

**HARTCROWSER**

Earth and Environmental Technologies

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J-2365-01

November 6, 1989

Chevron U.S.A., Inc.
P. O. Box 220
Seattle, Washington 98111

Attn: Mr. Mel Knutson

Re: Summary of Work Accomplished to Date and Pending
Former Chevron Bremerton Bulk Plant
Bremerton, Washington

Dear Mr. Knutson:

This letter presents a summary of work accomplished and proposed to date at the former Chevron Bulk Plant in Bremerton, Washington (Figure 1).

SITE DESCRIPTION

The former Chevron Bulk Plant facility occupied a 1.5-acre site in Bremerton, Washington (Figure 1). The site is located approximately one-third mile north of the Manette Bridge on the west side of the Port Washington Narrows. The site lies at an elevation approximately 10 to 25 feet above mean sea level.

The former bulk plant facility is divided into the Lower Yard and the Upper Yard (Figure 2). The Upper Yard occupies the southern half of the property and lies at an elevation approximately 10 feet higher than the Lower Yard. The Upper Yard is the former location of the above-ground tanks (Figure 3). These above-ground tanks stored primarily diesel and gasoline.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 2

The northern one-half of the site is designated as the Lower Yard. The area formerly contained the office buildings, garage facilities, and loading racks. In 1946 the north boundary of the Lower Yard was defined by the east-west trending wooden bulkhead shown on Figures 2 and 3. Based on aerial photographs, the facility was expanded northward to its present boundaries between 1946 and 1963. During the expansion the location of the majority of the facilities did not appear to change. However, the northern loading rack apparently was moved from a location near MW-11 to the area outlined by concrete pads near MW-9. Presently, the facilities on site consist of the fenced boundary, several concrete pads, and part of the loading dock (Figure 2).

General Soil Description

Upper Yard. The soils encountered in the Upper Yard consist primarily of a thin layer of fill overlying very dense native soil. The fill consists of loose, brown, silty, fine sand and the native soil consisted of very dense, silty fine sand with gravel which is interpreted as glacial till. Underlying the till at a depth of about 27 feet is a seven-foot layer of hard, dark gray silt. This layer is underlain by a layer of very dense, gray, fine to medium sand.

The native soils encountered in the Upper Yard disappear toward the north near MW-7 (see Figure 3, Hart Crowser, May 15, 1989). The edge of the native soil coincides with the ten-foot elevation change from the Upper Yard to the Lower Yard. It is likely that the native soil formed a small bluff on the Port Washington Narrows prior to backfilling on the northern half of the site.

Lower Yard. The Lower Yard consists of a series of fill deposits. The fill material ranges from a medium dense, gray, slightly silty, sandy gravel to a soft, gravelly, very sandy silt. The fill appears to be approximately 18 feet thick in the Lower Yard.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 3

Groundwater Underlying the Site

Upper Yard. One monitoring well was installed in the Upper Yard (MW-12). Based on the geologic log from this well, a water-bearing zone was encountered at a depth of about 33 feet. This water-bearing zone was located below a seven-foot layer of hard silt. The water level in the monitoring well ranges from 15 to 18 feet suggesting that the water-bearing zone encountered is under confined conditions. The well is screened with a 25-foot screen from a depth of about 10 to 35 feet below the ground surface.

Lower Yard. Groundwater was encountered in the fill material in the Lower Yard between the depths of 6 and 13 feet below the ground surface. Inorganic analysis of water from MW-11 (Hart Crowser, May 15, 1989), indicated that the water in the fill was primarily fresh water. It is likely that groundwater in the fill material is recharged by surface infiltration and by upward flow from the water-bearing zone encountered at a depth of about 33 feet in the Upper Yard (Figure 3, Hart Crowser, May 15, 1989).

SUMMARY OF SUBSURFACE ENVIRONMENTAL CONDITIONS

Upper Yard

Free phase hydrocarbons were observed in MW-12. A GC-FID screening identified the free phase hydrocarbon as diesel. Monitoring well MW-12 is screened within an apparent confined groundwater system. Therefore, the free phase hydrocarbons observed in this well are likely from the upper unsaturated zone screened by this well.

The total petroleum hydrocarbon (TPH) concentrations in the soil samples collected from test pit explorations generally ranged between below the laboratory detection limit to 220 ppm as gasoline and 250 ppm as diesel. Three test pits (TP-1, TP-15, and TP-16) had TPH concentrations between 1,000 and 2,000 ppm.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 4

Lower Yard

Elevated petroleum hydrocarbon concentrations were observed in several soil samples collected from test pits and monitoring well explorations in the Lower Yard. Based on the chemical analyses the petroleum hydrocarbon in the soils is primarily gasoline with minor amounts of diesel.

The highest petroleum hydrocarbon concentrations are located north of the wooden bulk head (TP-8, TP-9, and MW-5) between depths of about six feet and the groundwater table depths of 8 to 13 feet (Figure 6, Hart Crowser, May 15, 1989). The majority of soil samples with detectable levels of petroleum hydrocarbons were collected below a depth of six feet and above the water table surface. The exception was from test pit TP-9 which had elevated petroleum hydrocarbon concentrations near the ground surface and below six feet. This test pit was located near the former location of a loading rack.

Free phase hydrocarbons were observed in several of the monitoring wells. The thickest free phase hydrocarbons measurements were made in monitoring wells MW-4, MW-6, and MW-9. A free phase recovery system has been installed in monitoring wells MW-4 and MW-6.

The east-west trending wooden bulkhead located in the Lower Yard appears to effect the movement of free phase petroleum hydrocarbons on-site. In the vicinity of monitoring wells MW-4, MW-5A, and MW-6, the wooden bulkhead appears to be functioning as an oil/water separator. The wells upgradient of the bulkhead (MW-4 and MW-6) have free phase hydrocarbon thicknesses up to 4 feet. The monitoring well downgradient from the bulkhead (MW-5A) does not contain measurable free phase petroleum hydrocarbons.

The wooden bulkhead may also facilitate the eastward movement of free phase petroleum hydrocarbons from the area near TP-9 and MW-9. The eastward movement may be evidenced in the concentration of petroleum hydrocarbons in soil from test pit TP-8 and monitoring well MW-5 and the presence of free phase hydrocarbons in monitoring well MW-8.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 5

REMEDIAL ACTIVITIES ACCOMPLISHED AND PROPOSED

Interim Free Phase Hydrocarbon Recovery System

A interim free phase hydrocarbon recovery system was installed in MW-4 and MW-6 upgradient of the wooden bulkhead. The details of this system are presented in our proposal dated May 10, 1989 (Attachment D) and in our project status report dated September 29, 1989 (Attachment F). The free phase hydrocarbon thickness in MW-6 declined from a maximum of about 4.3 feet to a sheen during recovery operations. The free phase petroleum hydrocarbons in this well have not recovered, therefore, the pump has been removed from this well and will be placed in MW-9 during the installation of the soil venting system described below.

Designs for a soil venting system for the Lower Yard have been submitted to Chevron for review on November 1, 1989 (Attachment G). The proposed soil venting system will consist of four trenches located north of the wooden bulkhead. Petroleum hydrocarbon will be extracted from the unsaturated zone within the fill as vapors. The extracted soil gas will initially pass through a treatment system prior to release into the surrounding atmosphere. The soil venting system will be installed and begin operation near the end of November or the beginning of December of 1989. This date is dependent upon availability of equipment and obtaining the appropriate Puget Sound Air Pollution Control Agency (PSAPCA) permit.

We are presently assessing the effectiveness of an enhanced free phase hydrocarbon recovery system in the vicinity of the wooden bulkhead. This system would consist of several extraction wells or an extraction trench which is intended to lower the water table surface near the bulkhead and increase the groundwater gradient to facilitate the free phase hydrocarbon recovery. Using the data from our slug test and grain size analyses, we are assessing the hydraulic conductivity of the fill material to evaluate the viability of such a system. Our assessment will be submitted to Chevron within the month.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 6

Once the remediation systems in the Lower Yard are finalized, we will continue to assess the subsurface environmental condition of the Upper Yard.

SUMMARY OF PREVIOUS STUDIES

Attachments to this letter present the reports and proposals by Hart Crowser and others summarized in the following sections. Refer to the attached reports for more specific information and expanded discussion.

GeoEngineers Investigations

A GeoEngineers, Inc., report dated November 16, 1988, (Attachment A) presents findings of a subsurface contamination investigation performed under Contract M66CNW00696X, Release No. 9 for Chevron U.S.A., Inc.

Reference to another GeoEngineers report dated August 22, 1988, indicates that two (2) monitoring wells were installed on-site at that time. No free phase hydrocarbons were detected in the wells but hydrocarbon odors were detected in soil samples and drill cuttings from both borings and flammable gases were detected in the wells. These wells were subsequently destroyed by demolition activities at the site.

The 1988 work accomplished by GeoEngineers included: drilling twelve exploratory borings - nine of which were completed as monitoring wells; excavating seven test pits; collecting and analyzing 17 soil samples for BTEX and for total petroleum hydrocarbons (TPH) as gasoline and as diesel; collecting and analyzing groundwater samples for BTEX and for TPH; measuring water level relative to an assumed on-site datum; sampling each well for presence of free phase hydrocarbons; and measuring hydrocarbon vapor concentrations in each well.

Analytical results for soil and groundwater samples are presented in Tables 1 and 2, respectively, of the report in Attachment A. Monitoring well and test pit locations are presented on Figure 2 in Attachment A.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 7

Free phase hydrocarbons were detected in two of the monitoring wells -- thickness of 1.35 feet (MW-4) and 0.03 foot (MW-8) -- during this study. Analysis of the free phase hydrocarbons indicated 82 percent gasoline and 18 percent diesel.

Flammable gases were detected at concentrations of 7,800 ppm (70 percent LEL) in MW-7 and in excess of 10,000 ppm (92 percent LEL) in the other eight wells.

Hart Crowser Involvement

On January 4, 1989, Hart Crowser, Inc., submitted a Proposal for Remediation Services to Chevron U.S.A., Inc. Although in concurrence with the tasks defined in the proposal, Chevron indicated a desire to initiate a phased approach. As a consequence of this decision, another proposal dated March 15, 1989 (Attachment B) was negotiated with Chevron and the work was performed by Hart Crowser. Results of this phase of investigation have been presented in a report titled Phase I - Remediation Services, Bremerton Bulk Plant, Bremerton, Washington, dated May 15, 1989 (Attachment C).

During this phase, Hart Crowser sampled and analyzed groundwater from well MW-11 (Task 1.1); measured groundwater levels and free phase hydrocarbons thicknesses in existing on-site monitoring wells (Task 1.2); conducted slug tests in selected on-site wells to assess hydraulic conductivity of site soils (Task 1.3); and sampled soil from nine test pits excavated during this phase and analyzed them for TPH using EPA Methods 418.1 and modified 8015 (Task 1.4).

The test pit locations are presented on Figure 2 in Attachment C.

Results of groundwater quality analysis of well MW-11 indicated exceedence of Washington MCLs for turbidity, iron, and manganese; and relatively low concentrations of chloride and sodium indicative of a fresh water condition. This is consistent with a groundwater flow direction toward Port Washington Narrows.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 8

Water level and free phase hydrocarbon thickness data presented in Table 1 in Attachment C indicate higher water level (seasonal 1989 spring levels approximately 3 feet above 1988 fall levels) and up to 4 feet of free phase hydrocarbons (approximately 3 times the maximum thickness reported in the 1988 report). The maximum thickness of free phase hydrocarbons appeared to be present behind a wooden bulkhead wall which runs generally east-west across the property (see Figure 4 in Attachment C).

Results of *in situ* slug tests indicated a hydraulic conductivity of 0.1 to 0.2 feet/day (10^{-5} cm/sec) in the on-site fill material. However, it is felt these results were low based on experience in other fill materials which indicate values in the 0.3 to 3 feet/day (10^{-4} to 10^{-3} cm/sec) range.

Analytical results for soil samples from test pit excavations are presented in Table 2 and on Figures 5 and 6 in Attachment C. Hydrocarbon concentrations in the Upper Yard are predominantly diesel, generally less than 250 ppm with three samples between 1,300 and 1,900 ppm. Hydrocarbon concentrations in the Lower Yard vary with depth. Generally the highest petroleum hydrocarbon concentrations were measured below a depth of 6 feet. Test pits TP-9 and TP-13 had high petroleum hydrocarbon concentrations between the ground surface and 6 feet depth.

While analyzing and interpreting the results ultimately presented in the May 15, 1989, Hart Crowser report, a proposal dated May 10, 1989 (Attachment D), was presented to Chevron which called for the installation of an interim free phase hydrocarbon recovery system in the existing monitoring wells pending completion of final remediation planning, agency interaction, and permitting. An interim system, consisting of top-inlet, air-driven, total fluid pumps, was installed by May 25, 1989, in on-site monitoring wells MW-4 and MW-6.

Hart Crowser submitted another proposal to Chevron dated July 24, 1989 (Attachment E). Services to be performed included: installing additional wells for free phase product recovery; installing test vapor extraction and observation wells for soil venting; obtaining discharge



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 9

permits and designing and installing a recovery system; designing and installing a soil venting system; evaluating the need for a pump and treat groundwater remediation system; and monitoring the remediation system.

Hart Crowser implemented portions of this proposal as reported in their Project Status Report dated September 29, 1989 (Attachment F). That status report summarized site activities accomplished from May through August of 1989, and is our initial quarterly report presented at your request to keep you informed of the progress of our remediation activities.

The following sections summarize our activities during this period.

Fuel Finger Printing. Free phase hydrocarbons were sampled in monitoring wells MW-8, MW-9, and MW-12, and analyzed using a GC-FID fuel finger print screen. Comparison to fuel standards indicated that the free phase hydrocarbons samples from MW-8 and MW-9 are primarily gasoline with some diesel component also present in MW-9. The free phase hydrocarbons from MW-12 are primarily diesel.

These findings indicate gasoline in the Lower Yard and supports our proposed remediation of the Lower Yard by soil venting.

Interim Free Product Recovery System. Installation of the interim free product recovery system was completed on May 25, 1989, and has been operational since the first weeks of June. Pumps installed in monitoring wells MW-4 and MW-6 are discharging into a 2,000-gallon above-ground tank. Some difficulties including pump blockages, loss of prime, and system malfunctions are presently being addressed. A replacement ejector system installed in wells MW-4 and MW-9 has been proposed.

Permitting delays for the proposed on-site air stripper have necessitated the use of carbon canister filters to expedite the recovery process.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 10

Additional Well Installations. Monitoring wells MW-13, MW-14, MW-15, and MW-5A (replacement well for MW-5 destroyed during installation of the recovery system) were drilled and installed between August 7 and 9, 1989. One vapor extraction well (EX-1) and three vapor observation wells (OB-1 through OB-3) were also installed during the same period.

No free phase hydrocarbons were observed in the monitoring wells.

An air pumping test was conducted in EX-1 and monitored in OB-1 through OB-3 on August 17/18, 1989. Data gathered and analyzed indicate a radius of influence of about 22 feet for the extraction well. A subsequent proposal dated November 1, 1989, (Attachment G) presents the findings of this study and a schematic layout for a vapor venting system.

Groundwater Pump and Treat System. An initial round of groundwater samples from wells with no free phase hydrocarbons (MW-5A, MW-10, and MW-11) were collected for chemical analysis for BTEX using EPA Method 602. Results are presented in Table 5 of our summary report (Attachment F).

LIMITATIONS

This summary of work to date and proposed remediation work has been prepared for Chevron U.S.A., Inc., for submittal to the Washington State Department of Ecology. The work on this project has been performed in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the services were performed.

Any questions regarding the field work and this letter report, the presentation of the information, and the interpretation of the data are welcome and should be referred to Jennifer G. Martin.



Chevron U.S.A., Inc.
November 6, 1989

J-2365-01
Page 11

We trust this report will fulfill your current needs and
look forward to working with you in the near future.

Sincerely,

HART CROWSER, INC.

JENNIFER G. MARTIN
Sr. Staff Hydrogeologist

ALEX TULA
Associate

JGM/AT/GTB:cmr
L236501C/JOBS

Attachments:

- Attachment A - Report of Geotechnical Services
Subsurface Contamination Study
GeoEngineers, Inc.
- Attachment B - Proposal for Task 1 - Preliminary Site Work
- Attachment C - Phase I - Remediation Services Report
- Attachment D - Interim Free Phase Hydrocarbon Recovery
System Cost Estimate
- Attachment E - Continuing Environmental and Remediation
Services Proposal
- Attachment F - Project Status Report
- Attachment G - Soil Venting System Design and Cost Proposal

Vicinity Map



Base map prepared from USGS 7.5-minute quadrangles of West and East Bremerton, Washington, dated 1953.

0 2000 4000

Scale in Feet

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J-2365-01 9/89
Figure 1

Site Exploration Plan

Port Washington Narrows

