REGULATORY SUBMITTAL

TO
NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
50 WOLF ROAD
ALBANY, NY 12233

INTERIM REMEDIAL MEASURES
DUVA PROPERTY
TOWN OF CLAY, NEW YORK

SITE CODE: 7 - 34 - 051

VOLUME 1

CONTENTS: ENGINEERING REPORT
APPENDIX A - DESIGN INFORMATION

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

March 23, 1990

REVISED: MAY 1990

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TOWN OF CLAY, NEW YORK
STATE CODE 7-34-051

ENGINEERING REPORT

MARCH 1990
REVISED APRIL 1990
REVISED MAY 1990

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS
SCIENTISTS AND PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

TABLE OF CONTENTS

List of Tables

List of Figures

TABLE OF CONTENTS
(Continued)

List of Appendices

SUBMITTAL ORGANIZATION

1.0 INTRODUCTION

In accordance with terms contained in a proposed "Order On Consent" negotiated with the New York State Department of Environmental Conservation, the work here described is proposed to be undertaken to construct and operate the interim remedial measure designed for the purpose of intercepting identified ground water contaminants and preventing further migration.

This report and its attachments are prepared for the purpose of defining the work to be undertaken, the measures to be implemented and the methods to be utilized.

2.0 BACKGROUND INFORMATION

2.1 DESCRIPTION OF THE SITE

As shown in Figure 2, the Duva property consists of approximately five (5) acres wherein some drums of waste chemicals were discovered in 1987.

The Duva waste site is underlain by a layer of dense glacial till which dips from the surface near the waste deposit site to a depth of approximately 10' at MW-1. The deepening wedge of soil overlying the till is composed of several soil layers with moderately low permeabilities which serve to route ground water toward the adjacent homes.

2.2 PREVIOUS SITE ACTIVITIES

Various studies and efforts in the past have resulted in the following actions being taken.

1. The drums and some contaminated soils under the drums were removed for disposal as an initial cleanup effort in 1989.
2. Samples of remaining soil in the three (3) drum disposal areas (Figure 2-1) were analyzed for an extensive list of contaminants.
3. Sumps in the basements of several adjacent homes were sampled by the Health Department and analyzed for many of the contaminants found at the site. Detectable concentrations of contaminants above 1 ppb were found in the four (4) homes immediately downgradient of the site.
4. A contractor was employed in late 1989 to install covers and vent fans on the four (4) basement sumps in order to discharge any volatile compounds that might migrate into the indoor air.
5. Indoor air monitoring was conducted by the NYSDOH in January 1990. Such monitoring revealed concentrations in the four houses adjacent to the site above those found in a control home.
6. High volume air purifiers containing activated carbon filters were installed in all four of the homes in early March 1990.
7. Larger vent fans were installed in the homes in order to increase the volume of air discharged from the basements.

8. Follow-up air sampling was performed on March 14 and 15, 1990 to determine the effectiveness of the air purifiers and larger vent fans.

2.3 PLANNING FOR THE PROPOSED FACILITIES

Malcolm Pirnie Inc., (MPI) has been working for some time on various proposals for intercepting the ground water for treatment and/or discharge prior to its migration off the property.

A series of monitoring wells and piezometers were installed in Mid-1989 which showed silty sand deposits overlying glacial till. Volatile organic contaminants appeared to be restricted within these silty sand deposits above the glacial till. Because of the low permeability of the silty sands, it was determined that a collection trench containing a perforated pipe would be the most efficient ground water collection device and that such a system would efficiently intercept the contaminanted ground water migrating toward the houses. Appendix A-1 shows that ground water flow estimates into the trench range from 10 to 20 gpm (up to 30,000 gpd).

It was initially proposed to discharge the untreated ground water into the sanitary sewer on Platinum Drive, thereby routing it to the Ley Creek Pump Station and the Metropolitan Syracuse Treatment Plant for treatment and ultimate discharge to Onondaga Lake. After several months of negotiations, this alternative was ruled out due to the provisions in the County's SPDES permit which prohibited increased flows above 5000 gpd until the pump station is rebuilt and raw sewage overflows are eliminated.

After evaluating two other alternatives involving (1) treatment followed by ground water disposal, and (2) treatment with disposal to the storm sewer, it was determined that the case involving treatment and disposal to the storm sewer was the preferred alternative. Appendix A-2 contains a summary description of the alternatives evaluation.

2.4 PREVIOUS SUBMITTALS

On December 22, 1989, certain materials were submitted by MPI to the Syracuse office of the New York State Department of Environmental Conservation (NYSDEC) for use in determining the limits that would be applied to the treated discharge. Malcolm Pirnie personnel met with Steven Eidt of that office on January 5, 1990 to discuss the project. NYSDEC comment letters on January 19, 1990 and February 14, 1990 contained several comments on the previously furnished information and proposed effluent limitations which will govern the discharge. The Malcolm Pirnie personnel met with NYSDEC and NYSDOH personnel on March 2, 1990 in Albany to discuss the DEC's comments and examine their concerns with the project. It was agreed at that meeting that this Engineering Report and Attachments would be submitted for Agency review on March 23, 1990.

On March 30, 1990 MPI personnel met with members of the DEC concerning the March 23, 1990 submittal. Written comments from this meeting followed from the DEC to MPI dated April 3, 1990. A revision was then submitted on April 11, 1990. This revision (dated May 4, 1990) addresses further concerns of the State as presented in letters dated April 17, 1990 and April 25, 1990

3.0 FACILITIES DESIGN

3.1 GENERAL DESCRIPTION OF FACILITIES

Figure 3-1 is a layout of the proposed facilities. It is proposed that a ground water collection trench be installed downgradient of the drum disposal areas to collect the contaminated ground water flowing toward the four adjacent homes which have exhibited contamination in their basement sumps.

Water entering the trench would flow toward the center of the trench and be collected in a sump from where it will be pumped on a continuous basis to a treatment system. Ground water collected in the sumps of the four adjacent homes will join the water in the trench sump and also be pumped to the treatment system.

The ground water treatment system will include a metals removal system (primarily for iron) followed by granular activated carbon (GAC) canisters.

The treated ground water will then discharge through an approximately 1100-foot long gravity pipeline to the storm sewer serving the area. The treated water will flow approximately 1000 feet south through the storm sewer system before entering the headwaters of Bloody Brook. The water then flows southwesterly in Bloody Brook under Hopkins Road, Henry Clay Boulevard, the Thruway and eventually discharges into Onondaga lake south of the Village of Liverpool.

3.2 INFLUENT WASTEWATER CHARACTERISTICS

Table 3-1 shows the analyses of the ground water samples taken from the three monitoring wells downgradient of the drum disposal areas in the same general area as the proposed trench. The analyses show the characteristics of each well as well as the characteristics of a composite sample made from equal volumes of water from each of the three wells. Table 3-2 shows the analyses of the basement sumps in the four affected houses.

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Table 3-3 shows the analyses of the composite well sample and the individual sumps along with a hypothetical influent wastewater which includes all of the sources in proportion to the flow rates listed at the top of the table. Table 3-3 therefore represents the hypothetical average influent wastewater to the treatment system. It should be noted that the composite influent is heavily influenced by the contaminant levels in the Ullah sump.

3.3 EFFLUENT REQUIREMENTS

Table 3-4 below lists the effluent discharge limitations which are proposed for the effluent discharge to the storm sewer system.

TABLE #3-4
DUVA SITE EFFLUENT DISCHARGE LIMITATIONS

Parameter	Limit Weekly Average
Cis-1,1,-Dichloroethylene	5 ug/l
1,1,1-Trichloroethane	5 ug/l
Trichloroethylene	5 ug/l
Toluene	5 ug/l
Xylenes	5 ug/l
1,2-Dichloroethane	5 ug/l
1,1-Dichloroethane	5 ug/l
1,1-Dichloroethane	5 ug/l
Tetrachloroethylene	1 ug/l
1,4-Dichlorobenzene	5 ug/l
Ethyl Benzene	5 ug/l
1,3,5-Trimethylbenzene	5 ug/l
1,2,4-Trimethylbenzene	5 ug/l
Methyl-t-Butyl ether	10 ug/l
Vinyl Chloride	2 ug/l
Iron	0.3 mg/l
Manganese	2 mg/l
MEK	10 ug/l
BOD-5	5 mg/l

The treatment system will be operated in such a manner that the effluent concentrations of the listed contaminants are below the indicated levels.

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Facsimile Transmission Form

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TABLE 3-3

DUVA PROPERTY – ASSUMED INFLUENT CHARACTERISTICS

ANTICIPATED AVE. FLOW	COMP WELLS 20 gpm	ULLAH 5 gpm	KADARASK 2 gpm	SCULLIN 2 gpm	POLINSKY 1 gpm	TOTAL 30 gpm
1,4-Dichlorobenzene	5	125	0.5	0.5	0.5	24
1,2-Dichloroethane	5	1000	1	1	0.5	170
Cis-1,2-Dichloroethene	73	2500	24	1	3	467
Methylene Chloride	5	3	0.5	1	0.5	4
Tetrachloroethene	5	240	1	8	0.5	44
1,1,1-TCA	51	7400	3	0.5	0.5	1268
Trichloroethylene	5	21000	25.5	13	12.5	3507
Toluene	3	1600	0.5	2	0.5	269
Ethylbenzene	1	30	0.5	0.5	0.5	6
Total Xylenes	1	1100	0.5	0.5	0.5	184
1,3,5-Trimethylbenzene	1	4	0.5	0.5	0.5	1
1,2,4-Trimethylbenzene	1	10	0.5	0.5	0.5	2
MTBE	10	150	10	10	10	33
					Total ppb	5980
					Total ppm	5.98

NOTE: Levels of Toluene, Total Xylenes, and 1,1,1-Trichloroethane are not as shown on Tables 3.1 & 3.2. These values reflect new data obtained on March 6, 1990.

3.4 DETAILED DESCRIPTION OF KEY ELEMENTS

3.4.1 General

This section discusses the design of each of the key elements of the system. A detailed list of "Basis of Design" details for each element is included as Appendix A-3.

3.4.2 Ground Water Collection Trench

The details of the ground water collection trench are shown in Sheet #1 of the attached drawings. The trench will be approximately 3.5 feet wide and 8-foot deep in the center with the bottom sloping upward as it extends outward from the center. The collection system portion of the trench is designed to rest on the layer of compact till beneath the site in order to intercept the entire thickness of contaminated ground water within the silty sand deposits. The collection media in the trench consists of a 6-inch diameter HDPE perforated pipe surrounded by crushed stone and wrapped in a layer of geofabric. The collection bundle is laid in the trench at the desired slope and then surrounded by a special backfill material consisting of graded sand and gravel with a minimum of fines.

Construction of the trench will start in the center and the trench will be constructed outward from the center at the required slope. The trench will be sheeted using a trench excavation box in order to obtain vertical walls thereby minimizing the number of trees that are destroyed during construction.

The length of the trench will be determined in the field utilizing an HNU Model PI 101 organic vapor detector. Each bucket full of soil will be surveyed with the HNU meter. Buckets with a reading of 5 ppm or less will be deposited in the clean pile for reuse in backfilling the trench. Buckets with a reading in excess of 5 ppm will be deposited in the dirty pile for off-site disposal. It has been our experience on similar projects with chlorinated solvents in similar soils that the 5 ppm HNU reading generally results in volatile organic levels below the 1 mg/l range as determined by analysis using EPA Method 8020.

The trench will be continuously dewatered as excavation and installation proceed. The ground water removed from the trench during excavation will be settled and treated on site by use of the proposed system. Settled solids will be containerized for proper disposal.

3.4.3 Ground Water Collection Sump and Pumps

Sheet #2 of the attached drawings shows the ground water sump in the center of the collection trench which serves as a sump for pumping the collected ground water.

The sump will contain approximately 250 gallons of capacity below the level on the drainage pipes, providing roughly twelve minutes of detention at the average flowrate. Two submersible centrifugal pumps will be installed in the sump. Each pump will have a capacity of approximately 40 gpm at 22 feet. Controls will be installed to allow pump #1 to run continuously with pump #2 turning on when the inflow to the sump exceeds pump capacity. When the influent flows are less than pumping capacity, the lead pump will cycle according to inflow rate. When the flow is higher than pumping capacity of a single pump, the controls will again match the treatment plant influent to the higher flowrate necessary to maintain the sump level that will prevent long term submergence of the collection trench. The sump will be vented to the surface and a carbon filter will be added to the vent if solvent concentrations warrant.

3.4.4 Iron Removal System

The discharge line from the sump pumps will be routed to a 360 gallon tank. An oxodizing agent will be added at this tank and mixed with a mechanical mixer in order to facilitate total oxidation of soluable iron within the wastewater. This tank will overflow into a second 360 gallon tank where a commercial polymer will be added and flash mixed. This polymer is designed to coagulate small particles of iron. Overflow from this tank will be into a third 360 gallon tank where a slow mixing will take place in order to flocculate small particles into larger particles. This tank will overflow to a second sump.

Two (2) self-priming suction pumps will then pump the wastewater from the second sump through two (2) bag filters in series. These filters are designed to remove flocculated iron particles as well as other suspended material.

3.4.5 Carbon Canisters

The discharge line from the cartridge filters runs into a header providing four (4) parallel influent streams to four (4) separate trains of carbon canisters. Each train will consist of three canisters in series as shown in Sheet #2 of the attached drawings. Flow meters and valves will be installed on the four influent lines in order to balance the flow equally between the four carbon trains.

Each train of carbon provides for approximately 22 minutes detention time for the average flow rate of 7.5 gpm and 16.5 minutes at maximum flow rate or 10 gpm. Surface application rates vary from 2.4 gpm/ft^2 at average flow to 3.2 gpm/ft^2 at the anticipated maximum flow of 40 gpm (10 gpm/train).

The carbon canisters are placed on and are equipped with simple disconnects to allow changing of the canisters at exhaustion. The series arrangement of three canisters allows the full loading of the #1 canister prior to regeneration while still retaining effluent quality from the remaining canisters.

3.4.6 Effluent Sump and Discharge Lines

Effluent piping from the four carbon trains discharges to a common effluent chamber as shown in Sheet #2 of the attached drawings. The effluent chamber drains by gravity through a buried four inch diameter PVC pipe approximately 1100 feet to the west where it discharges into a manhole in the storm sewer serving the area.

In order to maintain the necessary slope, the upper portion of the line is above the frost line at a burial depth of approximately two feet. This section of the line (first 200') is protected against freezing by heat trace and insulation. As another protection against freezing, the effluent chamber is equipped with a dosing siphon which allows the chamber to fill and discharge with a sudden flush similar to the action of a toilet. This flushing action provides higher flows and greater velocities in the effluent pipe thus minimizing the detention time for freezing of the water in the pipe. During normal summer operations, the float is deactivated and the effluent simply overflows the outlet at the top of the chamber.

3.4.7 Treatment Building and Appurtenances

The treatment system will be enclosed in a 20' x 26' wooden frame building constructed on a concrete base slab. The base slab will be sloped such that any water spilling onto the floor will run to a floor drain which will empty back into the collection sump.

The treatment building will be finished with siding and roofing material which will blend with the general character of the neighboring properties.

The building will be maintained above freezing utilizing an electric heater. Electrical service for the lights, pumps and the heater will be extended across the property from Taft Road unless alternate service can be quickly arranged in a shorter route from Platinum Drive.

The present access road from Taft Road will be improved with the application of crushed gravel as necessary to maintain all weather traffic.

The site, including the contaminated soil areas and the treatment building, will be fenced with six-foot high chain link fence as shown on Sheet #4 of the attached drawings. A vehicle gate will be installed where the roadway enters the fenced area. Evergreen shrubs (five-foot high) will be planted along the fence to shield it from view by the adjacent neighbors in the affected houses.

4.0 FACILITIES CONSTRUCTION

4.1 CONSTRUCTION PLANS AND SPECIFICATIONS

Appendices B and C, Volume 2 of this submittal, contain the plans and specifications for the work described in the previous sections. These documents will be utilized to solicit bids from a minimum of three (3) contractors for the construction of the facilities.

4.2 CONSTRUCTION TIMING AND SEQUENCING

The facilities described will be constructed by a qualified contractor during late Spring and Summer of 1990.

Figure 4-1 is a proposed schedule of activities involved in the bidding and awarding of the construction contract(s), and construction of the facilities.

Activities will commence with the upgrading of the entrance road. Construction of the building will follow or run concurrently with road upgrading. Installation of the drain line would be concurrent with building construction. Following completion of the building all treatment equipment would be installed.

Following verification of the treatment system, work on the collection trench will begin. Dewatering from the trench will be treated in the building. Completion of the trench will be followed by regrading, seeding, cleanup and fence installation.

Electrical service will be brought onto the site during the building construction period so that the equipment can be activated as soon as it is installed.

Construction will conclude with installation of the security fence and site cleanup.

4.3 HEALTH & SAFETY ACTIVITIES DURING CONSTRUCTION

When required, the contractor will comply with the provisions of OSHA Regulation 29 CFR 1910.120. This regulation requires formal training and medical monitoring for persons encountering hazardous wastes during the construction activities. The trenching activities also are covered by OSHA regulations, specifically OSHA 29CFR 1926, Subpart P.

Appendix D, in Volume 3 of this submittal, contains a Health and Safety Plan for the construction and construction supervision activities at the site. The Health and Safety Plan describes the measures which must be undertaken to protect the Engineer's personnel and the occupants of the adjacent areas, as well as establishes the minimum requirements for protection of the contractor's personnel. This document, produced by the Engineer is not meant to cover all of the aspects of Health and Safety that are common to the contractors activities including equipment operation, etc. The Health and Safety Plan therefore requires the contractor to provide his own Health and Safety plan which builds upon the Engineer's plan and includes additional measures necessary to protect the contractor's employees.

The attached Health and Safety plan contains criteria for shutting down the work if airborne contaminant levels exceed certain predetermined levels.

5.0 FACILITIES OPERATION AND MAINTENANCE

5.1 PHASED OPERATIONS

A rather conservative design was utilized and considerable flexibility was included into the facilities. It is the intention that facility operations will be conducted in two (2) distinct phases as follows.

Phase A Full Scale Pilot Plant Operation

Phase B Stabilized Day-to-Day Operations

Descriptions of the operation and maintenance activities to be carried out in each of these distinct phases are included in the Operations and Maintenance Manual for the facility which is included as Appendix E-1 in Volume 3.

Since many of the Phase B operations will be dependent upon the results of the pilot plant testing, certain portions of the Phase B description will be provided upon the completion of the Phase A operations.

5.2 OPERATION AND MAINTENANCE RESPONSIBILITIES

It is proposed that the facilities be operated by Malcolm Pirnie Inc. during the pilot testing period which is anticipated to last from six to ten weeks.

Once the pilot testing is complete and the Operations and Maintenance Manual is finalized, operations will be turned over to an operator whom will operate the facility in conformance with the O&M Manual.

TABLE 3-1

DUVA SITE GROUND WATER DATA

	MW-1 06/27/89 MPI	MW-2 06/27/89 MPI	MW-3 06/27/89 MPI	MW-4 06/27/89 MPI	COMP 12/20/89 MPI	COMP 02/20/90 MPI
502.1						
Bromobenzene	<20	<1	<1	<1	<5	
Bromochloromethane	<20	<1	<1	<1	<5	
Bromodichloromethane	<20	<1	<1	<1	<5	
Bromoform	<20	<1	<1	<1	<5	
Bromomethane	<20	<1	<1	<1	<5	
Carbon tetrachloride	<20	<1	<1	<1	<5	
Chlorobenzene	<20	<1	<1	<1	<5	
Chloroethane	<20	<1	<1	<1	<5	
Chloroform	<20	<5	<5	<5	<5	
Chloromethane	<20	<1	<1	<1	<5	
2-Chlorotoluene	<20	<1	<1	<1	<5	
4-Chlorotoluene	<20	<1	<1	<1	<5	
Dibromochloromethane	<20	<1	<1	<1	<5	
1,2-Dibromoethane	<20	<1	<1	<1	<5	
Dibromomethane	<20	<1	<1	<1	<5	
1,2-Dichlorobenzene	<20	<1	<1	<1	<5	
1,3-Dichlorobenzene	<20	<1	<1	<1	<5	
1,4-Dichlorobenzene	<20	<1	<1	<1	<5	
Dichlorodifluoromethane	<20	<1	<1	<1	<5	
1,1-Dichloroethane	<20	<1	<1	<1	<5	
1,2-Dichloroethane	<20	<1	<1	<1	<5	
1,1-Dichloroethene	<20	<1	<1	<1	<5	
cis-1,2,Dichloroethene	740	<1	<1	<1	73	
trans-1,2-Dichloroethene	<20	<1	<1	<1	<5	
1,2-Dichloropropane	<20	<1	<1	<1	<5	
1,3-Dichloropropane	<20	<1	<1	<1	<5	
2,2-Dichloropropane	<20	<1	<1	<1	<5	
1,1-Dichloropropene	<20	<1	<1	<1	<5	
Methylene chloride	<20	<5	<5	<5	<5	
1,1,1,2-Tetrachloroethane	<20	<1	<1	<1	<5	
1,1,2,2-Tetrachloroethane	<20	<1	<1	<1	<5	
Tetrachloroethene	<20	<1	<1	<1	<5	
1,1,1-Trichloroethane	200	<1	<1	<1	51	
1,1,2-Trichloroethane	<20	<1	<1	<1	<5	
Trichloroethene	450	<1	9	<1	<5	
Trichlorofluoromethane	<20	<1	<1	<1	<5	
1,2,3-Trichloropropane	<20	<1	<1	<1	<5	
Vinyl chloride	<20	<1	<1	<1	<5	
503.1						
Benzene	<20	<1	<1	<1	<1	
Trichloroethene	450	<1	9	<1	5	
Toluene	31	<1	<1	<1	3	
Tetrachloroethene	<20	<1	<1	<1	<1	

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	MW-1 06/27/89 MPI	MW-2 06/27/89 MPI	MW-3 06/27/89 MPI	MW-4 06/27/89 MPI	COMP 12/20/89 MPI	COMP 02/20/90 MPI
Ethylbenzene	<20	<1	<1	<1	<1	
m,p-Xylene	22	<1	<1	<1	<1	
Chlorobenzene	<20	<1	<1	<1	<1	
p-Isopropyltoluene	<20	<1	<1	<1	<1	
o-Xylene	<20	<1	<1	<1	<1	
Isopropylbenzene	<20	<1	<1	<1	<1	
Styrene	<20	<1	<1	<1	<1	
n-Propylbenzene	<20	<1	<1	<1	<1	
t-Butylbenzene	<20	<1	<1	<1	<1	
o-Chlorotoluene	<20	<1	<1	<1	<1	
p-Chlorotoluene	<20	<1	<1	<1	<1	
Bromobenzene	<20	<1	<1	<1	<1	
sec-Butylbenzene	<20	<1	<1	<1	<1	
1,3,5-Trimethylbenzene	<20	<1	<1	<1	<1	
1,2,4-Trimethylbenzene	<20	<1	<1	<1	<1	
p-Dichlorobenzene	<20	<1	<1	<1	<1	
m-Dichlorobenzene	<20	<1	<1	<1	<1	
Cyclopropylbenzene	<20	<1	<1	<1	<1	
n-Butylbenzene	<20	<1	<1	<1	<1	
o-Dichlorobenzene	<20	<1	<1	<1	<1	
Hexachlorobutadiene	<20	<1	<1	<1	<1	
1,2,4-Trichlorobenzene	<20	<1	<1	<1	<1	
Naphthalene	<20	<1	<1	<1	<1	
1,2,3-Trichlorobenzene	<20	<1	<1	<1	<1	
MISC.						
PCBs, total						<0.1
Cyanide, total						<10
Iron, total						7000
Lead, total						<100
Manganese, total						2200

All data in ug/l.

Note: "Comp." refers to an equal volume composite of MW-1, 2 and 3.

TABLE 3-2 DUVA SITE - RESIDENTIAL SUMP DATA

Number->	5026	5024	5024	5022	5022	5020	5020
Date->	05/01/89	05/01/89	05/25/89	05/01/89	05/25/89	05/01/89	05/25/89
Sampler->	DOH/OCHD	DOH/OCHD	DOH/OCHD	DOH/OCHD	DOH/OCHD	DOH/OCHD	DOH/OCHD
USEPA 502.1							
Bromobenzene	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
Bromodichloromethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Bromoform	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Bromomethane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
Carbon tetrachloride	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Chlorobenzene	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
Chloroethane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
Chloroform	<0.5	<500	<500	<0.5	<0.5	15	10
Chloromethane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
2-Chlorotoluene	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
Dibromochloromethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1,2-Dibromoethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Dibromomethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1,2-Dichlorobenzene	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
1,3-Dichlorobenzene	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
1,4-Dichlorobenzene	<0.5	125	<500	<0.5	<0.5	<0.5	<0.5
Dichlorodifluoromethane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<500	<500	1	<0.5	<0.5	<0.5
1,2-Dichloroethane	1	1000	1000	1	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	38	<500	<0.5	<0.5	<0.5	<0.5
cis-1,2,Dichloroethene	1	2000	3000	24	23	3	2
trans-1,2-Dichloroethene	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1,2-Dichloropropane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1,3-Dichloropropane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Methylene chloride	1	3	<500	<0.5	<0.5	<0.5	<0.5
1,1,1,2-Tetrachloroethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	8	240	<500	1	1	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	3000	2000	2	4	<0.5	<0.5
1,1,2-Trichloroethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Trichloroethene	13	25000	17000	27	24	14	11
Trichlorofluoromethane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichloropropane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Vinyl chloride	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
2,3-Dichloropropene	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
t-1,3-Dichloropropene	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
c-1,3-Dichloropropene	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
2-Chloroethylvinyl ether	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
Pentachloroethane	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
1-chlorcyclohexene-1	<0.5	<500	<500	<0.5	<0.5	<0.5	<0.5
bis(2-Chloroethyl)ether	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
1,2-Dibromo-3-chloropropane	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
bis(2-Chloroisopropyl)ether	<0.5	<0.5	<500	<0.5	<0.5	<0.5	<0.5
USEPA 503.1							
Benzene	<0.5	<0.5	inter.	<0.5	<0.5	<0.5	<0.5
Toluene	2	360	30	<0.5	<0.5	<0.5	<0.5

TABLE 3-2 DUVA SITE - RESIDENTIAL SUMP DATA

Number-> Date-> Sampler->	5026 05/01/89 DOH/OCHD	5024 05/01/89 DOH/OCHD	5024 05/25/89 DOH/OCHD	5022 05/01/89 DOH/OCHD	5022 05/25/89 DOH/OCHD	5020 05/01/89 DOH/OCHD	5020 05/25/89 DOH/OCHD
Ethylbenzene	<0.5	30	2	<0.5	<0.5	<0.5	<0.5
m,p-Xylene	<0.5	110	8	<0.5	<0.5	<0.5	<0.5
p-Isopropyltoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o-Xylene	<0.5	60	6	<0.5	<0.5	<0.5	<0.5
Isopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Styrene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
t-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	<0.5	4	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	<0.5	10	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclopropylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Butylbenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
p-Bromofluorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
o/p-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m-Chlorotoluene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,3-Benzofuran	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
KETONES							
2-Butanone (MEK)			<10		<10		<10
4-Methyl-2-pentanone (MIBK)			<10		<10		<10
Acetone			<10		<10		<10
Methyl tert butyl ether			150		<10		<10

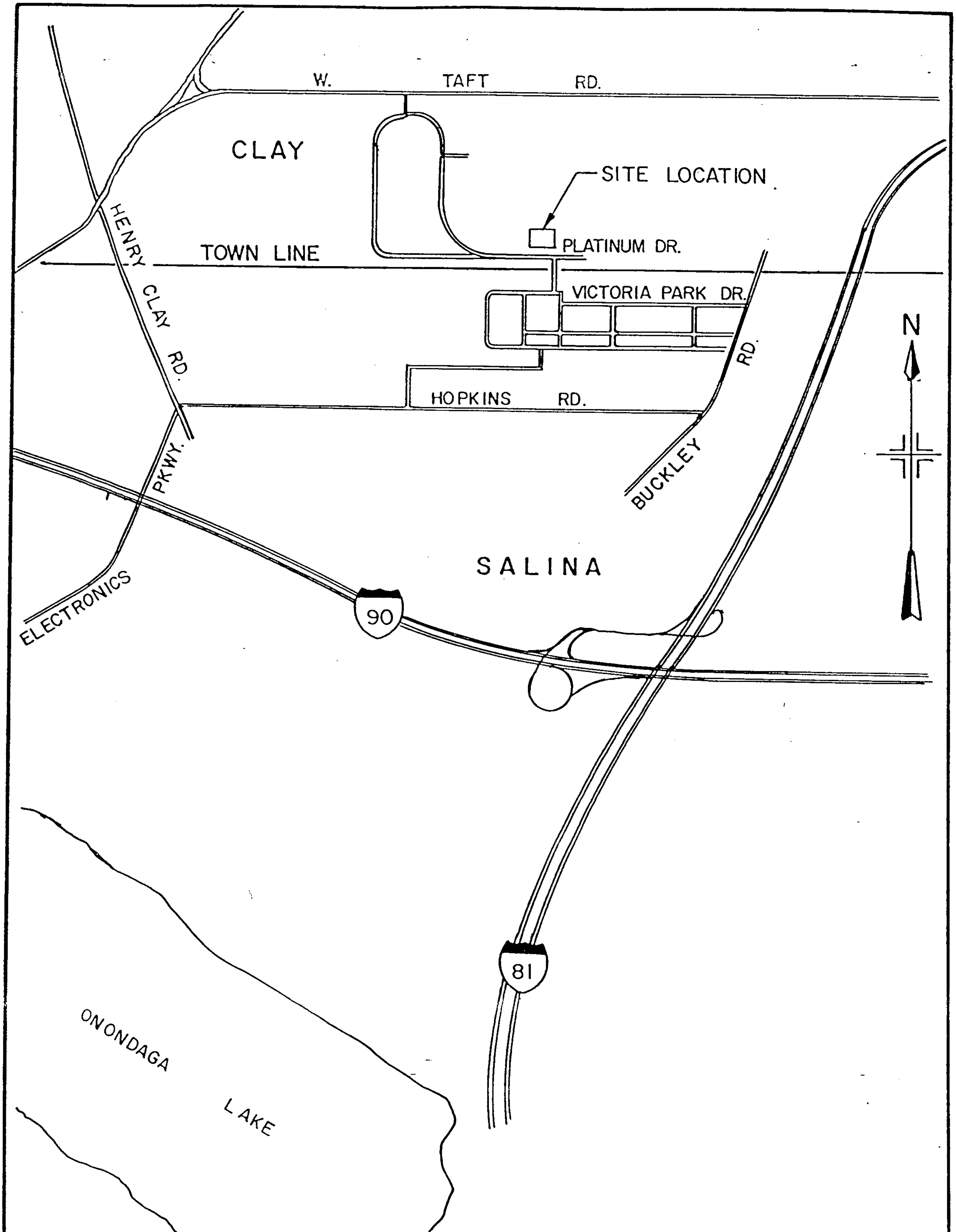
All data in ug/l.

TABLE #3-3

DUVA SITE - ASSUMED INFLUENT CHARACTERISTICS

ANTICIPATED AVERAGE FLOW (GPM)	COMP WELLS 20 gpm	ULLAH 5 gpm	KADARASKAS 2 gpm	SCULLIN 2 gpm	POLINSKY 1 gpm	TOTAL 30 gpm
Dibromomethane	5	2000	.5	.5	.5	337
1,4-Dichlorobenzene	5	125	.5	.5	.5	21
1,2-Dichloroethane	5	1000	1.0	1.0	.5	167
Cis-1,2-Dichloroethene	73	2500	24.0	1.0	3.0	467
Methylene Chloride	5	3	0.5	1.0	.5	4
Tetrachloroethene	5	240	1.0	8.0	.5	44
1,1,1-TCA	51	3000	3.0	.5	.5	534
Trichloroethylene	5	21,000	25.5	13.0	12.5	3506
Toluene	3	30	.5	2.0	.5	7.2
Ethylbenzene	1	2	.5	.5	.5	1
Total Xylenes	1	92	.5	.5	.5	1
1,3,5-Trimethylbenzene	1	4	.5	.5	.5	1.4
1,2,4-Trimethylbenzene	1	10	.5	.5	.5	2.4
MTBE	10	150	10.0	10.0	10.0	33
						5096.3 ppb or 5.1 ppm

30 gpm x 1440 = 43,200 gpd
5.1/120 x 43.2 = 1.84#/day organics



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SITE LOCATION MAP

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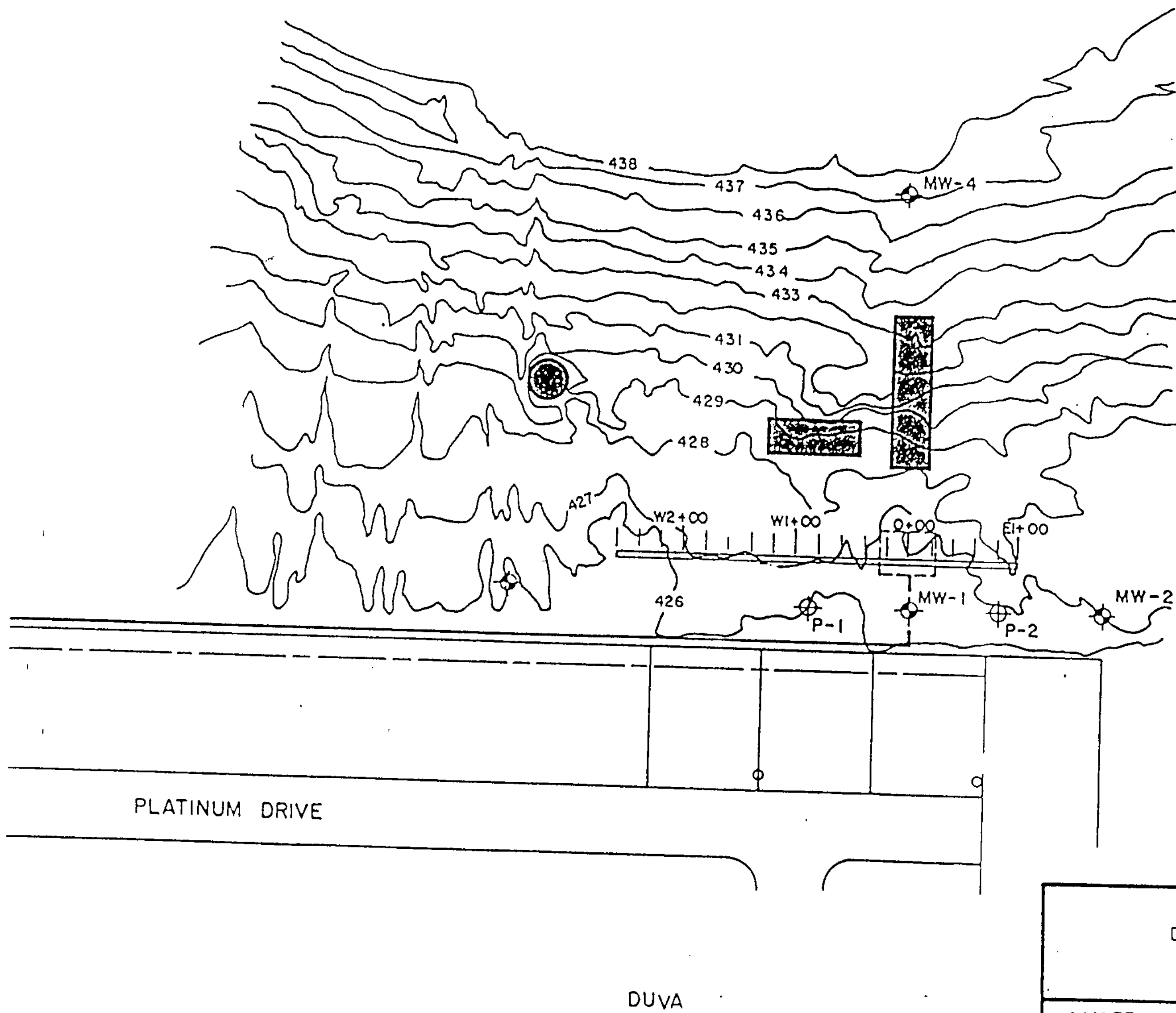
DATE: 3 - 90

FIGURE 2-1

143823



DUVA FARM SITE
SITE PLAN

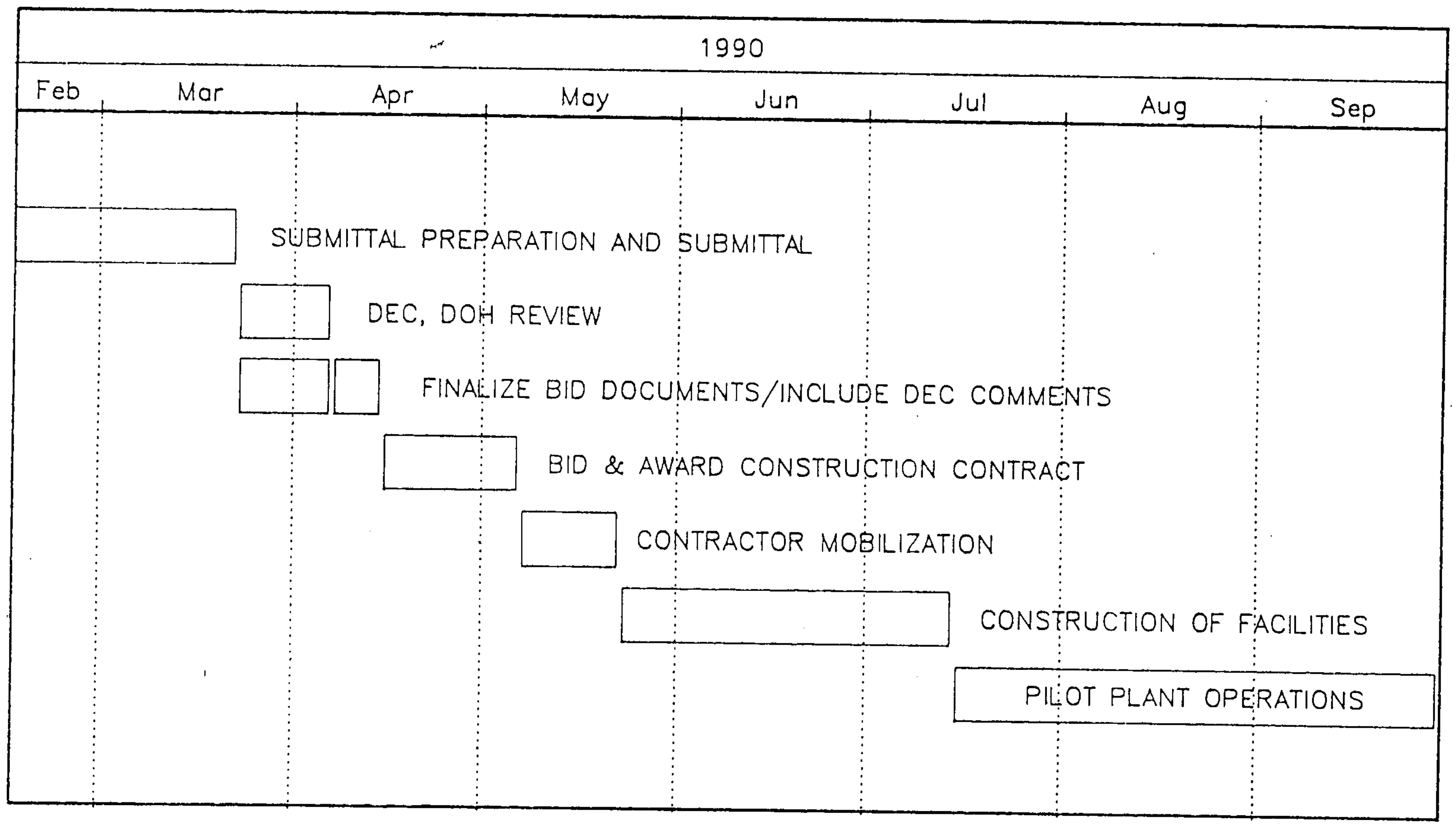
MALCOLM PIRNIE

DATE MARCH 1990	FIGURE	
JOB NO.	3 - 1	

FIGURE 4 - 1

SCHEDULE OF ACTIVITIES

DUVA FARM SITE



APPENDIX A

DESIGN INFORMATION

APPENDIX A-1

FLOW RATE ESTIMATION

REGULATORY SUBMITTAL

INTERIM REMEDIAL MEASURES
DUVA FARM PROPERTY
TOWN OF CLAY, NEW YORK
SITE CODE: 7-34-051

APPENDIX A-1
FLOW RATE ESTIMATION

MARCH 1990
REVISED APRIL 1990

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS AND PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

APPENDIX A-1

FLOW RATE ESTIMATION

The purpose of this report is to provide estimates of flow into the proposed trench at the Duva property. The flow rates are based on very limited field data and are therefore only estimates of the actual flow which will occur. However, we feel that the estimates are adequate for system design and are close enough so that they can be easily adjusted after bringing the system on line.

There are two sources of water inflow to the trench collection system; precipitation falling on the cone of influence of the trench which flows to the trench, and lateral ground water flow towards the trench influenced by the trench's cone of influence. The flow rates of precipitation reaching the trench was estimated using the average local precipitation and the cone of influence of the trench. Ground water inflow rates were estimated by two independent methods as a check.

1) Inflows to the Trench from Precipitation

An area around the trench will be dewatered during operations by withdrawals from the trench collection system (known as the area of influence or cone of influence of the trench). Because of the high infiltration potential of site soils (Soil Survey of Onondaga County), precipitation falling on this cone of influence will infiltrate quickly into the soils and flow to the trench. As ground water withdrawals continue, this cone of influence expands away from the trench. This expanding surface area increases the volume of precipitation infiltrating into the soils and flowing to the trench.

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The average precipitation for the Syracuse area averages around three inches per month and is fairly evenly distributed throughout the year. Some additional water enters the cone of influence from uphill runoff and some water is lost from the cone of influence by evapotranspiration during the growing months.

We assume that the net inflow of precipitation is two inches per month and there is a loss of one inch per month.
The total flow to the trench from net precipitation also depends on the surface area of the cone of influence of the trench at some time after start-up. This change in the area of influence was calculated by the Finite Line Sink model. Estimates of the change in flow of precipitation to the trench with time are listed on the following table.

TIME	AREA OF INFLUENCE	FLOW TO TRENCH
30 days	1.1 acres	2 gpm
100 days	2.5 acres	5 gpm
365 days	5 acres	10 gpm

2) Prediction of Ground Water Inflow into Excavations (by Ibrahim and Brutsaert, 1965; see attachment for method description)

The following equations describe the flow of ground water under steady state conditions to an excavation (in our case, a trench or drain).

$$\text{Tau} = \frac{K * H}{Sy * L * L}\, t \qquad \text{and} \qquad \text{Gamma} = \frac{Sy * L}{K * H * H}\, q$$

where:

H = saturated ground water thickness = 9 feet (trench design)

K = 3 x 10^{-4} cm/sec = 0.85 feet/day (field permeability data)

Sy = Specific yield of the trench = 0.15 (Soil Survey of Onondaga County)

L = 100 feet (distance to glacial till boundary)

t = 30, 100 and 365 days (to estimate flow changes with time)

Tau = 0.005 per day

TIME	GAMMA	TAU	q (ft/day)	q (gpm)
30 days	0.15	0.74	3.4	13
100 days	0.5	0.22	1.0	4
365 days	1.8	0.1	0.46	2

3) Steady Ground Water Flow to a Finite Line Sink (U. S. Dept. of the Interior - Office of Surface Mining, 1980; see attachment for method details)

This simulation estimates ground water inflows to a linear feature which acts as a ground water drain (line sink). The purpose of this simulation is to estimate both flow rates into the trench and changes in flow rates with time. The trench was broken into two line segments because of the way this model works. The flow rates for the two adjacent line sink segments were then summed to arrive at the total inflow from the entire trench.

Number of sinks = 2
K (permeability) = 0.85 feet/day
m (average drawdown) = 5 feet
Transmissivity = 32 gpd/ft
Coordinates of line sinks (feet)

Sink	X_{min}	Y_{min}	X_{max}	Y_{max}
1	1175	1275	1348	1375
2	1352	1375	1525	1475

RESULTS OF MODEL SIMULATION

TIME	b_e *	TOTAL FLOW
30 days	58 feet	10 gpm (not steady state)
100 days	106 feet	5 gpm
365 days	202 feet	2 gpm

(* radius of influence)

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4) Results of Inflow Estimates to Trench

The total rate of flow to the trench from precipitation and ground water sources is summarized on the following table and presented in graphical form on Figure 1.

Total Variation in Flow to Trench

Time	Q (ppt)	+	Q (g water)	=	Total Flow
30 days	2 gpm		13 gpm		15 gpm
100 days	5 gpm		5 gpm		10 gpm
365 days	10 gpm		2 gpm		12 gpm

The results of the simulations show that the flow to the trench will be greatest during startup (perhaps 20 gpm) and gradually decrease to a rate in the vicinity of 10 gpm. Short-term, high-intensity storm events will tend to fill up the dewatered cone of influence and therefore the total flow rate will increase towards the initial conditions of 20 gpm. Dry conditions or winter "deep freeze" periods will have the opposite effect, when the lowest flow rates are realized. A modular treatment system, consisting of small 10 gpm carbon canisters, can easily be altered to compensate for actual inflow rates after system startup.

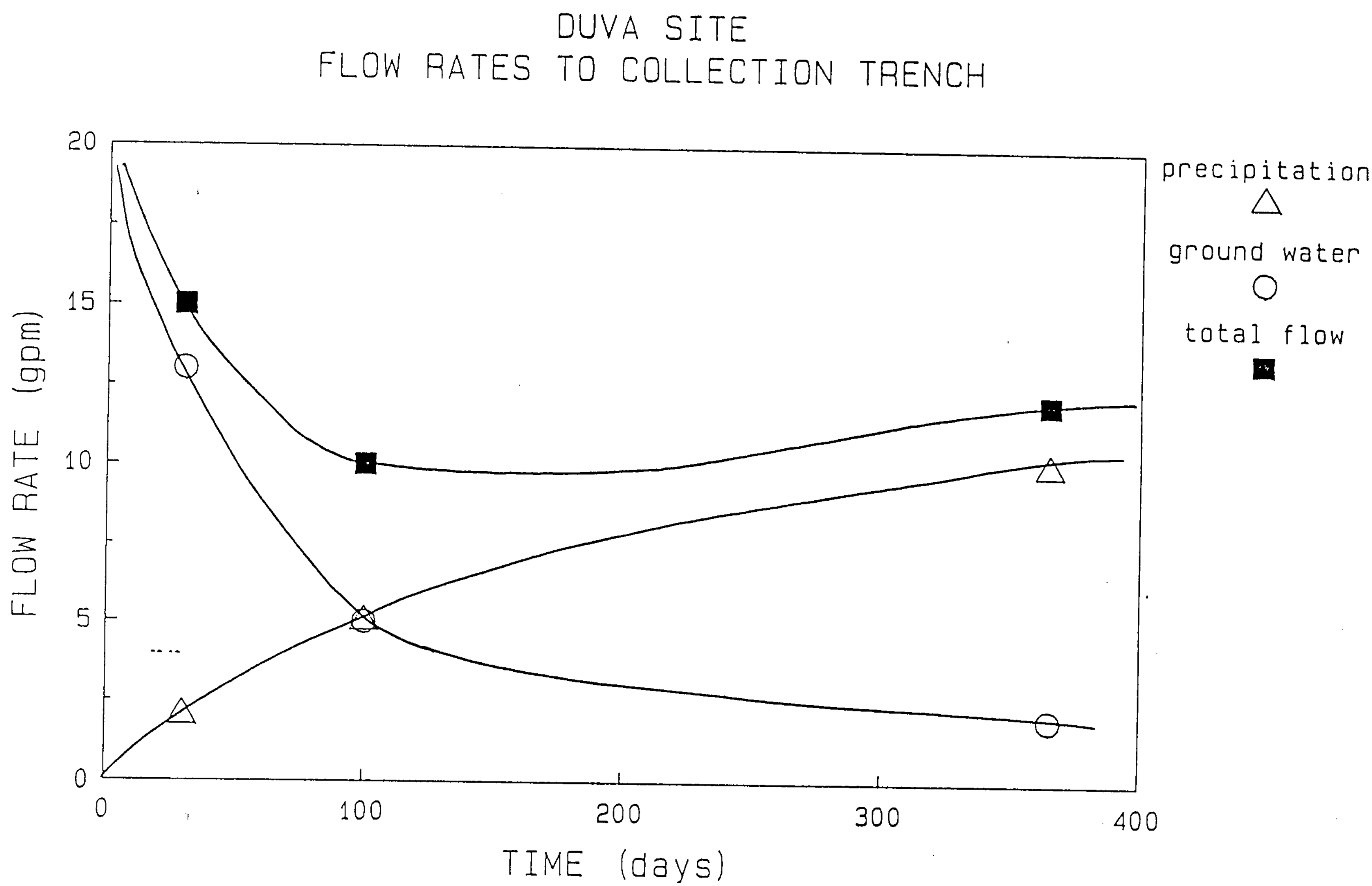
Very truly yours,

MALCOLM PIRNIE, INC.

Richard W. Klippel, P.E.
Senior Associate

RJK/slo
1357-02-1
attachments

FIGURE 1


DUVA SITE
FLOW RATES TO COLLECTION TRENCH
FLOW RATE (gpm)
TIME (days)
0
5
10
15
20
0
100
200
300
400
precipitation
ground water
total flow

STEADY FLOW TO A FINITE LINE SINK

by:
U.S. Department Of Interior
Office Of Surface Mining (1981)

PROGRAM 17: STUDY OF STEADY-STATE FLOW TO FINITE LINE SOURCES OR SINKS WITH DRAWDOWN AS THE GIVEN

Introduction

The flow rate to a finite length line sink is of interest when studying strip mines, ditches, canals, or groundwater flow to finite sections of rivers or streams. In these cases, the head or drawdown at the line sink is known and the flow rate is unknown. Using the strip mine procedures as an example, the mine plan may take on various shapes and highwall depth. The high walls usually take on straight line configurations with their depths being specified by the elevation of the deposit being mined. The length of the high wall, its depth, and the static water level of the deposit being mined governs the rate at which ground water flows to it. If there are other strip mines in the vicinity, a cumulative impact on flow results. Each mine interferes with the other resulting in a reduction of individual mine flows, but increasing the total regional flow.

The purpose of this program is to allow the study of the cumulative flow impacts of numerous finite line sinks (or sources) where the drawdowns are given and the flow rates are calculated. Since several lines are to be studied, each of them interfering with one another, a set of simultaneous equations has to be solved. Due to core storage limits of the TI-59, only six lines may be studied simultaneously.

The program uses the basic theory given in The Flow of Homogeneous Fluids Through Porous Media (Muskat, 1937, pages 181-199).

Program Theory

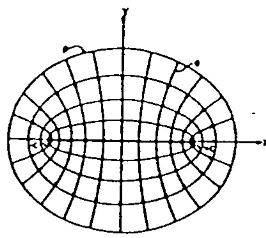
A typical plan view of the steady-state line configuration is shown in Figure 17.1. The drawdown for line i can be approximately expressed as:

$$s_i = s_{i1} + s_{i2} + \dots\dots\dots s_{ii} + \dots\dots +s_{ij}$$

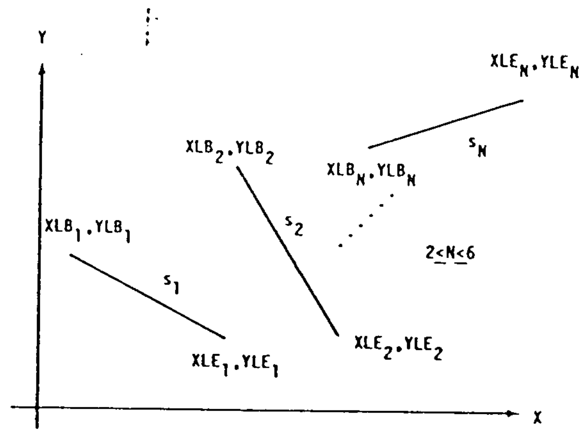
where:

s_i = total drawdown at line sink i
s_{i1} = partial drawdown at line sink i due to line sink 1, etc.
s_{ii} = partial drawdown at line sink i due to itself
s_{ij} = partial drawdown at line sink i due to line sink j

Basic Single Finite Line Response

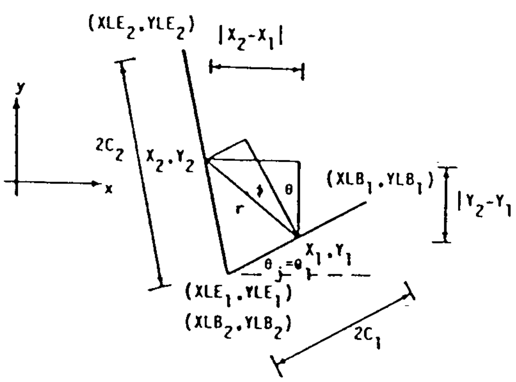


Multiple Line Configuration for Calculator



Where: XLB_i, YLB_i = coordinates of the beginning of line i, in feet
XLE_i, YLE_i = coordinates of the end of line i, in feet
s_i = drawdown to be specified along line i, in feet below static level

Generalized Line Sinks



Generalized Geometry of Line Sinks

$$\theta_k = \tan^{-1}\left|\frac{YLE_k - YLB_k}{XLE_k - YLB_k}\right|$$

$$\phi_j = \left|\tan^{-1}\left|\frac{X_2 - X_1}{Y_2 - Y_1}\right| \pm \theta_j\right| \qquad \begin{array}{l} - \ \theta_j < \theta_1 \\ + \ \theta_j \geq \theta_1 \end{array}$$

$$X' = r \sin \phi$$

$$Y' = r \cos \phi$$

$$r = \sqrt{(X_2-X_1)^2 + (Y_2-Y_1)^2}$$

Figure 17.1 Problem Layout and Equations for the Study of Steady-state Flow to Finite Line Sinks or Sources with Drawdown Given

The expressions used to generate the matrix equations are then:

$$s_{ii} = \frac{720\ Q_i}{\pi T} \ln \left[\frac{b_{ei} + [c_i^2 + b_{ei}^2]^{1/2}}{c_i} \right]$$

where

Q_i = the line sink/source discharge of line sink i (gpm),
b_{ei} = the external ellipse minor semi-axis length of line sink i at which the drawdown is zero (ft),
c_i = the half length of line sink i (ft),
T = aquifer transmissivity (gpd/ft).

and

$$s_{ij} = \frac{720\ Q_j}{\pi T} \left[\ln \left[\frac{b_{ej} + [c_j^2 + b_{ej}^2]^{1/2}}{c_j} \right] - \cosh^{-1}(H(X',Y')) \right]$$

where

Q_j, b_{ej}, C_j are as before except for line sink j. X' and Y' are also as before

$$H(X',Y') = \left[\frac{X'^2 + Y'^2 + c_j^2 + [(X'^2 + Y'^2 + c_j^2)^2 - 4x'^2c_j^2]^{1/2}}{2c_j^2} \right]^{1/2}$$

Therefore, the resulting matrix equation can be expressed by:

$$\overline{s} = A\ \overline{Q}$$

where

$\overline{s}$ and $\overline{Q}$ are the drawdown and discharge/recharge vectors, respectively, defined as:

$$\overline{s} = \begin{bmatrix} s_1 \\ s_2 \\ s_3 \\ \cdot \\ \cdot \\ \cdot \\ s_i \end{bmatrix} \text{ and } \overline{Q} = \begin{bmatrix} Q_1 \\ Q_2 \\ Q_3 \\ \cdot \\ \cdot \\ \cdot \\ Q_i \end{bmatrix}$$

$$\begin{array}{cc} & \longleftarrow j \longrightarrow \\ \updownarrow i & \begin{bmatrix} a_{11} & a_{12} & \cdot & \cdot & \cdot & \cdot & a_{1j} \\ a_{21} & a_{22} & & & & & a_{2j} \\ \cdot & & & & & & \\ \cdot & & & & & & \\ \cdot & & & & & & \\ \cdot & & & & & & \\ a_{i1} & a_{i2} & & & & & a_{ij} \end{bmatrix} \end{array}$$

$$a_{ij} = \frac{720}{\pi} \left[\ln \left[\frac{b_{ej} + [c_j^2 + b_{ej}^2]^{1/2}}{c_j} \right] \right] \quad \text{for } i = j \text{ (diagonal element)}$$

$$a_{ij} = \frac{720}{\pi} \left[\ln \left[\frac{b_{ej} + [c_j^2 + b_{ej}^2]^{1/2}}{c_j} \right] \right] - \cosh^{-1} [H(X',Y')]$$

for i not equal to j (non-diagonal elements)

A useful relationship is that $\cosh^{-1}(x) = \ln [x + (x^2 - 1)^{1/2}]$ for $x > 1$.

The matrix equation is solved for the $\overline{Q}$ vector using Master Library Program ML-02. Any questions about the matrix solution should be directed to the Master Library manual.

The equations above are for steady state conditions in an infinite flow field, assuming that the lines fully penetrate the aquifer, having a uniform transmissivity. The interference between lines is calculated by using the line sink/source midpoints as the specified drawdown reference points. In reality, the theory yields results for variable drawdown along each line. Yet, this type of analysis is reasonably accurate for field applications.

Limitations of Program

1. The number of lines must be <6 and >2. If the number of lines is 6, the execution module can only be run once and subsequently the load module must be rerun to reload the line sink data.

2. θ_k is stored to the nearest degree as an absolute value--so there is a slight error here.

3. The length of the line c_k is stored to the nearest foot. c_k should also be less than 99,999 ft.

4. Place all line sinks/sources in the first quadrant of the axes. None allowed on the axes. This restriction is due to the packing methods used in the program.

5. None of the finite line sinks or lines between the midpoints of finite line sinks can be vertical. Best results are obtained when all lines are neither vertical nor horizontal.

6. You must have a MASTER LIBRARY module for this problem. It is used for the matrix solution routine.

7. The radii of influence (b_e) must overlap at some point. If they do not, you are assuming there is no interaction between finite line sinks and there is no point in running the program.

30 days		100 days		365 days	
OSM REGION V FINITE LINE SINKS SPECIFIED DRAWDOWN		OSM REGION V FINITE LINE SINKS SPECIFIED DRAWDOWN		OSM REGION V FINITE LINE SINKS SPECIFIED DRAWDOWN	
2.	NL	2.	NL	2.	NL
32.	T	32.	T	32.	T
1.	ID	1.	ID	1.	ID
1175.	XLB	1175.	XLB	1175.	XLB
1275.	YLB	1275.	YLB	1275.	YLB
1348.	XLE	1348.	XLE	1348.	XLE
1375.	YLE	1375.	YLE	1375.	YLE
58.	BE	106.	BE	202.	BE
2.	ID	2.	ID	2.	ID
1352.	XLB	1352.	XLB	1352.	XLB
1375.	YLB	1375.	YLB	1375.	YLB
1525.	XLE	1525.	XLE	1525.	XLE
1475.	YLE	1475.	YLE	1475.	YLE
58.	BE	106.	BE	202.	BE
-1.6788683 01		3.4518798 01		1.0758849 02	
9.		9.		9.	
9.		9.		9.	
-5.168704389		2.513869043		9.	
-5.168704389		2.513869043		9.	
-10 gpm	Not Steady St.	5 gpm		.8065522505	
				.8065522505	
				1.6 gpm	

PREDICTION OF GROUND WATER
INFLOW INTO EXCAVATIONS

by:
Ibrahion and Brutsaert (1965)

Predictive Analysis of Groundwater Inflows Into Excavations

The development of quantitative methods of analysis for the prediction of groundwater inflow into excavations has lagged behind the development of such methods for many other problems in applied groundwater hydrology. The only analytical methods known to the authors are adaptations of methods designed for the prediction of inflow hydrographs to surface reservoirs from large unconfined aquifers. Brutsaert and his coworkers have analyzed the problem first presented in Figure 5.14 using each of the approaches schematically illustrated there. Verma and Brutsaert (1970) solved the complete saturated-unsaturated system with a numerical method. Verma and Brutsaert (1971) solved the problem numerically as a two-dimensional, saturated, free-surface problem; and analytically as a one-dimensional, saturated problem simplified by use of the Dupuit assumptions. The predictive methodology of Figure 10.18 is based on an earlier study (Ibrahim and Brutsaert, 1965) carried out with a laboratory model. The results were later confirmed by the mathematical models of Verma and Brutsaert (1970, 1971).

Figure 10.18(a) shows the geometry of the two-dimensional vertical cross section under analysis. It has relevance to the prediction of groundwater inflows into excavations only if the following assumptions and limitations are noted: (1) the excavated face is vertical; (2) the excavation is emplaced instantaneously; (3) the boundary conditions and initial conditions on the hydrogeological system are as shown on Figure 10.18(a); (4) the geological stratum is homogeneous and isotropic; and (5) the excavation is long and lineal in shape, rather than circular, so that the two-dimensional cartesian symmetry is applicable. While these assumptions may appear restrictive, results may nevertheless be of use in estimating the probable transient response of more complex systems.

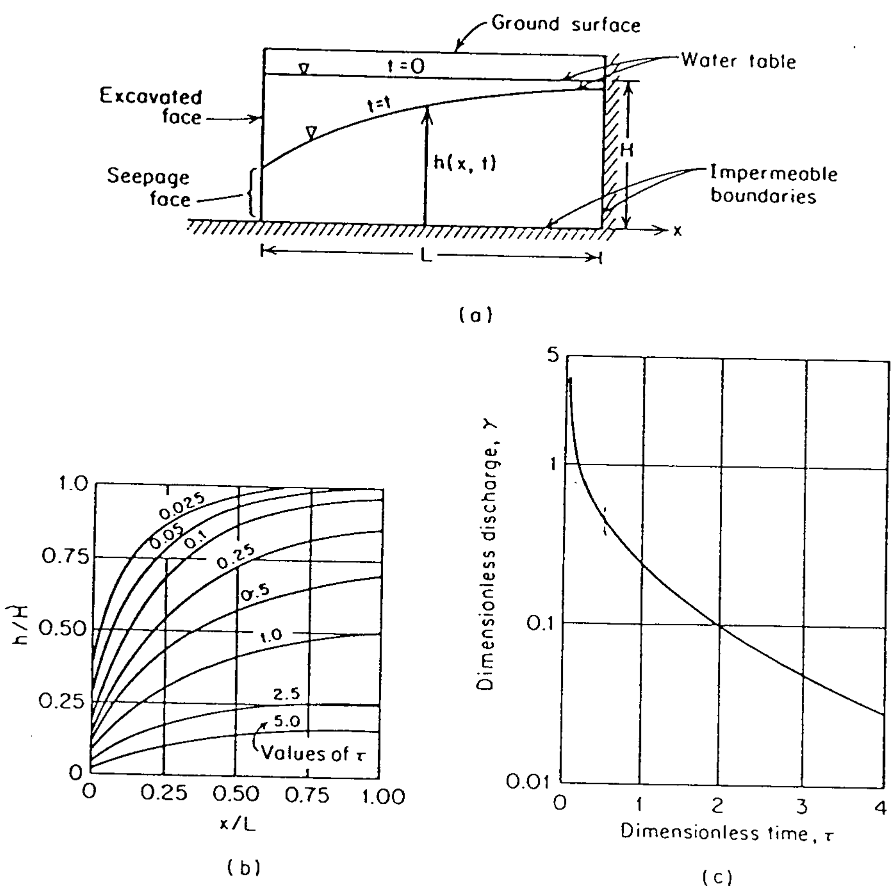


Figure 10.18 Prediction of groundwater inflows into an excavation (after Ibrahim and Brutsaert, 1965).

Figure 10.18(b) shows the transient response of the water table, plotted as dimensionless drawdown, h/H, versus dimensionless distance, x/L. The parameter τ is a dimensionless time given by

$$\tau = \frac{KH}{S_y L^2} t \tag{10.19}$$

where H and L are defined by Figure 10.18(a), K and S_y are the hydraulic conductivity and specific yield of the aquifer, and t is time. In Figure 10.18(c), the dimensionless discharge γ, defined by

$$\gamma = \frac{S_y L}{KH^2} q \tag{10.20}$$

is plotted against τ. The outflow $q = q(t)$ is the rate of flow (with dimensions L^3/T) into the excavation from the seepage face, per unit length of excavated face perpendicular to the plane of the diagram in Figure 10.18(a). To apply the method to a specific case, one must know K, S_y, H, and L. τ is calculated from Eq. (10.19) and $h(x, t)$ is determined from Figure 10.18(b). The $\gamma(\tau)$ values determined from Figure 10.18(c) can be converted to $q(t)$ values through Eq. (10.20). The formulas and graphs can be used with any set of consistent units.

It is possible to carry out similar analyses for circular pits, and for cases where the external boundary is a constant-head boundary, with $h(L, t) = H$ for all $t > 0$, rather than an impermeable boundary.

APPENDIX A-2

BASIS OF DESIGN

REGULATORY SUBMITAL

INTERIM REMEDIAL MEASURES
DUVA FARM PROPERTY
TOWN OF CLAY, NEW YORK
SITE CODE: 7-34-051

APPENDIX A-2
BASIS OF DESIGN

MARCH 1990
REVISED APRIL 1990
REVISED MAY 1990

MALCOLM PIRNIE, INC.
ENVIRONMENTAL ENGINEERS,
SCIENTISTS AND PLANNERS
7481 Henry Clay Boulevard
Liverpool, New York 13088

BASIS OF DESIGN

GROUND WATER COLLECTION & TREATMENT SYSTEM

DUVA FARMS WASTE SITE

I. SYSTEM COMPONENTS

A. Ground Water Collection System

1. Ground water collection trench
2. Home peripheral drains and sumps
3. Ground water pumps (2)

B. Ground Water Treatment System

B-1. IRON REMOVAL SYSTEM

a) Oxidation Tank
b) Polymer Mix Tanks (2)
c) Sump and Pumps
d) Prefilter
e) Filter

B-2. ORGANINCS REMOVAL SYTEM

a) Granular Activated Carbon
b) Flow Meters and Valves

C. Treated Water Discharge System

1. Treated water collection tank
2. Treated water discharge line

D. Treatment Building and Appurtenances

1. Utility building
2. Electrical service
3. Security fencing
4. Landscaping
5. Surface water diversion
6. Access roadways

II. KEY DESIGN CRITERIA

A. Ground Water Collection System

1. Ground water collection trench

type	interceptor drain
trench width	3 1/2'
trench depth	7' - 9'
trench length	360' FT$\pm$
pipe size/material	6" SDR 26 HDPE
pipe slope	0.005
discharge location	ground water sump

2. Home peripheral drains and sumps

number	4
size	2' diameter x 3' deep
pumps	submersible sumps
controls	float switch
average flow	10 gpm total
discharge piping	2" ABS pipe
discharge	ground water sump

3. Ground water pumps

number	2
flow	40 gpm each @ 22 ft of head
sump	48" diameter collection manhole
sump volume	250 gallons, below inlet
detention time	10 min. at average flow
discharge piping	2" SDR 35 HDPE
comments	UL Approved Explosion prooF

B. Ground Water Treatment System

B-1. Iron Removal System

a) Oxidation Tank

type	circular, HDPE
volume	360 gal
retention time	9 min at max flow

	oxidant	hydrogen peroxide
	mixing	mechanical mixer
	feed system	metering pump
b)	Polymer Mix Tanks	
	type	circular, HDPE
	volume	360 gal flocculation tank 360 gal coagulation tank
	retention time	floc. tank - 9 min at max flow coag. tank - 9 min at max flow
	polymer	Bentz Polymer 1120
c)	Sump and Pumps	
	sump type	48" concrete sump
	sump volume	200 gal
	No. of pumps	2
	flow rate	40 ppm each at 120'
d)	Prefilter	
	type	bag filter
	max flow rate	50 gpm
	effective size	40 microns
e)	Filter	
	type	bag filter
	max flow rate	50 gpm
	effective size	10 microns

B-2. Organics Removal System

a) Granular Activated Carbon

number	12 (4 trains of 3 each)
size	55 gallon drum
carbon content	200 lb. each
inlet	2"
outlet	2"
average flow condition	30 gpm
flow rate per train	7 1/2 gpm
surface loading rate	2.78 gpm/ft^2
detention time	22 minutes
maximum flow condition	40 gpm
flow rate per train	10 gpm
surface loading rate	3.70 gpm/ft^2
detention time	16.5 minutes/train
total carbon inventory	2400 lb
carbon replacement rate	800 lb/month $\pm$
disposal method	regeneration for reuse

b) Flow Meters and Valves

No. of meters	4
type of meters	Signet MK 575 Accum-U-Flow
No. of valves	4
type of valves	PVC 1/4 turn ball valves

C. Treated Water Discharge System

1. Treated water collection tank

dimensions	10' x 4' x 24" deep
capacity	600 gallons
inlet	2"
outlet	2"
discharge control	self-priming siphon

2. Treated water discharge line

size/material	4" Schedule 40 PVC
length	1100 ft ±
slope	0.002
average flow	30 gpm
maximum flow	40 gpm
freeze protection	4" insulation over first 200'
detention time	4 minutes at average flow

D. Treatment Building and Appurtenances

1. Utility building

dimensions	18' x 22' x 10' high
type	wood frame, stick construction
siding	wood
roofing	asphalt shingles
foundation	4' deep, 3' wide footing 8" block foundation 4" mesh reinforced concrete slab
entrance	1 - 42" personnel door 1 - 10' overhead door

2. Electrical services

source	overhead lines from Taft Road
power	1120 amps, 60 hz, 120 volt
equipment uses	1000 watt electric heater 300 watts of lighting (2) 1/2 HP pumps

3. Security fencing

height	6'
type	chain link
gates	2 vehicle gates
	1 personnel gate
length	1100 ft. ±

4. Landscaping

type	5' white pines
number	approximately 10
location	southern property line

5. Surface water diversion

type	upgradient swale or berm
length	1100 feet

6. Access Roadway

type	crushed gravel
entrance	from Taft Road
width	10'
length	800'±