SUBSURFACE PETROLEUM HYDROCARBON EVALUATION

FORMER CHEVRON BULK FUELS TERMINAL

Camas, Washington

Prepared For

Chevron U.S.A. Inc.

W-5770

November, 1988

RITTENHOUSE-ZEMAN & ASSOCIATES
Geotechnical & Hydrogeological Consultants

RZA

RZA
RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
Geotechnical & Hydrogeological Consultants
1400 140th Avenue N.E.
Bellevue, Washington 98005-4594
(206) 746-8020/FAX (206) 746-6364

14 November 1988

W-5770

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

Attention: Mr. Mel Knutson

Subject: Subsurface Petroleum Hydrocarbon Evaluation
Former Chevron Bulk Fuels Terminal
Camas, Washington

Gentlemen:

We are pleased to present herein a copy of the above referenced report. This report presents the results of additional site study including soil sampling, monitoring well installation and laboratory analyses. Our work has been performed in general accordance with our proposal letter P-2735 dated 13 July 1988. Authorization to proceed with this study was provided in release No. 91, dated 20 July 1988.

We appreciate this opportunity to be of continued service to you and would be pleased to discuss the contents of this report or other aspects of the project with you at your convenience.

Respectfully submitted,

Rittenhouse-Zeman & Associates, Inc.

David G. Cooper, P.G.
Senior Project Geologist

Subsurface Petroleum Hydrocarbon Evaluation
Former Chevron Bulk Fuels Terminal
Camas, Washington

Prepared For

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

Prepared By

Rittenhouse-Zeman & Associates, Inc.
1400 - 140th Avenue N.E.
Bellevue, Washington 98005

November 1988
W-5770

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Subsurface Petroleum Hydrocarbon Evaluation
Former Chevron Bulk Fuels Terminal
Camas, Washington

W-5770

1.0 SUMMARY

A brief summary of the results of our site evaluation and chemical analyses of the site soils is presented below. The main body of the letter should be consulted for detailed discussion of the report findings.

- Four exploratory borings were accomplished at this site for the study utilizing air-rotary/downhole hammer drilling techniques and split spoon sampling for retrieval of discreet soil samples. All four borings were completed as 2 inch monitoring wells. Wells MW-1, MW-2, and MW-4 are located near areas of previously existing above ground storage tanks, pumps, or loading racks, and monitoring well MW-3 is located in an area of the site inferred to be downgradient. Drilling conditions were extremely difficult due to the presence of cobbles and boulders.

- Subsurface conditions were generally consistent across the site. In general, approximately 3 feet of silty sand overlies gravel, cobbles and boulders extending to a depth of approximately 18 to 20 feet. At a depth of 18 to 20 feet, a 3 to 4 feet thick gravelly silt or silty gravel strata was present in all four borings. Soil moisture content increased at the interface with this silty substrate but no groundwater was encountered in our explorations.

- Split-spoon soil samples were screened in the field for the presence of volatile organic compounds utilizing an organic vapor analyzer (OVA). Field measurements indicated detectable concentrations of volatile organic compounds and noticeable petroleum hydrocarbon odor in explorations MW-1 and MW-4. Vapor samples extracted from each of the completed monitoring wells, indicated the highest concentration in monitoring well MW-1 in the northeast corner of the site. Laboratory analyses of two soil samples from each exploration showed total petroleum hydrocarbon (TPH) concentrations ranging from less than 5 to 552 parts per million (ppm), with the highest concentrations found in MW-1. No detectable concentrations of BTEX were found in any of the soil samples submitted.

- Based on our explorations accomplished for this study and the results of our preliminary study dated 8 December 1987, it appears that a relatively impermeable strata consisting of a silty gravel or gravelly silt exists at a depth of 18 to 22 feet in depth below the ground surface. No evidence of petroleum hydrocarbon saturated soils, free-phase petroleum hydrocarbons, or groundwater were encountered in any of our explorations. The regional groundwater table is approximately 45 feet below the site ground surface. This underlying aquifer is utilized by local municipalities for public water supply. No indications of groundwater contamination or poor water quality have been reported by the municipalities during our inquiries.

This summary is presented for introductory purposes and should be used only in conjunction with the full text of this report. The project description, site conditions, investigative techniques and evaluation of the results are presented in the text of the report.

2.0 PROJECT DESCRIPTION

The purpose of this study was to: 1) evaluate the site's subsurface soil quality with regard to petroleum hydrocarbon and volatile aromatic hydrocarbon concentrations and 2) provide a professional opinion of the relative risk the existing concentrations could pose to deeper, underlying groundwater resources as well as future site development. The scope of work consisted of; 1) subsurface exploration and monitoring well installation to further define subsurface conditions at the site; 2) identification of areas of significantly elevated petroleum hydrocarbon concentrations and; 3) data evaluation and report preparation.

This report has been prepared for the exclusive use of Chevron U.S.A. Inc. and their agents for specific application to this project in accordance with generally accepted hydrogeologic practices.

3.0 SITE CONDITIONS

The site is located at the southeast corner of SE 6th Avenue and SE Union Avenue in Camas, Washington (Figure 1). A preliminary petroleum hydrocarbon evaluation (W-5388) was conducted at the site by RZA on 8 December 1987. This preliminary study consisted of advancing two air rotary exploratory borings to a depth of approximately 20 feet and taking grab samples of drill cuttings for laboratory analyses. The results of laboratory analyses showed detectable concentrations of TPH, toluene and xylene, indicating the presence of older, degraded petroleum hydrocarbon contamination. Subsurface explorations and monitoring well installations were conducted for the present study in September 1988. The surface and subsurface conditions are described below. Exploration procedures and as-built logs are presented in Appendix A. Site conditions and approximate locations of the explorations accomplished for this study are indicated on the Site and Exploration Plan, Figure 2.

3.1 Surface Conditions

The subject site is roughly triangular in shape, extending approximately 160 feet in a north-south direction and about 300 feet in the east-west direction. Site topography is

relatively flat with an estimated maximum relief of approximately 2 feet. An existing terminal warehouse building and office is located in the southeast quarter of the site. An existing vehicle maintenance garage is located in the northwest portion of the site. Fuel pumps were formerly located immediately northeast of the warehouse building and storage tanks were formerly located immediately north of the pumps in the northeast portion of the site. It is our understanding that all above-ground bulk storage tanks, the TTLR and pumps were removed in 1984 following the closing of the facility in 1983. Site plans provided to us indicate the presence of an underground fuel-oil tank southwest of the office building and a septic tank in the northeast corner of the site.

With the exception of the building areas the site subgrade consists of crushed rock surfacing. No surface staining or evidence of spillage was observed. Portions of the ground surface are covered with a thick accumulation of weeds. Surface water drainage appears to be the southwest, towards SE Union Avenue. The predominant direction of surface runoff in the general vicinity of the site appears to be to the south-southwest. A raised railroad embankment directly north of the site precludes runoff flow in a northerly direction.

3.2 Subsurface Conditions

The subsurface exploration program accomplished for this study consisted of four air-rotary borings using a down-hole hammer with an eccentric over-reaming bit, drilled to a maximum depth of 26 feet below the ground surface. Due to the presence of gravels, cobbles and boulders, drilling conditions were extremely difficult. Split-spoon samples were taken at approximately 5 foot intervals. The borings were continuously logged by observing drill cuttings discharged by the air compressor, and by noting changes in drilling action. All four of the borings were completed as 2 inch I.D. Schedule 40 PVC monitoring wells with a maximum screened interval of 15 feet.

3.2.1 Soil

Subsurface soil conditions appear to be generally consistent across the site. Explorations encountered a 3 to 5 foot thick zone of silty sand with some gravel at the surface. Underlying this surficial silty sand was a very dense, sandy gravel with cobbles and boulders. This sandy gravel extended the full depth of our explorations. A very silty zone within this gravel was encountered at depths ranging from 18 to 22 feet across the site. The silty gravel was wet and apparently acts as a barrier of relatively lower permeability or an aquitard to downward migration of surface waters. This silty gravel

was penetrated in some of the explorations and ranged in thickness from 3 to 5 feet. Underlying this silty gravel were interbeds of cleaner sandy gravel, again with silty gravel zones at depth. In general, it appears that there are numerable, thin, relatively low permeability zones beneath the site with the uppermost one existing at a depth of about 18 feet below the ground surface. This stratigraphy is typical of Columbia River flood deposits.

The explorations were backfilled from the bottom of the boring to a depth of about 20 feet with bentonite in order to preserve the integrity of these relatively low permeability zones. Monitoring well installation was accomplished from a depth of about 20 feet to the ground surface.

3.2.2 Groundwater

No groundwater was encountered in any of our explorations at the time of this study or our previous study. Relative soil moisture content was damp to dry, and became moist to wet at the interface with the silty gravel zone at depth. Based on the geologic conditions, observed we would expect a seasonally perched groundwater table above this silty gravel zone, if any. Inquiries to the WDOE, City of Camas, City of Washougal, Clark County and the USGS indicate no shallow aquifers at this shallow depth, or any wells utilizing groundwater within this zone for beneficial use. Records do indicate the presence of a regional groundwater aquifer, approximately 45 feet below the ground surface. Water is withdrawn from this aquifer to supply the City of Camas and the City of Washougal. Well No. 6 maintained by the City of Camas is located approximately 250 feet to the north-northeast of the site with a 1,450 gallon per minute rating. No information was available as to groundwater gradient for this aquifer. Based on topography and the likely influence of the adjacent Washougal River, we would expect a gradient to the southwest towards the Columbia River. Appendix C contains the locations and logs of local municipal water wells maintained by the City of Camas.

4.0 PETROLEUM HYDROCARBON OCCURRENCE

The concentrations of petroleum hydrocarbons existing in the subsurface materials were determined by testing for:

1. Total petroleum hydrocarbon (TPH) by EPA Method 418.1;
2. Volatile aromatic hydrocarbons (i.e. benzene, ethyl benzene, toluene, xylene or BETX) by EPA Method 8020 and;
3. Field volatile organic vapor measurements in the headspace of the soil samples and completed monitoring wells.

To assure continuity and comparability of results, the same analytical laboratory was used as our previous study. Sample S-4A was submitted as a duplicate of S-4 for quality assurance. Samples from each boring were screened in the field for the presence of volatile organic compounds by flame ionization, utilizing a Foxboro Model 128 OVA. Two samples with the highest headspace measurements and/or representative of near-surface soil and soils at depth were submitted from each boring for laboratory analyses. This information is summarized in Table 1.

No detectable concentrations of BETX (detection limits ranging from 10 to 20 ppb) were found in any of the samples submitted for this study. The chemist's interpretation of the gas chromatograph indicated the likely presence of diesel in those samples showing detectable concentrations of TPH.

TABLE 1
SUMMARY OF FIELD MEASUREMENTS
AND ANALYTICAL DATA

Boring Number	Sample Number	Depth (feet)	Soil Odor	Field Headspace (ppm)	TPH (ppm)	BETX (ppb)
MW-1	S-2	8.5-9.5	Yes	100	552.0	ND
	S-5*	22-23	Yes	150	552.0	ND
MW-2	S-1	3.5-4.0	No	34	<5.0	ND
	S-5	22.5-23.5	No	0	<5.0	ND
MW-3	S-2	8.5-9.5	No	16	111.0	ND
	S-5	22.5-24.0	No	0	<5.0	ND
MW-4	S-1	3.5-4.0	No	2	24.2	ND
	S-4*	16-17	Yes	42	8.6	ND
	S-4A	16-17			11.0	ND

Note:
1) Field headspace readings accomplished using a Foxboro Model OVA 128
2) BETX = benzene, ethylbenzene, toluene, xylenes
3) ND indicates not detected
* Grab sample from discharge hose

Following installation of the monitoring wells, headspace measurements in the monitoring wells utilizing a photoionization where accomplished in all four wells (Table 2).

TABLE 2
WELL HEADSPACE READINGS

Boring Number	Headspace Readings (ppm)
MW-1	225
MW-2	39
MW-3	2
MW-4	24

These readings were accomplished following the application of a vacuum to the well to remove several well volumes of air. It should be noted that the soil stratum screened by these wells consists of an extremely permeable sandy gravel which would allow for the rapid migration of volatile organic vapors. Therefore, these readings should not be construed to indicate the presence of a petroleum hydrocarbon source at the well location itself, but give a general indication of the petroleum hydrocarbon vapor concentrations in the vicinity of the monitoring well.

The conclusions presented in this report are professional opinions and are based on the explorations and testing accomplished for this study along with interpretation of data from the previous study. The number, location and depth of the monitoring well installations were completed within the site and proposal constraints to yield the information required.

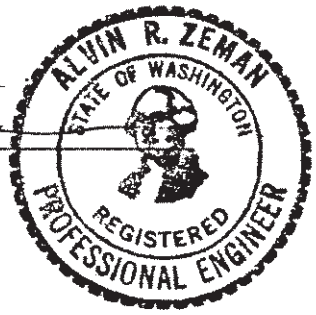
We appreciate the opportunity to be of service to you on this project. If you have any questions regarding this report, please do not hesitate to call.

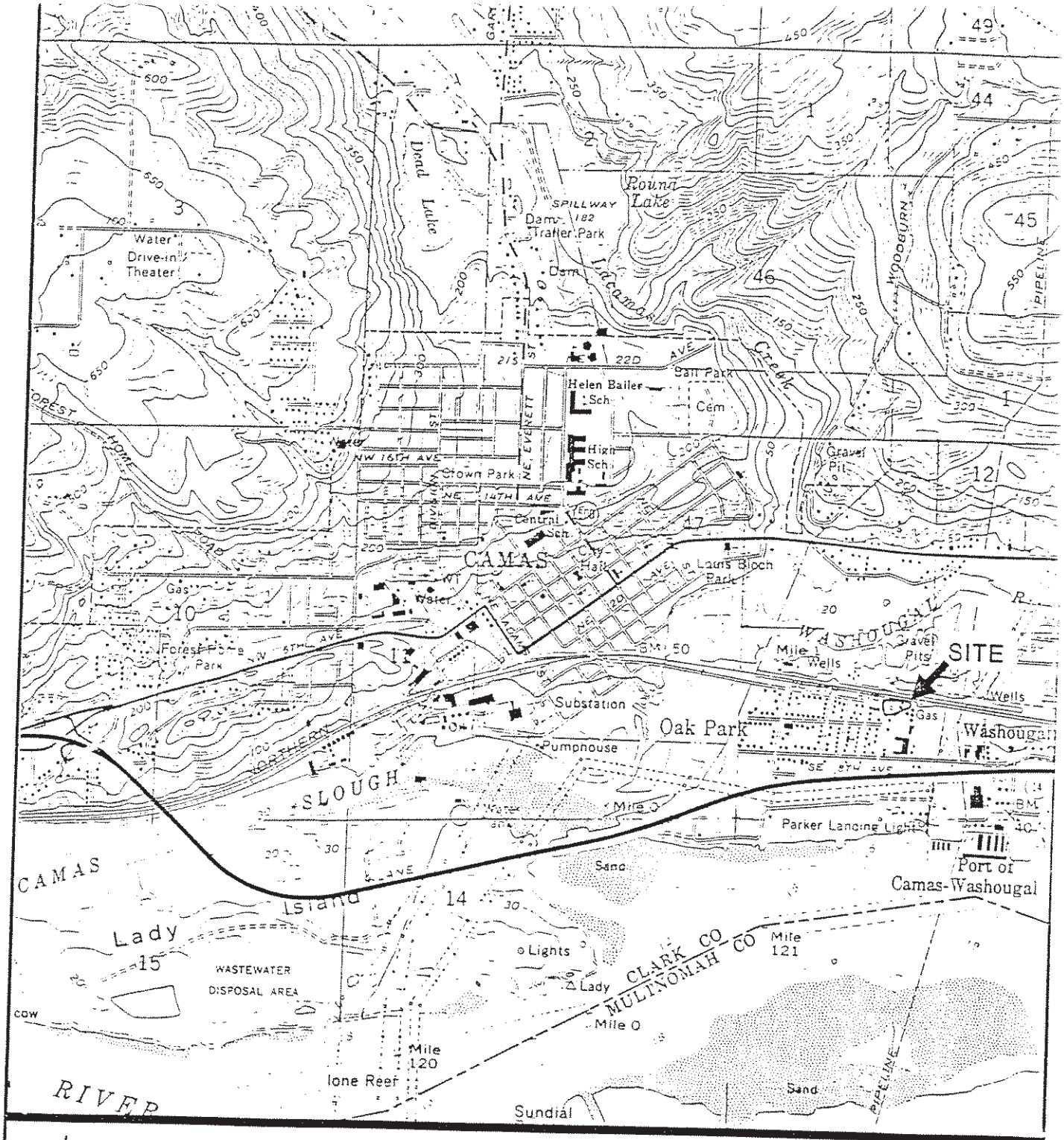
Respectfully submitted,

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

David G. Cooper, P.G.
Senior Project Geologist

Alvin R. Zeman, P.E.
President





CHEVRON BULK FUELS TERMINAL
CAMAS, WASHINGTON

SITE VICINITY MAP
FIGURE 1

W.O. W-5770
BY DGC
DATE NOV 1988
SCALE N/A

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Geotechnical & Hydrogeological Consultants
1400 140th Avenue N.E.
Bellevue, WA 98005

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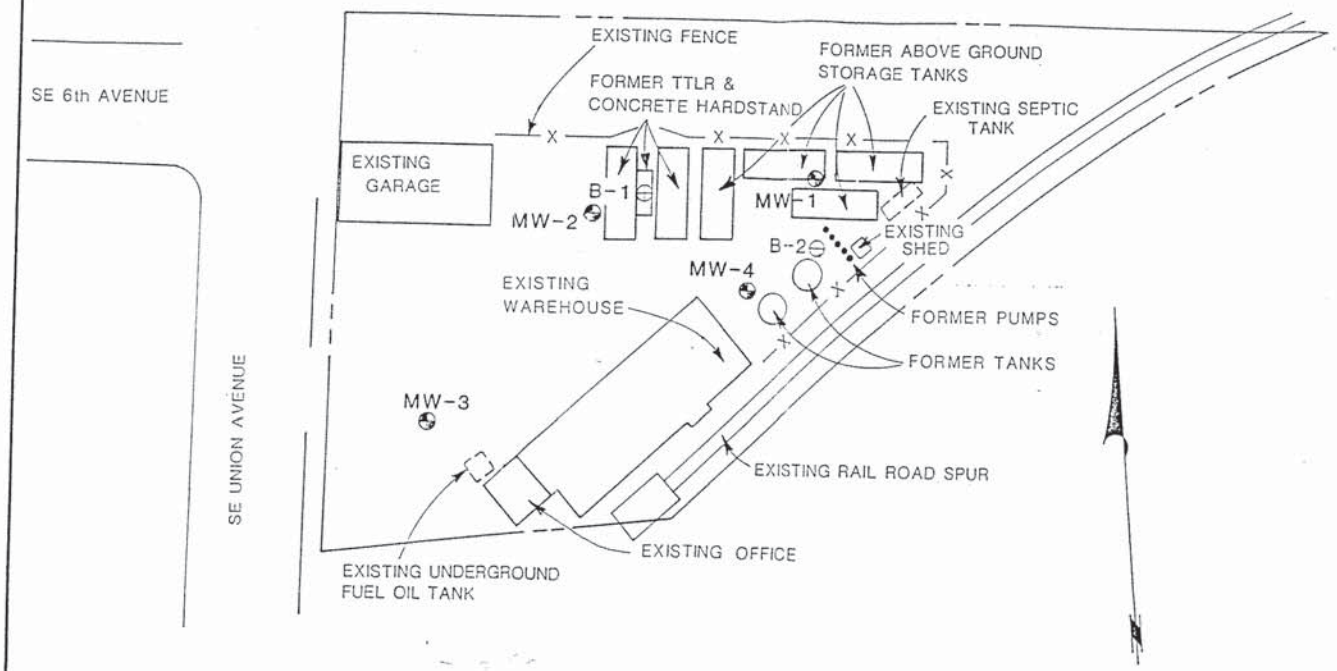

EXPLANATION

B-2 ⊕ INDICATES BORING NUMBER & APPROXIMATE LOCATION FOR PREVIOUS STUDY, W-5388, OCT. 1987

MW-4 ⊕ MONITORING WELL LOCATION CURRENT STUDY

Base map from 12-72 revised Ground Plan by Standard Oil Company of California Western Operations, Inc.

CHEVRON BULK FUELS TERMINAL
CAMAS, WASHINGTON

SITE & EXPLORATION PLAN
FIGURE

W.O. W-5770
BY DGC
DATE NOV 1988
SCALE NOTED

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Geotechnical & Hydrogeological Consultants
1400 140th Avenue N.E.
Bellevue, Washington 98005

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APPENDIX A
SUBSURFACE EXPLORATION
W-5770

Appendix A
Subsurface Exploration
W-5770

Four soils borings were advanced on the site to: 1) obtain soil samples; 2) determine the presence or absence of petroleum hydrocarbons; 3) allow installation of monitoring wells. The approximate exploration locations are shown on the Site and Exploration Plan, Figure 2. The borings were drilled by an exploration drilling company under subcontract to our firm. The borings consisted of advancing 6-inch diameter steel casing utilizing an air-rotary drill rig equipped with down-hole hammer and a Halco eccentric bit. No foam, water or other substances were introduced during drilling. The explorations were advanced ranging from 23 to 26 feet in depth. Split spoon samples were obtained at approximately 5 foot intervals by using the Standard Penetration Test procedure as described in ASTM:D 1586. The explorations were logged under the full time supervision of an engineering geologist. The engineering geologist classified the subsurface materials, kept a detailed log and maintained custody of the recovered samples. The drill rig and all rods and tools were steam cleaned prior to drilling at each monitoring well location. The sampler was decontaminated between each sampling interval by scrubbing with an alconox solution, rinsed with tap water and rinsed with distilled water.

All four explorations were completed as monitoring wells. Each monitoring well consisted of 2-inch I.D., Schedule 40, flush-threaded, PVC casing coupled to a 15-foot length of 0.02 inch slotted well screen. The screen portion of the well was backfilled using eight aqua Monterey sand to approximately 2 feet above the screen. Above the sand-packed portion of the well, the annulus of the boring was backfilled with bentonite to the surface. Flush monuments mounted in concrete completed the monitoring wells at the surface. Each well was equipped with a water-tight locking cap.

Monitoring well locations are shown on the Site and Exploration Plan, Figure 2. Monitoring well as-built information is included in this Appendix.

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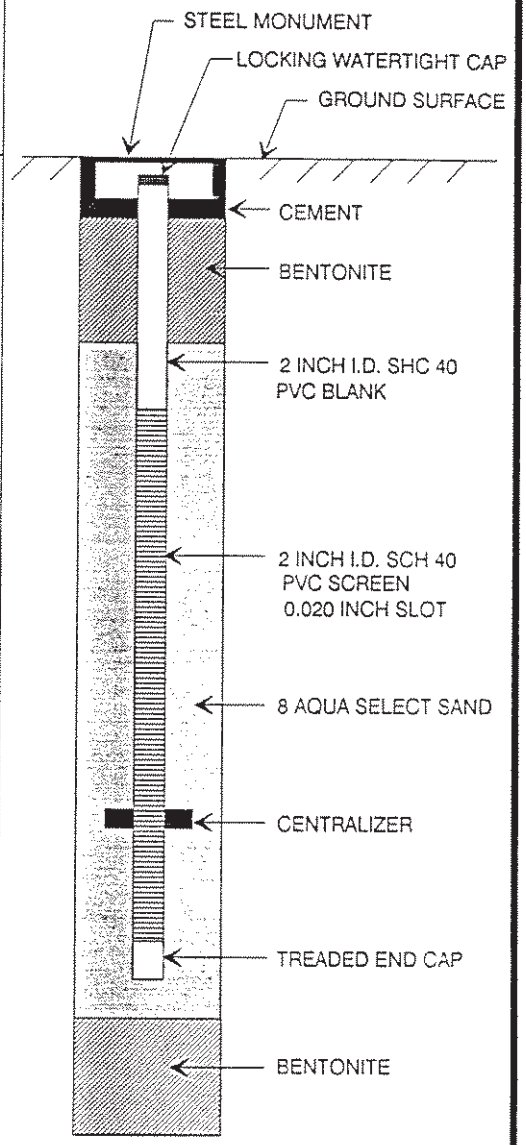
WELL NUMBER MW-1 PAGE 1 OF 1
PROJECT NAME CAMAS W.O. W 5770

DRILLED BY: SOIL SAMPLING SERVICE
DRILLING METHOD: AIR ROTARY
REFERENCE ELEVATION: USGS
CASING:
GROUND: APPROX. 45'

SOIL OR ROCK DESCRIPTION	OVA READING	SOIL SAMPLES
CRUSHED ROCK SURFACING		
MEDIUM DENSE, MOIST, BROWN, SILTY SAND WITH SOME GRAVEL	34	S-1
VERY DENSE, DAMP, GREY, SANDY GRAVEL	100	S-2
	10	S-3
	50	S-4
WET, GREY, SILTY GRAVEL/GRAVELLY SILT	150	S-5
	74	S-6
DENSE, DRY, BROWN, SILTY GRAVEL	8	S-7
BOTTOM OF BORING 26.0 FEET COMPLETED 1 SEPT 88		

DEPTH (IN FEET): 5, 10, 15, 20, 25, 30, 35

AS-BUILT



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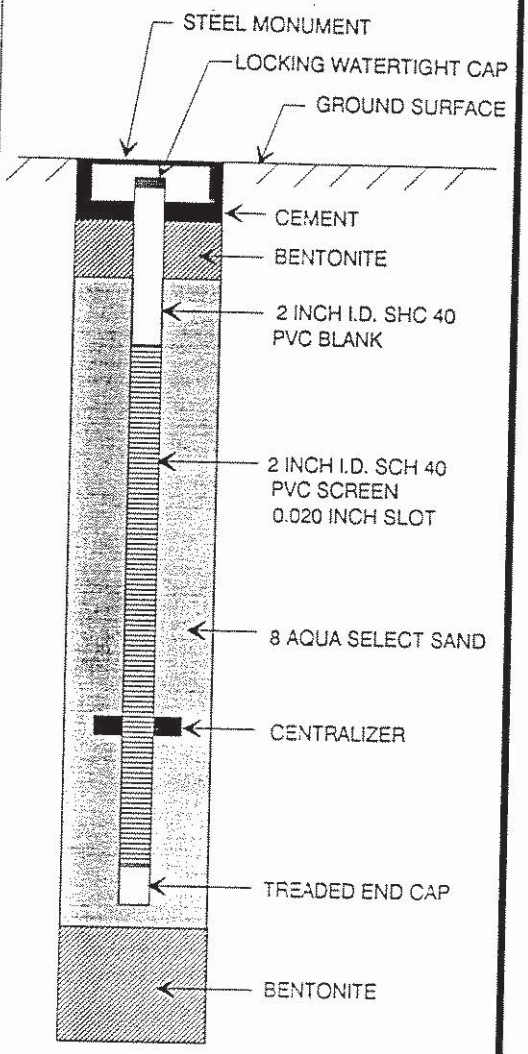
Geotechnical & Hydrogeological Consultants

WELL NUMBER MW-2 PAGE 1 OF 1
PROJECT NAME CAMAS W.O. W 5770

SOIL OR ROCK DESCRIPTION	GRAPHIC LOG	OVA READING	WATER LEVEL	DEPTH (IN FEET)	SOIL SAMPLES
DRILLED BY: SOIL SAMPLING SERVICE DRILLING METHOD: AIR ROTARY REFERENCE ELEVATION: USGS CASING: GROUND: APPROX. 45'					
CRUSHED ROCK SURFACING DENSE, MOIST, BROWN, SILTY GRAVEL		34		5	S-1
VERY DENSE, DAMP, GREY, SANDY GRAVEL		0		10	S-2
		0		15	S-3
		0		20	S-4
WET, GREY, SILTY GRAVEL/GRAVELLY SILT		0			S-5
BOTTOM OF BORING 23.5 FEET COMPLETED 2 SEPT 88				25 30 35	

AS-BUILT



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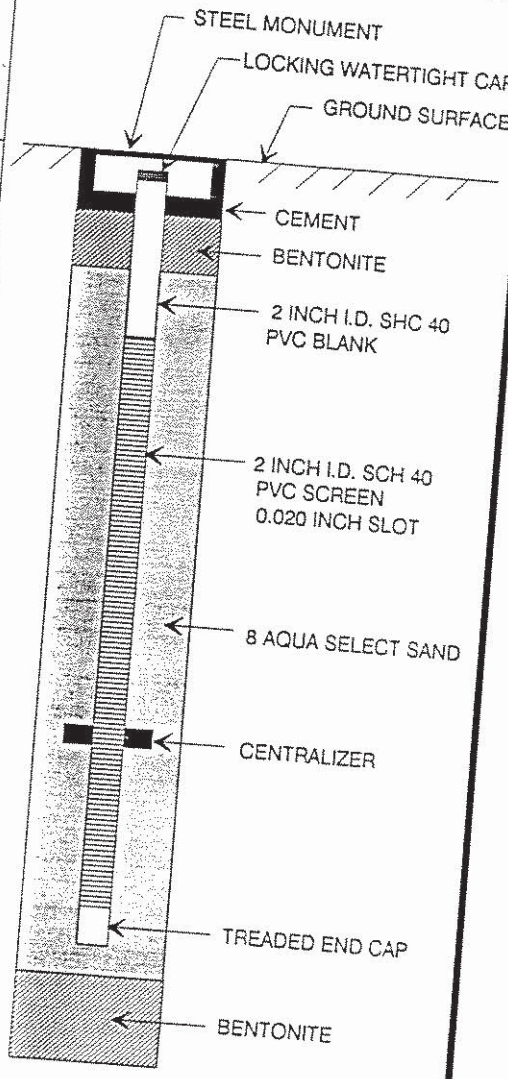
Geotechnical & Hydrogeological Consultants

WELL NUMBER MW-3
PROJECT NAME CAMAS

W.O. W 5770

SOIL OR ROCK DESCRIPTION	GRAPHIC LOG	OVA READING	WATER LEVEL	DEPTH (IN FEET)	SOIL SAMPLES
DRILLED BY: SOIL SAMPLING SERVICE DRILLING METHOD: AIR ROTARY REFERENCE ELEVATION: USGS CASING: GROUND: APPROX. 45'					
CRUSHED ROCK SURFACING					
VERY DENSE, WET BROWN, GRAVELLY, SILT		0		5	S-1
VERY DENSE, DAMP, GREY, SANDY GRAVEL		16		10	S-2
		0		15	S-3
WET, GREY, SILTY GRAVEL/GRAVELLY SILT		0		20	S-4
GRAVELLY SAND INTERBED		0			S-5
BOTTOM OF BORING 24.5 FEET COMPLETED 6 SEPT 88				25 30 35	

AS-BUILT



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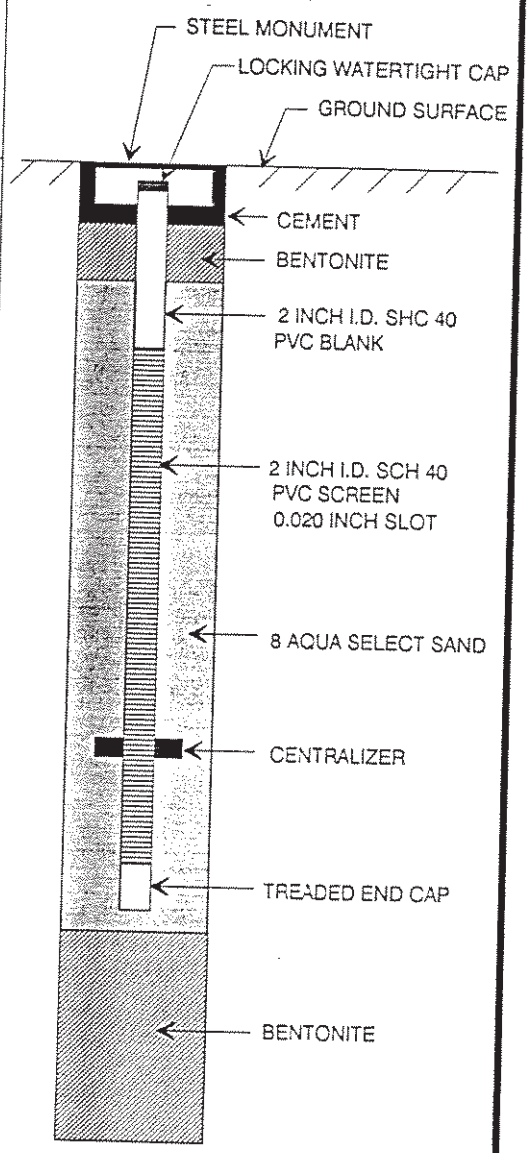
Geotechnical & Hydrogeological Consultants

WELL NUMBER MW-4 PAGE 1 OF 1
PROJECT NAME CAMAS W.O. W 5770

SOIL OR ROCK DESCRIPTION	GRAPHIC LOG	OVA READING	WATER LEVEL	DEPTH (IN FEET)	SOIL SAMPLES
DRILLED BY: SOIL SAMPLING SERVICE DRILLING METHOD: AIR ROTARY REFERENCE ELEVATION: USGS CASING: GROUND: APPROX. 45'					
CRUSHED ROCK SURFACING VERY DENSE, MOIST, SILTY GRAVEL					
		2		5	S-1
VERY DENSE, DAMP, GREY, SANDY GRAVEL		1		10	S-2
		15		15	S-3
BECOMING SILTY		42			S-4
WET, GREY, SILTY GRAVEL/GRAVELLY SILT		0		20	S-5
DAMP, BROWN, SANDY, GRAVEL WITH SOME SILT		0		25	S-6
BOTTOM OF BORING 26.0 FEET COMPLETED 7 SEPT 88				30 35	

AS-BUILT



APPENDIX B
ANALYTICAL LABORATORY RESULTS
W-5770

am test inc.
14603 N.E. 87th St. • REDMOND, WASHINGTON 98052 • 206/885-1664

SEP 16 1988

ANALYSIS REPORT

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: David Cooper
8050 SW Cirrus
Beaverton, OR 97005

DATE RECEIVED: 9/12/88
DATE REPORTED: 9/14/88
PROJECT NO.: W5770

Laboratory Sample Numbers	Client Identification	Total Petroleum Hydrocarbons (ug/g)
818007	MW-1, S-2	552.
818008	MW-1, S-5	552.
818009	MW-2, S-1	<5.0
818010	MW-2, S-5	<5.0
818011	MW-3, S-2	111.
818012	MW-3, S-5	<5.0
818013	MW-4, S-1	24.2 27.8]
818014	MW, S-4	8.6
818015	MW, S-4A	11.0

Analysis by EPA Method 418.1

JTD/pb

REPORTED BY _____
John T. Dailey

am test inc.
14603 N.E. 87th St. • REDMOND, WASHINGTON 98052 • 206/885-1664

ANALYSIS REPORT

CLIENT: Rittenhouse Zeman & Associates DATE RECEIVED: 9/12/88

REPORT TO: David Cooper
1400 - 140th Avenue N.E.
Bellevue, WA 98005

DATE REPORTED: 9/25/88

PROJECT NO.: W5770

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS
by EPA Method 8020

Laboratory Sample Number	818008	818009	818010	Detection Limit
Client Identification	MW1, S-5	MW2, S-1	MW2, S-5	(ug/kg)
COMPOUND				
Benzene	ND	ND	ND	10.
Toluene	ND	ND	ND	10.
Ethylbenzene	ND	ND	ND	10.
m+p-Xylene	ND	ND	ND	22.
o-Xylene	ND	ND	ND	10.

All results in ug/kg.
m-Xylene & p-Xylene coelute

Continued . . .

CLIENT: Rittenhouse Zeman & Associates DATE RECEIVED: 9/12/88

REPORT TO: David Cooper DATE REPORTED: 9/25/88

PROJECT NO.: W5770

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS
by EPA Method 8020

Laboratory Sample Number	818011	818012	818013	Detection Limit
Client Identification	MW3, S-2	MW3, S-5	MW4, S-1	(ug/kg)
COMPOUND				
Benzene	ND	ND	ND	10.
Toluene	ND	ND	ND	10.
Ethylbenzene	ND	ND	ND	10.
m+p-Xylene	ND	ND	ND	20.
o-Xylene	ND	ND	ND	10.

All results in ug/kg.
m-Xylene & p-Xylene coelute

Continued . . .

CLIENT: Rittenhouse Zeman & Associates DATE RECEIVED: 9/12/88

REPORT TO: David Cooper DATE REPORTED: 9/25/88

PROJECT NO.: W5770

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS by EPA Method 8020

Laboratory Sample Number	818013	818014	818015	Detection Limit
Client Identification	Duplicate MW4, S-1	MW4, S-4	MW4, S-4A	(ug/kg)
COMPOUND				
Benzene	ND	ND	ND	10.
Toluene	ND	ND	ND	10.
Ethylbenzene	ND	ND	ND	10.
m+p-Xylene	ND	ND	ND	20.
o-Xylene	ND	ND	ND	10.

All results in ug/kg.
m-Xylene & p-Xylene coelute

KP/ja

REPORTED BY: Kenneth Pang

am test inc.
14603 N.E. 87th St. • REDMOND, WASHINGTON 98052 • 206/885-1664

ANALYSIS REPORT

CLIENT: Rittenhouse Zeman & Associates

REPORT TO: David Cooper
1400 - 140th NE
Bellevue, WA 98005

DATE RECEIVED: 9/12/88
DATE REPORTED: 10/18/88
PROJECT NO.: W5770

BTEX BY EPA METHOD 8020

Laboratory Sample Nos.	Client I.D.	Benzene	Toluene	m+p-Xylene	o-Xylene	Ethyl Benzene
818007	MW1, S-2	ND	ND	ND	ND	ND
DETECTION LIMIT		10.	10.	20.	10.	10.

All values are reported in ug/kg.

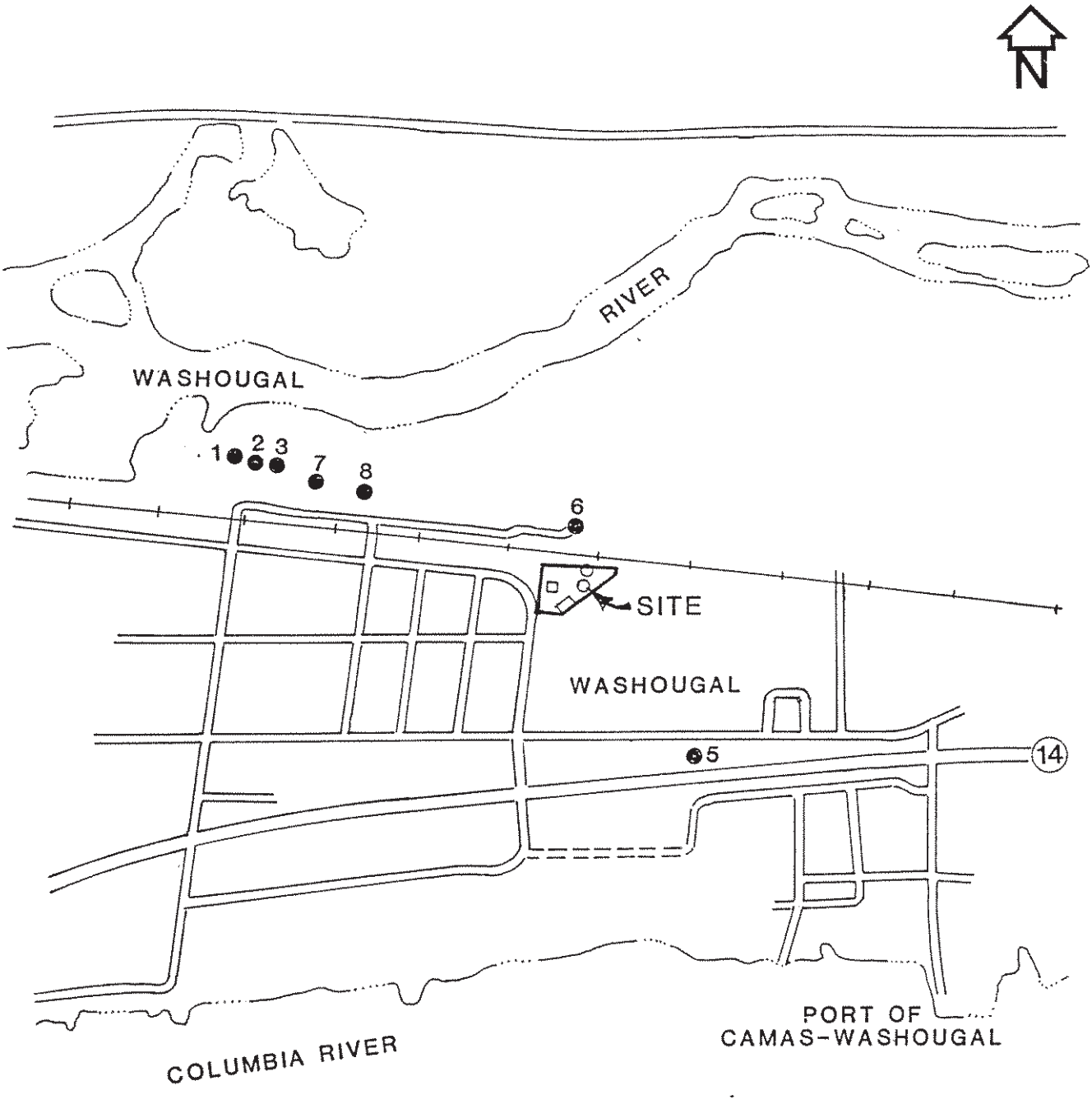
ND = Not Detected.

NOTE: Sample was not in VOA vial.

KP/pb

REPORTED BY Kenneth Pang
Kenneth Pang

APPENDIX C
MUNICIPAL WATER WELL LOCATIONS/LOGS
W-5770



8 MUNICIPAL WATER WELL NUMBER
● AND APPROXIMATE LOCATION

NOTE:

WELL LOGS REGISTERED WITH WDOE FOR WELL No.'s 5,6, & 8 ARE ATTACHED.

CITY OF CAMAS
MUNICIPAL WATER
WELL LOCATIONS

SITE PLAN

APPENDIX C

W.O. W-5388
BY DGC
DATE DEC 1988
SCALE N.T.S.

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
Geotechnical & Hydrogeological Consultants
1400 140th Avenue N.E.
Bellevue, WA 98005

RZA

File Original and First Copy with the Division of Water Resources
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT NO. 5

STATE OF WASHINGTON

Permit No. 8627

(1) OWNER: Name City of Camas Address 616 N.E. 4th Avenue

(2) LOCATION OF WELL: County Clark - Lot 9, Plat of Orchard ¼ ¼ Sec. T. N., R. W.M.

Bearing and distance from section or subdivision corner Home within City of Camas& road right of way abutting thereto to the East of Sec. 12 TIN R3 East of WM

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches. Drilled 71 ft. Depth of completed well 71 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from .... ft. to .... ft.
Threaded ☐ .... " Diam. from .... ft. to .... ft.
Welded ☒ .... " Diam. from .... ft. to .... ft.

Perforations: Yes ☒ No ☐
Type of perforator used ....
SIZE of perforations 3/8" in. by 1-1/4" in.
408 perforations from 44'6" ft. to 65 ft.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ....
Type .... Model No ....
Diam. .... Slot size .... from .... ft. to .... ft.
Diam. .... Slot size .... from .... ft. to .... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ....
Gravel placed from .... ft. to .... ft.

Surface seal: Yes ☐ No ☐ To what depth? 22 ft.
Material used in seal Concrete grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? .... Depth of strata ....
Method of sealing strata off gravity

(7) PUMP: Manufacturer's Name Johnson
Type: V.H.S. Turbine H.P. 75

(8) WATER LEVELS: Land-surface elevation above mean sea level .... 36 ft.
Static level 36 ft. below top of well Date 7-25-68
Artesian pressure .... lbs. per square inch Date ....
Artesian water is controlled by .... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? O.J. Norris
Yield: 450 gal./min. with 1 ft. drawdown after 8 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 3-16-68
Bailer test .... gal./min. with .... ft. drawdown after .... hrs.
Artesian flow .... g.p.m. Date ....
Temperature of water 53° Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Surface dirt with small boulder	0	3
Gravel & Bouxlers, very little binder	3	7
Gravel & boulders w/ clay binder	7	21
Large gravel & small boulders, loose	21	24
Med. size gravel, fairly loose	24	33
Med size gravel	33	35
Large to fine gravel, some red grav el	35	45
Started making water at 35 feet		
Med. to fine gravel, clean some red - very little sand	45	48
Some larger gravel	48	56
Med. to fine gravel, clean & loose	56	60
Med to fine gravel clean, loose	60	65
Med to fine gravel, clean, loose	65	67' 6'
Loose gravel formation	67'6"	68' 6'
Loose gravel formation	68'6"	69' 6
Fine yellow sand	69'6"	71
Sealed bottom with concrete	71	

Work started Feb. 14, 19 68 Completed Mar. 19, 19 68

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME O.J. NORRIS - WATER WELL DRILLING (Person, firm, or corporation) (Type or print)
Address 4411 N.E. 59th Avenue Vancouver, Washington
[Signed] O J Norris (Well Driller)
License No. 223 02 4069 Date Sept. 9, 19 68

See attached copy

(USE ADDITIONAL SHEETS IF NECESSARY)

S. W. No. 7355—(Rev. 2-66)—2-68—6M. 4516.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

No. 8

Application No. .....

Permit No. .....

(1) OWNER: Name [illegible] Address Camas, Washington

(2) LOCATION OF WELL: County Clark — NE ¼ SW ¼ Sec. 12 T. 1 N., R. 3 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☑
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 8
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 14 inches.
Drilled [illegible] ft. Depth of completed well 82 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 14" Diam. from 0 ft. to 82 ft.
Threaded ☐ ..." Diam. from ... ft. to ... ft.
Welded ☐ ..." Diam. from ... ft. to ... ft.
(8" [illegible] added for future [illegible])

Perforations: Yes ☑ No ☐
Type of perforator used Mills Knife
SIZE of perforations 1/4 in. by 3/4 in.
[illegible] perforations from 44 ft. to 79 ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

Screens: Yes ☐ No ☑
Manufacturer's Name ...
Type ... Model No. ...
Diam. ... Slot size ... from ... ft. to ... ft.
Diam. ... Slot size ... from ... ft. to ... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: ...
Gravel placed from ... ft. to ... ft.

Surface seal: Yes ☑ No ☐ To what depth? 20 ft.
Material used in seal Cement
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? ... Depth of strata ...
Method of sealing strata off ...

(7) PUMP: Manufacturer's Name ...
Type: ... H.P. ...

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level [illegible] ft. below top of well Date 5/10/72
Artesian pressure ... lbs. per square inch Date ...
Artesian water is controlled by ... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☑ No ☐ If yes, by whom? driller
Yield: [illegible] gal./min. with [illegible] ft. drawdown after 2 hrs.
" [illegible] " [illegible] " 6 "
" [illegible] " [illegible] " 2 "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
[illegible]	[illegible]				
[illegible]	[illegible]				

Date of test ...
Bailer test ... gal./min. with ... ft. drawdown after ... hrs.
Artesian flow ... g.p.m. Date ...
Temperature of water ... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Topsoil	0	[illegible]
Gravel, small boulders	[illegible]	[illegible]
Gravel, boulders	[illegible]	[illegible]
Gravel, small boulders,	[illegible]	[illegible]
brown clay seams		
Gravel, loose, some brown	[illegible]	[illegible]
clay		
Gravel, sand, gray	[illegible]	[illegible]
Gravel, sand, gray, water	[illegible]	[illegible]
bearing		
Gravel, medium size, sand,	[illegible]	[illegible]
gray, loose, water bearing		
Gravel, small to large,	[illegible]	[illegible]
loose, water bearing		
Gravel, medium to large,	[illegible]	[illegible]
loose		
Gravel, large, red clay	[illegible]	[illegible]
Clay, red	[illegible]	[illegible]

Work started ..., 19.. Completed ..., 19..

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME NORRIS DRILLING & PUMP CO., INC.
(Person, firm, or corporation) (Type or print)
Address 1102 [illegible] St., Vancouver, Washington [illegible]

[Signed] ...
(Well Driller)

License No. ... Date ..., 19..

(USE ADDITIONAL SHEETS IF NECESSARY)

the Division of Water Resources
Second Copy — Owner's Copy
Third Copy — Driller's Copy

#10

WATER WELL REPORT

STATE OF WASHINGTON

NO. 6

Application No. .....

Permit No. 8544

(1) OWNER: Name City of Camas Address 616 N.E. 4th Avenue

(2) LOCATION OF WELL: County Clark David C Parker D.L.C. 449 ¼ ¼ Sec. 12 T. 1 N. R. 3E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .... #6
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 16 inches.
Drilled 85 ft. Depth of completed well 85 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 16"OD Diam. from 0 ft. to 85 ft.
Threaded ☐ ." Diam. from ft. to ft.
Welded ☒ ." Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Mill knife
SIZE of perforations 5/16 in. by 3-1/2 in.
552 perforations from 56 ft. to 80 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 22 ft.
Material used in seal Concrete grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata 27
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level .... 48 ft.
Static level 45 ft. below top of well Date 6-29-68
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? City
Yield: 1600 gal./min. with 5 ft. drawdown after 12 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test June 28, 1968
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 53° Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Surface Soil	0	2
Gravel & Small Boulders	2	6
Gravel & Boulders	6	10
Gravel & Small Boulders	10	14
Boulders	14	15
Pea Gravel	15	17
Boulders	17	19
Boulders	19	21
Large to Medium gravel	21	26
Medium to fine gravel, some sand	26	30
Medium to fine gravel with a few boulders	30	40
Med. to fine gravel with fine sand	40	48'6"
Med to fine gravel with some sand	48'6"	53
Water bearing gravel and sand	53	55
Med to fine gravel, water bearing	55	59
Med to fine gravel, water bearing	59	69
Med to fine gravel, some black sand water bearing	69	76
Med to large gravel	76	80
Gravel & small boulders, very tight formation	80	83'9"
Med hard gray rock	83'9"	85

Work started June 5, 1968 Completed 6-27-68, 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME O.J. NORRIS-WATER WELL DRILLING
(Person, firm, or corporation) (Type or print)
Address 4411 N.E. 59th Avenue Vancouver, Washington

[Signed] (Well Driller)

License No. 223 02 4069 Date Sept. 9, 1968

One Enclosed

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—(Rev. 2-66)—2-66—5M. 4516.