Terracon

REMEDIATION SYSTEM REVIEW REPORT
WALLY'S OIL
ROUTE 7, BOX 89
WILTON, MINNESOTA
MPCA SITE ID #: LEAK000089

Terracon Project No. 41057007
February 24, 2006

Prepared for:

MINNESOTA POLLUTION CONTROL AGENCY
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February 24, 2006

Ms. Arlene Furuseth
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Detroit Lakes Area Office
Lake Avenue Plaza, Suite 220
714 Lake Avenue
Detroit Lakes, Minnesota 56501

RE: Remediation System Review Report
Wally's Oil
Route 7, Box 89
Wilton, Minnesota
MPCA Site ID #: LEAK000089
Terracon Project No. 41057007

Dear Ms. Furuseth:

Please find enclosed Terracon's report documenting our review of the corrective action design (CAD) and associated remediation system at the Wally's Oil site in Wilton, Minnesota. The CAD review was performed for the Minnesota Pollution Control Agency (MPCA) and authorized by the MPCA under Work Order LTE-06027. The report presents results of background review and a site visit to evaluate past remedial activities at the site.

If you have questions or require additional information, please do not hesitate to contact our office at 651-770-1500.

Sincerely,
Terracon

David J. Wolfgram P.E.
Senior Engineer

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Introduction

Terracon has been commissioned by the Minnesota Pollution Control Agency (MPCA) to provide environmental and engineering services for review of corrective action designs (CADs) and operating remedial systems for various sites in the state of Minnesota. The system reviews are designed to identify common items of system design and operation which require modification to ensure a high degree of future cost-effectiveness. The review will also determine appropriate revisions in data collection techniques and report documentation to bring these processes in line with current technologies and practices. The MPCA authorized the work under Work Order LTE-06027.

The first step in the review process is to identify the site-specific clean up goals. The goals should be identified in the CAD and should be related to site-specific conditions. These goals are to be based on actual impacts or risks. To achieve the site specific goals and maximize cost-effectiveness, engineered remediation systems must be designed in context of the site geology and hydrogeology. Engineered remediation systems also must be operated at maximum efficiency and effectiveness. System efficiency can be demonstrated through system operation monitoring for:

1. Mechanical Performance (run-time, flow rates, flow volumes, pressure, etc).
2. Effectiveness (progress towards and achievement of remediation goals that the system is designed to achieve, measured through reduction in contamination concentration and/or mitigation of impacts to receptors).
3. Discharge Compliance (e.g., waste streams such as air and liquids).

This report describes the review of the CAD system that previously operated at the Wally's Oil site in Wilton, Minnesota. The following items were evaluated during the review:

- Determine whether the consultant clearly identifies the actual impacts or risks that the proposed engineered remediation system is designed to address.
- Determine whether the consultant clearly identifies measurable site remediation goals including estimated time to achieve those goals.
- Determine whether the consultant identifies a sufficient plan for how they will collect data and evaluate progress towards measurable site remediation goals.

- Determine whether any pilot testing was indicated and if so, was adequately performed and documented.
- Determine whether the pilot test results are used appropriately for full-system design.
- Determine whether sufficient full-scale system design information is adequately documented, and deemed appropriate for the site conditions.
- Determine if the system operation monitoring plan is adequate to demonstrate mechanical performance, effectiveness, and discharge compliance.
- Determine whether the consultant has set clear performance objectives for the system as designed, including expected duration of system operation, expected contaminant reduction loads, and appropriate compliance points.
- Answer the questions:
    - Is the system operating efficiently and effectively?
    - When will the system reach its maximum effectiveness and eliminate actual impacts or sufficiently reduced identified risks?
- Determine whether the system was installed as proposed in the CAD Report.
- Determine whether sufficient information has been collected and adequately presented (figures, tables, etc.) to evaluate system performance.
- Determine whether system operational monitoring is adequate to address mechanical performance, system effectiveness, and discharge compliance.
- Determine whether the consultant provides an adequate evaluation of progress relative to measurable site remediation goals.
- Determine how the MPCA can better evaluate whether the consultant's assigned staff are knowledgeable and experienced with the type of system being operated.

Background Information

Site Summary

The site is located south of Highway 2 (Route 2) at the intersection of Highway 2 and County Road 14 in Wilton, Minnesota (Figure 1). The site is occupied by Wally's Oil Company, which has been operating a bulk fuel storage facility that also distributes fuel via pump island dispensers. The site had various underground storage tanks (USTs) and above-ground storage tanks (ASTs) present. Some of the tanks have been removed and/or moved or replaced.

File Review Summary

Terracon reviewed the MPCA file for the Wally's Oil site at the MPCA office located in St. Paul, Minnesota on December 28, 2005. The following reports, forms, letters or other documents were noted in the file.

- *Project Status Report* prepared by Terracon dated June 23, 2004.
- *Corrective Action Design System Monitoring Worksheet* prepared by Northern Environmental dated June 3, 2003.

- *Annual Monitoring Report* prepared by Northern Environmental dated January 14, 2002.
- *Remedial Investigation Report* prepared by Northern Environmental dated November 14, 2000.
- *Corrective Action Design System Monitoring Worksheet* prepared by Northern Environmental dated July 12, 2000.
- *Annual Monitoring Report* prepared by Northern Environmental dated July 12, 2000.
- *Excavation Report* prepared by Northern Environmental dated June 9, 2000.
- *Corrective Action Design System Monitoring Worksheet* prepared by Northern Environmental dated May 26, 1999.
- *Annual Monitoring Report* prepared by Northern Environmental dated May 26, 1999.
- *Quarterly Monitoring Report* prepared by Northern Environmental dated August 13, 1998.
- *Corrective Action Design Installation Notification Worksheet* prepared by Northern Environmental dated July 9, 1998.
- *Project Update and Quarterly Monitoring Report* prepared by Northern Environmental dated May 13, 1998.
- *Updated Delineation Decision Workplan Addendum and Corrective Action Plan* prepared by Northern Environmental dated November 7, 1997.
- *Delineation Decision Workplan and Modified Conceptual Corrective Action Plan* prepared by Northern Environmental dated August 4, 1997.
- *Revised Workplan for Additional Remedial Investigation* prepared by Northern Environmental dated February 20, 1997.
- *Work Plan for Additional Remedial Investigation* prepared by Northern Environmental dated August 15, 1996.
- *Annual Monitoring Report / Corrective Action Design System Monitoring Worksheet* prepared by Dahl and Associates, Inc. (Dahl) dated July 28, 1996.
- *Site Monitoring Worksheet / Corrective Action Design System Monitoring Worksheet* prepared by Dahl dated January 3, 1996.
- *Site Monitoring Worksheet / Corrective Action Design System Monitoring Worksheet* prepared by Dahl dated October 26, 1995.
- *Site Monitoring Worksheet / Corrective Action Design System Monitoring Worksheet* prepared by Dahl dated June 29, 1995.
- *Site Monitoring Worksheet / Corrective Action Design System Monitoring Worksheet* prepared by Dahl dated February 20, 1995.
- *Site Monitoring Worksheet / Corrective Action Design Installation Worksheet* prepared by Dahl dated June 7, 1994.
- *Supplemental Corrective Action Design* prepared by Delta dated September 13, 1993.
- *Corrective Action Design System Monitoring Worksheet* prepared by Dahl dated August 26, 1993.
- Multiple letter reports titled *Quarterly Monitoring Results* by Delta Environmental Consultants, Inc. (Delta) were noted in the file. These reports included recovery well water flow data and air stripper effluent laboratory reports.
- *Annual Monitoring Report* prepared by Delta dated January 30, 1991.
- *Pump Test Results* prepared by Delta dated September 14, 1989.

- *Remedial Investigation Report – Phase II* prepared by Delta dated May 31, 1989.
- *Project Status Report* prepared by Delta dated December 19, 1988.
- *Gasoline Loss Investigation* prepared by Delta dated September 11, 1987.

Petroleum Release(s) Summary

Based on the available information, Terracon has prepared the following summary of the petroleum release(s) that occurred at the site. Wally's Oil was the active business at the site when the initial petroleum release occurred which reportedly included a gasoline release from a 15,000-gallon AST that ruptured on November 10, 1986 (Figure 3). This release and subsequent release(s) have been assigned to MPCA file number LEAK0000089. The AST rupture allowed approximately 1,830 gallons of unleaded gasoline to be released to the ground surface within and outside of the containment berm located at the south side of the site. Reportedly, the Wally's Oil owner excavated the impacted soil with a loader and placed the soil into a catch basin that was located south of the release area. The amount of the release was reportedly overestimated and the amount was changed to 300 gallons. In addition to the reported gasoline release, Delta reported that fuel oil contamination was identified during assessment activities and that the fuel oil contamination was likely from surface spills near petroleum loading (i.e., transfer/dispensing) stations. The responsible party retained a consultant to conduct the initial assessment and subsequent corrective actions for the release. The corrective actions implemented include utilizing a recovery well to capture and extract the impacted groundwater in order to prevent and/or limit down-gradient potable wells from becoming impacted and an air sparge/soil vapor extraction system to remediate the source area. The recovery well (RW) is currently present at the south side of the site and is located approximately 160 feet east-southeast of the release area (Figures 2 and 3).

Subsequent to the initial release from the AST a separate release located at the north side of the site was identified. Indoor air impacts were identified at the Wally's Oil store and the Wilton Liquor Bar, which is located directly to the east of the site across County Road 14. Indoor air blowers (i.e., air exhange systems) were installed within the store and bar to mitigate the indoor air impacts. Apparently, a recovery well was located on the west side of the Wilton Liquor Bar which likely was utilized to recover free product. However, information reviewed does not indicate free product was recovered from the well. To remediate the source and to mitigate soil vapors at the Wally's Oil store a SVE system was installed. A temporary above-ground soil vapor extraction system, which was later completed below ground, was installed around the periphery of the bar building to also mitigate vapor impacts to that building.

scaling of pit in Liquor Store basement?

For purposes of distinguishing between the two identified source areas at the site, the AST release that occurred at the south side of the site will be referred to as Source Area 1 and the release(s) that occurred at the north side of the site will be referred to as Source Area 2.

Site Visit

Terracon visited the Wally's Oil site on various occasions between 2004 and the present. During some of the site visits Terracon staff observed the locations of the remediation equipment and components present at the site. Two buildings that house remediation equipment are present at the site. One building is located at the south end of the site and one building is located at the north end of the site. The south building was observed to have an air stripper, compressor, manifold and a control panel. The control panel was lying on the floor. Terracon assumes that the control panel was the panel used during the air stripper system operation. The control panel was noted as having the following:

- (1) cycle counter
- (1) time counter (Hours)
- (1) pump warning light
- (1) separator tank full warning light
- (1) separator tank Full or Bypass switch
- (1) Pump Hand or Auto switch
- (1) Compressor Hand or Auto switch

In addition, one set of seven and one set of three PVC pipes were observed extending through the floor of the building and cutoff above grade. The PVC pipes are likely associated with the former AS/SVE system which included seven AS points and three SVE vents. The north building was observed to contain two blowers, two air/water separator vessels, various PVC pipes connected to the blowers inside the building and control panels on the buildings' exterior. The configuration of the blowers and the piping appears to be consistent with the reported installation of nested SVE vents in the area of the Wally's Oil station and installation of nested SVE vents in the area of the Wilton Liquor Bar, which is located east of Wally's Oil station. A ball valve, sample tap, temperature gauge and pressure gauge was observed installed in each of the vent pipes. A sample tap, temperature gauge, pressure gauge, a pitot tube and a magnahelic gauge connected to the pitot tube were observed on the discharge pipe downstream of the vacuum blowers.

? "nested" usually means more than on casing/screen installed in a given boring with the screens set at different depths with an annular seal between screened intervals

Current Site Activities

Terracon is currently conducting groundwater monitoring and additional environmental assessment activities at the Wally's Oil site located in Wilton, Minnesota. The activities include the following which are being conducted under a separate Work Order specific to the Wally's Oil site.

- Monthly site visits to collect water samples from the potable water supply (i.e., potable well) carbon treatment system present at the Wally's Oil store. The water samples are laboratory analyzed for volatile organic compounds (VOCs), gasoline range organics (GRO) and diesel range organics (DRO).
- Evaluating the potential for providing a new water supply (i.e., potable well) to the Wally's Oil store.
- Semi-annual groundwater monitoring of the monitoring well network and potable wells at the site.

- Locating abandoned monitoring well MW-24 and reconstructing the top of the well.
- Fixing and/or reconstructing the wellhead completions of three soil vapor extraction well heads.

In addition, Terracon has prepared a Work Plan that includes installation of two new monitor wells, vapor intrusion assessment, contaminated surface soil assessment and implementation of a new water supply (i.e., potable well) for Wally's Oil store that is anticipated to be conducted during fiscal year 2006.

SOURCE AREA 1 (AST Release)

Environmental Assessment and Monitoring Activities

Purpose

This section describes the background information related to the environmental assessment work conducted prior to, and/or during, the CAD activities. The purpose of this section is to evaluate the information to determine if the assessment work was sufficient in regards to delineating the extent, magnitude and risks associated with the identified release in conjunction with the design of an engineered remediation system. In addition, where applicable this section also includes evaluating the site monitoring activities proposed and/or conducted including data parameters used for assessing the site in conjunction with progress towards meeting the site goals.

Summary

Initial assessment of Source Area 1 appears to have been conducted in February 1987 and included installation of four monitoring wells (MW-1, MW-2, MW-3 and MW-4, Figure 2). In March 1989 one additional monitoring well (MW-6) and one recovery well (RW) were installed in the area east of the release towards the Benson residence. Apparently, there is not a monitoring well identified as MW-5. The recovery well was constructed as a 12-inch diameter well to 23 feet below ground surface (bgs). A five-foot sump was attached to the bottom of the well screen to provide additional drawdown due to low well efficiency. Additional assessment of the Benson Residence (currently Seeger Residence) potable well, the Wally's Oil potable well and the Wally's Oil garage well was also conducted. The results of the assessment indicated groundwater near the AST release, up-gradient of the release and down-gradient of the release was impacted with petroleum hydrocarbons. The Benson well was also identified as having low petroleum hydrocarbon impacts. Therefore, the purpose of installing the recovery well, which is located between the Benson residence and the AST release area, reportedly was to capture and/or divert the migrating plume to prevent the plume from further impacting the Benson potable water supply well.

In October, 1993 monitoring well MW-7 was installed southeast of the release area between the release area and Grant Creek. Laboratory analytical results for samples collected from monitoring well MW-7 identified DRO impacts in that well.

Select monitoring wells were sampled on a quarterly basis. The sampling generally included laboratory analytical testing for GRO and BETX with DRO testing at less frequent sampling intervals.

The geology in the vicinity of the Wally's Oil station as stated in Delta's *Remedial Investigation Report – Phase II* dated May 31, 1989 is as follows:

> *"The regional geology is characterized by unconsolidated Pleistocene sediments underlain by Precambrian igneous and metamorphic rock, Archean and Proterozoic in age. The unconsolidated sediments in the area consist of sand and gravel outwash underlain by ground moraine of the Itasca moraine association (Hobbs and Goevel, 1982). The outwash sediments were deposited by meltwaters originating from a decaying continental ice mass. Itasca ground moraine consists of pebble loam (equal parts sand, silt, and clay with pebbles, cobbles, and boulders intermixed) and characteristically contains many buried channels. There materials were deposited at the base of an ice mass. End moraine, deposited at the edge of a stagnating ice sheet, lies northwest of Wilton, forms hummocky topography, and contains many lakes and ponds."*

Logs of soil borings/monitoring wells indicate the site consists of up to 10 feet of fill soils overlying a thin layer of peat or buried topsoil overlying coarse sand. Terracon's review of available geologic information indicates that the upper 30 to 40 feet of soils consist primarily of sand, which is consistent with the soil samples collected during installation of monitoring wells in April 2005. Clayey soils are present between depths of approximately 40 to 90 feet and sand soils underlay the clayey soils. Based on groundwater monitoring activities of monitoring wells located at the site, the groundwater levels generally vary between five to fifteen feet bgs depending on the monitoring well observed. Fluid level data collected from the monitoring well network indicates the local horizontal groundwater flow direction is to the east-southeast (Figure 4). The nearest surface water to the site is Grant Creek, which adjoins the site to the south.

Information presented in Delta's *Remedial Investigation Report – Phase II* dated May 31, 1989 indicates the groundwater velocity would range between 0.0032 feet per day (ft/d) to 0.03 ft/d assuming a hydraulic gradient of 0.0003, a hydraulic conductivity ranging from 0.000037 feet per second (ft/s) to .00031 ft/s (3.2 to 26.8 ft/d) and an effective porosity of 30 percent (%). These values were later changed based upon pumping test results, model results and assumptions made

(see below). Terracon estimated a hydraulic conductivity ranging from 177 ft/d to 255 ft/d based on grain size analysis of soil samples collected by Terracon.

Comments/Discussion
Terracon used the following questions as a tool to assess the environmental activities related to corrective actions at the site.

1.1 Was the source of the identified release(s) identified? ☒*Yes*☐*No*
Discussion/Comments: None

1.2 Was the extent and magnitude of the identified release(s) adequately defined including the impacts to soil, surface water, groundwater and the presence of free phase product? ☐*Yes*☒*No*
Discussion/Comments:

- Based on the available information, it is Terracon's opinion that the assessment activities completed for Source Area 1 did not sufficiently delineate the horizontal extent of the dissolved phase petroleum plume. Between the period when the release from the AST occurred (1986) and the time when a recovery well operated (1989 to 1993), the area having a high probability of being down-gradient with respect to groundwater flow (i.e., towards Grant Creek) was never assessed; no intrusive assessment activities appear to have been conducted between the release area southeast to Grant Creek. Furthermore, additional assessment to delineate the extent of the petroleum impacts to the north and east for impacts identified at monitoring well MW-6 and the Benson potable well was not conducted at that time.
- Prior to conducting AS/SVE testing and CAD design work, the extent of the impacted soil was not defined.

1.3 Were potential receptors fully identified? ☐*Yes*☒*No*
Discussion/Comments:

- The Benson residence was identified as a receptor and corrective actions (i.e., recovery well) were taken to mitigate impacts to the Benson Residence.
- However, impacts to Grant Creek do not appear to have been adequately assessed with soil/groundwater sampling at inferred down-gradient flow directions (i.e., towards Grant Creek).

1.4 Was the lythology of the site adequately defined? ☒*Yes*☐*No*
Discussion/Comments: None

1.5 Was the hydrogeology of the site adequately defined? ☐*Yes*☒*No*

Discussion/Comments:

- Many of the groundwater contour maps show contour lines beyond the monitoring wells, thereby inferring the groundwater flow levels and directions in those areas. For example, groundwater contour maps showing the groundwater contours during the operation of the recovery well show contours at side-gradient and down-gradient locations (i.e., toward the Benson residence and other areas) relative to the recovery well which are not supported by direct measurements of water levels in those areas.
- The initial hydraulic conductivites reported were significantly different from the hydraulic conductivites later determined by pump testing.

1.6 Was monitoring work conducted to determine contaminant fate and transport? ☒*Yes*☐*No*

Discussion/Comments:

- The monitoring activities conducted appear to be adequate in regards to tracking the progress to achieving the site cleanup goals (i.e., RALs). The groundwater monitoring activities appear to have been used to evaluate the performance of the recovery well and the subsequent AS/SVE system. Although Terracon believes additional monitoring point locations should have been included, the resulting groundwater monitoring activities did indicate that the recovery well was ineffective which apparently led to the installation of the AS/SVE system.

Site-Specific Goals

Purpose

This section describes the background information related to site specific cleanup goals established for the site prior to, and/or during, the CAD activities. The purpose of this section is to evaluate the information to determine if site specific cleanup goals were defined, what the goals are, how the goals were established and what actions were proposed for meeting the goals, including the estimated time to achieve the goals.

Summary

No site specific cleanup goals were apparent prior to 1993, although, documentation indicates the groundwater contaminant concentrations for groundwater samples were compared to recommended allowable limits (RALs). File information indicates site cleanup goals were discussed in 1993 and documented in an MPCA letter regarding *Groundwater Cleanup Goal and System Operation* dated July 21, 1993 which states the groundwater cleanup goal is the RALs. The letter also indicates the cleanup goals maybe increased to ten times the RALs if receptor wells located within one-half mile of the site were abandoned.

The information reviewed does not indicate that source area corrective actions were proposed and/or conducted prior to the September 13, 1993 *Supplemental Corrective Action Design* report. The report indicated the recovery well was not effective at remediating the site. Although the recovery well appears to have been effective in the intended purpose by limiting the migration of the contaminant plume associated with the AST release to the Benson residence.

Comments/Discussion
Based on the available information, it is Terracon's opinion that the utilization of the recovery well did meet its prescribed purpose of limiting the migration of dissolved phase contaminants within the groundwater towards the Benson well. However, actions to remediate the source do not appear to have been addressed or reported at that time and the resultant effect was to run the recovery well indefinitely or until the source no longer contributed to the dissolved phase contaminant concentrations. Due to the solubility of petroleum constituents and the mobility of petroleum constituents in groundwater, a small source (i.e., a few gallons of product) could invariably contribute to groundwater contamination for many years.

Pilot Test(s)

Purpose
This section describes the background information related to the pilot testing work conducted during CAD activities. The purpose of this section is to evaluate the information to determine if the pilot testing activities were conducted sufficiently in regards to providing adequate information (i.e., data) for evaluating the feasibility of using the respective remedial technology and to design and/or implement a full scale remedial system.

Recovery Well Summary
As described above, the initial remedial activity conducted for Source Area 1 included installation of a recovery well (RW-1) to capture and/or divert the migrating petroleum plume to reduce and/or limit the petroleum impacts to the Benson potable well. The design of the recovery well was based on site specific subsurface parameters, such as soil type, groundwater levels, laboratory analytical results, analytical groundwater flow models (i.e., equations) and various assumptions. The resulting design specified a flow rate of 10 gallons per minute (gpm) from the recovery well which would reportedly provide a capture zone with a radius of influence of 200 feet (Figures 5 and 6). The flow rate and radius of influence were later revised after a groundwater pumping test was conducted (see below).

The water recovered from the recovery well was treated on-site within a treatment shed (Figure 7). The treatment units utilized include a product separation tank followed by a diffused aerator. The treated water was discharged to Grant Creek.

A groundwater pumping test was conducted about three months after the recovery well was installed; the recovery well was installed during March 27 through March 31, 1989 and the pumping test was conducted on July 6 and 7, 1989. The test included operating the recovery well pump at 9.5 gpm and monitoring the drawdown in the recovery well and nearby monitoring wells for a period of 29.3 hours. The pumping test activities and results are presented in Delta's *Pump Test Results* letter report dated September 14, 1989. Results presented in the report suggest that drawdown was observed at the five monitoring wells, which ranged a distance of 77 feet to 264 feet from the recovery well. The report indicates a drawdown of 0.09 feet for the closest well (MW-6, 77 feet) and a drawdown of 0.12 feet for the furthest well (MW-3, 264 feet). Water levels measured during recovery (i.e., after the recovery well pump was turned off) were also conducted and, based on the recovery measurements, the water levels in the monitoring wells did not rebound significantly, except for wells MW-6 (0.05 feet) and MW-1 (0.04 feet). The total drawdown for the recovery well was reported as 3.47 feet after 1728 minutes. The report indicates a hydraulic conductivity, aquifer transmissivity and storage coefficients were calculated based on the pumping test data. The report showed hydraulic conductivities at 433, 431 and 426 ft/d, which is not consistent with previously indicated hydraulic conductivities of less than 26.8 ft/d (see above). Based on the pump test results, the recovery well pump was operated at 6 to 7 gpm which, according to the report, would provide a radius of influence that encompassed the Benson potable well.

Comments/Discussion

The recovery well was used to conduct a pumping test that was used for evaluating the feasibility/effectiveness of using a recovery well. The results of the environmental assessment activities appear to have been used to design the pump & treat system. The specific parameters used, such as the groundwater contaminant concentrations, for designing the treatment units (i.e., OWS and DAT) were not identified or reported. The groundwater pumping test data does not appear to be adequate to support the inferred radius of influence of the recovery well.

Air Sparge/Soil Vapor Extraction Summary

AS/SVE pilot testing was conducted during July 1993 to determine the feasibility of using the AS/SVE technology and for collecting data for full scale design. The Delta's 1993 *Supplemental Corrective Action Design* report describes the pilot testing activities and includes the MPCA *Soil Venting Pilot Test Worksheet (Fact Sheet #8)* and the MPCA *Air Sparging Pilot Test Worksheet (Fact Sheet #9)*. Based on review of the report and fact sheets, Terracon noted the following:

- SVE testing
    - One vent point (V-1) was installed for monitoring the pilot testing (Figure 8). Nearby monitoring wells were also used for monitoring the pilot testing. The closest monitoring point to the vent/sparge point (SPV-1) was monitoring well MW-1 which was located approximately 10 feet from SPV-1. The screened interval of MW-1 was 7 to 17 feet bgs. The second closest monitoring point was monitoring point V-1 located approximately 21 feet from SPV-1. Monitoring point V-1 was screened from 3 to 13 feet bgs.

- One nested vent/sparge point (SPV-1) was installed that was used for air extraction/air injection points. The vent point screened interval was 5 to 15 feet bgs and the static water level measured at the vent point was approximately 12 feet bgs. Therefore, three feet of the screen was submerged below the groundwater table.
- The SVE testing was conducted prior to the AS testing. The SVE test ran for approximately 1 hour and 15 minutes.
- Data collected during the SVE testing include: vacuum measurements of the extraction point, air flow rate at the extraction point, vacuum measurements at nearby monitoring wells, oxygen measurements of the off-gas and LEL readings of the off-gas.
- The SVE point (SPV-1) was installed in a 10-¼ inch diameter borehole with a 2-inch, 10-foot long, PVC 10-slot screen set at 3 to 13 feet bgs.
- The water table was observed at approximately 10 feet bgs during installation of the SVE vent point.
- The SVE test reportedly operated at 55 standard cubic feet per minute (scfm) and 10-inches of water vacuum for the 1 hour and 15 minutes. No other venting conditions (i.e., step tests) with varying air flow rates/vacuums were conducted.
- A radius of influence of 80 feet was reported that was based on the results of the SVE test (i.e., direct measurements at the monitoring wells).
- Four extraction wells were recommended that would each operate at 55 cubic feet per minute (cfm) at a vacuum of 10-inches of water giving a total air flow of 220 cfm.

- AS testing
  - The AS testing was conducted shortly after completing the SVE testing. The AS test ran for approximately three hours.
  - The same monitoring points as described above for the SVE testing were used for the AS testing.
  - The AS point screened interval was 20.5 to 24 feet bgs and the static water level measured at the AS point was approximately 12.3 feet bgs. Therefore, top of the screen was submerged approximately 8.2 feet below the groundwater table.
  - Data collected during the AS testing include: pressure measurements at the injection point, air flow rate at the injection point, pressure measurements at nearby monitoring wells, water levels at nearby monitoring wells, visual observations, and dissolved oxygen (DO) readings taken before and after sparging.
  - The AS point was installed nested with the SVE vent point with a 2-inch, 3.5-foot long, galvanized steel 10-slot screen set at 20.5 to 24 feet bgs, which corresponds to approximately 10.5 to 14 feet below static water level.
  - The AS test included three steps that reportedly operated at 10 standard cubic feet per minute (scfm) and 131.7-inches of water pressure for the initial 1 hour and 27 minutes followed by 20 scfm and 138.7-inches of water for 22 minutes and 40 scfm and 173.3-inches of water for the remaining 32 minutes.

  - A radius of influence of 20 to 25 feet was reported for flow rates between 10 and 20 cfm at pressures of 5 pounds per square inch (psi), which is equal to 139 inches of water.
  - Seven sparge points were recommended. The AS system would cycle each point at 20 cfm and 10 psi (277 inches of water). The rational for specifying the air flow rate/pressure was not discussed and did not include the length of the cycling periods.
- A map showing the proposed vent and sparge point locations along with the respective radius of influence areas depicted was included in the CAD (Figure 9). Three vent points are shown on the map which is not consistent with the four proposed.
- A piping and instrumentation diagram showing the proposed AS/SVE system was also included in the CAD (Figure 10).

Comments/Discussion

The purpose of conducting AS/SVE pilot testing includes determining the combination of air flow rates, air pressures, and radius of influences for a full-scale system. In addition, organic vapor monitoring and SVE air discharge samples should be collected to quantify potential air emissions. These data are used to determine the feasibility of utilizing the AS/SVE technology and to design the full scale system. Critical components of the AS/SVE systems that are specified based on the results of the AS/SVE pilot test data include the control panel, AS compressor size, SVE blower size, off-gas treatment and the number of AS and SVE points. Excluding the treatment building, these components account for more than 90 percent of the purchase and installation costs for an AS/SVE system. In addition, the operations and monitoring costs are dependant on the number of components (i.e., monitoring points), configuration of the system, and power needed to run the compressor/blower.

Direct measurements and observations conducted during the AS/SVE pilot test support the specified radius of pressure/vacuum influence. Although it is Terracon's opinion that the methods and procedures used to collect the data should have been more thoroughly described. In addition, the vapor extraction air flow rate was operated at a constant flow rate and pressure, which is insufficient for evaluating possible alternatives to the size of blower and the number of vent points. Furthermore, the screen size (i.e., 10-slot and 10 feet in length) used and the depths at which the screen was set (i.e., 3 to 13 feet bgs) for the vent point may have provided poor air vacuum/air flow performance data due to the proximity to groundwater and the ground surface. Upwelling is more common when 10-slot screens are used. A greater influence from short-circuiting and/or preferential air flow occurs when the top of vent screens are located close (i.e., within five feet) to the ground surface. Moreover, a radius of influence of 80 feet for a vapor extraction vent screened at 3 to 13 feet is suspect, unless an impervious surface cover (i.e., pavement) was present.

It is common practice to use water level measurements, dissolved oxygen measurements and vacuum/pressure measurements during AS/SVE pilot testing to determine the radius of influence. However, analysis of the measurements should include the accuracy and precision of such

measurements including identifying natural background effects (i.e., barometric pressure changes), sampling/testing effects and other potential effects that could bias the data measurements. In addition, the pressure/vacuum observed at various distances from a AS/SVE point indicate a pressure differential that should induce air to flow. However, the pressure/vacuum measurements do not indicate the actual air flow rate within the subsurface soils.

Corrective Action Design (CAD)

Purpose

This section describes the background information related to the full-scale system design. The purpose of this section is to evaluate the information to determine if the CAD includes adequate information pertaining to the feasibility of utilizing the proposed technology. In addition, an evaluation of proposed monitoring activities including methods, procedures, instrumentation, and testing for monitoring the mechanical performance, remedial effectiveness and discharge compliance.

Recovery Well Summary

The pump & treat technique was used to limit migration of groundwater contamination. The pump & treat technique was proposed in Delta's 1988 *Project Status Report*. A formal CAD report was not prepared for the pump & treat system.

Comments/Discussion

Based on the hydrogeologic conditions at the site, pump & treat is a feasible technology for capturing a dissolved phase contaminant plume by drawing down the water table using a recovery well. The capture zone (i.e., radius of influence) is site specific and depends on the construction of the recovery well, the subsurface lythology at and near the recovery well, the groundwater flow including influences (i.e., proximity to surface water, drain fields, precipitation, etc.), and the groundwater pumping rate at the recovery well. Therefore, the performance of a pump & treat system should be based on direct measurements collected at points within the prescribed cleanup zone prior to full scale implementation which was not conducted at the Wally's Oil site prior to full scale implementation of the recovery well.

The fate and transport mechanisms of the source contaminants should be thoroughly evaluated prior to using a pump & treat system to assess the effect the pump & treat system will have on the source. The pump & treat system associated with Source Area 1 was installed to capture the migrating dissolved phase contaminants by drawdown of the water table and could, in effect, have propagated the migration of the source laterally and vertically within the subsurface. A CAD should describe these issues as they relate to a proposed remedial system. Since a CAD was not completed, the effect the remedial system may have had regarding the contaminated zone was not identified, such as causing the smear zone to migrate laterally and vertically.

AS/SVE Summary

The AS/SVE technique was proposed in Delta's 1993 *Supplemental Corrective Action Design* report. Review of the documents indicates the objective of the pump & treat system was to capture and/or divert the migrating contaminant plume to prevent further impacts to the Benson well and the objective of the AS/SVE system was to remediate the source area. The review did not identify system operation monitoring activities or objectives for the duration of operation, contaminant reduction loads or compliance points. Moreover, the CAD for the AS/SVE system appears to be based on results of the AS/SVE pilot test, which were not fully compliant with the pilot test criteria documented in the MPCA *Soil Venting Pilot Test Worksheet, Fact Sheet #8 (April 1993).* In addition, the *Supplemental Corrective Action Design* report did not include specific details of the AS/SVE system design, except for the number of AS/SVE points, the proposed locations of the points and the configuration of the AS/SVE system (Figures 9 and 10).

Comments/Discussion

Air sparging is a proven technique for removing volatile organic compounds from water. Air sparging is generally the pumping of air via a compressor into the ground below the water table. The air provides a vapor phase medium that the VOCs can migrate to when the VOCs and air come into contact. The buoyancy effects of the air in water causes the air to rise to the surface of the groundwater table, unless an impermeable layer is present, thereby removing the VOCs from the groundwater. The effectiveness of air sparging to remove dissolved phase contaminants depends on the VOCs vapor pressure (ability to move from the dissolved phase to the vapor phase), the contact time between the VOC and air, the density of the VOC, and the concentration of the VOC. Furthermore, the addition of air also provides oxygen to the subsurface which may inhibit aerobic biological activity that could degrade the contaminants.

At a minimum, the following parameters should be used to design an air sparge system:

- Identify the extent and magnitude of the source area to be treated.
- Identify the fate and transport mechanisms of the contaminants to be treated.
- Hydrogeologic conditions (soil type, depth to groundwater, groundwater flow direction, etc.).
- Pilot test data (air flow rates, air pressure, radius of influence).

Based on the CAD report, the extent of the source area was not determined or reported. The area to be treated by the AS system was not reported. The CAD did not discuss the feasibility of using the air sparging technique relative to the hydrogeologic conditions or the contaminants of concern. The CAD did not describe the methods or procedures by which the system would be monitored. The CAD indicated SVE points were not located along the south perimeter of the air sparging area. In addition, since two of the SVE points were located within a few feet of each other and within a few feet from some sparge points, the AS/SVE system may have propagated the migration of contaminants and may have had limited vapor recovery (Figure 9). Presumably, the extent of the

contamination should extend east, southeast and south of the release area based on the impacts that were identified (and recovery efforts conducted) in those directions. However, the plotted AS points do not cover areas down-gradient of the noted release area. Furthermore, it is not apparent as to why two vent points were located within 32 feet of each other when the radius of influence was reported as 80 feet and given that presumably only three vent points were installed when the CAD recommended four.

It is Terracon's opinion that air sparging was an appropriate remediation technique for remediating Source Area 1. However, the design of the full-scale AS/SVE system lacked many essential components for proper design of the full-scale system. The design could have been improved if more thorough assessment work was completed and the basis of using AS was more thoroughly discussed in the CAD. For instance, the area of the dissolved phase plume which the AS system was designed to treat was not defined and the area of the liquid phase and/or absorbed phase petroleum impacts within the vadose zone which the SVE system was designed to treat was not defined. In addition, review of the available information did not identify design personnel qualifications or specific background experience associated with AS/SVE design team.

CAD System Installation

Purpose

This section describes the background information related to the installation of the full-scale remedial system(s). The purpose of this section is to evaluate the information to determine if the remedial system was installed in accordance with the CAD.

AS/SVE Summary

An MPCA *CAD Installation Notification Worksheet, Fact Sheet #10 (April 1993)* prepared by Dahl, dated June 7, 1994, was noted in the MPCA file for the site. Terracon's review of the worksheet noted the following:

- The full scale AS/SVE system was installed April 26, 1994, tested during April and May 1994 and started operating June 15, 1994.
- Air injection rate is not reported on the worksheet. However, a table shows the air injection rates varied between 11.80 to 17.59 scfm for individual injection points.
- Total air removal is reported as 120 scfm.
- Radius of influence of vent points is reported as 75+ feet based on vacuum of 0.12 inches of water observed at monitoring well MW-4, which is located approximately 75 feet from the nearest vent point. No other vacuum measurements were reported for other monitoring points [i.e., MW-1 (5-feet), MW-3 (5-feet) or MW-6 (120 feet)].
- Radius of influence of sparge points is reported as 75 feet based on an increase of dissolved oxygen observed at monitoring well MW-4. No other DO measurements were reported for other monitoring points [i.e., MW-1 (5-feet), MW-3 (5-feet) or MW-6 (120 feet)].

- Based on the Process Flow Diagram, three vent points and seven sparge points were installed. The information was deficient and did not include the configuration of each vent point or sparge point such as the depth of screen, type of construction materials, etc, or a figure showing the locations of the points.
- Based on the Process Flow Diagram, the SVE system consisted of a condensate trap, particulate filter, vacuum blower and discharge silencer.
- Based on the Process Flow Diagram, the AS system consisted of a particulate filter and an air compressor. The note included below the Soil Vapor Extraction and Ground-Water Ventilation table states the GWV (ground-water ventilation, or air sparging injection) operates sequentially among the air sparge points which indicates the sparge points are cycled at the reported air flow rates.
- Many items depicted on the Process Flow Diagram are not defined on the legend or within the text of the report. For instance, various valves are depicted which are not distinguishable as to the type of valve or how the valve is controlled. (i.e., what they were for

Comments/Discussion

Based on the information, Terracon noted the following: the SVE system was operating at a total of 120 scfm, which is significantly lower than the 220 scfm proposed; the AS system was operating between 11.8 and 17.6 scfm for individual sparge points, which is below the 20 scfm proposed; the radius of influence of the AS points was reported as 75 feet, which is considerably higher than the 20 to 25 feet distance proposed; the construction of the AS or the SVE points is unknown; the type and size of the blower and compressor were not specified. The dissolved oxygen measurements were not reported on a summary table and, therefore, cannot be evaluated.

There is not enough information to evaluate whether the blower or the compressor were sized appropriately. However, the reported information indicates direct measurements and/or observations confirm the radius of influence. The methods and procedures describing the measurement techniques were not reported. Furthermore, dissolved oxygen measurements can be suspect depending on the measurement technique (i.e., do meter, colorimetric, laboratory analyzed, etc.). Dissolved oxygen can vary considerably over the range of depth in monitoring points (i.e., monitoring wells) and can be influenced by exposure to atmosphere and/or agitation during sampling. Lastly, it is not apparent what the effect of the AS system would have if, in fact, the radius of influence was 75 feet rather than the proposed radius of influence of 20 to 25 feet. The CAD shows the SVE points located in reference to the AS points so that the sparged air can be captured by the SVE points. Therefore, if the radius of influence of the AS points has changed significantly as indicated, the resulting SVE capture zone may not cover the entire area of influence of the AS system.

CAD System Operation/Maintenance

Purpose

This section describes the background information related to the operating & maintenance activities associated with the remedial system(s). The purpose of this section is to evaluate the information to determine if the information reported is adequate to evaluate the performance of the remedial system in regards to achieving the remedial goals.

Recovery Well Summary

An *Annual Monitoring Report* (AMR) prepared by Delta in 1991 and *Quarterly Monitoring Results* letters prepared by Delta describe the pump & treat system operation and maintenance activities including groundwater monitoring activities. The AMR describes the treatment units and treatment building installed to treat the water recovered from the recovery well (see above). In addition, the AMR includes tables summarizing the pump & treat system O&M data. The following list summarizes the reported O&M data.

- Operating Log, Table 1
  - Date
  - Interval between measurements (Days)
  - Pump operating hours
  - Pump cycles
  - Hours/Day
  - Gallons/Cycle
  - Flow (GPM)
  - Flow (GPD)
  - Flow (Total)
- Diffused Aeration Tank Performance Data, Table 2
  - Date
  - THCG Influent
  - THCG Effluent
  - % Removal
- Water Levels, Table 3

The *Quarterly Monitoring Results* letters include the date and time of site visits, the total flow observed at the time of the site visits and a copy of the laboratory analytical report for effluent water samples collected from the DAT. The letter reports did not include comprehensive data tables.

The pump & treat system was reportedly turned off on August 5, 1993.

Comments/Discussion

Based on the reported data, it appears the pump & treat system had a flow totalizer, a system cycle counter and a system operation time counter. Based on these three parameters, the average flow rate of water pumped from the recovery well in gallons per day (gpd), gallons per minute (gpm) or gallons per cycle (gpc) can be determined. However, the data presented on the table does not correlate among the observed data (dates, operating hours, cycles, total flow) and the calculated values (gpd, gpm, gpc) between the parameters. For example, the total number of hours reported for 10/11/1990 is 8,099 and for 11/06/1990 is 8,390 giving 291 operating hours, the reported flow rate for 11/06/1990 is 7.00 gpm and the total flow for the period is 59,386 minus 55,021 giving 4,365 gallons. Calculating the total flow based on the reported rate and operating hours is 122,220 gallons, which is significantly different from 4,365 gallons. The 1993 *CAD System Monitoring Worksheet* prepared by Delta includes a data table that presents cumulative data from the initial startup of the pump & treat system through January, 14, 1993. It appears that a change in the O&M activities occurred sometime in early 1991, since the data reported for total flow increased from 74,486 reported for 1/17/1991 to 2,458,640 reported for 5/9/1991. Only the total flow, days in the period and the flow rate in gpd was included in the 1993 worksheet. The worksheet, also, did not describe any changes in the operation or maintenance activities.

Based on the available information, it is Terracon's opinion that the preliminary assessment of the site did not adequately define the hydrogeologic conditions, which appear to have included poor assumptions (i.e., hydraulic conductivity, transmissivity, etc.) prior to installation of the recovery well (i.e., pump & treat). The increased cycling of the recovery pump over time indicates groundwater recharge slowed, the pump was malfunctioning, the flow rate was changed or the pump was replaced with a different size pump. Causes of poor recharge, or yield, include plugging of the pore spaces within the filter pack or well screen due to scaling/biofouling, fine grained soils or corrosion. Therefore, a significant change in the cycling of the well pump indicates a change in the operating conditions of the system and a potential for a reduction in the performance of the system. Potential effects caused by a significant increase in the cycling may include a reduced average flow rate, a reduced radius of influence, an increase in operating costs (i.e., power consumption), or a change in hydrologic conditions.

In regards to the operation and controls of the pump & treat system, the increased cycling of the recovery pump further reduces the lifespan of the pump. The starting and stopping action of the pump causes increased wear on the motor windings and pump. In addition, the available information does not indicate how the pump flow rates were regulated or the range of operating conditions (i.e., flow, head pressure, etc.) that the well pump was capable of handling. Therefore, it is not possible to determine if the pump was sized properly.

The groundwater treatment system appears to have been adequately designed based on the laboratory analytical results of the influent and effluent water samples collected. Presumably, the

constituents that the treatment system was designed to treat include primarily volatile organic compounds. If properly designed, DAT systems are effective at removing VOCs from water. However, DATs would not be as effective at removing less volatile compounds, such as many of the constituents found in fuel oil or diesel fuel, which is supported by the reported DRO concentrations in the effluent samples from the DAT.

The performance monitoring for a pump & treat system should include the following parameters in order to evaluate the capture zone (i.e., radius of influence), contaminant concentration trends, contaminant transport, quantity of contaminant removed, and effectiveness of treatment.

- Fluid levels at distributed monitoring points.
- Groundwater quality monitoring/sampling at distributed monitoring points.
- Groundwater flow gradients.
- Recovery well pumping rates.
- Treatment system influent and effluent water quality.

Based on the available information, the data gathered for the pump & treat system appears to have been adequately collected. However, the data was not reported consistently or thoroughly among the reports reviewed. Therefore, to effectively assess the performance of the pump & treat system, the data parameters described above need to be reported wholly within a comprehensive monitoring report that distinguishes between the field parameters collected, the calculated parameters and assumptions made. Moreover, a performance evaluation appears to have been conducted since the pump & treat system was determined in 1993 to be inadequate for contaminant source remediation. The documentation reviewed did not identify specific causes or reasons for the pump & treat systems ineffectiveness at remediating the source.

AS/SVE Summary

Neither Delta's *Supplemental Corrective Action Design* report dated September 13, 1993 or Dahl's *Corrective Action System Installation Notification* report dated August 26, 1993 describe the methods, procedures, equipment or other means regarding operation and maintenance activities for the AS/SVE system. Therefore, Terracon assumes the data parameters reported that are associated with the AS/SVE system were used for performance evaluations. The following list summarizes the reported O&M data.

- Pressure/Vacuum readings at monitoring wells, AS manifold and SVE manifold.
- Air flow rates measured at AS manifold and SVE manifold.
- Flame ionization detector readings of the exhaust stack of the SVE system.
- Exhaust stack sampling and laboratory analytical testing.
- Ambient barometric pressure.
- Vapor moisture content by wet bulb/dry bulb measurements of the SVE exhaust.

The AS/SVE system was shutdown in 1996, when indoor air impacts were identified at the Wilton Liquor Store. The data suggest elevated organic vapors were being extracted by the SVE system at the time the AS/SVE system was shutdown.

Comments/Discussion

In general, the reported data was presented on custom formatted tables and figures, which were not easily decipherable, or user friendly. Based on the reported data, it appears the system was monitored for appropriate data parameters within quarterly monitoring intervals, except for pressure/vacuum measurements collected from monitoring points (i.e., monitoring wells). A review of the air injection flow rates reported indicates some suspect data. For instance, the air flow rates reported for February 20, 1996 show the seven injection wells as having the following flow rates: 23.11, 30.57, 30.57, 30.57, 30.57, 30.57, and 32.68 cubic feet per minute (cfm), which five of the seven flow rates are equal to within 1/100 of a cfm. Flow rates among air injection wells will generally vary over a broader range. Little information was presented beyond the data tables or figures such as a discussion on the performance of the AS/SVE system, the estimated time to meet cleanup objectives, or changes to the operation of the AS/SVE system.

Based on the groundwater quality, the AS/SVE system does appear to have reduced the overall contaminant concentrations. The groundwater quality shows an overall decreasing trend in the dissolved phase petroleum hydrocarbons. However, a seasonal trend is also apparent with significant decreases in the contaminant concentrations during mid-summer(s) with subsequent rebounding. It is not apparent that the data at that time supported shutting down the system due the seasonal fluctuations of contaminants. In addition, the soil vapor extraction discharge air sample analytical results do not indicate a stable, decreasing trend in the off-gas petroleum concentrations. Since the system operated for over 21 months, a stable decreasing trend of VOC concentrations in gas samples collected from the SVE discharge should have occurred. Since a stable trend is not apparent, the AS/SVE system was not operating effectively cleanup the site.

Some causes of limited reduction of off-gas contaminant levels include inadequate air flow rates within the subsurface soil, limited migration or preferential flow of air injected into the subsurface, contaminant mass present at the fringes of the radius of influence, and rate limited contaminant removal (i.e., vaporization, absorption, adsorption, diffusion, etc.).

SOURCE AREA 2 (North Side Release)

Environmental Assessment and Monitoring Activities

Purpose

This section describes the background information related to the environmental assessment work conducted prior to, and/or during, the CAD activities. The purpose of this section is to evaluate the information to determine if the assessment work was sufficient in regards to delineating the extent, magnitude and risks associated with the identified release in conjunction with the design of an engineered remediation system. In addition, where applicable this section also includes

evaluating the site monitoring activities proposed and/or conducted including data parameters used for assessing the site in conjunction with progress towards meeting the site goals.

Summary

Assessment of Source Area 2 began after indoor air impacts consisting of petroleum related compounds were identified in the Wilton Liquor Bar building in May 1996. The indoor air impacts were classified as requiring an emergency response by the MPCA that included vapor mitigation. At the time when the indoor vapor impacts were identified the previously identified release at Source Area 1 was considered as a potential source of the vapor impacts. Five monitoring wells (MW-8 through MW-12) were installed in June 1996 following advancement of eighteen push probes (GP-1 through GP-18) that were completed earlier that month. A recovery well was also installed west of the Wilton Liquor Bar. In addition, potable well samples were collected from potable wells located nearby.

The results of the assessment indicated groundwater extending from the AST tank farm, pump island dispensers and USTs eastward to the Wilton Liquor Bar property was impacted with petroleum hydrocarbons. The Skime Residence potable well was also identified as having high petroleum hydrocarbon impacts.

In May, 1997 an additional seventeen soil borings (TB-1 through TB-15, V-10 and V-11) and twelve monitoring wells (MW-13 through MW-24) were advanced/installed at the site.

Select monitoring wells were sampled on a quarterly basis. The sampling generally included laboratory analytical testing for GRO, BTEX and DRO.

Comments/Discussion

Terracon used the following questions as a tool to assess the environmental activities related to corrective actions at the site.

1.1 Was the source of the identified release(s) identified? ☐*Yes*☒*No*

Discussion/Comments:

- No specific release was identified for the soil, vapor and groundwater impacts identified at Source Area 2. The records do not show that corrective measures were taken to identify a continuing release source (i.e., leaking UST, leaking dispensers/piping, contaminated soil or other possible leak source).

1.2 Was the extent and magnitude of the identified release(s) adequately defined including the impacts to soil, surface water, groundwater and the presence of free phase product? ☒*Yes*☐*No*

Discussion/Comments: None

1.3 Were potential receptors fully identified? ☐*Yes*☒*No*

Discussion/Comments:

- Potable wells identified in the area were sampled and the wells identified with impacts were either replaced with deeper wells or had water treatment systems installed to treat the water.
- However, impacts to Grant Creek do not appear to have been adequately assessed with soil/groundwater sampling at inferred down-gradient flow directions (i.e., towards Grant Creek).

1.4 Was the lythology of the site adequately defined? ☒*Yes*☐*No*

Discussion/Comments: None.

1.5 Was the hydrogeology of the site adequately defined? ☒*Yes*☐*No*

Discussion/Comments: None.

1.6 Was monitoring work conducted to determine contaminant fate and transport? ☒*Yes*☐*No*

Discussion/Comments: None.

Site-Specific Goals

Purpose

This section describes the background information related to site specific cleanup goals established for the site prior to, and/or during, the CAD activities. The purpose of this section is to evaluate the information to determine if site specific cleanup goals were defined, what the goals are, how the goals were established and what actions were proposed for meeting the goals, including the estimated time to achieve the goals.

Summary

No site specific cleanup goals were identified.

Pilot Test(s)

Purpose

This section describes the background information related to the pilot testing work conducted during CAD activities. The purpose of this section is to evaluate the information to determine if the pilot testing activities were conducted sufficiently in regards to providing adequate information (i.e., data) for evaluating the feasibility of using the respective remedial technology and to design and/or implement a full scale remedial system.

Soil Vapor Extraction Summary

SVE pilot testing was not conducted. Reportedly, the previous pilot testing results and full-scale AS/SVE system results associated with Source Area 1 were used to design the SVE systems installed at the Wilton Liquor Bar and the Wally's Oil store. The design was apparently made based upon the assessment results, which indicated the site soils were fairly homogeneous, and the need to take corrective actions as soon as possible to mitigate indoor air impacts.

Comments/Discussion

The purpose of conducting SVE pilot testing includes determining the combination of air flow rates, air pressures, and radius of influences for a full-scale system. In addition, organic vapor monitoring and SVE air discharge samples should be collected to quantify potential air emissions. These data are used to determine the feasibility of utilizing the SVE technology and to design the full scale system. Critical components of the SVE systems that are specified based on the results of the SVE pilot test data include the control panel, SVE blower size, off-gas treatment and the number and location of SVE points. Excluding the treatment building, these components account for more than 90 percent of the purchase and installation costs for an SVE system. In addition, the operations and monitoring costs are dependant on the number of components (i.e., monitoring points), configuration of the system, and power needed to run the blower.

It is Terracon's opinion that if a pilot test was conducted, then the full-scale design and operation of the SVE systems would not have had many of the problems that occurred (see below). Without having conducted a pilot test, a CAD design would likely be based on assumptions which generally are more conservative to account for possible unknowns. However, apparently the installed SVE systems for Source Area 2 did not account for some possible issues, such as the potential air emissions.

Corrective Action Design (CAD)

Purpose

This section describes the background information related to the full-scale system design. The purpose of this section is to evaluate the information to determine if the CAD includes adequate information pertaining to the feasibility of utilizing the proposed technology. In addition, an evaluation of proposed monitoring activities including methods, procedures, instrumentation, and testing for monitoring the mechanical performance, remedial effectiveness and discharge compliance.

Recovery Well Summary

Rather than attempt to remediate the source and/or groundwater, the corrective actions at the site focused on mitigating impacts to receptors by installing soil vapor extraction system(s) near buildings and replacing potable wells.

The pump & treat technique was used to limit migration of groundwater contamination. A formal CAD report was not prepared for the pump & treat system.

SVE Summary

The SVE technique was proposed in Northern Environmental's August 4, 1997 *Delineation Decision Workplan and Modified Conceptual Corrective Action Plan* report. Review of the documents indicates the objective of the SVE system was to mitigate indoor air impacts at the Wilton Liquor Bar and the Wally's Oil store. The review did not identify system operation monitoring activities or objectives for the duration of operation, contaminant reduction loads or compliance points. Moreover, the CAD for the SVE system appears to be based on results of the Source Area 1 AS/SVE pilot test, which were not fully compliant with the pilot test criteria documented in the MPCA *Soil Venting Pilot Test Worksheet, Fact Sheet #8 (April 1993).* In addition, the report did not include specific details of the SVE system, except for the number of SVE points, the proposed locations of the points and the configuration of the SVE system.

Northern Environmental's CAD indicated ten vent points would be installed at the Wally's Oil property and six vent points would be installed around the periphery of the Wilton Liquor Bar (Figure 11). The radius of influence as depicted on Figure 11 for the vent points is 36 feet. However, the rational for specifying the radius of influence was not noted. Figures 12 and 13 show configuration of each (Wally's SVE system and Wilton Bar SVE system) SVE system proposed. The construction of the vent points was not fully reported; the screened intervals for the vent wells were not provided.

Comments/Discussion

Based on the available information, it is Terracon's opinion that the replacement of potable wells that were completed within a confined aquifer at depths of around 160 feet bgs was an appropriate corrective action, which resulted in removing the risk to the receptors from the contaminated groundwater.

Soil vapor extraction is a proven technique for capturing and extracting vapor phase volatile organic compounds from vadose zone soils. SVE is generally the pumping of air via a blower from the vadose zone.

At a minimum, the following parameters should be used to design a SVE system.

- Identify the extent and magnitude of the source area to be treated.
- Identify the fate and transport mechanisms of the contaminants to be recovered:
- Hydrogeologic conditions (soil type, depth to groundwater, groundwater flow direction, etc.).
- Pilot test data (air flow rates, air pressure, radius of influence).

Based on the CAD report, the extent of the source area was not determined or reported. The area to be treated by the SVE system was not reported. The flow rate/vacuum for each individual well was not proposed. No off-gas treatment was proposed. The CAD did not discuss the feasibility of using the SVE technique relative to the hydrogeologic conditions or the contaminants of concern. The CAD did not describe the means by which the system would be monitored. Results of laboratory analytical testing of the SVE off-gas indicate the off-gas VOC concentrations exceeded the allowable emission limits. In addition, review of the available information did not identify design personnel qualifications or specific background experience associated with SVE design work.

It is Terracon's opinion that SVE was an appropriate remediation technique for remediating the vadose zone soils at Source Area 2. However, the use of SVE alone appears to have been inadequate at addressing future risks or effective source area cleanup. The extent and magnitude of the petroleum impacts indicate that a significant release occurred and that a significant mass of the release was present at the soil/groundwater interface. The SVE technique is limited to the remediation of the vadose zone while having little effect on the capillary fringe and the soil/groundwater interface. Therefore, based on a source present within the capillary fringe and the soil/groundwater interface, a continued migration of petroleum vapors is expected to occur over an extended period of time which leads to an extended period of SVE operation.

CAD System Installation

Purpose

This section describes the background information related to the installation of the full-scale remedial system(s). The purpose of this section is to evaluate the information to determine if the remedial system was installed in accordance with the CAD.

SVE Summary

An MPCA *CAD Installation Notification Worksheet, Fact Sheet #3.28 (April 1996)* prepared by Northern Environmental and dated July 9, 1998 was noted in the MPCA file for the site. Terracon's review of the worksheet noted the following:

- The two full-scale SVE systems were installed April, 1998, tested during April and May 1998 and started operating in May, 1998.
- Total air removal is reported as 320 scfm for the Wilton Liquor Bar SVE system and 614 scfm for the Wally's Oil SVE system.
- Radius of influence of vent points is reported as 150 feet based on graphical interpolation (Figure 14).
- The installation, startup and operation of a recovery well was conducted March 1998.

- The recovery well system (i.e., pump & treat) consisted of a 25 foot deep well, underground piping connecting the well to the treatment shed, an air stripper, and a discharge to Grant Creek.
- The information did not include the configuration of each vent point such as the depth of screen, type of construction materials, etc.
- No as-built process flow diagram was included.
- A figure showing groundwater flow directions and contours was included.
- A figure showing radius of influence contours was included.
- Groundwater treatment influent and effluent samples were collected and laboratory analyzed for BTEX and GRO.

Comments/Discussion
Based on the information, Terracon noted the following: the radius of influence of the SVE points was reported as 150 feet based on graphical interpollation, which appears to be based on vacuum measurements at the well heads of the SVE vent points, the construction of the SVE points is unknown; the type and size of the blowers were not specified.

There is not enough information to evaluate whether the blowers were sized appropriately. However, the reported information states direct measurements and/or observations confirm the radius of influence. The methods and procedures describing the measurement techniques were not reported. The radius of influence map is misleading, since the well head vacuum measurements do not represent the subsurface soil conditions due primarily to the formation air vacuum losses. The groundwater contour map is misleading, since the water level measurements shown on the map do not confirm the groundwater flow direction is towards the recovery well.

CAD System Operation/Maintenance

Purpose
This section describes the background information related to the operating & maintenance activities associated with the remedial system(s). The purpose of this section is to evaluate the information to determine if the information reported is adequate to evaluate the performance of the remedial system in regards to achieving the remedial goals.

Recovery Well Summary
The following list summarizes the reported O&M data.

- SVE O&M
  - Measurement date(s).
  - Total air flow rates.
  - Vacuum/pressure measurements in vent stack, vent manifold and vent pipes.
  - Temperature in vent stack.

  - Organic vapor readings (i.e., PID readings) of off-gas and vent pipes.
  - Limited vacuum/pressure measurements in monitoring points (i.e., monitoring wells).
  - SVE off-gas sample laboratory analytical results.
- Pump & Treat O&M
  - Measurement date(s).
  - Flow meter readings.
  - Flow rate.
  - BTEX/GRO Influent.
  - BTEX/GRO Effluent.
  - Water Levels.

The monitoring reports indicate the SVE systems (i.e., blowers) frequently shutdown and were subsequently turned on during scheduled site visits.

Comments/Discussion
Based on the reported data, it appears the pump & treat system had a flow meter, a flow totalizer, a system cycle counter and a system operation time counter. Based on these three parameters, the average flow rate of water pumped from the recovery well in gpd, gpm or gpc can be determined. In addition, the laboratory results of the influent and effluent samples collected from the treatment system indicate the treatment system (i.e., air stripper) was effectively treating the water for the parameters tested. Other parameters, such as DRO, do not appear to have been monitored. Based on the water level measurements, the radius of influence of the recovery well cannot be confirmed as reported.

The SVE monitoring data does not appear to be sufficient for evaluating the performance of the SVE systems. Air flow rates were not measured for each individual vent line. Limited organic vapor measurements were collected including some anomalies that appear to be associated with the sampling technique. The SER's were exceeded over an extended period of time. The SVE system was noted as having various operational malfunctions and shutdowns. Little information was presented beyond the data tables or figures such as a discussion on the performance of the pump & treat and the SVE systems, the estimated time to meet cleanup objectives, or changes to the operation of the systems.

Based on the groundwater quality, the pump & treat and the SVE systems do not appear to have had a significant impact on reducing the overall contaminant concentrations at the site. The groundwater quality did not change significantly during the first two years of operation of the pump & treat and the SVE systems. However, a sharp decline in contaminant concentrations was noted for groundwater monitoring events conducted in late 2000 and early 2001. The result of the sharp decline during that period was not identified.

The pump & treat and SVE systems were apparently shutdown sometime in 2002. It is not apparent that the data at that time supports shutting down the systems due to the continued risk to receptors.

Conclusions and Recommendations

In conclusion, Terracon has completed a CAD review of the Wally's Oil project. The results of the review were used to evaluate various items (i.e., questions) presented in the bulleted list at the Introduction section of this report. The following summarizes the conclusions and recommendations based on the results of the Wally's Oil CAD review. The summary has been organized by item for each item listed in the introduction section of this report.

Item 1. Determine whether the consultant clearly identifies the actual impacts or risks that the proposed engineered remediation system is designed to address.

The consultant(s) did report the purpose of implementing each specific remediation system in regards to the impacts and risks to be mitigated by the recommended systems However, the purpose was presented as a general statement, such as "the recovery well will capture and/or divert the migrating plume to limit and/or reduce the impacts to down-gradient potable wells".

Item 2. Determine whether the consultant clearly identifies measurable site remediation goals including estimated time to achieve those goals.

The consultant(s) did not identify measurable site remediation goals.

Item 3. Determine whether the consultant identifies a sufficient plan for how they will collect data and evaluate progress towards measurable site remediation goals.

The consultant(s) generally did not describe the methods and/or procedures proposed to obtain field and/or laboratory analytical data.

Item 4. Determine whether any pilot testing was indicated and if so, was adequately performed and documented.

Limited pilot testing was conducted. The pilot testing conducted was not fully compliant with the existing reporting requirements at the time reported. The review of the Wally's Oil project identified various problems associated with the full-scale implementation of a remedial system that was inefficient, or ineffective, due to poor pilot testing or having conducted no pilot test.

Item 5. Determine whether the pilot test results are used appropriately for full-system design.

There is not sufficient information presented on the methods, calculations and assumptions to determine how the pilot test data was used for design of the full-system. Presumably, the radius of influence for the sparge point and the vent point were used to specify the number and locations of the points. Based on the number of points it appears the blower/compressor was specified based on the flow rates and pressures/vacuums observed during the pilot testing.

Item 6. Determine whether sufficient full-scale system design information is adequately documented, and deemed appropriate for the site conditions.

There is not sufficient information that adequately documented the full-scale system design. Monitoring point, vent point and sparge point construction diagrams were not noted. There was no, or poor quality, process schematic and flow diagrams. Terracon believes the remedial technologies used were appropriate for their intended purpose as described in the information reviewed. However, the rational for using the remedial technology should have been discussed.

Item 7. Determine if the system operation monitoring plan is adequate to demonstrate mechanical performance, effectiveness, and discharge compliance.

No system operation monitoring plan was noted during the review of the available information. Various documents included system operation monitoring data, such as effluent sampling, off-gas sampling, system run-time, system pressure, etc.

Item 8. Determine whether the consultant has set clear performance objectives for the system as designed, including expected duration of system operation, expected contaminant reduction loads, and appropriate compliance points.

- Answer the questions:
  - Is the system operating efficiently and effectively?
  - When will the system reach its maximum effectiveness and eliminate actual impacts or sufficiently reduced identified risks?

The consultant(s) did not set performance objectives. However, the purpose of the remedial systems proposed were discussed in the documentation reviewed. Based on Terracon's review, there is not sufficient information to determine whether the systems operated efficiently. The remedial systems appear to have been effective at reducing the risks to receptors. However, an expected duration for system operation was not listed. Therefore, system effectiveness at meeting remediation goals can not be evaluated.

Terracon believes at the time when the AS/SVE systems were shutdown that there was not sufficient information to confirm the contaminant mass was adequately reduced or the risk to receptors was reduced sufficiently.

Item 9. a) Make recommendations on how the specific CAD Report could be improved.

Based on the information reviewed, the CAD report information was presented in various documents and in various document formats. Terracon noted that the documents reviewed have unique formats, customized tables and information spread among various reports. Therefore, to more effectively evaluate the proposed CAD, the CAD reports should be prepared in a standardized format that requires the various CAD criteria in a specified order. In addition, Terracon recommends supplemental documents to be used for established remedial technologies, such as AS and/or SVE, for presenting data in tables and/or figures.

b) Provide observations and opinions on how CAD Reports in general could be improved to meet the above objective.

See Item 9a above.

Item 10. Determine how the MPCA can better evaluate whether the consultant's assigned design staff are knowledgeable and experienced with the type of system being proposed.

Terracon did not identify information that would indicate the degree of knowledge and/or experience of the consultant's staff.

Item 11. Determine whether the system was installed as proposed in the CAD Report.

There is not sufficient information to determine if the systems were installed as proposed. Available information indicates the systems installed were different from those proposed in the CAD report.

Item 12. Determine whether sufficient information has been collected and adequately presented (figures, tables, etc.) to evaluate system performance.

The monitoring reports reviewed do not include sufficient information to adequately evaluate the system performance. The method of presenting data varied among most of the reports reviewed. In many instances the data reported could not be verified or easily compared.

Item 13. Determine whether system operational monitoring is adequate to address mechanical performance, system effectiveness, and discharge compliance.

No system operation monitoring plan was noted during the review of the available information. Various documents included system operation monitoring data, such as effluent sampling, off-gas sampling, system run-time, system pressure, etc. The data reported could be used to evaluate the effectiveness of the system and determine if discharge requirements are met. However, the method of presenting the data including a discussion regarding calculations conducted and/or assumptions made would improve the process of evaluating system performance.

Item 14. Determine whether the consultant provides an adequate evaluation of progress relative to measurable site remediation goals.

No measurable site remediation goals were note. Therefore, no evaluation towards meeting remediation goals was reported.

Item 15. a) Make recommendations on how the specific CAD Installation Notification Worksheet could be improved.

N/A

b) Provide general observations and opinions on how CAD Installation Notification Worksheet in general could be improved to meet the above objective.
See Item 15a above.

Item 16. Determine how the MPCA can better evaluate whether the consultant's assigned staff are knowledgeable and experienced with the type of system being operated.

N/A

General Comments

The analysis and opinions expressed in this report are based upon data obtained from the boring assessments and laboratory chemical analyses at the indicated locations and from other information discussed in reports that Terracon has reviewed. This report does not reflect variations in subsurface stratigraphy, hydrogeology, and contaminant distribution that may occur across the site. Actual subsurface conditions may vary and may not become evident without further assessment.

This report is prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted environmental engineering practices. No warranties, express or implied are intended or made. In the event any changes in the nature or location of suspected sources of contamination as outlined in this report are observed, the conclusions and recommendations contained in this report shall not be valid unless these changes are reviewed and the opinions of this report are modified or verified in writing by Terracon.

If you have questions or require additional information, please do not hesitate to contact our office at 651-770-1500.

Sincerely,
Terracon

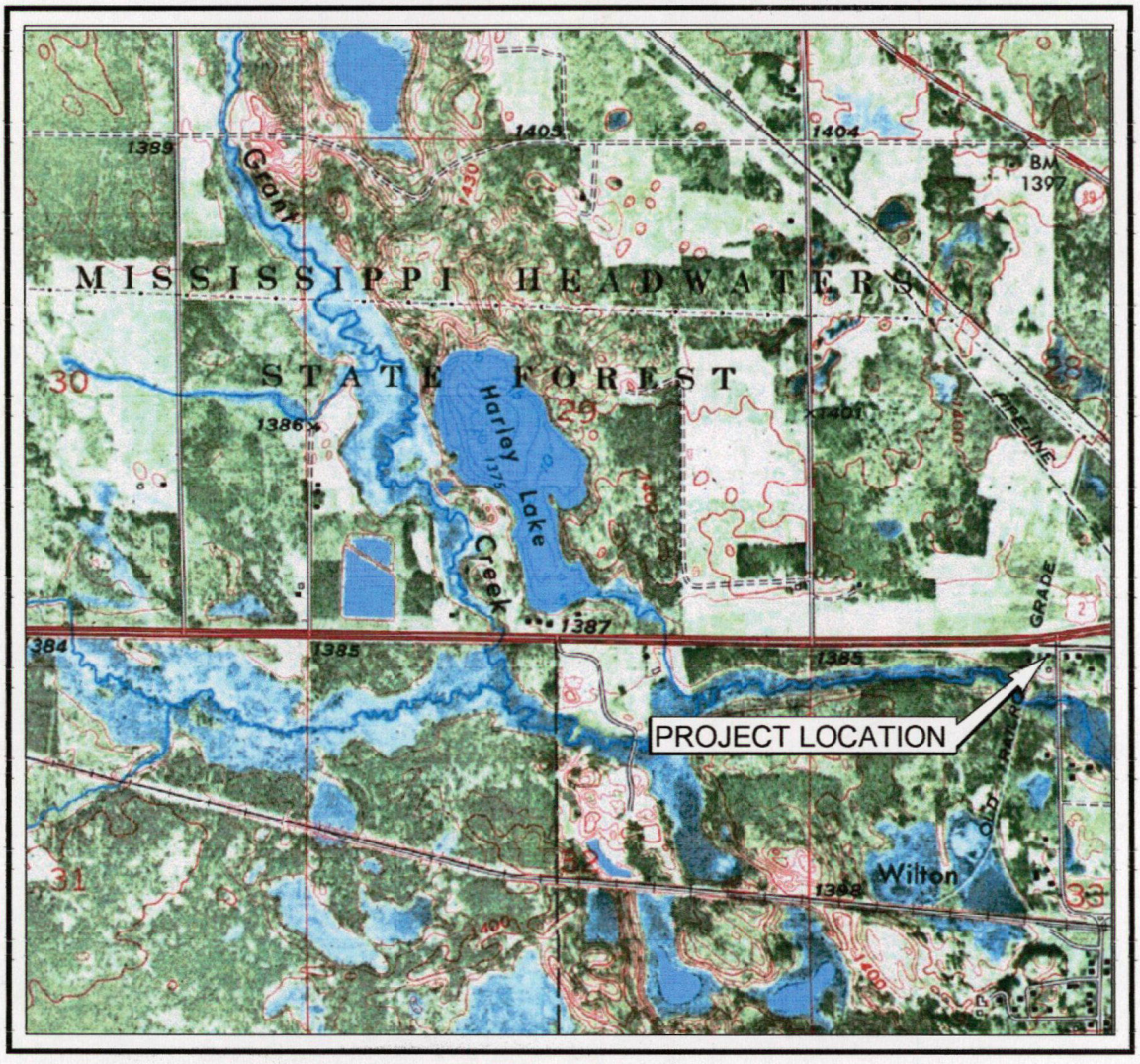
Brett J. Staeden, P.E.
Project Engineer

David J. Wolfgram P.E.
Senior Engineer

Paul J. Wiese, P.G.
Project Manager

BJS/PJW/DJW:bjs N:\05\05_7007\WALLY'S OIL (Pump&treat, AS-SVE).DOC

UNITED STATES - DEPARTMENT OF THE INTERIOR - GEOLOGICAL SURVEY



SCALE 1:24 000

1 .5 0 KILOMETERS 1 2

1000 0 METERS 1000 2000

1 .5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

FEET

WILTON QUADRANGLE

MINNESOTA - COUNTY

7.5 MINUTE SERIES (TOPOGRAPHIC)

N

SITE LOCATION MAP

WALLY'S OIL

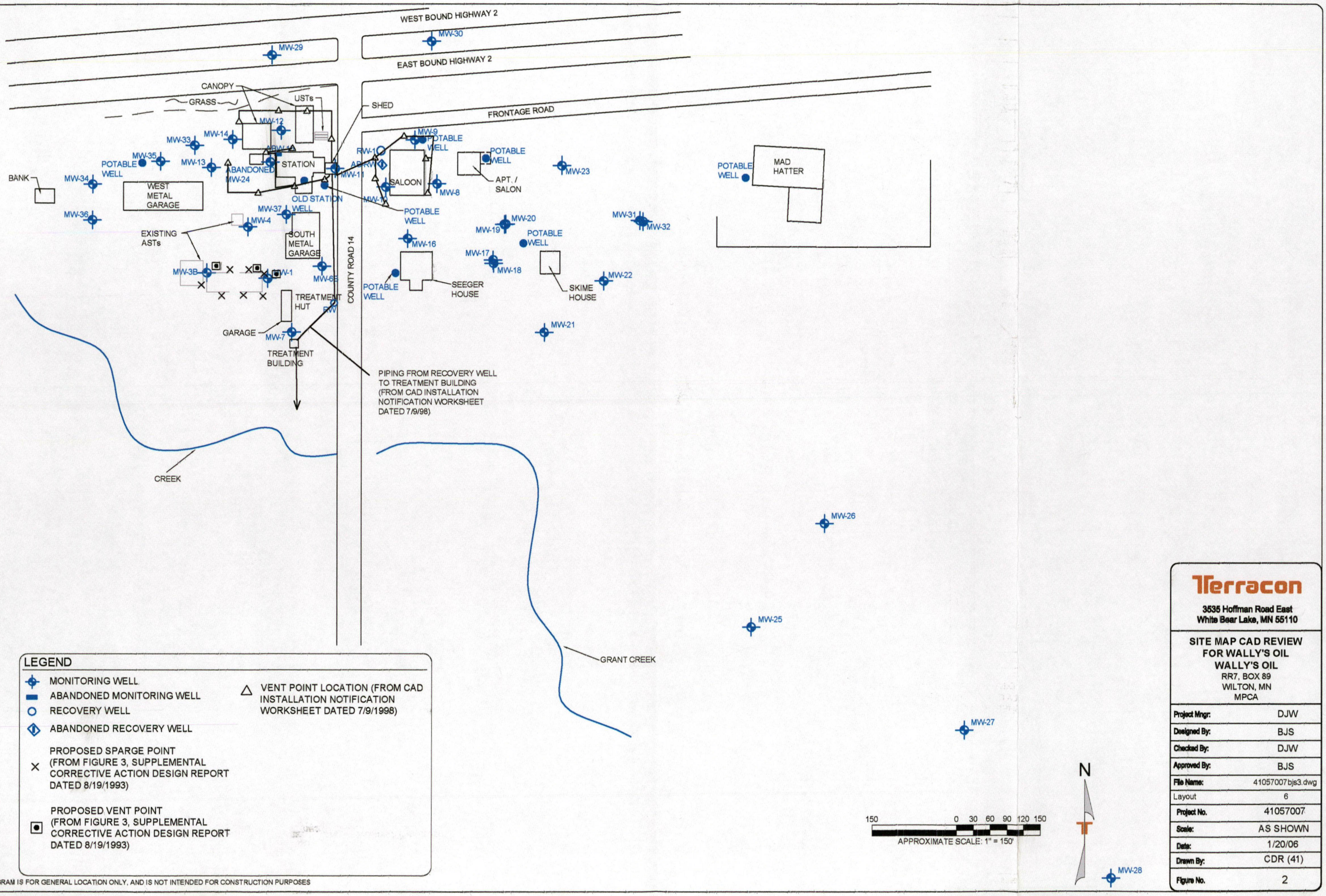
RR 7, BOX 89

WILTON, MN

MPCA

Project Mngr:	DJW	Terracon	Project No. 41057002
Designed By:	BJS		Scale: AS SHOWN
Checked By:	BJS	3535 Hoffman Road East White Bear Lake, MN 55110	Date: 4/26/04
Approved By:	DJW		Drawn By: CDR (41)
File Name:	41057007sl.dwg TOPO		Figure No. 1

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES



Terracon

3535 Hoffman Road East
White Bear Lake, MN 55110

SITE MAP CAD REVIEW FOR WALLY'S OIL
WALLY'S OIL
RR7, BOX 89
WILTON, MN
MPCA

Project Mngr:	DJW
Designed By:	BJS
Checked By:	DJW
Approved By:	BJS
File Name:	41057007bjs3.dwg
Layout	6
Project No.	41057007
Scale:	AS SHOWN
Date:	1/20/06
Drawn By:	CDR (41)
Figure No.	2

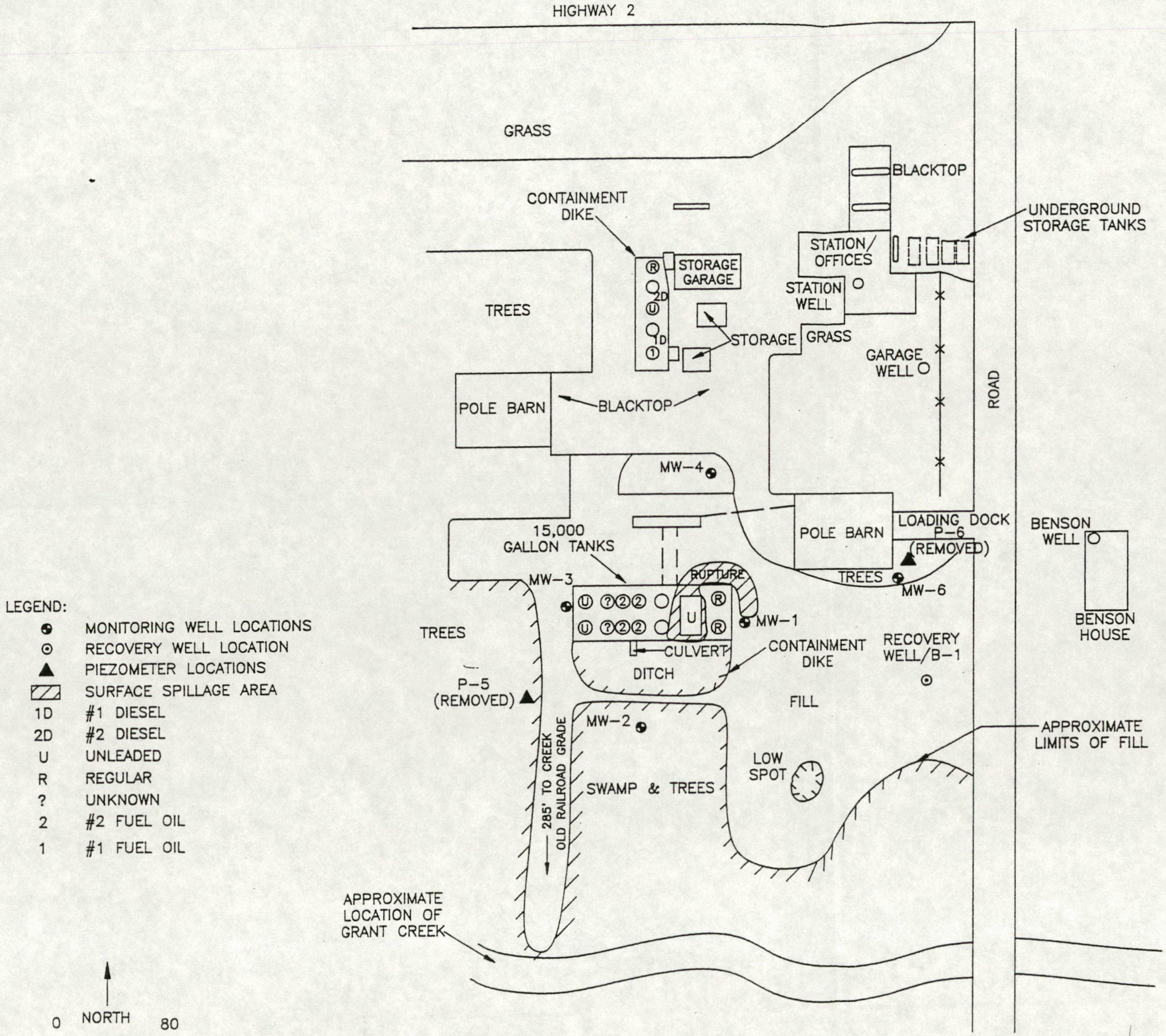


FIGURE 3

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 3
SITE MAP
WALLY'S OIL COMPANY
WILTON, MINNESOTA

PROJECT NO.	PREPARED BY
10-87-011	NTH/LS
DATE	REVIEWED BY
5-10-89	

Delta Environmental Consultants, Inc.

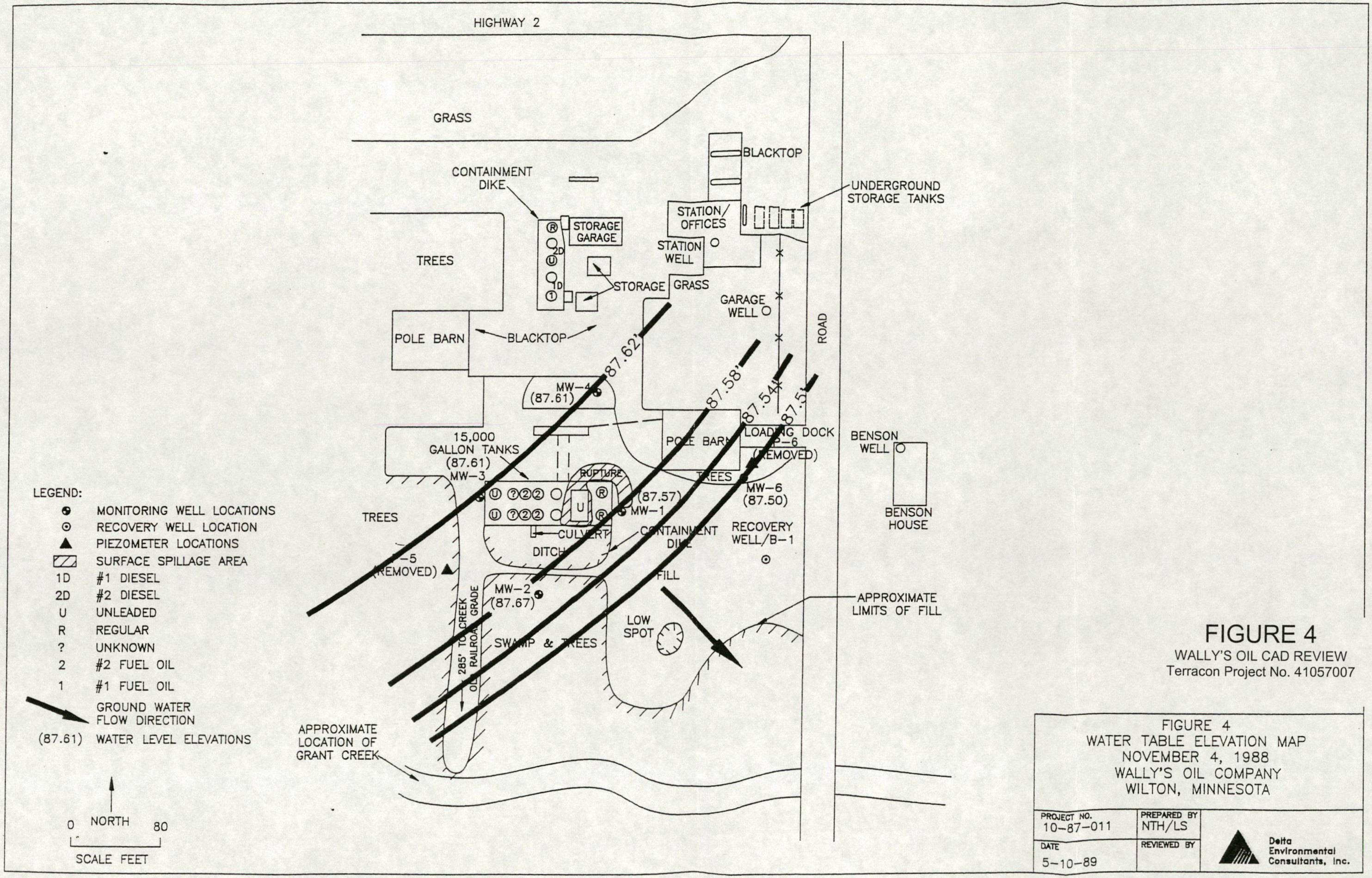
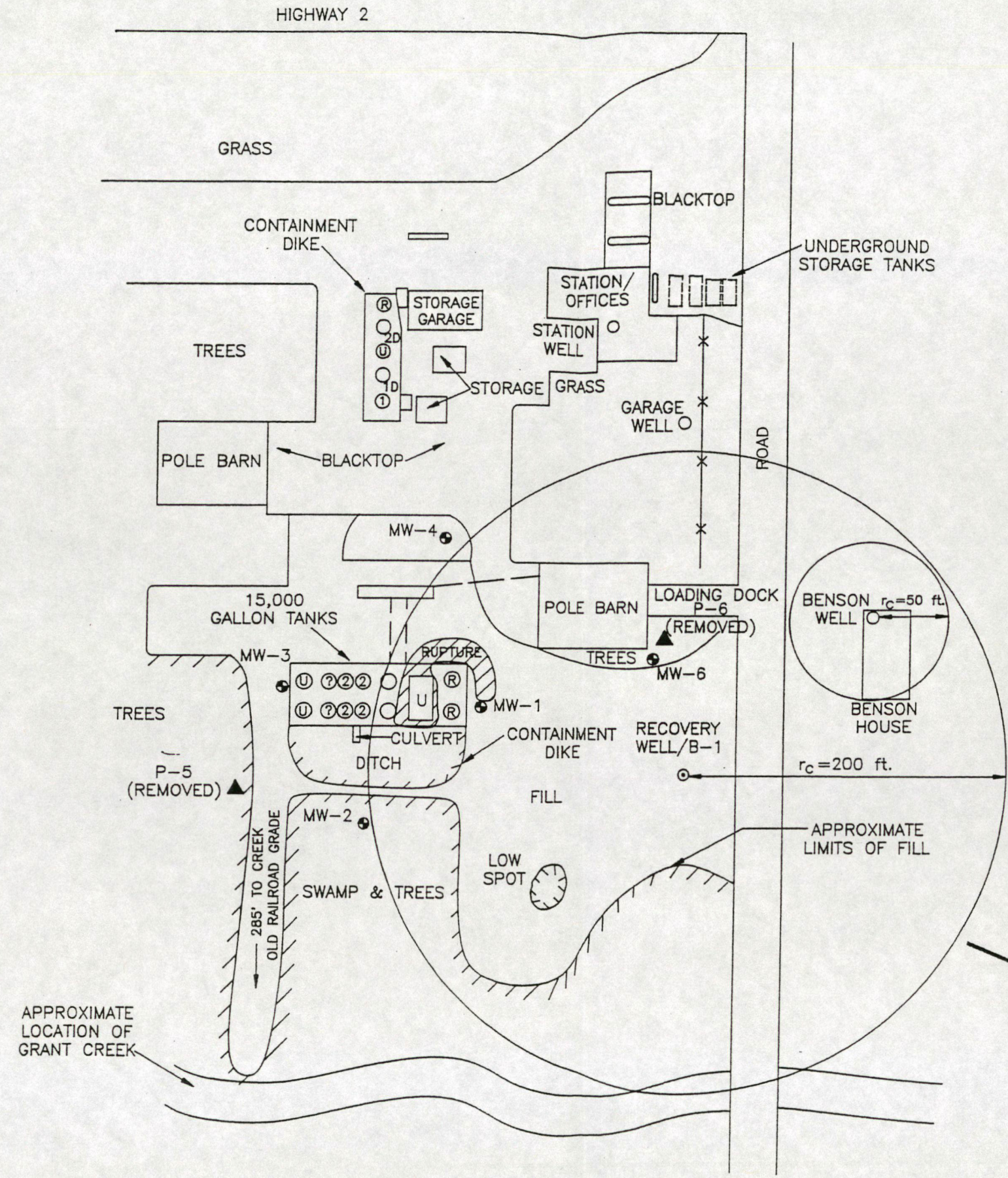


FIGURE 4

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 4
WATER TABLE ELEVATION MAP
NOVEMBER 4, 1988
WALLY'S OIL COMPANY
WILTON, MINNESOTA

PROJECT NO.	PREPARED BY	
10-87-011	NTH/LS	Delta Environmental Consultants, Inc.
DATE	REVIEWED BY	
5-10-89		



AQUIFER PARAMETERS:

HYDRAUDLIC CONDUCTIVITY (K) = 18.85 ft/day

TRANSMISSIVITY (T) = 169.69 ft^2/day = 1269 gpd/ft

STORAGE COEFFICIENT (S) = 0.075

GRADIENT (i) = 0.0003 ≃ 0

CAPTURE RADIUS (r_c)

r_c = 200 ft

ESTIMATED PUMPING RATE:

MAXIMIUM = 10 gpm

FIGURE 5

WALLY'S OIL CAD REVIEW

Terracon Project No. 41057007

FIGURE 7
ESTIMATED RECOVERY WELL CAPTURE ZONE
(THEIS SOLUTION)
WALLY'S OIL COMPANY
WILTON, MINNESOTA

PROJECT NO.	PREPARED BY
10-87-011	NTH/LS
DATE	REVIEWED BY
5-10-89	

Delta Environmental Consultants, Inc.

RECOVERY WELL
@ 10 gpm

BENSON WELL
@0.07 gpm

25'

50'

75'

100'

125'

150'

b=9'

IMPERMEABLE

RECOVERY WELL CAPTURE ZONE
CALCULATIONS THEIS METHOD

T = 169.65 ft^2/day
= 1269 gal/day/ft
S = 0.075 (UNCONFINED)
t = 1 day (EQUILIBRIUM)
b = 9 ft
K = 18.85 ft/day
CAPTURE RADIUS (r_c) = 200 ft

SCALE:
HORIZONTAL: 1"=12.5'
VERTICAL: 1"=2.5"

Delta Environmental Consultants, Inc.

FIGURE 6
WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 8
DRAWDOWN VS DISTANCE MAP
WALLY'S OIL COMPANY
WILTON, MINNESOTA
DELTA NO. 10-87-011

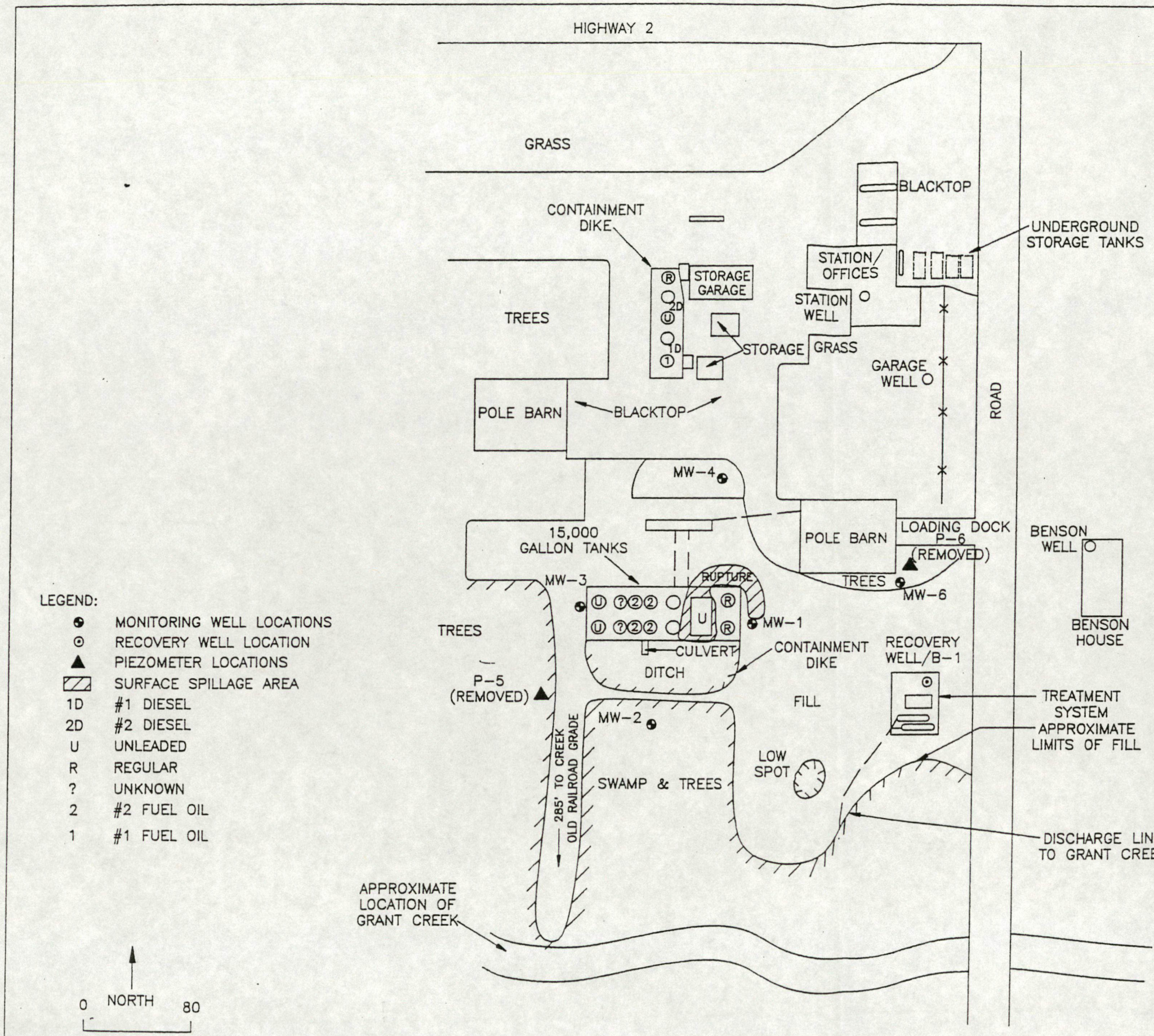
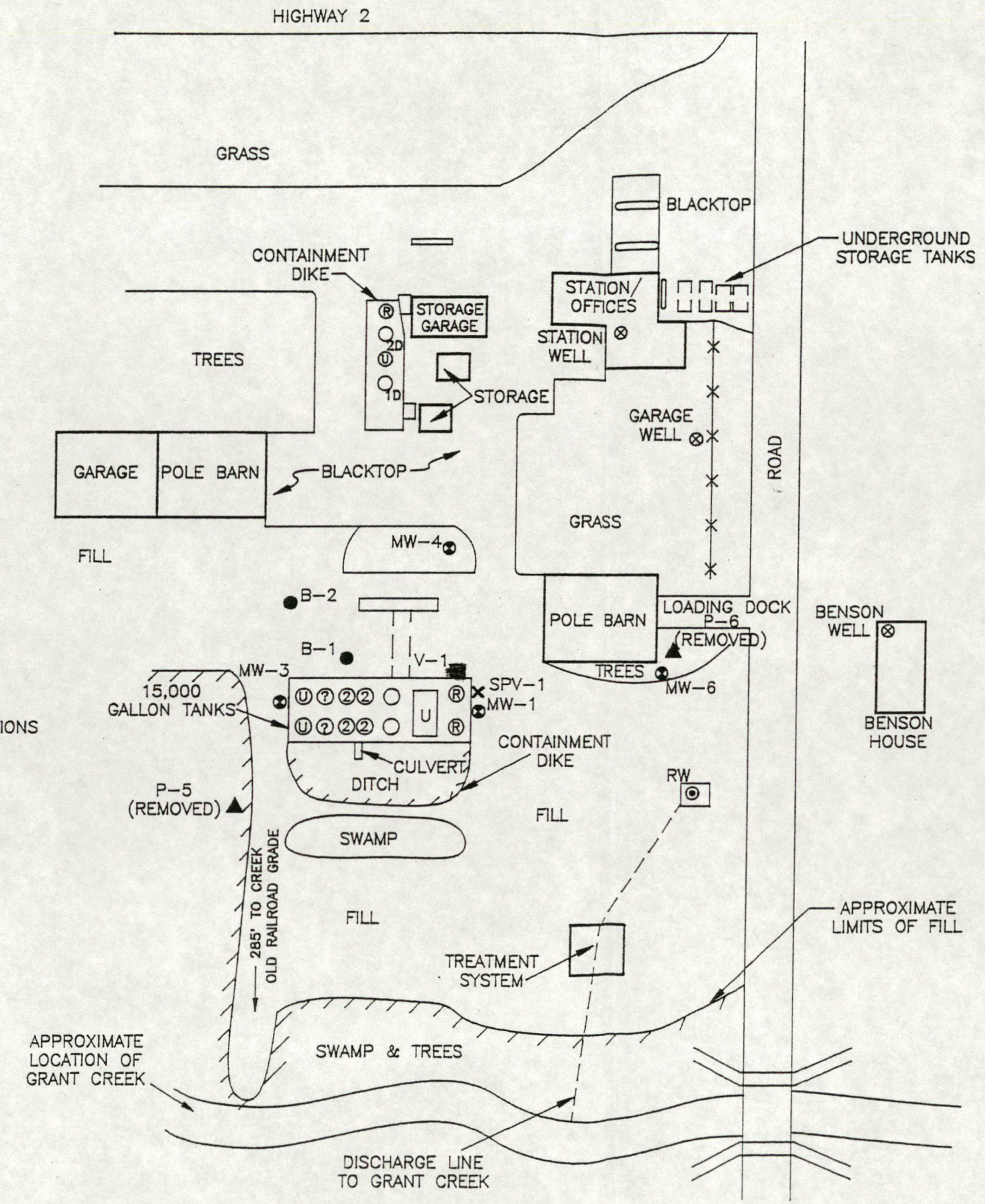


FIGURE 7

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 9
PROPOSED RECOVERY TREATMENT SYSTEM
WALLY'S OIL COMPANY
WILTON, MINNESOTA

PROJECT NO.	PREPARED BY	
10-87-011	NTH/LS	Delta Environmental Consultants, Inc.
DATE	REVIEWED BY	
5-10-89		



LEGEND:

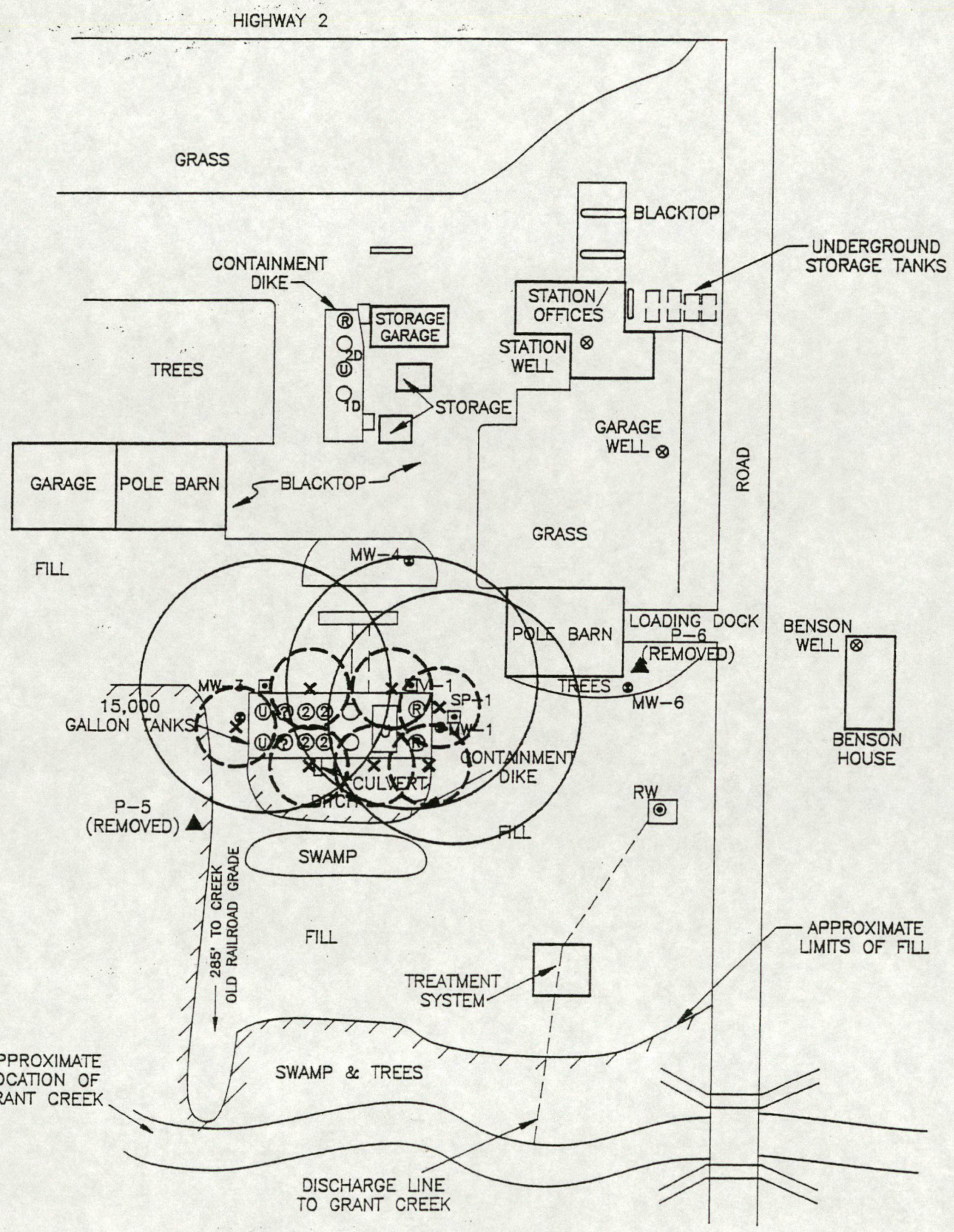
- MONITORING WELL LOCATIONS
- SOIL BORING LOCATIONS
- RECOVERY WELL LOCATION
- WATER WELL LOCATIONS
- ABANDONED PIEZOMETER LOCATIONS
- SOIL VENT LOCATION
- SPARGE/VENT POINTS
- 1D #1 DIESEL
- 2D #2 DIESEL
- U UNLEADED
- R REGULAR
- 2 #2 FUEL OIL
- 1 #1 FUEL OIL

FIGURE 8

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 1
SITE MAP
WALLY'S OIL COMPANY
WILTON, MINNESOTA

PROJECT NO.	PREPARED BY	REVIEWED BY	
10-92-547	RAE/LS	RAE	Delta Environmental Consultants, Inc.
DATE	REVISION NO.	FILE NAME	
9-10-93		92547-2	



LEGEND:

⊙	MONITORING WELL LOCATIONS
⊙	RECOVERY WELL LOCATION
⊗	WATER WELL LOCATIONS
▲	ABANDONED PIEZOMETER LOCATIONS
⊡	PROPOSED SOIL VENT LOCATION
1D	#1 DIESEL
2D	#2 DIESEL
U	UNLEADED
R	REGULAR
2	#2 FUEL OIL
1	#1 FUEL OIL
×	PROPOSED SPARGE POITS
○	EXTIMATED AREA OF INFLUENCE

N

0 80

SCALE IN FEET

FIGURE 9

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

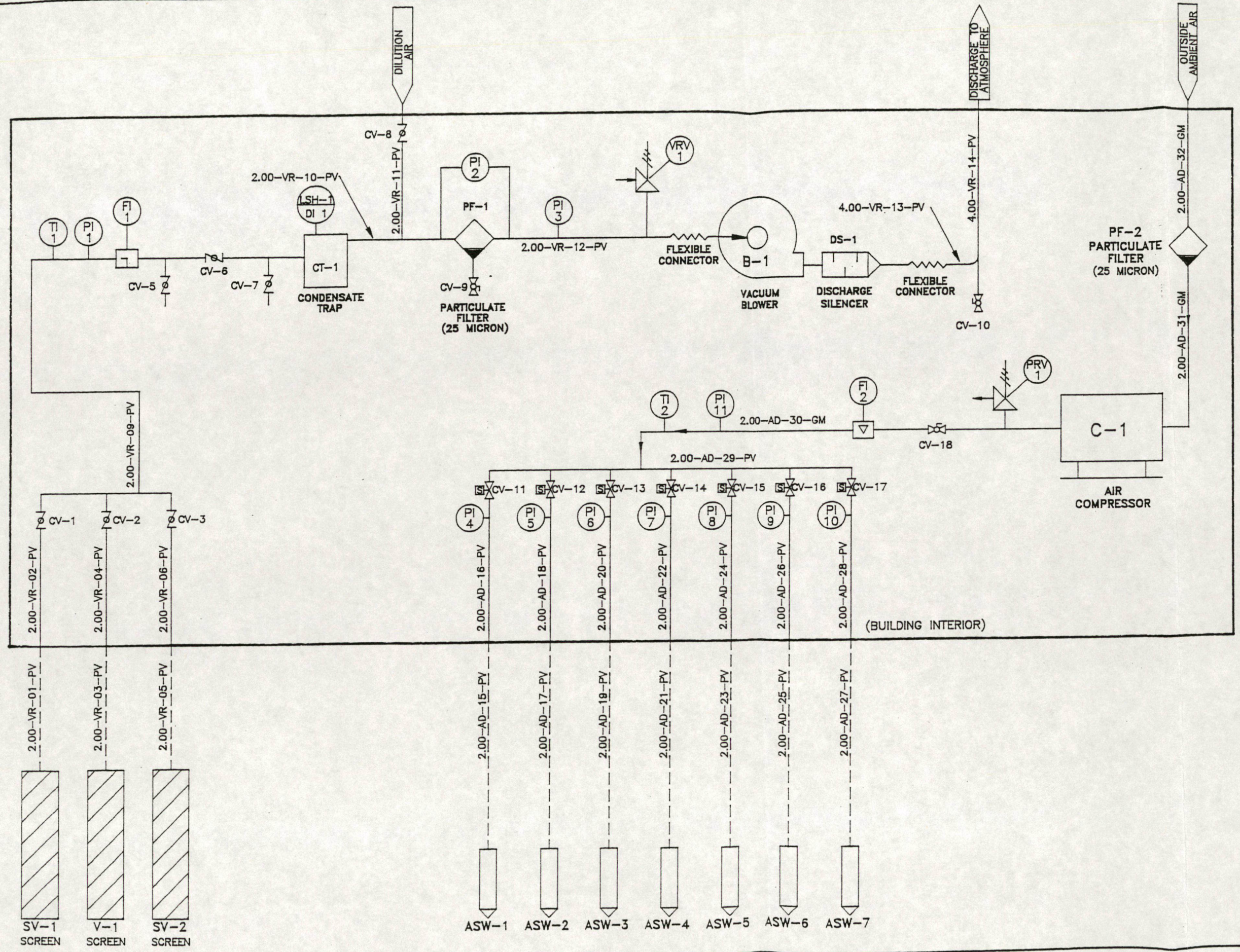
REV	DATE	DESCRIPTION	DRAWN	REVIEW

PREPARED BY	REVIEWED BY
CSR/SO	TAC
DATE 8/19/93	DATE

FIGURE 3
PROPOSED AS/SV POINTS AND ESTIMATED AREA OF INFLUENCE
AS/SVE SYSTEM
WALLY'S OIL COMPANY
WILTON, MINNESOTA

Delta Environmental Consultants, Inc.

DELTA PROJECT NUMBER	FILE NAME	DRAWING NO.
10-92-547	92547-G2	G-2



NOTES:

FI-1 = FLOW TOTALIZING OR RATE METER

PRV-1 = PRESSURE RELIEF VALVE

LSH-1 = HIGH LEVEL SWITCH

VRV-1 = VACUUM RELIEF VALVE

PI-1 = PRESSURE INDICATOR

TI-1 = TEMPERATURE INDICATOR

THIS DRAWING IS INTENDED TO SUPPLEMENT PROJECT DRAWINGS AND SPECIFICATIONS, WHICH TOGETHER SHALL BE USED FOR PERFORMING THE WORK. ALL BUILDING LAWS, RULES, AND REGULATIONS, HAVING JURISDICTION OVER THIS PROJECT, SHALL BE PART OF THE DRAWINGS AND SPECIFICATIONS PREPARED BY THE OWNER AND THE CONTRACTOR PERFORMING THE WORK AND SHALL BE COMPLIED WITH BY THE OWNER AND THE CONTRACTOR.

REV
PREP
DATE

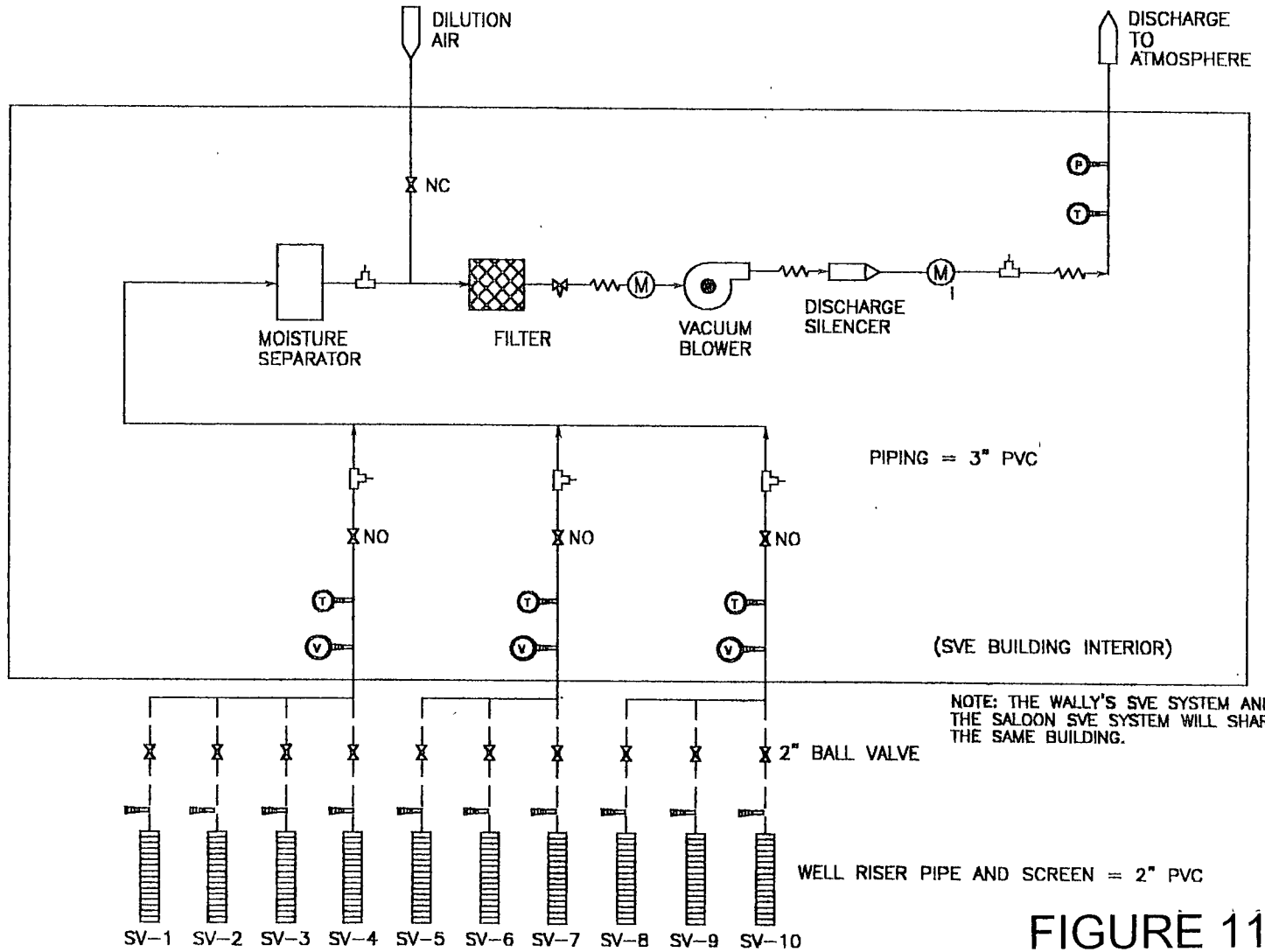
FIGURE 10

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

FIGURE 4
PIPING & INSTRUMENTATION DIAGRAM
AS/SVE SYSTEM
WALLY'S OIL COMPANY
WILTON, MINNESOTA

Delta Environmental Consultants, Inc.

DELTA PROJECT NUMBER	FILE NAME	DRAWING NO.
10-92-547	92547-P2	P-1



EXPLANATION

- FLEXIBLE CONNECTOR
- VACUUM RELIEF VALVE
- VACUUM GAUGE
- TEMPERATURE GAUGE
- PRESSURE GAUGE
- SAMPLE PORT
- ISOLATION VALVE (BALL VALVE)
- FLOW METER (INSTANTANEOUS)
- NO: NORMALLY OPEN
- NC: NORMALLY CLOSED
- VACUUM GAUGE FITTING

FIGURE 11

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

DRAWN BY: JPS	PROJECT: WOC630012	DATE: 10/02/97
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Hydrologists • Engineers • Geologists

REMEDIAL SYSTEM FLOW SCHEMATIC
(WALLY'S SYSTEM)

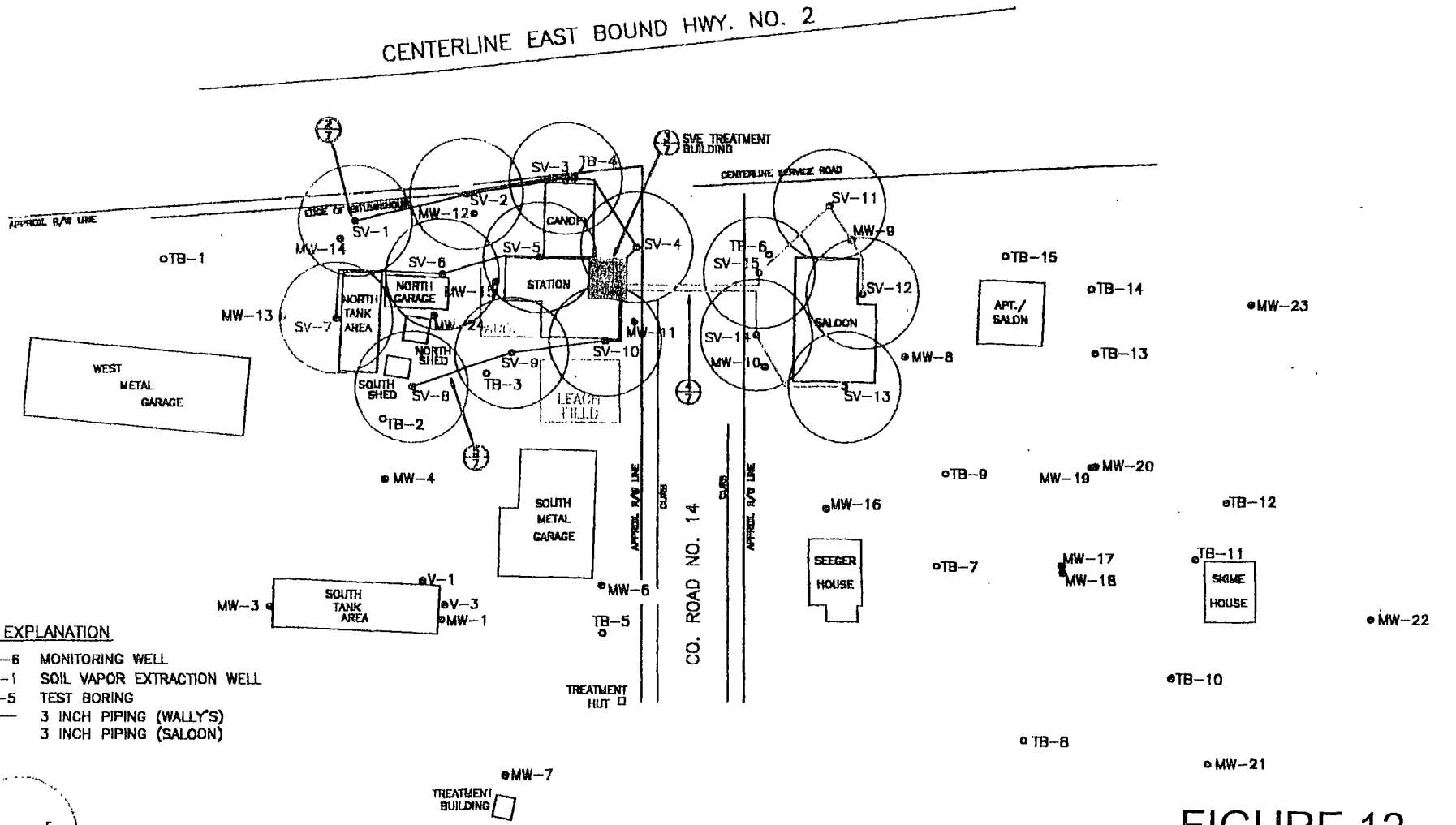

FIGURE 12

WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007

DRAWN BY: MTJ	PROJECT: WOC630012	DATE: 10/21/97
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	Northern Environmental Hydrologists • Engineers • Geologists	SVE LAYOUT

D:\BRAINERD\PROJECTS\WOC\630012\FIGURES\SVELAY3.DWG

GROUND-WATER EXTRACTION
PIPING = 3" PVC

EXISTING TREATMENT
BUILDING INTERIOR

AIR EXHAUST TO OUTSIDE

AIR INTAKE FROM OUTSIDE

LOW PROFILE AIR STRIPPER

BLOWER

AERATOR PUMP

DISCHARGE PUMP

NO

TO GRANT CREEK

NOTE: THE WALLY'S SVE SYSTEM AND THE SALOON SYSTEM WILL SHARE THE SAME BUILDING. THE GROUND-WATER EXTRACTION SYSTEM WILL BE HOUSED IN THE EXISTING TREATMENT BUILDING.

DILUTION AIR

DISCHARGE TO ATMOSPHERE

NC

MOISTURE SEPARATOR

FILTER

VACUUM BLOWER

DISCHARGE SILENCER

WELL RISER PIPE AND SCREEN = 2" PVC
SVE PIPING = 3" PVC

NO

NO

(SVE BUILDING INTERIOR)

2" BALL VALVE

SV-12 SV-11 SV-15 SV-13 SV-14

COYOTE PUMP CONTROLLER

VADOSE ZONE

SATURATED ZONE

SUBMERSIBLE PUMP

EXTRACTION WELL
RW-1

WELL RISER PIPE
AND SCREEN = 8" PVC

EXPLANATION

- FLEXIBLE CONNECTOR
- VACUUM RELIEF VALVE
- VACUUM GAUGE
- TEMPERATURE GAUGE
- PRESSURE GAUGE
- SAMPLE PORT
- ISOLATION VALVE (BALL VALVE)
- FLOW METER (INSTANTANEOUS)
- NO: NORMALLY OPEN
- NC: NORMALLY CLOSED
- VACUUM GAUGE FITTING
- STRAINER

WALLY'S OIL
WILTON, MINNESOTA

REMEDIAL SYSTEM FLOW SCHEMATIC
(SALOON SYSTEM)

DRAWING 4 OF 6

DRAWN BY: MTJ | PROJECT: WOC630012 | DATE: 10/28/97

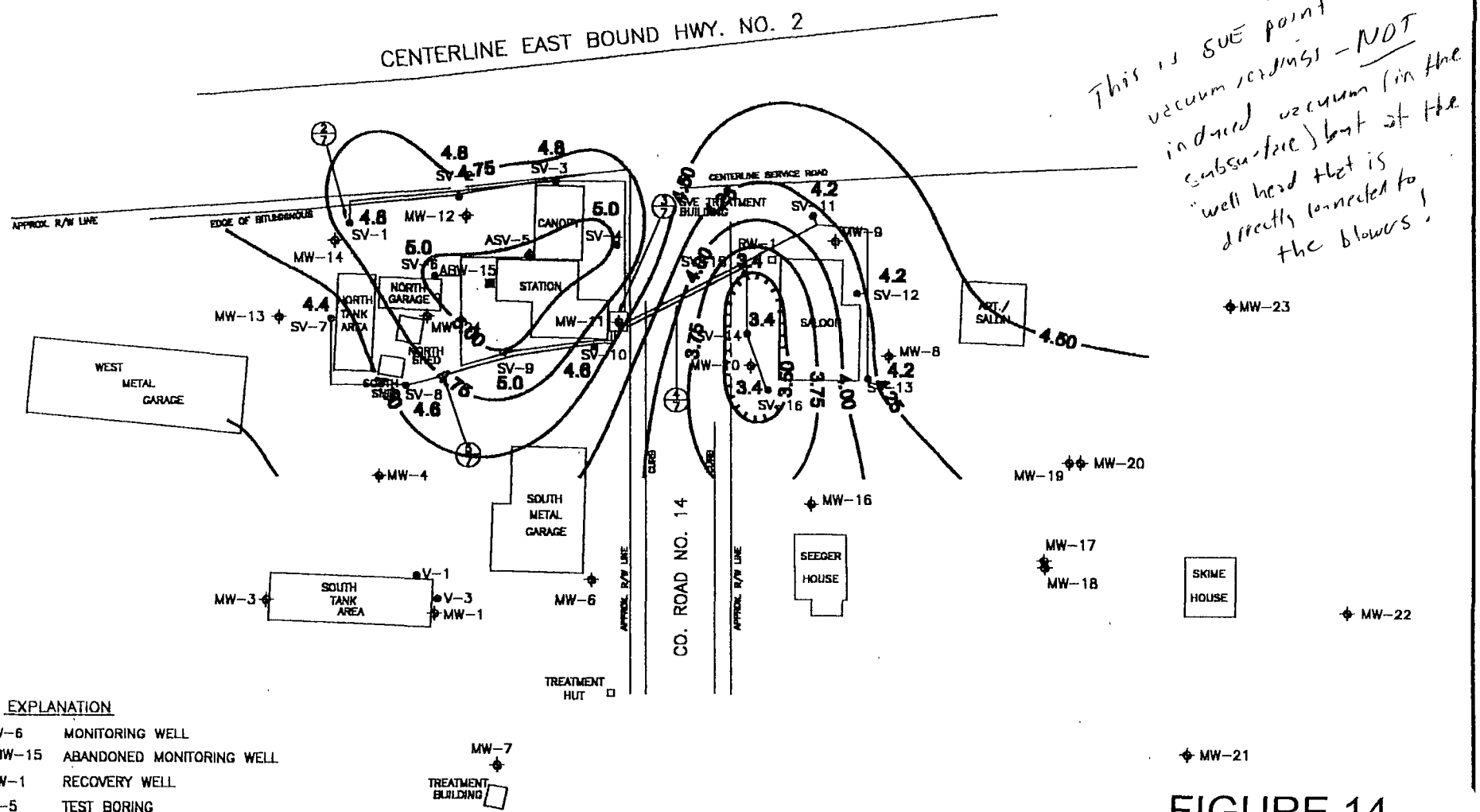
REV. DATE

Northern Environmental
Hydrologists • Engineers • Geologists

NG NOT TO SCALE

\WOC\630012\FIGURES\SYSTEM1.DWG

FIGURE 13
WALLY'S OIL CAD REVIEW
Terracon Project No. 41057007



This is SVE point vacuum readings - NOT induced vacuum (in the subsurface) but at the "well head that is directly connected to the blowers!

EXPLANATION

- MW-6 MONITORING WELL
- ABW-15 ABANDONED MONITORING WELL
- RW-1 RECOVERY WELL
- TB-5 TEST BORING
- SV-1 SOIL VAPOR EXTRACTION WELL
- ASV-5 ABANDONED SOIL VAPOR EXTRACTION WELL

SCALE IN FEET

50 0 50 100

N

FIGURE 14

WALLY'S OIL CAD REVIEW

Terracon Project No. 41057007

DRAWN BY: JPS	PROJECT: 06-1408-0012	DATE: 06/10/98
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SOIL VAPOR EXTRACTION WELLS
VACUUM READINGS (06/09/98)

C:\BRAINERD\PROJECTS\WOC\FIGURES\SVELAY3.DWG

REPORT REVIEW ROUTING LIST
CAD WORK GROUP

REPORT NAME: Remediation System Rev - Leak 89
REPORT DATE: 3/24/06
REPORT AUTHOR: Terracon

ROUTING

REVIEWER	DATE REVIEWED
Paul Stock	3-22-06
Sandeep Burman	3-31-06
Jeff Lewis	
Don Milless	
Arlene Furuseth	

Route to staff in order indicated above. Furuseth to retain reports for future reference.

Report copy sent to PRP Project Team (PM/PL and Hydro)?

To whom? Arlene Furuseth
By whom? AF
Date? 3/1/06

Report copy sent to John Houck, Petrofund?

By whom? AF
Date? 3/1/06

Report routed to program hydros: 3/1/06