SUPPLEMENTAL REMEDIAL ACTION PLAN PILOT

AMOCO SUPERIOR TERMINAL

SUPERIOR, WISCONSIN

DELTA NO. A088-457-1

July 94

Test Well Construction Suit.

More Draw near WT due to using MW

what is submitted next

Air Permit
Treatment
Water Disp.

Increased Bio?
Rain Event for Pilot

Prepared by:

Delta Environmental Consultants, Inc.
3900 Northwoods Drive, Suite 200
St. Paul, MN 55112
(612) 486-8022

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1.0 INTRODUCTION

The purpose of this Supplemental Remedial Action Plan (RAP) is to increase the rate of petroleum recovery, increase the area of influence of the IPRS, and to limit further migration of free-phase petroleum. The increase in the rate of product recovery will be accomplished by replacing the existing submersible recovery pumps with more efficient skimmer pumps. The rate of product recovery at these wells will be enhanced by the application of a vacuum. Application of a vacuum will also increase the effective radius of influence of each of the product extraction points. The target area is a zone near the northwest corner of the property, where the greatest impacts to the soil and groundwater have been detected. The performance of the proposed system will be monitored, adjusted to optimize operational parameters, and compared to initial objectives. If these objectives are met, the feasibility of expanding the system to address other portions of the site will be evaluated.

2.0 BACKGROUND

The Amoco Oil Company (Amoco) Superior Terminal is located in Superior, Wisconsin (Figure 1). This facility serves as a diesel fuel, heating oil and gasoline supply source for peripheral service stations, C & IS customers, and jobber bulk plants. Soil borings, monitoring wells and other site investigative tools indicate the presence of petroleum product, primarily gasoline, on the shallow surficial water table. The remedial objective for the site has been to remove liquid petroleum product from the surficial water table. The IPRS, consisting of six recovery wells and including electric submersible product pumps and product recovery storage tanks at recovery wells RW-1, RW-2, and RW-6 was installed at the site in 1990. Additional information regarding the extent and magnitude of petroleum impacts is presented in the following reports.

Supplemental Site Investigation Report, Delta, March 14, 1991.
Product Recovery Field Test, Delta, March 30, 1992

In addition to these reports, letters and other correspondence presenting the amount of petroleum recovered to date, flow rate and other IPRS operational parameters, and discussions of site activities have been submitted to the Wisconsin Department of Natural Resources (WDNR) on a regular basis.

marginally

The IPRS has been generally effective of removing product. Approximately 3,900 gallons of petroleum product have been recovered from the site. The thickness of free-phase hydrocarbons at the recovery and monitoring wells has generally decreased. However, there is a concern that the migration of free-phase product may be continuing. Therefore, potential methods to increase the rate of product recovery and minimize further migration of contaminants off the site were evaluated.

3.0 SVE PILOT SYSTEM AND FIELD TEST

A soil vacuum enhancement (SVE) field test was conducted at the site between August 19 and September 6, 1990. The results of that test are presented in **Product Recovery Field Test**, Delta, March 30, 1992. During the SVE field test a vacuum equivalent to about 50 inches of water was applied to recovery wells RW-4 and RW-6. The resultant vacuum was measured at sets of monitoring probes installed at 5, 19, and 49 feet away from the applied vacuum point. The monitoring probe sets consisted of a shallow point screened near the surface, or about 15 feet above the water table, and a deeper monitoring point screened about 3 feet above the static water table, near the boundary between the surficial clay layer and the underlying silty sand unit. At both RW-4 and RW-6 a vacuum was measured in both the shallow and the deeper monitoring points, at all three sets of monitoring probes. In general, the resultant vacuum was greater at the deeper monitoring points than the shallow monitoring points. In addition to the monitoring probes, the resultant vacuum was measured at nearby monitoring wells, which are screened near the water table interface which roughly corresponds to the boundary between the clay and silty sand unit boundary. Vacuums were measured in wells over 100 feet from the applied vacuum points.

The resultant flow through the subsurface was less than 10 standard cubic feet per minute (scfm). Although most of the flow appeared to be through the vadose zone immediately above the water table, vacuums were also measured in the shallow monitoring points indicating some influence in, and air flow through, the overlying clay unit. The length of exposed screen above the water table during the pilot test was about 2 feet initially, and than increased as the water level was drawn down by pumping. Based on the results presented in the referenced report, the increase in exposed screen did not result in a measurable increase in the flow rate.

In summary, the results of the pilot test presented in the referenced report indicate that application of a moderate vacuum equivalent to about 50 inches of water can influence an area with a radius of greater than 100 feet, with a relatively low resultant flow of less than 10 scfm per vacuum point. Furthermore, the field test indicated that the rate of product recovery is increased by application of a vacuum at the recovery wells. Additional details pertaining to the field test are presented in the referenced report. The design presented in this RAP is based upon the results of the field test presented in the report.

4.0 PROPOSED IPRS ENHANCEMENT

4.1 Free-Phase Hydrocarbon Recovery

The existing IPRS utilizes submersible product pumps at recovery wells RW-1, RW-2, and RW-6. The intake levels of these pumps are manually adjusted each month to intersect the product-water interface. In this manner about 3,900 gallons of free-phase hydrocarbons have been extracted. However, even with monthly manual adjustment of the pump levels the existing product recovery pumps are only effective at removing accumulations of product greater than 1.5 feet in the well, leaving considerable amounts of free-phase hydrocarbons on the water table surface. Furthermore, between 0.5 and 7 feet of free-phase hydrocarbon is present in fourteen other wells at the site (Table 1). Product is periodically hand bailed from these wells.

It is proposed to upgrade the IPRS by replacing the existing product pumps with a more efficient skimmer pump system. Delta is in the process of soliciting proposals from various product skimmer equipment vendors. It is anticipated that electronically controlled pumps with motorized reel units that can accurately track ground water fluctuations over a range greater than 10 feet with product recovery, and that will allow for product recovery removal to 1/10 inch will be installed in recovery wells RW-1, RW-4, and RW-6. A similar portable unit that can be easily transported to each of the other wells with measurable accumulations of free-phase hydrocarbons will be placed at the site for weekly product recovery.

4.2 Soil Vacuum Enhancement

To further increase the rate of product recovery and to limit migration of the product plume off of the site, a vacuum will be applied to points along the northwestern boundary of the site. A discussion of proposed additional vacuum points, the anticipated flow rate, and a brief description of key components of the system is presented in the following sections.

4.2.1 Proposed Additional Vacuum Points

The results of the SVE field test indicate a radius of influence of 100 feet at an applied vacuum equivalent to about 50 inches of water. Based on these results, application of a vacuum to about three points along the northwestern property boundary would result in a line of influence which intersects the path of migration of the plume. Existing recovery wells RW-1 and RW-4 are located along the northwest property boundary and will be connected to the vacuum system to increase the radius of influence of free-phase hydrocarbon recovery. However, RW-4 has a screened interval that has been submerged below the fluid except for a brief period in 1990. Similarly, RW-1 has been periodically submerged.

Installation of 6 additional vacuum points as indicated on Figure 2 is proposed to adequately cover the indicated area and completely intersect the path of migration of the plume, and to allow continuous operation during periods of high water elevation. The vacuum points will be constructed with 15 foot lengths of 4-inch diameter #10 slot PVC screens installed to intersect the zone of maximum impact, including the water table interface. A cross section showing the proposed location of the vacuum points in relation to the soil stratigraphy is presented on Figure 3.

Big enough?

Each of the vacuum points will be fitted with a sealing well cover with access points for measuring vacuum, water levels, and for insertion of the product skimming unit. Valves will be installed to increase the flexibility of the system, by allowing for control of the flow from each vacuum point and for isolation of individual vacuum points as warranted.

4.2.2 Anticipated Flow Rate

Results of the field test indicate that application of a vacuum of about 50 inches of water results in a flow of less than 10 standard cubic feet per minute (scfm) through the subsurface. The length of exposed screen above the water table during the pilot test was about 2 feet initially, than increased as the water level was drawn down by pumping. The increase in exposed screen did not result in a measurable increase in the flow rate. Therefore, the resultant flow can be expressed either as less than 5 scfm per foot of exposed screen, or as less than 10 scfm per vacuum point. It is anticipated that there will be 8 vapor points, including two existing recovery wells and 6 additional installed points, and that the total length of exposed screen in all of the proposed vacuum extraction points will be between 40 and 80 feet, depending on the water table elevation. In this manner the total flow rate from the proposed system can be calculated to be between 70 and 300 scfm. The total flow is anticipated to be less than 200 scfm, at an applied vacuum of about 50 inches of water. As each vacuum point is installed it will be tested to further define the anticipated flow rate.

Pumping water?

4.2.3 SVE Components

4.2.3.1 Vacuum Blower

The vacuum blower will be rated for a combined duty of at least 60 inches of water vacuum and a positive pressure displacement to overcome the pressure drop across the off gas treatment unit, and designed to operate at an optimum vacuum and flow rate. Certain types of vacuum units are adversely affected by excessive vacuum, moisture, and particulate matter. An appropriate vacuum relief valve, condensate collector, and particulate filter will be included in the flow stream to prevent damage to the vacuum unit.

4.2.3.2 Flow Meter

Flow meters will be installed to allow measurement of flow from each individual vacuum point and through the system.

4.2.3.3 Discharge Silencer

A discharge silencer will be installed to maintain the noise level at the exhaust point below 80 decibels.

4.2.3.4 Vacuum Gauges

Vacuum gauges will be installed across the particulate filter (if installed) and at the manifold.

4.2.3.5 Manifold

The individual vacuum lines will be connected to a 6-inch diameter PVC manifold.

4.2.3.6 Manual Control Valves

Adjustable globe or ball valves will be installed to allow adjustment of the flow from the manifold to each soil vent, or to isolate individual soil vents from the system.

4.2.3.7 Flexible Sleeves

Flexible sleeves or vibration dampers will be provided at key points of the system, particularly near the inlet and outlet points to prevent the system from being adversely affected by vibration from the vacuum blower.

4.3 Air Emissions

As previously discussed in Section 4.2.2, after each vacuum point is installed it will be tested to further define the anticipated flow rate. During this testing, samples of the extracted vapor will be obtained and analyzed for hydrocarbon concentrations. This additional information will be evaluated and used to refine air emission estimates. The revised estimates will be forwarded to the Bureau of Air Management and the WDNR project leader.

Preliminary estimates of the anticipated rate of hydrocarbon emissions from the vacuum system have been calculated based on the results of the field testing. Based on these results, the rate of benzene emissions at a flow rate of 30 scfm could potentially be 400 pounds per year, (average of RW-4 and RW-6, assuming continuous operation without treatment). If necessary to limit the emissions of hydrocarbons, the exhaust will be treated to achieve no less than 95 percent destructive efficiency.

The concentrations of total hydrocarbons (THC) in the air removed from RW-4 and RW-6, during the field test, averaged 41,000 parts per million (ppm) and 10,800 ppm, respectively. The average concentration from the two wells was about 26,000 ppm. Concentrations of THC above the lower explosive limit (LEL), or above 12,000 ppm for gasoline, are most economically incinerated using a thermal oxidizer (gas burner), because the high heat content of the vapors minimizes the need for additional fuel to support the combustion process. As the concentration of hydrocarbons in the discharged soil vapor decreases, additional fuel (natural gas) will be required, and operational expenses will increase. If the concentrations decrease to about 6,000 ppm, or 50 percent of LEL, operating expenses for a thermal oxidizer are approximately equal to those for a catalytic oxidizer. However, because of the potential for explosion, catalytic oxidizers should not be used when hydrocarbon concentrations exceed 25 percent of the LEL. Delta is currently soliciting proposals for a thermal oxidizer unit to be used for this project if treatment of the SVE exhaust is necessary.

4.4 Remediation Building

Key components of the system will be housed within a proposed treatment building near the northeast corner of the property. The proposed treatment building will be an enclosure where ignitable concentration of gases or vapors may exist because of repair or maintenance operations; or in which a breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors. Therefore, all equipment housed within the enclosure, including motors, wiring, lights, heaters, etc., shall be suitable for a National Electrical Code Class I, Group D, Division II location.

The building will have exterior dimensions of approximately 12 feet by 16 feet and will be of wood frame, slab on grade construction. A thermostatically controlled heater will be installed to prevent freezing of the equipment or process fluids. The heater will be rated at around 3.6 kilowatts. A ventilation fan will be installed to remove hazardous vapors and excess heat that could potentially build-up within the enclosure. The fan will evacuate air at a rate of about 150 cubic feet per minute and will be controlled by a thermostat within the building and by a Hand-Auto-Off switch mounted within the control panel on the outside of the building.

4.5 System Performance Monitoring

The performance of the system will be monitored by evaluating the rate of free phase hydrocarbon recovery, the level of free-phase hydrocarbon remaining in the wells, the resultant vacuum and flow through the subsurface, and the concentrations of hydrocarbons in the air removed from the subsurface.

Samples of the vacuum exhaust will be collected and analyzed for benzene, toluene, ethylbenzene, xylenes and volatile organic compounds in accordance with WDNR guidelines.

4.5.1 Additional Monitoring Points

4.5.1.1 Vacuum Monitoring

To provide additional information regarding the performance of the system, particularly with regard to the effect on the surficial clay unit vs. the underlying silty sand soil, four sets of vacuum monitoring points will be installed at the locations indicated on Figure 2. Each set of monitoring points will consist of one screen set at about 5 to 10 foot depths within the clay unit and a deeper screen set across the ground water interface. The points will be constructed with 5-foot lengths of 2-inch diameter PVC screen. Although the monitoring points are not intended to be utilized for the extraction of vapors, they will be connected to the SVE system via the underground piping network to increase the flexibility of the system. Data gathered from these points will be used to optimize the operating efficiency of the system and to evaluate the feasibility of expanding the system to address other portions of the site.

4.5.1.2 Settlement Monitoring Plates

There is potential for consolidation and differential settlement of the clay layer related to possible drying out of the clay caused by increased air flow through the clay. This settlement potential will be evaluated with respect to the possible compromise of the integrity of underground utilities and the petroleum product pipelines which run through the clay. It is our preliminary opinion that the potential effect is negligible. However, if warranted, plates to directly measure settlement will be installed.

5.0 COST ESTIMATE

An estimate of anticipated expenses associated with this project is presented below.

Free Product Skimming System	30,000.00
Well Modifications	10,000.00
Trenching and Plumbing	15,000.00
Vacuum Unit	15,000.00
Air Treatment (If Warrented)	30,000.00
Controls	10,000.00
Building	10,000.00
Six Month O&M Evaluation	20,000.00
Engineering & Project Management	50,000.00
	$ 190,000.00

An estimate of annual operating expenses can be provided at your request.

6.0 SCHEDULE

Following WDNR review and approval Delta will finalize the design of the proposed remedial action plan pilot and begin preparation of equipment plans and specifications to be used to solicit bids for the system installation. Installation of the proposed system is tentatively scheduled for Fall 1994.

The performance of the proposed RAP will be evaluated in the spring of 1995, or after about 6 months of operation. It is anticipated that at this time there will be sufficient data to conclusively demonstrate the feasibility of expanding the RAP to address other areas of the site. Upgrading and expansion of the RAP would then be scheduled for the late summer or fall of 1995.

7.0 REMARKS

The recommendations contained in this report represent our professional opinions. These opinions are based on currently-available information and are arrived at in accordance with currently-accepted hydrogeologic and engineering practices at this time and location. Other than this, no warranty is implied or intended.

TABLE 1

FREE-PHASE HYDROCARBON LEVELS (FT)
AMOCO SUPERIOR TERMINAL
SUPERIOR, WISCONSIN
DELTA NO. A088-457-1

as of ______

MW1	MW2	MW12	MW14	MW16	MW22	MW23	MW24
1.76	5.31	0.57	5.07	5.72	1.58	6.34	7.01

MW25	MW26	MW27	RW1	RW2	RW4	RW5	RW6
2.89	2.65	2.23	2.35	0.82	3.42	1.87	2.00

This report was prepared by **DELTA ENVIRONMENTAL CONSULTANTS, INC.**

Bill Fellows ______________________ Date: 7-14-94

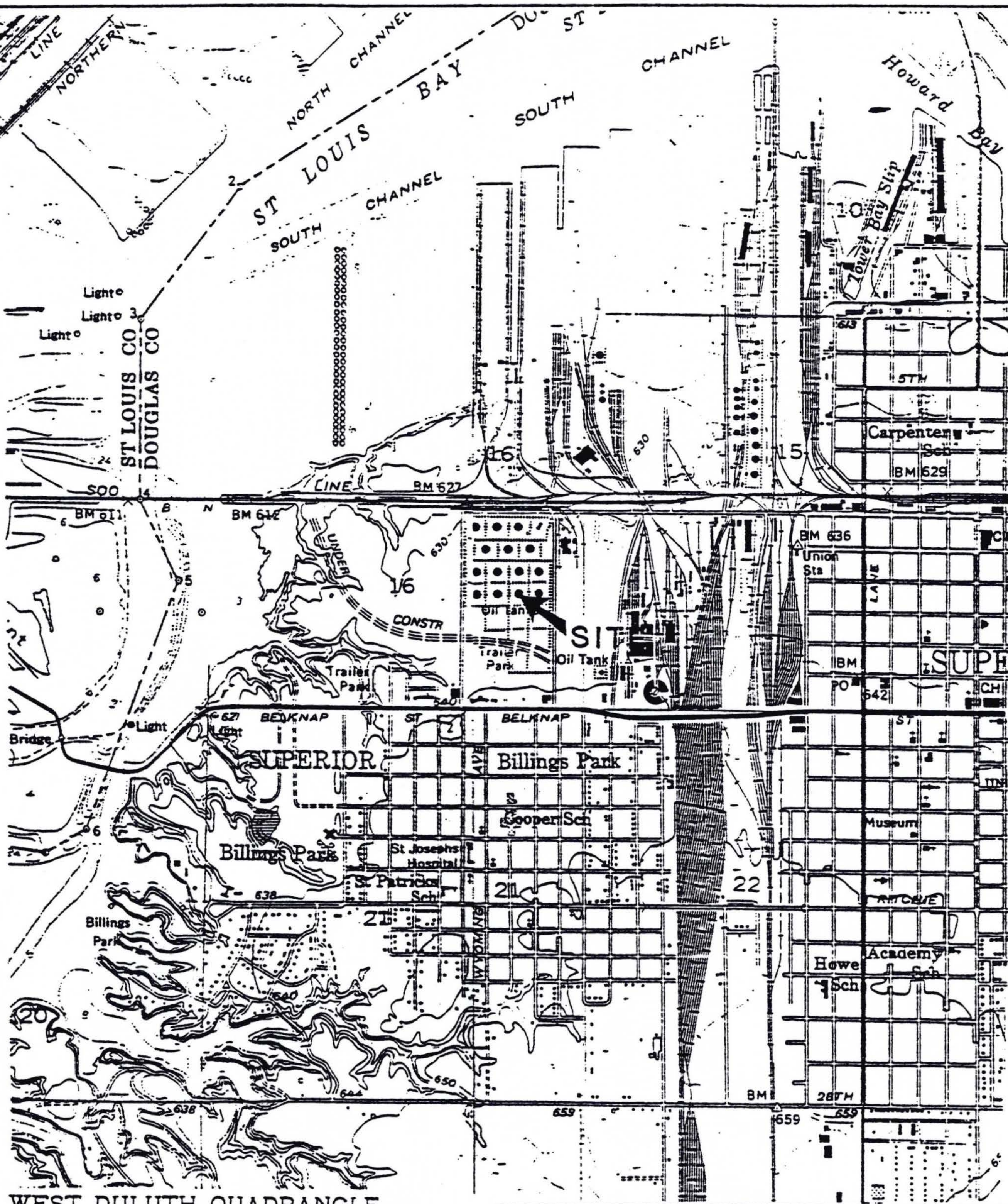
William E. Fellows
Senior Engineer

Reviewed by:

______________________ Date: 7/19/94

Daniel L. Sanville
Senior Project Manager

drl:071494



WEST DULUTH QUADRANGLE

MINNESOTA—WISCONSIN

7.5 MINUTE SERIES (TOPOGRAPHIC)

NW/4 SUPERIOR 15' QUADRANGLE

QUADRANGLE LOCATION

NORTH

0 2000

SCALE IN FEET

FIGURE 1
SITE TOPOGRAPHIC MAP
SUPERIOR TERMINAL
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY
10-88-457	JCG/PAJ
DATE	REVIEWED BY
10/23/90	[signature]

Delta Environmental Consultants, Inc.

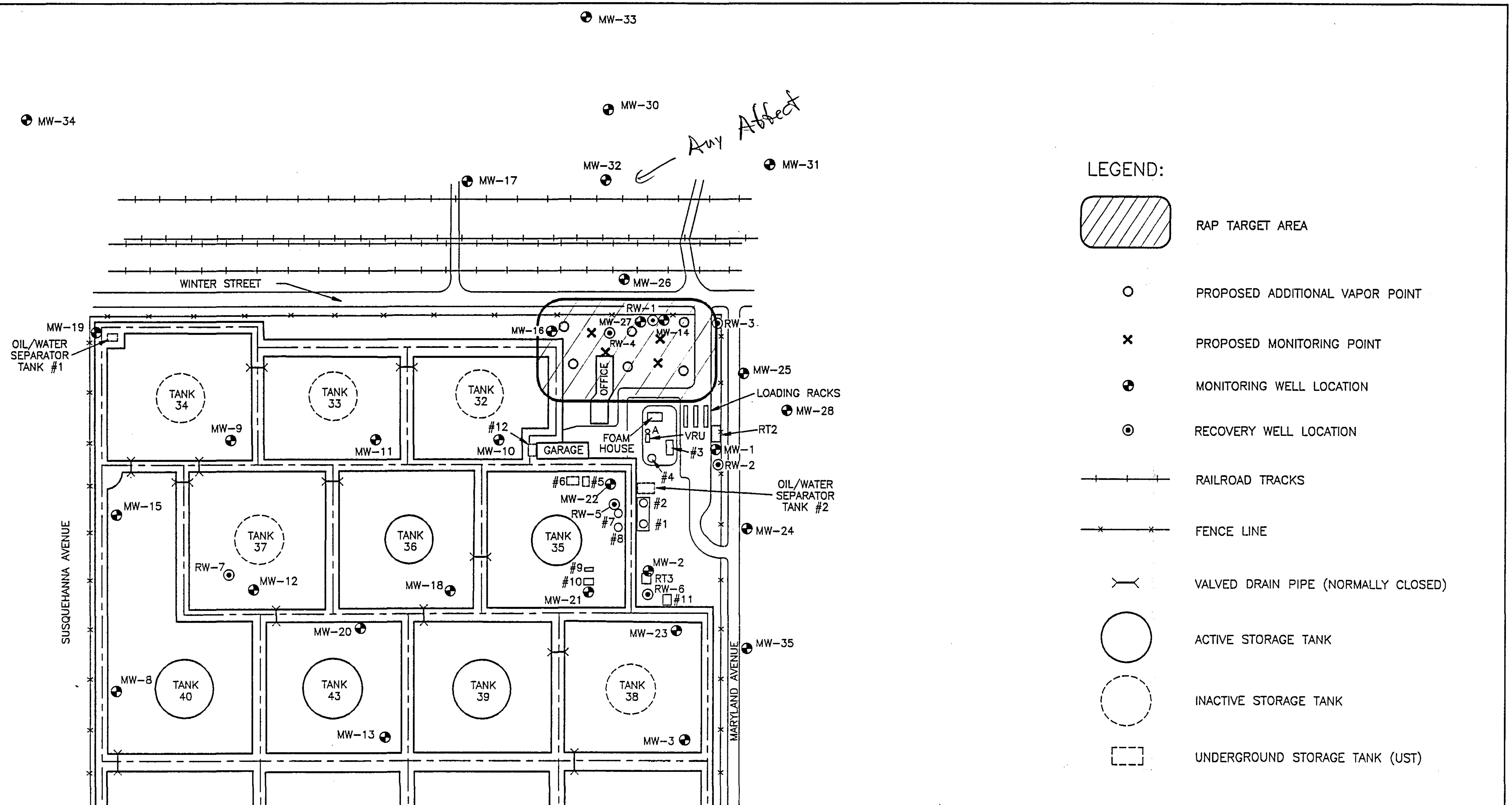
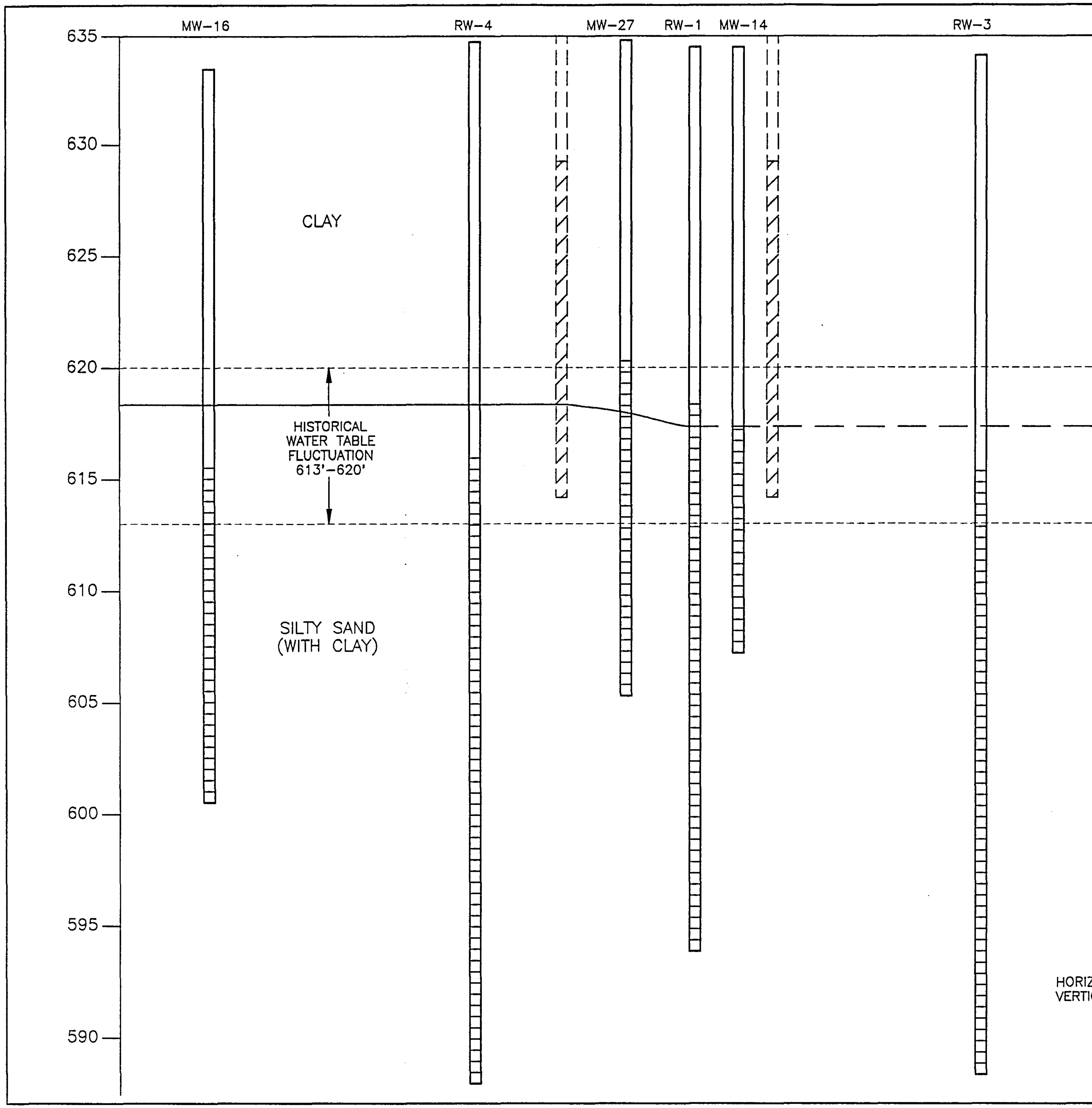


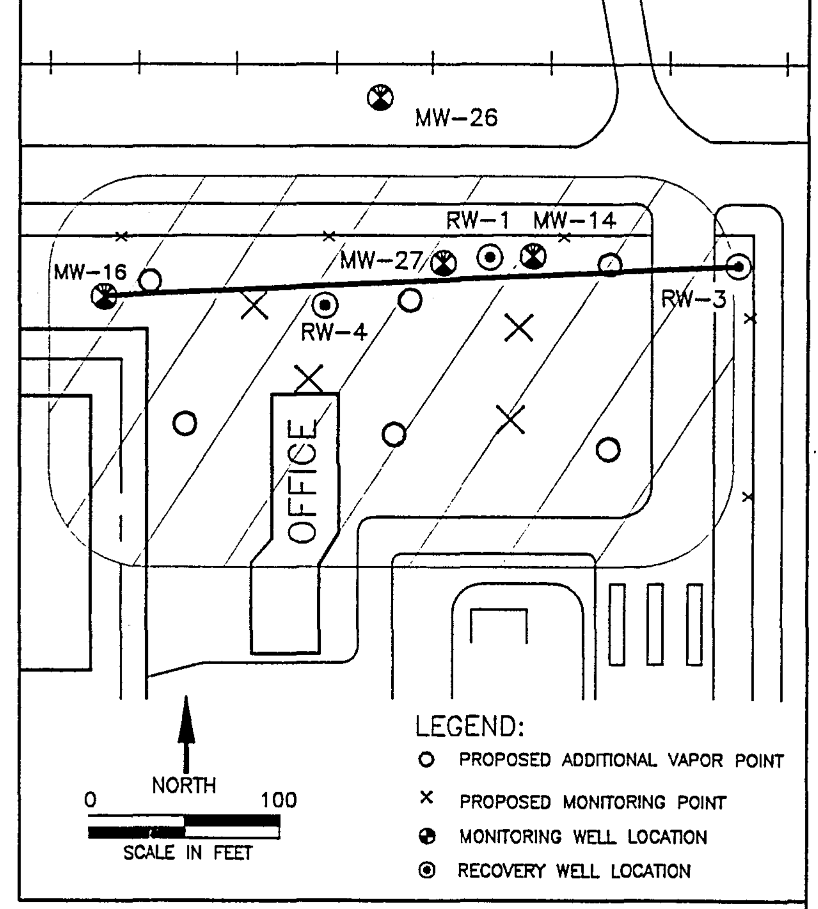
FIGURE 2
PROPOSED SOIL VACUUM POINTS
AMOCO OIL COMPANY
SUPERIOR TERMINAL
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY	REVIEWED BY
10-88-457	BEF/DD	
DATE	REVISION NO.	FILE NAME
6/3/94		88457-50

Delta Environmental Consultants, Inc.



CROSS SECTION LOCATION MAP



LEGEND:

MONITORING WELL OR RECOVERY WELL WITH SCREENED INTERVAL

PROPOSED SOIL VACUUM POINTS

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 5'

FIGURE 3
PROPOSED SOIL VACUUM POINTS–CROSS SECTION
AMOCO SUPERIOR TERMINAL
SUPERIOR, WISCONSIN

PROJECT NO.	PREPARED BY	DRAWN BY
A088-457	BEF	DD
DATE	REVIEWED BY	FILE NAME
7/7/94		A088457

Delta Environmental Consultants, Inc.