7.6.4

W. R. Grace & Company
ACTON ENVIRONMENTAL PROGRAM
QUARTERLY REPORT ON
AQUIFER RESTORATION

JULY 1985

GRACE

James F. Murphy, Jr.
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July 9, 1985

Mr. John R. Moebes
U.S. Environmental Protection Agency
Region 1
J. F. Kennedy Federal Building
Room 1903
Boston, Massachusetts 02203

Mr. Edmond G. Benoit
The Commonwealth of Massachusetts
Department of Environmental
Quality Engineering
Central Region
75 Grove Street
Worcester, Massachusetts 01605

Dear Messrs. Moebes and Benoit:

Enclosed is the Supplemental Aquifer Restoration Report as required by the "Addendum to Final Report on Aquifer Restoration Program".

Very truly yours,

James F. Murphy, Jr.

James F. Murphy, Jr.

JFM,JR/mlr

cc: H. I. Fox - Sierra Club, Washington, D.c.
O. M. Favorito - Grace/Cambridge
K. E. Wenger - EPA/Boston
B. J. Murphy, Jr. - Town of Acton
John MacLeod - Acton Water District
Steven Anderson - Palmer & Dodge

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## 1. SUMMARY

The aquifer restoration system at the W. R. Grace & Co. Acton facility has been operating since March 22, 1985. This first quarterly report describes operations, hydraulic monitoring, contaminant modeling, and new field work that has been undertaken.

Hydraulically, the system is operating as planned. The groundwater elevations that have been measured show that levels within the influence of the pumping wells are still dropping. Even though these absolute levels have yet to stabilize, the shape of the contours as of June 11/12 showed that the size and shape of the planned containment area was being achieved.

Sampling and analysis for volatile organics have shown a decrease with time in the tower influent that is expected to continue. More work will be required to determine the precise location of the emergence of contaminated groundwater up into Fort Pond Brook. Additional well points in Fort Pond Brook and a sampling well are recommended to clarify the presence of contamination at the farthest downstream sampling point.

More field work by Grace northeast of the Secondary Lagoon is not recommended at this time. It is also concluded that existing monitoring locations and sampling schedules in the Mass. Broken Stone Pit are sufficient.

## 2. INTRODUCTION

### System Description

The aquifer restoration system at the W.R. Grace & Co. Acton Facility was constructed and tested in the winter of 1984-1985 and placed into operation on March 22, 1985.

The system consists of seven pumping wells at five locations (two wells are paired) all discharging to a packed tower air stripper. The pumping wells are designed both to recover the groundwater under the site for treatment and to provide hydraulic containment (ie to prevent off-site migration of contaminated water by creating a depressed zone in the groundwater table). The air stripper is designed to remove volatile organic compounds from the groundwater. The treated water is discharged from the tower to Sinking Pond and infiltrates through the pond bottom back into the aquifer. Some of this treated water is recovered and recycled through the treatment system, while the balance moves southward either to the Assabet River or to the two pumping wells described below.

Two previously existing pumping wells (WRG-3 and RP-1) are also operating on the site. RP-1 protects the Assabet Well Field by pumping contaminated groundwater from the fractured bedrock. It discharges, through its own small packed tower air stripper, to the WRG-3 well casing. WRG-3 pumpage is partly used in the Daramic battery separator plant; the remainder is discharged directly to Sinking Pond.

The entire Aquifer Restoration System is shown in Figures 2-1 and 2-2. Characteristics of the pumping wells are summarized in Table 2-1.

### Startup and System Operation

The system was first activated on March 22, 1985. All wells, except for the WLF well, have been operating with few exceptions since that time. A flow record of the Aquifer Restoration wells is presented in Table 2-2.

The WLF well, though operable, has not been run since startup because of its proximity to an off-site landfill owned by Agway Inc. which was reported to be formerly used for disposal of agricultural chemicals. DEQE advised Grace and CDM of this potential problem in January 1985. Independent studies are currently being planned by others to determine if contaminants from this landfill have reached the groundwater. If it can be demonstrated that contaminants have not reached the groundwater under this landfill, then the WLF well can be activated. Meanwhile, groundwater elevation contours which are generated periodically as part of the Aquifer Restoration Monitoring program are studied to ensure that the containment zone developed by the pumping wells does not include the Agway landfill. The flow from the pumping system was reduced in mid-May to reduce the head in Sinking Pond, and thus to reduce the eastward component of the gradient in the vicinity of the Agway landfill. Head readings did not clearly show the Agway landfill to be coming within the combined area of influence of the Grace pumping system, but the developing gradients appeared to justify



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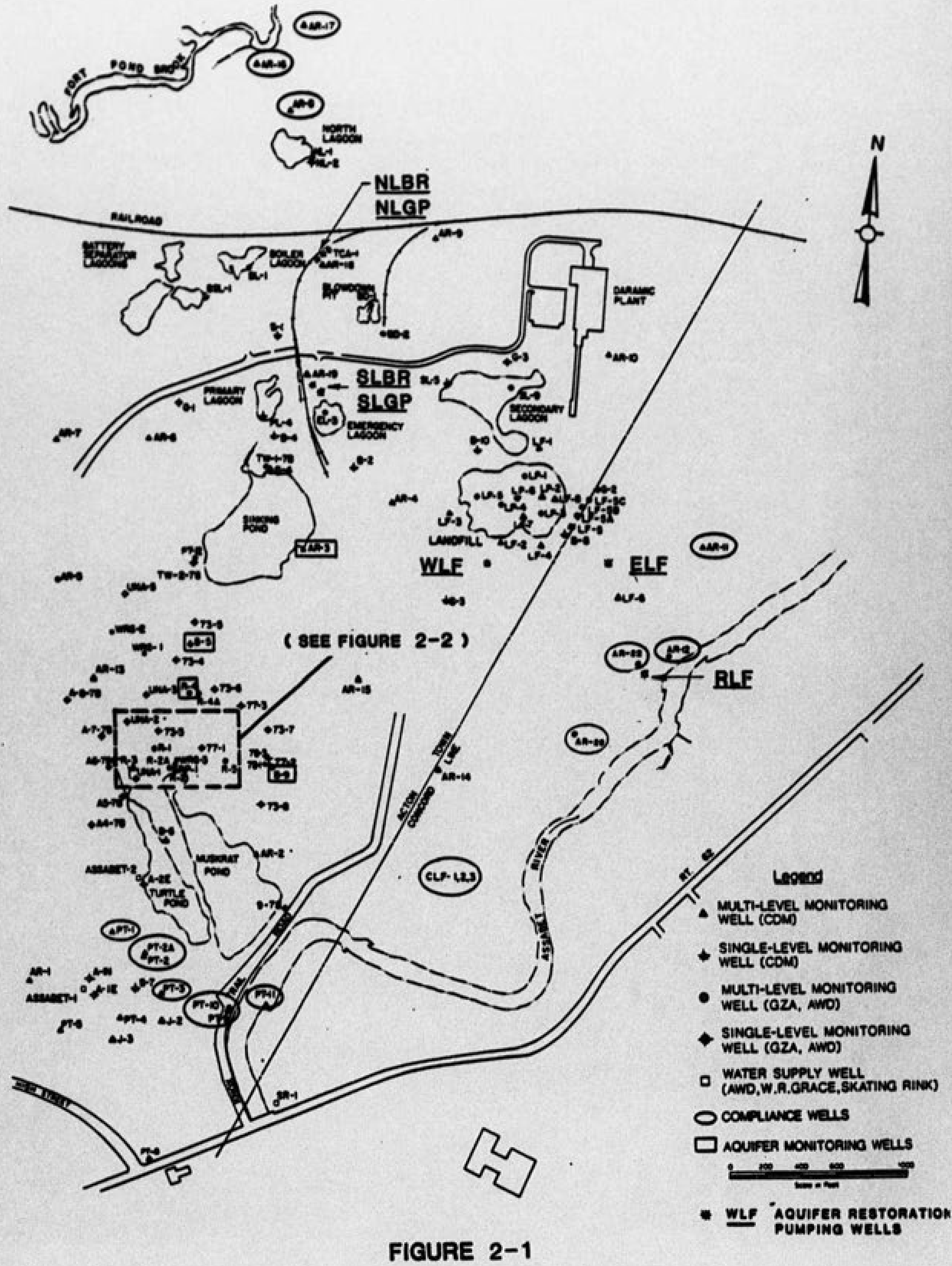


FIGURE 2-1

AQUIFER RESTORATION WELL LOCATIONS

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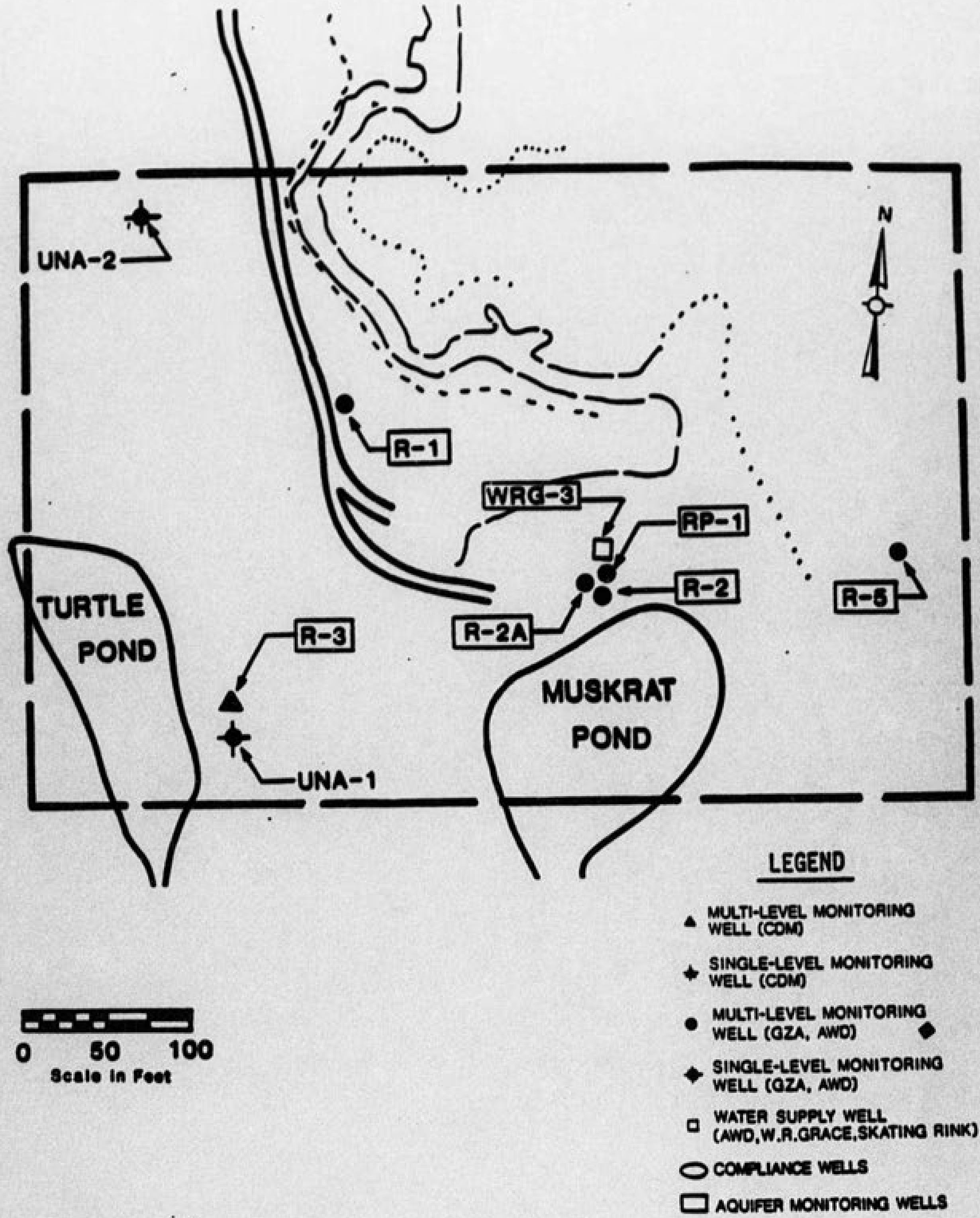


FIGURE 2-2

AQUIFER RESTORATION WELL LOCATIONS

TABLE 2-1

W.R. GRACE & COMPANY, ACTON FACILITY
AQUIFER RESTORATION PROGRAM

KEY CHARACTERISTICS OF PUMPING WELLS

| WELL | REFERENCE ELEV | DEPTH TO SCREEN (FT BELOW REF EL) TOP | BOTTOM |
|---|---|---|---|
| NLBR | 182.76 | 94 | 104 |
| NLGP | 182.91 | 72 | 87 |
| SLBR | 180.92 | 129 | 139 |
| SLGP | 181.88 | 92 | 112 |
| ELF | 197.35 | 60.6 | 100.6 |
| RLF | 147.01 | 32 | 41 |
| WLF | 198.24 | 93.4 | 111.4 |
| WRG-3 | NA | 45 | 60 |
| RP-1 | NA | 78 | 88 |

TABLE 2-2

WR GRACE--AQUIFER RESTORATION PUMPING WELL FLOWS--ALL FLOWS IN GPM (PRESSURE-PSI)

| DATE | WLF | ELF | RLF | WLBR | WLGP | SLBR | SLGP | TOTAL AR FLOW | WRG-3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| 29-Mar-85 | 0 | 25 | 0 | 37 | 5 | 38 | 330 | 435 | 336 | |
| 03-Apr-85 | 0 | 22 | 16 | 37 | 5 | 39 | 300 | 419 | | |
| 05-Apr-85 | 0 | 25 | 15.5 | 37 | 5 | 26.5 | 300 | 409 | 295 | ELF 15 TO 25 |
| 12-Apr-85 | 0 | 25 | 15.2 | 36 | 5 | 27 | 300 | 408.2 | 290 | ELF 20 TO 27 |
| 19-Apr-85 | 0 | 27 | 5 | 37 | 5 | 39 | 300 | 413 | 290 | |
| 22-Apr-85 | 0 | 47 | 21 | 43 | 12 | 0 | 380 | 503 | | |
| 26-Apr-85 | 0 | 25 | 15 | 38 | 5 | 39 | 300 | 422 | 308 | ELF NO GAGE |
| 03-May-85 | 0 | 25 | 14 | 35 | 5 | 39 | 310 | 428 | 299 | ELF NO GAGE |
| 10-May-85 | 0 | 25 | 14.8 | 36 | 5 | 40 | 270 | 390.8 | 290 | ELF NO GAGE |
| 17-May-85 | 0 | 25 | 14.5 | 36 | 5 | 40 | 270 | 390.5 | 292 | ELF NO GAGE |
| 24-May-85 | 0 | 25 (55) | 14.5 (106) | 35.5 (46) | 5 (95) | 40 (27) | 182 (44) | 302 | 299 | ELF NO GAGE |
| 31-May-85 | 0 | 32.5 (56) | 14.2 (108) | 35.5 (46) | 5 (87) | 40.5 (27) | 200 (44) | 327.7 | 290 | |
| 07-Jun-85 | 0 | 33.5 (59) | 14.2 (108) | 35.8 (46) | 5 (88) | 40.5 (27) | 190 (45) | 319 | 299 | |
| 14-Jun-85 | 0 | 24.7 (69) | 14.2 (109) | 35.8 (47) | 5 (90) | 37 (28) | 190 (42) | 306.7 | 303 | ELF REDUCED TO 20.8 (72) |
| 20-Jun-85 | 0 | 17.5 (76) | 14.2 (109) | 35.6 (47) | 5 (93) | 37 (27) | 225 (41) | 334.3 | 290 | WLGP NO GAGE<br>ELF REDUCED TO 10 (80) |
| 28-Jun-85 | 0 | 34.5 (58) | 7 (110) | 35.5 (48) | 5 (101) | 40.8 (30) | 260 (31) | 382.8 | 299 | RESTARTED 6/27 AFTER<br>1 DAY POWER OUTAGE<br>ELF WIDE OPEN |

this precautionary measure. Data presented in Section 3 show that the Agway landfill is not within the influence of the Grace pumping system.

Each well is equipped with a low level cutoff switch which automatically shuts the pump off when a preset low water level is sensed in the well casing. The ELF, RLF and NLGP wells have experienced shutdowns due to low water level. Their discharges have been reduced to enable continuous operation. The ELF well was further throttled in mid-June to reduce possible loadings of acetone and MEK to the air stripper (details explained in Section 3).

As predicted before startup, high levels of dissolved iron were in the raw water entering the stripper. It soon became apparent that this iron could, upon oxidation during the air stripping process, result in the formation of sufficient iron precipitate within the tower to coat the packing. Such fouling might ultimately affect the efficiency of the treatment process. This problem did occur after about eight months of operation at the small air stripper associated with the RP-1 recovery well. In early 1985, that tower became completely plugged with iron deposits. The RP-1 tower media were replaced and the tower was returned to service.

To date, the amount of iron precipitate in the full-scale tower is not threatening the operating efficiency; however, bench scale testing has been performed to develop a method of cleaning the tower before the accumulation becomes serious. To date, muriatic acid and hydrogen peroxide, each in weak solution, have been effective in cleaning media placed in a 6-inch diameter test column. The neutral pH residue after hydrogen peroxide cleaning makes peroxide the more attractive alternative for further study.

Iron or other material precipitating in the ELF discharge line plugged the pressure sensing ports in that well's orifice meter after about 1 month of operation. The gage and a short length of piping was cleaned and placed back in service in late May. That gage has since shown normal readings. The NLGP gage has recently started to indicate anomalous readings. That problem has not yet been diagnosed.

Other minor problems have developed during the last three months' operation. All well controls are housed in buried concrete vaults. Small amounts of rainfall leaking through the vault covers and small piping leaks that develop from time to time result in puddling of water within the vault and high humidity. A few small holes drilled in the concrete vault floors solved that problem. Minor repairs were also done to the control panel and conduit supports in Building No. 10 (adjacent to the full-scale stripping tower); this building houses the power supply, main breakers and status light panel for the Aquifer Restoration System). A few minor electrical system faults, including an undiagnosed control anomaly which could possibly cause problems for future operations, have not yet been repaired.

Immediately upon startup of the aquifer restoration pumping and treatment system, foaming was observed in the sump to which the air stripping tower discharges. That foaming has abated, but a sample was taken for semivolatile analysis (acid/base/neutral extractable organics) on April 12, 1985. The goal of this sample was to identify the cause of the foaming and to determine any nonvolatile compounds in the discharge. No priority pollutants were found, but the library search tentatively identified the following compounds:

| Compound | Estimated Concentration (ug/l) | Spectral Match |
|---|---|---|
| Ethyloxirane | 64 | Poor |
| 1-methyl-1,2,4-Triazole | 14 | Poor |
| 1,1'-oxybisbutane | 14 | Good |
| 1,4-cyclohexanedione | 30 | Poor |
| Trans-1,2-cyclobutane-dicarbonitrile | 8 | Poor |

Four of these peaks, as shown above, were not judged by the analyst to have a good match to any compound on the EPA/NIH/NBS mass spectral data base. None of the five compounds is listed on the Merck Index of 10,000 chemicals, indicating that they have little, if any, commercial, industrial, or medicinal use. Toxicological data are not available, and it is not known whether these substances are natural or man-made.



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## 3. RESULTS OF MONITORING

The data on heads, flows, and concentrations of contaminants are summarized in this section.

### A. Groundwater Flow

The groundwater head measurements made to date are listed in Table 3-1. In addition to the required full round during June, earlier readings were made on selected wells during March and April. One purpose of these early readings was to observe any tendency for groundwater beneath the Agway site to come under the influence of the Grace pumping system. These early readings showed a marginal possibility of that behavior occurring. The best way to reduce that possibility was to reduce the head in Sinking Pond. Therefore, the Southern Lagoon Gravel Pack Well, which pumps most of the water through the aquifer restoration treatment system to the pond, was cut back from about 300 gpm to 200 gpm.

The flow field inferred from the heads shown in Table 3-1 is shown on Figure 3-1. For comparison, the predicted flow field is shown on Figure 3-2 (a reproduction of Figure 6.2, Vol. III, "Final Report on the Aquifer Restoration Program," June 1984). Comparison of actual and predicted flow fields reveals that overall, the two flow fields are quite similar. The inactive status of the Western Landfill well causes some differences in that vicinity. Absolute elevations vary somewhat between the prediction and the field data, but the shape of the contours, which governs flow directions, is as expected.

Those monitoring wells that have water level readings from more than one occasion have shown a tendency for water elevations to decrease with time, indicating that equilibrium has not been established. As time passes and the contours/cones of depression become stable, the absolute water levels are expected to be closer to the predicted water levels.

### B. Water Quality Data

The available data on volatile organics are tabulated and discussed here under four categories:

1. Performance of Aquifer Restoration System
2. Protection of Assabet Well Field
3. Fort Pond Brook
4. Laws Brook Well Field

1. <u>Aquifer Restoration System.</u> In this category of data are the monitoring wells intended to check overall system performance, the Grace pumping wells installed in the fall of 1984, and those samples associated with the air stripping tower and Sinking Pond. Data for these wells are summarized on Table 3-2.

   Levels of contamination in the tower influent are already decreasing as shown in Figure 3-3.

TABLE 3-1

W.R.GRACE, ACTON FACILITY, GROUNDWATER ELEVATION SUMMARY PAGE 1/3

| WELL NO. | * | REF. EL | ** | WATER ELEVATION 3/29/85 | 4/3/85 | 4/12/85 4/16/85 | 6/11/85 6/12/85 |
|---|---|---|---|---|---|---|---|
| A-2E | * | 132.70 | ** | | | | 122.85 |
| A4-78 | * | 134.98 | ** | | | | 126.19 |
| A5-78 | * | 132.32 | ** | | | | 126.73 |
| A6-78 | * | 138.55 | ** | | | | 127.53 |
| A8-78 | * | 141.28 | ** | | | | 130.90 |
| AR-1 | * | 139.91 | ** | | | | 125.96 |
| AR-2 | * | 137.38 | ** | | | | 125.69 |
| AR-3 | * | 153.96 | ** | | 141.04 | | 140.80 |
| AR-4 | * | 171.72 | ** | | 140.11 | | 139.73 |
| AR-5 | * | 199.31 | ** | | | | 136.38 |
| AR-6 | * | 199.67 | ** | | | | 141.14 |
| AR-7 | * | 202.70 | ** | | | | 147.64 |
| AR-8 | * | 141.39 | ** | | 133.85 | | 132.72 |
| AR-9 | * | 187.84 | ** | 140.55 | 140.47 | 140.30 | 139.53 |
| AR-10 | * | 191.68 | ** | 139.42 | | | 138.58 |
| AR-11 | * | 141.37 | ** | 134.84 | 134.93 | | 134.32 |
| AR-12 | * | 141.45 | ** | 124.06 | 124.06 | | 123.44 |
| AR-13 | * | 142.75 | ** | | | | 131.32 |
| AR-14 | * | 152.31 | ** | | 128.54 | | 128.27 |
| AR-15 | * | 160.93 | ** | | 136.64 | | 136.55 |
| AR-16DP(A) | * | 137.46 | ** | | | | 129.92 |
| AR-16SH(B) | * | 137.53 | ** | | | | 129.46 |
| AR-17DP(B) | * | 145.09 | ** | | | | 131.36 |
| AR-17SH(A) | * | 143.01 | ** | | | | 131.01 |
| AR-18 | * | 185.47 | ** | 137.75 | 137.55 | | 136.35 |
| AR-19DP(B)PZ | * | 184.22 | ** | 138.70 | 138.68 | | 138.02 |
| AR-19SH(A)PZ | * | 184.92 | ** | 135.65 | 136.47 | | 136.01 |
| AR-20 | * | 147.72 | ** | 129.46 | 129.30 | | 128.84 |
| AR-20A | * | 147.80 | ** | 134.45 | 134.29 | | 133.27 |
| AR-21 | * | 197.80 | ** | 129.41 | 129.14 | 129.02 | 128.77 |
| AR-21A | * | 197.61 | ** | 129.52 | 128.69 | 128.43 | 128.31 |
| AR-21B | * | 197.71 | ** | 136.39 | 136.30 | 136.13 | 135.59 |
| AR-22 | * | 148.47 | ** | | 114.15 | | 114.85 |
| AR-23 | * | 165.99 | ** | | 136.22 | | 135.13 |
| AR-23A | * | 165.81 | ** | | 136.33 | | 135.22 |
| AR-23B | * | 165.53 | ** | | 136.10 | | 135.02 |
| ASS.RIV.(HIGH ST) | * | | ** | | 126.94 | | |
| B-1 | * | 178.28 | ** | 140.25 | 138.93 | | 138.07 |
| B-2 | * | 178.03 | ** | 140.17 | 140.24 | | 139.90 |
| B-3 | * | 168.28 | ** | 138.18 | 138.24 | | 138.01 |
| B-4 | * | 168.06 | ** | 139.88 | 139.83 | | 139.49 |
| B-6 | * | 139.13 | ** | | | 125.52 | 124.20 |
| B-7 | * | 137.43 | ** | | | | 123.45 |
| B-10 | * | 197.04 | ** | | 139.87 | | 139.25 |
| BD-1 | * | 195.90 | ** | 140.00 | 139.78 | | 138.53 |
| BD-2 | * | 195.91 | ** | 140.03 | 139.83 | | 138.64 |
| BL-1 | * | 177.42 | ** | 138.47 | 138.08 | | 136.88 |
| BSL-1 | * | 178.67 | ** | | 140.99 | | 139.99 |
| CLF-1 | * | 151.24 | ** | | 126.30 | | 125.96 |
| CLF-2P1(C) | * | 131.78 | ** | | 125.51 | | 124.70 |
| CLF-2P2(B) | * | 129.81 | ** | | 125.00 | | 124.39 |

| WELL NO. | * | REF. EL | ** | WATER ELEVATION 3/29/85 | 4/3/85 | 4/12/85 4/16/85 | 6/11/85 6/12/85 |
|---|---|---|---|---|---|---|---|
| CLF-2P3(A) | * | 131.65 | ** | | 124.19 | | 123.62 |
| CLF-3P1(A) | * | 132.10 | ** | | 125.24 | | 123.12 |
| CLF-3P2(B) | * | 133.23 | ** | | 124.84 | | 123.28 |
| CLF-3P3(C) | * | 133.25 | ** | | 124.86 | | 124.24 |
| EL-3 | * | 174.74 | ** | 139.40 | 139.27 | | 138.73 |
| ELF-OBS | * | 197.97 | ** | 134.75 | 134.72 | | 135.67 |
| G-1 | * | 201.75 | ** | | | | 140.74 |
| G-2 | * | 198.31 | ** | 138.15 | 138.08 | | 137.34 |
| G-3 | * | 192.13 | ** | | | | 139.04 |
| J-2P | * | 139.30 | ** | | | | 123.45 |
| J-3P | * | 135.70 | ** | | | | 122.67 |
| LF-1 | * | 192.96 | ** | | | | 138.25 |
| LF-2 | * | 195.01 | ** | | 137.74 | | 136.79 |
| LF-3 | * | 202.10 | ** | | 141.11 | | 140.64 |
| LF-4 | * | 199.42 | ** | 137.81 | 137.76 | | 138.14 |
| LF-5 | * | 199.64 | ** | 137.13 | 137.92 | | 137.00 |
| LF-5A | * | 199.74 | ** | 137.88 | 137.84 | | 137.12 |
| LF-5B | * | 198.55 | ** | 138.14 | 137.94 | | 137.22 |
| LF-5C | * | 197.90 | ** | 138.06 | 137.98 | | 137.24 |
| LF-6N | * | 198.21 | ** | 131.91 | 131.63 | | 131.54 |
| LF-6C | * | 198.62 | ** | 134.85 | 134.70 | | 134.37 |
| LF-6S | * | 198.62 | ** | 137.00 | 136.93 | | 136.29 |
| LF-7 | * | 194.94 | ** | | | 138.28 | 137.67 |
| LF-8 | * | 195.76 | ** | | | 137.72 | 137.64 |
| NL-1 | * | 142.12 | ** | 137.19 | 137.08 | | 136.10 |
| NL-2 | * | 140.32 | ** | | | | 137.40 |
| PT-1 | * | 135.54 | ** | | | | 122.30 |
| PT-2 | * | 134.58 | ** | | | | < 123.58 |
| PT-2A | * | 134.56 | ** | | | | DRY |
| PT-3 | * | 138.57 | ** | | | | 123.75 |
| PT-4 | * | 135.90 | ** | | | | 122.65 |
| PT-5 | * | 137.25 | ** | | | | 122.76 |
| PT-9 | * | 134.65 | ** | | | | 124.72 |
| PT-10 | * | 135.23 | ** | | | | 124.54 |
| PT-11 | * | 133.33 | ** | | | | 124.73 |
| PT-12 | * | 153.54 | ** | | | | 141.06 |
| R-1 | * | 155.98 | ** | | | 127.61 | 127.08 |
| R-2 | * | 138.94 | ** | | | 123.93 | 123.38 |
| R-2A | * | 138.86 | ** | | | 121.74 | 120.93 |
| R-3 | * | 146.53 | ** | | | 126.86 | 126.04 |
| R-4 | * | 139.11 | ** | | | 132.70 | 132.29 |
| R-4A | * | 140.59 | ** | | | 134.17 | 133.80 |
| R-5 | * | 139.02 | ** | | | 126.54 | 125.72 |
| SL-5 | * | 191.41 | ** | | | | < 141.29 |
| SL-9 | * | 181.61 | ** | | 139.82 | | 139.02 |
| TCA-1 | * | 183.62 | ** | | 139.39 | | 138.01 |
| TF-1 | * | 194.58 | ** | 138.74 | | | 137.78 |
| TF-2 | * | 195.01 | ** | 138.78 | | | 137.76 |
| TW-2-78 | * | 151.61 | ** | | | 139.26 | 139.08 |
| UNA-1 | * | 143.57 | ** | | | 126.70 | 125.94 |
| UNA-2 | * | 138.39 | ** | | | 129.66 | 129.12 |

| WELL NO. | * | REF. EL | ** | WATER ELEVATION 3/29/85 | 4/3/85 | 4/12/85 4/16/85 | 6/11/85 6/12/85 |
|---|---|---|---|---|---|---|---|
| UNA-3 | * | 154.79 | ** | | | 132.32 | 131.93 |
| UNA-5 | * | 157.75 | ** | | | | 136.78 |
| WLF-OBS | * | 199.15 | ** | 137.19 | 137.20 | | 136.72 |
| WRG-1-DW | * | 146.18 | ** | | | | 134.49 |
| WRG-2-CW | * | 146.83 | ** | | | | 134.44 |
| 73-3 | * | 130.96 | ** | | | 126.39 | 124.22 |
| 73-4 | * | 138.11 | ** | | | | 134.11 |
| 73-6 | * | 134.20 | ** | | | 134.20 | 129.26 |
| 73-7 | * | 134.65 | ** | | | | 127.68 |
| 77-1 | * | 132.09 | ** | | | | 123.95 |
| 77-2 | * | 133.63 | ** | | | | 125.89 |
| 77-3 | * | 134.26 | ** | | | | 128.64 |
| 78-3 | * | 133.29 | ** | | | | 126.00 |
| 9-78 | * | 137.00 | ** | | | | 125.67 |
| NLBR | * | 182.76 | ** | | 131.43 | | 130.63 |
| WLF | * | 198.24 | ** | | 136.77 | | 136.35 |
| ELF | * | 197.35 | ** | | 97.63 | | 132.28 |
| RLF | * | 147.01 | ** | | 111.84 | | 112.21 |
| SLGP | * | 181.88 | ** | | | | 128.82 |
| SLBR | * | 180.92 | ** | | 130.20 | | 130.04 |
| SINKING POND | * | NA | ** | 143.27 | 143.53 | 143.70 | 143.41 |
| BARCAD WELLS | * | | ** | | | | |
| AR-18B | * | 185.47 | ** | 131.53 | 131.49 | | 130.78 |
| AR-19B | * | 183.93 | ** | 136.77 | 137.95 | | 134.73 |
| LF-7B-SH | * | 194.91 | ** | | | 137.90 | 137.62 |
| LF-7B-DP | * | 194.91 | ** | | | 137.10 | 137.19 |
| LF-8B | * | 194.74 | ** | | | 135.54 | 134.80 |
| R-3B1 | * | 146.53 | ** | | | | 126.01 |

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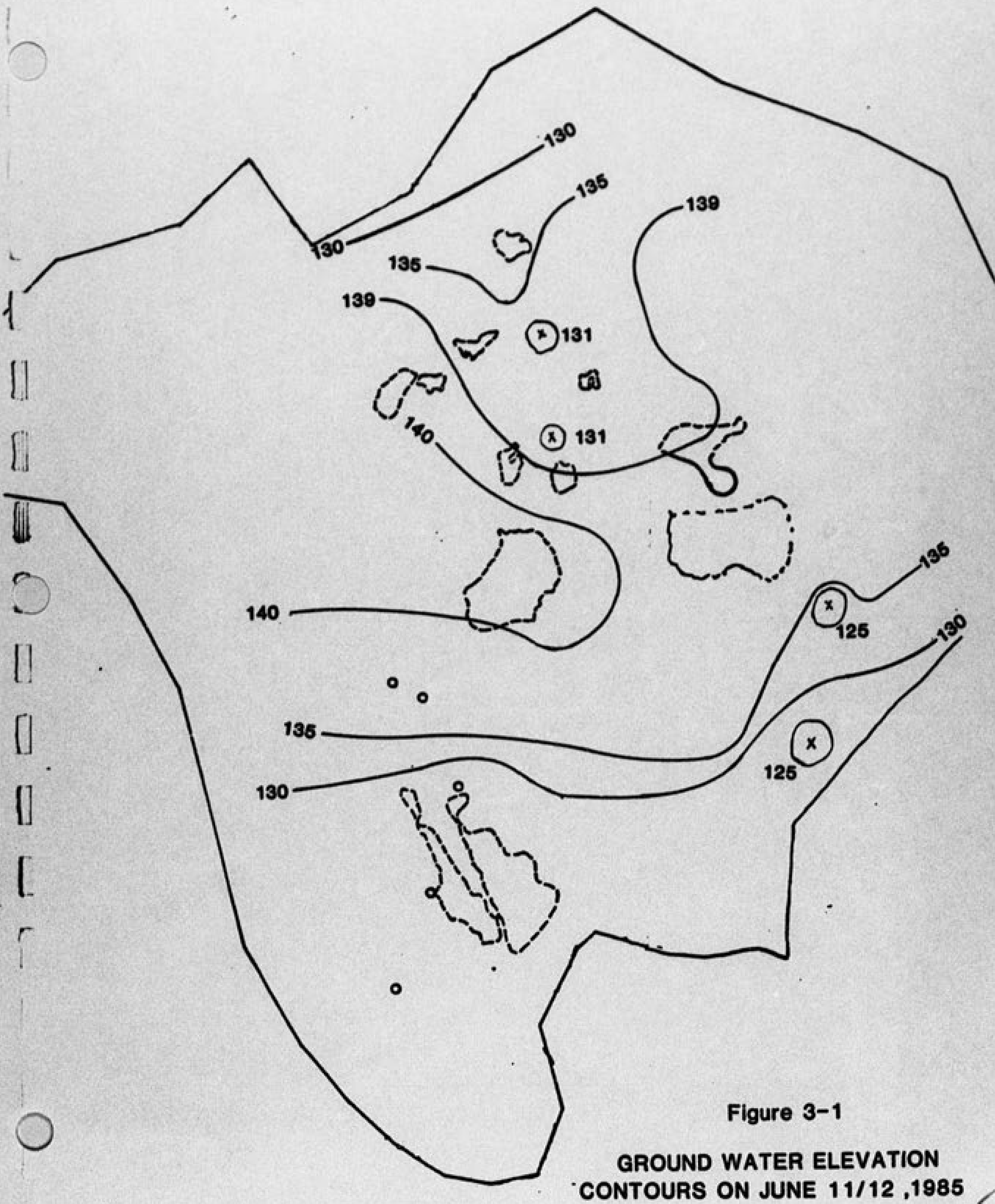


Figure 3-1

GROUND WATER ELEVATION CONTOURS ON JUNE 11/12 ,1985

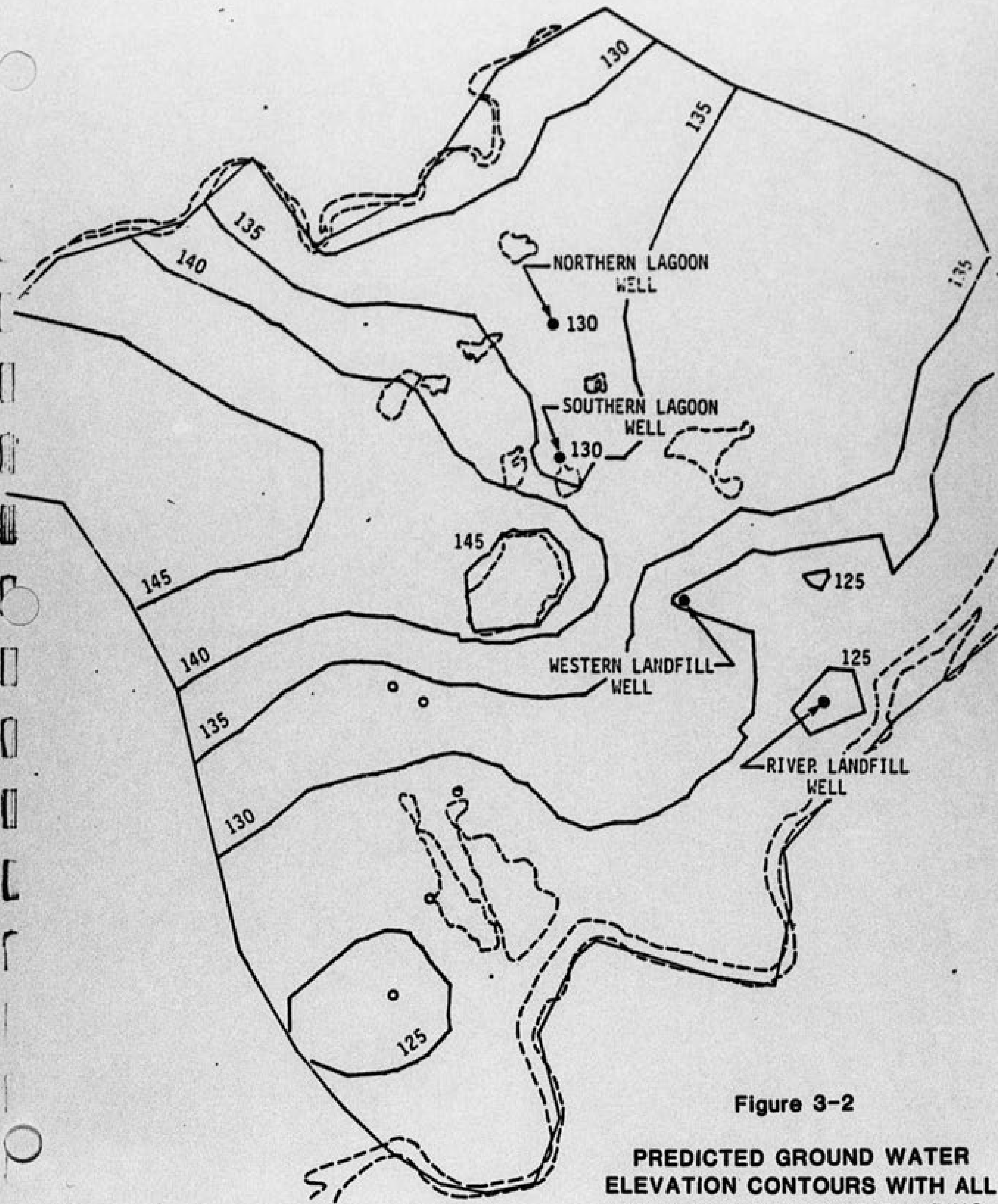


Figure 3-2

**PREDICTED GROUND WATER ELEVATION CONTOURS WITH ALL RESTORATION WELLS PUMPING**

## Table 3-2

WR GRACE ACTON
AQUIFER RESTORATION PROGRAM--VOA DATA
PERFORMANCE OF AQUIFER RESTORATION SYSTEM

| DATE | LOC. | REF NO | V-chl | VDC | 1,2-DCEa | Benz | Tol | etbz | xylene | DL |
|---|---|---|---|---|---|---|---|---|---|---|
| 28-Mar-85 | AR-21 | 1547 | | 10 | | 30 | | | | 10 |
| 12-Apr-85 | AR-21 | 1573 | | | | 200 | | | | 10 |
| 28-Mar-85 | AR-21A | 1546 | | 30 | | | | | | 10 |
| 17-Apr-85 | AR-21A | 1577 | | 60 | | | | | | 10 |
| 11-Apr-85 | AR-9B1 | 1556 | | | | | | | | 10 |
| 11-Apr-85 | AR-9P | 1555 | | | | | | | | 10 |
| 28-Mar-85 | ASBRIV-DN | 1543 | | | | | | | | 1 |
| 17-Apr-85 | ASBRIV-DN | 1579 | | | | | | | | 1 |
| 28-Mar-85 | ASBRIV-UP | 1542 | | | | | | | | 1 |
| 17-Apr-85 | ASBRIV-UP | 1578 | | | | | | | | 1 |
| 26-Apr-85 | ELF | 1591 | | | | 700 | 1000 | 70 | 50 | 10 |
| 24-May-85 | ELF | 1647 | | | 110 | 840 | 1700 | 130 | 50 | 10 |
| 29-Mar-85 | ISP | 1550 | | | | | | 36 | | 10 |
| 09-Apr-85 | ISP | 1552 | | | | | | | | 10 |
| 12-Apr-85 | ISP | 1567 | | | | | | | | 10 |
| 26-Apr-85 | ISP | 1584 | | | | | | | | 10 |
| 03-May-85 | ISP | 1599 | | | | | 10 | | 40 | 10 |
| 10-May-85 | ISP | 1603 | | | | | | | | 10 |
| 17-May-85 | ISP | 1631 | | | | | | | | 10 |
| 24-May-85 | ISP | 1641 | | | | | | 20 | | 10 |
| 03-May-85 | ISP-10X1 | 1600 | | | | | | | | 10 |
| 19-Apr-85 | ISPU | 1581 | | | | | | | | 10 |
| 26-Apr-85 | NLBR | 1593 | | 1800 | | | | | | 10 |
| 24-May-85 | NLBR | 1646 | | 2000 | | 30 | | | | 10 |
| 26-Apr-85 | NLGP | 1592 | | 1200 | | | | | | 10 |
| 24-May-85 | NLGP | 1645 | | 1300 | | | | | | 10 |
| 26-Apr-85 | RLF | 1590 | | | | | | | | 10 |
| 24-May-85 | RLF | 1648 | | | | | | | | 10 |
| 26-Apr-85 | SLBR | 1589 | 1600 | 1300 | | 40 | 20 | 80 | 40 | 10 |
| 24-May-85 | SLBR | 1644 | | 2200 | | 70 | | | 60 | 10 |
| 26-Apr-85 | SLGP | 1588 | | 560 | | 110 | | 1300 | 70 | 10 |
| 24-May-85 | SLGP | 1643 | | 730 | | 90 | 30 | 730 | 120 | 10 |
| 29-Mar-85 | TOW-EF | 1549 | | | | | | 120 | | 10 |
| 26-Apr-85 | TOW-EF | 1583 | | | | | | | | 10 |
| 10-May-85 | TOW-EF | 1602 | | | | 20 | 10 | 30 | | 10 |
| 17-May-85 | TOW-EF | 1630 | | | | | | 20 | | 10 |
| 24-May-85 | TOW-EF | 1640 | | | | | | | | 10 |
| 29-Mar-85 | TOW-IN | 1548 | 460 | 950 | | 170 | 150 | 1100 | | 10 |
| 09-Apr-85 | TOW-IN | 1551 | 1200 | 1100 | | 100 | 50 | 1200 | | 10 |
| 12-Apr-85 | TOW-IN | 1566 | 890 | 800 | | 110 | 50 | 1100 | | 10 |
| 19-Apr-85 | TOW-IN | 1580 | 580 | 590 | | 90 | 40 | 730 | | 10 |
| 26-Apr-85 | TOW-IN | 1582 | 430 | 920 | | 180 | 140 | 1150 | 160 | 10 |
| 03-May-85 | TOW-IN | 1598 | 260 | 960 | | 140 | 110 | 760 | 110 | 10 |
| 10-May-85 | TOW-IN | 1601 | | 830 | | 130 | 100 | 730 | 100 | 10 |
| 17-May-85 | TOW-IN | 1629 | | 670 | | 100 | 80 | 430 | 130 | 10 |
| 24-May-85 | TOW-IN | 1639 | 60 | 640 | | 40 | 20 | 50 | 40 | 10 |

NOTE: ALL CONCENTRATIONS IN PPB

LEGEND
V chl=Vinyl Chloride
VDC=1,1 Dichloroethylene
1,2-DCEa=1,2-Dichloroethane
etbz=Ethylbenzene
xylene=Total Xylenes
Benz=Benzene
Tol=Toluene

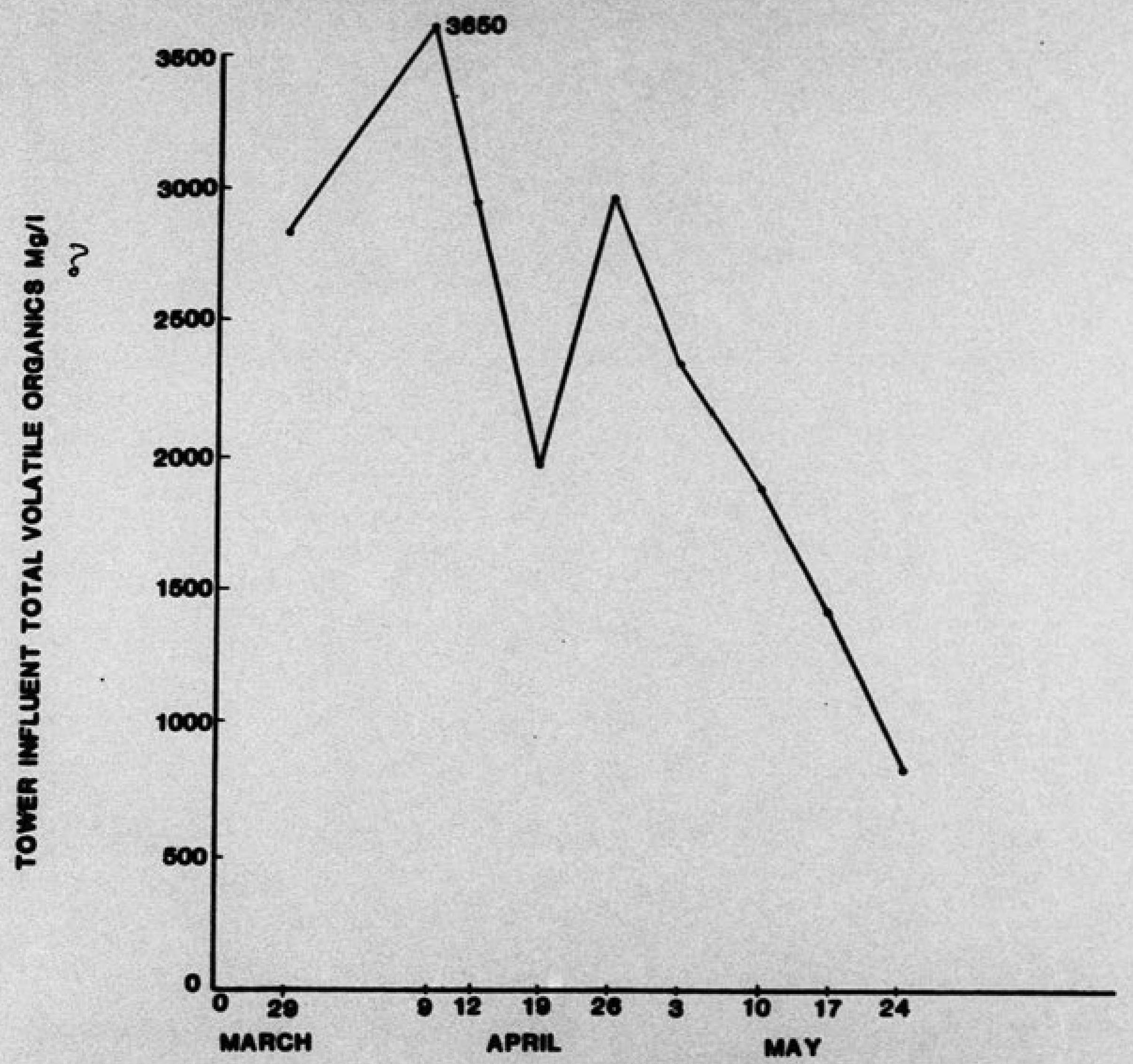
TOWER INFLUENT TOTAL VOLATILE ORGANICS Mg/l
3650
3500
3000
2500
2000
1500
1000
500
0
0
29
9
12
19
26
3
10
17
24
MARCH
APRIL
MAY

Figure 3-3

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The data on tower effluent quality show that removal of volatiles has been consistently above 95%. Of greater importance is the quality of water entering Sinking Pond, after mixing with the WRG-3 discharge and further stripping in the cascade channel. Of the nine samples collected, six have been below detection limits for all priority pollutant VOC's. The sample on March 29 showed 36 ppb ethylbenzene, but was taken not at the entrance to Sinking Pond itself but at the upsteam end of the "stilling basin" that separates the cascade from the pond itself. On May 3, a sample taken at the inlet to Sinking Pond showed 10 ppb toluene and 40 ppb of total xylenes (not a priority pollutant). A sample taken on May 3 from the pond, 10 ft away from the inlet and 1 ft deep, contained no detectable volatile organics. Later samples from the inlet to the pond have shown no detectable volatile organics, except for a May 24 sample which was reported as containing 140 ppb trichloroethylene and 20 ppb ethylbenzene. This sample was questioned with the laboratory because, on the same day, the undiluted tower effluent was reported BDL (below detection limits). Moreover, the May 24 reports of trichloroethylene in this and two other samples are the first reports of this compound in any sample since system startup. The laboratory's records showed that, at the same time these samples were run, samples from another site with extremely high concentrations of volatiles were being run in the same room. Cross-contamination via vapor transfer between open bottles is quite likely. CAA, the analytical laboratory, reported the above observations when questioned, and has prepared a letter documenting this likely contamination. Because of this situation, none of the samples with TCE reported appear in Table 3-2. The laboratory analyzed duplicates that had not been opened earlier for all three samples and detected no TCE.

Other items of interest on Table 3-2 include:

- Two samples of the Assabet River downstream of the site have shown no contamination
- VDC is being collected primarily by the Northern Lagoon Gravel Pack and Bedrock and the Southern Lagoon Gravel Pack and Bedrock pumping wells. Vinyl chloride appears primarily in the Southern Lagoon Bedrock pumping well.
- Ethylbenzene appears primarily in the Southern Lagoon Gravel Pack pumping well
- Other monitoring wells required for quarterly sampling have been sampled, but laboratory reports are not expected until late July. These are, for the most part, outlying wells where changes would not be expected yet.

2. <u>Protection of Assabet Well Field</u>. This part of the aquifer restoration system, consisting of the pumping wells WRG-3 and RP-1 (the "bedrock pumping well"), has been operating since early 1984. Monitoring of this part of the system is achieved primarily through the R-series monitoring wells in and near the fractured upper bedrock. Monitoring of the Assabet well field itself is achieved by sampling Assabet 1 and 2 and several monitoring wells with the prefix "PT". Data are shown on

Table 3-3. Plots of actual and predicted time trends for RP-1 and Assabet 2 are shown in Figure 3-4. Progress toward cleanup appears to be as expected. WRG-3 monthly samples for the past year have mostly been below detection limits. The need to pump this well at its present rate is therefore being reevaluated.

3. Fort Pond Brook. Well points (1 1/2" diameter) were driven through the brook bottom at the locations shown in Figure 3-5. Screened intervals are shown in Table 3-4, together with the head difference between the subsurface and the brook surface water. Gradients in five of the six samplers were upward toward the brook on the day of sampling. FP-4 showed a slight downward gradient. FP-4 is near an active gravel washing operation that may alter the gradients in that vicinity. Samples were collected from the well points and the adjacent surface waters on May 29. Results of analyses for volatile organics are shown on Table 3-5. FP-1 and FP-5 have been resampled to verify the results shown. There has not been enough time to fully interpret these data.

   In order to ascertain a more complete understanding of the presence of VDC in the vicinity of FP-5, W. R. Grace plans to conduct additional investigations in Fort Pond Brook. These investigations will include: (a) resampling and analysis of both the groundwater and surface waters at FP-1 through FP-5, (b) installation of 2 or 3 additional well points into the stream sediments downstream of FP-5, (c) installation of a monitoring well next to FP-5 into the aquifer below the level of the streambed sediments (10 to 15 feet below the streambed) to sample and analyze the groundwater at that location, and (d) collection and analysis of sample(s) of the streambed sediments for volatile organics, particle size, gradation, and organic carbon.

4. Laws Brook Well Field. Existing monitoring wells and production wells in the vicinity of the Laws Brook Well Field were sampled by CDM, accompanied by Larry Dayian of the Acton Water District, on May 14. Locations are shown on Figure 3-6, and results on Table 3-6. No volatile organic compounds were detected in any of the samples (detection limit = 1 ppb).

C. Analytical Quality Control/Quality Assurance

The standard procedures developed for the Consent Decree and Administrative Order were used to generate the water quality data in this report, including precautions to collect and preserve representative samples, chain-of-custody protocols, and furnishing blind replicates and trip blanks to laboratories. All VOA data presented earlier in this report were furnished by Cambridge Analytical Associates, using Method 624. The ERCO analytical laboratory was used for quality control. Table 3-7 shows all of the intralab and interlab comparisons. Some anomalies appeared and have been/are being investigated. For example, ERCO routinely analyzes for several non-priority pollutants. In the samples of stripping tower effluent collected on May 10, ERCO reported the presence of acetone and 2-butanone (methyl ethyl ketone, or MEK). CDM requested CAA to review the records for the comparative sample for evidence of these two compounds; CAA reported that peaks for these compounds were absent in that sample's chromatogram.



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Table 3-3

WR GRACE ACTON
AQUIFER RESTORATION PROGRAM--VOA DATA
PROTECTION OF ASSABET WELL FIELD

| DATE | LOC. | REF NO | V-chl | VDC | 1,1,1-TCEa | Benz | TetCethy | Tol | etbz | xylene | DL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27-Mar-85 | AIRSTRP | 1536 | | | | | | | | | 10 |
| 11-Apr-85 | AIRSTRP | 1557 | | | | | | | | | 10 |
| 28-Mar-85 | ASB-ONE | 1544 | | 9 | 70 | | | | | | 1 |
| 30-Apr-85 | ASB-ONE | 1596 | | 11 | 70 | | | | | | 1 |
| 28-Mar-85 | ASB-TWO | 1545 | | 17 | | | | | | | 1 |
| 30-Apr-85 | ASB-TWO | 1597 | | 22 | | | | | | | 1 |
| 27-Mar-85 | B5-B4 | 1528 | | 110 | | | | | | | 10 |
| 11-Apr-85 | B5-B4 | 1563 | | 120 | | | | | | | 10 |
| 27-Mar-85 | B6-B5 | 1527 | | 1200 | | | | | | | 10 |
| 11-Apr-85 | B6-B5 | 1562 | 580 | 980 | | | | | | | 10 |
| 24-May-85 | B6-B5 | 1655 | | 1100 | | 40 | | | | | 10 |
| 27-Mar-85 | R-1P | 1525 | | 60 | | | | | | | 10 |
| 11-Apr-85 | R-1P | 1560 | | 70 | | | | | | | 10 |
| 27-Mar-85 | R-2A | 1530 | | | | | | | | | 10 |
| 11-Apr-85 | R-2A | 1565 | | | | | | | | | 10 |
| 27-Mar-85 | R-2P | 1529 | | 60 | | | | | | | 10 |
| 11-Apr-85 | R-2P | 1564 | | 20 | | | | | | | 10 |
| 27-Mar-85 | R-3B1 | 1526 | | | | | | | | | 10 |
| 11-Apr-85 | R-3B1 | 1561 | | | | | | | | | 10 |
| 24-May-85 | R-3B1 | 1654 | | | | | | 20 | | | 10 |
| 27-Mar-85 | R-3P | 1533 | | | | | 360 | | | | 10 |
| 12-Apr-85 | R-3P | 1570 | | | | | | | | | 10 |
| 27-Mar-85 | R-4 | 1532 | | 90 | | | | | | | 10 |
| 12-Apr-85 | R-4 | 1571 | | 40 | | | | | | | 10 |
| 27-Mar-85 | R-5 | 1531 | | 1100 | | | | | | | 10 |
| 12-Apr-85 | R-5 | 1572 | 570 | 680 | | 30 | | | | | 10 |
| 27-Mar-85 | RP-1 | 1535 | | 260 | | | | | | | 10 |
| 11-Apr-85 | RP-1 | 1558 | | 450 | | | | | | | 10 |
| 27-Mar-85 | WRG-3 | 1534 | | 30 | | | | | | | 10 |
| 11-Apr-85 | WRG-3 | 1559 | | | | | | | | | 10 |

NOTE: ALL CONCENTRATIONS IN PPB

LEGEND
V chl=Vinyl Chloride
VDC=1,1 Dichloroethylene
1,1,1-TCEa=1,1,1 Trichloroethane
TetCethy=Tetrachloroethylene
etbz=Ethylbenzene
xylene=Total Xylenes
Benz=Benzene
Tol=Toluene

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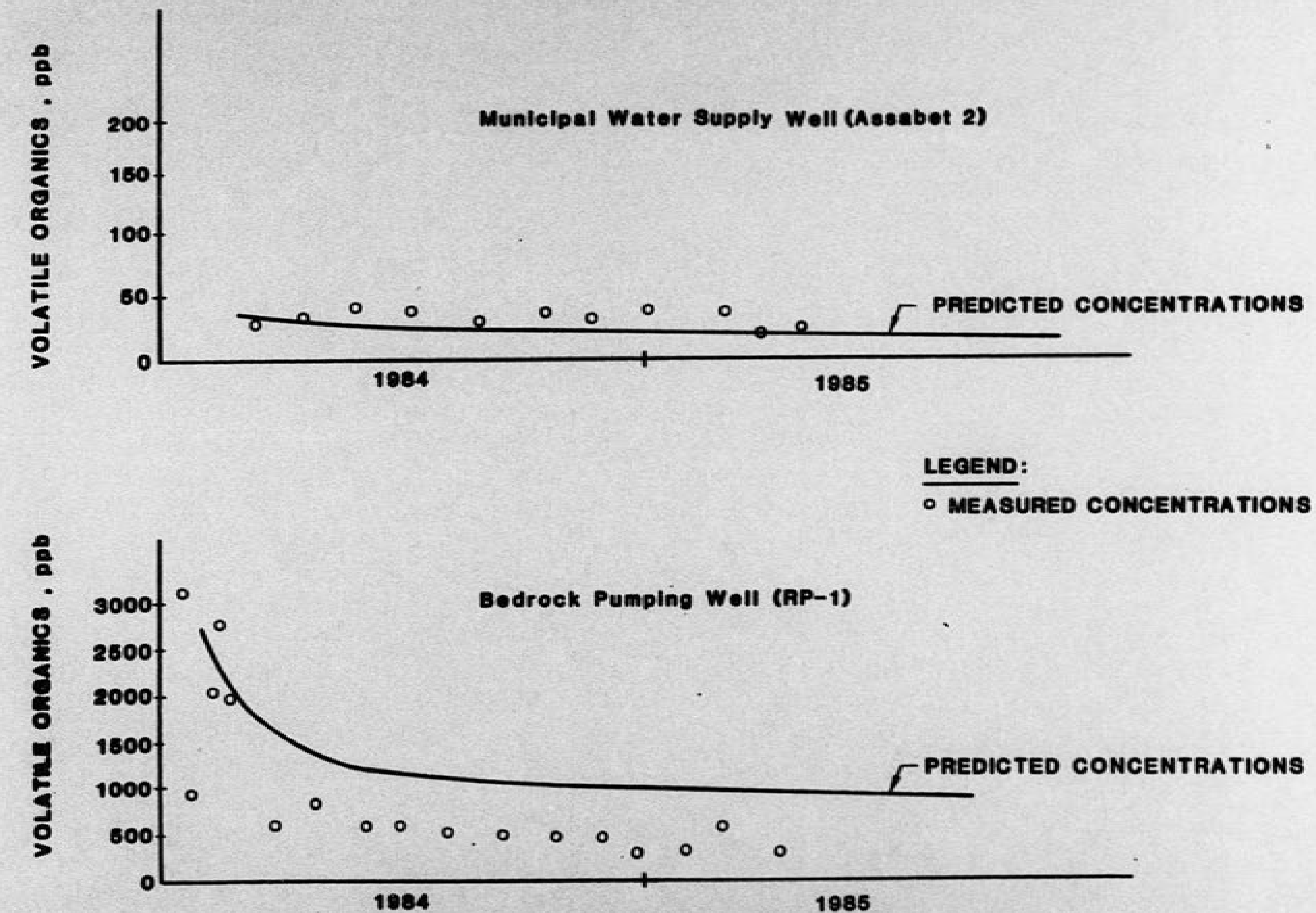


Figure 3-4

TREND OF MEASURED AND PREDICTED VOC

1

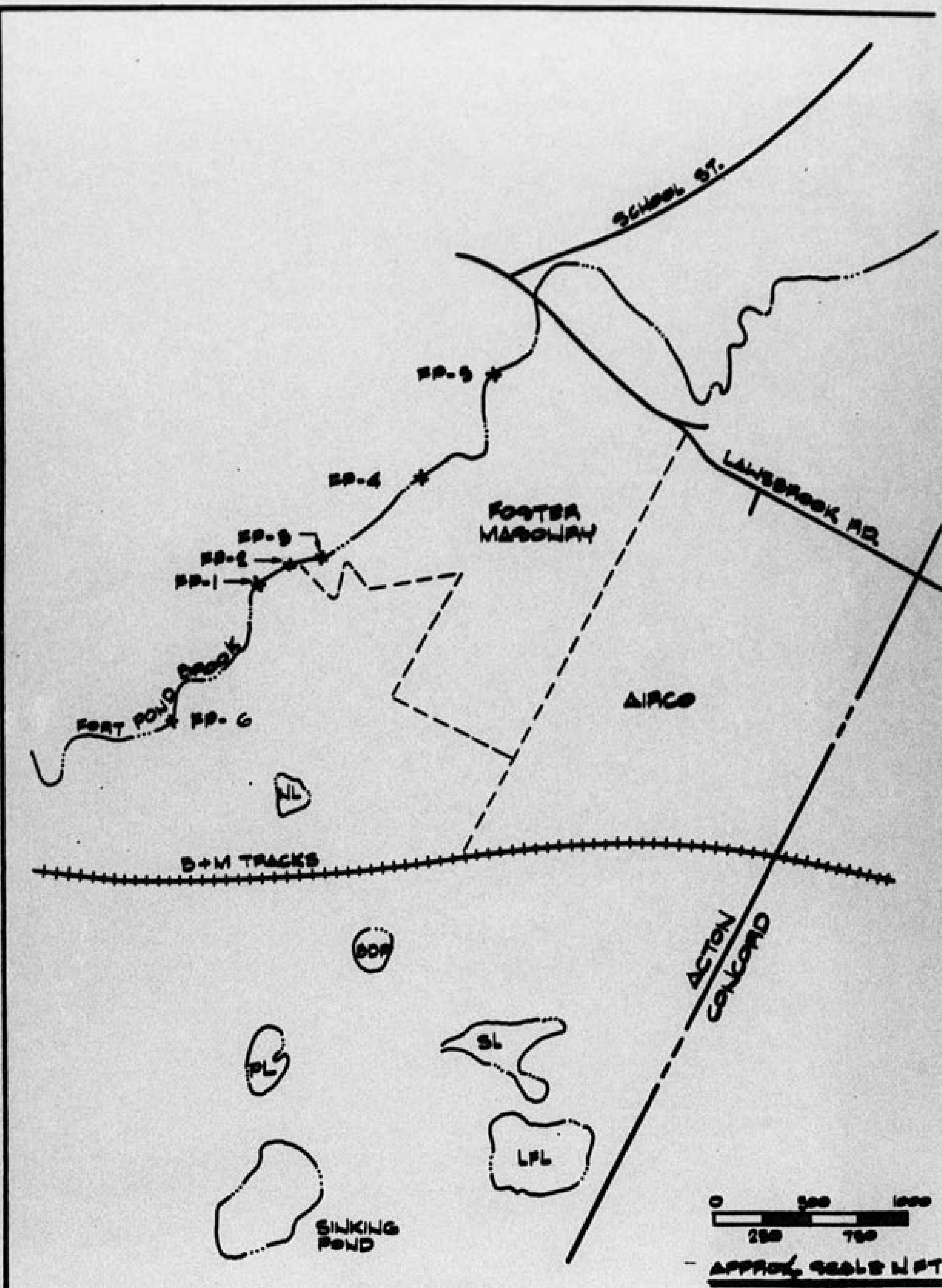


FIGURE 3-5

WELL POINT LOCATIONS IN FORT POND BROOK

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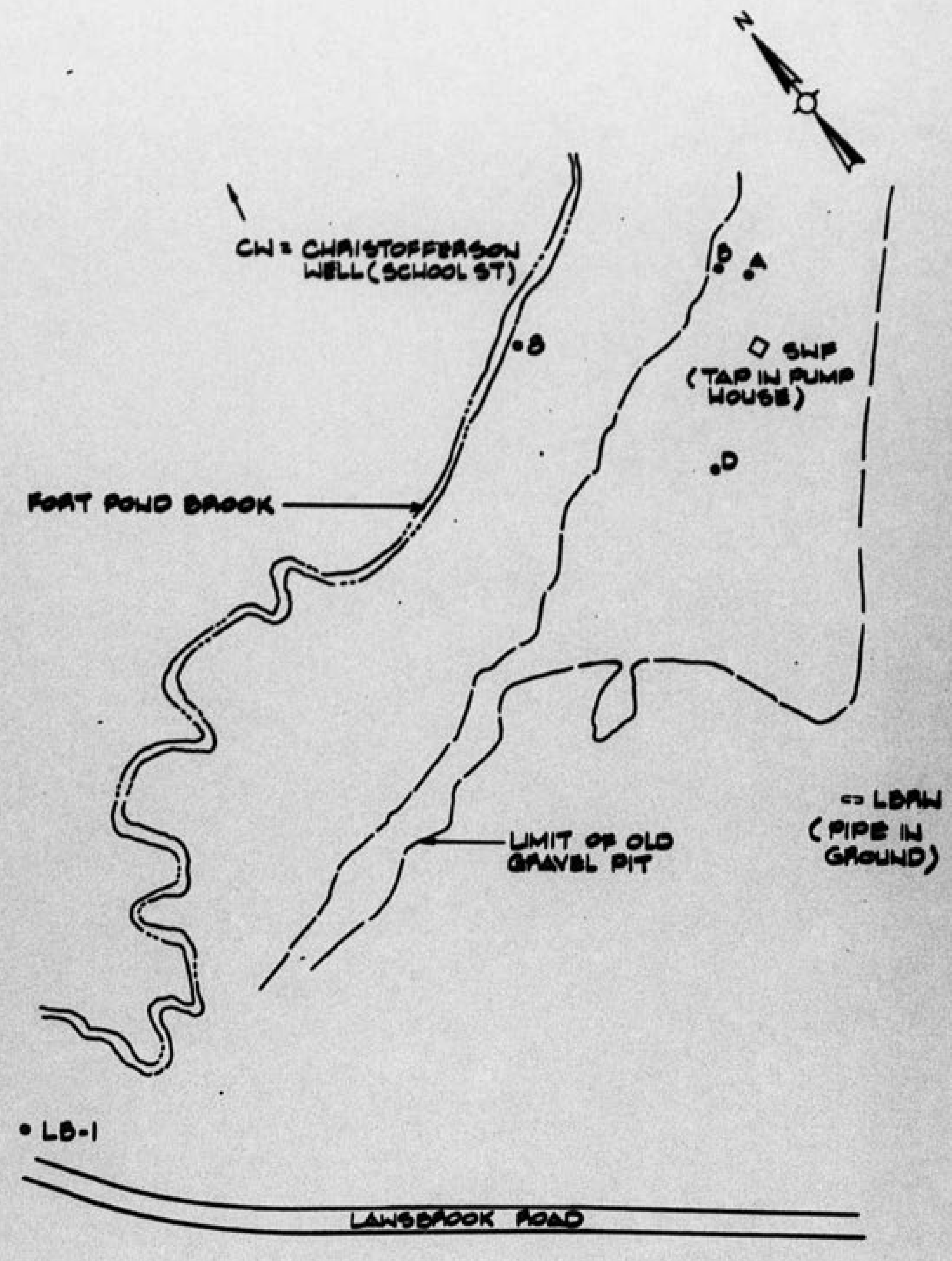


Figure 3-6

SAMPLING POINTS NEAR LAWS BROOK WELL FIELD

## TABLE 3-4

## WELL POINTS IN FORT POND BROOK

| | FP-1 | FP-2 | FP-3 | FP-4 | FP-5 | FP-6 |
|---|---|---|---|---|---|---|
| Screened Interval (ft. below streambed) | 1.5-3.5 | 2.03-4.03 | 1.43-3.43 | 1.05-3.05 | 2.34-4.34 | 2.7-4.7 |
| Difference in Water Level Between Piezometer and Adjacent Brook Water on 5/29/85 (ft) | 0.06 up | 0.04 up | 0.03 up | 0.02 down | 0.11 up | 0.13 up |

## TABLE 3-5

### WATER QUALITY DATA FOR MAY 29, 1985 WITHIN AND BENEATH FORT POND BROOK

| Location | Water Source | 1,1-Dichloro-ethylene (VDC) | Toluene | Total Xylenes | Other |
|---|---|---|---|---|---|
| FP-1 | Surface | ND | ND | ND | ND |
| FP-1 | Ground | ND (ND) | ND (ND) | ND (ND) | ND (ND) |
| FP-2 | Surface | ND | 2 | 1 | ND |
| FP-2 | Ground | ND | ND | ND | ND |
| FP-3 | Surface | ND | ND | ND | ND |
| FP-3 | Ground | ND | ND | ND | ND |
| FP-4 | Surface | ND | ND | ND | ND |
| FP-4 | Ground | ND * | 1* | ND * | ND * |
| FP-5 | Surface | ND | ND | ND | ND |
| FP-5 | Ground | 8 (3) | ND (ND) | ND (ND) | ND (ND) |
| FP-6 | Surface | ND | ND | ND | ND |
| FP-6 | Ground | ND | ND | ND | ND |

All Results in ug/l (ppb)
Detection Limit 1 ug/l
ND = Not Detected
* Duplicate was ND for all VOC
( ) = Repeat sample on July 3



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Table 3-6

WR GRACE ACTON
AQUIFER RESTORATION PROGRAM--VOA DATA LAWS BROOK WELL FIELD SAMPLING

| DATE | LOC. | REF NO | V-chl | VDC | Benz | Tol | etbz | xylene | DL |
|---|---|---|---|---|---|---|---|---|---|
| 14-May-85 | 8 | 1624 | | | | | | | 1 |
| 14-May-85 | A | 1620 | | | | | | | 1 |
| 14-May-85 | B | 1622 | | | | | | | 1 |
| 14-May-85 | C-109 | 1627 | | VOLATILE ORGANIC PRIORITY | | | | | 1 |
| 14-May-85 | CW | 1626 | | POLLUTANTS NOT FOUND | | | | | 1 |
| 14-May-85 | D | 1623 | | ABOVE 1PPB DETECTION LIMIT | | | | | 1 |
| 14-May-85 | D-131 | 1628 | | | | | | | 1 |
| 14-May-85 | LB-1 | 1625 | | | | | | | 1 |
| 14-May-85 | LBRW | 1621 | | | | | | | 1 |
| 14-May-85 | SWF | 1619 | | | | | | | 1 |

NOTE: ALL CONCENTRATIONS IN PPB

LEGEND
V chl=Vinyl Chloride
VDC=1,1 Dichloroethylene
etbz=Ethylbenzene
xylene=Total Xylenes
Benz=Benzene
Tol=Toluene

C-109 = Duplicate of Christofferson Well Sample
CW = Christofferson Well
D-131 = Field Blank
LBRW = Laws Brook Well
SWF = Scribner Well

A review of the other ERCO analyses in Table 3-7 showed no reports of acetone or MEK. Samples from the inlet to Sinking Pond were collected in triplicate in June 1985, and were submitted to CAA, ERCO, and CDM laboratories in an effort to clarify whether false positives or false negatives are occurring. Pending these results, to reduce the possible problem raised by ketones, the flow from the Eastern landfill well has been reduced.

Table 3-8 shows the results of field blanks. No false positives are indicated.

# TABLE 3-7

WR GRACE ACTON
AQUIFER RESTORATION PROGRAM--VOLATILE ORGANIC DUPLICATE ANALYSES

| DATE | LOC. | REF NO | V-chl | ACE | VDC | 1,1-DCEa | 1,2-DCEa | 2-BUT | 1,1,1-TCEa | 1,2-DCP | Benz | TetCethy | Tol | etbz | xylene | DL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27-Mar-85 | C-102 | 1537 | | | | | | | | | | | | | | 10 |
| 27-Mar-85 | AIRSTRP | 1536 | | | | | | | | | | | | | | 10 |
| 27-Mar-85 | C-103 | 1540 E | | | 55 | | | | | | 3 | | | | | 2-25 |
| 27-Mar-85 | AIRSTRP | 1539 E | | | 47 | | | | | | | | | | | 2-25 |
| 09-Apr-85 | C-104 | 1553 | 600 | | 1700 | | | | | | 50 | | 20 | 1200 | | 10 |
| 09-Apr-85 | TOW-IN | 1551 | 1200 | | 1100 | | | | | | 100 | | 50 | 1200 | | 10 |
| 12-Apr-85 | C-105 | 1568 | | | | | | | | | | | | | | 10 |
| 12-Apr-85 | ISP | 1567 | | | | | | | | | | | | | | 10 |
| 12-Apr-85 | C-106 | 1575 E | | | | | | | | | | | | 31 | | 2-25 |
| 12-Apr-85 | ISP | 1574 E | | | | | | | | | | | | 24 | | 2-25 |
| 26-Apr-85 | C-107 | 1594 | | | 2300 | | | | | | | | | | | 10 |
| 26-Apr-85 | NLBR | 1593 | | | 1800 | | | | | | | | | | | 10 |
| 10-May-85 | C-108 | 1606 | | | | | | | | | 20 | | 10 | 20 | 10 | 10 |
| 10-May-85 | TOW-EF | 1602 | | | | | | | | | 20 | | 10 | 30 | | 10 |
| 10-May-85 | C-109 | 1608 E | 7.0 | 51 | 37 | | 2.2 | 16 | | | 6.6 | | | | | 2-25 |
| 10-May-85 | TOW-EF | 1607 E | 6.0 | 70 | 34 | | 2.5 | 24 | | | 6.4 | | | | | 2-25 |
| 17-May-85 | C-110 | 1633 | | | | | | | | | | | | | | 10 |
| 17-May-85 | TOW-EF | 1630 | | | | | | | | | | | | 20 | | 10 |
| 24-May-85 | C-111 | 1649 | | | | | | | | | | | | | | 10 |
| 24-May-85 | RLF | 1648 | | | | | | | | | | | | | | 10 |
| 24-May-85 | C-112 | 1651 E | 16 | | 41 | 4.7 | | | | 14 | 5.4 | | | | | 2-25 |
| 24-May-85 | RLF | 1650 E | 13 | | 41 | 4.3 | | | | 12 | 4.5 | | | | | 2-25 |

NOTE: ALL CONCENTRATIONS IN PPB
REF NO's APPENDED WITH "E" INDICATE ANALYSES PERFORMED BY ERCO

LEGEND
V chl=Vinyl Chloride
VDC=1,1 Dichloroethylene
1,1,1-TCEa=1,1,1 Trichloroethane
TetCethy=Tetrachloroethylene
etbz=Ethylbenzene
xylene=Total Xylenes
Benz=Benzene
Tol=Toluene
ACE=Acetone
2-BUT=2-Butanone
1,2-DCEa=1,2-Dichloroethane
1,1-DCEa=1,1-Dichloroethane
1,2-DCP=1,2-Dichloropropane

## TABLE 3-8

WR GRACE ACTON
AQUIFER RESTORATION PROGRAM--VOLATILE ORGANIC ANALYSES OF TRIP BLANKS

| DATE | LOC. | REF NO | V-chl | ACE | VDC | 1,1-DCEa | 1,2-DCEa | 2-BUT | 1,1,1-TCEa | 1,2-DCP | Benz | TetCethy | Tol | etbz | xylene | DL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24-May-85 | D-113 | 1652 | | | | | | | | | | | | | | 2-25 |
| 27-Mar-85 | D-123 | 1538 | | | | | | | | | | | | | | 1 |
| 03-Apr-85 | D-124 | 1541 | | | | | | | | | | | | | | 2-25 |
| 09-Apr-85 | D-125 | 1554 | | | | | | | | | | | | | | 1 |
| 12-Apr-85 | D-126 | 1569 | | | | | | | | | | | | | | 10 |
| 12-Apr-85 | D-127 | 1576 | | | | | | | | | | | | | | 2-25 |
| 26-Apr-85 | D-128 | 1595 | | | | | | | | | | | | | | 10 |
| 10-May-85 | D-129 | 1605 | | | | | | | | | | | | | | 10 |
| 10-May-85 | D-130 | 1609 | | | | | | | | | | | | | | 2-25 |
| 17-May-85 | D-132 | 1634 | | | | | | | | | | | | | | 10 |
| 24-May-85 | D-134 | 1653 | | | | | | | | | | | | | | 10 |

VOLATILE ORGANIC PRIORITY POLLUTANTS

NOT FOUND ABOVE DETECTION LIMITS

NOTE: ALL CONCENTRATIONS IN PPB

LEGEND
V chl=Vinyl Chloride
VDC=1,1 Dichloroethylene
1,1,1-TCEa=1,1,1 Trichloroethane
TetCethy=Tetrachloroethylene
etbz=Ethylbenzene
xylene=Total Xylenes
Benz=Benzene
Tol=Toluene
ACE=Acetone
2-BUT=2-Butanone
1,2-DCEa=1,2-Dichloroethane
1,1-DCEa=1,1-Dichloroethane
1,2-DCP=1,2-Dichloropropane

# 4. RECOMMENDATIONS

## A. Site Closure

The numerical model's prediction of aquifer cleanup rates is based on the assumption that the waste sites have been closed. This assumption is not valid at present. On the one hand, this fact should cause no immediate environmental concern because the active leachate sources are hydraulically contained by the aquifer restoration system. On the other hand, continuing leachate production retards the rate of cleanup of the aquifer. Moreover, the continued introduction of oxygen-demanding materials into the aquifer will cause anoxic conditions and, consequently, dissolved iron, to persist in the groundwater. The oxidation of this iron in the stripping tower will require continued maintenance to remove scale from the packing. For these reasons it is recommended that the actions of all parties related to site closure be completed in a timely manner.

## B. Continued Operation

The aquifer restoration system is fulfilling its expectations. Continued operation and, if possible, speedy resolution by DEQE of the Western Landfill Well issue are recommended.

## C. Fort Pond Brook

The data from beneath and within Fort Pond Brook, presented here, address the agreement in the October 1984 "addendum" to determine "the location of the identified VDC plume discharge to Fort Pond Brook." Some resampling and other work as outlined in Section 3.B.3 (Fort Pond Brook) to clarify this issue is planned. Given the fact that VDC was found at FP-1 in the brook water at very low stream flow in the autumn of 1984, it would appear that the plume emerges adjacent to the Grace property upstream of FP-1. Additional groundwater sampling will have to be done upstream of FP-1 to determine this point.

## D. Field Studies North of Secondary Lagoon

The following field data are now available:

- Well point FP-5 showed 8 and 3 ug/l of VDC, respectively, on two sampling dates. The adjacent surface water in the brook was below detection limits of 1 ppb for VDC.
- Eight wells in and near the Laws Brook Well Field, sampled on May 14, were below detection limits of 1 ppb for VOC's. For the pathways from the Secondary Lagoon hypothesized by GZA to be valid, at least "LB-1" and "8" would be expected to show contamination.
- The measured water level elevations of AR-9, AR-10, G-3, and SL-9 are consistent with the predicted contours for that area. Thus, the CDM aquifer model has been further validated for the area in question.



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In addition, as we have pointed out before, several serious flaws exist in the arguments that have been put forth by the Acton Water District and its consultant, GZA. Included in these flaws are the following:

- o GZA's March 1985 report failed to take into account the slow vertical migration through the layered glacial deposits under the lagoon. This movement is one of the reasons why CDM does not believe that northward lagoon of contamination exceeded about 200 feet. Two-dimensional modeling, ignoring vertical movement and resistance thereto, is inappropriate near a groundwater divide where vertical flow predominates.

- o GZA's report hypothesized that a reason for the discrepancy between its conclusions and those of CDM was that CDM did not inject particles in the northern part of the Secondary Lagoon in the contaminant transport model. CDM had refuted this idea in a meeting with GZA and the government parties on August 16, 1984. As stated at that meeting and at the meeting on March 28, 1985, particles were injected along the north shore and other places in the northern part of the lagoon during calibration runs. Outputs are shown in Figures 4-1 and 4-2. Contaminant distributions are slightly different, but the maximum distance travelled north still does not exceed 200 feet in 17 years.

- o At the March 28 meeting, GZA presented a modeled location for the present groundwater divide showing it to be approximately beneath the northern shore of the Secondary Lagoon. Also on the figure was CDM's modeled location for the divide. GZA acknowledged at the meeting that the CDM divide was more consistent with field data than the GZA divide, thus revealing a bias toward northward flow in the GZA model structure.

In summary, we believe that the existing data, together with the CDM modeling results that place those data in perspective, show the unlikelihood that materials from the Secondary Lagoon are responsible for any problems in the AWD wells to the north. The finding of 8 and 3 ppb VDC at FP-5 is the only evidence of a possible plume in that area. Any such plume is probably at barely detectable concentrations (given the lack of detection of VOC's at eight wells in and near the Laws Brook Well Field). As stated previously, additional work, as outlined in Section 3.B.3 (Fort Pond Brook), is planned to clarify this issue. On this basis, no additional field work northeast of the Secondary Lagoon is warranted.

E. <u>Mass Broken Stone Pit</u>

The principal function of monitoring wells in the Mass Broken Stone Pit is to verify that the expected flow patterns and contaminant flushing are occurring. Review of the actual flow field indicates the sufficiency of existing wells AR-3, AR-15, B-5 and B-9 for this purpose. All levels of these multilevel wells undergo periodic sampling and analysis for volatile organics.

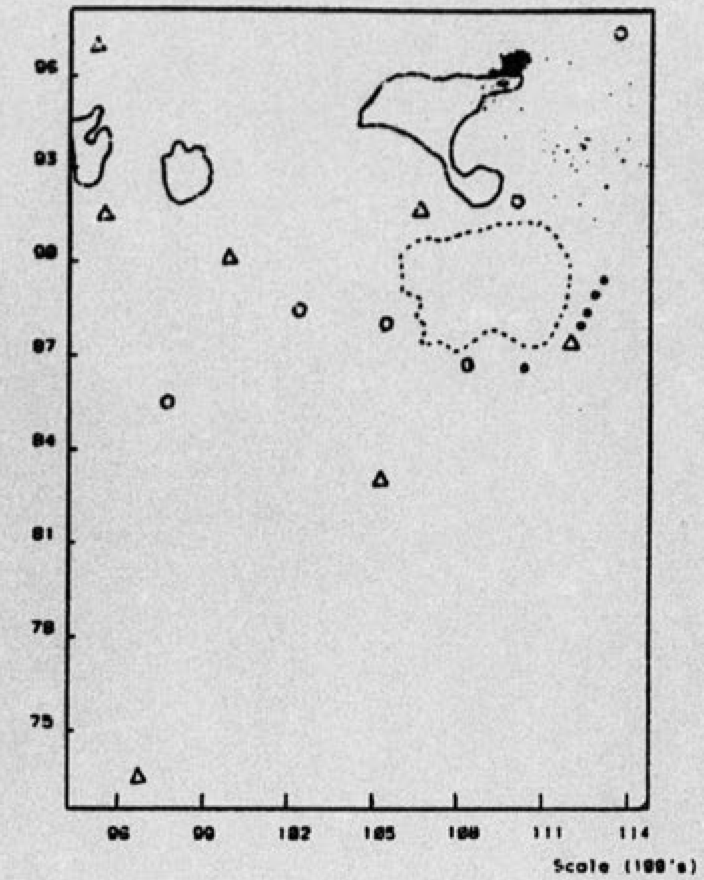


Figure 4-2

PARTICLE CLOUD FOR CONTAMINATION ENTERING NORTHEASTERN PART OF SECONDARY LAGOON