2705486

[redacted]

**RZA AGRA, Inc.**
*(formerly Rittenhouse Zeman & Associates, Inc )*
*Engineering & Environmental Services*

11335 NE 122nd Way
Suite 100
Kirkland, WA 98034-6918
(206) 820-4669
FAX (206) 821-3914

28 July 1992

W-7436-1

Mobil Oil Corporation
3800 West Alamedia Avenue, #2000
Burbank, California 91505

Attention Ms Cherine Foutch

Subject Executive Summary and Recommended Remedial Actions
Petroleum Hydrocarbon Remediation Study
Former Mobil Service Station No 10-315
5403 Pacific Highway South
Fife, Washington

Dear Ms Foutch

RZA AGRA, Inc is pleased to present this letter which provides a summary of the findings regarding the petroleum hydrocarbon remediation study recently completed at the above referenced site Field work for the study was conducted in March, April, and May of 1992 A brief summary of the findings of the evaluation is presented below

- A subsurface study was conducted to assess some of the physical parameters of the soil and shallow unconfined aquifer underlying the site to provide information for the design of a system to remediate petroleum hydrocarbon impacted soil and groundwater The study included resampling groundwater from 5 on site monitoring wells, and conducting a vapor extraction test, bail tests, a pump test, and infiltration tests

- TPH and BTEX concentrations in excess of the MTCA Method A cleanup levels were measured in groundwater from monitoring wells MW-2, MW-4, and MW-5 A benzene concentration slightly in access of the MTCA Method A cleanup level was also measured in groundwater from monitoring well MW-3

- A vapor extraction test was conducted in the northwest corner of the site in the vicinity of monitoring wells MW-2 and MW-4 Intrinsic permeability values calculated from the test data ranged from 18 to 456 darcies Based on these values the calculated radius of influence surrounding an extraction point under a vacuum of 15 inches of water ranged form approximately 12 to 39 feet

- Bail tests were conducted on wells MW-2 and MW-4 Approximate hydraulic conductivity values of 1 47 X $10^{-4}$ centimeters per second and 3 56 X $10^{-4}$ centimeters per second were calculated from the bail test results

- Two infiltration tests were conducted in the grass covered area in the eastern portion of the site Average infiltration rates measured at the 2 test locations were 0 18 and 0 60 inches per minute

- A constant discharge pump test was conducted using well MW-4 as the pumping well for the test A pumping rate of approximately 0 43 gpm was sustained for approximately 7 hours before the water level in the well reached the pump intake at a depth of approximately 7 65 feet below static water level Maximum drawdown measured in observation well VP-3, located 11 feet from the pumping well, was 0 17 feet Hydraulic conductivity values calculated from the pump test data ranged from 1 5 X $10^{-5}$ cm/s to 8 7 X $10^{-4}$ cm/s Based on the test results, the specific yield of the aquifer is estimated to be approximately 0 2

The information presented above briefly summarizes the findings of the evaluation performed at the above referenced site RZA AGRA's report to Mobil Oil Corporation entitled "Petroleum Hydrocarbon Remediation Study" (W-7436-1), dated 11 June 1992, should be referenced for a detailed discussion of the report findings Our recommendations for remediation of petroleum hydrocarbon impacted soil and groundwater at the site based on the results of the findings is presented below

## REMEDIATION RECOMMENDATIONS

### Remediation of Vadose Zone Soil

Petroleum hydrocarbon impacted soil has been identified in the south central portion of the site in the vicinity of monitoring well MW-5, in the northwest corner of the site in the vicinity of monitoring wells MW-2

and MW-4, and in the vicinity of a former underground storage tank discovered in the southwestern portion of the site during repair of the adjacent sidewalk and 54th Avenue S

Because the site is currently an operating BP Station, insitu remediation of vadose zone soil involving excavation and landfarming or off-site soil disposal is not practical Based on laboratory test results, fugitive petroleum hydrocarbons present in the subsurface appear to be primarily gasoline For this reason and because of the relatively permeable nature of the vadose zone soil, we recommend that petroleum hydrocarbon impacts to the vadose zone be remediated utilizing a vapor extraction system (VES)

Essentially, a VES consists of underground vapor extraction points manifolded to an above ground vacuum blower The vapor extraction points would consist of 2 inch I D PVC monitoring wells screened in the vadose zone These vapor extraction points would be installed using a hollow stem auger drill rig Some of the benefits of the VES would include

- Volatilization of petroleum hydrocarbons in the area of the vadose zone and groundwater interface,
- Aeration of the soil created during venting enhances biodegradation of petroleum hydrocarbons in the soil by indigenous microbes,
- The VES would not generate large volumes of waste material,
- Remediation would occur insitu thereby allowing operations of a service station to continue through remediation

Based on the results of the vapor extraction test conducted for this study, we recommend that the VES include an array of 8 vapor extraction wells to provide influence over the entire known impacted areas Because of the short screen length within the vadose zone of most of the existing monitoring wells, we recommend that only VP-3 be included in the VES The locations of VP-3 and the other proposed vapor extraction wells are shown in Figure 1 The estimated area of influence of the VES is also shown in Figure 1

We recommend that the VES be vented utilizing a Rotron DR-606 regenerative blower (200 SCFM maximum capacity) Additional above ground VES equipment would include a combustible gas indicator (CGI), a vacuum gauge, and a condensate knock out tank with particle filter, fresh air bleed valve and highwater shut down sensor The CGI would monitor combustible gas concentrations in the VES exhaust stack and would be interfaced with the system control panel to shut down the blower should the emissions reach a

predetermined explosivity level (percent LEL) The above ground VES equipment would be secured inside a fenced equipment compound on a concrete slab, located in the planter area adjacent to the north side of the gasoline UST field (Figure 2) A schematic of the above ground equipment has been included in Figure 2

Individual tightline PVC piping would be extended from each vapor extraction well to the equipment compound The lines would be manifolded together and to the vacuum blower inside the equipment compound Gate valves would be installed on each manifold line to allow control of the vacuum applied to each vapor extraction well

Because the site is located in Pierce County, no secondary treatment of VES off-gas is presently required for volatile organic compound (VOC) emissions from VES systems The Puget Sound Air Pollution Control Agency (PSAPCA) has set a limit of 15 pounds of VOC emissions per day from VES systems Typically, PSAPCA considers the sum of the daily BTEX emissions to be representative of the total VOC emissions from a VES venting soil impacted by gasoline We propose that monitoring of the VES BTEX emissions would be conducted upon system start up, at two week intervals for the first month of operation, and monthly thereafter Once a correlation between BTEX emissions and the combustibility of the VES off-gas can be established, the CGI would be programmed to shut down the vacuum blower at a combustibility that approximately corresponds to the 15 pound per day BTEX emission limit

**Remediation of Saturated Zone Soil and Groundwater**

Petroleum hydrocarbon impacted groundwater has been identified in the same areas found to contain petroleum hydrocarbon impacted soil Additionally, a benzene concentration slightly in excess of the MTCA Method A cleanup level has been measured in monitoring well MW-3 Because no detectible concentration of petroleum hydrocarbons were identified in soil at this location, we do not recommend pursuing active remediation in this area at this time We recommend that MW-3 be monitored on a quarterly basis

Based on observations of soil quality during drilling, it appears that site soil is impacted by petroleum hydrocarbons to a depth of approximately 10 feet below the static water level The results of the pump test indicated that groundwater yield from the shallow aquifer is fairly low and drawdown in wells as close as 11 feet from the pumping well was minimal Given this information, it appears that dewatering of the entire petroleum impacted area to allow remediation of this material by vapor extraction would involve installation of an extensive number of recovery wells Installation of a high enough density of recovery wells to dewater the impacted area would be costly and difficult given the number of underground utilities at the active

service station Additionally, costs associated with purchase of equipment (depression pumps, groundwater treatment) and construction of an effluent infiltration system make this approach to remediation even less desirable The physical aquifer parameters that would be used for design of a dewatering system were obtained from the pump test should this approach be considered at a future date However, cost effective and efficient approach may be in situ sparging For this reason, we recommend that an insitu sparging pilot study be conducted at the site

The insitu sparging pilot study would consist of installation of one sparging well in the vicinity of monitoring wells MW-2 and MW-4 (Figure 1) The sparging well would be installed by over drilling well VP-1 using 10¼ inch I D hollow stem auger The large borehole created by the large diameter auger would serve to increase the area influenced by the sparging well over that which would be influenced using more conventional 6 inch I D hollow stem auger The well itself would consist of a 4 inch I D PVC outer casing screened from approximately 12½ to 15 feet below ground surface and again from approximately 20 to 25 feet below ground surface A 2 inch I D PVC casing would be suspended inside the 4 inch casing The 2 inch casing would be screened from approximately 18 to 19 feet below ground surface Sparging would be accomplished by blowing air through the 2 inch casing using a Rotron DR-505 regenerative blower Air and water would exit the 4 inch casing through the upper slotted section Water exiting the upper slotted section of the 4 inch casing would be replaced by water draw in through the lower slotted section The net effect would be to create a convection cell where a portion of the water displaced from the well would recirculate back into the well through the lower slotted section This would tend to reduce the groundwater mounding associated with sparging wells constructed with a singular screened interval The groundwater recirculation would also tend to increase the area influenced by the sparging A construction detail of the proposed sparging well and a diagram of a the theoretical stream line distribution in the vicinity of the sparging well is shown in Figure 3

Air bubbles passing through the aquifer in the vicinity of the sparging well would volatilize petroleum hydrocarbons adsorbed to the soil and dissolved in the groundwater An additional benefit of the sparging would be enhanced microbial breakdown of petroleum hydrocarbons in the aquifer due to oxygenation of the groundwater The volatilized petroleum hydrocarbons would be transported to the vadose zone by the air bubbles where they would be evacuated from the soil by the VES

The reason for operating this sparging well as part of a pilot study is because it is not known how large an area will be influenced by the sparging By monitoring dissolved oxygen and aqueous phase petroleum hydrocarbon concentrations in groundwater, and oxygen, and VOC concentrations in the head space of

surrounding wells during sparging, an assessment of the area influenced by the sparging well could be made Monitoring levels in peripheral wells would also provide a measurement of the potential for groundwater mounding in the vicinity of the sparging well Once this is accomplished, recommendations for modification of the system to remediate the remaining impacted areas could be made

In order to avoid interferences from the effects of the VES and natural background conditions, we recommend that monitoring for the above mentioned parameters be conducted weekly for 4 consecutive weeks prior to initiating sparging to obtain a range of base line levels We recommend that weekly monitoring continue for an additional 4 weeks after sparging begins and monthly thereafter through the first 3 months of operation After that time, recommendations for modification of the system would be provided

We appreciate this opportunity to be of continued service to Mobil Oil Corporation An itemized cost estimate to conduct the recommended scope of work will be provided under separate cover If you have any questions regarding this letter or other aspects of this project, please do not hesitate to call at your earliest convenience

Respectfully submitted,

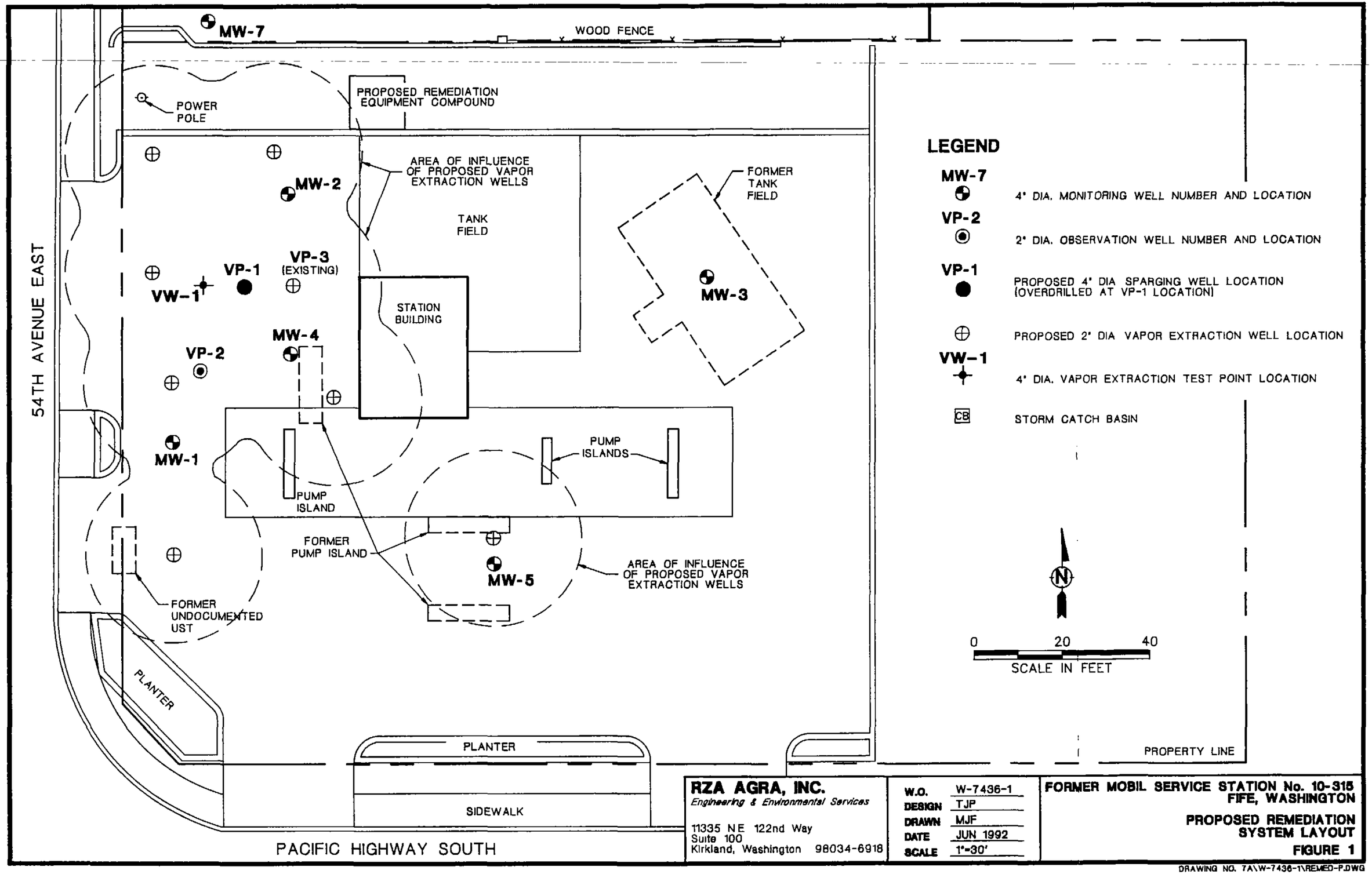
RZA AGRA, Inc

Timothy J Peter
Project Hydrogeologist

David G Cooper, P G
Associate Environmental Geologist

TJP/DGC/LAD

Enclosures Figure 1 - Proposed Remediation System Layout
Figure 2 - Vapor Extraction System Typical Above Ground Features
Figure 3 - Proposed Sparging Well Detail




**RZA AGRA, INC.**
*Engineering & Environmental Services*

11335 N.E. 122nd Way
Suite 100
Kirkland, Washington 98034-6918

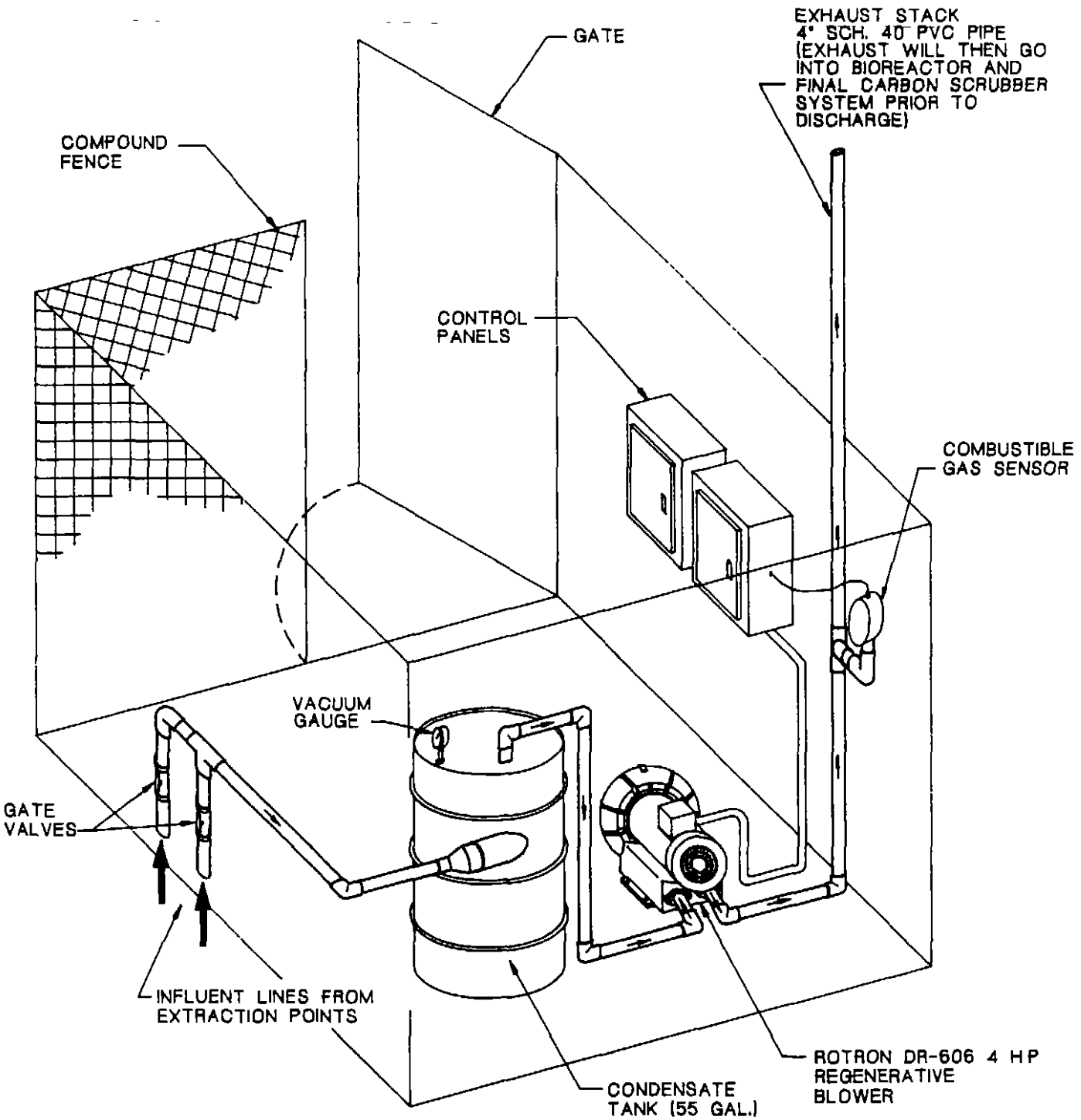
| | |
|---|---|
| W.O. | W-7436-1 |
| DESIGN | TJP |
| DRAWN | MJF |
| DATE | JUN 1992 |
| SCALE | 1"=30' |

**FORMER MOBIL SERVICE STATION No. 10-315**
**FIFE, WASHINGTON**

**PROPOSED REMEDIATION SYSTEM LAYOUT**

**FIGURE 1**

DRAWING NO. 7A\W-7436-1\REMED-P.DWG




# TYPICAL VAPOR EXTRACTION COMPOUND

**RZA AGRA, INC.**
*Engineering & Environmental Services*

11335 NE 122nd Way
Suite 100
Kirkland, Washington 98034-6918

| | |
|---|---|
| W.O. | W-7436-1 |
| DESIGN | TJP |
| DRAWN | BDT |
| DATE | JUN 1992 |
| SCALE | N.T.S. |

**FORMER MOBIL STATION No. 10-315**
**FIFE, WASHINGTON**

**VAPOR EXTRACTION SYSTEM**
**TYPICAL ABOVE GROUND FEATURES**

**FIGURE 2**

DRAWING NO \7A\W-7436-1\VES-COMP.DWG