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Report

Interim Remedial Measure Work Plan

Hadco Corporation
Owego, New York

March 1993

BLASLAND & BOUCK ENGINEERS, P.C.
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Table of Contents

1.0 - Introduction

1.1 General

This document presents the proposed conceptual design of an Interim Remedial Measure (IRM) for initiating the remediation of volatile organic compounds (VOCs) in the ground water at the Hadco Corporation (Hadco) facility in Owego, New York. The Remedial Investigation (RI) activities implemented have identified elevated concentrations of VOCs in the ground water at the Hadco facility. However, the site has not yet been sufficiently characterized to support implementation of the Feasibility Study and selection of the overall site remedial program. Therefore, Hadco has proposed to perform an IRM consisting of ground-water withdrawal and treatment. The NYSDEC has agreed that it would be appropriate to implement this IRM concurrently with the completion of the RI/FS program at the site.

This work plan presents a description of the specific activities to be implemented in connection with the design and operation of the IRM for the site. This document also presents the basis for design of the IRM along with the results of the evaluation of IRM treatment system components and a discussion of the IRM conceptual design. The IRM implementation schedule is also presented in this work plan.

1.2 Interim Remedial Measure Objective

The objectives of the IRM are to begin remediating the dissolved organic constituents observed in the ground water downgradient of the source area and to minimize the potential off-site migration of the VOCs in the ground water in the overburden until a final ground-water remedy can be implemented. To accomplish these objectives, an interim ground-water withdrawal and treatment system will be constructed and operated until a final remedial ground-water alternative is identified.

2.0 - Basis for Interim Remedial Measure Design

2.1 General

The basis of the IRM includes a discussion of the site characterization information that was used to aid in the conceptual design of the ground-water treatment system and a discussion of the results of an evaluation of treatment system components conducted to determine which treatment system components will provide the most cost-effective system for treatment of VOCs in ground water. The proposed ground-water treatment system consists of ground-water withdrawal, treatment and discharge into the Town of Owego's Publicly Owned Treatment Works (POTW) in accordance with a POTW administered discharge permit.

2.2 Existing Site Data

In August of 1992, a pump test was conducted by Blasland & Bouck Engineers, P.C. (Blasland & Bouck) at pumping well #3 (PW-3) located adjacent to the south end of the Hadco building as shown on the site plan presented as Figure 1. Attachment I is a description of the pump test as presented in Appendix D of the Remedial Investigation Report for the Hadco facility prepared by Blasland & Bouck in December 1992. Based on a 10- to 12-gallon per minute (gpm) pumping rate during the pump test and water level measurements at surrounding monitoring wells (PW-3, MW-17, MW-19, MW-23, MW-24, MW-26, and MW-27), a capture zone was defined based on the observed drawdown. The location of PW-3 and the expected capture zone is shown on Figure 1. Fourteen shallow overburden and deep overburden monitoring wells (MW) and pumping well PW-3 are located within this capture zone. These monitoring wells include MW-1 through MW-4, MW-6, MW-7, MW-9, MW-10, MW-19, and MW-23 through MW-27. Based on the analytical results obtained from the sampling of these monitoring wells and PW-3 in October 1991 and September 1992, the calculated average and highest observed (worst-case) concentrations of select VOCs and inorganic compounds were determined to establish the anticipated concentration range of VOCs and inorganics in the treatment system influent. These concentration ranges are presented on Tables 1 and 2.

2.3 Discharge Limitations

The proposed ground-water treatment system will be required to comply with the Town of Owego's POTW discharge limits for discharging ground water into the POTW. The following table presents a summary of the Town of Owego's POTW discharge limit for VOCs and inorganic compounds:

Parameter	Discharge Limit
Total VOCs	2.13 parts per million (ppm)
Copper	5.0 ppm
Nickel	2.0 ppm
Lead	0.5 ppm
Tin	2.5 ppm

In addition, the treated ground water will be monitored for pH, suspended solids, and oil & grease in accordance with Hadco's existing POTW discharge permit.

2.4 Preliminary Design Conditions

The preliminary design conditions for the treatment system components were based on an influent flow rate of ground water between 10 and 12 gpm and the average and high concentrations of VOCs and inorganics presented in Tables 1 and 2. Four specific design conditions were established to provide at least a 100 percent margin of safety in meeting the Town of Owego sanitary sewer discharge limit for total VOCs of 2.13 ppm and to evaluate the treatment system components' performance and costs (capital, operation and maintenance) over a wide range of influent and effluent conditions. These four different design conditions are as follows:

1. Average VOC influent concentrations with treatment to achieve less than 1.0 ppm total VOCs in the effluent;
2. Maximum VOC influent concentrations with treatment to achieve less than 1.0 ppm total VOCs in the effluent;
3. Average VOC influent concentrations with treatment to achieve less than 0.01 ppm for each VOC in the effluent; and
4. Maximum VOC influent concentrations with treatment to achieve less than 0.01 ppm for each VOC in the effluent.

Preliminary design conditions were not established to address inorganics in the ground water. The Town of Owego sanitary sewer discharge limits and the calculated average and highest observed influent concentrations of inorganics are presented as follows:

Parameter	Town of Owego Sanitary Sewer Discharge Limits (ppm)	Influent Concentration (ppm) Average	Influent Concentration (ppm) Highest Observed
Lead	0.5	0.028	0.18
Nickel	2.0	0.204	1.07
Copper	5.0	2.044	22.5
Tin	2.5	<1.0	<1.0

Based on the inorganic data presented above, the average and highest observed concentrations of lead, nickel, and tin in the ground water are less than the Town of Owego sanitary sewer discharge limits. The average concentration of copper is less than the discharge limit, however, the highest observed concentration of copper of 22.5 ppm at MW-19 was above the discharge limit. Historically, the concentration of copper at all of the other monitoring wells has been less than 0.728 ppm (MW-6). Therefore, the concentration of copper in the influent will most likely be near the calculated average concentration and will not exceed the POTW discharge limit.

2.5 Evaluation of Treatment System Components

Three potential treatment system components were identified and evaluated based on each components ability to treat the VOCs in the ground water and to meet the four design conditions. The three treatment system components evaluated were as follows:

- Liquid-phase activated carbon;
- Shallow tray-type air stripper; and
- Packed tower-type air stripper.

Based on a review of the preliminary design conditions outlined in Section 2.4 above, and vendor information on the capability of each component, all three treatment system components are capable of meeting the discharge limits for VOCs under the four design conditions. A cost comparison of the three treatment system components revealed that the liquid-phase activated carbon option was higher in cost than the shallow tray-type air stripper and packed tower-type air stripper, which were comparable in cost. Due to the high cost of the liquid-phase activated carbon, only the shallow tray-type air stripper and packed tower-type air stripper were retained for further evaluation based on their respective construction, operation and maintenance advantages/disadvantages. Although the packed tower-type air stripper and the shallow tray-type air stripper are capable of meeting VOC discharge limits and are comparably priced, the shallow tray-type air stripper has distinct advantages over the packed tower-type air stripper. These advantages are as follows:

1) the shallow tray-type unit is more compact and could be placed inside a building enclosure;

2) because the shallow tray-type unit is more compact and can fit into a building enclosure, a heat source will not be required to prevent the unit from freezing during the winter (the packed tower stripper would be restricted to outdoor application due to its height of 21 feet) and would require heat tracing; and

3) the shallow tray-type stripper will require less maintenance due to fouling by inorganics.

Therefore, the shallow tray-type air stripper was recommended for treatment of the ground water as part of the IRM.

2.6 Description of Recommended System

The recommended IRM ground-water treatment system for the Hadco facility consists of a shallow tray-type air stripper to treat VOCs in the ground water pumped from PW-3. For ongoing operation and maintenance (O&M) of the shallow tray-type air stripper, the stripper will most likely be equipped with components to monitor system performance including:

- A control panel with alarm interlocks, motor starter, and panel lights;
- Low pressure alarm switch;
- High water level alarm switch;
- Line sampling ports;
- Water pressure gauges;
- Digital water flow indicator and totalizer;
- Air flow meter; and
- Temperature gauges.

A simple process flow diagram of the shallow tray-type air stripper treatment system is shown on Figure 2. A review of the potential air emissions from the shallow tray-type air stripper will be conducted to determine if vapor phase carbon treatment is required to treat VOCs discharged from the stripper.

The pre-treatment of inorganics most likely will not be required since the trays of the shallow tray-type air stripper are each equipped with two removable plugs that allow access to clean the tray interior (i.e, if inorganics cause fouling). The ground-water treatment system will be designed in such a manner which will allow pre-treatment system components for inorganics to be easily retrofitted, in the event that inorganic pre-treatment is required.

3.0 - Scope of IRM Implementation Activities

3.1 General

This section presents the scope of the IRM activities to be completed under the following tasks:

Task 1 - Preparation of Final Design Drawings & Specifications;

Task 2 - Contractor Selection & IRM System Construction;

Task 3 - IRM System Start-up; and

Task 4 - Preparation of Final Engineering Report

Task 5 - Operation and Monitoring of the IRM.

A detailed description of each work task is presented below.

3.2 Task 1 - Preparation of Final Design Drawings and Specifications

Under this task, design drawings and technical specifications for the recommended ground-water treatment system described in Section 2.6 above will be prepared by Hadco's Engineer. At minimum, the design drawings and technical specifications will include the following:

1) Site plan;
2) Process equipment layout;
3) Recovery well details;
4) Pipe trench details;
5) Process and instrumentation diagram;
6) Enclosure floor plan;

7) Enclosure section and details;
8) Structural details;
9) Electrical one-line diagram; and
10) Miscellaneous piping details.

The design drawings, which will include technical specifications, will be signed and sealed by a licensed professional engineer registered in New York State and will be submitted to the NYSDEC for review. Upon NYSDEC review, the design drawings will be revised, if necessary, and finalized.

3.3 Task 2 - Contractor Selection and Interim Remedial Measure Construction

Under this task, the design drawings and technical specifications outlined above in Task 1 will be distributed to Hadco-approved contractors for competitive bidding. The selected contractor will be required to submit a Health and Safety Plan and shop drawings for review by Hadco and Hadco's engineer.

Hadco's engineer will be responsible for reviewing shop drawings and providing an on-site observer during construction to document that the IRM ground-water treatment system has been constructed in general conformance with the design drawings and technical specifications, and reviewed shop drawings.

3.4 Task 3 - Interim Remedial Measure System Start-Up

Under this task, Hadco's engineer will develop a start-up plan for the ground-water treatment facility. The system start-up plan may consist of the following:

1) an influent and effluent sampling program which will require influent sampling and more frequent effluent sampling than the POTW discharge permit in order to ensure system effluent concentrations meet the POTW permit requirements during start-up and to develop data regarding the influent;

2) an operation monitoring program to develop the operational history of the ground-water treatment system; and

3) an air monitoring program for the vapor phase carbon treatment system, if required.

Hadco currently has an on-going quarterly monitoring program at this site which involves the collection of ground-water samples from six wells including MW-2, MW-11, MW-15, MW-17, MW-19, and MW-25. Each of these ground-water samples are analyzed for TCL volatile organic constituents by SW-846 Method 8240. To establish baseline conditions prior to the start-up of the IRM, the last quarterly sampling round to be completed before the initiation of the IRM will be expanded to include the following 11 additional wells located downgradient of the source area: MW-6, MW-23, MW-24, MW-26, MW-27, MW-29, MW-30, MW-31, MW-32, MW-33, and PW-3. These ground-water samples will be analyzed for TCL volatile organic compounds. In addition, each of the ground-water samples collected for this expanded round of sampling will be analyzed for chromium, copper, and zinc.

In addition, Hadco's engineer will provide an on-site observer during the start-up of the facility to monitor the operation of the system and to provide training for Hadco's treatment system operator.

3.5 Task 4 - Preparation of Final Engineering Report

Upon completion of the construction phase of the IRM, an engineer licensed to practice by the State of New York will prepare a Final Engineering Report presenting as built drawings and a certification that the construction activities were completed in accordance with this IRM Work Plan.

3.6 Task 5 - Monitoring and Operation of the Interim Remedial Measures

Under this task, the monitoring plan to be implemented for the life of the IRM ground-water treatment system will be developed by Hadco's engineer. The monitoring plan will include provisions for sampling and analysis of ground-water samples from on-site monitoring wells for VOCs, chromium, copper and zinc. The monitoring wells to be sampled will be agreed to by NYSDEC and Hadco prior to IRM start-up. To monitor the effectiveness of the IRM, the quarterly monitoring program will be expanded to include the following eight additional wells: MW-23, MW-26, MW-29, MW-30, MW-31, MW-32, MW-33, and PW-3. In addition, monthly monitoring will be performed at selected wells during the first six months that the IRM is operational. These selected wells would include MW-19, MW-23, MW-25, MW-26, and PW-3. Ground-water samples collected from the eight additional wells and from the monthly monitoring activities will be analyzed for TCL volatile organic compounds as well as for chromium, copper, and zinc. At the conclusion of the first six months of IRM operation, the effectiveness of the IRM monitoring program will be evaluated.

Prior to start-up of the IRM, Hadco's engineer will also develop an Operation and Maintenance (O&M) Manual for the IRM ground-water treatment system. The O&M manual will include the following:

1) a description of system operation;
2) a description of operation alarms;
3) system maintenance requirements;
4) operating procedures including daily log sheets; and
5) manufacturer's literature on the equipment.

Operation of the ground-water IRM treatment system will be conducted in accordance with the O&M manual.

4.0 - Schedule

The project schedule for implementation of the IRM is presented as Figure 3.

TABLES

TABLE 1

HADCO CORPORATION
OWEGO, NEW YORK

VOLATILE ORGANIC COMPOUNDS IN CAPTURE ZONE

Parameter	Concentration (ppb)		
	Average	Highest Observed	Monitoring Well Location
Acetone	18.7	320	MW-19
Benzene	19.3	340	MW-19
Bromodichloromethane	0.5	10	MW-19
Chlorobenzene	0.1	1	MW-23
Chloroethane	0.2	4	MW-23
Chloroform	5.0	79	MW-19
1,1-Dichloroethane	140.4	1,400	MW-23
1,1-Dichloroethene	2,036	23,000	MW-19
1,2-Dichloroethane	7.0	100	MW-19
1,2-Dichloroethene (total)	238	1,500	MW-23
Ethylbenzene	64.9	770	MW-19
2-Hexanone (MEK)	3.1	66	MW-23
Methylene Chloride	635	8,100	MW-19
4-Methyl-2-Pentanone (MIBK)	18.1	320	MW-19
Tetrachloroethene	217	2,200	MW-19
Toluene	2,171	24,000	MW-19
1,1,1-Trichloroethane	16,240	190,000	MW-19
Trichloroethylene	57,576	630,000	MW-19
Vinyl Chloride	11.4	56	MW-26
Xylene (total)	276	2,900	MW-19
Total VOCs	79,682	879,099	

Notes:

1. Analytical data from 15 ground-water monitoring wells located within the capture zone of pumping well PW-3 form the basis for the statistics on this table.

2. Ground-water samples were collected during sampling rounds in October 1991 and September 1992.

3. Concentrations are reported in parts per billion (ppb).

TABLE 2

HADCO CORPORATION
OWEGO, NEW YORK

INORGANICS IN CAPTURE ZONE

Parameter	Concentration (ppb)		
	Average	Highest Observed	Monitoring Well Location
Aluminum	7,969	92,300	MW-19
Arsenic	7.0	52	MW-19
Beryllium	1.0	9.8	MW-19
Cadmium	1.3	12	MW-19
Chromium	2,288	18,100	MW-7
Cobalt	10.6	129	MW-19
Copper	2,044	22,500	MW-19
Iron	22,724	128,000	MW-19
Lead	27.9	180	MW-6
Magnesium	13,869	53,500	MW-19
Manganese	3,346	12,200	MW-19
Mercury	0.1	1.4	MW-19
Nickel	204	1,070	MW-19
Silver	4.0	27	MW-1
Sodium	41,419	203,000	MW-23
Vanadium	7.6	78	MW-19
Zinc	47.3	873	MW-19

Notes:

1. Analytical data from 15 ground-water monitoring wells located within the capture zone of pumping well PW-3 form the basis for the statistics on this table.

2. Ground-water samples were collected during sampling rounds in October 1991 and September 1992.

3. Concentrations are reported in parts per billion (ppb).

FIGURES

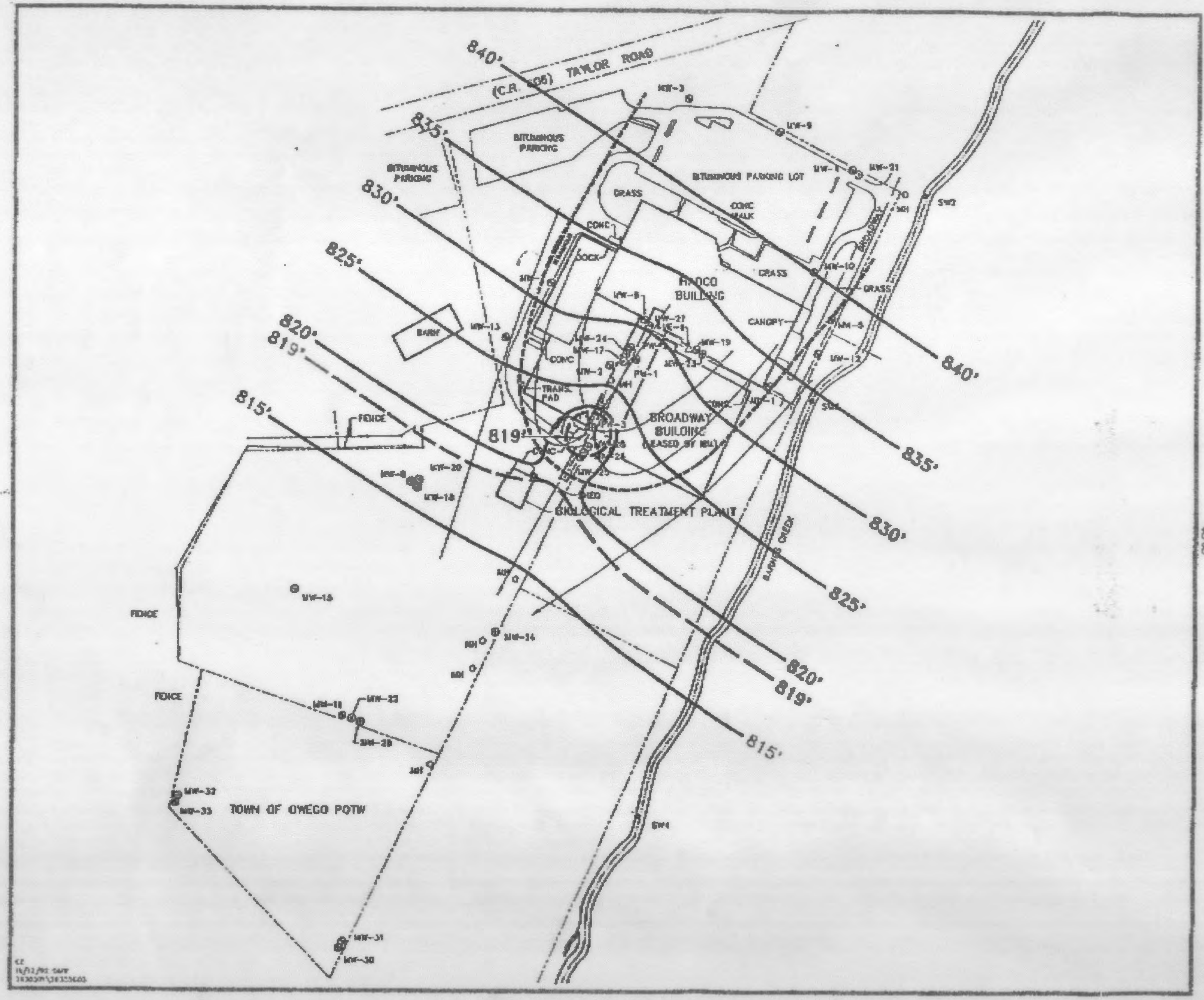

FIGURE 1

LEGEND

- INTERMITTENT STREAM WITH OF STREAM BANKS SHOWN
- SHALLOW OVERBURDEN MONITORING WELL
- DEEP OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- SURFACE WATER SAMPLE
- VAPOR EXTRACTION WELL
- 820' / 819' SIMULATED POTENTIOMETRIC CONTOUR LINE
- SIMULATED CAPTURE ZONE LIMIT
- SIMULATED FLOW LINE

HADCO CORPORATION
OWEGO, NEW YORK

PLAN VIEW OF SIMULATED PW-3 CAPTURE ZON IN DEEP OVERBURDEI

SCALE

200' 0 200'

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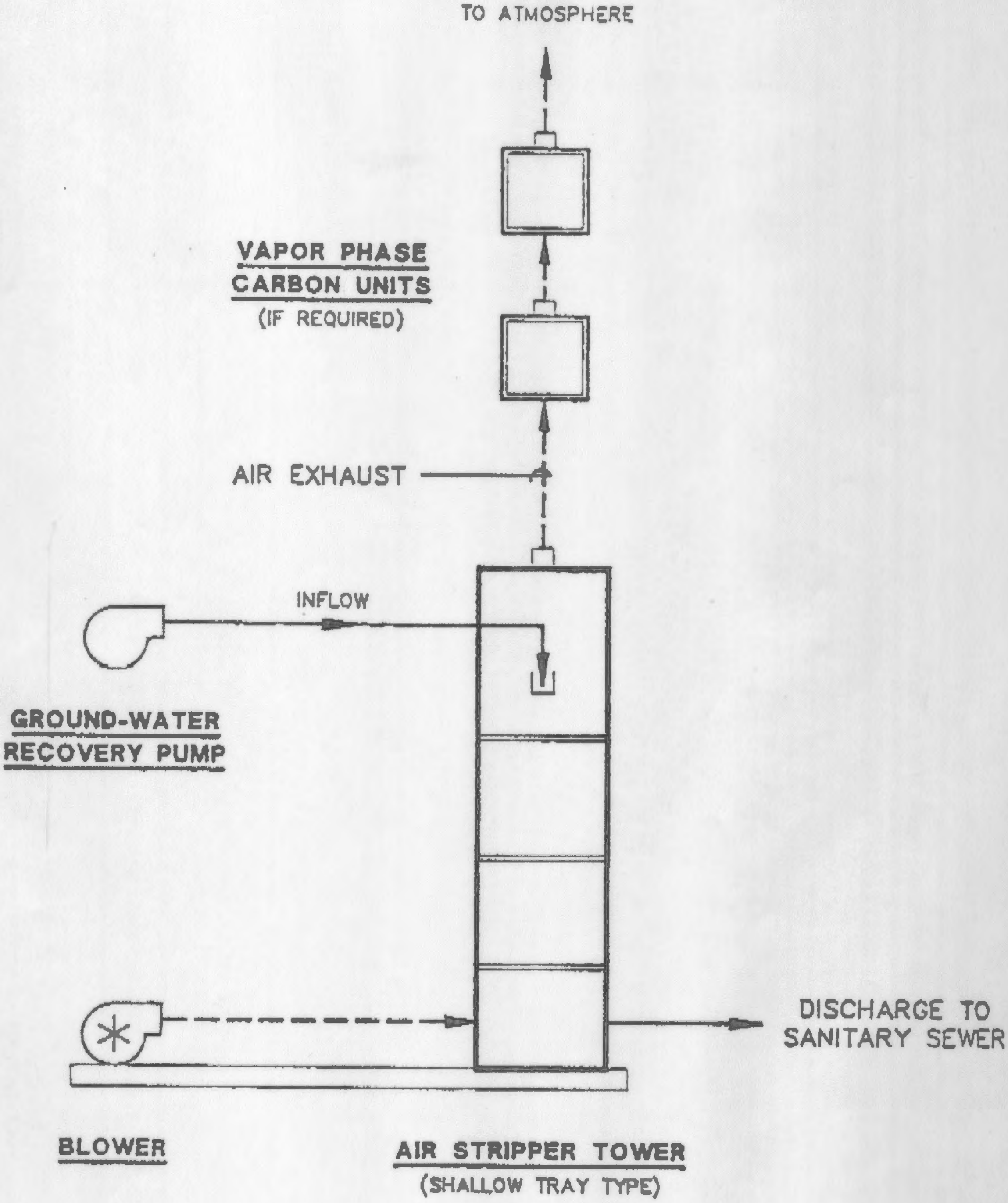

LEGEND

——— GROUND-WATER PIPING

- - - - AIR PIPING

BLASLAND & BOUCK ENGINEERS, P.C.

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HADCO CORPORATION
OWEGO, NEW YORK

GROUND-WATER TREATMENT

PROCESS FLOW DIAGRAM

FIGURE 2

FIGURE 3

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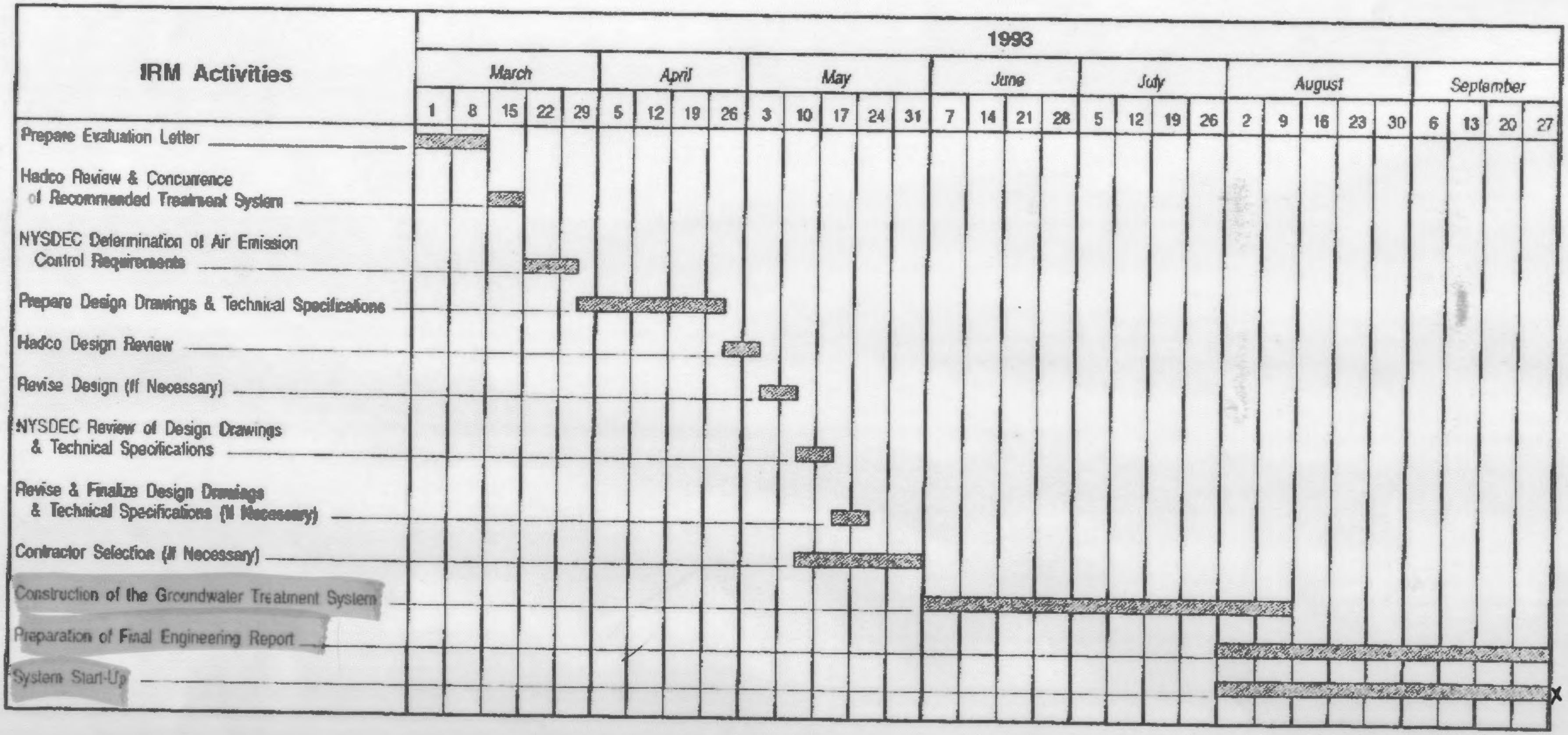
OWEGO, NEW YORK

GROUNDWATER IRM
TENTATIVE PROJECT SCHEDULE



NOTE:
1. Schedule is dependent upon NYSDEC review and approval time frames.

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ATTACHMENT 1

APPENDIX D

PW-3 CAPTURE-ZONE SIMULATION

APPENDIX D

Introduction

This Appendix describes a numerical modeling effort performed to help delineate the ground-water capture zone that may be achieved during long-term pumping from recovery well PW-3. The key objectives of ground-water flow modeling were to: (1) evaluate whether pumping from PW-3 may hydraulically control and remove shallow overburden groundwater from the vicinity of PW-3, which is screened in the deep overburden; (2) illustrate in plan view and cross section the capture zone of groundwater that may be achieved by pumping from PW-3; and (3) assess the down-gradient limit of the three-dimensional capture zone.

Conceptual Model of Overburden Ground-Water Flow

The geologic data generated during monitoring well installation at the site demonstrate that the overburden is geologically heterogeneous, including zones of sand; sand and gravel; silt, sand, and gravel; clay; and till. No laterally-continuous, low-permeability, confining unit has been identified, however, within the unconsolidated overburden deposits. The numerical model described in this section, therefore, treats the overburden as a single, complex hydrogeologic unit.

Hydrogeologic data from monitoring well boreholes indicate that the overburden is grossly stratified parallel to the top-of-rock surface. In bulk, these stratified deposits may be expected to be more permeable in the horizontal than the vertical direction. The numerical model accommodates this anisotropy by allowing input of greater horizontal than vertical hydraulic conductivity for the overburden as a whole.

Model Selection

The model selected for PW-3 capture zone simulation was "MODFLOW," the USGS Modular Three-Dimensional Finite-Difference Ground-Water Flow Model (McDonald and Harbaugh, 1988). Using a three dimensional array of rectilinear finite flow units, or cells, MODFLOW offered the flexibility to represent the complex hydrogeologic flow regime, including a variable horizontal to vertical conductivity ratio and three dimensional flow.

Three Dimensional Model Grid Setup

The MODFLOW model was designed to simulate the entire overburden formation as a single hydrogeologic unit. The model grid developed to simulate the hydraulic response to pumping from PW-3 consisted of 4 layers, 19 rows, and 33 columns. The grid orientation is shown schematically in Figure D-1. To facilitate the modeling process, the model grid was designed to utilize the symmetry of the flow system during pumping. Column #1 (of 17 columns) crossed through the location of PW-3, and was oriented parallel to the south-southwestward hydraulic gradient across the site. The entire modeled zone was thus simulated using a model grid covering one half of the symmetrical flow system.

The cell representing PW-3 was in the middle of Column #1 in the bottom model layer (Layer #4). The model grid extended from PW-3 toward the north-northeast, south-southwest, and east-southeast to a distance of approximately 2000 feet, where the potentiometric responses to pumping from PW-3 were assumed to be negligible. Cells along Rows #1 and #33, and Column #17, therefore, were assigned constant head values compatible with the preexisting south-southwestward hydraulic gradient of 0.03 feet per foot, parallel to the columns in the model grid. Head values at all other cells in the grid were variable.

As shown in Figure D-2, four model layers were used to evaluate the simulated response to pumping from PW-3 in three dimensions. The layer thicknesses from top (Layer #1) to bottom (Layer #4) were 12 feet, 12 feet, 15 feet, and 18 feet, respectively, corresponding the 57- foot thick overburden zone penetrated by PW-3.

Model Calibration

Prior to simulating the affects of long-term pumping from PW-3, the model was calibrated against the actual potentiometric responses observed at observation wells MW-25 and MW-26 during the pumping test of PW-3 performed on August 18, 1992. After 10 hours of pumping from PW-3 on August 18, 1992, potentiometric drawdowns of 0.18 feet and 2.89 were observed at shallow overburden well MW-25 and deep overburden well MW-26, respectively. The objective of the calibration, therefore, was to identify parameters that, when used in the MODFLOW model, yielded computed drawdowns that match these observed drawdowns. The iterative calibration process entailed:

- running the MODFLOW model with PW-3 pumping at 11 gpm for 10 hours, as during the pumping test;
- determining the simulated drawdowns at MW-25 and MW-26;
- comparing the simulated drawdowns to the observed drawdowns of 0.18 feet MW-25 and 2.89 feet at MW-26;
- adjusting the model parameters; and
- re-running the model.

Based on the pumping test results and hydrogeologic data obtained during monitoring well installation at the site, the following hydrogeologic parameters were initially used in the calibration effort:

- horizontal and vertical hydraulic conductivity (K) = 1.8 x 10^{-5} cm/sec;
- ratio of horizontal to vertical K (Kh/Kv) = 1;
- Layer #1 storativity = 0.2, Layers #2-4 storativity = 0.001;
- hydraulic gradient = 0.03 ft/ft south-southwestward;
- PW-3 pumping rate = 11 gpm; and
- pumping time = 10 hours.

After 19 iterations of the calibration process, the simulated drawdown values of 0.18 feet and 2.69 feet were computed, providing a reasonable match with the 0.18 feet and 2.89 feet of drawdown observed at MW-25 and MW-26 after 10 hours of pumping PW-3 at 11 gpm. The parameters that were modified to provide this calibration "match" are:

- horizontal hydraulic conductivity (Kh) = 9.1 x 10^{-4} cm/sec, vertical hydraulic conductivity (Kz) = 1.8 x 10^{-4} cm/sec;
- ratio of horizontal to vertical K (Kh/Kv) = 5; and
- Layer #1 storativity = 0.05, Layers #2-4 storativity = 0.001.

The calibrated vertical hydraulic conductivity is controlled within the model by assigned values of vertical "conductance" between the model layers. Storativity values calculated from short-term pumping periods typically are low, but the effective storativity increases during pumping (Nwankwor, 1984). This affect results from delayed drainage of stored water at the top of the saturated zone. The calibrated value of 0.05 is appropriate for the relatively short 10-hour pumping test modeled during the calibration procedure. During long-term pumping, however, the effective storativity value for the top of the overburden flow system would expected to approach the specific yield of the unconfined aquifer material, approximately 0.1 to 0.3. The calibrated Layer #1 storativity value of 0.05 was thus replaced with an estimated value of 0.2 for use in long-term capture-zone modeling. Increasing the storativity slightly reduces the computed drawdown in Layer #1 and is conservative with respect to capture zone simulation.

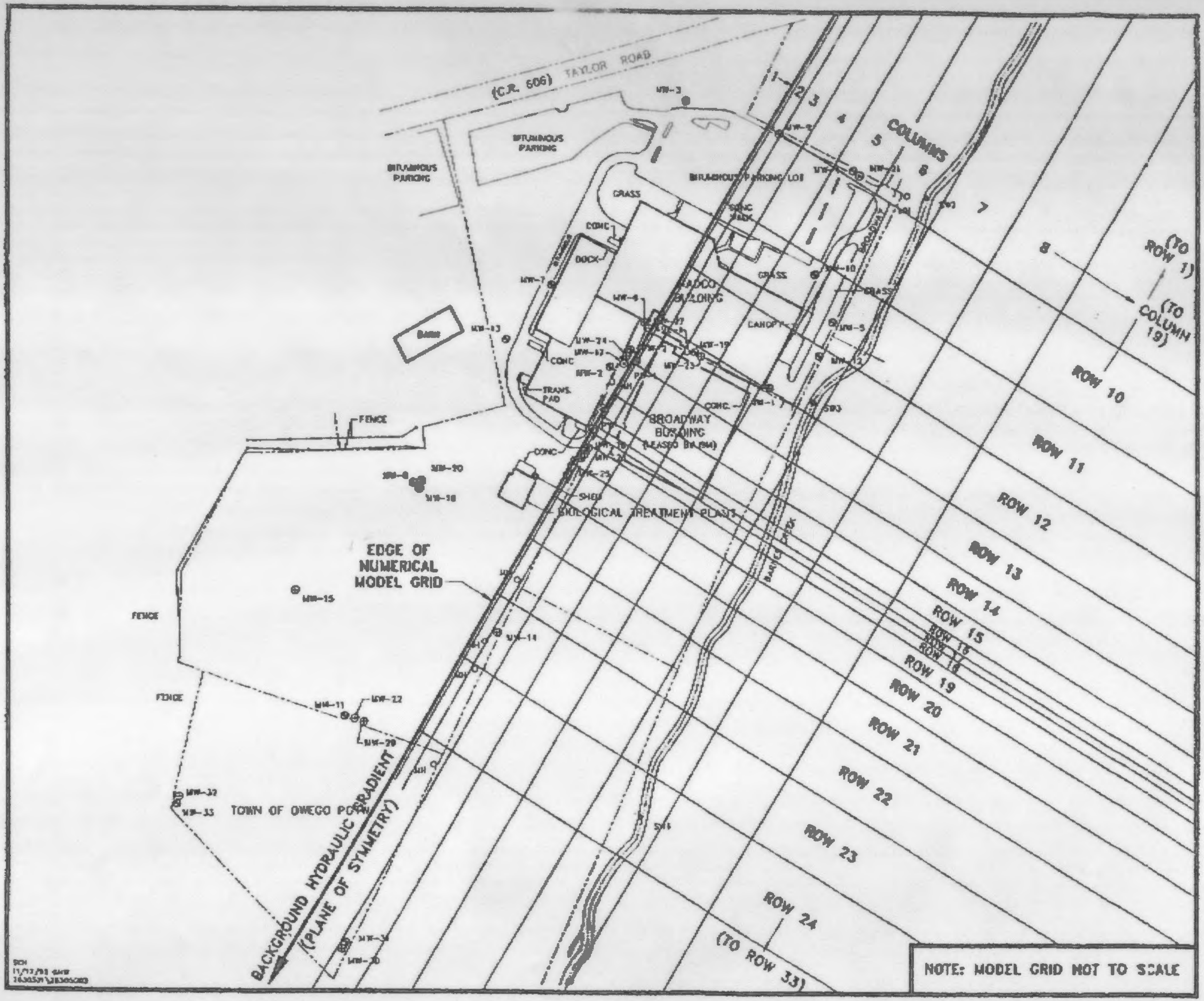
Capture-Zone Simulation

To simulate the capture zone that may be achieved during long-term pumping from PW-3, the calibrated MODFLOW model was run using a pumping rate of 11 gpm at PW-3 and a pumping duration of 60 days. The hydraulic heads computed by the model were used to depict the simulated capture zone of PW-3. The flow system in the vicinity of PW-3 is assumed to be symmetrical. Head values computed for the modeled half of the flow system, therefore, were projected across the plane of symmetry through PW-3 to enable depiction of the entire, symmetrical capture zone.

The results of the simulation are depicted on Figures D-2 and D-3. To evaluate the vertical profile of the capture zone through PW-3, head values computed along Column #1 in all four model layers are plotted and contoured on Figure D-2. Simulated flow lines also are drawn, showing the vertical capture zone through PW-3 parallel to the pre-existing hydraulic gradient. The simulated capture zone suggests that pumping 11 gpm from PW-3 for 60 days may hydraulically control shallow, intermediate, and deep overburden ground-water. The simulated capture zone is unlimited in the upgradient direction. The predicted capture zone downgradient of PW-3 extends to a distance of approximately 80 to 100 feet for shallow or deep overburden groundwater, respectively.

Figure D-3 shows a plan view of the capture zone computed for deep overburden groundwater. The computed head values from model Layer #4 are contoured, and the simulated ground-water flow lines are drawn showing the computed capture zone. The capture zone of deep overburden groundwater predicted by the model extends approximately 600 feet cross-gradient and approximately 100 feet downgradient of PW-3.

FIGURE D-1



LEGEND

- INTERMITTENT STREAM WITH OF STREAM BANKS SHOWN
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- BEDROCK MONITORING WELL
- SURFACE WATER SAMPLE
- Δ VAPOR EXTRACTION WELL

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NUMERICAL MODEL GRID SCHEMATIC ORIENTATION

SCALE

200' 0 200'

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FIGURE D-2

MODFLOW MODEL SETUP

LAYER	THICKNESS	HORIZONTAL HYDRAULIC CONDUCTIVITY (cm/s)	VERTICAL CONDUCTANCE (day^{-1})	STORATIVITY (DIMENSIONLESS)
LAYER 1	12 FT.	9.1×10^{-4}	0.043	0.2
LAYER 2	12 FT.	9.1×10^{-4}	0.038	0.001
LAYER 3	15 FT.	9.1×10^{-4}	0.031	0.001
LAYER 4	18 FT.	9.1×10^{-4}	NOT APPLICABLE	0.001

57 FT.

OVERALL HYDRAULIC CONDUCTIVITY

$K_H = 9.1 \times 10^{-4}$ cm/s

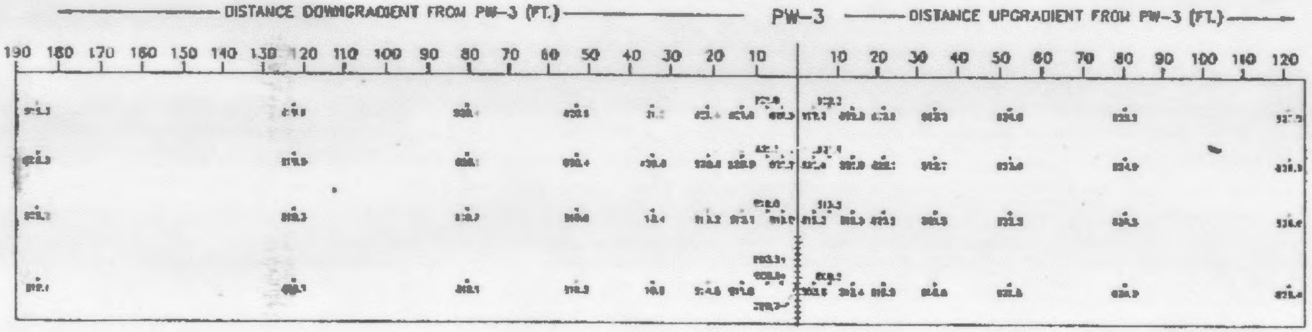
$K_V = 1.8 \times 10^{-4}$ cm/s

$K_H = 5K_V$

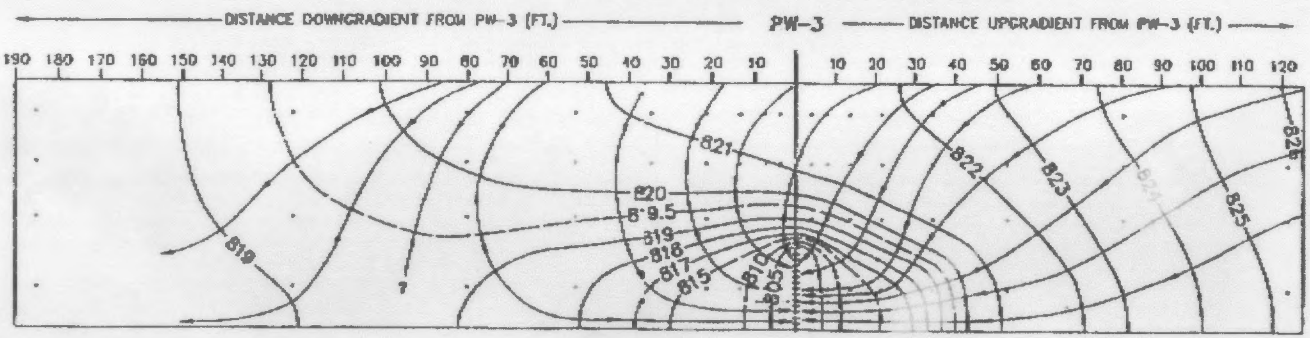
PW-3 PUMPING VALUES

RATE = 11 GPM
TIME = 60 DAYS

SIMULATED HEAD DISTRIBUTION



SIMULATED HEAD CONTOURS AND GROUND-WATER FLOW LINES



LEGEND

- MODEL CELL NODE
- SIMULATED HEAD DURING PUMPING AT PW-3
- SIMULATED GROUND-WATER FLOW LINE
- 817 / 815 SIMULATED POTENTIOMETRIC HEAD CONTOURS

HADCO CORPORATION
OWEGO, NEW YORK

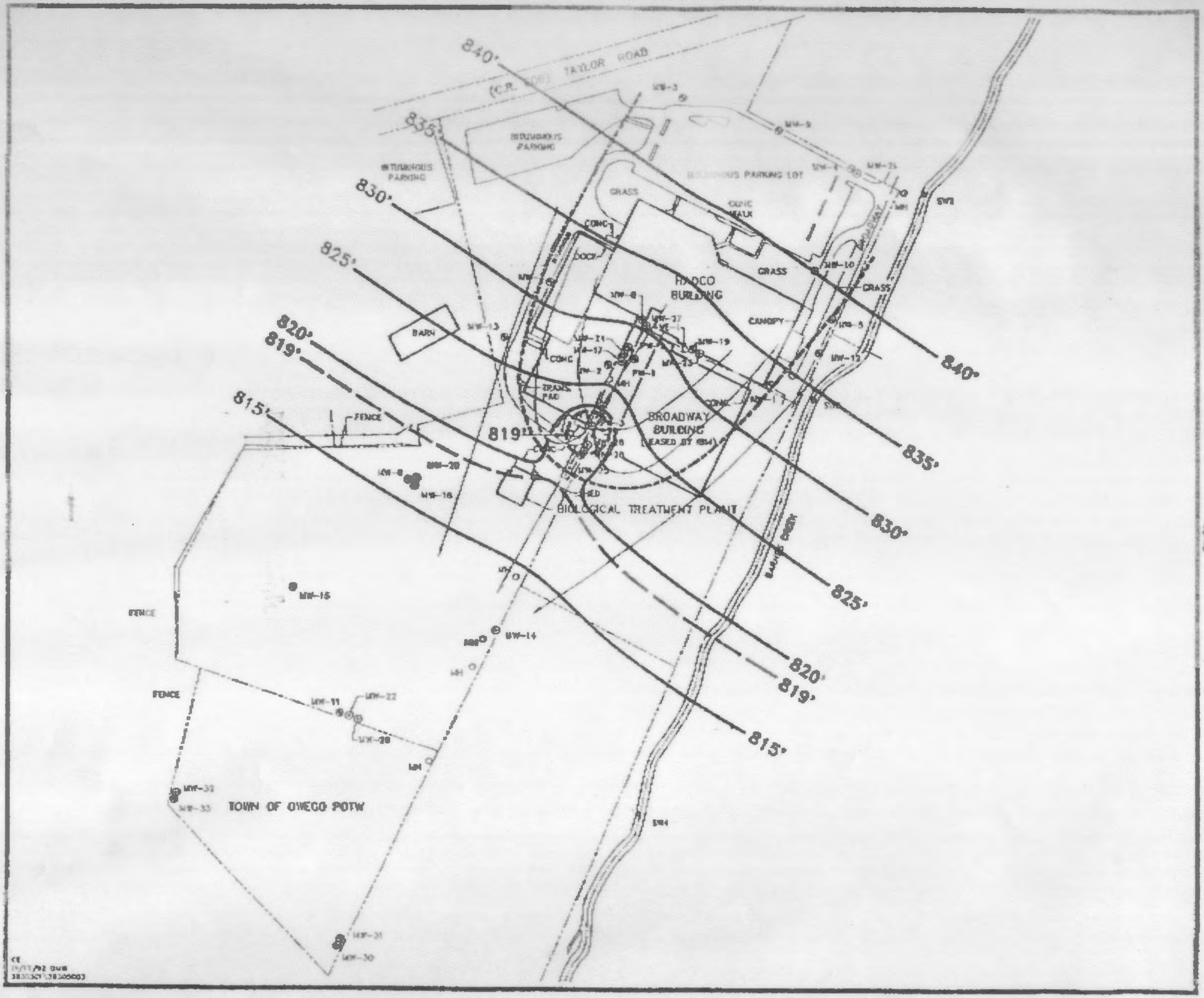
CROSS SECTION OF SIMULATED PW-3 CAPTURE ZONE

HORIZONTAL AND VERTICAL SCALE

30' 0 30'

BLASLAND & BOUCK ENGINEERS, P.C.
ENGINEERS & GEOSCIENTISTS

FIGURE D-3



LEGEND

INTERMITTENT STREAM WITH OF STREAM BANKS SHOWN

SHALLOW OVERBURDEN MONITORING WELL

DEEP OVERBURDEN MONITORING WELL

BEDROCK MONITORING WELL

SURFACE WATER SAMPLE

VAPOR EXTRACTION WELL

820' 819' SIMULATED POTENTIOMETRIC CONTOUR LINE

SIMULATED CAPTURE ZONE LIMIT

SIMULATED FLOW LINE

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PLAN VIEW OF
SIMULATED
PW-3 CAPTURE ZONI
IN DEEP OVERBURDEI

SCALE

200' 0 200'

BLASLAND & BOUCK ENGINEERS, P.C.