DATA REPORT
SOIL SAMPLING AT RAILROAD/LOADING DOCK AND FORMER OIL SHED AREAS

ADDENDUM NO. 1

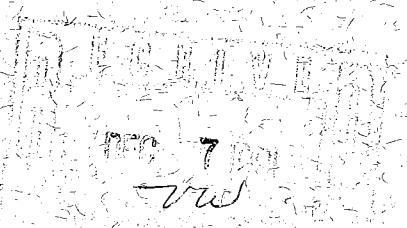
Prepared for

KEYES FIBRE COMPANY
WENATCHEE, WASHINGTON

Prepared by

CH2M HILL Northwest, Inc.

September 1991



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RECEIVED
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DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

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Introduction

In May 1991, Keyes Fibre Company summarized three soil sampling and analysis events conducted at its Wenatchee, Washington plant in *Data Report, Soil Sampling at Railroad/Loading Dock and Former Oil Shed Areas*. This addendum provides additional information pertinent to the data report, including:

- Soil boring log and sample descriptions for the May 1991 sampling event
- Results of water well survey
- Quality control review of laboratory data from all three soil sampling events (January, April, and May)
- Description of laboratory methods for analysis of total petroleum hydrocarbons (TPH) and discussion of differences in results among different methods and laboratories

sea7916/031q.51

Boring Log and Soil Sample Descriptions
May 1991 Sampling Event

Soil Boring Log and Sample Descriptions
May 1991 Sampling Event

In May 1991, 20 soil borings were drilled inside and outside of the main plant building and soil samples from them were collected and analyzed to further delineate the extent of oily soils in the railroad/loading dock and former oil shed areas of the plant. This program and the results of the analyses are described in Section 4 of *Data Report, Soil Sampling at Railroad/Loading Dock and Former Oil Shed Areas.*

During drilling of the borings, a geologic log of each one was recorded on field forms. Because the geologic materials encountered showed little variation within or among the borings, a representative log was drafted for one of the deeper borings (B18). It is included herein. For the other 19 borings, descriptions of the soil samples were prepared and are provided in the following table.

In reviewing the log and descriptions, it should be noted that the USCS designations pertain to the finer-grained matrix within which abundant large cobbles were embedded. Recognition of the relative abundance of cobbles is essential for appreciating the nature of the soils at the Wenatchee Plant.

sea7916/032q.51

GEOLOGIC SOIL BORING LOG

PROJECT NUMBER	BORING NUMBER	SHEET 1 OF 2
SEA31436.A0	B 18	

PROJECT KEYES FIBRE, WENATCHEE
ELEVATION (TOP OF WELL CASING) N/A
WATER LEVEL ELEVATION N/A
DRILLING CONTRACTOR TACOMA PUMP & DRILLING CO.
DRILLING METHOD TRUCK MOUNTED B61, HOLLOW STEM AUGER

LOCATION EASTERN EDGE OF LOADING DOCK AREA
SURFACE ELEVATION APP. 660-670 FT. (USGS TOPO.)
START DATE 5/11/91 08:00
FINISH DATE 5/11/91 11:30
GEOLOGIST M. PEHL, B. NUNN

DEPTH (Ft)	SAMPLE HNu	SAMPLE BLOWS (RECOVERY) %	GEOLOGIC LOG & FIELD OBSERVATIONS	USCS DESIGNATION *	COMMENTS
					BLOW COUNTS IN THIS BORING DO NOT REPRESENT TRUE SOIL DENSITIES DUE TO THE COBBLY NATURE OF THE SOILS
		130-6"	NO RECOVERY		LARGE COBBLES, 4" TO 5", IN CUTTINGS
5		100-2"	NO RECOVERY		
		19-0"	NO RECOVERY		LARGE COBBLE OBSTRUCTING BOREHOLE
		94-6"	NO RECOVERY		LARGE ROCK IN END OF SAMPLER
10		72-6"/ 100-3"	SILTY SAND WITH GRAVEL, grey, dry, very dense	SM	KF-B18-120-13191-XX
		150-5.5"	NO RECOVERY		TWO LARGE ROCKS IN SAMPLER
15		150/ 100-2"	SANDY COBBLES TRACE SILT, grey, dry, very dense	GP	KF-B18-174-13191-XX
		61/ 100-1"	SANDY SILT WITH GRAVEL, grey, moist, very dense	ML	KF-B18-210-13191-XX
		63/ 100-2.5"	SANDY SILT WITH GRAVEL, grey, dry, very dense	ML	KF-B18-222-13191-XX

GEOLOGIC SOIL BORING LOG

PROJECT NUMBER	BORING NUMBER	SHEET 2 OF 2
SEA31436.A0	B 18	

PROJECT KEYES FIBRE, WENATCHEE
ELEVATION (TOP OF WELL CASING) N\A
WATER LEVEL ELEVATION N/A
DRILLING CONTRACTOR TACOMA PUMP & DRILLING CO.
DRILLING METHOD TRUCK MOUNTED B61, HOLLOW STEM AUGER

LOCATION EASTERN EDGE OF LOADING DOCK AREA
SURFACE ELEVATION APP. 660-670FT. (USGS TOPO.)
START DATE 5/11/91 08:00
FINISH DATE 5/11/91 11:30
GEOLOGIST M. PEHL, B. NUNN

DEPTH (Ft)	SAMPLE HNu	SAMPLE BLOWS (RECOVERY) %	GEOLOGIC LOGS & FIELD OBSERVATIONS	USCS DESIGNATION *	COMMENTS
20					BLOW COUNTS IN THIS BORING DO NOT REPRESENT TRUE SOIL DENSITIES DUE TO THE COBBLY NATURE OF THE SOILS
		150-5"	NO RECOVERY		
25		150-5"	SILTY SAND WITH GRAVEL, grey, moist, very dense	SM	KF-B18-300-13191-XX
		120-4"	NO RECOVERY		
		150/ 50-1.5"	SILTY SAND WITH GRAVEL, grey, moist, very dense	SM	KF-B18-352-13191-XX
30			BOTTOM OF BORING		
35					* NOTE: The USCS designation applies only to the finer grained matrix within which the abundant large cobbles occurred.

Summary of Soil Samples
Borings 1 through 20
May 7 - 11, 1991

Boring No. (Total depth in inches)	Attempted Sample Depths (inches)	Sample Description	Date
B01 (237)	60	Silty sand, some gravel, light brown, moist, very dense.	5/7/91
	90	Silty sand, some gravel, light brown, moist, very dense.	
	120	Silty sand with gravel, brown, moist, very dense, slight oil odor.	
	150	No sample recovered.	
	234	No sample recovered.	
B02 (088)	48	Silt with some gravel, light brown, moist, dense to very dense. Bottom six inches of sample at 48 inches appears contaminated with oils.	5/7/91
	78	No sample recovered.	
	87	No sample recovered.	
B03 (240)	60	No recovery.	5/8/91
	90	Sandy silt, some fine to coarse gravel, light brown, moist, very dense.	
	120	Sandy silt, some fine to coarse gravel, light brown, moist, very dense.	
	150	No sample recovered.	
	180	No sample recovered.	
	210	No sample recovered.	
	240	Sandy silt, some fine to coarse gravel, light brown, moist, very dense.	
B04 (30)	30	Large rock caught in the end of the sampler at 30 inches.	5/8/91
B05 (234)	30	Sandy silt, some gravel, light brown, dry, very dense.	5/8/91
	60	Sandy silt, some gravel, light brown, dry, very dense.	
	90	Silty sand, some gravel, light brown, dry, very dense.	
	114	Silty sand, some gravel, light brown, dry, very dense.	
	150	No sample recovered.	
	192	No sample recovered.	
	200	Silty sand, some gravel, grey, dry, very dense.	
	234	No sample recovered.	
B06 (98)	48	Silty sand, some gravel, light brown, dry, dense.	5/8/91
	84	Silty sand, some gravel, light brown, dry, dense.	
	92	Silty sand, some gravel, light brown, dry, dense.	

Summary of Soil Samples
Borings 1 through 20
May 7 - 11, 1991

Boring No. (Total depth in inches)	Attempted Sample Depths (inches)	Sample Description	Date
B07 (78)	24	Silty sand, some gravel, light brown, slightly moist, dense.	5/9/91
	34	Silty sand with some gravel, light brown, moist, dense.	
	36	Oil stains on rocks in the cuttings at 36 inches.	
	60	Silty sand, some gravel, brown, moist, dense. *HNU reads 17 ppm at 60 inches. No sample recovered.	
B08 (240)	30	No sample recovery.	5/9/91
	60	Sandy silt/some gravel, light brown, dry to moist, very dense.	
	90	Silty sand, light brown, dry, very dense.	
	120	No sample recovery.	
	150	No sample recovery.	
	180	No sample recovery.	
	210	Sandy silt, some gravel, light grey, very dense.	
B09 (84)	48	Silty sand with some gravel, light brown, moist, dense.	5/9/91
	72	Silty sand with some gravel, light brown, moist, dense. *HNU reads 100 ppm at 72 inches. No sample recovered.	
B10 (121)	30	Silty sand, some gravel, brown, moist, very dense.	5/9/91
	60	Silty sand, some gravel, moist, very dense.	
	90	No sample recovered.	
	120	Sandy silt, some gravel, tan, moist, very dense.	
B11 (49)	48	Sandy silt, trace gravel, brown, moist, very dense.	5/9/91
B12 (78)	48	Silty sand some gravel, light brown, moist, very dense. *HNU reads 70 ppm at 40 inches.	5/9/91
	66	Silty sand, some gravel, light brown, dry, very dense. *HNU reads 300 ppm at 66 inches.	

Summary of Soil Samples
Borings 1 through 20
May 7 - 11, 1991

Boring No. (Total depth in inches)	Attempted Sample Depths (inches)	Sample Description	Date
B13 (247)	30	Silty sand, some gravel, brown, dry, very dense.	5/9/91
	42	Silty sand, red brown, dry, very dense.	
	60	No sample recovered.	
	90	No sample recovered.	
	120	Sandy silt, some gravel, grey tan, dry, very dense.	
	150	No sample recovered.	
	180	No sample recovered.	
	210	No sample recovered.	
	240	Silty sand, some gravel, grey, dry, very dense.	
B14 (360)	120	No sample recovered.	5/10/91
	150	Silty sand, some gravel, light brown, dry, very dense.	
	180	No sample recovery.	
	210	Sandy silt, some gravel, brown, dry, very dense.	
	240	No sample recovered.	
	270	Sandy silt, some gravel, light brown, dry, very dense.	
	300	Sandy silt, some gravel, light brown, dry, very dense.	
	330	No sample recovered.	
	360	Sandy silt, some gravel, light brown, dry, very dense.	
B15 (66)	36	Silty sand, some gravel, light brown, dry to moist, very dense.	5/10/91
	60	Silty sand, some gravel, light brown, moist, very dense.	
B16 (30)	30	No sample recovered. Refusal at 30 inches.	5/10/91
B17 (360)	60	Silty sand, some gravel, light brown, moist, very dense.	5/10/91
	90	Silty sand, some gravel, tan, dry, very dense.	
	120	No sample recovered.	
	150	No sample recovered.	
	180	No sample recovered.	
	210	No sample recovered.	
	240	No sample recovered.	
	270	No sample recovered.	
	300	No sample recovered.	
	342	Silty sand, some gravel, light brown, moist, very dense.	
	360	No sample recovered.	

Summary of Soil Samples
Borings 1 through 20
May 7 - 11, 1991

Boring No. (Total depth in inches)	Attempted Sample Depths (inches)	Sample Description	Date
B18 (357)	30	No sample recovered.	5/11/91
	60	No sample recovered.	
	90	No sample recovered.	
	108	No sample recovered.	
	120	Silty sand, some gravel, grey, dry, dense.	
	150	No recovery.	
	168	Silty cobbles, trace sand, grey, dry, very dense.	
	210	Sandy silt, with gravel, grey, moist, very dense.	
	222	Sandy silt, with gravel, grey, dry, very dense.	
	270	No recovery.	
	300	Silty sand, with gravel, grey, moist, very dense.	
	330	No sample recovered.	
	342	Silty sand, with gravel, grey, moist very dense.	
B19 (243)	30	Sandy silt, some gravel, red brown, moist, very dense.	5/11/91
	60	No sample recovery.	
	90	No sample recovery.	
	120	No sample recovery.	
	150	No sample recovery.	
	180	No sample recovery.	
	210	No sample recovery.	
	240	Sandy silt, some gravel, brown, dry, very dense.	
SB20 (365)	180	Silty sand with gravel, gray, moist, very dense.	5/11/91
	210	No sample recovery.	
	240	Silty sand with gravel, grey, dry, very dense.	
	270	Silty sand with gravel, grey, dry, very dense.	
	300	Silty sand with gravel, grey, dry, very dense.	
	336	Silty sand with gravel, grey, dry, very dense.	
	360	Silty sand with gravel, grey, dry, very dense.	

*HNU uses a photoionization detector for measuring concentrations of volatile organic compounds in the field. Readings were taken in head space of split spoon.
Note: The sample descriptions apply to the material retained by the sampling device. The soil also contained abundant cobbles that were too large to enter the sampling device. The presence of these cobbles was largely responsible for the lack of sample recovery at many places.

sea7914/012.51

Results of Water Well Survey

Results of Water Well Survey

During the course of the voluntary remedial action program at the Wenatchee Plant, Keyes was concerned about the possibility that the oily soils could be adversely affecting groundwater in the vicinity. To obtain information to use in assessing this possibility, Department of Ecology personnel in the Yakima Regional Office were requested to provide copies of all water well records for Township 23 North, Range 20 East, Sections 9, 10, 11, 14, 15, 16, 21, 22, 23, 26, 27, and 28. Records for seven wells were received (copies are attached). The area searched and approximate locations of the identified wells are shown on the attached figure. Pertinent information from the records is summarized in the attached table.

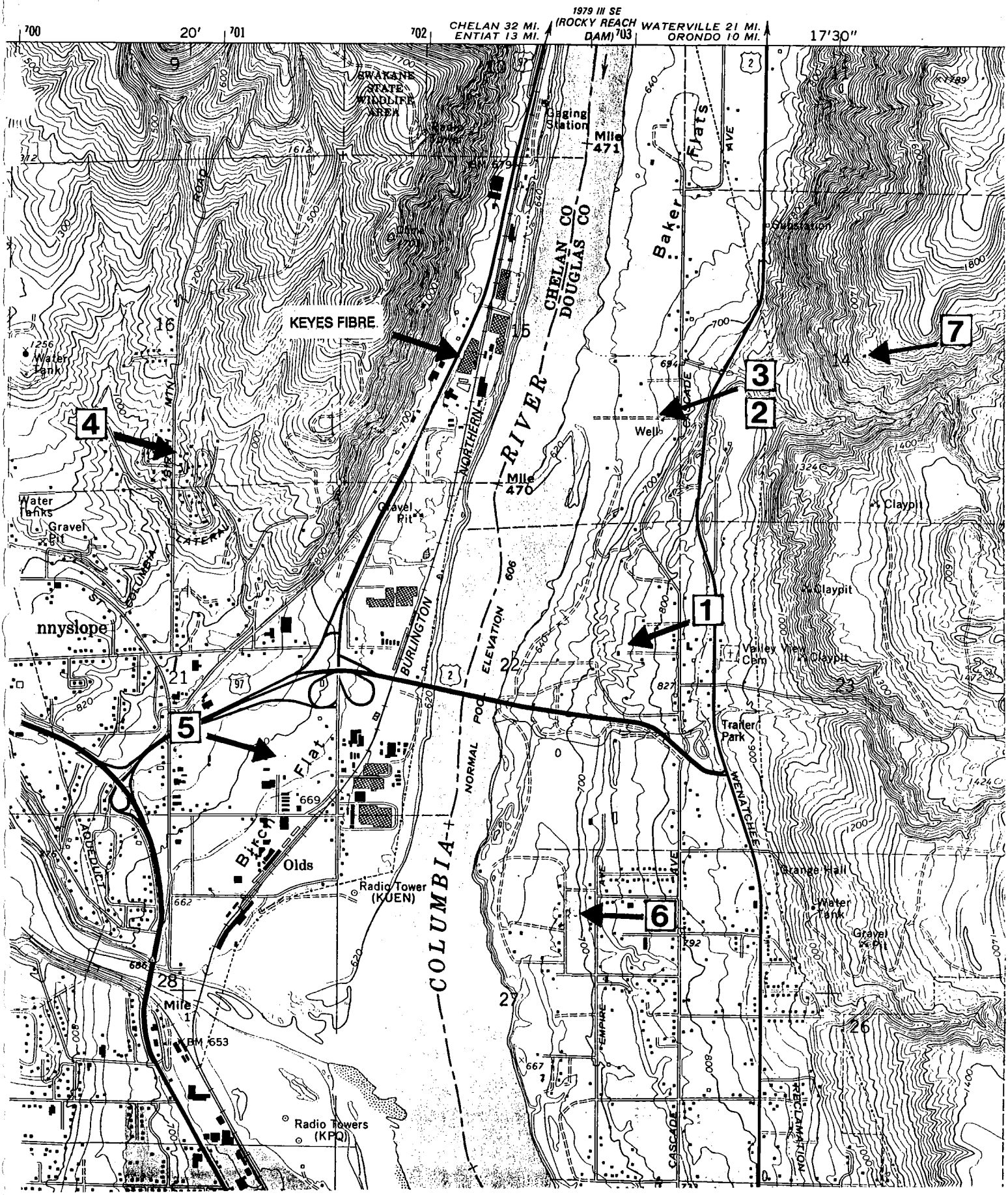
The location of the well listed in row 2 on the Summary of Well Information was recorded incorrectly on the State of Washington Water Well Report. The well report gives the location as SE 1/4, SW 1/4, Sec 15, which would be west of the Columbia River and south of the Keyes Fibre Plant. Contact with the owner indicated that the well is in fact located in an orchard east of the river. Thus, SE 1/4, SE 1/4, Sec 15 appears to be the correct location.

There are no wells recorded in the vicinity of the plant, and so impact on current groundwater users is not a concern.

None of the 20 borings drilled in May 1991 (some of which extended to 30 feet) encountered saturated soils. Thus, there is direct evidence that groundwater occurs no higher than 30 feet depth. However, because of the lack of wells in the vicinity, there are no other direct data on the depth to groundwater near the plant. In addition, contacts with the USGS office in Spokane and Ecology offices in Spokane and Yakima indicated that they were not aware of any other site-specific groundwater information for the nearby area.

However, indirect information concerning possible groundwater levels is available from the USGS 7.5-minute quadrangle map of the area (Wenatchee, Washington), which indicates that the plant's elevation is approximately 660 to 670 feet above sea level. The "normal pool elevation" of the Columbia River east of the plant is 606 feet. If it is assumed (as suggested by the USGS) that local ground water levels are controlled by the river, and that the net water movement is away from the river, then the groundwater level at the plant can be inferred to be approximately 50 to 65 feet or more below the ground surface.

sea7916/033q.51



Locations are approximate, based on Ecology well records. Not field verified.

APPROXIMATE WATER WELL LOCATIONS

NORTH WENATCHEE

SEA 31436.A0, 6/18/91

Summary of Water Well Information

	Owner Name and Address	Location of Well	Year Drilled	Depth of Well (ft)	Type of Use
1	Stemilt Growers Wenatchee Washington	SE 1/4, NE 1/4, Section 22, T23N, R20E	08/12/74	120	Domestic/Industrial
2	John Tontz 214 39th Northwest East Wenatchee, WA 98802	SE 1/4, SE 1/4, Section 15, T23N, R20E (See note below)	12/29/88	40	Domestic
3	Fred Gibson Route 3, Box 3163 Wenatchee, WA	Section 15, T23N, R20E	07/12/75	95	Domestic/Irrigation
4	Roger Starkweather 3525 Burch Mountain Road Wenatchee, WA	SW 1/4, SE 1/4, Section 16, T23N, R20E	03/24/87	486	Domestic
5	Don Holman Route 1, Box 200A Cashmere, WA	SE 1/4, SE 1/4, Section 21, T23N, R20W	03/06/81	100	Domestic
6	R.A. Johnson Route 3 Box 3328 Wenatchee, WA 98861	NW 1/4, NE 1/4, Section 27, T23N, R20W	03/21/81	185	Domestic
7	Hal Waterhouse 4141 Sunset Highway East Wenatchee, WA 98801	SW 1/4, NE 1/4, Section 14, T23N, R20W	04/28/87	180	Domestic

Note: Well report gives location as SE 1/4, SW 1/4, Sec 15, which would be west of the Columbia River. Contact with owner indicated that the well is in fact located in an orchard east of the river. Thus, SE 1/4, SE 1/4, Sec 15 appears to be the correct location.

sea7914\005.51

Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Permit No. [illegible] C

(1) OWNER: Name STEWART Growers Inc. Address Wenatchee Washington

(2) LOCATION OF WELL: County CHELAN S½ SE/4 SE ¼ NE ¼ Sec. 22 T. 23 N., R. 20 E W.M.

Bearing and distance from section or subdivision corner

PROPOSED USE: Domestic [X] Industrial [X] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 8" inches.
Drilled 120 ft. Depth of completed well 103 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 0 ft. to 110 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " Diam. from ft. to ft.

Perforations: Yes [X] No [ ]
Type of perforator used Mill
SIZE of perforations ¼ in. by 2 in.
15 perforations from 88 ft. to 90 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [X]
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name STA-RITE
Type: Submersible H.P. 5

(8) WATER LEVELS: Land-surface elevation above mean sea level.... 665 ft.
Static level 42 ft. below top of well Date 7/11/74
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?
Yield: gal./min. with ft. drawdown after 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
Bailer test 20 gal./min. with 5 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(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
Gravel & Small Boulders	0	36
Brown Sand	36	45
Blue Clay	45	86
Corse Sand	86	94
Fine Sand with Some Clay	94	120
Sand Stone	120	

RECEIVED
JUL 15 1974
DEPT. OF ECOLOGY

Work started June 27, 19 74 Completed July 12, 19 74

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 Albert Glessner
(Person, firm, or corporation) (Type or print)

Address Mansfield Wash

[Signed] Albert Glessner
(Well Driller)

License No. Date July 12, 19 74

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

OK

196

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

Application No. .....
Permit No. 98802

(1) OWNER: Name John Toutz Address 214 39th NW Wenatchee Wash

(2) LOCATION OF WELL: County Douglas SE ¼ SW ¼ Sec 15 T 23 N., R 20E 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).... 1
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☒ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 25 ft. Depth of completed well 70 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from -7 ft. to 390' ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to 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? ft.
Material used in seal
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 70 ft. below top of well Date 12/29/88
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?
Yield: gal./min. with ft. drawdown after 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
Bailer test 20 gal./min. with 0 ft. drawdown after 1 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
Old well	0	12'
Sand, Gravel & Boulders	12'	30'
River Sand & Gravel	30'	400'

RECEIVED
DEC 29 1988
DEPARTMENT OF ECOLOGY

Work started 12/28, 1988 Completed 12/29, 1988

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 Close Well Drilling (Person, firm, or corporation) (Type or print)
Address P.O. Box 125 Quincy Wa. 98848
[Signed] (Well Driller)
License No. 701 Date 12/29, 1988

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

Application No. _____
Permit No. G3-24[illegible]

(1) OWNER: Name Fred Hibson Address Rt 3 Box 3163 Wenatchee Wash

(2) LOCATION OF WELL: County Douglas Courtland 4 ¼ ¼ Sec 15 T 23 N R 20 E WM
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) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 8" inches.
Drilled 96 ft. Depth of completed well ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8 " Diam. from 1 ft. to 95 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to 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 BENTONITE
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Jacuzzi
Type: Submergible H.P. 3

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 35' ft. below top of well Date 7-12-75
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?
Yield: gal./min. with ft. drawdown after 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
Bailer test 60 gal./min. with 6' ft. drawdown after 1 hrs.
Artesian flow NO 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
Sand	0	11'
Sand - Gravel + Boulders	11'	46'
Blue Clay	46'	92'
Coarse Sand & Gravel	92'	95'

RECEIVED
JUL 1975
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 6-30, 19 75 Completed 7-12, 19 75

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 Elmer Drilling (Person, firm, or corporation) (Type or print)
Address Box 125 Quincy, WN
[Signed] Elmer Drilling (Well Driller)
License No. 0088 Date 7-12 19 75

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

Well Log OK
7/28/75

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

Application No. Q
Permit No. ....

(1) OWNER: Name Roger Stallweather Address 3525 Burch Mt Rd Wenatchee Wa.

(2) LOCATION OF WELL: County Chelan SW ¼ SE ¼ Sec. 16 T. 23 N., R. 20E 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) .... New well ☒ Method: Dug ☐ Bored ☐ Deepened ☐ Cable ☐ Driven ☐ Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 & 8 inches. Drilled 486 ft. Depth of completed well 486 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8" Diam. from +1.5 ft. to 66 ft.
Threaded ☐ 6" Diam. from 66 ft. to 486 ft.
Welded ☒ ..." Diam. from ... ft. to ... ft.

Perforations: Yes ☐ No ☐
Type of perforator used ....
SIZE of perforations ... in. by ... in.
... perforations from ... ft. to ... 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? 26 ft.
Material used in seal Bentonite Slurry
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? Sulfur Depth of strata 6
Method of sealing strata off cased

(7) PUMP: Manufacturer's Name Grundfos H.P. 2
Type: Sub

(8) WATER LEVELS: Land-surface elevation above mean sea level .... 900 ft.
Static level 15 ft. below top of well Date 4-9-87
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 driller
Was a pump test made? Yes ☒ No ☐ If yes, by whom? ....
Yield: 8.5 gal./min. with 250 ft. drawdown after 2 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 4-9-87
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
Sand	0	6
Silt & sand	6	14
Sand & gravel	14	16
Silty sand & gravel	16	26
Sand wet	26	32
Silt	32	38
Wet clay brown	38	40
Cleaner sand & gravel	40	46
sandstone/siltstone	46	62
quartzite sandstone	62	70
Fractured sandstone grey-brown	70	215
granite broken	215	217
Firm granite, black/white	217	426
granite soft	426	429
granite hard, black/white	429	440
Soft broken granite, blue	440	448
medium hard granite, black & white	448	486

RECEIVED
APR 16 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 3-18 19 87 Completed 3-24 19 87

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 MVM Quality Drilling (Person, firm, or corporation) (Type or print)
Address 760 Highland Rd Bridgeport Wa 98813
[Signed] Marshall V Miller (Well Driller)
License No. 1437 Date 4-1 19 87

(USE ADDITIONAL SHEETS IF NECESSARY)

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

Application No. /
Permit No. /

(1) OWNER: Name Don Holman Address R+1 Box 200A Cashmere Wa

(2) LOCATION OF WELL: County Chelan SE ¼ SE ¼ Sec. 21 T. 23 N., R. 20 W.M.

Bearing and distance from section or subdivision corner

R

(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 100 ft. Depth of completed well 99 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 8" Diam. from 0 ft. to 30 ft.
Threaded ☐ 6" Diam. from 3 ft. to 99 ft.
Welded ☑ Plastic Diam. from ft. to ft.

Perforations: Yes ☑ No ☐
Type of perforator used Spill saw
SIZE of perforations 8 in. by 10 in.
120 perforations from 40 ft. to 98 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? 30 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 9 ft. below top of well Date 3-6-81
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?
Yield: gal./min. with ft. drawdown after 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
Bailer test 20 gal./min. with 90 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date 3-6-81
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
Clay	0	10
Clay and gravel	10	20
Silty sand	20	29
Shale	29	50
Sand Stone	50	82
Shale	82	92
Sand Stone water	92	100

RECEIVED
JUN 26 1981
DEPART...
CENTR...

GP 7-28-81

Work started 3-3 19 81 Completed 3-6 19 81

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 Tumwater Drilling Corp (Person, firm, or corporation) (Type or print)
Address RT 1 Box 133C Leavenworth Wa
[Signed] Clayton Blythe (Well Driller)
License No. 0950 Date 3-6-81 19

(USE ADDITIONAL SHEETS IF NECESSARY)

3

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

Application No. .....
Permit No. 48867

(1) OWNER: Name R. Dwarld Johnson Address Rt 3. Box 3328 Wenatchee WE

(2) LOCATION OF WELL: County Douglas Co. NW ¼ NE ¼ Sec 27 T. 23 N., R. 20 W.M.

ing 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) .....
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 185 ft. Depth of completed well 185 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Diam. from 0 ft. to 80 ft.
Threaded ☐ ..... " Diam. from ..... ft. to ..... ft.
Welded ☑ ..... " Diam. from ..... ft. to ..... ft.

Perforations: Yes ☐ No ☑
Type of perforator used .....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... 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 Bentonite
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 115 ft. below top of well Date 3-20-81
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? .....
Yield: ..... gal./min. with ..... ft. drawdown after ..... 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 3-21-81
Bailer test 5 gal./min. with 80 ft. drawdown after 1 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
Sand Brown	0	15
Gravel Fine	15	18
Gravel Fine	18	38
Gravel Coarse	38	80
Sand Stone Gray	80	165
Quartz White W/B	165	167
Sand Stone Gray Lava	167	185

MAY - 1 1981

Work started 3-20-, 1981 Completed 3-21-, 1981

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 AAA + Well Drilling (Person, firm, or corporation) (Type or print)
Address Rt 1 Box 38a Malaga, Wa 98828
[Signed] Dennis M. Jackson (Well Driller)
License No. 0676 Date 3-21-, 1981

(USE ADDITIONAL SHEETS IF NECESSARY)

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

Application No. .....
Permit No. 5

(1) **OWNER:** Name Hal Waterhouse Address 4141 Sunset HW, East Wenatchee, WA 98801

(2) **LOCATION OF WELL:** County Chelan — SW ¼ NE ¼ Sec. 14 T. 23 N., R. 20 W.M.

Bearing and distance from section or subdivision corner

(3) **PROPOSED USE:** Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 180 ft. Depth of completed well 180 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 6 " Diam. from +1 ft. to 176 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " Diam. from ft. to ft.

Perforations: Yes [XX] No [ ] Air
Type of perforator used
SIZE of perforations ¼ in. by 2 in.
150 perforations from 150 ft. to 165 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes [ ] No [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes [ ] No [X] Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes [X] No [ ] To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes [ ] No [XX]
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 115 ft. below top of well Date
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?
Yield: 40 gal./min. with ft. drawdown after 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
er test gal./min. with ft. drawdown after hrs.
tesian 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
Top Soil	0	3
Sandy Clay	3	12
Sand, Gravel, Boulders	12	45
Sand, Gravel	45	70
Sand, Gravel, Some Water	70	75
Brown Clay	75	120
sand, Gravel, Water	120	166
Brown Clay	166	175
Shale	175	180

RECEIVED MAY 11 1987 DEPT. OF ECOLOGY CENTRAL REGION OFFICE

RECEIVED MAY - 7 1987 DEPARTMENT OF ECOLOGY CENTRAL REGION OFFICE

Work started 4/24, 19 87 Completed 4/28, 19 87

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 CCT Well Drilling (Person, firm, or corporation) (Type or print)

Address Box 150, Nespelem, WA 99155

[Signed] Joseph L Bartlett (Well Driller)

License No. #0564 Date 5/4/, 19 87

(USE ADDITIONAL SHEETS IF NECESSARY)

Quality Control Review of Laboratory Data

QUALITY CONTROL REVIEW OF LABORATORY DATA

Laboratory data from all three soil sampling events were presented in the May data report. Information obtained from the quality control (QC) samples was reviewed to assess whether or not any qualifiers needed to be attached to use of the data.

QC data (laboratory method blank, reagent blank, matrix spike, matrix spike duplicate, and duplicate sample results) from the 1991 sampling at Keyes Fibre in Wenatchee were reviewed. This review included samples sent to CH2M HILL's Redding Laboratory in January, samples sent to Eureka Laboratories in April and May, and the onsite close support laboratory data collected in May. The QC review indicates the sample data are usable for quantitative purposes.

The following abbreviations are used in the QC review:

CLP = EPA contract laboratory program.

MB = Method blank. This is a sample of the reagent that has been treated to the full extraction and analysis procedure.

RB = Reagent blank. This is a reagent sample that has not been extracted.

MS = Matrix spike sample. This sample has had a known amount of analyte added to it prior to extraction.

MSD = Matrix spike duplicate sample.

RS = Reagent spike sample. This is a reagent sample with a known amount of analyte added to it. This is run when there is insufficient environmental sample to run a MS.

%D = Percent difference. A measurement of precision calculated using calibration samples. The formula is:

$$\%D = \frac{\textit{true value} - \textit{detected value}}{\textit{true value}} \times 100$$

The target range is a %D of less than 20 percent.

RPD = Relative percent difference. A measurement of precision calculated using laboratory duplicate or MS/MSD pairs. The formula is:

$$RPD = \frac{detected\ value_1 - detected\ value_2}{\left(\frac{detected\ value_1 + detected\ value_2}{2}\right)}$$

The target range for soil samples is RPD of less than 35 percent and for water samples an RPD of less than 20 percent. The organic compounds analyzed by Eureka Laboratories in April were compared to EPA's CLP ranges.

%R = Percent recovery. A measurement of accuracy calculated using MS and RS. The formula is:

$$\%R = \left(\frac{detected\ value_{MS} - detected\ value_{sample}}{amount\ of\ spike\ added}\right) X\ 100$$

The target range is 75 to 125 percent R. The organic compounds analyzed by Eureka Laboratories were compared to EPA's CLP ranges.

CH2M HILL Redding Laboratory

The Redding Laboratory received two soil samples collected during the January sampling event for analysis of TPH by method 418.1, flashpoint by method 1010, TCLP metals by extraction method 1311/analysis methods 6010 and 7470, and PCBs by method 8080. The laboratory provided case narratives but no data sheets for QC samples except for method blanks.

The laboratory reported that all laboratory QC criteria were met except for arsenic recovery in the TCLP extract and surrogate spike recovery for the PCB analyses. The arsenic values should be considered as estimates. The surrogate used for PCB analysis was degraded by the cleanup step required by matrix interference.

Eureka Laboratories Data

Eureka received nine soil stockpile samples in April for analysis of

- PCBs by method 8080

- TPH by method 418.1
- TCLP metals by extraction method 1311 and analysis methods 6010, 7060, 7470, and 7740
- Ignitability by method 1010
- Purgeable aromatic compounds by method 8020

Nine verification soil samples collected in April were analyzed for TPH by method 418.1. Two soil samples were submitted for further characterization. These two samples were analyzed for TPH and priority pollutants as follows:

- TPH by method 8015
- Total metals by method 6010/7000 series
- Volatile organics by method 8240
- Semivolatile organics by method 8270
- Pesticides/PCBs by method 8080

Eight soil samples were submitted to Eureka in May for TPH by method 418.1. Two of the samples were also analyzed for TPH by method 8015. The QC data for Eureka Laboratories are summarized in Table 1.

Accuracy, as measured by MS and RS recovery, was within the target ranges except for two parameters. The spike duplicate samples for each parameter that exceeded the target range were within the target range, so no qualifiers are recommended.

Precision, as measured by the RPD between duplicate analyses, was within the target range for all parameters.

No contaminants were reported in MB or RB.

Onsite Laboratory Data

Sixty-nine soil samples were run for TPH by method 418.1. Initial calibrations were run on 3 days out of the 4 days onsite. The linear regression run on the six standards on May 8 indicated that one or more of the standards was not on the straight line. No samples were run on this day. The other two sets were calculated for just the four lower concentration standards. These had acceptable regressions and samples were run both days. The day where no initial calibration was run, the continuing calibration samples had recoveries within the target range. The CH2M HILL protocols for onsite analysis of TPH do not require an initial calibration set be run every day, so no data qualifiers are needed.

Table 1
Eureka Laboratories QA/QC

Parameter	Percent Recovery		RPD
	MS	MSD	
TPH by 418.1	101	103	2.0
TPH by 8015, gas	94	125	28
TPH by 8015, diesel	88	122	32
Phenol	89	92	3.3
2-Chlorophenol	49	54	9.7
4-Chloro-3-methylphenol	78	69	12
4-Nitrophenol	92	89	3.3
Pentachlorophenol	65	67	3.0
1,4-Dichlorobenzene	46	55	18
N-Nitrosodi-n-propylamine	90	91	1.1
1,2,4-Trichlorobenzene	75	72	4.1
Acenaphthene	59	66	11
2,4-Dinitrotoluene	64	68	6.1
Pyrene	53	44	18
1,1-Dicholoroethene	95	100	5.1
Trichloroethene	100	97	3.0
Benzene	98	101	1.0
Toluene	98	100	2.0
Chlorobenzene	106	102	3.8
Silver	79	80	1.3
Beryllium	92	91	1.1
Cadmium	84	85	1.2
Chromium	86	86	0.0
Copper	90	91	1.1
Nickel	84	85	1.2
Antimony	86	85	1.2
Zinc	89	84	5.8
Thallium	88	85	3.5

Table 1
Eureka Laboratories QA/QC

Parameter	Percent Recovery		RPD
	MS	MSD	
Lead	100	99	1.0
Mercury	86	88	2.3
Arsenic	77	77	0.0
Selenium	83	82	1.2
Aldrin	68	68	0.0
Lindane	77	72	6.7
4,4-DDT	77	61	5.1
Dieldrin	81	62	27
Heptaclor	98	83	17
PCB	95	92	3.2
TPH by 418.1	100	101	1.0
TCLP/Silver	84	86	2.4
TCLP/Barium	88	88	0.0
TCLP/Cadmium	87	89	2.3
TCLP/Chromium	80	82	2.5
TCLP/Lead	88	90	2.2
TCLP/Mercury	90	80	12
TCLP/Arsenic	83	86	3.6
TCLP/Selenium	82	81	1.2
Benzene	86	79	8.6
Chlorobenzene	89	82	8.2
1,2-Dichlorobenzene	108	103	4.8
1,3-Dichlorobenzene	88	82	7.1
1,4-Dichlorobenzene	96	89	7.6
Ethylbenzene	87	81	7.1
Toluene	91	92	1.1
Xylenes	94	89	5.5
TPH by 8015, diesel	123	131[a]	6.3

Table 1
Eureka Laboratories QA/QC

Parameter	Percent Recovery		RPD
	MS	MSD	
TPH by 418.1	100	102	2.0
TPH by 418.1	108	97	11
TPH by 418.1	97	101	4.0
TPH by 418.1	63[a]	85	30
TPH by 418.1	104	111	6.5

[a]Value is outside target criterion.

Table 2
Onsite Laboratory
Continuing Calibration Standards

Standard	Detected Concentration	%D
76.6	78.14	2.01
76.6	75.10	1.96
76.6	75.10	1.96
76.6	60.48	21.0
38.4	36.42	5.16
191.8	182.31	4.95
19.2	19.38	0.94
76.6	72.10	5.87
76.6	69.13	9.70

The continuing calibrations had %D within the target range. The values are shown in Table 2.

Accuracy, as measured by %R of MS, was within the target range for the majority of the samples run. The MS samples are shown in Table 3. The samples were all spiked with 38.36 ppm of the standard solution. Three of the MS, where the sample had measurable TPH, had recoveries below the target range. This indicates a possible low bias to the detected results, but data are not generally qualified just on the basis of matrix spikes because of the inherent heterogeneity of soil samples. One MS exceeded the upper limit. Since this sample was not run as a MSD, the source of this exceedance cannot be determined.

Precision, as measured by the RPD between duplicate samples, was generally within the target range. For the MS/MSD, this is shown on Table 3. For the field and laboratory duplicates the values are shown on Table 4. Of the 11 duplicate pairs, three had RPD that exceed the target range of 0 to 35 percent. For five pairs, the RPD could not be calculated because no TPH was detected in either sample. Because of the exceedances, detected values for May 9 and 10 should be considered as estimates.

QC samples were run at the rate specified in the CH2M HILL close support laboratory analytical method (see *Data Report, Soil Sampling at Railroad/Loading Dock and Former Oil Shed Area*, May 1991, Appendix F).

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Table 3
Onsite Laboratory
Matrix Spike Samples

Sample ID	Concentration			% Recovery		RPD
	Sample	MS	MSD	MS	MSD	
KF-B02-048-12791-XX	33.9	54.9	--	54.7[a]	--	--
KF-B07-036-12891-XX	5.77	44.15	46.79	100.0	106.9	6.67
KF-B13-042-12991-DU	3.58	36.42	36.42	85.6	85.6	0.0
KF-B18-222-13191-XX	60.48	90.77	78.14	79.0	46.0[a]	52.8
KF-B19-030-13191-XX	7.98	72.10	--	167.1[a]	--	--

[a]Recovery is outside target range.

Table 4
Onsite Laboratory
Duplicate Samples

Sample	Concentration		RPD
	Sample	Duplicate	
KF-B02-048-12791-XX*	667	1,244	60.4
KF-B05-030-12891-XX	408	442	8.0
KF-B12-048-12991-XX	60	144	82
KF-B13-042-12991-XX	7U	7U	NC
KF-B15-036-13091-XX	7U	7U	NC
KF-B17-060-13091-XX	7U	7U	NC
KF-B20-336-13191-XX	7U	7U	NC
KF-B20-360-13191-XX	7U	7U	NC

U = Sample was below detection limit.
NC = RPD is not calculable.

*This sample was a laboratory duplicate. All other duplicates were field duplicates.

Discussion of
Total Petroleum Hydrocarbon Data

Discussion of
Total Petroleum Hydrocarbons (TPH) Data

Description of Analytical Methods for TPH

TPH is a difficult parameter to quantify because of the large number of organic compounds that are members of the petroleum hydrocarbon class. Common petroleum products, such as gasoline or diesel fuel, are a mixture of many different compounds. There are two common approaches to analyzing TPH. Both methods have been used as indicated on Table 1. Both methods have been modified from the original EPA methods. Method 418.1 had to be modified to extract soil samples because it was originally a method for analyzing only water. Method 8015 was modified (originally by the State of California) to expand the method from individual compounds to TPH classes.

Modified Method 8015: Gas Chromatography (GC) Analysis

One way to separate a complex mixture of hydrocarbons is to use GC to separate the individual components by differences in boiling points. This method allows the hydrocarbons to be grouped into three categories by increasing building points or molecular weights--gasoline, diesel, and heavy petroleum. Method 8015 detects volatile nonchlorinated organic compounds after the compounds have been separated from the bulk material by either purge and trap (Method 5030, preferred for low boiling compounds or mixtures such as gasoline) or extraction (Method 3540 or 3550, preferred for higher boiling compounds and diesel mixtures and then injected into the GC). The initial calibration of the GC have been modified to include petroleum standards n-dodecane (a 12-carbon chain), n-tetracosane (24-carbon chain), and n-triacosane (a 30-carbon chain). Reference spectra are also run for the various petroleum fractions (gasoline, kerosene, jet fuel, etc,) so that the unknown sample can be compared to known patterns. Depending on the method used, the concentration of some of the individual compounds can be measured. This method works best if the TPH source is either gasoline or diesel. The heavy petroleum constituents may have boiling points that are too high to be separated under the normal GC conditions.

Modified Method 418.1: Infrared (IR) Spectrophotometric Analyses

The second method for analyzing TPH and Ecology's recommended method for heavy petroleum is to measure the intensity of the carbon-hydrogen stretch by IR spectrophotometry. This method was used by both the onsite and offsite laboratories.

The analysis procedure for Method 418.1 involves acidifying a 1-liter water sample, extracting the organic compounds from the water into Freon-113 (1,1,2-trichloro-1,2,2-trifluoromethane), drying the freon and treating it with silica gel to remove polar compounds such as animal fats and phenols, and measuring the intensity of the carbon-

Table 1
TPH Analyses Keyes Fibre Wenatchee Plant

Date	Number of Samples	Method	Laboratory	Purpose
January 1991	2	418.1	CH2M HILL Redding Laboratory	Preliminary site characterization
April 1991	9	418.1	Eureka Laboratories	Excavation verification
	9	418.1	Eureka Laboratories	Characterization for disposal
	2	8015	Eureka Laboratories	Confirmation that the detected TPH was heavy petroleum
May 1991	69	418.1	Onsite CSL	Characterization, information used to guide investigation
	8	418.1	Eureka Laboratories	General check on CSL results
	2	8015	Eureka Laboratories	Additional characterization of samples when onsite/offsite results showed relatively large differences

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hydrogen stretching frequency. There is no one, unique frequency for the carbon-hydrogen stretch, so method 418.1 uses the peak at 2930 cm^{-1} for quantitation. This frequency represents the strongest stretching mode for linear hydrocarbons (such as n-octane) but will not include the carbon-hydrogen stretch for alkenes (carbon-carbon double bond), alkynes (carbon-carbon triple bond) or aromatic compounds (such as benzene and toluene). These compounds are also hydrocarbons and are minor components in petroleum products but are not quantitated by this method. The attached figure illustrates the C-H stretching frequency region for several hydrocarbons.

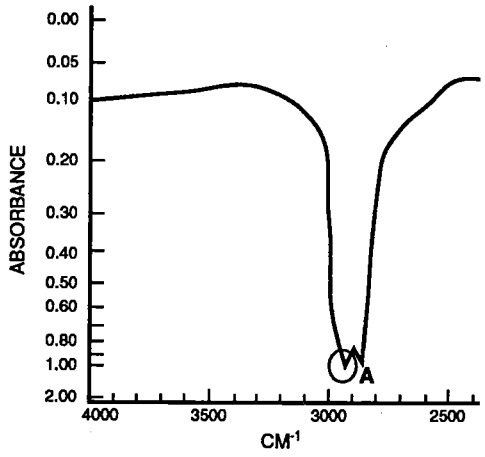
To extract the organic compounds from a soil sample the soil is dried, acidified, extracted into freon (there are several acceptable methods--the onsite laboratory used sonication), treated with silica gel and analyzed. The onsite laboratory used the method described in an appendix to the May 1991 report. The offsite laboratory followed a similar preparation procedure, but quantified the results differently.

Discussion of Differences Between The Results

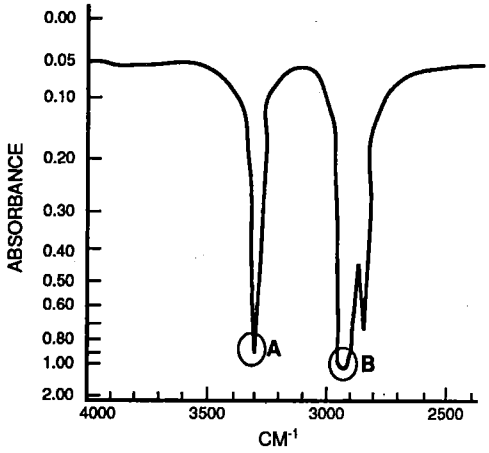
Two samples from the May sampling effort were submitted to an offsite laboratory (Eureka Laboratories) for analysis by modified method 8015 to verify that the oily materials in the soils were in the heavy petroleum range. These samples are shown in Table 2. Both samples had measurable TPH that was, as expected, in the heavy petroleum range (the laboratory quantifies this range against motor oil). The Washington State Department of Ecology (Ecology) has recommended that method 418.1 be used to quantitate heavy petroleum products rather than method 8015 (See *Guidance for Site Checks and Site Assessments for Underground Storage Tanks*, February 1991, and the draft *Total Petroleum Hydrocarbons Analytical Methods*, July 10, 1991) and so Method 4181.1 was used as the principal method for subsequent TPH analysis.

Following Ecology's guidance on method selection, method 418.1 should be the appropriate analytical method for the petroleum contamination at Keyes Fibre's Wenatchee Plant. The TPH levels detected by method 8015 may not be quantitatively accurate, however these results do indicate that heavy petroleum is present.

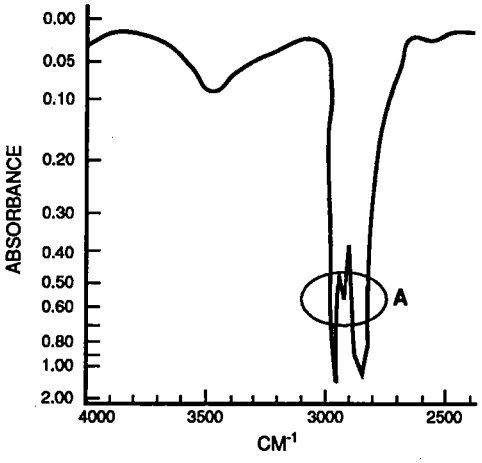
Except for the samples from borings B06 and B07 (KF-B06-092-12891-XX and KF-B07-034-12891-XX, respectively), the detected value reported by the offsite laboratory are consistent and considerably larger than the levels reported by the onsite laboratory. The onsite laboratory followed the procedure for method 418.1 and quantitated TPH using the intensity of the peak at 2,930 cm^{-1}. The offsite laboratory used an IR spectrophotometer (that has been developed since method 418.1 was introduced) that has the capability of measuring the area of the carbon-hydrogen stretch peaks. The machine measures the peaks from 2500 to 3200 cm^{-1}, which is the full range of C-H stretching frequencies. This can result in larger reported concentrations even though the calibrations are also run on area rather than peak height, because the standard calibration solution does not include alkenes, alkynes, or aromatic compounds. (For



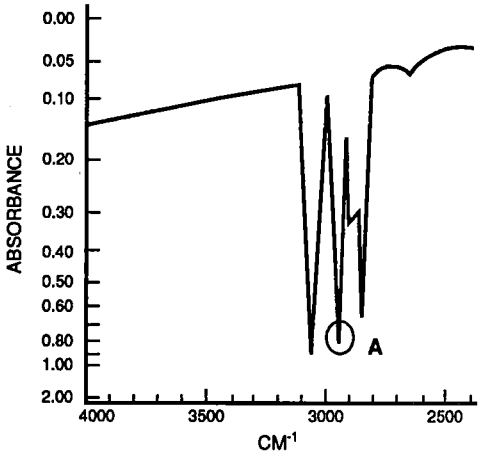
Examples of a "normal" petroleum hydrocarbon. Peak "A" is quantitation peak.



Peak "A" is due to the C-H stretch for a C-C triple bond. Peak "B" is quantitation peak.



Peak "A" would be the peak quantitated by Method 418.1.



Compound has C-C double bonds, which give rise to the peak to the left of "A". Peak "A is the quantitation peak.

Figure

SAMPLE CHROMATOGRAMS SHOWING QUANTITATION PEAK

Keyes Fibre Company
Wenatchee, Washington

Disk 79-4 SEA 314. KEYES FIBRE S. Trudell Sample Chromatograms 9-5-91 LKW

KF-B07-034-12891-XX, the concentration is close to the reporting limit and is subject to the inherent difficulty in measuring small concentrations.) The three analytical methods (onsite and offsite 41.8 and offsite 8015) all quantitate petroleum hydrocarbons, but each measures different properties of TPH. Modified Method 8015 does a good job of quantitating low boiling fractions of petroleum, and is useful in determining that the detected compounds originated from petroleum products but it is not the best method for quantitating heavy petroleum because some of the compounds will not move through the column to the detector. Method 4181.1 is not a good quantitation method for gasoline because the more volatile compounds can be lost during the extraction procedure but is a good method for freon soluble heavier petroleum compounds. (Note that neither method is very good at quantitating petroleum fractions such as asphalt or roofing tar.) The offsite 418.1 method quantitates literally all hydrocarbon (H-C) bond stretch. The method, however, was originally designed to quantitate TPH by focusing on the dominant feature of petroleum fractions--the linear, saturated carbon chain, which is characterized by the peak at 2930 cm^{-1}. As can be seen in the attached figure, two peaks that have similar intensity could have very different areas as one is a broad peak and the second is narrow.

The quality control (QC) results for all the TPH runs indicate that the data can generally be used as reported (some of the onsite TPH results are estimates because of the QC results). The difference between samples run by more than one method are consistent with the differences in the focus of the analytical methods. In terms of which value is "correct," the onsite laboratory data was obtained following the method specified Ecology; and these are the appropriate values to compare to the petroleum contaminated soil cleanup criteria.

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