) | Acceptance Range (mg/kg) | Acceptance Range (%) |

** Practical quantitation level is the lowest concentration measurable for samples with normal chemical and physical composition during routine laboratory operations.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory and method specified acceptance range except as noted.

Client: Olin Chemical

24-Sep-91

# ABB Environmental Analytical Services Division Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

| | | DUPLICATE RESULTS | | | | | | MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Concentration or Quantity | | | | | Matrix Spike Recovery (%) | | | | |
| Parameter | ABB Environmental Sample No. | Units | Sample Measurements Rep 1 | Sample Measurements Rep 2 | Mean Conc | RPD (%) | Acceptance Range for RPD (%) | Units | Sample Only | Spike Added | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Acceptance Range (%) | RPD (%) | Acceptance Range (%) |
| Chloride | 91259011 | mg/L | 42.2 | 42.0 | 42.1 | 0.5 | 0-20 | mg/L | 33.7 | 12.5 | 47.7 | 47.6 | 112 | 111 | 80-120 | 0.7 | 0-20 |
| Chromium, VI | 91259011 | mg/L | <0.010 | <0.010 | <0.010 | NC | 0-20 | | | | | | | | | | |
| | 91259013 | | | | | | | mg/L | <0.010 | 0.086 | 0.074 | NA | 86.0 | NA | 80-120 | NA | 0-20 |
| Cyanide, Total | 91259011 | ug/L | <20 | <20 | <20 | NC | 0-20 | ug/L | <20 | 105 | 115 | NA | 110 | NA | 80-120 | NA | 0-20 |
| Fluoride | 91259011 | mg/L | <0.20 | <0.20 | <0.20 | NC | 0-20 | mg | <0.020 | 0.200 | 0.193 | NA | 96.5 | NA | 80-120 | NA | 0-20 |
| Ammonia | 91259011 | mg/L | 0.323 | 0.313 | 0.318 | 3.1 | 0-20 | mg/L | 0.310 | 1.25 | 1.52 | NA | 96.8 | NA | 80-120 | NA | 0-20 |
| TKN | 91259011 | mg/L | 0.277 | 0.257 | 0.267 | 7.5 | 0-20 | mg/L | 0.267 | 1.25 | 1.53 | NA | 101 | NA | 80-120 | NA | 0-20 |
| Nitrate+Nitrite | 91259011 | mg/L | 0.208 | 0.164 | 0.186 | 24 * | 0-20 | mg/L | 0.167 | 1.20 | 1.44 | NA | 106 | NA | 80-120 | NA | 0-20 |
| | 91259015 | mg/L | 0.422 | 0.130 | 0.276 | 106 * | 0-20 | | | | | | | | | | |
| Nitrate | 91259011 | mg/L | 0.208 | 0.164 | 0.186 | 24 * | 0-20 | mg/L | 0.167 | 1.20 | 1.44 | NA | 106 | NA | 80-120 | NA | 0-20 |
| | 91259015 | mg/L | 0.422 | 0.130 | 0.276 | 106 * | 0-20 | | | | | | | | | | |
| Nitrite | 91259011 | mg/L | <0.050 | <0.050 | <0.050 | NC | 0-20 | mg/L | <0.050 | 0.250 | 0.205 | NA | 82.0 | NA | 80-120 | NA | 0-20 |
| pH (Laboratory) | 91259011 | | 6.46 | 6.48 | 6.47 | 0.3 | 0-20 | | | | | | | | | | |
| TDS | 91259011 | mg/L | 143 | 138 | 141 | 3.6 | 0-20 | | | | | | | | | | |
| Sulfate | 91259011 | | | | | | | mg | 0.67 | 0.50 | 1.15 | NA | 96.0 | NA | 80-120 | NA | 0-20 |

RPD = Relative percent difference, which is the absolute value of the difference between two replicate results divided by the mean concentration then multiplied by 100%.

NC = Relative percent difference cannot be calculated for sample results less than the PQL.

NA = Not applicable.

Because of the large uncertainty (i.e., 33% or greater) associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such low concentrations is 0-100%.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory or contract specified acceptance range except as noted.

# ABB Environmental
# Analytical Services Division
# Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

| | | *DUPLICATE RESULTS* | | | | | | *MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ABB Environmental | | Sample Measurements | | Mean | | Acceptance Range | | Concentration or Quantity | | | | Matrix Spike Recovery (%) | | | | |
| Parameter | Sample No. | Units | Rep 1 | Rep 2 | Conc | RPD (%) | for RPD (%) | Units | Sample Only | Spike Added | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Sample +Spike Dup 1 | Sample +Spike Dup 2 | Acceptance Range (%) | RPD (%) | Acceptance Range (%) |

* Precision of replicate analysis as measured by RPD is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

Client: Olin Chemical

25-Sep-91

**ABB Environmental**
**Analytical Laboratory Services Division**
**Quality Control Report**

Summary Report

## Inorganic Laboratory Summary Report

All sample analyses for wet chemistry referenced by this Quality Control Report were routine and were conducted in accordance with appropriate analytical protocols and laboratory standard operating procedures except as noted.

ABB Environmental Sample No. 91259011,91259015
Parameter: Nitrate+Nitrite
Description of Problem/Summary of Laboratory Actions: The RPD for the duplicate analysis of these samples is outside of laboratory accepted criteria. All of the Laboratory Control Standards (LCS) and method blanks run concurrently with these samples are within acceptable laboratory criteria. The analyte concentration, determined in these samples, is close to the intrument's PQL, sample homogeneity is a potential factor.

ABB Environmental Sample No. 91259011,91259015
Parameter: Nitrate
Description of Problem/Summary of Laboratory Actions: The RPD for the duplicate analysis of these samples is outside of laboratory accepted criteria. All of the Laboratory Control Standards (LCS) and method blanks run concurrently with these samples are within acceptable laboratory criteria. The analyte concentration, determined in these samples, is close to the intrument's PQL, sample homogeneity is a potential factor.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Methods, Chronology of Analysis and Method Blank Results

Microextractables by GC Method 504

Water Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Analyzed | | ABB Sample Nos. | Date Received | Date Analyzed |
|---|---|---|---|---|---|---|
| 91259009 | 16-Sep-91 | 20-Sep-91 | | | | |
| 91259010 | 16-Sep-91 | 20-Sep-91 | | | | |
| 91259011 | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259012 | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259013 | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259013DUP | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259014 | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259015 | 16-Sep-91 | 21-Sep-91 | | | | |
| 91259015MS | 16-Sep-91 | 21-Sep-91 | | | | |
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METHOD BLANK RESULTS*

| Compound | | Conc. (ug/L) |
|---|---|---|
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* Only positive hits have been included.
The remaining compounds were below the Laboratory Practical Quantitation limits.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Laboratory Control Sample Results

Microextractables by GC Method 504

Water Matrix

Date of Extraction: 19-Sep-91
Date of Analysis: 21-Sep-91

| Compound | Units | Spike Conc. | LCS Measured Conc. | LCS Dup. Measured Conc. | LCS % Recovery | LCS Dup. % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|
| Ethylene Dibromide (EDB) | ug/L | 0.500 | 0.283 | 0.378 | 56.6 | 75.6 | 25-125 | 29 | 0-50 |
| 1,2-Dibromo-3-chloropropane (DBCP) | ug/L | 0.500 | 0.414 | 0.435 | 82.8 | 87.0 | 25-125 | 4.9 | 0-50 |

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Sample Duplicate Results

Microextractables by GC Method 504

Water Matrix

ABB Sample No. Duplicated: 91259013

| Compound* | Units | Sample Conc. | Sample Duplicate Conc. | Average Conc. | RPD (%) | RPD Acceptance Range (%) |
|---|---|---|---|---|---|---|
| No compounds detected. | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limit.

ND = Not detected.

NC = Not calculated; relative percent difference and average concentration are not calculated for sample results less than the PQL.

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Matrix Spike/Matrix Spike Duplicate Results

Microextractables by GC Method 504

Water Matrix

ABB Sample No. Spiked: 91259015

| Compound | Units | Spike Conc. | Sample Conc. | MS Measured Conc. | MSD Measured Conc. | MS % Recovery | MSD % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethylene Dibromide (EDB) | ug/L | 0.200 | ND | 0.148 | NA | 74.0 | NA | 25-125 | NA | 0-50 |
| 1,2-Dibromo-3-chloropropane (DBCP) | ug/L | 0.200 | ND | 0.192 | NA | 96.0 | NA | 25-125 | NA | 0-50 |

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

ND = Not detected.
NA = Not applicable.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Methods, Chronology of Analysis and Method Blank Results

Volatile Analysis by GC/MS Method 524.2

Water Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Analyzed | Dilution Factor ~ | ABB Sample Nos. | Date Received | Date Analyzed | Dilution Factor ~ |
|---|---|---|---|---|---|---|---|
| 91259-014 | 16-Sep-91 | 20-Sep-91 | 1.0 | | | | |
| 91259-014MS | 16-Sep-91 | 20-Sep-91 | 1.0 | | | | |
| 91259-011 | 16-Sep-91 | 20-Sep-91 | 1.0 | | | | |
| 91259-012 | 16-Sep-91 | 20-Sep-91 | 1.0 | | | | |
| 91259-013 | 16-Sep-91 | 20-Sep-91 | 1.0 | | | | |
| 91259-014DUP | 16-Sep-91 | 21-Sep-91 | 1.0 | | | | |
| 91259-015 | 16-Sep-91 | 21-Sep-91 | 1.0 | | | | |
| 91259-016 | 16-Sep-91 | 21-Sep-91 | 1.0 | | | | |
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METHOD BLANK RESULTS*

| Compound | Conc. (ug/L) |
|---|---|
| Methylene chloride | 0.11J |
| Ethylbenzene | 0.03J |
| Napthalene | 0.15J |
| Hexachlorobutadiene | 0.05J |
| | |

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Methods, Chronology of Analysis and Method Blank Results

Volatile Analysis by GC/MS Method 524.2

Water Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Analyzed | Dilution Factor ~ | ABB Sample Nos. | Date Received | Date Analyzed | Dilution Factor ~ |
|---|---|---|---|---|---|---|---|
| 91259009 | 16-Sep-91 | 18-Sep-91 | 1.0 | | | | |
| 91259010 | 16-Sep-91 | 18-Sep-91 | 1.0 | | | | |
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METHOD BLANK RESULTS*

| Compound | Conc. (ug/L) |
|---|---|
| Methylene chloride | 0.19J |
| 1,3,5-Trimethylbenzene | 0.05J |
| sec-Butylbenzene | 0.05 |
| 1,2,4-Trichlorobenzene | 0.14 |
| Naphthalene | 0.15J |
| Hexachlorobutadiene | 0.13 |

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 18-Sep-91

| Compound | Units | Spike Conc. | LFB Measured Conc. | LFB % Recovery | Recovery Acceptance Range (%) |
|---|---|---|---|---|---|
| Dichlorodifluoromethane | ug/L | 0.50 | 3.18 | 636 | 80-120 |
| Chloromethane | ug/L | 0.50 | 0.44 | 88.0 | 80-120 |
| Vinyl Chloride | ug/L | 0.50 | 0.60 | 120 | 80-120 |
| Bromomethane | ug/L | 0.50 | 0.70 | 140 | 80-120 |
| Chloroethane | ug/L | 0.50 | 0.64 | 128 | 80-120 |
| Trichlorofluoromethane | ug/L | 0.50 | 0.82 | 164 | 80-120 |
| 1,1-Dichloroethene | ug/L | 0.50 | 0.68 | 136 | 80-120 |
| Methylene Chloride | ug/L | 0.50 | 2.82 | 564 | 80-120 |
| trans-1,2-Dichloroethene | ug/L | 0.50 | 0.62 | 124 | 80-120 |
| 1,1-Dichloroethane | ug/L | 0.50 | 0.63 | 126 | 80-120 |
| cis-1,2-Dichloroethene | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| 2,2-Dichloropropane | ug/L | 0.50 | 0.83 | 166 | 80-120 |
| Chloroform | ug/L | 0.50 | 0.68 | 136 | 80-120 |
| Bromochloromethane | ug/L | 0.50 | 0.50 | 100 | 80-120 |
| 1,1,1-Trichloroethane | ug/L | 0.50 | 0.76 | 152 | 80-120 |
| 1,2-Dichloroethane | ug/L | 0.50 | 0.46 | 92.0 | 80-120 |
| 1,1-Dichloropropene | ug/L | 0.50 | 0.71 | 142 | 80-120 |
| Carbon Tetrachloride | ug/L | 0.50 | 0.71 | 142 | 80-120 |
| Benzene | ug/L | 0.50 | 0.66 | 132 | 80-120 |
| 1,2-Dichloropropane | ug/L | 0.50 | 0.54 | 108 | 80-120 |
| Trichloroethene | ug/L | 0.50 | 0.71 | 142 | 80-120 |
| Dibromomethane | ug/L | 0.50 | 0.45 | 90.0 | 80-120 |
| Bromodichloromethane | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| cis-1,3-Dichloropropene | ug/L | 0.80 | 0.82 | 103 | 80-120 |
| Toluene | ug/L | 0.50 | 0.64 | 128 | 80-120 |
| trans-1,3-Dichloropropene | ug/L | 0.20 | 0.14 | 70.0 | 80-120 |
| 1,1,2-Trichloroethane | ug/L | 0.50 | 0.42 | 84.0 | 80-120 |
| 1,3-Dichloropropane | ug/L | 0.50 | 0.46 | 92.0 | 80-120 |
| Dibromochloromethane | ug/L | 0.50 | 0.53 | 106 | 80-120 |
| Tetrachloroethene | ug/L | 0.50 | 0.75 | 150 | 80-120 |
| 1,2-Dibromoethane | ug/L | 0.50 | 0.35 | 70.0 | 80-120 |
| Chlorobenzene | ug/L | 0.50 | 0.55 | 110 | 80-120 |
| 1,1,1,2-Tetrachloroethane | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| Ethylbenzene | ug/L | 0.50 | 0.60 | 120 | 80-120 |
| m+p-Xylene | ug/L | 1.00 | 1.25 | 125 | 80-120 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 18-Sep-91

| Compound | Units | Spike Conc. | LFB Measured Conc. | LFB % Recovery | Recovery Acceptance Range (%) |
|---|---|---|---|---|---|
| Bromoform | ug/L | 0.50 | 0.46 | 92.0 | 80-120 |
| o-Xylene | ug/L | 0.50 | 0.64 | 128 | 80-120 |
| Styrene | ug/L | 0.50 | 0.50 | 100 | 80-120 |
| 1,1,2,2-Tetrachloroethane | ug/L | 0.50 | 0.42 | 84.0 | 80-120 |
| 1,2,3-Trichloropropane | ug/L | 0.50 | 1.20 | 240 | 80-120 |
| Isopropylbenzene | ug/L | 0.50 | 0.55 | 110 | 80-120 |
| Bromobenzene | ug/L | 0.50 | 0.43 | 86.0 | 80-120 |
| 2-Chlorotoluene | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| n-Propylbenzene | ug/L | 0.50 | 0.51 | 102 | 80-120 |
| 4-Chlorotoluene | ug/L | 0.50 | 0.44 | 88.0 | 80-120 |
| 1,3,5-Trimethylbenzene | ug/L | 0.50 | 0.90 | 180 | 80-120 |
| tert-Butylbenzene | ug/L | 0.50 | 0.79 | 158 | 80-120 |
| 1,2,4-Trimethylbenzene | ug/L | 0.50 | 0.50 | 100 | 80-120 |
| sec-Butylbenzene | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| 1,3-Dichlorobenzene | ug/L | 0.50 | 0.52 | 104 | 80-120 |
| p-Isopropyltoluene | ug/L | 0.50 | 0.51 | 102 | 80-120 |
| 1,4-Dichlorobenzene | ug/L | 0.50 | 0.53 | 106 | 80-120 |
| 1,2-Dichlorobenzene | ug/L | 0.50 | 0.54 | 108 | 80-120 |
| n-Butylbenzene | ug/L | 0.50 | 0.46 | 92.0 | 80-120 |
| 1,2-Dibromo-3-chloropropane | ug/L | 0.50 | 0.67 | 134 | 80-120 |
| 1,2,4-Trichlorobenzene | ug/L | 0.50 | 1.10 | 220 | 80-120 |
| Naphthalene | ug/L | 0.50 | 1.04 | 208 | 80-120 |
| Hexachlorobutadiene | ug/L | 0.50 | 1.27 | 254 | 80-120 |
| 1,2,3-Trichlorobenzene | ug/L | 0.50 | 1.24 | 248 | 80-120 |
| 2,4,4-Trimethyl-1-pentene | ug/L | 0.50 | 0.69 | 138 | 80-120 |
| 2,4,4-Trimethyl-2-pentene | ug/L | 0.50 | 0.61 | 122 | 80-120 |

Client: Olin Chemical

26-Sep-91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91

| Compound | Units | Spike Conc. | LFB Measured Conc. | LFB % Recovery | Recovery Acceptance Range (%) |
|---|---|---|---|---|---|
| Dichlorodifluoromethane | ug/L | 0.50 | 0.19 | 38 | 80-120 |
| Chloromethane | ug/L | 0.50 | 0.46 | 92 | 80-120 |
| Vinyl Chloride | ug/L | 0.50 | 0.37 | 74 | 80-120 |
| Bromomethane | ug/L | 0.50 | 0.67 | 134 | 80-120 |
| Chloroethane | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| Trichlorofluoromethane | ug/L | 0.50 | 0.84 | 168 | 80-120 |
| 1,1-Dichloroethene | ug/L | 0.50 | 0.69 | 138 | 80-120 |
| Methylene Chloride | ug/L | 0.50 | 2.14 | 428 | 80-120 |
| trans-1,2-Dichloroethene | ug/L | 0.50 | 0.68 | 136 | 80-120 |
| 1,1-Dichloroethane | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| cis-1,2-Dichloroethene | ug/L | 0.50 | 0.62 | 124 | 80-120 |
| 2,2-Dichloropropane | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| Chloroform | ug/L | 0.50 | 0.67 | 134 | 80-120 |
| Bromochloromethane | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| 1,1,1-Trichloroethane | ug/L | 0.50 | 0.72 | 144 | 80-120 |
| 1,2-Dichloroethane | ug/L | 0.50 | 0.52 | 104 | 80-120 |
| 1,1-Dichloropropene | ug/L | 0.50 | 0.67 | 134 | 80-120 |
| Carbon Tetrachloride | ug/L | 0.50 | 0.70 | 140 | 80-120 |
| Benzene | ug/L | 0.50 | 0.63 | 126 | 80-120 |
| 1,2-Dichloropropane | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| Trichloroethene | ug/L | 0.50 | 0.62 | 124 | 80-120 |
| Dibromomethane | ug/L | 0.50 | 0.58 | 116 | 80-120 |
| Bromodichloromethane | ug/L | 0.50 | 0.62 | 124 | 80-120 |
| cis-1,3-Dichloropropene | ug/L | 0.80 | 0.79 | 98.75 | 80-120 |
| Toluene | ug/L | 0.50 | 0.78 | 156 | 80-120 |
| trans-1,3-Dichloropropene | ug/L | 0.20 | 0.19 | 95 | 80-120 |
| 1,1,2-Trichloroethane | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| 1,3-Dichloropropane | ug/L | 0.50 | 0.58 | 116 | 80-120 |
| Dibromochloromethane | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| Tetrachloroethene | ug/L | 0.50 | 0.69 | 138 | 80-120 |
| 1,2-Dibromoethane | ug/L | 0.50 | 0.60 | 120 | 80-120 |
| Chlorobenzene | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| 1,1,1,2-Tetrachloroethane | ug/L | 0.50 | 0.62 | 124 | 80-120 |

Client: Olin Chemical

26-Sep-91

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91

| Compound | Units | Spike Conc. | LFB Measured Conc. | LFB % Recovery | Recovery Acceptance Range (%) |
|---|---|---|---|---|---|
| Ethylbenzene | ug/L | 0.50 | 0.62 | 124 | 80-120 |
| m+p-Xylene | ug/L | 1.00 | 1.21 | 121 | 80-120 |
| Bromoform | ug/L | 0.50 | 0.63 | 126 | 80-120 |
| o-Xylene | ug/L | 0.50 | 0.65 | 130 | 80-120 |
| Styrene | ug/L | 0.50 | 0.54 | 108 | 80-120 |
| 1,1,2,2-Tetrachloroethane | ug/L | 0.50 | 0.71 | 142 | 80-120 |
| 1,2,3-Trichloropropane | ug/L | 0.50 | 1.81 | 362 | 80-120 |
| Isopropylbenzene | ug/L | 0.50 | 0.63 | 126 | 80-120 |
| Bromobenzene | ug/L | 0.50 | 0.59 | 118 | 80-120 |
| 2-Chlorotoluene | ug/L | 0.50 | 0.58 | 116 | 80-120 |
| n-Propylbenzene | ug/L | 0.50 | 0.54 | 108 | 80-120 |
| 4-Chlorotoluene | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| 1,3,5-Trimethylbenzene | ug/L | 0.50 | 0.58 | 116 | 80-120 |
| tert-Butylbenzene | ug/L | 0.50 | 0.66 | 132 | 80-120 |
| 1,2,4-Trimethylbenzene | ug/L | 0.50 | 0.60 | 120 | 80-120 |
| sec-Butylbenzene | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| 1,3-Dichlorobenzene | ug/L | 0.50 | 0.60 | 120 | 80-120 |
| p-Isopropyltoluene | ug/L | 0.50 | 0.57 | 114 | 80-120 |
| 1,4-Dichlorobenzene | ug/L | 0.50 | 0.50 | 100 | 80-120 |
| 1,2-Dichlorobenzene | ug/L | 0.50 | 0.63 | 126 | 80-120 |
| n-Butylbenzene | ug/L | 0.50 | 0.43 | 86 | 80-120 |
| 1,2-Dibromo-3-chloropropane | ug/L | 0.50 | 0.83 | 166 | 80-120 |
| 1,2,4-Trichlorobenzene | ug/L | 0.50 | 0.98 | 196 | 80-120 |
| Naphthalene | ug/L | 0.50 | 2.43 | 486 | 80-120 |
| Hexachlorobutadiene | ug/L | 0.50 | 0.95 | 190 | 80-120 |
| 1,2,3-Trichlorobenzene | ug/L | 0.50 | 1.21 | 242 | 80-120 |
| 2,4,4-Trimethyl-1 pentene | ug/L | 0.5 | 0.77 | 154 | 80-120 |
| 2,4,4-Trimethyl-2 pentene | ug/L | 0.5 | 0.81 | 162 | 80-120 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report



## Laboratory Fortified Sample Matrix (LFM) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91
ABB Sample Number Spiked: 91259-014

| Compound | Units | Spike Conc. | Sample Measured Conc. | LFM Measured Conc. | LFM % Recovery | Recovery Acceptance Range (%)~ |
|---|---|---|---|---|---|---|
| Dichlorodifluoromethane | ug/L | 2.00 | | 1.67 | 83.5 | 80-120 |
| Chloromethane | ug/L | 2.00 | | 1.45 | 72.5 | 80-120 |
| Vinyl Chloride | ug/L | 2.00 | | 3.37 | 169 | 80-120 |
| Bromomethane | ug/L | 2.00 | | 3.15 | 158 | 80-120 |
| Chloroethane | ug/L | 2.00 | | 3.07 | 154 | 80-120 |
| Trichlorofluoromethane | ug/L | 2.00 | | 3.40 | 170 | 80-120 |
| 1,1-Dichloroethene | ug/L | 2.00 | | 2.99 | 150 | 80-120 |
| Methylene Chloride | ug/L | 2.00 | 0.54B | 4.16 | 208 | 80-120 |
| trans-1,2-Dichloroethene | ug/L | 2.00 | | 3.05 | 153 | 80-120 |
| 1,1-Dichloroethane | ug/L | 2.00 | | 2.94 | 147 | 80-120 |
| cis-1,2-Dichloroethene | ug/L | 2.00 | | 2.71 | 136 | 80-120 |
| 2,2-Dichloropropane | ug/L | 2.00 | | 2.90 | 145 | 80-120 |
| Chloroform | ug/L | 2.00 | | 3.00 | 150 | 80-120 |
| Bromochloromethane | ug/L | 2.00 | | 3.17 | 159 | 80-120 |
| 1,1,1-Trichloroethane | ug/L | 2.00 | | 2.95 | 148 | 80-120 |
| 1,2-Dichloroethane | ug/L | 2.00 | | 3.20 | 160 | 80-120 |
| 1,1-Dichloropropene | ug/L | 2.00 | | 3.00 | 150 | 80-120 |
| Carbon Tetrachloride | ug/L | 2.00 | | 3.06 | 153 | 80-120 |
| Benzene | ug/L | 2.00 | | 2.75 | 138 | 80-120 |
| 1,2-Dichloropropane | ug/L | 2.00 | | 2.93 | 147 | 80-120 |
| Trichloroethene | ug/L | 2.00 | | 2.92 | 146 | 80-120 |
| Dibromomethane | ug/L | 2.00 | | 3.16 | 158 | 80-120 |
| Bromodichloromethane | ug/L | 2.00 | | 3.21 | 161 | 80-120 |
| cis-1,3-Dichloropropene | ug/L | 3.20 | | 4.59 | 143 | 80-120 |
| Toluene | ug/L | 2.00 | | 2.86 | 143 | 80-120 |
| trans-1,3-Dichloropropene | ug/L | 0.80 | | 1.24 | 155 | 80-120 |
| 1,1,2-Trichloroethane | ug/L | 2.00 | | 3.04 | 152 | 80-120 |
| 1,3-Dichloropropane | ug/L | 2.00 | | 3.03 | 152 | 80-120 |
| Dibromochloromethane | ug/L | 2.00 | | 3.39 | 170 | 80-120 |
| Tetrachloroethene | ug/L | 2.00 | | 2.69 | 135 | 80-120 |
| 1,2-Dibromoethane | ug/L | 2.00 | | 2.84 | 142 | 80-120 |
| Chlorobenzene | ug/L | 2.00 | | 2.78 | 139 | 80-120 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

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## Laboratory Fortified Sample Matrix (LFM) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91
ABB Sample Number Spiked: 91259-014

| Compound | Units | Spike Conc. | Sample Measured Conc. | LFM Measured Conc. | LFM % Recovery | Recovery Acceptance Range (%)~ |
|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ug/L | 2.00 | | 3.13 | 157 | 80-120 |
| Ethylbenzene | ug/L | 2.00 | | 2.50 | 125 | 80-120 |
| m+p-Xylene | ug/L | 4.00 | | 5.95 | 149 | 80-120 |
| Bromoform | ug/L | 2.00 | | 3.39 | 170 | 80-120 |
| o-Xylene | ug/L | 2.00 | | 2.88 | 144 | 80-120 |
| Styrene | ug/L | 2.00 | | 2.32 | 116 | 80-120 |
| 1,1,2,2-Tetrachloroethane | ug/L | 2.00 | | 3.24 | 162 | 80-120 |
| 1,2,3-Trichloropropane | ug/L | 2.00 | | 2.68 | 134 | 80-120 |
| Isopropylbenzene | ug/L | 2.00 | | 2.84 | 142 | 80-120 |
| Bromobenzene | ug/L | 2.00 | | 2.63 | 132 | 80-120 |
| 2-Chlorotoluene | ug/L | 2.00 | | 3.16 | 158 | 80-120 |
| n-Propylbenzene | ug/L | 2.00 | | 2.46 | 123 | 80-120 |
| 4-Chlorotoluene | ug/L | 2.00 | | 1.88 | 94 | 80-120 |
| 1,3,5-Trimethylbenzene | ug/L | 2.00 | | 3.06 | 153 | 80-120 |
| tert-Butylbenzene | ug/L | 2.00 | | 2.85 | 143 | 80-120 |
| 1,2,4-Trimethylbenzene | ug/L | 2.00 | | 2.78 | 139 | 80-120 |
| sec-Butylbenzene | ug/L | 2.00 | | 2.74 | 137 | 80-120 |
| 1,3-Dichlorobenzene | ug/L | 2.00 | | 2.36 | 118 | 80-120 |
| p-Isopropyltoluene | ug/L | 2.00 | | 2.55 | 128 | 80-120 |
| 1,4-Dichlorobenzene | ug/L | 2.00 | 0.19 | 2.13 | 97 | 80-120 |
| 1,2-Dichlorobenzene | ug/L | 2.00 | | 3.33 | 167 | 80-120 |
| n-Butylbenzene | ug/L | 2.00 | | 1.97 | 98.5 | 80-120 |
| 1,2-Dibromo-3-chloropropane | ug/L | 2.00 | | 2.20 | 110 | 80-120 |
| 1,2,4-Trichlorobenzene | ug/L | 2.00 | | 2.21 | 111 | 80-120 |
| Naphthalene | ug/L | 2.00 | | 1.51 | 75.5 | 80-120 |
| Hexachlorobutadiene | ug/L | 2.00 | | 2.81 | 141 | 80-120 |
| 1,2,3-Trichlorobenzene | ug/L | 2.00 | | 2.83 | 142 | 80-120 |
| 2,4,4-Trimethyl-1-pentene | ug/L | 2.00 | | 2.59 | 130 | 80-120 |
| 2,4,4-Trimethyl-2-pentene | ug/L | 2.00 | | 2.53 | 127 | 80-120 |

~ These acceptance criteria are for advisory purposes only, and are not to be utilized as sample validation criteria.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Sample Duplicate Results

Volatile Organics by GC

Water Matrix

ABB Sample No. Duplicated: 91245014

| Compound* | Units | Sample Conc. | Sample Duplicate Conc. | Average Conc. | RPD (%) | RPD Acceptance Range (%) |
|---|---|---|---|---|---|---|
| Methylene chloride | ug/L | 0.54B | 0.45B | 0.49 | 18.0 | |
| 1,4-Dichlorobenzene | ug/L | 0.19 | 0.14 | 0.16 | 30.0 | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Methods, Chronology of Analysis and Method Blank Results

Semivolatile Organics by GC/MS Method 625

Water Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor ~ | ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor ~ |
|---|---|---|---|---|---|---|---|---|---|
| 91259009 | 16-Sep-91 | 17-Sep-91 | 17-Sep-91 | 1.0 | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011DUP | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011MS | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259014 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |

METHOD BLANK RESULTS*

| Compound | Conc. (ug/L) |
|---|---|
| | |
| | |
| | |
| | |

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Laboratory Control Sample Results

Semivolatile Organics by GC/MS

Water Matrix

Date of Extraction: 13-Sep-91
Date of Analysis: 18-Sep-91

| Compound | Units | Spike Conc. | LCS Measured Conc. | LCS Dup. Measured Conc. | LCS % Recovery | LCS Dup. % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|
| Phenol | ug/l | 200 | 86.8 | 73.6 | 43.4 | 36.8 | 5-112 | 16 | 0-23 |
| 2-Chlorophenol | ug/l | 200 | 156 | 149 | 78.0 | 74.5 | 23-134 | 4.6 | 0-29 |
| 1,4-Dichlorobenzene | ug/l | 100 | 52.1 | 49.7 | 52.1 | 49.7 | 20-124 | 4.7 | 0-32 |
| N-Nitroso-di-n-propylamine | ug/l | 100 | 67.8 | 67.9 | 67.8 | 67.9 | 3-125 | 0.1 | 0-34 |
| 1,2,4-Trichlorobenzene | ug/l | 100 | 48.9 | 50.5 | 48.9 | 50.5 | 44-142 | 3.2 | 0-28 |
| 4-Chloro-3-methylphenol | ug/l | 200 | 150 | 149 | 75.0 | 74.5 | 22-136 | 0.7 | 0-37 |
| Acenaphthene | ug/l | 100 | 66.1 | 64.8 | 66.1 | 64.8 | 47-127 | 2.0 | 0-28 |
| 4-Nitrophenol | ug/l | 200 | 53.4 | 44.0 | 26.7 | 22.0 | D-132 | 19 | 0-47 |
| 2,4-Dinitrotoluene | ug/l | 100 | 54.2 | 58.0 | 54.2 | 58.0 | 39-139 | 6.8 | 0-22 |
| Pentachlorophenol | ug/l | 200 | 184 | 156 | 92.0 | 78.0 | 14-150 | 16 | 0-42 |
| Pyrene | ug/l | 100 | 76.5 | 63.3 | 76.5 | 63.3 | 52-115 | *19 | 0-18 |

* These limits are for advisory purposes only, and are not to be used as sample validation criteria.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Sample Duplicate Results

Semivolatile Organics by GC/MS

Water Matrix

ABB Sample No. Duplicated: 91259011

| Compound* | Units | Sample Conc. | Sample Duplicate Conc. | Average Conc. | RPD (%) | RPD Acceptance Range (%) |
|---|---|---|---|---|---|---|
| No compounds detected. | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |

* Only positive results have been included. The remaining compounds were not detected.

ND = Not detected.

NC = Not calculated; relative percent difference is not calculated for sample results less than the PQL

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Matrix Spike/Matrix Spike Duplicate Results

Semivolatile Organics by GC/MS

Water Matrix

ABB Sample No. Spiked: 91259011

| Compound | Units | Spike Conc. | Sample Conc. | MS Measured Conc. | MSD Measured Conc. | Theoretical Sample Spike Conc. | MS % Recovery | MSD % Recovery | Recovery Acceptance Range (%) | RPD (%) | Acceptance Range (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Phenol | ug/l | 192 | ND | 69.3 | NA | 192 | 36.1 | NA | 12-89 | NA | 0-42 |
| 2-Chlorophenol | ug/l | 192 | ND | 137 | NA | 192 | 71.4 | NA | 27-123 | NA | 0-40 |
| 1,4-Dichlorobenzene | ug/l | 96.0 | ND | 67.8 | NA | 96 | 70.6 | NA | 36-97 | NA | 0-28 |
| N-Nitroso-di-n-propylamine | ug/l | 96.0 | ND | 80.3 | NA | 96 | 83.6 | NA | 41-116 | NA | 0-38 |
| 1,2,4-Trichlorobenzene | ug/l | 96.0 | ND | 68.1 | NA | 96 | 70.9 | NA | 39-98 | NA | 0-28 |
| 4-Chloro-3-methylphenol | ug/l | 192 | ND | 128 | NA | 192 | 66.7 | NA | 23-97 | NA | 0-42 |
| Acenaphthene | ug/l | 96.0 | ND | 80.0 | NA | 96 | 83.3 | NA | 46-118 | NA | 0-31 |
| 4-Nitrophenol | ug/l | 192 | ND | 61.4 | NA | 192 | 32.0 | NA | 10-80 | NA | 0-50 |
| 2,4-Dinitrotoluene | ug/l | 96.0 | ND | 72.3 | NA | 96 | 75.3 | NA | 24-96 | NA | 0-38 |
| Pentachlorophenol | ug/l | 192 | ND | 103 | NA | 192 | 53.6 | NA | 9-103 | NA | 0-50 |
| Pyrene | ug/l | 96.0 | ND | 69.2 | NA | 96 | 72.1 | NA | 26-127 | NA | 0-31 |

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Methods, Chronology of Analysis and Method Blank Results

Pesticides/PCBs by GC Method 509A

Soil/Solid Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor~ | ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor~ |
|---|---|---|---|---|---|---|---|---|---|
| 91259009 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | 91259015 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 |
| 91259010 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011DUP | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259011MS | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259012 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259013 | 16-Sep-91 | 17-Sep-91 | 18-Sep-91 | 1.0 | | | | | |
| 91259014 | 16-Sep-91 | 17-Sep-91 | 19-Sep-91 | 1.0 | | | | | |

METHOD BLANK RESULTS*

| Compound | Conc. (ug/kg) |
|---|---|
| None | |
| | |
| | |
| | |

* Only positive hits have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Laboratory Control Sample Results

Pesticides/PCBs by GC

Water Matrix

Date of Extraction: 09-17-91
Date of Analysis: 09-18-91

| Compound | Units | Spike Conc. | LCS Measured Conc. | LCS Dup. Measured Conc. | LCS % Recovery | LCS Dup. % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | ug/l | 0.2 | 0.149 | 0.168 | 74 | 84 | 32-127 | 13.0 | 0-23 |
| Heptachlor | ug/l | 0.2 | 0.156 | 0.178 | 78 | 89 | 34-111 | 13.0 | 0-20 |
| Aldrin | ug/l | 0.2 | 0.122 | 0.140 | 61 | 70 | 42-122 | 14.0 | 0-21 |
| Dieldrin | ug/l | 0.5 | 0.458 | 0.501 | 92 | 100 | 36-146 | 8.0 | 0-38 |
| Endrin | ug/l | 0.5 | 0.488 | 0.538 | 98 | 110 | 30-147 | 12.0 | 0-37 |
| 4,4'-DDT | ug/l | 0.5 | 0.501 | 0.546 | 100 | 109 | 25-160 | 9.0 | 0-36 |

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Sample Duplicate Results

Pesticides/PCBs by GC

Water Matrix

ABB Sample No. Duplicated: 91259011

| Compound* | Units | Sample Conc. | Sample Duplicate Conc. | Average Conc. | RPD (%) | RPD Acceptance Range (%) |
|---|---|---|---|---|---|---|
| | ug/L | < | < | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |
| | ug/L | | | | | |

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Matrix Spike/Matrix Spike Duplicate Results

Pesticide/PCBs by GC Method 608

Water Matrix

ABB Sample No. Spiked: _____

| Compound | Units | Spike Conc. | Sample Conc. | MS Measured Conc. | MSD Measured Conc. | Theoretical Spiked Sample Conc. | MS % Recovery | MSD % Recovery | Recovery Acceptance Range (%) | RPD (%) | Acceptance Range (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | ug/L | 0.2 | < | 0.135 | NA | 0.2 | 68.0 | NA | 32-127 | NA | 0-30 |
| Heptachlor | ug/L | 0.2 | < | 0.143 | NA | 0.2 | 72.0 | NA | 34-111 | NA | 0-30 |
| Aldrin | ug/L | 0.2 | < | 0.114 | NA | 0.2 | 57.0 | NA | 42-122 | NA | 0-30 |
| Dieldrin | ug/L | 0.5 | < | 0.403 | NA | 0.5 | 81.0 | NA | 36-146 | NA | 0-30 |
| Endrin | ug/L | 0.5 | < | 0.433 | NA | 0.5 | 87.0 | NA | 30-147 | NA | 0-30 |
| 4,4'-DDT | ug/L | 0.5 | < | 0.42 | NA | 0.5 | 84.0 | NA | 25-160 | NA | 0-30 |

NA = Not applicable.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Methods, Chronology of Analysis and Method Blank Results

Herbicides by GC Method 509B

Water Matrix

CHRONOLOGY

| ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor~ | ABB Sample Nos. | Date Received | Date Extracted | Date Analyzed | Dilution Factor~ |
|---|---|---|---|---|---|---|---|---|---|
| 91259009 | 16-Sep-91 | 17-Sep-91 | 23-Sep-91 | 1.0 | 91259015 | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 |
| 91259010 | 16-Sep-91 | 17-Sep-91 | 23-Sep-91 | 1.0 | | | | | |
| 91259011 | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |
| 91259011DUP | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |
| 91259011MS | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |
| 91259012 | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |
| 91259013 | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |
| 91259014 | 16-Sep-91 | 17-Sep-91 | 24-Sep-91 | 1.0 | | | | | |

METHOD BLANK RESULTS*

| Compound | Conc. (ug/L) |
|---|---|
| | |
| | |
| | |
| | |

* Only positive hits have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Laboratory Control Sample Results

Herbicides by GC Method 509B

Water Matrix

Column: DB-608
Date of Extraction: 09-17-91
Date of Analysis: 09-24-91

| Compound | Units | Spike Conc. | LCS Measured Conc. | LCS Dup. Measured Conc. | LCS % Recovery | LCS Dup. % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|
| 2,4-D Methyl Ester | ug/l | 5.0 | 2.14 | 4.00 | 43 | 36 | 25-125 | | 0-50 |
| Silvex Methyl Ester | ug/l | 5.0 | 1.81 | 2.88 | 80 | 58 | 25-125 | | 0-50 |

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Matrix Spike/Matrix Spike Duplicate Results

Herbicides by GC Method 509B

Column: DB-608

Date of Extraction: 09-17-91

Date of Analysis: 09-24-91

Water Matrix

ABB Sample No. Spiked: 91259011

| Compound | Units | Spike Conc. | Sample Conc. | MS Measured Conc. | MSD Measured Conc. | MS % Recovery | MSD % Recovery | Recovery Acceptance Range (%)* | RPD (%) | RPD Acceptance Range (%)* |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4-D Methyl Ester | ug/L | 5.0 | < | 4.08 | NA | 82.0 | NA | 25-125 | NA | 0-50 |
| Silvex Methyl Ester | ug/L | 5.0 | < | 3.81 | NA | 76.0 | NA | 25-125 | NA | 0-50 |

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

NA = Not applicable.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

## Sample Duplicate Results

Herbicides by GC Method 509B

Water Matrix

ABB Sample No. Duplicated: 91259011

| Compound* | Units | Sample Conc. | Sample Duplicate Conc. | Average Conc. | RPD (%) | RPD Acceptance Range (%) |
|---|---|---|---|---|---|---|
| | ug/L | | | | | 0-20 |
| | ug/L | | | | | 0-20 |

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limit.

ND = Not detected.

NC = Not calculated; relative percent difference and average concentration are not calculated for sample results less than the PQL.

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%

# ANALYSIS REQUEST FORM

Date Received 09-16-91
Lab Location TAN-C / METALS / BLACK (EXTRA SAMP TAN-A/MS BLACK)
Results Due
Client I.D. No. ~~37131~~ 37118

Client Information: Name Mike Bellotti
Company Olin Chemical
Mailing Address

Purchase Order/Job Number 9623

Where to Send Report ☑ Directly to Client
☐ ABB - Name

Analyses Requested By: Technical Project Professional

Approved By: Project Manager

☐ Solid Waste Data File
☐ Data Documentation Req'd
☐ Entered in Computer

Type of Sample Drinking $H_2O$
List Any Hazards none known

☐ SPECIAL PROCEDURE

☐ Filtered in Field ☑ Non-Filtered

Additional Information or Special Procedures
QC Level MADEP
*Indicator parameters - verbals due 091891
S/N 91259011 - extra sple provide for extractables MS & DUP, use this site for all MS/DUPs if possible.
Verbal due dates:
Wet Chemistry: 091991 GC : 09-20-91
Elements : 091991 GC/MS - 09-19-91

| Sample Identification | Lab Numbers | Date Sampled | Sampled By | Analyses Required |
|---|---|---|---|---|
| DW 1 | 91259009 | 091691 | K. Nelson | Drinking Water VOAs (524.2) + TMP + 2-Chloroethyl vinyl ether (MDLs) + Library Search (20 peaks); PP SVOAs (625) + Library Search (20 peaks); Ethylene dibromide (504); 1,2-Dibromo-3-chloropropane; SDWA Pesticides (509A); SDWA Herbicides (509B); $NH_3$*, $Cl^-$*, $SO_4^{=}$*, $Cr^{+6}$*, total $CN^-$, $F^-$, $NO_3$, Total Coliform, Fecal Coliform, pH, TDS; TKN Priority Pollutant Metals + 5 metals GFAA - Sb, As, Cd, Pb, Se, Tl ICP - Be, Cr*, Cu, Ni, Ag, Zn, Fe, Na, Ba, Al, Mn CVAA - Hg |
| | | | | RUSH |
| DW 1A (Field Duplicate) | 91259010 | 091691 | K. Nelson | Same as Above |
| DW 2 | 91259011 | 091691 | K. Nelson | ↓ |
| DW 3 | 91259012 | 091691 | K. Nelson | |
| DW 4 | 91259013 | 091691 | K. Nelson | |
| DW 5 | 91259014 | 091691 | K. Nelson | |
| DW 6 | 91259015 | 091691 | K. Nelson | |
| Trip Blank | 91259016 | 091691 | K. Nelson | DW VOAs (524.2-MDLs) + TMPs 2-Chloroethylvinyl ether + Library Search 20 peaks |

All sites were collected in duplicate, so additional sample is available.

OH-62

ABB Environmental Services, Inc.

# CHAIN OF CUSTODY RECORD



PROJECT NO.:

PROJECT NAME: OLIN CHEMICAL DOMESTIC WELL

SAMPLERS (SIGNATURE): Kim A. Nelson

| STA. NO. | DATE | TIME | COMP. | GRAB | STATION LOCATION | NO. OF CONTAINERS | 40 ml VOA | 1 l plastic | 500 ml plastic | 1 l Amber | 250 ml plastic | 1 l glass | 250 ml plastic | 100 ml glass | 40 ml VOA | 250 ml plastic | 1 l amber glass | REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9/16/91 | 11:55 | | | DW-1 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 11:55 | | | DW-1A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 14:35 | | | DW-2 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | 2 | 1 | 4 | |
| | | 14:35 | | | DW-2A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:00 | | | DW-3 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:00 | | | DW-3A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:25 | | | DW-4 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:25 | | | DW-4A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:50 | | | DW-5 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 15:50 | | | DW-5A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 16:15 | | | DW-6 | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | 16:15 | | | DW-6A | | 2 | 1 | 1 | 1 | 1 | 4 | | 2 | | 1 | | |
| | | | | | ~~DW-7~~ | | ~~2~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~4~~ | | ~~2~~ | | ~~1~~ | | NOT NEEDED |
| | | | | | ~~DW-7A~~ | | ~~2~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~1~~ | ~~4~~ | ~~1~~ | | | ~~1~~ | | |

| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) | RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|---|---|
| Kim A. Nelson | 9/16/91 16:30 | John L. Shields | | | |
| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) | RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED BY: (SIGNATURE) |
| | | | | | |
| RELINQUISHED BY: (SIGNATURE) | DATE/TIME | RECEIVED FOR DISPOSAL BY: (SIGNATURE) | DATE/TIME | REMARKS | |
| | | | | | |

000049

ABB Environmental Services, Inc.

OH-62

Client: OLIN CORP.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

*Sample Receiving Documentation*

| ABB Environmental Sample Numbers | Date Sample Received | Sample Matrix Description | Condition Upon Receipt | Chain of Custody Present | Requested Analyses | pH Checked |
|---|---|---|---|---|---|---|
| 91259009 | 09-16-91 | WATER | COOL + INTACT | YES | $Cr^{+6}$ | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, PEST, PCB, HERB | NA |
| 91259010 | | | | | $Cr^{+6}$ | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |

Client: OLIN CORP.

# ABB Environmental
# Analytical Laboratory Services Division
# Quality Control Report

*Sample Receiving Documentation*

| ABB Environmental Sample Numbers | Date Sample Received | Sample Matrix Description | Condition Upon Receipt | Chain of Custody Present | Requested Analyses | pH Checked |
|---|---|---|---|---|---|---|
| 91259010 | 09·16·91 | WATER | COOL + INTACT | YES | SVOA, PEST, PCB, HERB | NA |
| 91259011 | | | | | Cr+6 | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |
| | | | | | CYANIDE | >12 |
| | | | | | TOTAL COLIFORM | NA |
| | | | | | FECAL COLIFORM | NA |
| | | | | | METALS | <2 |
| | | | | | VOA | |
| | | | | | VOA | |
| | | | | | SVOA, PEST, PCB, HERB | NA |
| 91259012 | | | | | Cr+6 | NA |
| | | | | | $NH_3$ | <2 |
| | | | | | Cl, $SO_4$, $NO_3$, F, pH, TDS | NA |

# APPENDIX K

# APPENDIX K

# CONTAMINANT FATE AND TRANSPORT SUMMARY

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## K.1.0 CONTAMINANT FATE AND TRANSPORT

Facility-related chemicals have been detected in groundwater, surface water, sediment, surface soil and subsurface soil samples.

The potential chemical migration pathways which exist at the Facility include:

- groundwater flow;
- surface water runoff;
- atmospheric dispersion from surface soils; and
- tracking of surface soils/sediments.

Section K.1.1 presents a general description of the physical and chemical properties of the Facility-related chemicals and the influence of these properties on their fate and transport. The chemical migration potential for each of the identified pathways are evaluated in Sections K.1.2 through K.1.5. Section K.1.6 presents a discussion of the probable behavior and environmental fate of the primary chemical constituents at the Site.

### K.1.1 PHYSICAL AND CHEMICAL PROPERTIES OF FACILITY-RELATED COMPOUNDS

Contaminant mobility, a factor in contaminant migration, depends upon the physical and chemical properties of both the contaminants

and the media in which they are identified. Properties which affect contaminant mobility include, but are not limited to, solubility, liquid density, vapor pressure and chemical affinity. The partitioning of chemicals between media is controlled by a variety of factors such as absorption, volatilization, solubility and chemical affinity.

Chemicals released to a soil medium may be adsorbed by the soil until the adsorptive capacity of the soil is reached. Under continued release(s) of the chemicals, the chemicals may migrate both horizontally and vertically, expanding the area of contaminated soils as the adsorptive capacity of the soil in the vicinity of the release is attained. Similarly, infiltration of precipitation or release(s) of other chemicals may cause the initial chemical to migrate at a rate primarily controlled by the adsorptive capacity of the soil and by the solubility of the initial chemical in the transport media.

Chemicals which have migrated to the groundwater may solubilize in the groundwater to the aqueous solubility limit of the chemical. The solubilized chemical may migrate with the groundwater and sorb onto adjacent soils. Under continued migration to the groundwater from the soils above the water table, the extent of groundwater contamination may expand as the adsorptive capacity of the soils beneath the water table in the vicinity of the release is attained.

When chemicals migrate from soils above the water table to the groundwater at a rate greater than the solubility capacity of the groundwater, the migration of the excess chemicals will result in a separate non-aqueous phase liquid (NAPL). The migration of NAPL is governed

primarily by its density. If the chemical's density is less than one, it will tend to float on the surface of the groundwater and may migrate horizontally in the direction of groundwater flow. If the chemical's density is greater than one, it may tend to migrate vertically downward until a low-permeability geologic unit is encountered, at which point the chemical may tend to migrate horizontally in the direction of the surficial slope of the geologic unit. The extent of chemical migration, above or below the water table, may expand as the sorption capacity of the respective geologic unit is attained.

The physical and chemical properties of the Site-related chemicals detected in the different media at the Site are presented in Table K.1. The chemical properties include molecular weight, aqueous solubility, vapor pressure, Henry's law constant, sorption coefficient and specific density. Table K.2 presents descriptive ranges of values for chemical and physical properties and their relation to chemical transport. Table K.2 also lists examples of Site-related chemicals which exhibit these characteristics.

The molecular weight of a compound is useful for many calculations including weight/volume unit conversions; molar volume determinations and estimating Henry's law constants.

Aqueous solubility is an important factor in estimating a chemical's fate and transport in groundwater and surface water. Compounds with high aqueous solubilities have a tendency to desorb from soils and sediment; are less likely to volatilize from water; and, are susceptible to biodegradation. Compounds with a high solubility will generally enter the

TABLE K.1

CHEMICAL PROPERTIES OF SITE-RELATED PARAMETERS
WILMINGTON FACILITY

| | *Formula Weight (g/mole)* | *Aqueous Solubility at 25°C (mg/L)* | *Vapor Pressure at 25°C (mm Hg)* | *Henry's Law Constant at 25°C (atm-m$^3$/mol)* | $K_{oc}$ | *Specific Density* |
|---|---|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | | | |
| Acetone | 58 | 1.00E+06 | 2.70E+02 | 2.06E-05 | 2.2 | 0.7899 |
| 2-Butanone | 72.11 | 2.06E+05 | 1.00E+02 | 4.66E-05 | 1.23 | 0.805 |
| 2-Hexanone | 100.2 | 3.50E+04 | 3.80E+00 | 1.75E-03 | 134.9 | 0.8113 |
| Toluene | 92 | 5.15E+02 | 2.81E+01 | 6.66E-03 | 300 | 0.8669 |
| 2,4,4-Trimethyl-1-pentene | 112.2 | NA | 7.75E+01 | NA | NA | 0.7150 |
| 2,4,4-Trimethyl-2-pentene | 112.2 | NA | 7.75E+01 | NA | NA | 0.724 |
| ***Semi-Volatile Organic Compounds*** | | | | | | |
| N-Nitrosodiphenylamine | 198 | 4.00E+01 | 1.00E-01 | 6.60E-04 | 830-1830 | 1.23 |
| N-Nitrosodipropylamine | 130.2 | 9.90E+03 | 8.60E-02 | 1.47E-06 | 129 | 0.916 |
| Phenol | 94.1 | 9.30E+04 | 3.50E-01 | 2.70E-07 | 26.9 | 1.06 |
| *Phthalate Esters* | | | | | | |
| Bis(2-ethylhexyl)Phthalate | 391 | 2.85E-01 | 6.20E-08 | 1.10E-05 | 100000 | 0.9861 |
| Butyl Benzylphthalate | 312 | 2.69E+00 | 8.60E-06 | 1.30E-06 | 68-347 | 1.12 |
| Di-n-Butylphthalate | 278 | 1.30E+01 | 1.00E-05 | 2.82E-07 | 170000 | 1.047 |
| Di-n-Octylphthalate | 391 | 3.00E-01 | 1.40E-04 | 1.41E-12 | 980000000 | 0.99 |
| *PAHs* | | | | | | |
| Indeno (1,2,3-cd)Pyrene | 276 | 5.30E-04 | 1.00E-10 | 6.86E-08 | 1600000 | NA |
| Benzo(b) Fluoranthene | 252 | 1.40E-02 | 5.00E-07 | 1.19E-05 | 550000 | NA |
| Benzo(a) Anthracene | 228 | 9.00E-03 | 2.20E-08 | 1.10E-06 | 200000 | 1.274 |
| Benzo(a) Pyrene | 252 | 1.20E-03 | 5.60E-09 | 4.90E-07 | 5500000 | 1.351 |
| Chrysene | 228 | 1.80E-03 | 6.30E-09 | 1.05E-06 | 200000 | 1.274 |
| ***Inorganics*** | | | | | | |
| Aluminum | 27 | NA | NA | NA | NA | 2.702 |
| Ammonia | 17 | 5.30E+05 | 7.60E+03 | 1.60E-05 | 3.1 | NA |
| Calcium | 40 | NA | NA | NA | NA | NA |
| Chloride | 53.5 | NA | NA | NA | NA | 1.0 |
| Chromium III | 52 | NA | NA | NA | NA | 1.01 |
| Chromium VI | 52 | NA | NA | NA | NA | 1.01 |
| Copper | 63.5 | NA | NA | NA | NA | NA |
| Iron | 55.8 | NA | NA | NA | NA | NA |
| Manganese | 55 | NA | NA | NA | NA | 1.01 |
| Potassium | 39.1 | NA | NA | NA | NA | NA |
| Sodium | 23.0 | NA | NA | NA | NA | NA |
| Sulphate | 132 | NA | NA | NA | NA | 1.0 |
| Zinc | 65.4 | NA | NA | NA | NA | NA |

References:

Montgomery, John H. and Linda M. Welkom "Groundwater Chemicals Desk Reference", Michigan, 1990.
"USEPA Superfund Public Health Evaluation Manual", October 1986, EPA/540/1-86/060.
Howard H. Philip, "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume II, Solvents", Michigan.

TABLE K.2

DESCRIPTIVE RANGES FOR PHYSICAL AND CHEMICAL PROPERTIES
OF SITE-RELATED CHEMICALS
WILMINGTON FACILIITY

| *Property* | *Description* | *Units* | *Descriptive Ranges* | *Examples of Site Contaminants* |
|---|---|---|---|---|
| Liquid density | The density of a chemical in its pure liquid form, relative to water. | D ($g/cm^3$) | <1 -- less dense than water | acetone, 2-hexanone, 2-butanone<br>N-Nitrosodipropylamine<br>2,4,4-Trimethylpentene |
| | | | > 1 -- more dense than water | BBP, chrysene, phenol, PAHs |
| Aqueous solubility | The amount of a chemical at equilibrium that will be dissolved in pure water. | mg/L | high -- soluble in water (>100) | acetone, ammonia, toluene<br>N-Nitrosodipropylamine<br>2-butanone, 2-hexanone, phenol |
| | | | low -- insoluble in water (<1) | BEHP, PAHs |
| Vapor Pressure | The partial pressure of a vapor at equilibrium with the chemical in its pure state; describes the tendency of a chemical to evaporate. | Vp (mm Hg) | high -- volatile (>16) | VOCs |
| | | | low -- nonvolatile ($<10^{-4}$) | SVOCs |
| Partitioning between air and water | The proportion of a chemical at equilibrium in the vapor phase in the space above an aqueous solution of the chemical; describes the tendency of a chemical to transfer between air and water. | Henry's law constant, H (atm $m^3$/mol) | $<10^{-7}$ -- nonvolatile | indeno(1,2,3-cd) pyrene |
| | | | $10^{-7}$ to $10^{-5}$ -- low volatility | phthalates<br>benzo (b) fluoranthene<br>benzo (a) anthracene<br>benzo (a) pyrene, chrysene<br>phenol |

TABLE K.2

DESCRIPTIVE RANGES FOR PHYSICAL AND CHEMICAL PROPERTIES
OF SITE-RELATED CHEMICALS
WILMINGTON FACILIITY

| *Property* | *Description* | *Units* | *Descriptive Ranges* | *Examples of Site Contaminants* |
|---|---|---|---|---|
| | | | $10^{-5}$ to $10^{-3}$ -- moderate volatility | acetone<br>N-Nitrosodiphenylamine<br>2-butanone, 2-hexanone |
| | | | $>10^{-3}$ -- high volatility | toluene |
| Partitioning between organic matter and water | The proportion of a chemical at equilibrium sorbed to organic material in a water-soil or water-sediment system; more strongly sorbed chemicals tend to be less mobile | $K_{oc}$ (ml/g) | 0 to 50 -- very high mobility | acetone, ammonia<br>2-Butanone, Phenol |
| | | | 50 to 100 -- high mobility | |
| | | | 100 to 500 -- moderate mobility | toluene, 2-hexanone<br>N-Nitrosodipropylamine |
| | | | 500 to 2,000 -- low mobility | N-Nitrosodiphenylamine |
| | | | 2,000 to 20,000 -- slight mobility | BBP |
| | | | >20,000 -- immobile | Di-n-octyl phthalate,<br>benzo(a) pyrene<br>benzo (b) fluoranthene<br>benzo (a) anthracene<br>chrysene<br>indeno (1,2,3-cd) pyrene<br>BEHP<br>DBP<br>DOP |

groundwater more readily than relatively less soluble compounds. Aqueous solubility is affected by temperature, pH and other dissolved constituents. Site-related volatile organic compounds have aqueous solubilities ranging from 515 mg/L Toluene to $1.00 \times 10^6$ mg/L for Acetone. Semi-volatile organic compounds detected at the Site have relatively low solubilities ranging from 0.00053 mg/L to 40.0 mg/L.

The sorption coefficient ($K_{OC}$) indicates the tendency of a compound to partition between particles containing organic carbon and water. The sorption coefficient is inversely related to aqueous solubility such that a compound that binds strongly to organic carbon will have a low solubility. Compounds that adsorb onto organic materials in an aquifer are retarded in their movement in groundwater such that the compound migrates at a linear velocity less than the groundwater flow velocity.

Generally, volatile organic compounds have relatively low $K_{OC}$ values ranging from 2.2 (Acetone) to 300 (Toluene). Semi-volatile compounds generally have a much higher adsorption capacity with $K_{OC}$ values ranging from 68 (butyl benzylphthalate) to $9.8 \times 10^8$ (di-n-octylphthalate).

The specific density of a compound is equivalent to the density of the substance relative to the density of water. Hydrophobic (low aqueous solubility) compounds with a specific density greater than one will generally tend to sink through the water table as dense non-aqueous phase liquids. Hydrophobic compounds with a specific density less than one will generally tend to float on the water table. Hydrophilic compounds (high

aqueous solubility) behave differently. Acetone, for example, with a specific density of 0.790 does not float on water because it is highly soluble in water. Therefore, the solubility of a substance must be considered in conjunction with the specific density of a compound.

The vapor pressure of a compound provides a semi-quantitative rate at which volatilization will occur from soil and/or water to the atmosphere and/or soil gas. Generally, the Site-related volatile organic compounds have relatively high vapor pressures ranging from 28.1 mm Hg (Toluene) to 270 mm Hg (Acetone). The Site-related semi-volatile organic compounds generally have low vapor pressures and a low potential for volatilization with values ranging from $1.00 \times 10^{-10}$ mm Hg (indeno(1,2,3-cd)pyrene) to 0.1 mm Hg (N-Nitrosodiphenylamine).

Henry's law constants provide an indication of the relative volatility of a compound (see Table K.2) and its tendency to evaporate from water. Henry's law constants are greatest for volatile organic compounds detected at the Site, all of which are greater than $10^{-5}$ atm $m^3$/mol. Site-related semi-volatile organic compounds generally have lower Henry's law constant values.

### K.1.2 CHEMICAL MIGRATION VIA GROUNDWATER FLOW

The analytical results for groundwater samples collected from the Site monitoring wells indicate that chemical migration is occurring via the overburden groundwater flow system. Site-related chemicals have

been detected in the overburden groundwater at locations downgradient of the former acid pits/lagoons/Lake Poly area.

### K.1.3 CHEMICAL MIGRATION VIA SURFACE WATER RUNOFF

Chemical migration by surface water runoff is primarily restricted to chemicals present in surficial soils and sediments in drainage ditches. Seepage of groundwater to the ground surface, as identified immediately west of the Facility, can also contribute chemicals for potential transport via surface water runoff. Migration may occur by physical transport of the soils or by dissolution.

### K.1.4 CHEMICAL MIGRATION VIA ATMOSPHERIC DISPERSION

Atmospheric dispersion of chemicals at the Site is primarily restricted to chemicals present in surficial soils. The chemicals may be released to the atmosphere by volatilization and/or by atmospheric entrainment of chemicals adsorbed onto particulate matter. Once released, the chemicals may be transported by the wind. Chemicals in the atmosphere may be broken down by photochemical reaction with hydroxyl radicals, direct photolysis or may be returned to the surface by gravitational settling or scavenging by rainfall.

## K.1.5 CHEMICAL MIGRATION VIA INADVERTENT TRACKING

Tracking of chemicals at the Site could potentially be caused by workers or wildlife walking across surface soils containing Site-related chemicals or by vehicular traffic through the Site. As the areas with elevated chemical concentrations in the surface soils are relatively limited, this potential migration route is considered to be insignificant.

## K.1.6 ENVIRONMENTAL FATE

The basic physical and chemical properties of all detected Site-related organic constituents are presented in Table K.1.

The probable behavior and environmental fate of all constituents can be assessed to some extent by evaluating the physical and chemical properties of the constituent. The mobility and persistence of these constituents are of primary importance in this evaluation. Mobility is the potential for a chemical to migrate away from the Site. Persistence is a measure of how long a chemical will remain in the environment. Factors that affect the mobility and persistence of Site-related constituents include, but are not limited to:

1) physical properties,
2) chemical properties,
3) moisture levels,
4) microbial environment,

5) water chemistry, and

6) pH.

The water solubility is the maximum concentration of a compound that can dissolve in water at a specific temperature and pH. Compounds with high solubilities generally exhibit increased mobility.

Vapor pressure and Henry's Law Constants provide an indication of the volatility of a compound. High vapor pressures and Henry's constants indicate a greater tendency for a compound to volatilize. Compounds with high Henry's constants and high vapor pressures generally do not persist in surface water or surface soil environments.

The organic carbon partitioning coefficient ($K_{OC}$) indicates the tendency of a compound to be adsorbed to organic matter in soils or sediments. High $K_{OC}$ values generally indicate lower mobility.

The general degree to which these chemical properties affect the environmental fate of Site-related constituents is summarized in Table K.2.

The chemical fate and transport of the significant Site-related parameters are discussed in the following subsections. The Site-related parameters have been grouped into the following categories to facilitate the discussion:

1. Volatile Organic Compounds

Acetone
2-Butanone
2-Hexanone
Toluene
2,4,4-Trimethyl-1-Pentene
2,4,4-Trimethyl-2-Pentene

2. Semi-Volatile Organic Compounds

N-Nitrosodiphenylamine
N-Nitrosodipropylamine
Phenol

*Phthalate Esters*
Bis(2-ethylhexyl) phthalate
Butyl Benzylphthalate
Di-n-Butylphthalate
Di-n-Octylphthalate

*Polycyclic Aromatic Hydrocarbons (PAHs)*
Benzo(b) Fluoranthene
Benzo(a) Anthracene
Benzo(a) Pyrene
Chrysene
Indeno (1,2,3-cd) Pyrene

3. Inorganics

Aluminum
Ammonia
Calcium
Chloride
Chromium III
Chromium VI
Iron
Copper
Manganese
Potassium
Sodium
Sulphate
Zinc

The physical description and primary uses of the primary Site-related compounds are presented in Table K.3.

The chemical fate and transport of the primary Site-related compounds are summarized in Table K.4.

K.1.6.1 Volatile Organic Compounds

K.1.6.1.1 Acetone

The chemical fate and transport mechanisms for Acetone is characterized by a high vapor pressure of 270 mm Hg and a high Henry's

TABLE K.3

CHEMICAL IDENTITY OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *CAS Registry Number* | *Formula* | *Physical Description* | *Primary Uses* |
|---|---|---|---|---|
| ***Volatile Organic Compounds*** | | | | |
| Acetone | 67-64-1 | $C_3H_6O$ | Colorless, volatile liquid with a sweet fragrant odor. | Paint, varnish and lacquer solvent. |
| 2-Butanone | 78-93-3 | $C_4H_8O$ | Colorless liquid with a sweet mint-like odour | Solvent for coatings Industry |
| 2-Hexanone | 591-78-6 | $C_6H_{12}O$ | Colorless liquid | Solvent and denaturant |
| Toluene | 108-88-3 | $C_6H_6$-$CH_3$ | Colorless, water-white liquid with odor. | Solvent for paints and coatings, aviation fuel, gas exhaust. |
| 2,4,4-Trimethyl-1-pentene | 107-39-1 | $C_8H_{16}$ | Colorless liquid | Organic synthesis, motor fuel synthesis, particularly isooctane, peroxide reactions |
| 2,4,4-Trimethyl-2-pentene | 107-40-4 | $C_8H_{16}$ | Colorless liquid | Organic Synthesis |
| ***Semi-Volatile Organic Compounds*** | | | | |
| N-Nitrosodiphenylamine | 86-30-6 | $C_{12}H_{10}N_2O$ | Green platy or dark blue crystals. | Rubber processing. |
| N-Nitrosodipropylamine | 621-64-7 | $C_6H_{14}N_2O$ | yellow to gold colored liquid | Research Chemical |
| Phenol | 108-95-2 | $C_6H_6O$ | White crystals or light pink liquid which slowly turns brown on exposure to air. Sweet tarry odor. | Used in resins, adhesives, iron and steel, aluminum, leather and rubber industries. |
| *Phthalate Esters* | | | | |
| Bis(2-ethylhexyl) Phthalate | 117-81-7 | $C_{24}H_{38}O_4$ | Colorless, oily liquid with a very faint odor. | Plasticizer; in vacuum pumps. |
| Butyl Benzylphthalate | 85-68-7 | $C_{19}H_{20}O_4$ | Clear, oily liquid. | Plasticizer for PVC. |
| Di-n-Butylphthalate | 84-74-2 | $C_{16}H_{22}O_4$ | Colorless, oily liquid with mild aromatic odor. | Plasticizer, insect repellant, organic synthesis. |
| Di-n-Octylphthalate | 117-84-0 | $C_{24}H_{38}O_4$ | Clear, viscous liquid with slight odor. | Plasticizer for PVC. |
| *PAHs* | | | | |
| Indeno(1,2,3-cd)Pyrene | 193-39-5 | $C_{22}H_{12}$ | Solid. | Derived from coal gasification. |
| Benzo(b) Fluoranthene | 205-99-2 | $C_{20}H_{12}$ | Solid. | Research chemical. |
| Benzo(a) Anthracene | 56-55-3 | $C_{18}H_{12}$ | Colorless leaflets or plates with a greenish-yellow fluorescence. | Research chemical. |
| Benzo(a) Pyrene | 50-32-8 | $C_{20}H_{12}$ | Odorless, yellow crystals. | Research chemical. |
| Chrysene | 218-01-9 | $C_{18}H_{12}$ | Orthorhombic plates exhibiting strong fluorescence under ultraviolet light. | Organic Synthesis. |

TABLE K.3

CHEMICAL IDENTITY OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *CAS Registry Number* | *Formula* | *Physical Description* | *Primary Uses* |
|---|---|---|---|---|
| *Inorganics* | | | | |
| Aluminum | 7429-90-5 | Al | Tin white, with bluish tint | |
| Ammonia | 7664-41-7 | $NH_3$ | Colorless, gas at room temperature | |
| Calcium | 7440-70-2 | Ca | moderately soft, silver-white crystalline metal | |
| Chloride | | $Cl^-$ | | |
| Chromium III | | Cr | Steel gray, solid | |
| Chromium VI | | Cr | Steel gray, solid | |
| Copper | 7440-50-8 | Cu | Distinctive reddish color, ductile | |
| Iron | 7439-89-6 | Fe | Silver-white malleable metal | |
| Manganese | 7439-96-5 | Mn | Silver in color, solid | |
| Potassium | 7440-09-7 | K | soft, silvery metal | |
| Sodium | 7440-23-5 | Na | Soft, silvery white solid | |
| Sulphate | | $SO_4^{2-}$ | | |
| Zinc | 7440-66-6 | Zn | Shiny white metal with bluish-gray luster | |

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *Compound* | *Air* | *Soil* | *Surface Water* | *Groundwater* |
|---|---|---|---|---|---|
| Volatile Organic Compounds | Acetone | - acetone will photochemically react with hydroxyl radicals (half-life 22 days)<br>- direct photolysis | - volatilize and leach into the ground and probably biodegrade (VP=270 mm Hg)<br>- evidence suggests biodegradation is fairly rapid<br>- does not adsorb appreciably to soil (Koc=2.2) | - rapid volatilization to atmosphere (HC = $2.06 \times 10^{-5}$ atm•m$^3$/mol) | - moderate to high mobility |
| | 2-Butanone | - volatalize rapidly from soil or water<br>- once in air, will primarily exist in the vapor phase<br>- will undergo photolysis and photochemical reactions with hydroxyl radicals (half-life 2.3 days) | - volatilize rapidly from soil or water<br>- will leach to groundwater due to low adsorption tendencies ($K_{OC}$ = 1.23) | - rapid volatilization to atmosphere (HC = 4.7E - 05 atm•m$^3$/mol) | - moderate to high mobility |
| | 2-Hexanone | - subject to direct photolysis (half-life 15 hours)<br>- reacts with hydroxyl radicals (half life 16 to 17 hours) | removal from soil via direct photolysis, volatilization or aerobic biodegradation<br>- low adsorption tendencies and leaches to groundwater ($K_{OC}$ = 135) | - rapid volatilization to atmosphere (HC = 1.75E-03 atm•m3/mol) (half-life 15 - 33 hours) | - moderate to high mobility |
| | Toluene | - primarily vapor phase<br>- photochemical reaction with hydroxyl radicals (half-life 13 hours)<br>- no direct photolysis<br>- scavenged by rainfall | - rapid volatilization to atmosphere and vadose zone (VP=28.1 mmHg)<br>- moderate adsorption (Koc=300) and leaches to groundwater<br>- rapid biodegradation | - rapid volatilization to atmosphere (HC=$6.66 \times 10^{-3}$atm•m$^3$/mol) (half-life 5 to 6 hours)<br>- rapid biodegradation<br>- sediment adsorption and bioconcentration are insignificant | - moderate to high mobility<br>- rapid biodegradation |
| | 2,4,4-Trimethyl-1-pentene<br>2,4,4-Trimethyl-2-pentene | - primarily vapor phase | - no available data to predict fate and transport in soil | - no available data to predict fate and transport in surface water | |
| Semi-Volatile Organic Compounds | N-Nitrosodiphenylamine | - primarily in vapor phase<br>- adsorbs sunlight, suggesting direct photolysis in a sunlit environment<br>- react with hydroxyl radicals (half-life 7 hours) | - low mobility in soil<br>- leaching to groundwater is not significant (Koc=830 to 1830)<br>- rapid biodegradation | - volatilization will be slow but significant (HC=$6.6 \times 10^{-4}$atm•m$^3$/mol)<br>- rapid biodegradation | - low mobility |

TABLE K.4



CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *Compound* | *Air* | *Soil* | *Surface Water* | *Groundwater* |
|---|---|---|---|---|---|
| Semi-Volatile Organic Compounds Cont'd. | N-Nitrosodipropylamine | - rapidly degraded by photolysis and photochemical reaction with hydroxyl radicals | - high water solubility and low $K_{oc}$ ($K_{oc}$ = 129)<br>- leaching to groundwater can potentially be significant<br>- low adsorption capacity | - rapid photolysis<br>- photolysis half-life is approximately 2.5 hours | - moderate mobility |
| | Phenol | - primarily in vapor phase<br>- slow volatilization from soils and/or water | - rapid biodegradation (half-life 2 - 5 days)<br>- degradation rates will be much slower under anaerobic conditions than aerobic conditions<br>- low adsorption tendencies and leaches to groundwater ($K_{oc}$ = 27) | - rapid biodegradation under aerobic conditions<br>- evaporation, hydrolysis, adsorption to sediment or bioconcentration in aquatic organisms are not significant removal process | - high mobility |
| Phthalate Esters | Bis(2-ethylhexyl) phthalate | - primarily adsorbed to particulate matter<br>- transported long distances by particulate dispersion<br>- scavenged by rainfall | - volatilization to atmosphere and vadose zone is insignificant ($VP=6.2 \times 10^{-8}$mmHG)<br>- very strong tendency for soil adsorption ($Koc=1 \times 10^{5}$)<br>- leaching to groundwater is not significant<br>- some biodegradation in soil may occur | - volatilization to atmosphere is insignificant ($HC=1.1 \times 10^{-5}$stm.$m^3$/mol)<br>- rapid biodegradation in surface waters (half-life 2 to 3 weeks)<br>- significant sediment adsorption<br>- bioconcentration in aquatic organisms is significant | - insignificant mobility in groundwater<br>- biodegradation may occur but is insignificant under anaerobic conditions |
| | Di-n-Butylphthalate | - primarily adsorbed to particulate matter<br>- gravitational settling and scavenged by rainfall<br>- vapor phase di-n-butylphthalate will photochemically react with hydroxyl radicals (half-life 18 hours) | - volatilization to atmosphere and vadose zone is insignificant ($VP=1.0 \times 10^{-5}$mmHg)<br>- very strong tendency of soil adsorption ($Koc=1.7 \times 10^{5}$)<br>- leaching to groundwater is not significant<br>- slow biodegradation | - volatilization to atmosphere is insignificant ($HC=2.82 \times 10^{-7}$atm•$m^3$/mol)<br>- rapid biodegradation (half-life 2 to 17 days)<br>- moderate adsorption to sediment<br>- slight aquatic bioconcentration offset by its rapid metabolism | - low mobility<br>- transport may be due to formation of water soluble complex with fluvial acid<br>- fate in groundwater is unknown although biodegradation may occur anaerobically |

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *Compound* | *Air* | *Soil* | *Surface Water* | *Groundwater* |
|---|---|---|---|---|---|
| Phthalate Esters Cont'd. | Butyl Benzyl Phthalate | - volatilization to atmosphere is not significant (half-life 1 to 5 days) | - volatilization will not be significant ($VP=8.6x10^{-6}$ mm Hg))<br>- biotic degradation will not be significant<br>- biodegradation is significant<br>- expected to adsorb and not to leach extensively (Kov=68.347) | - volatilization will not be significant ($HC=1.30x10^{-6}$ atm•$m^3$/mol)<br>- rapid biodegradation (half-life 2 days) | - biodegradation may occur anaerobically |
| Polycyclic Aromatic Hydrocarbons (PAHs) | - Benzo(a) anthracene<br>- Benzo(a) pyrene<br>- Benzo(b) fluoranthene<br>- Chrysene<br>- Indeno (1,2,3-cd) pyrene | - present in the gaseous phase or sorbed to particulates<br>- can undergo photochemical oxidation with the formation of nitrated PAHs, phenols and other compounds<br>- atmospheric half-lives are generally less than 30 days | - Koc values range from $10^5$ to $10^6$ which indicates very strong tendencies to be adsorbed to sediments or soils<br>- evidence suggests microbial degradation is fairly rapid in contrast to photolysis and volatilization<br>- half-life reported for benzo(a)pyrene in soil is 420 to 480 days | - tend to be removed from the water column by volatilization, adsorption to particulates or sediments, biodegradation or bioaccumulation into aquatic organisms<br>- limited volatilization from water (HC - ranges from $10^{-5}$ to $10^{-8}$)<br>- adsorb strongly onto suspended particulates | - low mobility |
| Inorganics | Aluminum | - atmospheric transformations are not expected to occur during transport<br>- does not degrade in air | - Aluminum is found in the soil complexed with other electron rich species such as fluoride, sulfate, and phosphate<br>- absorption of aluminum out of clay surfaces affects aluminum mobility in soil<br>- decreasing pH results in an increase in mobility of aluminum<br>- does not degrade | - concentrations of dissolved aluminum in water vary with pH levels and the humic derived acid content of the water<br>- absorbs to suspended solids in surface water<br>- no biodegradation | |

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *Compound* | *Air* | *Soil* | *Surface Water* | *Groundwater* |
|---|---|---|---|---|---|
| Inorganics Cont'd. | Ammonia | - removal from air by rain or snow washout is dominant fate process<br>- absorption by surface water<br>- half-life estimated to be a few days | - adsorption occurs in most moist or dry soils<br>- some volatilization to the atmosphere (VP=7600 mm Hg)<br>- nitrification by microbial activity<br>- taken up by plants and other organisms | - volatilizes to the atmosphere<br>- volatilization will increase with increasing pH and temperature<br>- adsorbs to sediment and suspended organic material (Kov=3.1) | |
| | Calcium | | - governs the soluble stage of trace elements in soil | - behaviour in general is governed by the availability of the more soluble calcium-containing solids and by solution and gas-phase equilibria that involve carbon dioxide species, or by the availability of sulphur in the form of sulphate | |
| | Chromium | - primarily removed from the atmosphere by fallout and precipitation<br>- chromium particles may remain airborne for long periods of time<br>- may be transported long distances | - may be transported to atmosphere in the form of aerosol<br>- runoff and leaching may transport chromium from soil to surface waters and groundwaters<br>- half-life of chromium in soils may be several years | - volatilization to atmosphere is insignificant<br>- most Chromium III will precipitate in sediments<br>- most Chromium IV will be present in soluble form | |
| | Copper | - released in the form of particulate matter or adsorbed to particulates<br>- removed by gravitational settling, dry deposition, washout by rain, and rainout (scrubbing action below clouds)<br>- removal rate and distance travelled from the source will depend on source characteristics, particle size and wind velocity | - strongly adsorb and remains in the upper few centimeters of soil<br>- adsorption of copper to soil is influenced by pH, organic matter and ionic strength of the soil | - present in natural waters to Cu (II)<br>- complexed or tightly bound to organic matter<br>- subject to sedimentation | |

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

| *Chemical Group* | *Compound* | *Air* | *Soil* | *Surface Water* | *Groundwater* |
|---|---|---|---|---|---|
| Inorganics Cont'd. | Iron | - released in the form of particulate matter or adsorbed to particulate matter | - oxidizing and alkaline conditions promote the precipitation of Fe whereas acid and reducing conditions promote the solution of the compounds<br>- often complexes with organic ligands | - chemical behaviour and solubility in water depend strongly on the oxidation intensity in the system and pH | |
| | Manganese | - manganese containing particles are mainly removed from the atmosphere by gravitational settling<br>- the half-life of airborne particles is usually on the order of days | - adsorption to soil depends on pH and EH, and the organic composition of the soil | - solubility is a factor of the specific chemical form present pH of surface water will affect solubility<br>- binds to suspended particles and sediments<br>- subject to microbial activity | |
| | Manganese | - exist in air as suspended particulate matter<br>- removed by gravitational settling, dry deposition, washout by rain and rainout | - adsorption to soils and sediments is influenced by the organic composition and the carbon exchange capacity of the soil | - solubility is controlled or affected by the pH, Eh (oxidation - reduction potential) and the characteristics of available amins. | |
| | Potassium | | - essential element for both plants and animals<br>- liberated with greater difficulty from silicate-minerals and exhibits a strong tendency to be reincorporated into solid weathering products, especially certain dry minerals | | |

law constant of $2.06 \times 10^{-5}$ atm•$m^3$/mol. As indicated by these values, Acetone will volatilize rapidly from soil, surface water and groundwater.

In the atmosphere, Acetone will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. Half-life estimates from these combined processes is 22 days. Being miscible in water, wash out by rain should be an important removal process.

Soil adsorption is relatively low for Acetone as indicated by a low $K_{OC}$ value of 2.2. Thus, groundwater leaching is a major transport process for Acetone. Sediment adsorption and aquatic bioconcentration is negligible for Acetone.

K.1.6.1.2 Toluene

Toluene has a relatively high vapor pressure of 28.1 mg Hg and a relatively high Henry's law constant of $6.66 \times 10^{-3}$ atm·$m^3$/mol. Volatilization of Toluene from surface soil, surface water and groundwater to the atmosphere is the primary transport mechanism for this compound. Under typical conditions, the rate of volatilization from the surface soil to air is within 24 hours. Depending on whether the water is static or turbulent, the rate of volatilization for surface water is 1 to 16 days or 5 to 6 hours, respectively.

In the atmosphere, Toluene exists primarily in the vapor phase and will undergo photochemical reactions with hydroxyl radicals, with

a half-life of approximately 13 hours. Toluene is not subjected to direct photolysis. It is generally persistent in the atmosphere due to the high emission rate associated with vehicular traffic.

In groundwater, the rate of Toluene transport is dependent on the degree of adsorption to soil. Toluene has a relatively low $K_{OC}$ value of 300 which indicates that Toluene will be moderately adsorbed to soils rich in organic matter, but will readily leached from soils with low organic content.

Biodegradation of Toluene is rapid in soil and also in shallow groundwater.

The principle fate mechanisms for Toluene is rapid volatilization from surface soils and biodegradation in subsurface soil and groundwater.

K.1.6.1.3 <u>2-Butanone</u>

2-Butanone or Methyl Ethyl Ketone is produced commercially for use as a solvent especially in the coatings industry. Natural sources include volcanos, forest fires, by-product of biodegradation and it is a natural component of food.

Environmental Fate

Due to its high vapour pressure of 100 mm Hg at 25°C, volatilization from soil or water will be rapid. Once in the air, it will exist primarily in the gas phase. Predominant removal processes include photolysis and photochemical reactions with hydroxyl radicals (half-life 2.3 days).

2-Butanone is highly soluble in water but once released to water, volatilization into the atmosphere is expected to be rapid as indicated by its high vapour pressure and moderate Henry's Law Constant. The estimated half-lives in rivers and lakes is 3 and 12 days, respectively. Biodegradation is slow in both fresh and salt water. Hydrolysis, photo-oxidation, adsorption to sediments and bioconcentration are not significant removal processes.

If 2-Butanone is released to soils, it will partially evaporate into the atmosphere from near-surface soil and may leach into groundwater. Based on its low estimated $K_{OC}$ value of 1.23, 2-Butanone will be expected to exhibit very high mobility in soil and thus, may leach to the groundwater.

K.1.6.1.4 2-Hexanone

2-Hexanone or Methyl Isobutyl Ketone is commercially produced for use as a solvent and denaturant with a wide variety of applications in a large number of industries. Such industries include rare

metal extractors and manufacturers of coatings (i.e. lacquers, varnishes, paints), pharmaceuticals, pesticides, rubber processing chemicals, and adhesives.

Environmental Fate

In the air, 2-Hexanone will be subject to direct photolysis (half-life 15 hours) and reaction with hydroxyl radicals (half-life 16 to 17 hours). In photochemical smog conditions, 2-Hexanone may also react with nitrogen oxides.

Based on its high Henry's Law Constant value of $1.75 \times 10^{-3}$ atm•$m^3$/mol, the primary removal mechanism from water is expected to be volatilization (half-life 15 to 33 hours). 2-Hexanone is not expected to undergo chemical oxidation or hydrolysis, bioaccumulate in aquatic organisms or adsorb significantly to suspended solids or sediments in water.

If released to soil, 2-Hexanone may be removed by direct photolysis on soil surfaces, volatilization or aerobic biodegradation. The low estimated $K_{OC}$ value of 135 indicates that 2-Hexanone would be highly mobile in soils and would not adsorb significantly to soils or sediments.

K.1.6.1.5 2,4,4-Trimethylpentene

Two isomers of 2,4,4-Trimethylpentene, namely 2,4,4-Trimethyl-1-Pentene and 2,4,4-Trimethyl-2-Pentene which are colorless liquids, were reported on Site. Known uses of both compounds include organic synthesis, with 2,4,4-Trimethyl-1-Pentene utilized in the production of motor fuel particularly isooctane.

The atmospheric fate and transport mechanisms for the two isomers of 2,4,4-Trimethylpentene is characterized by a high vapor pressure of 77.5 mm Hg at 38°C. This indicates potentially significant volatility from soil, surface water and groundwater.

There are no available data found regarding water solubility but these compounds are known to be soluble in organic solvents such as benzene and chloroform.

Soil adsorption cannot be predicted due to the lack of available $K_{OC}$ values in literature.

K.1.6.2 Semi-volatile Organic Compounds

K.1.6.2.1 N-Nitrosodiphenylamine

N-Nitrosodiphenylamine has been produced commercially in the United States since 1945. It was primarily used as a

vulcanization retardant in the rubber-processing industry and as an intermediate in the manufacture of p-nitrosodiphenylamine. Retardants are chemicals that prevent premature vulcanization of rubber compounds during certain rubber-processing steps such as mixing and calendering. Evidence also suggests the production of N-Nitrosodiphenylamine by microorganisms in the environment.

Environmental Fate

N-Nitrosodiphenylamine has a vapor pressure of 0.1 mm Hg at 25° C and thus, it should exist almost entirely in the vapor phase in the atmosphere. In air, the main degradation pathways include photodecomposition as well as chemical reactions with hydroxyl radicals in the atmosphere.

Solubility in water is 40 mg/L. Volatilization and microbial degradation are two major environmental fate processes in water. Volatilization from water will be slow but should be a significant transport process as indicated by its Henry's Law Constant of $6.6 \times 10^{-4}$ atm•$m^3$/mol. A biodegradability test was conducted on N-Nitrosodiphenylamine at levels of 5 and 10 ppm, and using domestic waste water as the microbial inoculum. After a 7-day period, 87% degradation was achieved in the original inoculum of 5 ppm and 47% degradation was achieved in the original inoculum of 10 ppm. After the second 7-day period, 100% degradation was achieved in the original culture of 5 ppm and 63% degradation was achieved in the original culture of 10 ppm. This demonstrated that N-Nitrosodiphenylamine was degradable (1).

The (log Kow) logarithm of n-octanol/water coefficient for N-Nitrosodiphenylamine was estimated to range from 2.57 to 3.13, indicating a low potential for bioaccumulation. A continuous 14-day exposure study of bluegill sunfish with a mean water concentration of 9.21 ppb resulted in an experimental bioconcentration factor of 217 for N-Nitrosodiphenylamine. The half-life of N-Nitrosodiphenylamine in fish was found to be less than 1 day when the fish were placed in a pollutant-free environment after the exposure period. The relatively low experimental bioconcentration potential and short half-life of N-Nitrosodiphenylamine indicated that biomagnification in the aquatic food chain was not a major environmental fate process.

The soil sorption coefficient ($K_{OC}$) for N-Nitrosodiphenylamine was estimated to range from 830 to 1830 which is indicative of low mobility in soil or sediment. Thus, significant leaching is not expected to occur in most types of soils and/or sediments. The major degradation pathway for N-Nitrosodiphenylamine in soil is microbial degradation.

K.1.6.2.2 <u>N-Nitrosodipropylamine</u>

N-Nitrosodipropylamine is not produced commercially and it is solely used as a research chemical.

The atmospheric fate and transport mechanisms for N-nitrosodipropylamine is characterized by a low estimated vapor pressure of 0.086 mm Hg at 20C and a Henry's Law Constant of 1.47E-06 atm•$m^3$/mol at 20°C. These values are indicative of low volatility from soil, surface water and groundwater.

In the atmosphere, N-Nitrosodipropylamine vapor would be rapidly degraded by photolysis and photochemical reaction with hydroxyl radicals.

The predominant removal process form water for N-Nitrosodipropylamine is photolysis and microbial degradation. In lake surface water, photolytic half-life for N-Nitrosodipropylamine is approximately 2.5 hours with N-propylamine as a major by-product. Without sunlight, microbial degradation, although expected to be a slow process, is the primary removal pathway.

As indicated by an estimated $K_{OC}$ value of 129 and a high water solubility of 9.894 mg/L, soil adsorption is relatively low. Thus, groundwater leaching is a major transport process for N-Nitrosodipropylamine.

K.1.6.2.3 <u>Phenols</u>

Phenol is commercially produced in large quantities due to its wide range of applications in resins, adhesives, iron and steel,

Aluminum, leather and rubber industries. It is also found in cigarette smoke and vehicular exhaust as well as disinfectants and medicinal products. Natural sources include animal wastes and as decomposition product of organic wastes.

Environmental Fate

Volatilization is not expected to be rapid for Phenol due to its low vapour pressure and Henry's Law Constant. However, if Phenol is released into the atmosphere, it will exist predominantly in the vapor phase. Predominant removal process is photodegradation and photochemical reaction with hydroxyl radicals (half-life 0.61 days).

If Phenol is released to water, the primary removal process will be biodegradation which will generally be rapid under aerobic conditions in comparison to anaerobic conditions. Acclimation of resident microorganisms is rapid under aerobic conditions and may take a few weeks under anaerobic conditions. Evaporation, hydrolysis, adsorption to sediment or bioconcentration in aquatic organisms are not significant removal processes for Phenol.

Based on the reported and estimated $K_{OC}$ value of 27, Phenol will be expected to exhibit high to very high mobility in soil, and therefore, may leach to groundwater. Biodegradation of Phenol in soil will be rapid (2 to 5 days) and will also occur in the subsurface soils. Degradation rates will be much slower under anaerobic conditions than under aerobic conditions.

K.1.6.2.4 Phthalate Esters

The phthalate esters are used in virtually every major product such as construction, automotive, household products, apparels, toys and medical products. This results in wide occurrence of phthalate esters in the environment. Phthalate esters are used as plasticizers for polvinyl and cellulosic resins, primarily in polyvinyl chloride (PVC). The most commonly produced plasticizers are bis(2-ethylhexyl) phthalate (BEHP), di-n-butyl phthalate (DBP), di-n-octyl phthalate (DOP) and butyl benzyl phthalate (BBP). The physical and chemical constants for phthalate esters are summarized in Table K.1.

Because of its high efficiency and stability, BEHP has been used in large quantities as a plasticizer for polyvinyl chloride (PVC) and other polymers. As a result of its common use, BEHP may be found in common goods such as upholstery material, hospital sheeting, shower curtains, food packaging materials and various plastic products used daily by the general public. Pursuant to the banning of PCBs in dielectric fluids for transformers and capacitors, BEHP was selected by many manufacturers as the preferred material for dielectric fluids. BEHP is currently still used in the transformer and capacitor industry.

Environmental Fate

Atmospheric levels of phthalate esters are caused by volatilization during the manufacture and waste disposal of plastic products. Phthalate esters have high boiling points ranging from 230°C to 386°C and low vapor pressures ranging from $1.4 \times 10^{-4}$ to $6.2 \times 10^{-8}$ mm Hg at 25°C. This indicates a strong affinity to adhere to atmospheric particulate matter especially organic matter and soot. A significant removal process from the atmosphere is by rain washout. Direct photolysis and photoxidation are atmospheric processes that might occur but to a very limited extent.

In the presence of a direct pollution source, the extent of contamination in water systems by phthalate esters is influenced by the compound's water solubility. The water solubility for phthalate esters ranges from a minimum value of 285 ppb to a maximum value of 13000 ppb (13 ppm). Table K.1 presents the solubilities of diesters in water compiled from a number of sources. As expected, the length of alkyl side chains affect water solubilities of phthalate esters. Due to the larger alkyl side chains of BEHP its water solubility is considerably lower than the shorter alkyl-side chain phthalates such as DBP. Therefore, the apparently low water solubility will limit the amount of BEHP entering this media and BEHP will generally exhibit decreased mobility in aqueous system as demonstrated in previous sections.

Biodegradation in aquatic systems is quite rapid with a half-life of 2-3 weeks following a period of acclimation.

Primary removal of phthalate esters from water systems is through adsorption to suspended matter and sediments as indicated by the high organic carbon partitioning coefficient ($K_{OC}$). The $K_{OC}$ values for phthalate esters range from 68 to 980,000,000. As discussed earlier, a high $K_{OC}$ generally indicates an increased likelihood for the chemical to bind to soil or sediment rather than to remain in water. Thus, phthalate esters have significantly high $K_{OC}$ values which is indicative of lower mobility.

The Henry's Law constants for phthalate esters range from $1.1 \times 10^{-5}$ to $1.41 \times 10^{-12}$ atm•m3/mol. This is indicative of the extent of chemical partitioning between air and water at equilibrium. Due to the low Henry's Law Constants for phthalate esters, its volatilization to the atmosphere from water is likely to be negligible. This is true even under conditions, such as aeration, conducive to contaminant evaporation. For BEHP, evaporation and hydrolysis are not significant aquatic processes.

The phthalate esters, including BEHP, have a strong affinity for soil solids, including organic, humic fraction of soil. Both the mineral and organic fraction of solid soil particles tend to bind BEHP and other phthalates.

Degradation of phthalates in soil is mediated by a wide variety of microorganisms capable of metabolizing phthalates to simpler molecules. Several microorganisms including the saprophytic bacterium Serratia, Penicillium lilacinuns and Enterobacter erogenous, have been shown to degrade BEHP. Serratia can use the compound as a sole source of carbon and energy.

The rates of degradation, appear to increase with decreasing alkyl chain length. Biodegradability of BEHP is less biodegradable than short (less than 6 carbons) carbon-chain length phthalate esters but more biodegradable than several other long-carbon chain phthalates (i.e. >7 carbons). Microbial transformation of phthalate esters undoubtedly accounts for the major part of their biodegradation in the environment. Phthalates are biodegraded in water, sludge and soil under aerobic conditions. The degradation of BEHP in soil occurs under aerobic conditions, but only slowly, if at all under anaerobic conditions. Studies with $^{14}C$-carbonyl-labeled BEHP in aerobic freshwater hydrosoil yielded a degradation half-life of approximately 14 days.

"Phthalate esters are being broken down continually in the environment. Thus, current environmental levels must reflect an equilibrium between amounts released in the environment and those removed. However, the amounts in any environmental compartment for example silt, lakes, air and so forth, must represent varying levels of equilibria as the phthalate concentrations normalize. In aquatic environments, dialkyl phthalates have been shown to exist in the fatty surface layer of water and it seems likely that this renders them more liable to environmental degradation as many aquatic plants and animals live in this energy-rich zone. However at high concentrations, phthalates may still be degraded and furthermore degradation maybe complete."

Presence as a Laboratory Contaminant

BEHP is a common laboratory contaminant. Many studies have shown commercial organic solvents to be contaminated with BEHP. Various investigators have noted the general contamination of laboratory supplies, solvents, and reagents with BEHP to the extent that the detection limit for BEHP in investigative samples is determined by the reagent-laboratory blank.

Due to ambient conditions within the laboratory setting, BEHP contamination of investigative samples is a common occurrence. Based on this fact, BEHP concentrations determined in investigative samples must be carefully scrutinized for validation purposes. If BEHP is detected in an investigative sample and a laboratory blank, the concentration in the investigative sample must exceed the concentration found within the blank by a factor of 10 to be considered present (i.e. multiply concentration found in laboratory blank sample by 10 to determine detection limit for investigative sample).

K.1.6.2.5 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals formed during the incomplete combustion of virtually all forms of organic materials. The combustion of fuels in cars and in furnaces produces PAHs. Waste incinerators produce PAHs. Natural sources include volcanoes, forest fires, crude oil and shale oil. PAHs can also be found in substances such

as crude oil, coal tar pitch, creosote, road and roofing tar. A major source of exposure for humans is cigarette smoking, both active and passive. Therefore, PAHs are ubiquitous in the environment and the increasing levels found in the environment parallel industrial and urban development. Note the impact of urban sources (furnace fuels and vehicle exhaust, for example) on the PAH levels in surface soils as presented in Table K.5.

Chemical Identity

The following PAHs are considered as a group in this review of the chemical and physical properties of PAHs.

- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- chrysene
- indeno(1,2,3-cd)pyrene

Tables K.1 to K.3 summarize the physical and chemical properties of the above listed chemicals.

As pure chemicals, PAHs generally exist as colorless, white or pale yellow-green solids. Most PAHs do not occur alone in the environment, rather they are found as mixtures of two or more PAHs. The PAHs listed above are not commercially produced in the U.S. nor are there any known uses for them except as research chemical.

TABLE K.5

BACKGROUND SOIL CONCENTRATIONS OF
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

| | *Concentration (μg/kg)* | | |
|---|---|---|---|
| *Compound* | *Rural Soil* | *Agricultural Soil* | *Urban Soil* |
| Acenaphthene | 1.7 | 6 | |
| Acenaphthylene | | 5 | |
| Anthracene | | 11-13 | |
| Benzo(a)anthracene | 5-20 | 56-110 | 169-59,000 |
| Benzo(a)pyrene | 2-1,300 | 4.6-900 | 165-220 |
| Benzo(b)fluoranthene | 20-30 | 58-220 | 15,000-62,000 |
| Benzo(e)pyrene | | 53-130 | 60-14,000 |
| Benzo(g,h,i)perylene | 10-70 | 66 | 900-47,000 |
| Benzo(k)fluoranthene | 10-110 | 58-250 | 300-26,000 |
| Chrysene | 38.3 | 78-120 | 251-640 |
| Fluoranthene | 0.3-40 | 120-210 | 200-166,000 |
| Fluorene | | 9.7 | |
| Indeno (1,2,3-cd)pyrene | 10-15 | 63-100 | 8,000-61,000 |
| Phenanthrene | 30 | 48-140 | |
| Pyrene | 1-19.7 | 99-150 | 145-147,000 |

Sources:
IARC (1973)
White and Vanderslice (1980)
Windsor and Hites (1979)
Edwards (1983)
Butler et al. (1984)
Vogt et al. (1987)
Jones et al. (1987)

Environmental Fate

Some of the transport and partitioning characteristics of the PAHs are roughly correlated to their molecular weights. The Site-related PAHs are considered high molecular weight compounds ranging from 228 g/mol to 278 g/mol.

In air, PAHs are present in the gaseous phase or sorbed to particulates. The atmospheric residence time and transport distance depend on the size of the particles to which PAHs are adsorbed. That is, the larger the particulate size, the shorter the residence time and transport distance. PAHs can undergo photochemical oxidation with the formation of nitrated PAHs, Phenols, and other compounds. Atmospheric half lives are generally less than 30 days.

PAH compounds tend to be removed from the water column by volatilization to the atmosphere, adsorption to particulates or sediments, biodegradation or bioaccumulation into aquatic organisms. The high molecular weight PAHs have Henry's Law Constants in the range of $10^{-5}$ to $10^{-8}$ (refer to Table K.1) which indicates very limited volatilization from water. Half-lives for volatilization of benzo(a)anthracene and benzo(a)pyrene (high molecular weight PAHs) from water have been estimated to be greater than 100 hours.

High molecular weight PAHs have $K_{OC}$ values that range from $10^5$ to $10^6$ which indicates strong tendencies to adsorb to organic carbon. Due to their low water solubilities, PAHs are primarily found adsorbed to

sediments or soils. Adsorption of PAHs is a function of organic carbon content and particle size. The environmental fate of PAHs is described by USEPA in the document "Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons" which states:

> "PAH will adsorb strongly onto suspended particulates and biota and their (PAH) transport will be determined largely by the hydrogeologic condition of the aquatic system. PAH dissolved in the water column will probably undergo direct photolysis at a rapid rate. The ultimate fate of those which accumulate in the sediment is believed to be biodegradation and biotransformation by benthic organisms (USEPA, 1979).

This is restated in the USEPA document "Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs)" which states:

> "The predominant mechanism that is likely to dictate the fate of most PAHs in aquatic media is sorption to particulate matter and subsequent sedimentation and microbial degradation."

Since PAHs are most likely to stay in the sediment or soil, microbial degradation is the most likely ultimate environmental fate in contrast to photolysis and volatilization. Compounds with four cyclic rings or less are most amenable to microbial degradation. Benzo(a)pyrene (five cyclic rings) has a half life in soil inoculated with bacteria of less than eight days. The half-life reported for benzo(a)pyrene in soil reported in Superfund

Public Health Evaluation Manual (SPHEM, 1986) is 420 to 480 days but there is no reference to the microbial content in the soil.

### K.1.6.3 Inorganics

The final group of Site-related constituents includes a variety of inorganics which are typified by the following metals:

- Aluminum (Al)
- Ammonia ($NH_3$)
- Calcium (Ca)
- Chloride ($Cl^-$)
- Chromium III (Cr III)
- Chromium VI (Cr VI)
- Copper (Cu)
- Iron (Fe)
- Manganese (Mn)
- Potassium (K)
- Sodium (Na)
- Sulphate ($SO_4^{2-}$)
- Zinc (Zn)

The following sections will present a literature review of the properties of these metals. The goals of this review will be to determine and evaluate the properties of these metals in the environment that are important in determining the environmental fate.

### K.1.6.3.1 Aluminum (Al)

The largest source of particle-borne Aluminum is the flux of dust from ores and rock materials in the earth's surface. The sources of this dust are both natural processes, such as weathering of aluminosilicate crystal material and human activity, such as mining and agriculture. Aluminum has only one oxidation state (+3). Because of its reactivity, Aluminum is not found as a free metal in nature. It is found in the atmosphere mainly as aluminosilicates associated with particulate matter. However, because Aluminum can exist in only one oxidation state in the environment, atmospheric transformations are not expected to occur during transport. Aluminum is found in the soil complexed with other electron-rich species such as fluoride, sulphate, and phosphate. Soil characteristics which effect Aluminum mobility are pH and organic content. When pH of soil is decreased, possibly due to acid rain, Aluminum becomes more soluble. Aluminum will adsorb to organic matter in soils and therefore reduce mobility.

### K.1.6.3.2 Ammonia

Ammonia is a naturally-occurring compound which is a key intermediate in the nitrogen cycle. The commercial synthesis of Ammonia is thought to contribute less than 5% to the total global Ammonia budget. Because of its significance in natural cycles, Ammonia has a

background concentration in most environmental media. When Ammonia is found at a local concentration that is higher than these background levels, it is usually a result of man's influence. In determining the environmental fate of Ammonia, several factors should be considered. Ammonia is the most abundant basic gas in the environment. An acid-base reaction between water and Ammonia occurs, such that the dominant form of Ammonia in water at environmentally significant pHs, is the Ammonium ion ($NH_4^+$). Ammonia is a key intermediate in the nitrogen cycle which is tied to the other important biological cycles (i.e. sulfur cycle or carbon cycle).

Ammonia may be released to the atmosphere by volatilization from the following sources:

- decaying organic matter;
- animal livestock excreta;
- fertilization of soil;
- venting of gas, leaks, or spills during commercial synthesis, production, or transportation;
- sewage or wastewater effluent;
- burning of coal, wood, and other natural products; and
- volcanic eruptions.

Ammonia may be released to water through the following:

- effluent from sewage treatment plants;
- effluent from industrial processes;

- runoff from fertilized fields; and
- runoff from areas of concentrated livestock.

Ammonia may be released to soils by:

- natural or synthetic fertilizer application;
- a result of livestock excrement;
- decay of organic material from dead plants and animals; and
- the natural fixation of atmospheric nitrogen.

In the atmosphere, Ammonia can be removed by rain or snow washout. This seems to be the dominant fate process. Ammonia can also be removed from the atmosphere through the direct adsorption by surface waters in areas where local atmospheric concentration is high. The reaction with acidic substances, such as $H_2SO_4$, HCl or $HNO_3$; produced in high concentrations from anthropogenic activity produces Ammonium aerosols which can undergo dry or wet deposition. The gas phase reaction of Ammonia with photochemically produced hydroxyl radicals is thought to contribute about 10% to the overall atmospheric removal process. The best estimate of the atmospheric half-life of Ammonia is a few days.

In soil, Ammonia may either volatilize to the atmosphere, adsorb to soil, or undergo microbial transformation to nitrate or nitrate anions. Uptake by plants can also be a significant fate process. Adsorption of Ammonia occurs in most moist or dry soils, and Ammonia is predominantly, but not exclusively, held as the Ammonium ion. Generally

adsorption will increase with increasing organic content of the soil, and will decrease with increasing pH.

In water, Ammonia volatilizes to the atmosphere. This process is highly pH-dependent, and can also depend on other factors such as temperature and wind speed, and atmospheric concentrations. Adsorption of Ammonia to sediment and suspended organic matter can be important under proper conditions. Adsorption to sediment should increase with increasing organic content, increased metal ion content, and decreasing pH. Ammonia in water can be removed by the microbial processes of nitrification and denitrification which would produce ionic nitrogen compounds, and from these, elemental nitrogen. The ionic nitrogen compounds formed from the aerobic processes of nitrification, $NO_2^-$ and $NO_3^-$, can then leach through the sediment or be taken up by aquatic plants or other organisms.

K.1.6.3.3 Calcium (Ca)

Calcium is the most abundant of the alkaline-earth metals and is a major constituent of many rock minerals. It is an essential element for plant and animal life forms and is a major component of the solutes in most natural waters. Calcium has only one oxidation state, $Ca^{2+}$. Its behaviour in natural aqueous system is generally governed by the availability of the more soluble calcium-containing solids and by solution and gas-phase equilibria that involve carbon dioxide species, or by the availability of sulphur in the form of sulphate.

The usual dissolved form of calcium can be simply represented as the $Ca^{2+}$. In natural waters, the most common complexes of calcium are with hydroxide and carbonate ions. The pH of the surface water will directly affect which complexes are most dominant. Equilibria involving carbonates are a major factor in limiting the solubility of calcium in most natural waters.

Solutions of most soils contain an excess of $Ca^{2+}$, which in many soils constitutes more than 90 percent of the total cation concentration. $Ca^{2+}$ is, therefore, the most important cation in governing the soluble stage of trace elements in soils. The transport of dissolved elements such as calcium may take place through the soil solution (diffusion) and also with the moving soil solution (mass flow, leaching).

K.1.6.3.4 Chloride and Sulphate

Chlorides and sulphates are commonly present in soil and sediment. They are negligible compounds in soil that developed in a humid climate, but in soils of arid climatic zones they can be the dominant controls of the behavior of trace elements. Sulphates of heavy metals are also readily available to plants, and their occurrence in soils has practical importance in agriculture. Chlorides as the most soluble salts occur only in soils of arid or semi-arid climatic zones.

Once in the water, chloride ions do not significantly enter into oxidation or reduction reactions, form any important solute complexes

with other ions unless chloride concentration is extremely high, do not form salts of low solubility, are not significantly adsorbed on mineral surfaces and play few vital biochemical roles. Chloride ions moved with the water through most soils tested with less retardation or loss. Chloride forms ion pairs or complex ions with some of the cations present in natural waters, but these complexes are not strong enough to be of significance in water chemistry.

### K.1.6.3.5 Chromium (Cr)

Chromium (Cr) is a naturally occurring element found in continental crust, volcanic dust and gases. Chromium metal is a steel-gray solid and is primarily used in the steel and metallurgical industries. Chromium is also used in the following industries:

- refractory brick,
- metal finishing,
- manufacture of pigments,
- leather tanning,
- wood treatment, and
- water treatment

Society's use of this metal causes larger amounts of chromium to be emitted into the environment than from natural processes.

## Chemical Identity

The physical and chemical properties of chromium are presented in Table K.1. Chromium has an atomic weight of 51.996 g/mole. Chromium and its salts have various solubilities in water.

## Environmental Fate

Chromium occurs naturally in the Earth's crust but the majority of chromium which exists in the environment is a direct result of human activity. Chromium is released to the environment as follows:

| *Chromium (III)* 61% | *Chromium (VI)* 32% |
|---|---|
| • coal/oil combustion | • chemical manufacture |
| • steel production | • plating |
| | • metal production |

Chromium is removed from the atmosphere by fallout and precipitation. There are no known chromium compounds that can volatilize from water and thus transport of chromium from the water to the atmosphere is minimal.

Most of the chromium (III) is expected to precipitate in sediments. Limited amounts of Cr (III) remains in solution as soluble complexes. Cr (VI) may be transported over a significant distance but will eventually be reduced to Cr (III) by the organic matter in the water. The

residence time of chromium in lakewater is estimated to be between 4.6 and 18 years.

In soil, chromium will usually exist as $Cr_2O_3.nH_2O$ since the organic matter in the soil will convert soluble chromate to insoluble $Cr_2O_3$.

Speciation

In natural waters, at a neutral pH, chromium can exist in the aqueous phase at levels up to 500 ppb before $Cr(OH)_3(s)$ begins to precipitate.

K.1.6.3.6 Copper (Cu)

Copper and its compounds are naturally present in the earth's crust, primarily found as sulphides and oxides. Metallic Copper is prepared by smelting and electrolytic refining.

Copper is released to the atmosphere in the form of particulate matter or adsorbed to particulate matter. It is removed by gravitational settling (bulk deposition), dry deposition (inertial impaction characterized by a deposition velocity), washout by rain (attachment to droplets within clouds), and rainout (scrubbing action below clouds). The removal rate and distance travelled from the source will depend on source characteristics, particle size, and wind velocity. Gravitational settling governs

the removal of large particles (>5 μm), whereas smaller particles are removed by the other forms of dry and wet deposition.

In natural waters, Copper is predominantly in its Cu(II) state. Most of it is complexed or tightly bound to organic matter; little is present in the free (hydrated) or readily exchangeable form. The chemical conditions in most natural waters are such that, even at relatively high copper concentrations, these processes will reduce the free [Cu(II)] concentrations to extremely low values. Sediment is an important sink and reservoir for copper.

Most copper deposited in soil from the atmosphere, agricultural use, solid waste and sludge disposal will be strongly adsorbed and remain in the upper few centimeters of soil. Sandy soils with low pH have the greatest potential for leaching. In most temperate soil, the pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption.

K.1.6.3.7 Iron (Fe)

Iron (Fe) is widely distributed in the earth's crust and is a major component of the core. Most ores are complex oxides, which are reduced in a blast furnace. Iron, or more precisely its carbon alloy, steel, is the backbone of modern civilization, with total production exceeding that of all other metals combined.

Iron compounds, both ferrous (+2) and ferric (+3) have generally low solutibilities in water. The major exceptions are the halides and nitrates. The chemical behaviour of iron and its solubility in water depend strongly on the oxidation intensity in the system in which it occurs; pH is a strong influence as well.

In soils, the general rules governing the mobilization and fixation of Fe are that oxidizing and alkaline conditions promote the precipitation of Fe, whereas acid and reducing conditions promote the solution of Fe compounds. The released Fe readily precipitates as oxides and hydroxides, but it substitutes for Mg and Al in other minerals and often complexes with organic ligands. The content of soluble Fe in soils is extremely low in comparison with the total Fe content. The soluble Fe level reaches a minimum in the alkaline pH range and a maximum in very acidic soils. When soils are waterlogged, the reduction of $Fe^{3+}$ to $Fe^{2+}$ takes place and is reflected in an increase in Fe solubility

K.1.6.3.8 Manganese (Mn)

Manganese is an abundant element comprising about 0.1% of the earth's crust. Above-average exposures to manganese are most likely to occur in or near a factory or a waste site that releases significant amounts of manganese dust into the air. Manganese is also released into the air by combustion of leaded gasoline.

Manganese may exist in air as suspended particulate matter and are mainly removed from the atmosphere by gravitational settling. Removal by washout mechanisms such as rain may also occur, but is less important in removing manganese from the atmosphere than dry deposition.

The tendency of soluble manganese compounds to adsorb to soils and sediments depends mainly on the carbon exchange capacity and the organic composition of the soil. Soil adsorption contents for Mn(+2) span five orders of magnitude, ranging from 0.2 to 10,000 mL/g, increasing as a function of the organic content and the ion exchange capacity of the soil. Thus, adsorption may be highly variable.

The chemical fate and transport of manganese in water is controlled by the solubility of the specific chemical form present, which in turn is determined by pH, Eh (oxidation-reduction potential), and the characteristics of available anions. The metal may exist in water in any of four oxidation states (2+, 3+, 4+ or 7+). Divalent manganese ($Mn^{+2}$) predominates in most waters with pH of 4 to 7, but may become oxidized at pH greater than 8 or 9. The principal anion associated with Mn(+2) in water is usually carbonate ($CO_3^{-2}$), and the concentration of manganese is limited by the relatively low solubility (65 mg/L) of $MnCO_3$. Manganese is often transported in rivers as suspended sediments.

K.1.6.3.9 Potassium (K)

The crustal abundance of Potassium (K) is 2.59 percent. Potassium metal is used in organic syntheses. Several compounds have medicinal uses. KCl is used in fertilizer and plant nutrients, pharmaceuticals, photography, and spectroscopy and as a salt substitute, laboratory reagent, buffer, and food additive.

Potassium is known to behave differently than Sodium in natural systems. Sodium tends to remain in solution rather persistently once it has been liberated from silicate-numeral structures. Potassium, on the other hand, is liberated with greater difficulty from silicate-minerals and exhibits a strong tendency to be reincorporated into solid weathering products, especially certain clay minerals.

Potassium is an essential element for both plants and animals. Maintenance of optimum soil fertility entails providing a supply of available Potassium. The element is present in plant material and is lost from agricultural soil by crop harvesting and removal as well as by leaching and runoff acting on organic residues.

Potassium ions assimilated by plants become available for re-solution when the plants mature and die, or when leaves and other parts are shed at the end of the growing season. In the natural recycling that occurs in forests and grasslands; this Potassium is leached into the soil by rains during the dormant season or made available by the gradual decay of the organic material.

K.1.6.3.10 Sodium (Na)

In the United States, soda ash (technical grade $Na_2Co_3$) is the major Sodium compound produced. Natural soda ash is produced by electrolysis of sea water or lake brines. Sodium compounds are among the highest tonnage industrial chemicals. Major industrial uses of Sodium compounds include manufacturing Sodium glasses and detergents, bleaching pulp, paper, and textiles; and treating water. Sodium is the most familiar alkali metal, it is soft at ordinary temperatures and so reactive with water and oxygen it is stored under oxygen-free liquids such as kerosene. Practically all of its compounds are water soluble. Generally, the chemistry of the anion dominates the chemical behaviour and industrial use.

When Sodium has been brought into solution, it tends to remain in that status. There are no important precipitation reactions that can maintain low Sodium concentrations in water, in the way that carbonate precipitation controls calcium concentrations. Sodium is retained by adsorption on mineral surfaces, especially by minerals having high cation capacities such as clays.

K.1.6.3.11 Zinc (Zn)

Zinc is widely distributed in nature, consisting of 0.027 percent (by weight) of the earth's crust (Merck 1983), but it is usually not

found free in nature. The primary sources of Zinc in the environment are related to metallurgic wastes from smelter and refining operations. Releases to surface and groundwater are probably the greatest source of ambient Zinc. Zinc is not volatilized to any significant extent, but is primarily deposited on sediments as a result of discharge from industrial operations and weathering processes.

Zinc is released to the atmosphere as dust and fumes from Zinc production facilities. Total releases of Zinc to air account for only a small portion of the total environmental release. Volatilization does not appear to be an important process for Zinc. No estimate for the atmospheric lifetime of Zinc is available at this time. Atmospheric emissions of Zinc, consisting primarily of Zinc sorbed to submicron particulate matter and the oxide of Zinc are expected to be short-lived, due to surface deposition (EPA 1980).

In aquatic environments, sorption of Zinc is its dominant fate. Zinc partitions to sediments or suspended solids in surface waters through sorption onto hydrous iron and manganese oxides, clay minerals and organic material.

Zinc is likely to be strongly sorbed in soil. The mobility of Zinc in soil depends on the solubility of the speciated forms of the compound and on soil properties such as sorption potential, pH and salinity. No information specifically related to transformation and degradation in soil was identified in the available literature; however, chemical speciation of Zinc in soil is probably affected by the same factors affecting its fate in water.

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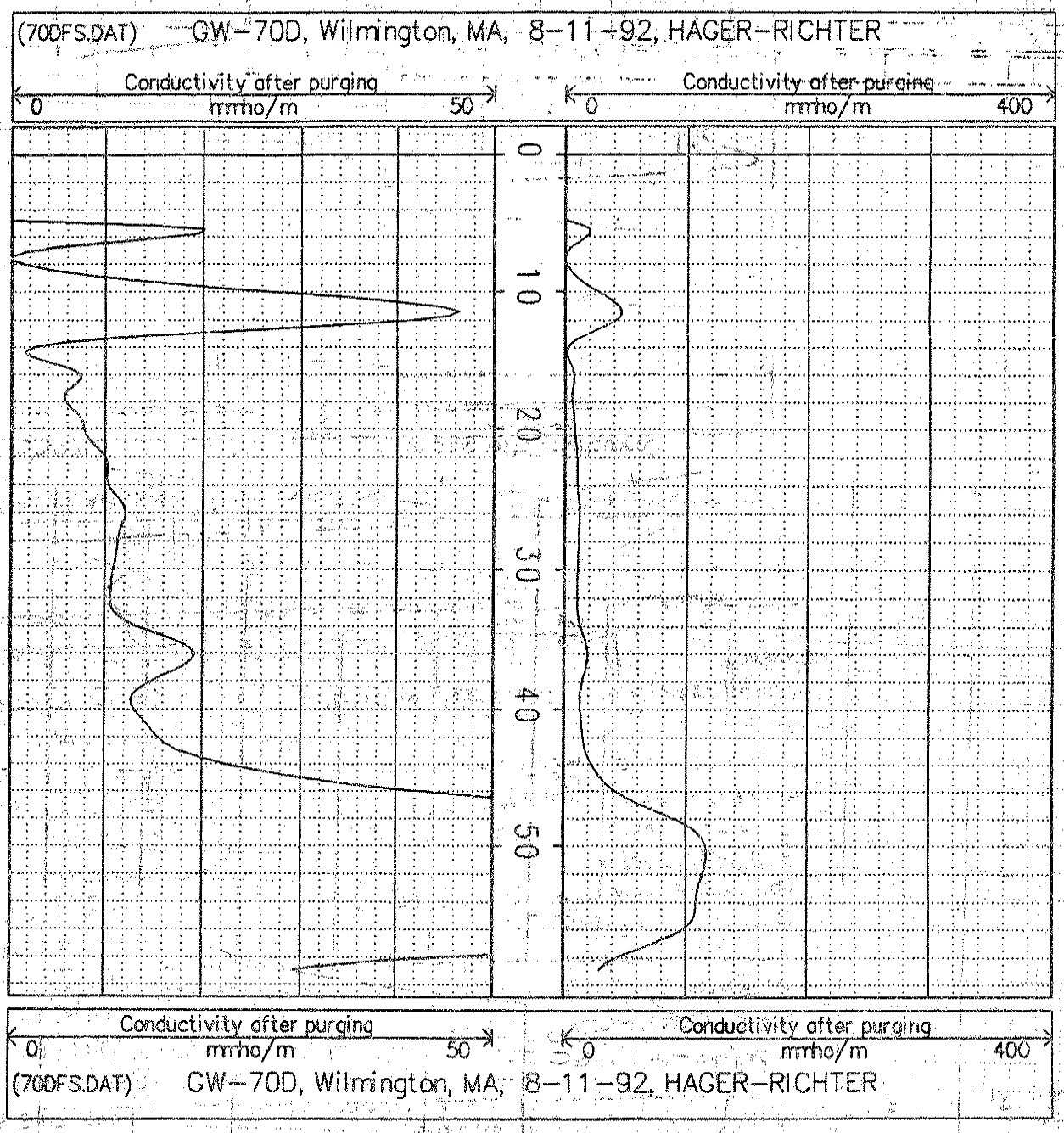
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-700

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 92.3 feet
LOG DATUM: Ground Level
CLIENT TD: 62 feet
H-R TD: 61.08 feet
STATIC WATER LEVEL: 11.74 feet
DEPTH TO BEDROCK: approx. 57 feet



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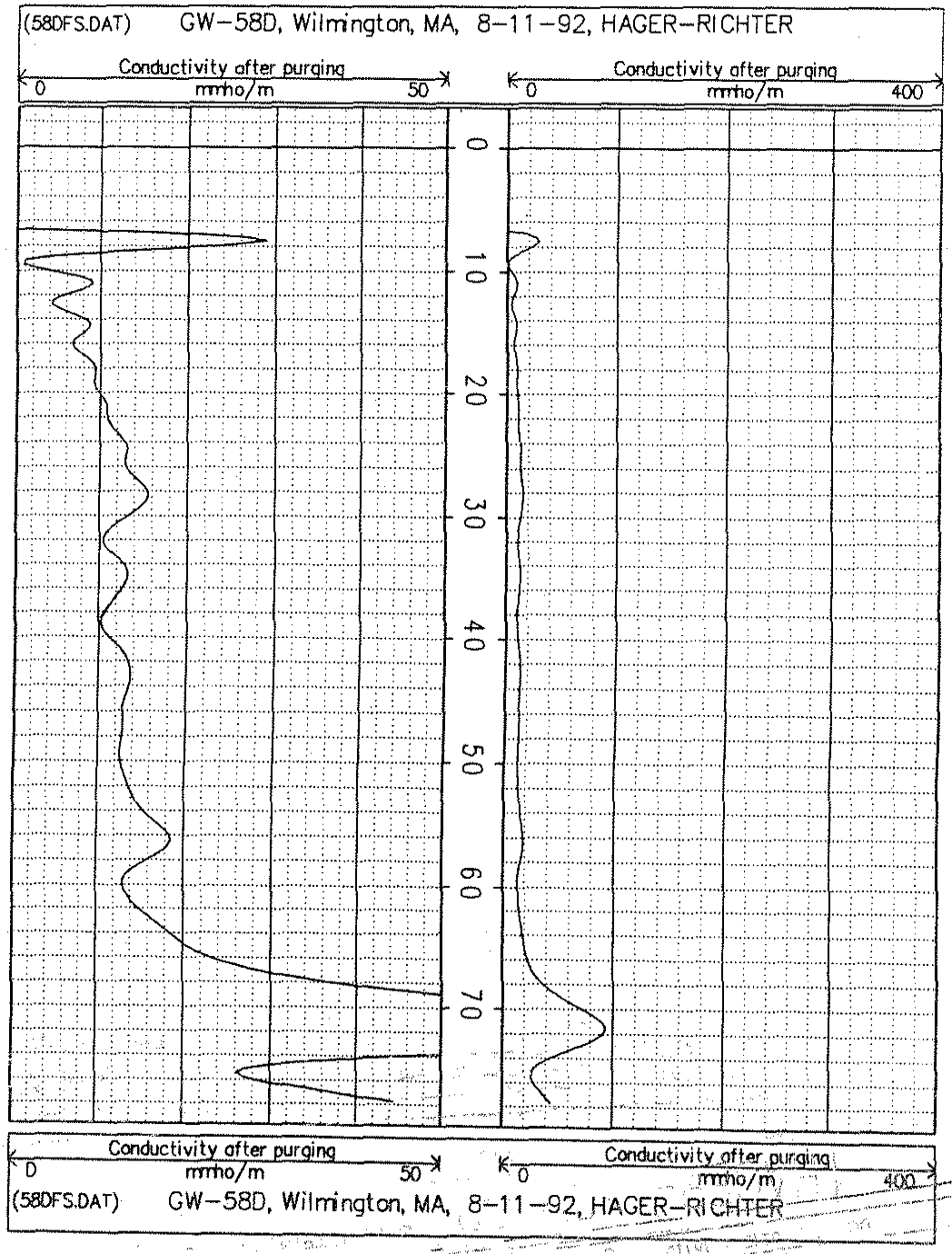
CONDUCTIVITY

WELL: GW-58D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 80 feet
H-R TD: 79.91 feet
STATIC WATER LEVEL: 17.9 feet
DEPTH TO BEDROCK: approx. 74 feet



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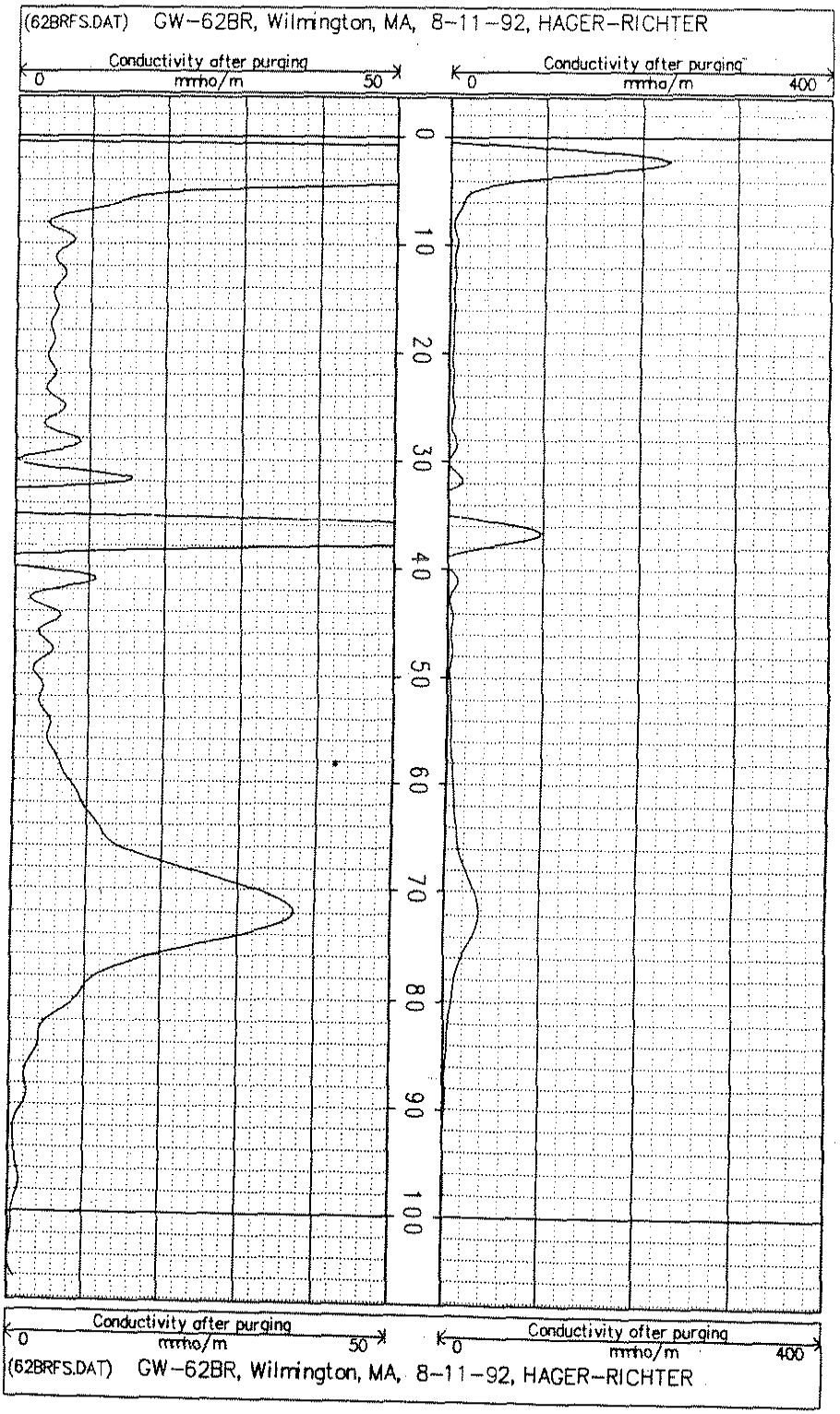
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-62BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Micheis
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 In. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 105 feet
H-R TD: 108.19 feet
STATIC WATER LEVEL: 3.84 feet
DEPTH TO BEDROCK: approx. 80 feet



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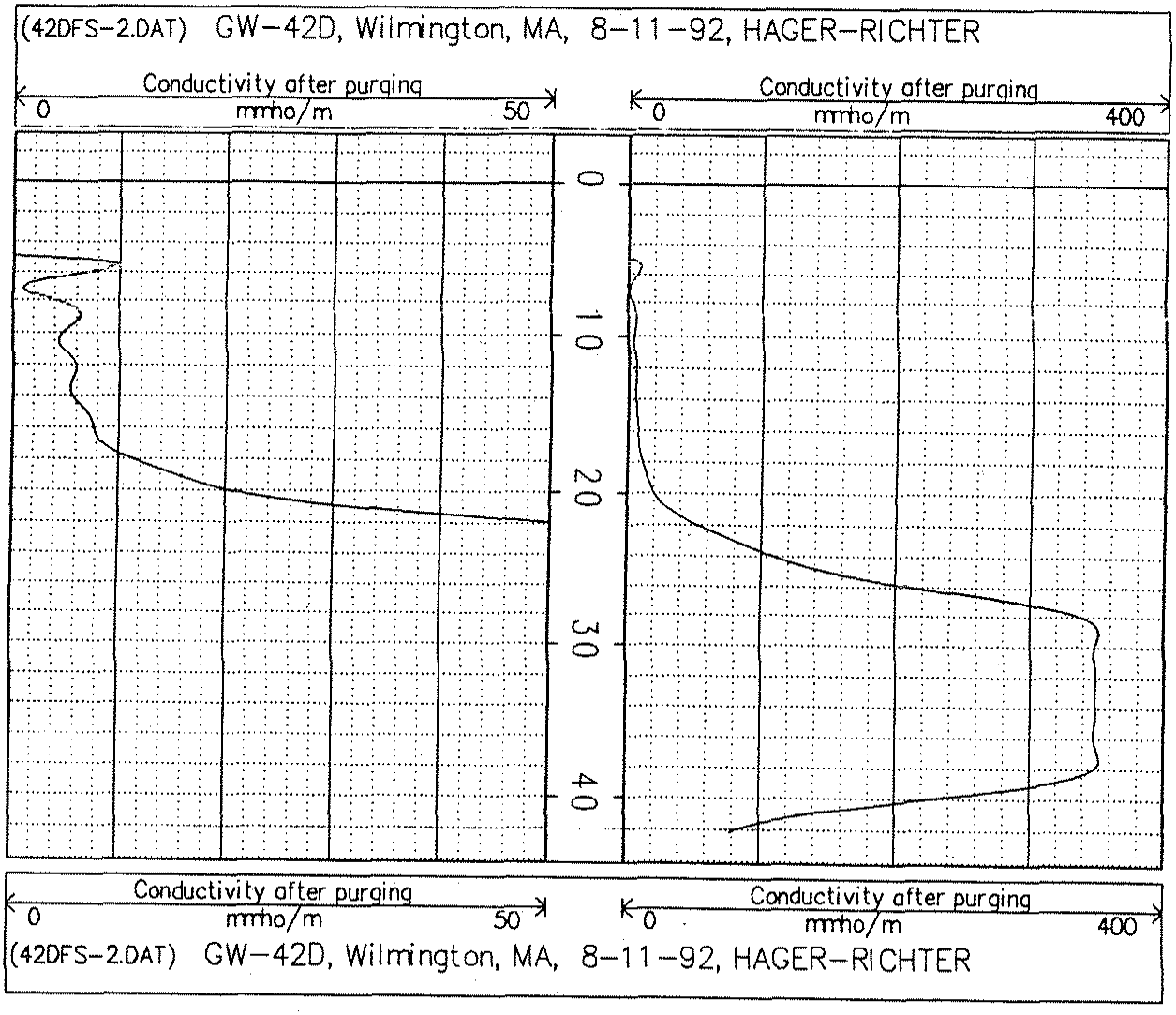
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



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PHONE: 603 893-9944
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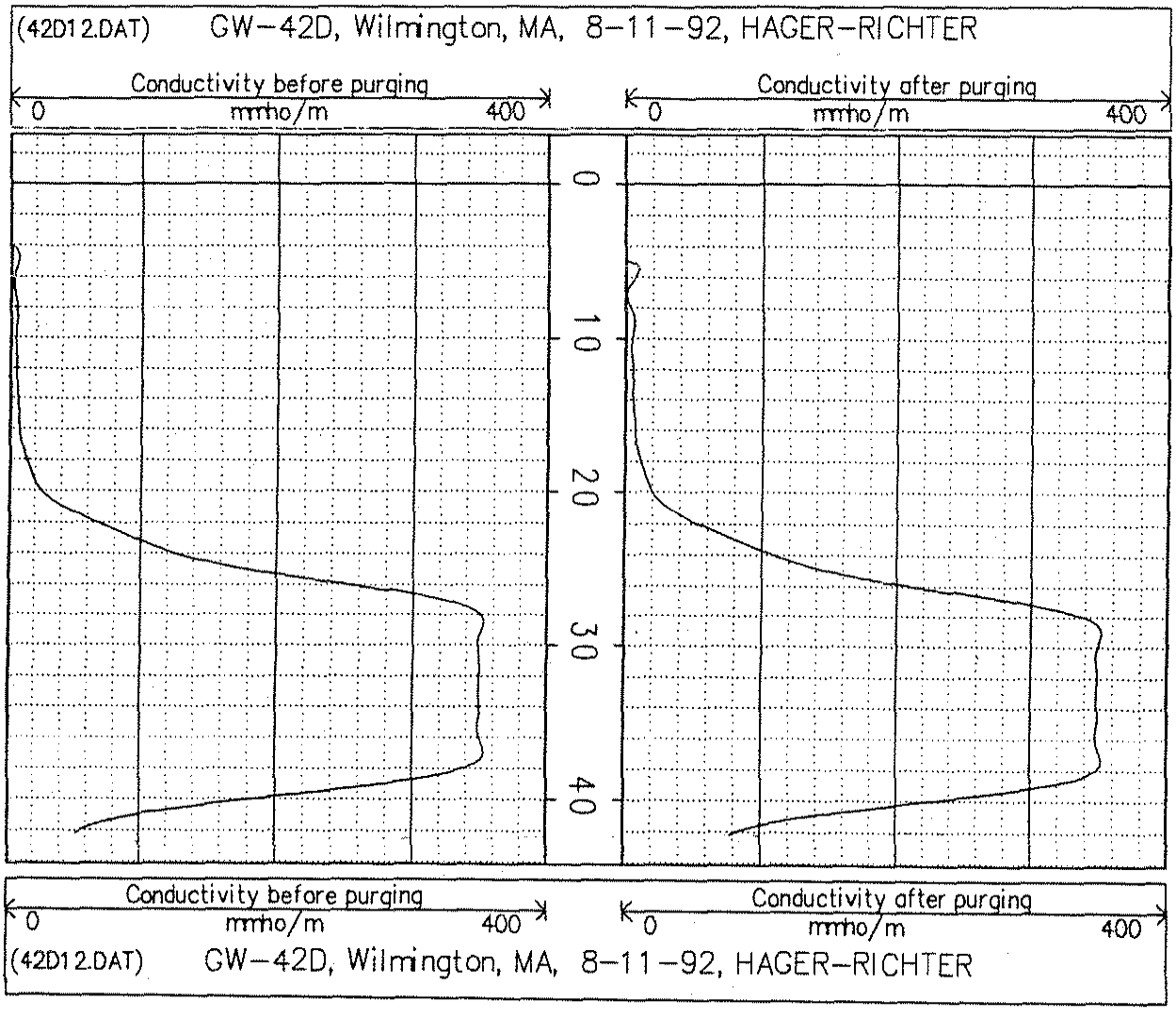
CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Monn
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



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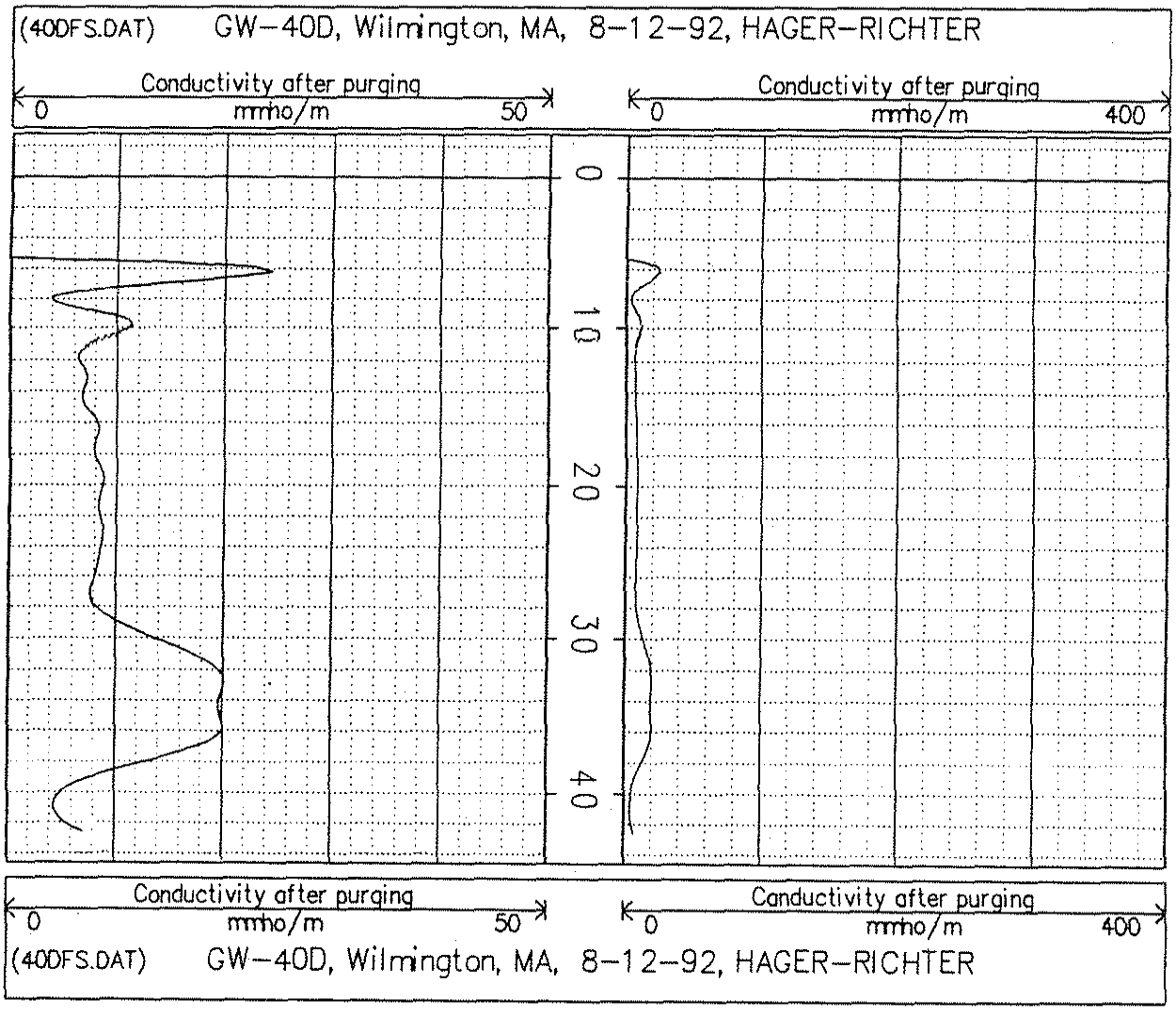
# CONDUCTIVITY

WELL: GW-40D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 86.4 feet
LOG DATUM: Ground Level
CLIENT TD: 45 feet
H-R TD: 44.73 feet
STATIC WATER LEVEL: 10.6 feet
DEPTH TO BEDROCK: 39.0 feet



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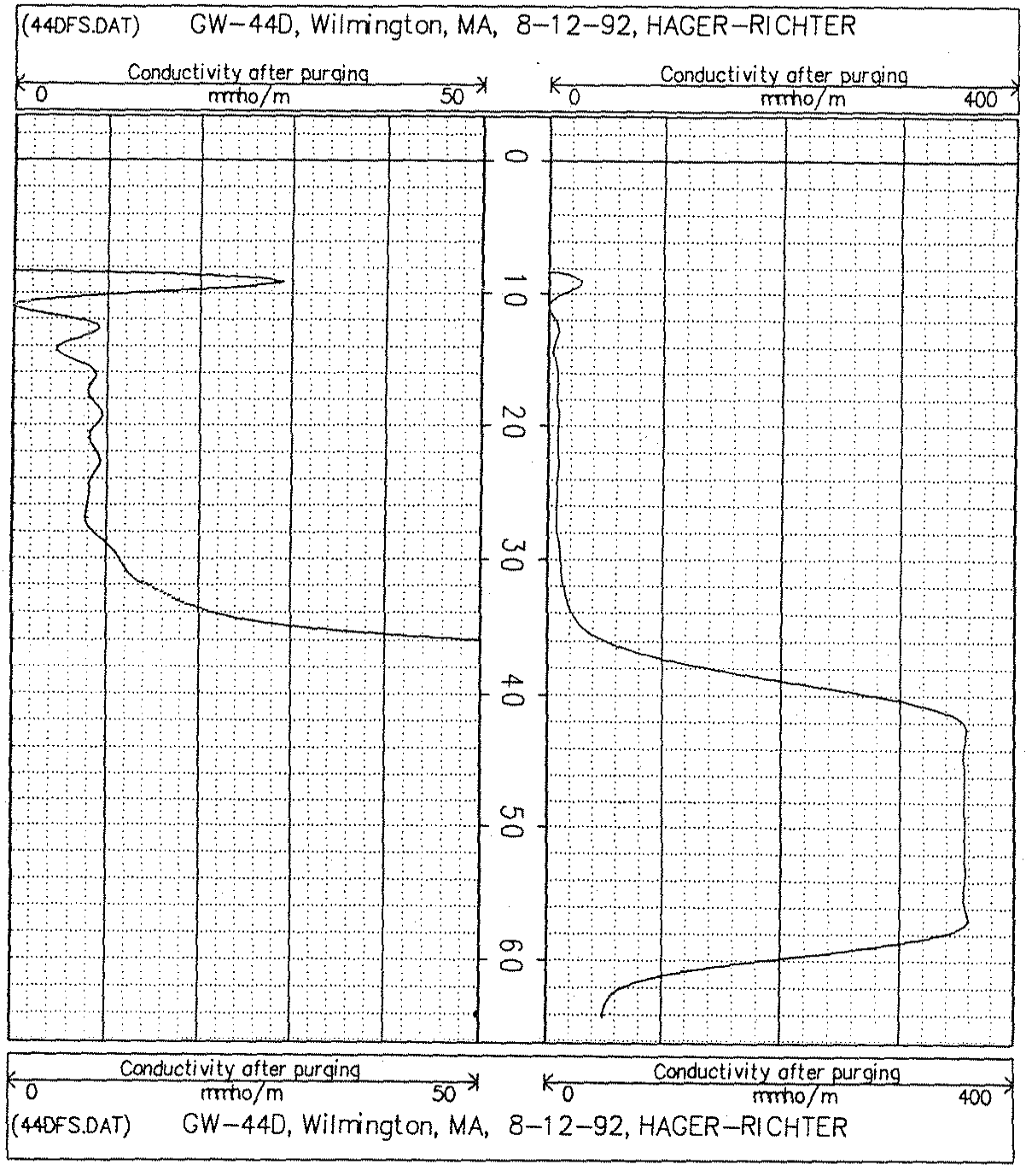
# CONDUCTIVITY

WELL: GW-44D

PROJECT: Olin Corporation Site
CLIENT: Conestogo-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 83.5 feet
LOG DATUM: Ground Level
CLIENT TD: 67 feet
H-R TD: 66.38 feet
STATIC WATER LEVEL: 5.94 feet
DEPTH TO BEDROCK: approx. 67 feet



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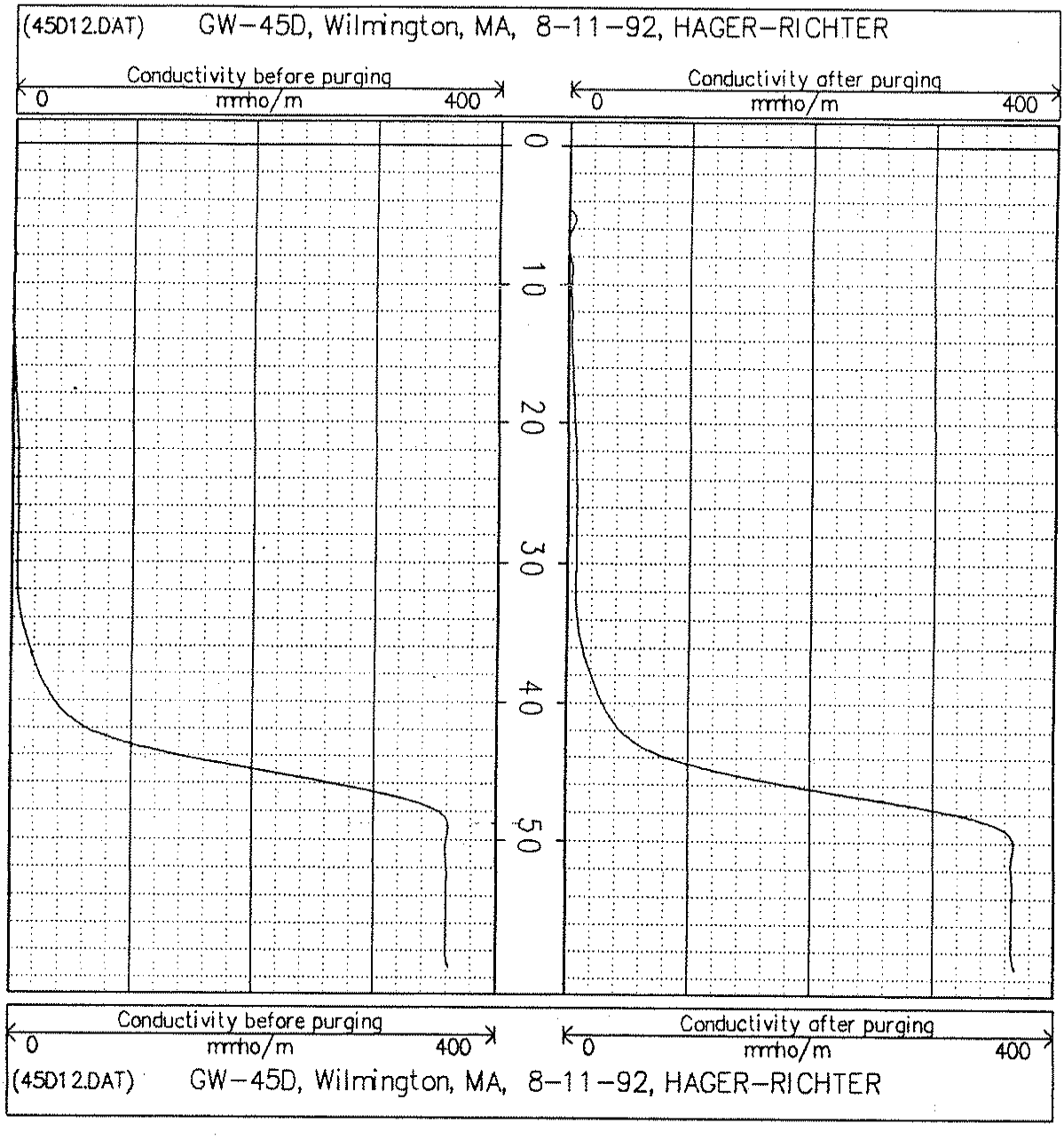
# CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



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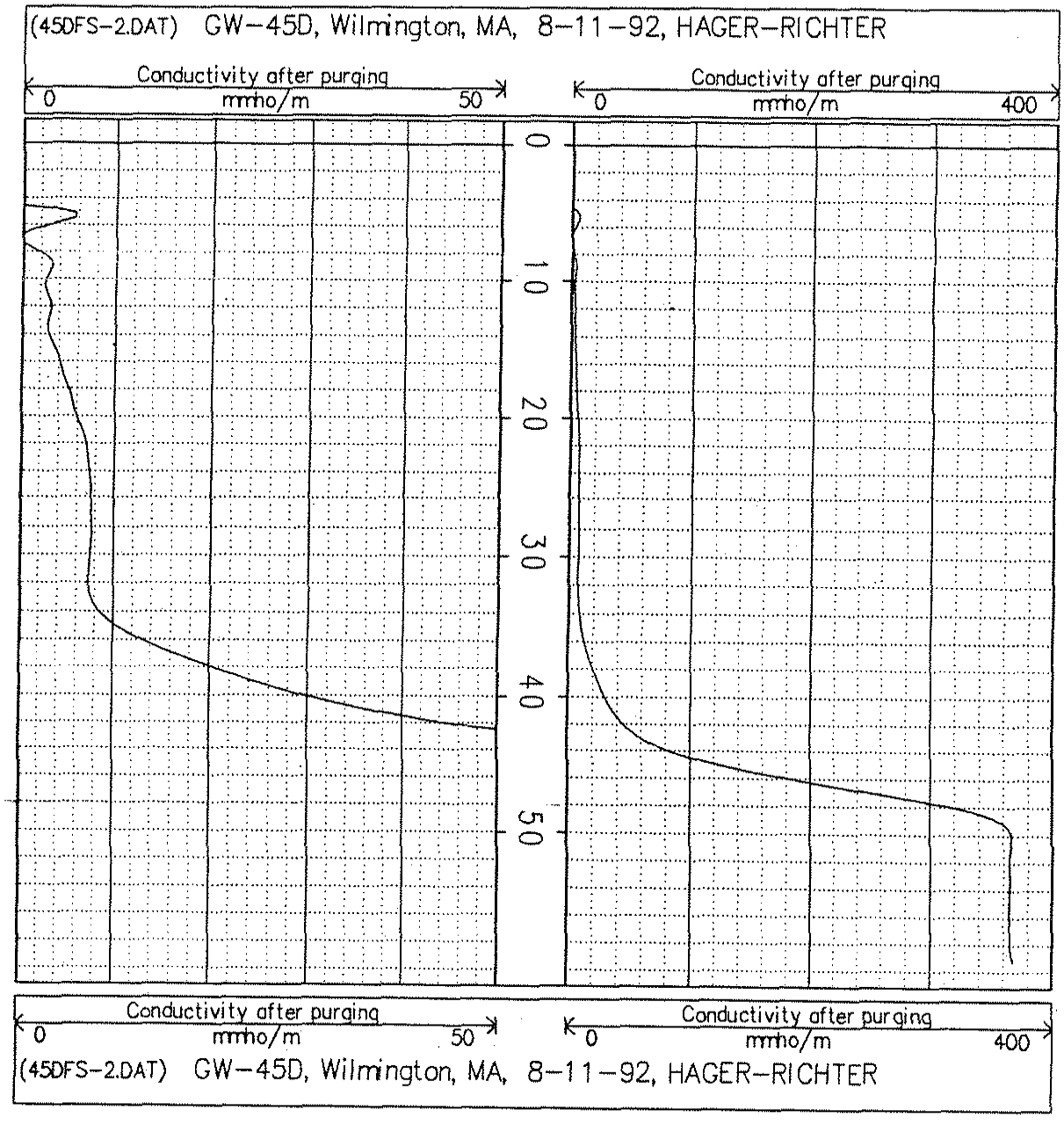
# CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



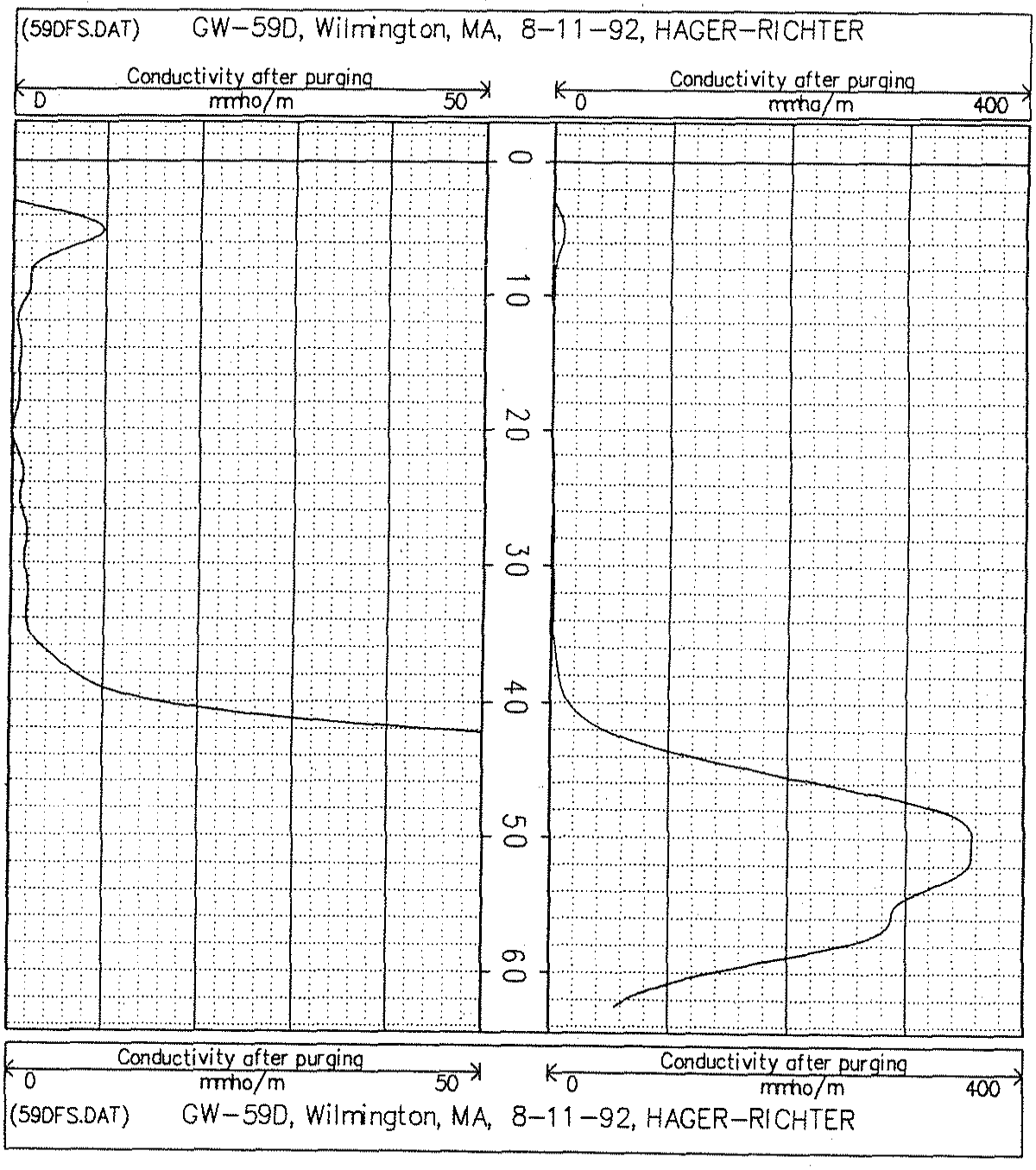
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-59D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.2 feet
LOG DATUM: Ground Level
CLIENT TD: 65 feet
H-R TD: 64.69 feet
STATIC WATER LEVEL: 4.57 feet
DEPTH TO BEDROCK: approx. 60 feet



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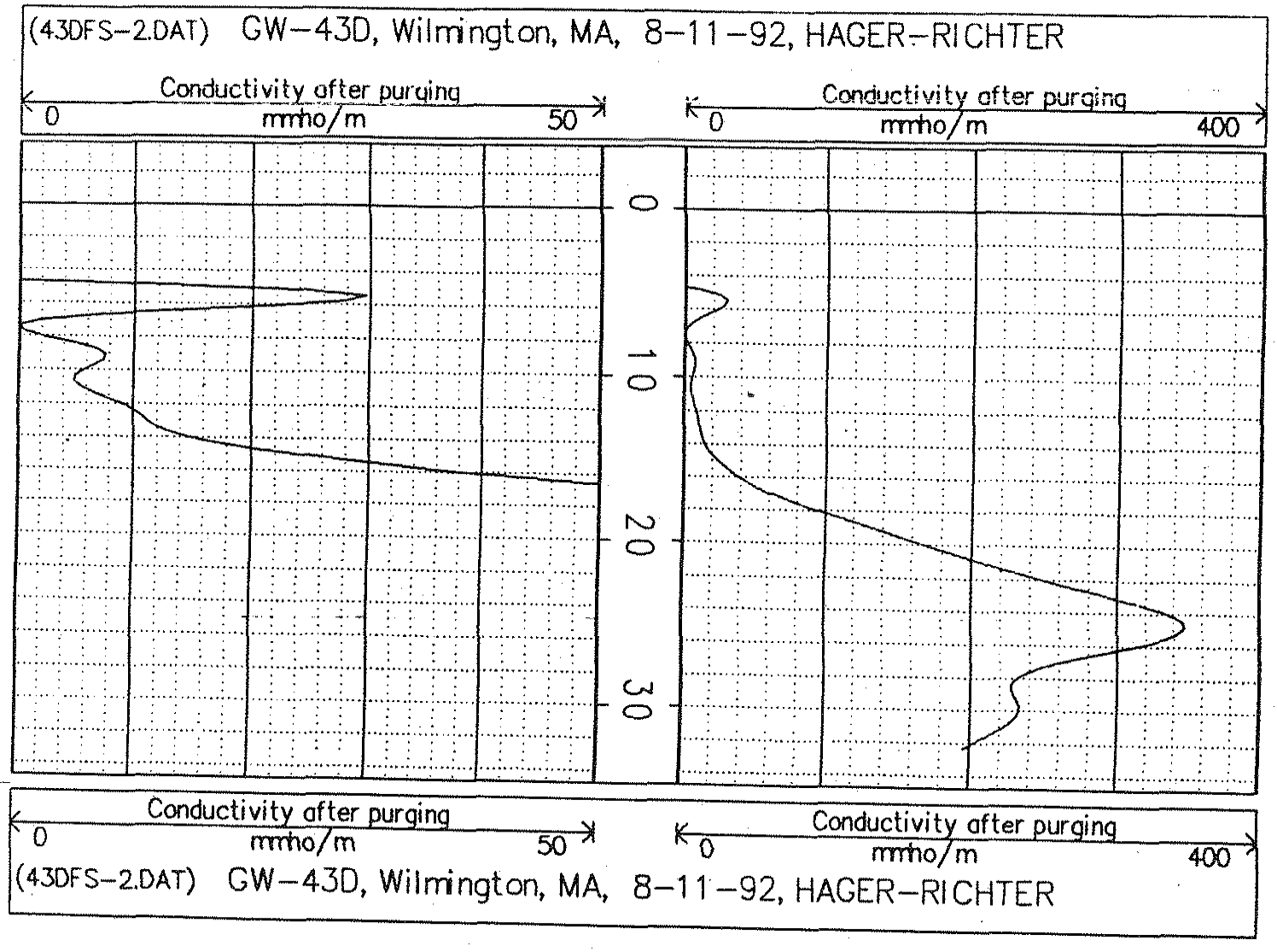
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet



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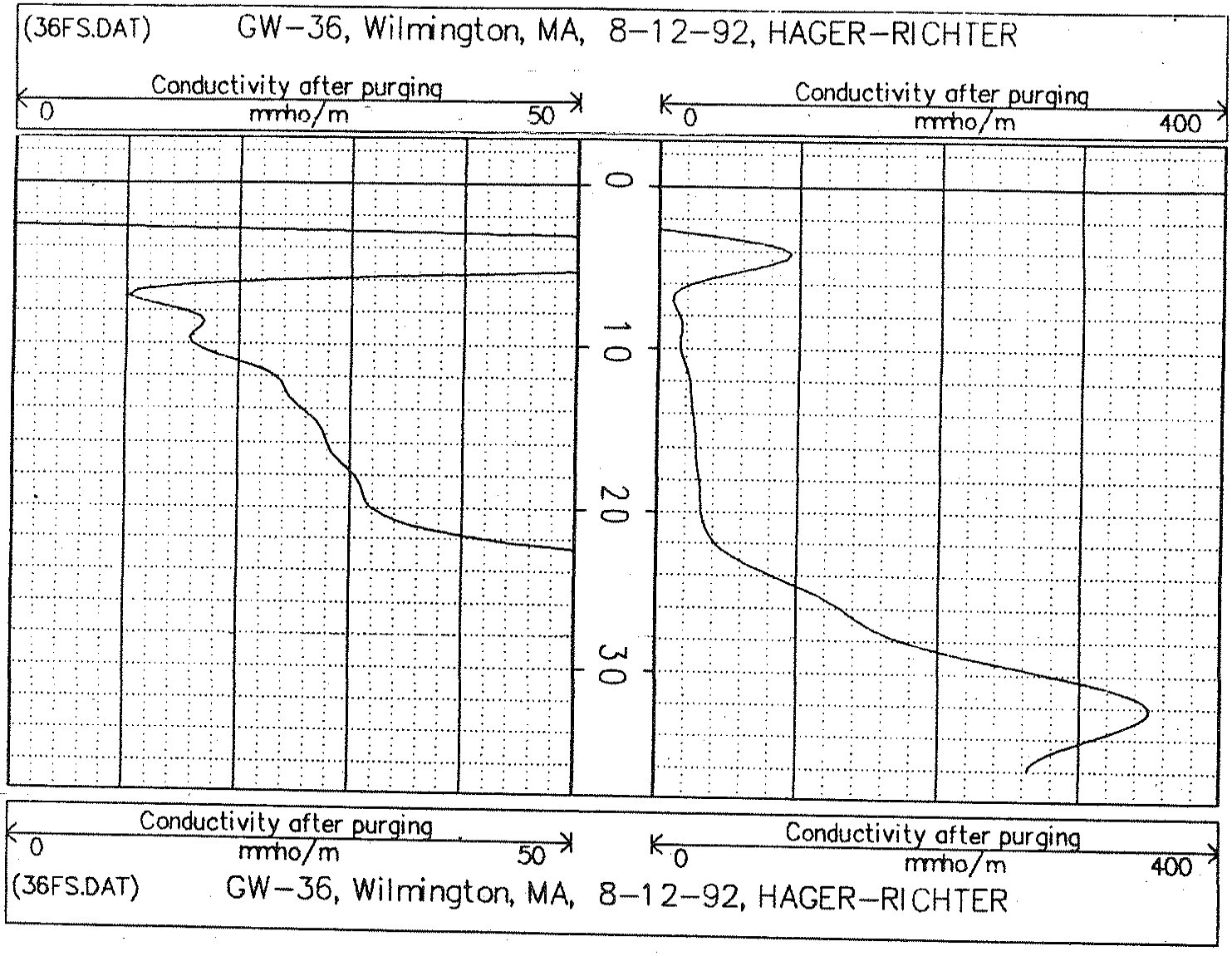
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-36

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 84.3 feet
LOG DATUM: Ground Level
CLIENT TD: 37 feet
H-R TD: 38.09 feet
STATIC WATER LEVEL: 5.4 feet
DEPTH TO BEDROCK: 36.5 feet



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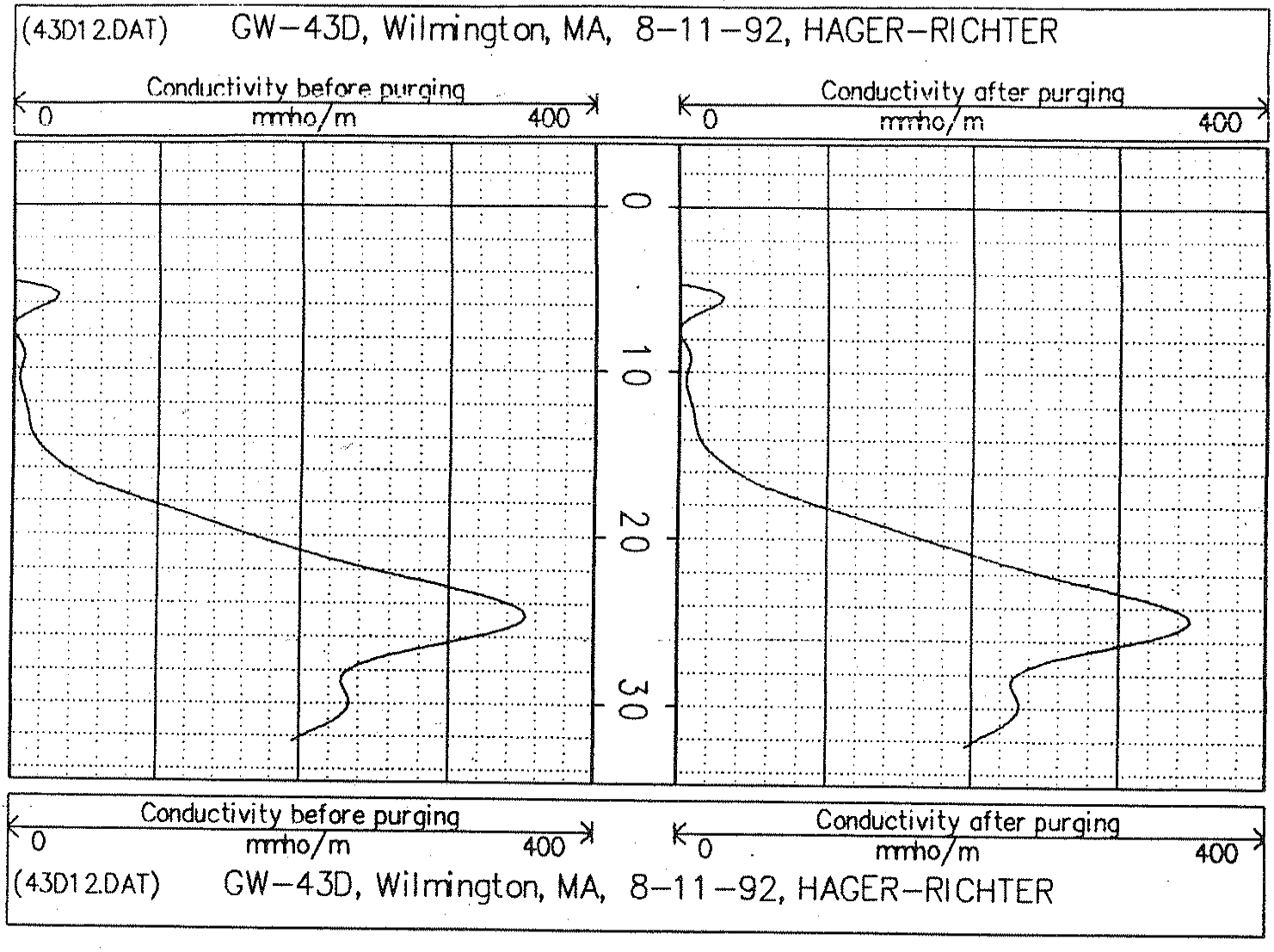
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet



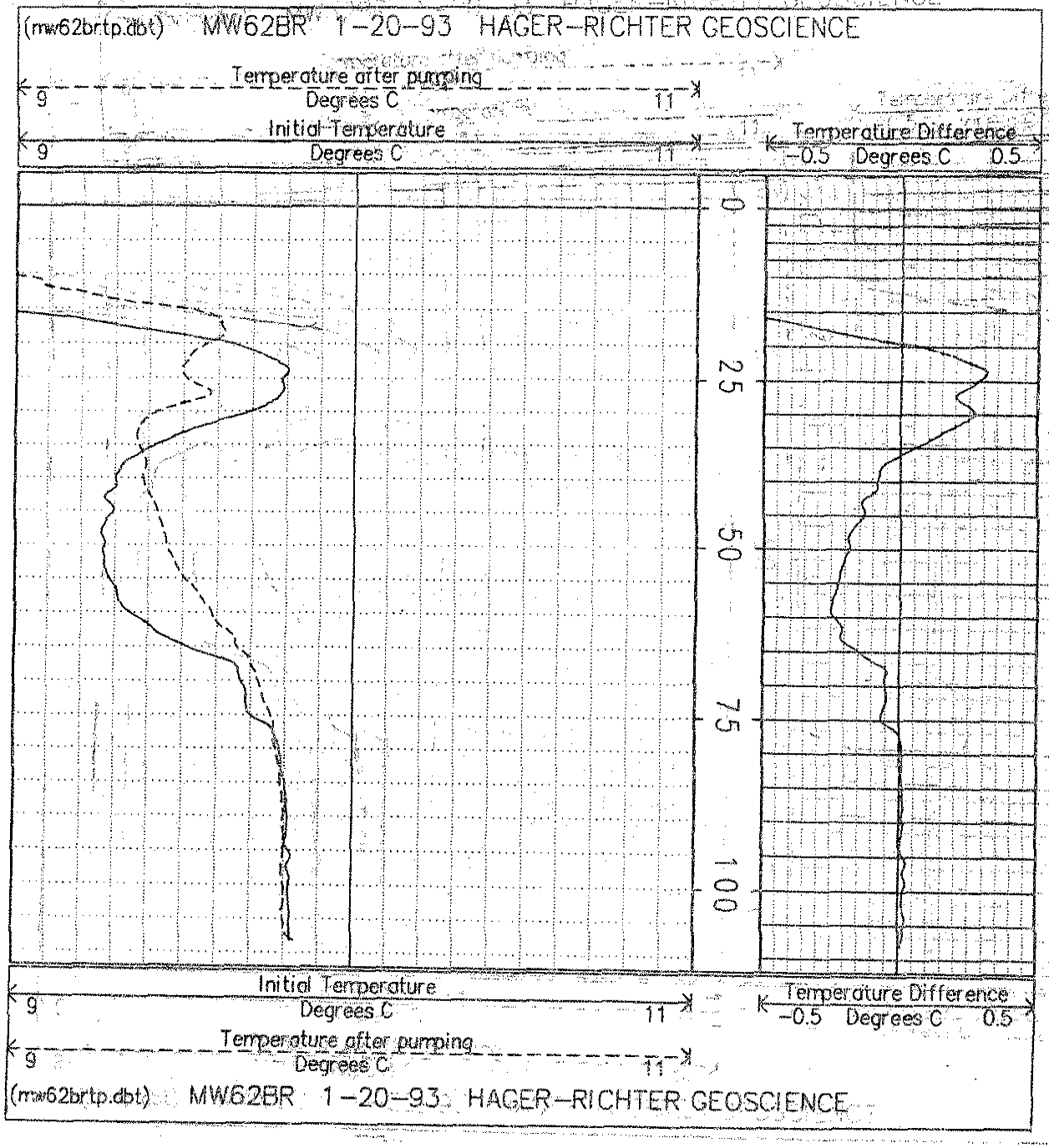
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-1.0
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW
WELL: GW62BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 80 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 110.3 feet
STATIC WATER LEVEL: 2.1 feet
DEPTH TO BEDROCK: 75 feet



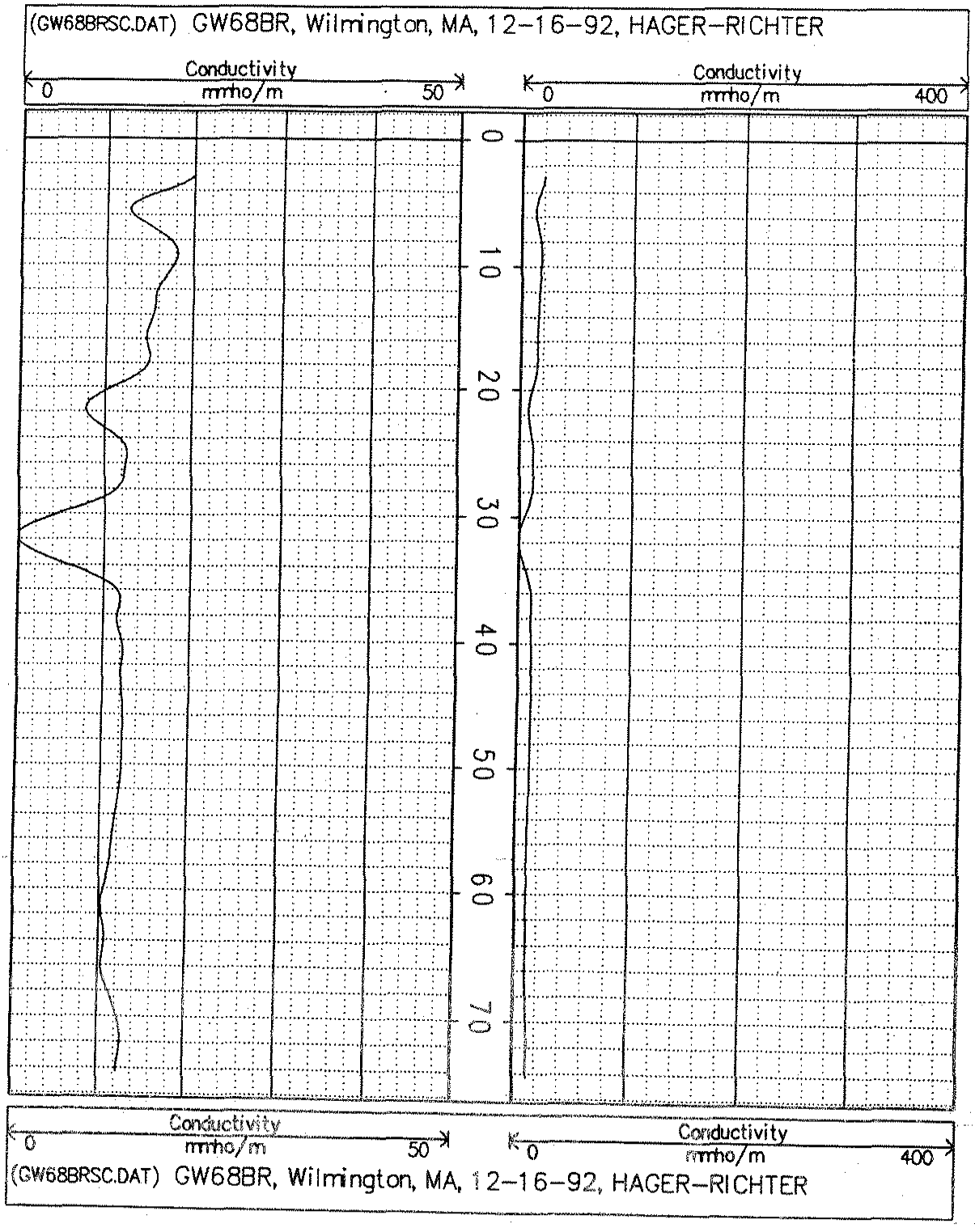
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 76.5 feet
STATIC WATER LEVEL: 18.6 feet
DEPTH TO BEDROCK: 21 feet



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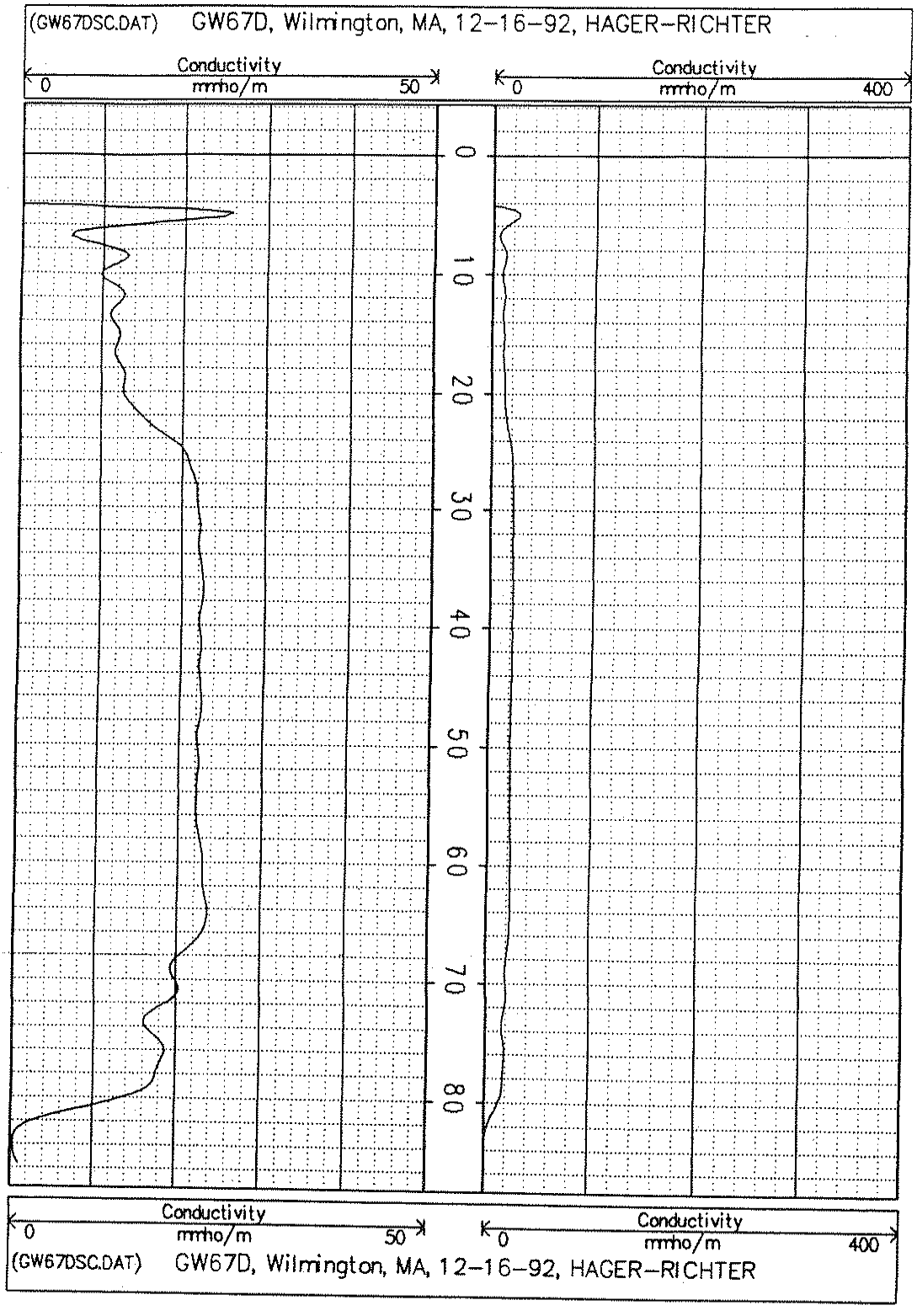
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW67D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 87.8 feet
STATIC WATER LEVEL: 17.3 feet
DEPTH TO BEDROCK:



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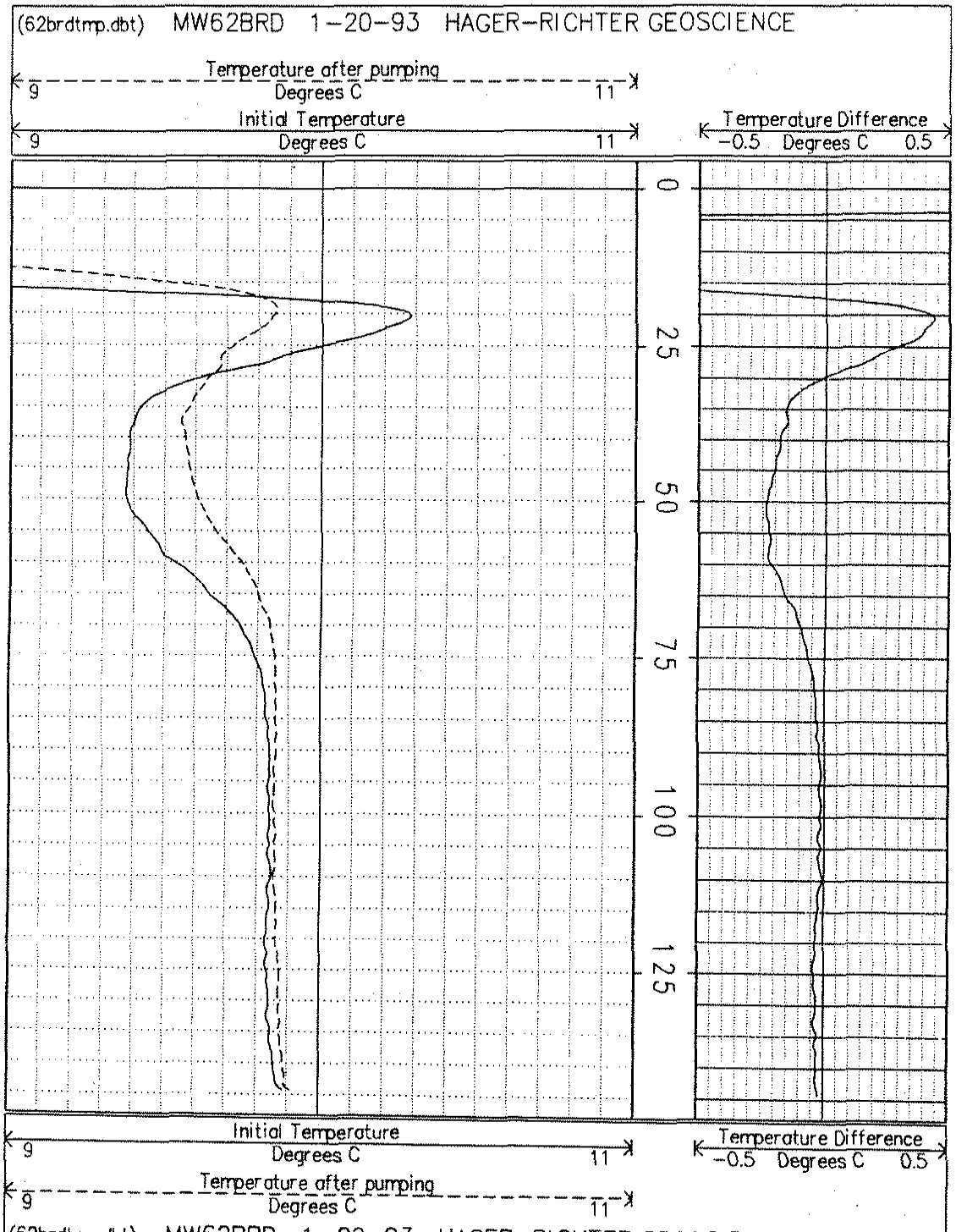
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW62BRD

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 105 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 145.9 feet
STATIC WATER LEVEL: 2.7 feet
DEPTH TO BEDROCK: 75 feet



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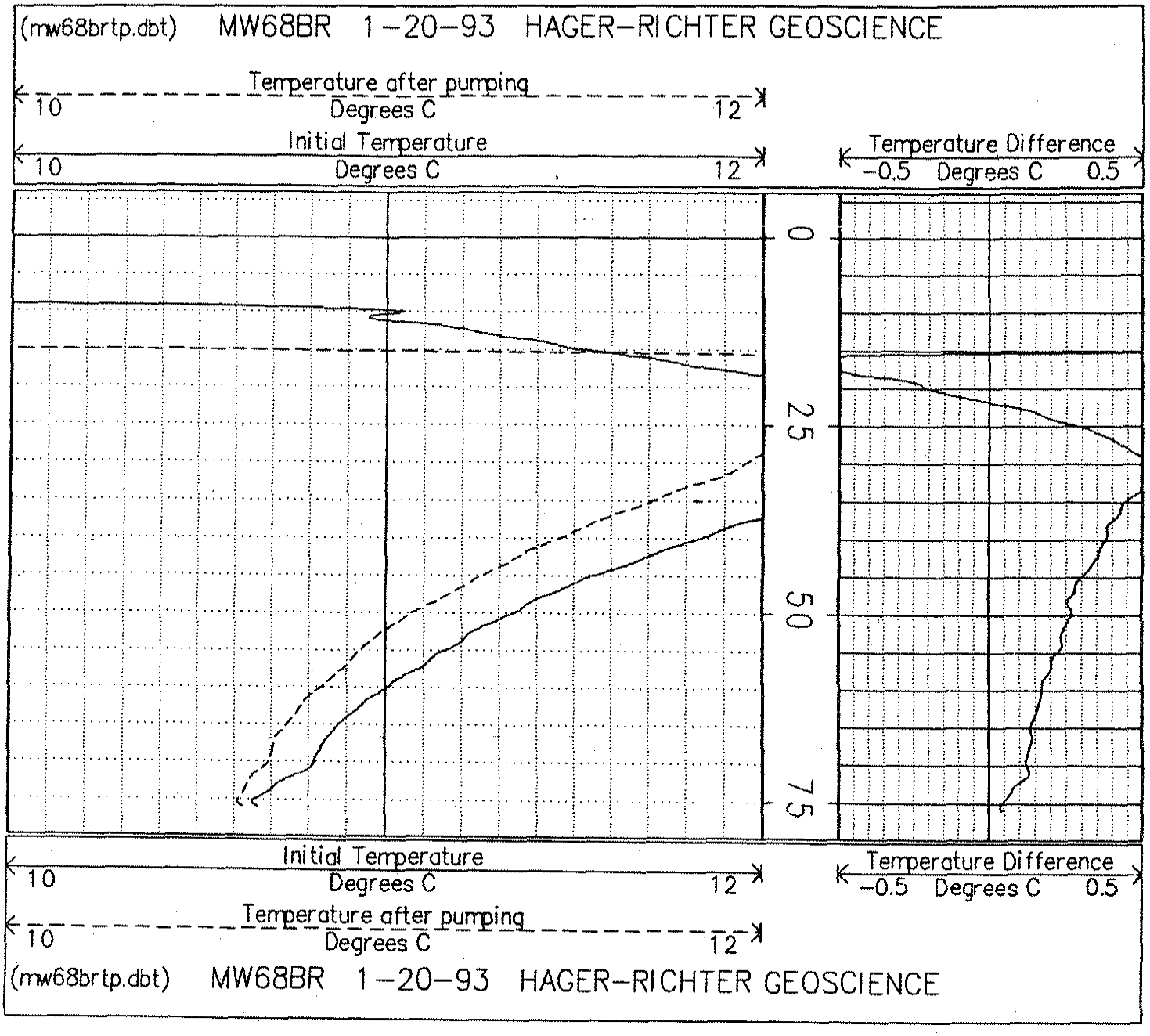
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# DUAL TEMPERATURE

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 26 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 75.7 feet
STATIC WATER LEVEL: 8.1 feet
DEPTH TO BEDROCK: 21 feet



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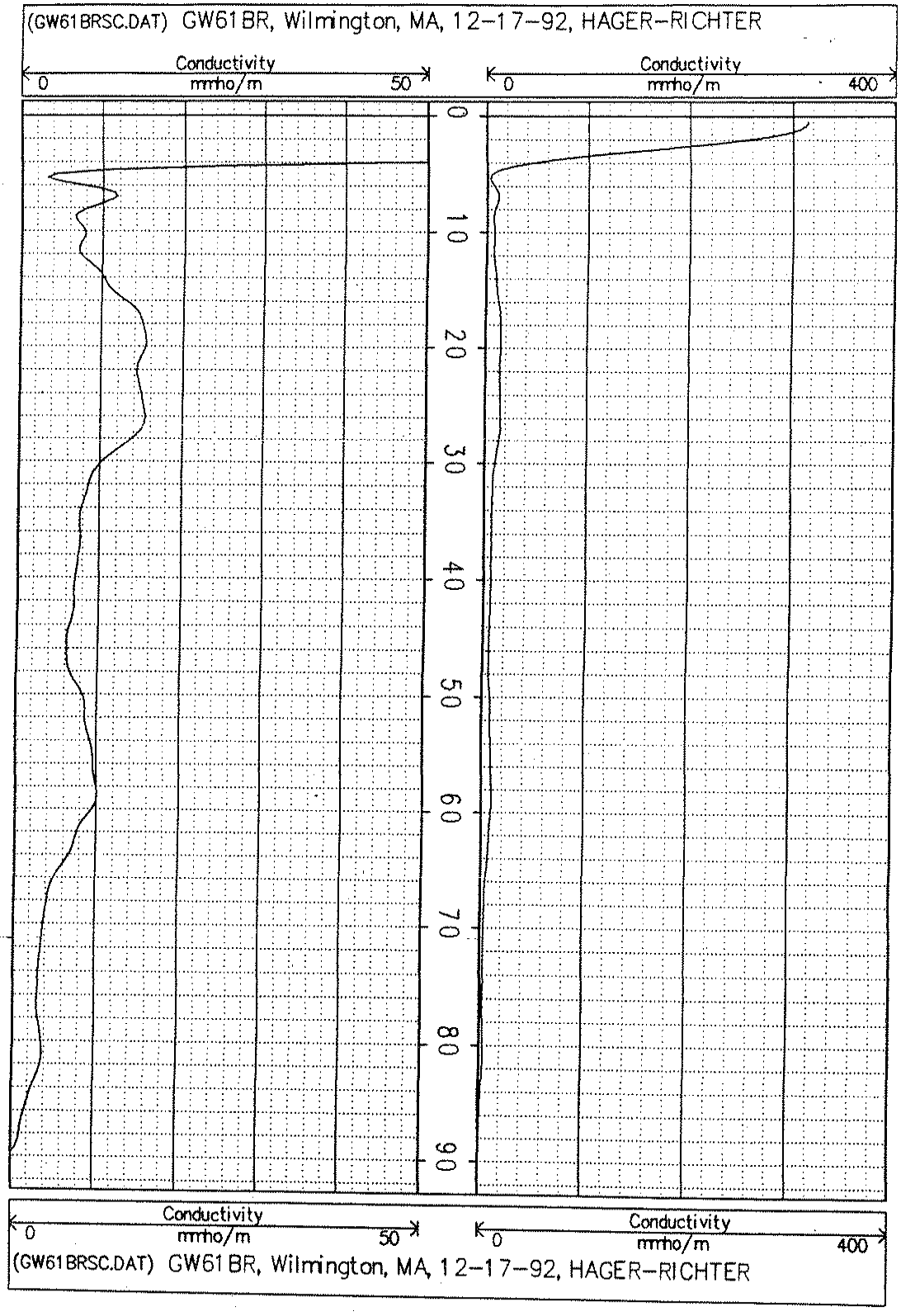
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW61BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 17, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 91.8 feet
STATIC WATER LEVEL: 4.7 feet
DEPTH TO BEDROCK:



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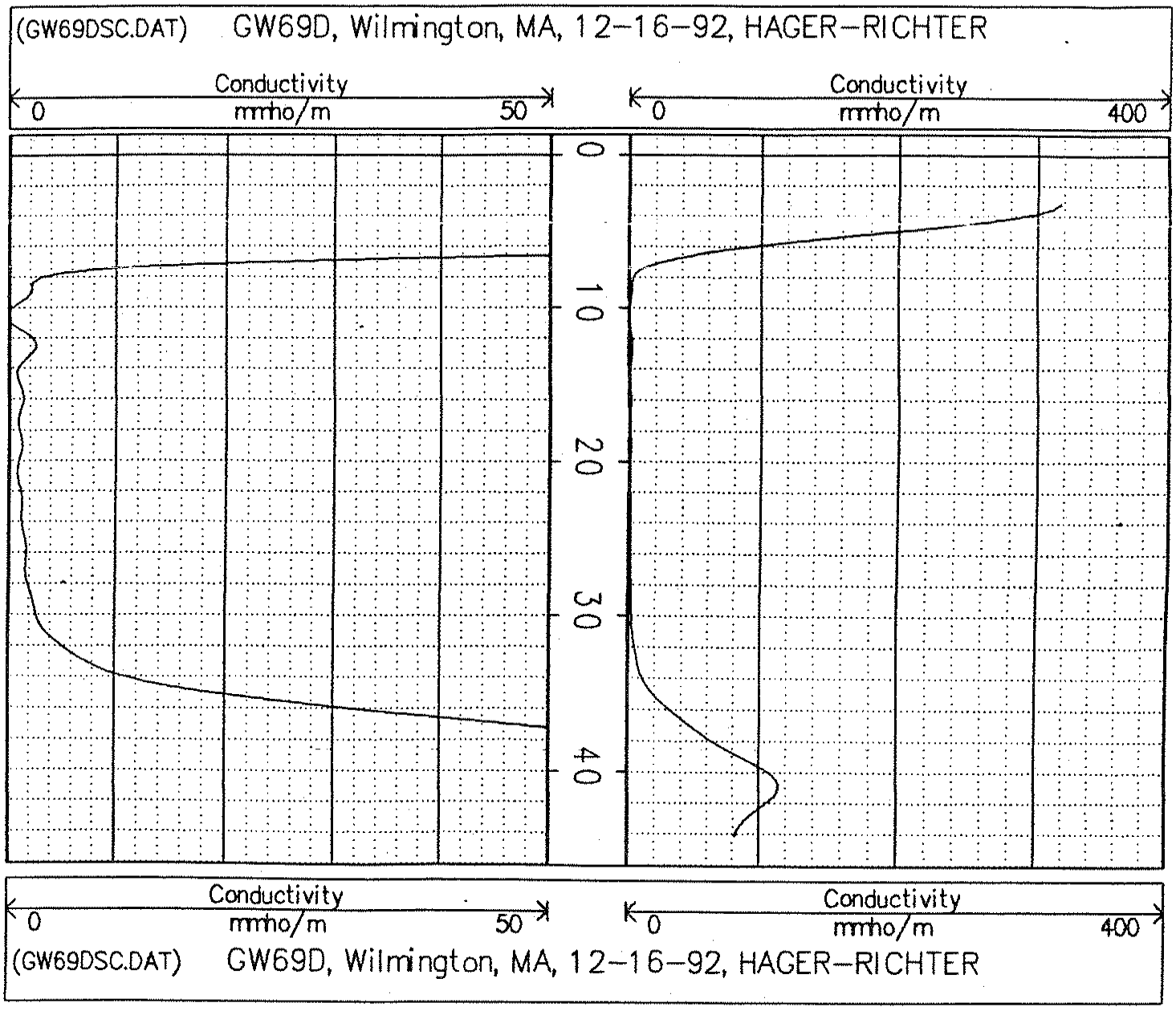
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW69D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jan Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

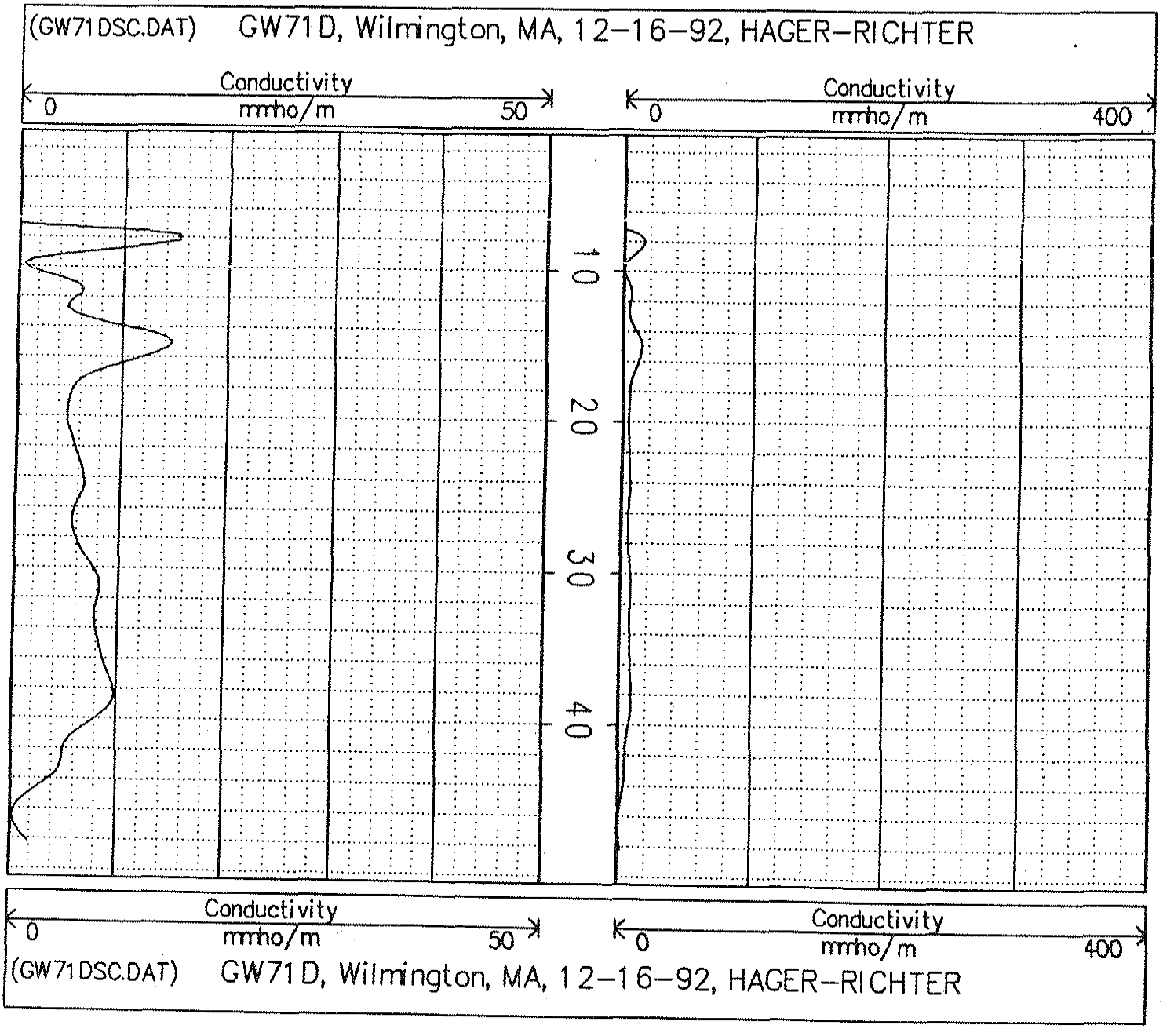
DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 46.3 feet
STATIC WATER LEVEL: 10.0 feet
DEPTH TO BEDROCK:



HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

# CONDUCTIVITY

WELL: GW-71 D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 50.3 feet
STATIC WATER LEVEL: 12.8 feet
DEPTH TO BEDROCK: