URS

September 25, 2000

Mr. Nnamdi Madakor
Department of Ecology
3190 160th Avenue SE
Bellevue, WA 98008-5452

Remedial Action Plan
Former Magic Cleaners
Lake Forest Park, WA
TCP ID #NW~~0081~~ 0617
URS Job No. 42368-179-189

Dear Mr. Madakor:

1.0 INTRODUCTION

As described in our August 23, 2000 letter to the Department of Ecology (Ecology), provided herein is a summary of hydrogeologic and groundwater quality data and our Remedial Action Plan (RAP) for the Former Magic Cleaners facility located in Lake Forest Park, Washington. We are providing this RAP on behalf of Seattle LFP Associates, LP. This information was compiled to assist in developing a "Site Conceptual Model" which was utilized to design the remedial action presented in the attached plan. Presented below is a summary of site information responsive to Ecology's request for additional information, including, (1) the pre-development location of the former Lyons Creek channel, (2) the location of site sewer utilities, (3) an assessment of this information in conjunction with existing hydrogeologic information and groundwater chemistry data, (4) a "Conceptual Model" for the site. This information was utilized to develop the RAP and specifically to remediate the volatile organic compounds (VOCs) in the groundwater

1.1 HYDROGEOLOGY

1.1.1. Physical Setting

The subject property is located at the intersection of Bothell Way NE and Ballinger Way NE in Lake Forest Park, King County, Washington (Figure 1). The site consists of a shopping center comprised of a main mall building and four detached buildings. The main building is leased to numerous tenants including Albertsons and Rite Aid. The four detached buildings include a professional building, two restaurants, and a bank (Figure 2).

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Lyons Creek flows in an open channel along the western property boundary and traverses its southwestern corner through a culvert and emerges again to flow along the southern property boundary (Figure 2). The subject property lies at an approximate elevation of 32 to 40 feet above mean sea level (msl). The ground surface gently slopes to the southeast toward Lake Washington that lies approximately 0.25 mile east of the site.

Lyons Creek was rerouted during initial site development. Based on historic topographic maps (Figure 3) and the stream relocation plan (Stacey Bennett, 1962) which was prepared prior to site construction, the former creek channel was oriented northwesterly to southeasterly as shown on Figure 3. The former channel ran diagonally across the southern portion of the property and exited the site in the vicinity of the current culvert location west of the bank building.

1.1.2. Site Geology

The site is underlain by Holocene alluvium which consist generally of stratified sand and gravel with some pebbly, organic-rich silt (USGS, 1983). The alluvium ranges from 3 to 16 feet in thickness. The surficial soils in the site vicinity also consist of more recent alluvial material deposited by Lyons Creek which has reworked the older alluvium. In addition, during site development, some sandy fill material (from 1 to 3 feet) was placed at the site.

A north to south geologic cross section across the site is shown on Figure 4. The upper portion of the saturated zone in the area of the former Magic Cleaners (current Rite Aid store) primarily consists of sandy material, designated as SP using the Unified Soil Classification (USC). This material was characterized by brown fine to medium sands to a depth of approximately 18 feet bgs. Deeper borings in this area confirmed the presence of lower permeability silts (ML) and clays (CL) at depths of between 26 feet to 29 feet bgs (Figure 4). Along the southern portion of the site, the saturated zone soils had increasing silt content and some interbedded silts and silty sands (SM) were evident (Figure 4). A west to east geologic cross section (Figure 5) indicate that soils adjacent to the former creek channel had greater amounts silt. In addition, interbedded peat layers were evident in the shallow saturated zone soils in close proximity to the former creek channel.

1.1.3. Groundwater Flow and Aquifer Characteristics

The static groundwater levels measured during our groundwater monitoring program are outlined on Table 1. The groundwater levels in the monitoring wells displayed seasonal fluctuation, with the highest levels occurring in the late winter and spring. Groundwater flow at the site has been consistently southerly to

southeasterly (Appendix A). The hydraulic gradient over 90% of the site from north (MW-1) to south (MW-3) measures approximately 0.015 feet/feet. The groundwater gradient along the southern property boundary is considerably steeper, measuring 0.56 feet/feet from north (MW-3) to south (MW-4).
Based on slug tests conducted at monitoring wells MW-2 and MW-4, the saturated zones' hydraulic conductivity is estimated to range from 9 to 10 feet/day. The groundwater flow velocity is estimated to range from 1 to 10 feet/day.

1.1.4. Surface Water Flow

Surface water levels were measured in Lyons Creek at two gauge locations (SG-1 and SG-2) installed along the segment of the creek adjacent to the southern property boundary (Appendix A). Surface water flow in this portion of Lyons Creek is predominantly northeasterly. Based on water level elevations measured in Lyons Creek during base flow conditions (typically from June through September), the groundwater appears to be discharging to the creek. Thus, the creek in this portion of the site is typically a gaining reach during these months. During the fall and winter months, we have observed significantly greater surface water flows in the creek which result in higher water levels in the stream channel. In fact, during winter storm events, the creek can develop full bank or overbank (flooding) conditions. During the wet season, we believe the creek in this portion of the site is likely a loosing reach. Therefore, the interactions of the groundwater and creek change in response to the seasonal flow patterns.

1.1.5. Subgrade Utilities

Subgrade utilities identified within the area of the VOC plume consist of the sanitary and storm sewer systems. Based on our field measurements of the pipelines located within the sanitary sewer manways, the depth of the sanitary sewer pipe appears to be below the groundwater table. The location of the sanitary sewer is shown on Figure 3 and the depth of the line is depicted on Figure 4. Based on the location and depth of the sanitary sewer line, it is possible that the sewer line may have acted as a preferential flow path.

Based on measurements of the pipe depths in the storm water catch basins, it appears that the storm sewer lines in the parking area are above the groundwater table. Therefore, the storm sewer lines are not believed to be pathways of groundwater flow.

2.0 CONTAMINANT DISTRIBUTION

2.1 FORMER MAGIC CLEANERS REMEDIAL HISTORY

Magic Cleaners coin operated dry cleaning laundromat began operations at the Lake Forest Park shopping center in 1965 and left the site in the mid-1980s. The facility was located in the northeastern corner of current Rite-Aid tenant space. A release of tetrachlorethylene (PCE) was detected during construction activities associated with remodeling in 1989 by the site owner at the time. Ecova Corporation implemented a cleanup in 1989 which included the excavation of PCE affected soil in the vicinity of the source area, the former dry cleaning machine. We understand that Ecology was on site during the remediation and at least informally approved it. The resulting excavation was approximately 20 feet by 10 feet by 8 feet in depth. The remediation included backfilling the excavation with gravel and installing a groundwater collection system. The purpose of the collection system was to facilitate dewatering beneath the concrete building foundation and to control affected groundwater.

Dames & Moore conducted multiple phases of site characterization, including several rounds of groundwater sampling to assess PCE and its degradation products concentrations in the groundwater from 1995 to 2000. Soil sampling was also conducted in the vicinity of the former source area at the dry cleaning machine within the building to determine whether residual levels of PCE were present. PCE was not detected in soil borings conducted in the former source area. PCE affected groundwater was found to extend south of the former source area to the southern property boundary.

In December 1998 and January 1999 and in February and March 1999 a pilot test consisting of periodic groundwater and soil vapor extraction from MW-3 and MW-6 was conducted. A total of about 35,600 gallons was extracted from the two wells. No significant fluctuations in VOC levels were detected in the wells as a result of the dual phase vacuum extraction.

2.2 PLUME CHARACTERISTICS

The chlorinated solvents detected during multiple site investigations include PCE, trichloroethene (TCE), dichloroethene (DCE) and vinyl chloride (VC). TCE, DCE and VC are common biodegradation products of PCE and their distribution suggests their presence is a result of the PCE release at the former coin operated dry cleaner. The plume has been defined horizontally and vertically and no dense non-aqueous phase liquids (DNAPL) were identified during our site investigations.

The extent of the plume is shown on Figure 3. The plume is approximately 200 feet wide at it widest extent and 580 feet long with a depth of less than 20 feet. The plume at the downgradient southern edge of the property narrows considerably and measures approximately 60 feet in width. The narrowness of the plume at the southern portion of the property may be due to the location of the former creek channel which cuts diagonally across the plume path (Figure 2). The shape of the plume may also be in response to preferential flow along the sanitary sewer line which is apparently within the groundwater table.

We estimated that less than a pound (approximately 0.7 lbs.) of PCE remains in the subsurface assuming an average concentration of 60 µg/l of PCE across the entire extent of the plume (150 feet x 580 feet x 20 feet in depth) and a average porosity of 0.3. Due to the low-level, diffuse nature of the VOC plume, previous site remedial efforts (described in Section 3.1), were not effective in significantly reducing the levels of PCE or its biodegradation products. Accordingly, an alternative remedial approach has been selected to address the VOCs in the groundwater. This approach is described in the following section.

3.0 REMEDIAL ACTION PLAN

3.1 OBJECTIVES

The cleanup action objectives are to protect human health and the environment as specified in WAC 173-340-710.

Soils: Based on previous soil sampling (Dames and Moore, 1996 and 1998) conducted in the vicinity of the former source area at the coin operated dry cleaner, PCE is not present in the soils at levels exceeding the MTCA method A cleanup levels. Thus, no further remedial efforts are warranted to address soils in the former source area. Nevertheless, the proposed remedial technology will further reduce the residual levels of VOCs present in the saturated zone soils.

Groundwater and Surface Water: The objectives of the proposed remediation are as follows:

- cleanup groundwater adjacent to Lyons Creeks to mitigate the potential of VOC-affected groundwater discharging to the creek

- cleanup VOC-affected groundwater in the vicinity of the highest detected groundwater PCE concentrations located adjacent to the Rite Aid building.

3.2 GROUNDWATER REMEDIATION AND MONITORING

3.2.1. Design and Installation of Groundwater Remediation System

Based upon the project objectives, Dames & Moore is proposing to utilize Density Driven Convection (DDC) technology to treat the VOC-affected groundwater. This *in situ* remediation technique, also referred to as ground water recirculation, creates a convection cell beneath the groundwater table. In general, the system consist of a series of wells screened within the contaminated groundwater zone which are equipped with a drop tube which supplies air to the bottom of the well. Air is injected into the well forms bubbles that flow upward displacing water creating an upward gradient which draws water in through the well screen. The aerated groundwater is eventually pushed out of the upper portion of the well which is screened near the top of the water table. The VOCs are subsequent stripped from the contaminated groundwater. The groundwater remediation system will be designed and installed by Wasatch Environmental Inc. of Salt Lake City, UT. The proposed remedial system will consist of two separate DDC systems located directly upgradient/adjacent to Lyons Creek and along the south wall of the Rite Aid building. The system design, installation and operation methods and procedures are outlined in Appendix B.

3.2.2. Groundwater and Surface Water Sampling

Quarterly water sampling is proposed during the first year of the DDC system operations. Groundwater samples will be collected from wells MW-2, MW-3, MW-4 and MW-6. A surface water sample (designated LC-1) will be collected in Lyons Creek directly downgradient of MW-3 at the location of the previous sole detection of VOCs in the creek (Figure 5).

Groundwater sampling will be conducted using low flow purging techniques. Groundwater field parameters will be continuously monitored until stabilized readings, as appropriate, are obtained per EPA guidelines (EPA, 1996). The groundwater field parameters will include dissolved oxygen (DO), pH, temperature and specific conductivity. The measurements will be made using a flow through cell and calibrated multimeter. The surface water samples will be collected directly into laboratory supplied glassware. The pH and temperature of the surface water will be taken directly at the creek sample location. The field parameter data will be recorded on sampling log forms that will include the sample location, date, time, weather conditions, field data and other general observations. The surface water sample will be collected during groundwater sampling events.

Following the first year of quarterly monitoring we will assess the frequency of sampling and may propose sampling on a biannual basis during the winter (generally high water table) and the summer (generally lowest water table) until MTCA Cleanup Level Method A/B levels are achieved.

Disposable nitrile gloves will be worn during sampling and changed between each well location. Appropriate quality assurance/quality control (QA/QC) measures will be instituted during the groundwater sampling. Samples will be stored in cooled ice chests and transported to the analytical laboratory under chain-of-custody protocol. The groundwater and surface water analytical testing program will be conducted by North Creek Analytical of Bothell, Washington, or another Ecology-accredited laboratory. The samples will be analyzed for VOCs using EPA Method 8260B

4.0 REPORTING

The results of DDC system installation and operation and groundwater monitoring will be provided to Ecology on a quarterly basis for the first year of operation. A biannual report will be provided thereafter. The reports will contain summaries of the analytical data and a copy of laboratory reports. The reports will also provide any other relevant data developed during the remedial action.

5.0 REFERENCES

EPA, 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures; EPA/540/S-95/504.

Dames and Moore, 1996; Site Characterization Report, January 11.

Dames and Moore, 1998; Supplemental Site Characterization Report, April 28.

♦ ♦ ♦

Please do not hesitate to contact us if you have any questions or require any additional information.

Very truly yours,

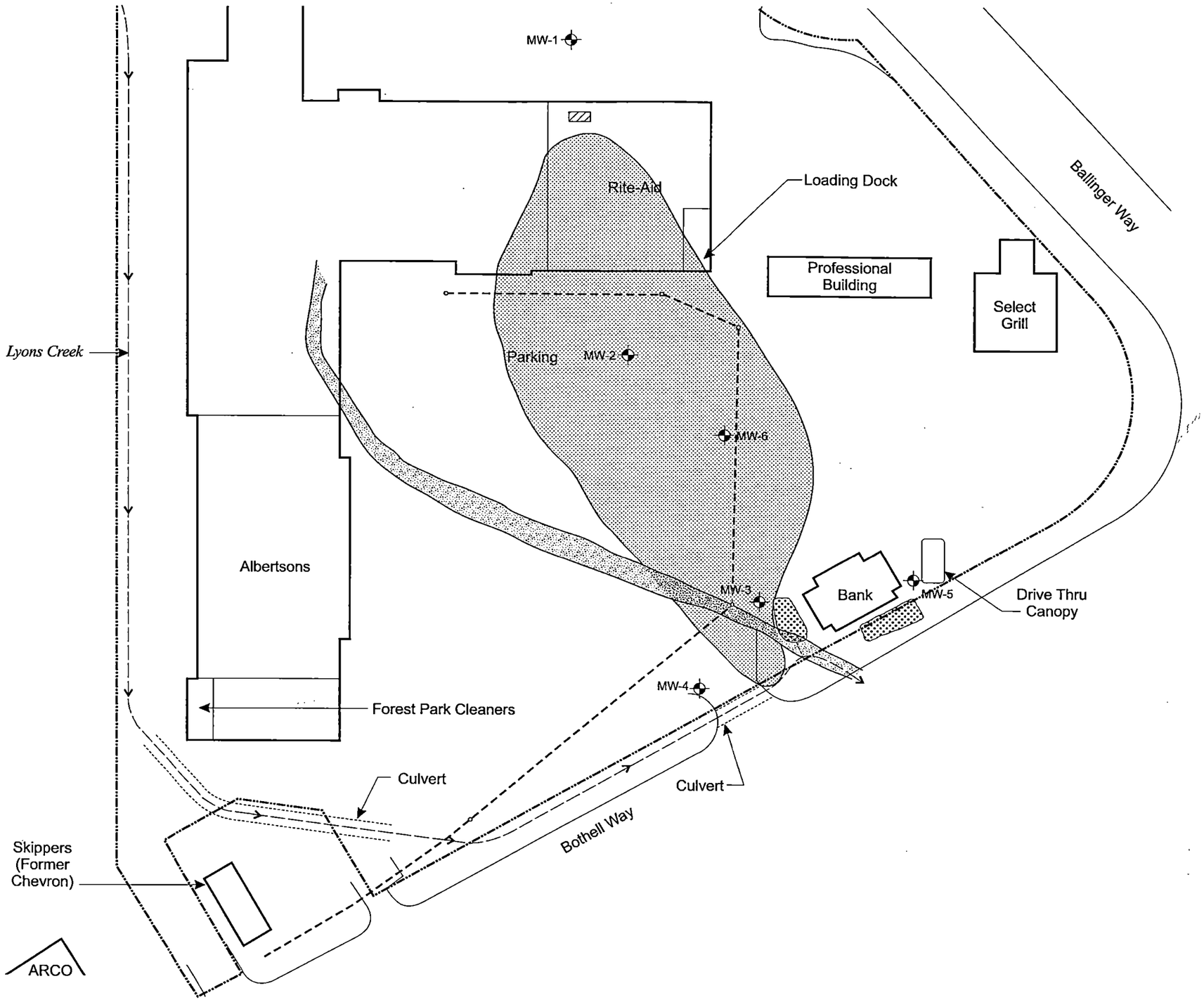
DAMES & MOORE

David R. Raubvogel
Senior Geologist

Copy: Ms. Rebecca Coles

Attachments:
Figures 1 through 5
Table 1
Appendix A – Groundwater Elevation Contour Maps
Appendix B – Wasatch Environmental DDC Remediation Plan

42368_10.CDR



LEGEND

- Property boundary
- MW-1 Monitoring well location
- Former Magic Cleaners coin-operated dry cleaner remediation area
- Stormwater retention pond
- Former stream channel
- Sanitary sewer and manhole
- Extent of VOCs in groundwater

N

0 100 200

Approximate Scale in Feet

Job No. 42368-179-189

Figure 2

EXTENT OF GROUNDWATER VOC PLUME

URS

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

42368_08.CDR

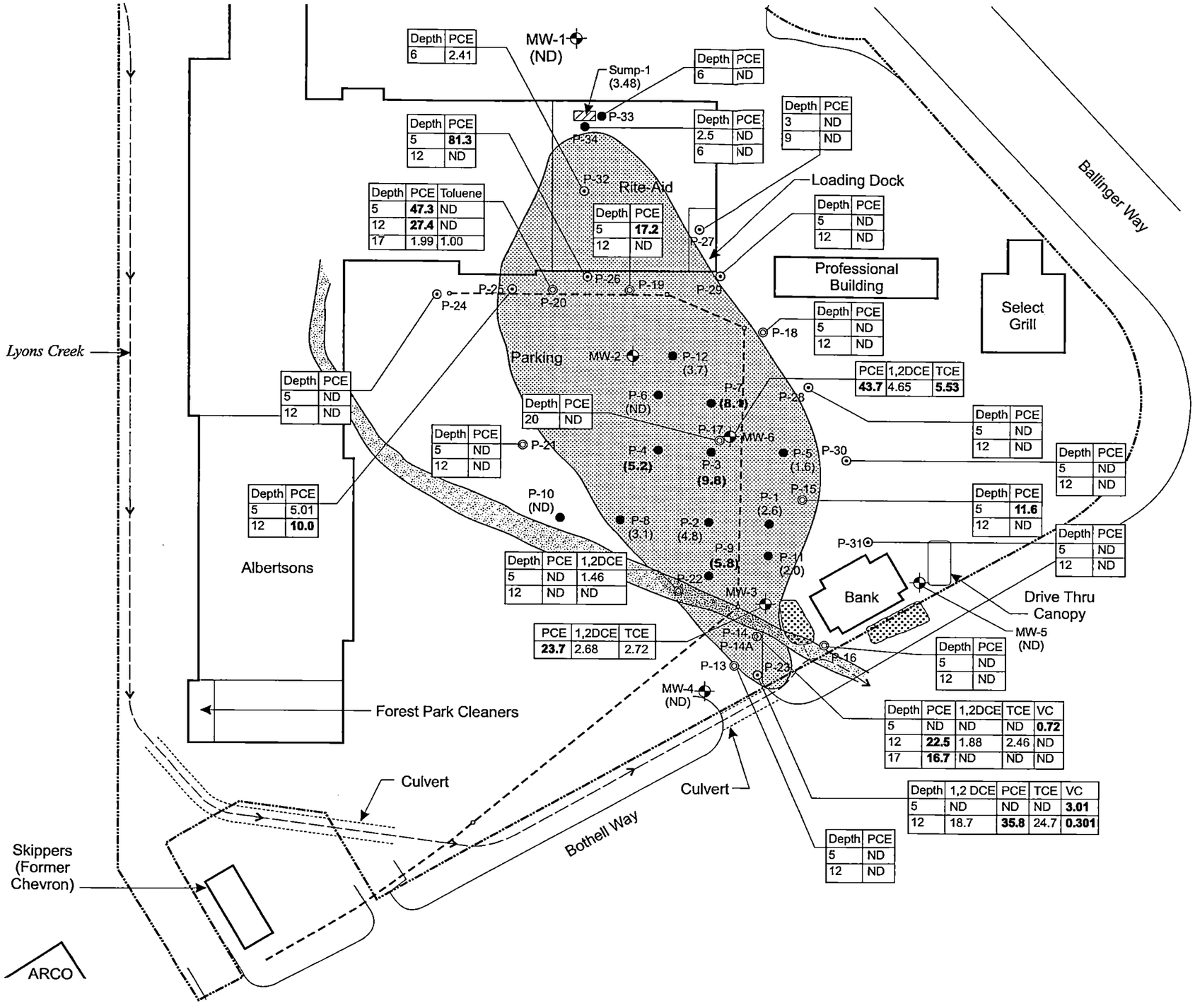


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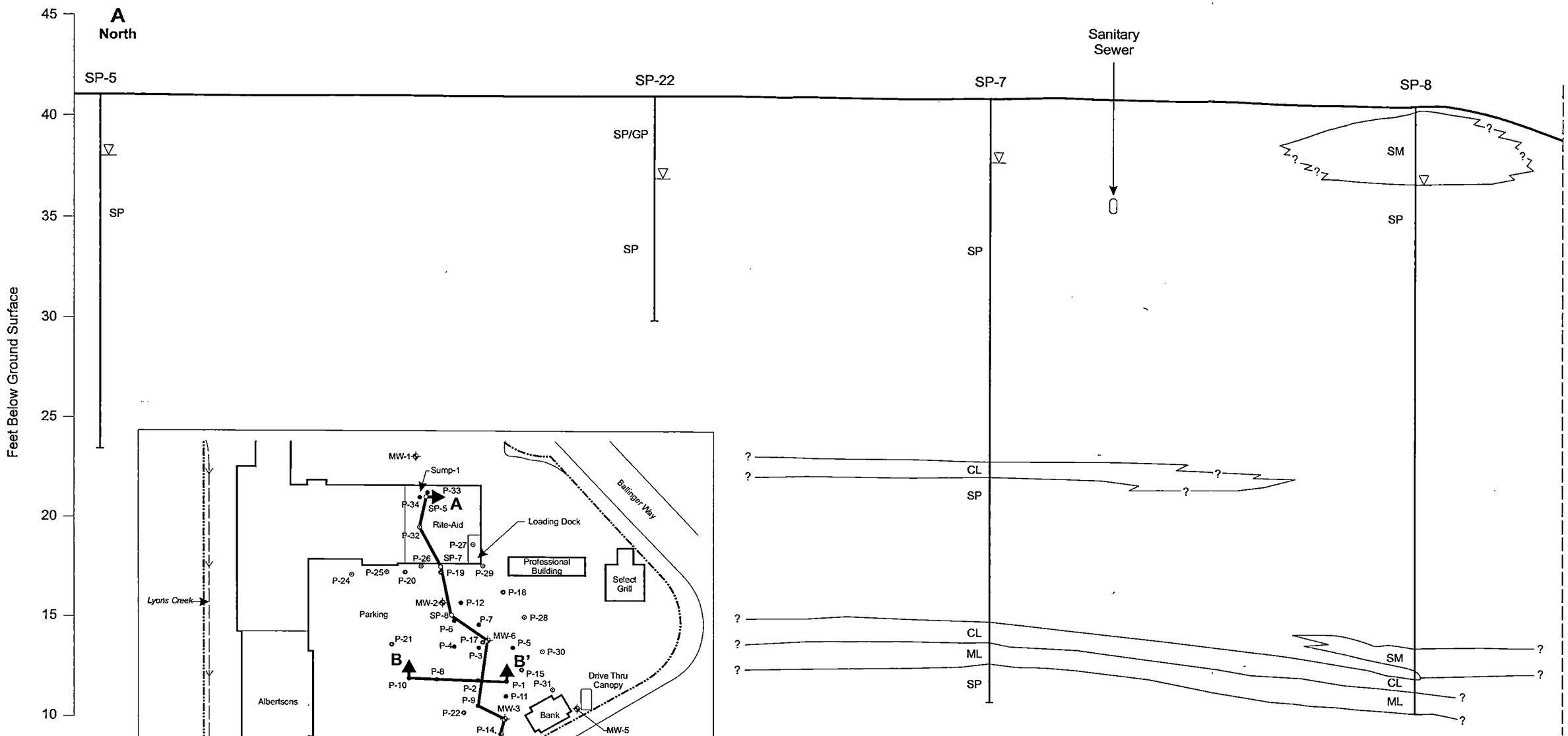
Figure 3

VOC CONCENTRATIONS IN GROUNDWATER

URS

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

42368_07.CDR



LEGEND

SP	Poorly-graded sands, gravely sands, little or no fines
SM	Silty sands, sand-silt mixtures
CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
▽	Groundwater level encountered during drilling

0 20 40

Horizontal Scale in Feet
Vertical Exaggeration = 4x

Job No. 42368-179-189

Figure 4

NORTH TO SOUTH GEOLOGIC CROSS SECTION A-A'

URS

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

42368_07.CDR

MATCHLINE

A'
South

Sanitary Sewer

Approximate Former Creek Channel

Existing Lyons Creek

MW-6

P-9

MW-3

P-14

SP

SP

SM

SM

ML

SM

SP

SP/SM

?

?

?

45

40

35

30

25

20

15

01

Feet Below Ground Surface

LEGEND

SP	Poorly-graded sands, gravely sands, little or no fines
SM	Silty sands, sand-silt mixtures
CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
▽	Groundwater level encountered during drilling

0 20 40

Horizontal Scale in Feet
Vertical Exaggeration = 4x

Job No. 42368-179-189

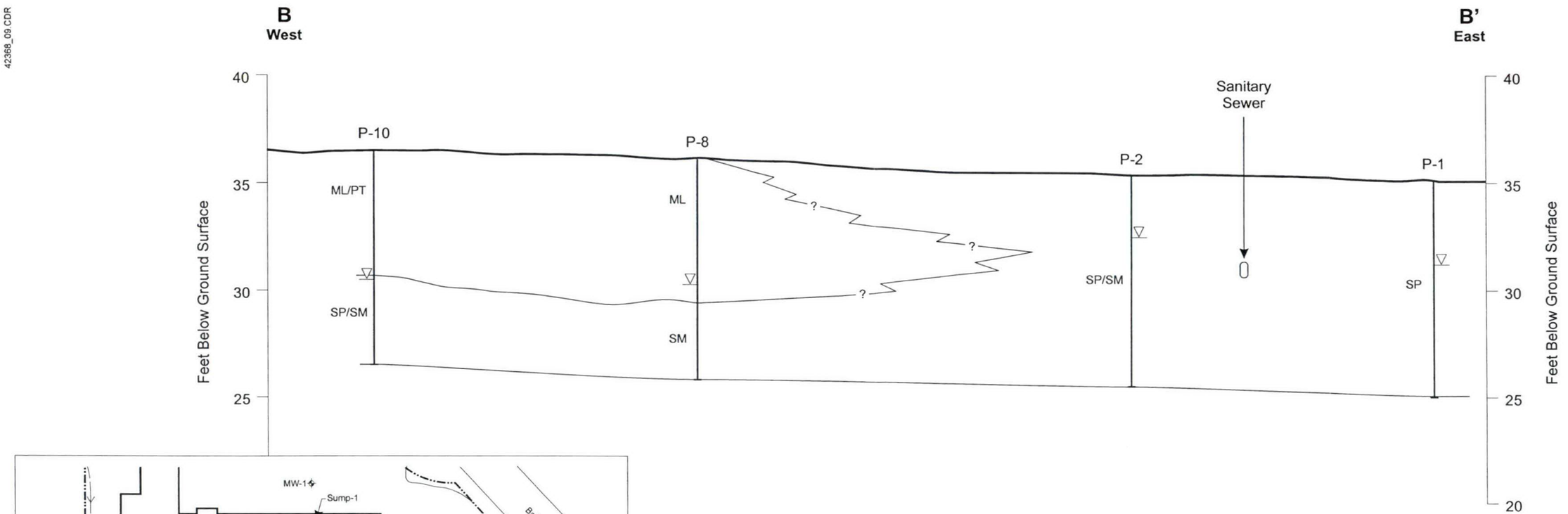
URS

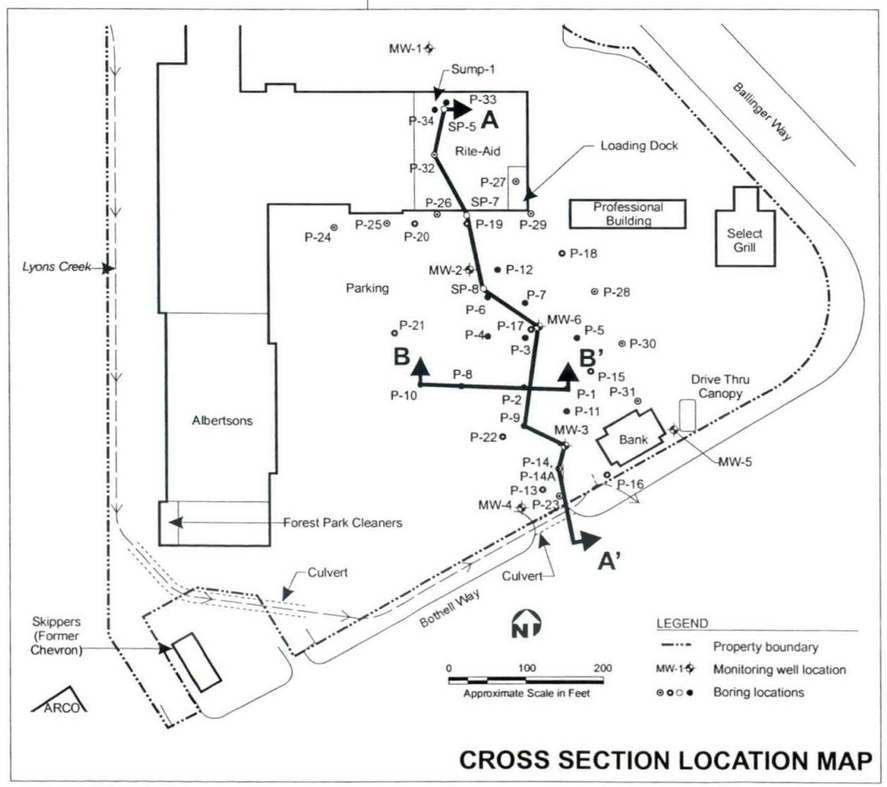
Figure 4

NORTH TO SOUTH GEOLOGIC CROSS SECTION A-A'

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

42368_09.CDR





CROSS SECTION LOCATION MAP

LEGEND

SP	Poorly-graded sands, gravely sands, little or no fines
SM	Silty sands, sand-silt mixtures
CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
▽	Groundwater level encountered during drilling

0 20 40

Horizontal Scale in Feet
Vertical Exaggeration = 4x

Job No. 42368-179-189

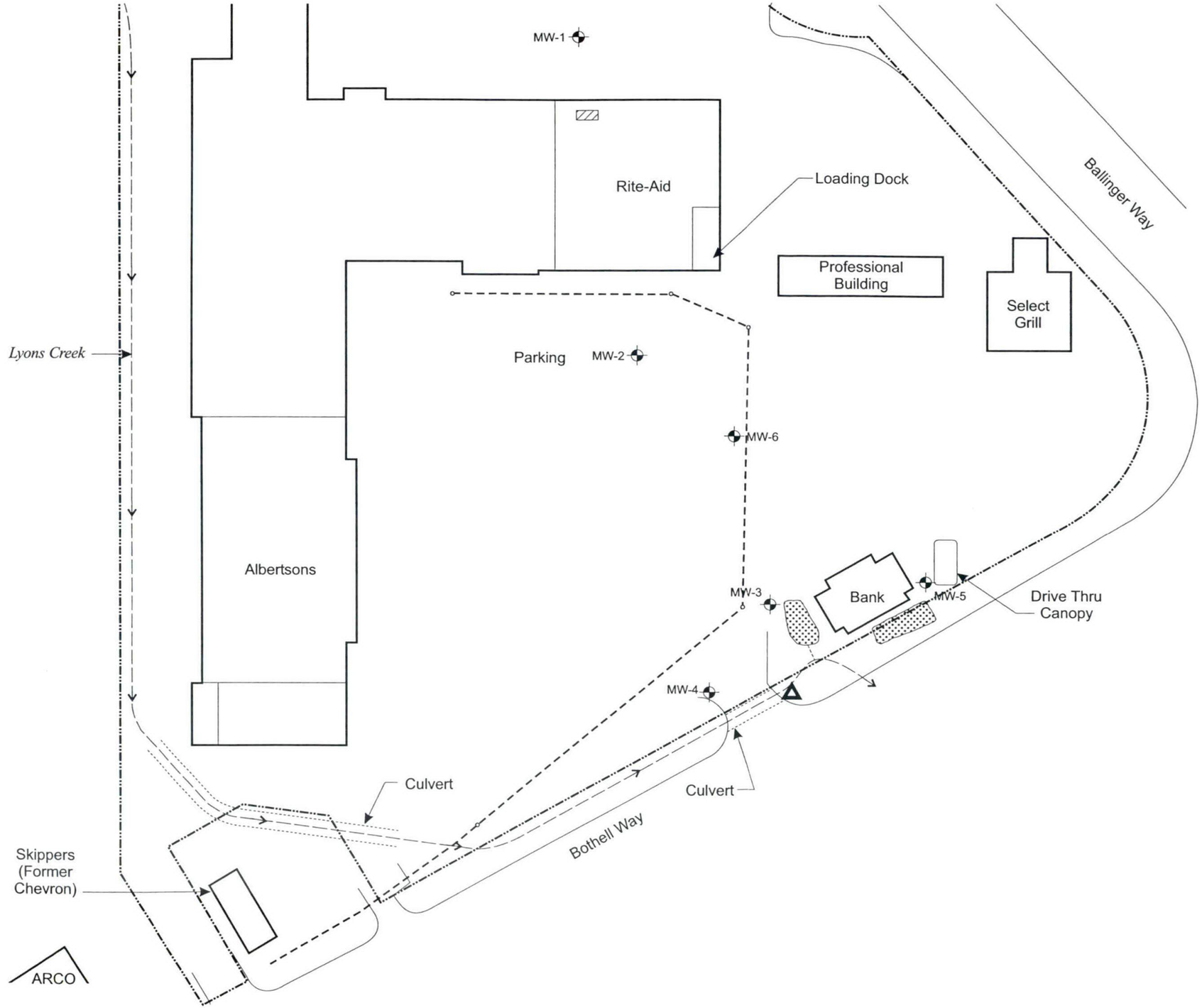
Figure 5

WEST TO EAST GEOLOGIC CROSS SECTION B-B'

URS

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

42368_12.CDR



LEGEND

- Property boundary
- MW-1 Monitoring well location
- Former Magic Cleaners coin-operated dry cleaner remediation area
- Stormwater retention pond
- Sanitary sewer and manhole
- Surface water sample location

N

0 100 200

Approximate Scale in Feet

Job No. 42368-179-189

Figure 6

GROUNDWATER AND SURFACE WATER MONITORING LOCATIONS

URS

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

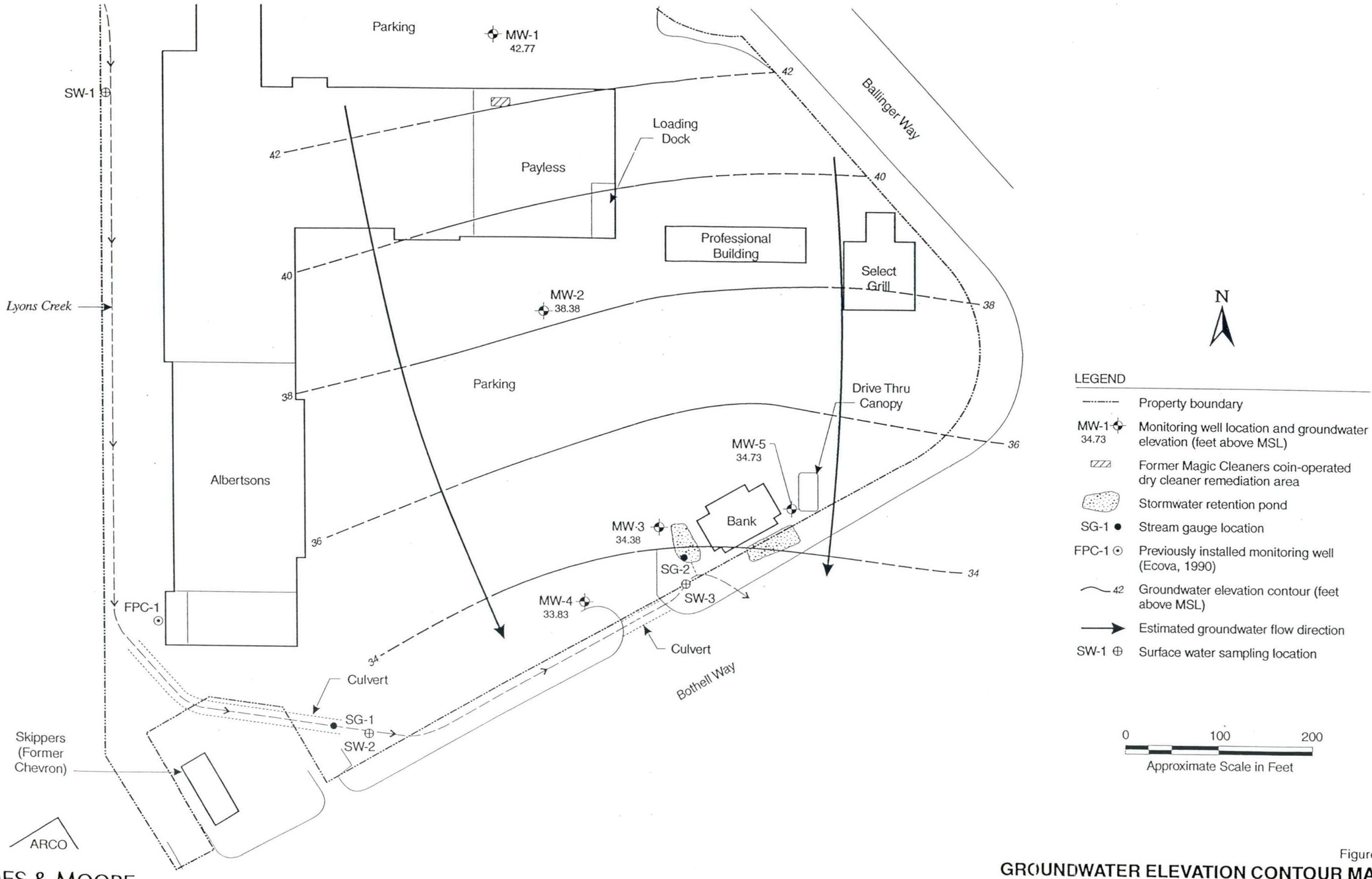


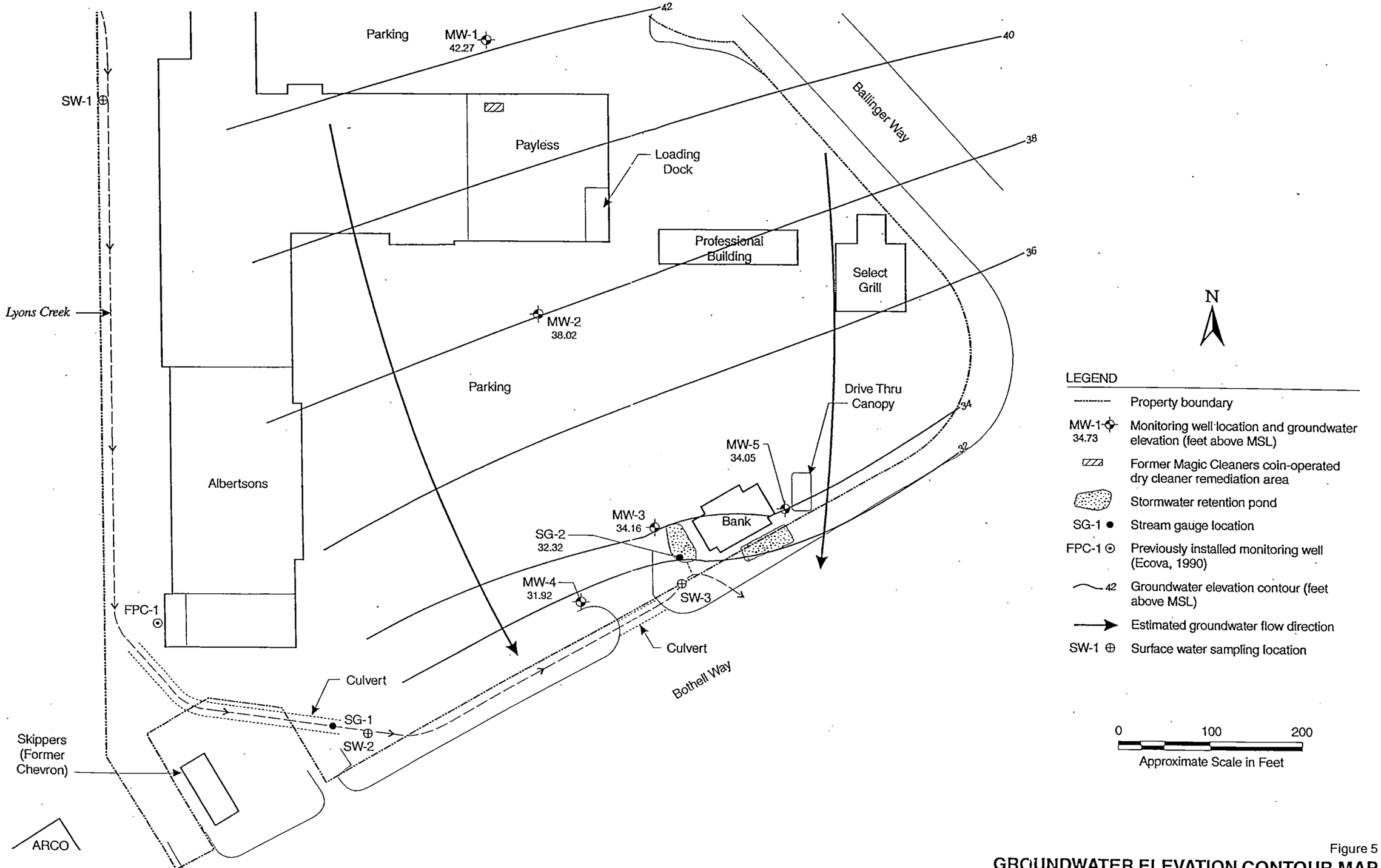
Figure 4

GROUNDWATER ELEVATION CONTOUR MAP JANUARY 30, 1997

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

DAMES & MOORE GROUP
A DAMES & MOORE GROUP COMPANY

Job No. 28171-585-005



DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Job No. 28171-585-005

Figure 5

GROUNDWATER ELEVATION CONTOUR MAP
SEPTEMBER 12, 1997

Former Magic Cleaners Coin-Operated Dry Cleaner Site
Lake Forest Park Town Center, Seattle, Washington

WASATCH ENVIRONMENTAL, INC.
ENVIRONMENTAL SPECIALISTS

WASATCH GEOTECHNICAL, INC.
SOILS AND FOUNDATION ENGINEERS

Mr. David Raubvogel
URS / Dames & Moore
500 Market Place Tower 2025 First Avenue
Seattle, Washington 98121

September 21, 2000
MagicCleaners

SUBJECT: Proposal for Groundwater and Soil Remedial Action
Lake Forest Park Town Center
Seattle, Washington

Dear Mr. Raubvogel:

Presented herewith is our proposal to provide a remediation system for volatile organic compounds (VOCs) at the Former Magic Cleaners site in Lake Forest Park, Washington. Enclosed please find a description of the proposed Density Driven Convection (DDC) systems and a list of our subcontractors. Wasatch plans to build two mechanical systems in our Salt Lake City office and then transport the prewired equipment packages to Seattle in six by six foot Tuff® sheds. This allows us to complete all electrical work and test the equipment prior to arrival on site. Each of the proposed systems would be closed loop in design and contain one 180-pound vapor phase carbon vessel. Using this design approach, there would be no emissions to the atmosphere.

Our services consist of professional opinions and recommendations made in accordance with generally accepted geotechnical and environmental engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

Thank you for considering our technology for this project. Please call if you have questions.

Sincerely,

WASATCH ENVIRONMENTAL, INC.

L. Boyde Breeding/cm

L. Boyd Breeding, P.E., P.HG.
Senior Project Engineer

LBB/LP

Copies: Addressee (1)
Fax (1)

I. INTRODUCTION

We are pleased to present our proposal for using Density Driven Convection (DDC) in-well aeration (U.S. Patent No. 5,425.598) to remediate soil and groundwater at the Former Magic Cleaner site located at the Lake Forest Park Town Center in Lake Forest Park, Washington. To date Wasatch has installed approximately 900 DDC wells at more than 50 sites in 14 states.

Review of the contaminants of concern and the subsurface hydrogeologic data indicate that the DDC technology is applicable to this site. PCE, TCE, DCE, and vinyl chloride are readily strippable from groundwater due to their high Henry's coefficients and the shallow aquifer is composed primarily of an interconnected poorly graded sand (SP).

The shallow depth to water encountered at the Lake Forest Park Town Center site requires that we install a larger diameter well (6-inch) than would ordinarily be required (4-inch). The use of a 6-inch diameter well decreases the groundwater lift by reducing the velocity of the air within the well. Wasatch would also extend the DDC wells approximately 3.5 feet above ground surface to accommodate the shallow groundwater conditions.

II. DESCRIPTION OF PROPOSED SYSTEMS

Wasatch proposes to install two separate closed loop systems at the site. System 1 would consist of four DDC wells located on the sidewalk immediately south of the Rite Aid store. The wells would be installed to a depth of approximately 25 feet and be spaced 40 feet apart (Figures 1 and 2). The equipment shed would be positioned within the loading dock area located on the southeast side of the Rite Aid store. The air supply and vapor return piping would be constructed beneath the existing sidewalk and then enter the loading dock area above grade. The construction would require that a two foot wide section of the concrete sidewalk be removed and then patched. Carbon steel pipe would be used for all above ground piping.

The vapors exiting each DDC well would be collected at the well head and then manifolded back to the treatment shed. Chlorinated solvents contained in the vapor would be removed by vapor phase carbon and then the clean effluent air manifolded to the air supply blower intake. In this closed loop design (Figure 3), there are no emissions to the atmosphere. The closed loop system also makes it easier to prevent well fouling if the site is found to be susceptible to carbonate precipitation or bacterial growth.

System 2 (Figure 4) would be constructed across the southern parking lot entrance off Bothell Way and north of Lyons Creek. This system would consist of three DDC wells similar to those described for System 1 above. This system would also be a closed loop and contain a single vapor phase carbon vessel.

Appendix A presents the projected DDC well performance data, including estimated water flow rates, radius of capture, stripping efficiencies, and projected mass removal. The modeling suggests that an air injection rate of approximately 20 standard cubic feet per minute (SCFM) would result in a rise of approximately 5 feet of water column when the air injection tube has a depth of submergence of 12.5 feet. The estimated water flow rate through the DDC well is 1.6 gallons per minute with an air to water ratio of approximately 80 to 1. The estimated PCE stripping efficiency is 98 percent and the initial mass removal rate projected at 0.001 pounds per day per well. The projected radius of influence of the DDC well is 21 feet.

III. SCOPE OF SERVICES PROVIDED

Wasatch has developed costs to provide the following services and materials: 1) system design, 2) system construction, and 3) system startup services including field training, air/groundwater analyses, and the preparation of an operations and maintenance manual.

IV. SCOPE OF SERVICES NOT COVERED BY THIS PROPOSAL

Prior to system startup Wasatch recommends that water quality parameters TDS, pH (insitu and purged), bicarbonate, Ca^{+2}, Mg^{+2}, and Fe^{+2} be evaluated from two monitoring wells on site. Once these data are available, Wasatch will calculate the Langlier and Ryznar stability indices to evaluate the carbonate scaling potential. A Ryznar index of less than 6.2 would suggest that scale may form and that a cylinder of CO_2 gas should be included in the closed loop design. Due to the geologic conditions at the site (rocks of volcanic origin), it is unlikely that calcium carbonate scale will be a concern at this site.

When operating a DDC system, it is common to observe an increase in pH due to the stripping of CO_2 from groundwater. In some cases a rise in pH can lead to the precipitation of solids (most commonly calcium and/or magnesium carbonates). If required, the CO_2 system would be designed to simply maintain the natural groundwater pH by bleeding enough CO_2 into the injection air stream to achieve chemical equilibrium. Once equilibrium is established, transfer of CO_2 from groundwater to air would cease. In the closed loop design the amount of CO_2 required to achieve equilibrium is very minute because the same air is being recycled over and over again. Once the appropriate amount of CO_2 is added to the air stream, only small additions would then be needed to account for leaks in the manifold system.

V. INSTALLATION OF DDC WELLS AND SYSTEM COMPONENTS

The DDC wells would be installed by Cascade Drilling of Woodinville, Washington, using a hollow-stem auger system. Wasatch would provide oversight of the drilling contractor during DDC well installation and development. For cost estimating purposes we have assumed that the site would require level D personal protective equipment.

Prior to drilling, the work areas would be cleared for buried utilities by the local utility locating service. Drawings showing the location of underground utilities would be provided to the Wasatch Environmental engineer prior to drilling. Trenching and piping would be conducted by Emerald Services of Seattle, Washington, under the oversight of Wasatch Environmental. All concrete and asphalt work would also be conducted by Emerald or their subcontractor(s) under the direction of Wasatch Environmental.

VI. PRELIMINARY SCHEDULE

Upon final regulatory approval and notice to proceed, Wasatch would order all mechanical and electrical components. Construction of the mechanical systems could be completed within one month of the notice to proceed. During this time frame it is recommended that the Lake Forest Park Town Center arrange for the installation of a power pole, if needed, for System 2.

Following completion of the wiring and setup of the two mechanical systems in our Salt Lake City office, Wasatch would mobilize an engineer/geologist to the site to initiate the drilling operations. A construction supervisor would then mobilize to the site with the two equipment sheds. The construction manager would be scheduled to arrive approximately three days after the start of drilling. It is recommended that the power drop be initiated immediately upon arrival and placement of the sheds.

Wasatch would drill the three wells included in System 2, followed by the construction of the trenching and piping for System 2. Drilling of the DDC wells for System 1 would be initiated during the construction of the System 2 piping. Following completion of the System 2 trenching and piping, an asphalt subcontractor would repair the parking lot entrance off of Bothell Way. Steel plates would be provided to allow traffic to cross the trenched areas until weather allowed for completion of the asphalt work.

Trenching and piping on System 1 (Rite Aid sidewalk) would begin immediately following backfill and compaction of the trenches for System 2. Well development would begin immediately following the well installation. Upon completion of the well development the engineer/geologist would demob. Following completion of the System 1 piping, backfill, and concrete finishing for System 1, the construction supervisor would demob. Wasatch would remobilize to conduct system startup after electrical service has been installed to the equipment sheds.

Due to the inherent requirements of well installation, in which drilling and casing installation must be completed without interruptions, the plan assumes 12-hour work days and access to the work areas on weekends.

VII. DESCRIPTION OF SYSTEM STARTUP / LONG TERM OPERATIONS AND MAINTENANCE

Due to the fact that the DDC systems have few moving components, the time required for operator training and the potential for significant operation and maintenance problems are less than for other competing technologies. Wasatch would provide guidance on the operation and maintenance of the air injection blower and the well field adjustments that may be necessary during the period of system operations. An Operations and Maintenance Manual would be prepared and provided to URS/Dames and Moore during the system startup.

Other maintenance typically required by DDC systems would be the occasional surging or pumping of the wells to remove sediment from the bottom of the well casing or scaling and biomass fouling from the screen. The DDC wells should be checked during normal groundwater monitoring events to evaluate if sediment is collecting in the casings.

When estimating your monthly operations and maintenance costs, include the following items:

- Electrical power at between $250 and $300/month total. This is based on an estimated 6.5 and 4.7 BHP required for Systems 1 and 2, respectively, and a cost of $0.0355/kilowatt hour for power.
- Monthly system check (our typical estimate for local systems is approximately $500/month). Note that most maintenance site visits can be combined with other monitoring requirements.
- Semiannual DDC well redevelopment at approximately $2500 per event.
- Miscellaneous filters belts and supplies at $500 per system per year.
- Carbon dioxide compressed gas cylinders (if needed) at $250 per cylinder. Although the CO_2 system is not likely to be required, a conservative estimate would include cylinder replacement every two months for each system.
- Groundwater and air emissions monitoring as negotiated with the agencies.

VIII. SUBCONTRACTOR LIST

The proposed subcontractors for this effort are as follows:

Cascade Drilling
Emerald Services

IX. MONITORING DATA

A licence to use the DDC technology at the Lake Forest Town Park site would be granted contingent on Wasatch being provided monitoring data acquired during operation of the system. The monitoring data would be provided to Wasatch quarterly or at some other agreed upon frequency. As the patent holder for the DDC groundwater remediation technology, Wasatch has an interest in the application and performance of these systems.

Wasatch would review the data, at no charge, and may periodically provide observations regarding system operation or recommendations to maintain or enhance performance. Our experience in operating DDC systems has provided us insight into the significance of data trends related to DDC performance and periodic review of the data allows us to provide the benefits of this experience.

Monitoring data would include:

I. Locations of all soil borings, wells, Geoprobe® borings, or test pits relative to the DDC system.

II. Stratigraphic logs of all soil borings, wells, Geoprobe® borings, or test pits relative to the DDC system.

III. Completion information for all DDC wells and wells monitored in relation to the DDC system including total depth, screened intervals, and casing elevations.

IV. Results of all chemical analysis of groundwater, air, and soil samples related to the DDC system.

V. Results of all field measurements related to the DDC system including, but not limited to groundwater depths, air flow rates, and pressure measurements.

VI. Records of maintenance, repairs, or modifications to the DDC system.

VII. Notification of regulatory changes in status related to the DDC system including approval to operate or site closure.

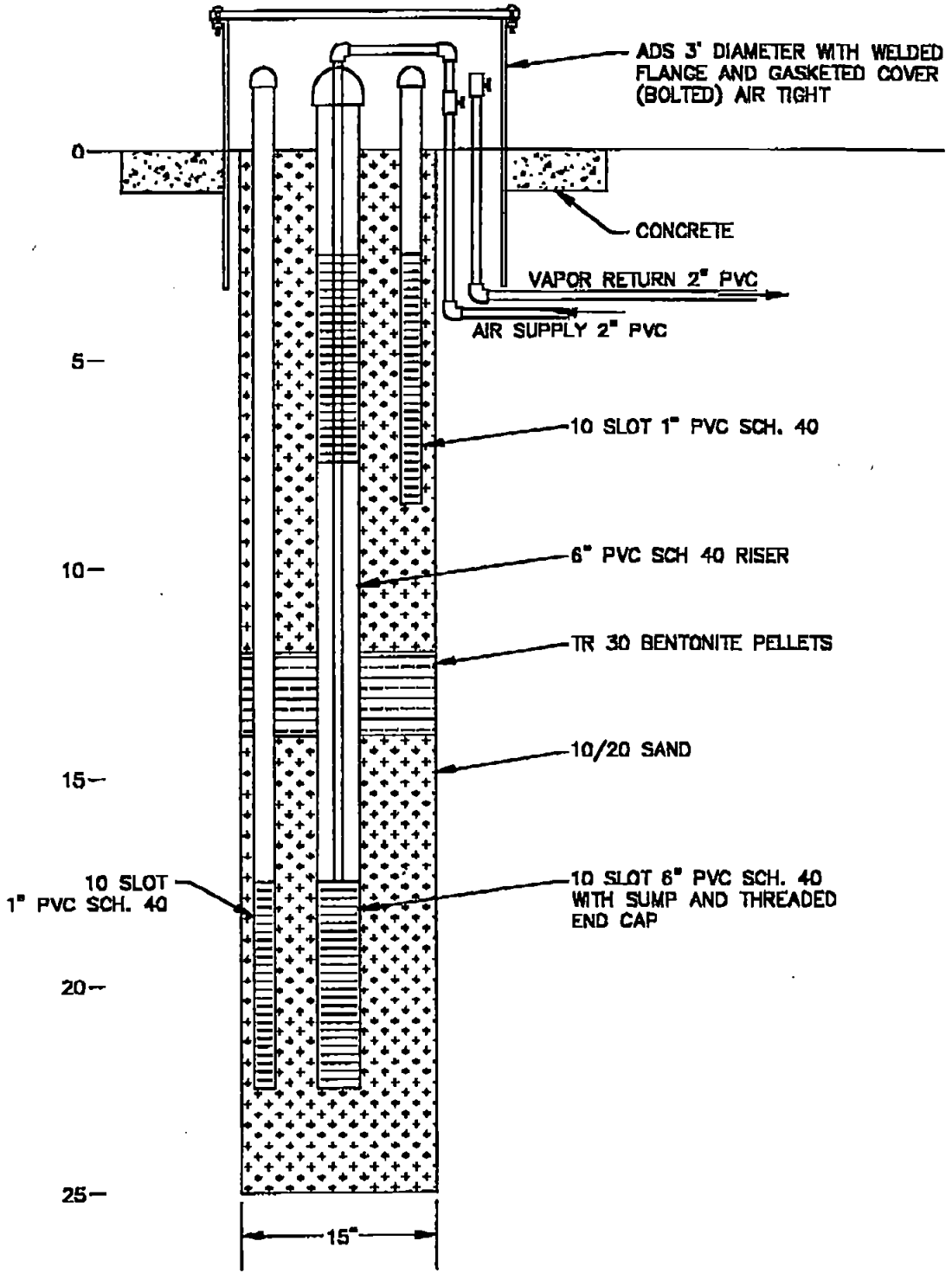
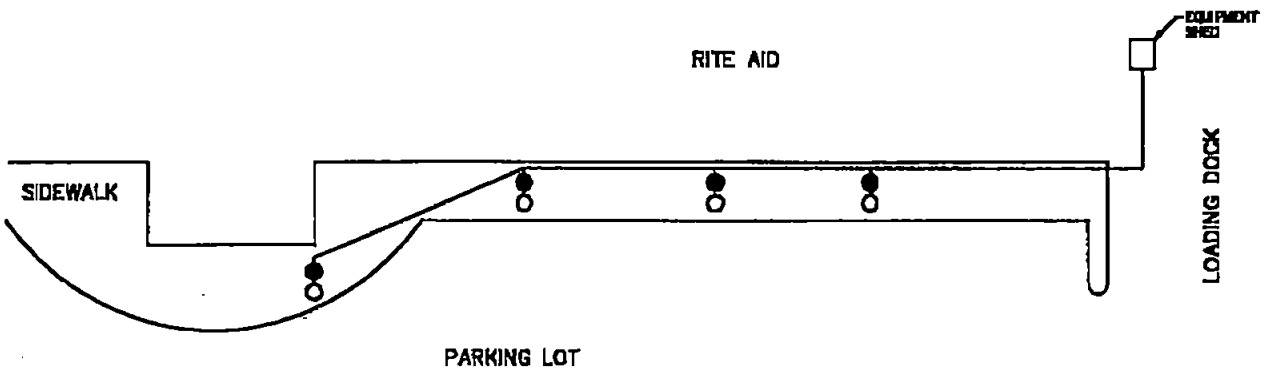


FIGURE 1: DDC WELL
WEI MAGIC CLEANERS
U.S. Patent No. 5,425,598



LEGEND

- o DDC well (4)
- ● Moisture knockout on vapor return (4)

APPROXIMATE SCALE (ft.)

0 20 40 80

FIGURE 2: SYSTEM #1
WEI MAGIC CLEANERS

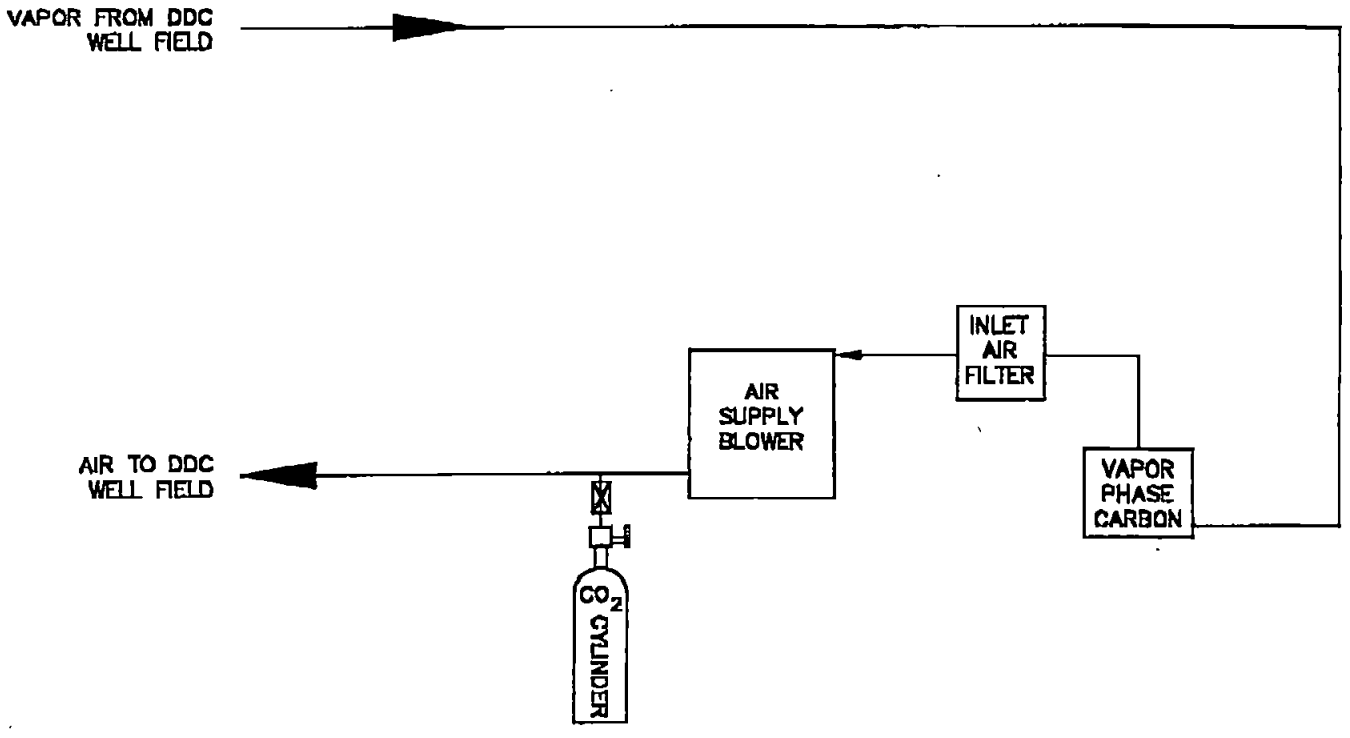


FIGURE 3: CONCEPTUAL LAYOUT FOR CLOSED LOOP DESIGN
WEI MAGIC CLEANERS

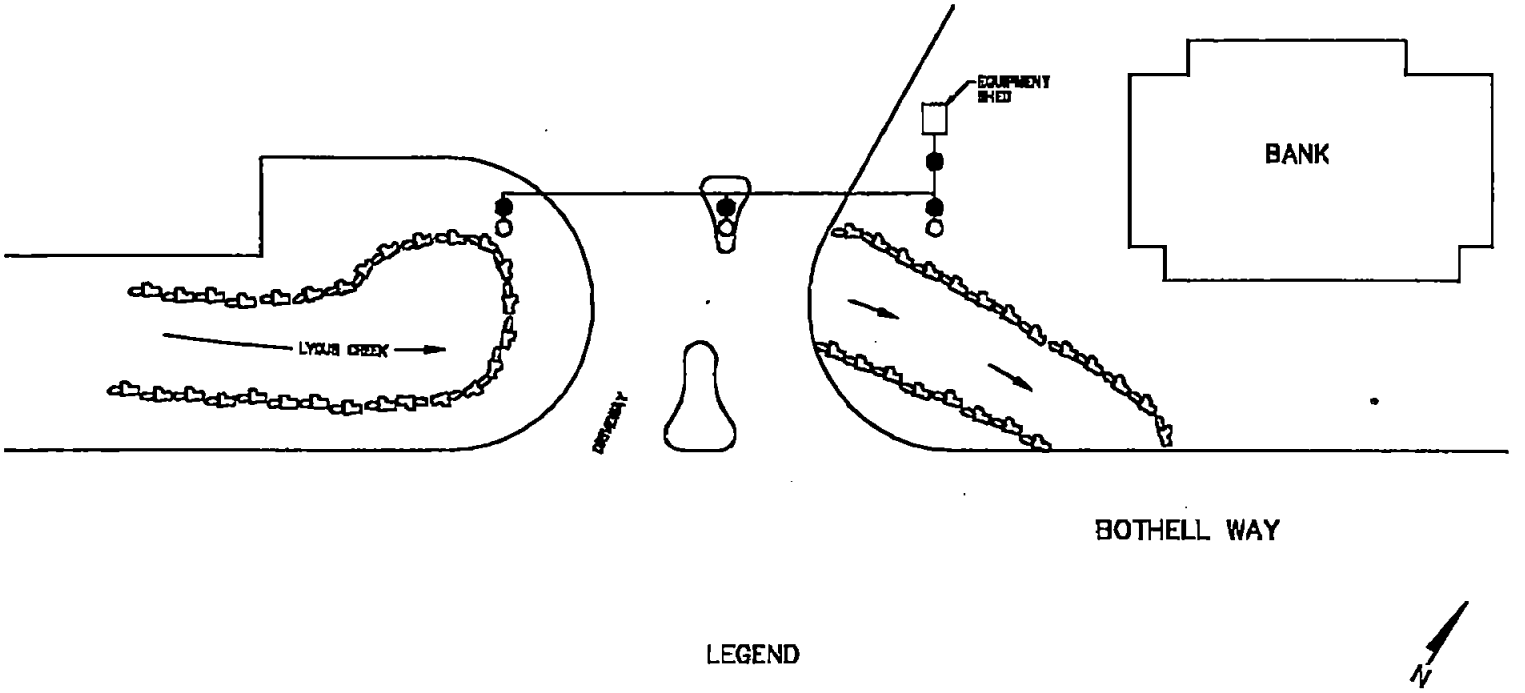


FIGURE 4: SYSTEM #2
WEI MAGIC CLEANERS

FACSIMILE TRANSMISSION

DATE: September 21, 2000

TO: David Raubvogel

COMPANY:

PHONE NUMBER:

FAX NUMBER: 206-727-3350

FROM: Boyd Breeding

AT:

WASATCH ENVIRONMENTAL, INC.

2410 WEST CALIFORNIA AVENUE
SALT LAKE CITY, UTAH 84104
PHONE: (801) 972-8400
FAX: (801) 972-8459
Website: www.wasatch-environmental.com
E-mail: wei@wasatch-environmental.com

NUMBER OF PAGES (INCLUDING COVER PAGE):3

Subject: Proposal for Groundwater and Soil Remedial Action
Lake Forest Park Town Center
Seattle, Washington