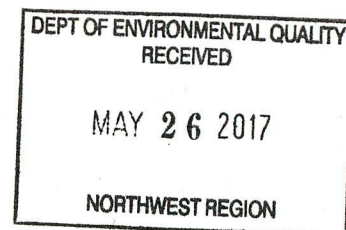


ORIGINAL



May 23, 2017

Mr. Andrew Danhof, Jr., PE
Environmental Manager
Arc Terminals
3000 Research Forest Drive, Suite 250
The Woodlands, Texas 77381

Re: Groundwater and LNAPL Gauging
Portland Terminal
5501 NW Front Avenue
Portland, Oregon 97210
2291-02

Dear Mr. Danhof:

Apex Companies, LLC (Apex) performed gauging activities on March 14, 2017 on behalf of Arc Terminals at the Portland Terminal (Terminal) to document the groundwater elevations and thickness of light non-aqueous phase liquid (LNAPL) in the area of a past naphtha release near Tank T-113. Measurements were made in five monitoring wells (A-4, W-31 to W-34) and eight sumps (S-1 to S-8) associated with the naphtha release. Except for upgradient well W-31 and cross-gradient sumps S-1 and S-8, all locations are downgradient of Tank T-113.

METHODOLOGY

An Apex field staff member mobilized to the Terminal on March 14, 2017; field notes are presented in Attachment A. Upon arrival at the field location, the covers were opened on wells A-4 and W-31 to W-34, as well as sumps S1 to S8, which allowed the groundwater level in each well to equilibrate in response to ambient atmospheric pressure (see Figures 1 and 2). An oil/water interface probe was used to measure the depth to LNAPL (when present) and the groundwater surface. These measurements were made to the nearest one-hundredth of a foot (i.e., 0.01 ft). Where only groundwater is present, two separate measurements are made and recorded on the Well Gauging Data Sheet (see Attachment A). When LNAPL is present, three separate measurements are made for the depths to the LNAPL and groundwater surfaces. Each set of values was averaged and the resulting mean value was recorded on Table 1, which presents the historical data from May 2013 to present. Groundwater elevations, LNAPL thickness, and groundwater surface contours are presented in Figure 3.

During the first quarter 2017, LNAPL purging events were performed on a regular basis by Terminal staff. LNAPL is removed from wells and sumps associated with the naphtha release. The most recent LNAPL purging was reportedly performed on March 13, 2017, which was the day before the gauging event.

FINDINGS

The groundwater measurements generally indicate a northeasterly flow direction, toward the Willamette River, at a gradient of approximately 0.013 foot per foot (ft/ft) across the gauged area. The groundwater flow direction was generally consistent with historical measurements. The groundwater levels in the sumps were approximately 1.20 to 1.65 feet (ft) higher than in December 2016, which reflects increasing rainfall available for infiltration into the subsurface during the previous three months. The groundwater levels in the wells increased between 1.58 to 2.04 ft relative to the December 2016 measurements. Figure 3 presents groundwater elevations and contours across the area of the gauged wells and sumps. As LNAPL was not measured in any of the sumps and wells, the groundwater

elevation measurements were not corrected for a layer of petroleum on the water column (i.e., using a lower specific gravity of 0.80 as a general value for petroleum LNAPL; see Table 1). The as-measured groundwater elevation values are presented on Figure 3 and are used for contouring.

Since LNAPL was not measured in any sumps and wells during the March 14, 2017 gauging event, the groundwater elevation results support site closure under the Oregon Department of Environmental Quality's required LNAPL thickness of less than 0.10 ft.

The next scheduled gauging event will be conducted in June 2017.

If there are any questions regarding the information in this report, or if I can be of further assistance, please contact me at (503) 924-4704.

Sincerely,



Gary Walvatne, R.G.
Senior Associate Geologist

ATTACHMENTS

Table 1 – Well Gauging

Figure 1 – Site Location Map

Figure 2 – Site Vicinity Plan

Figure 3 – Groundwater Elevations (March 14, 2017)

Attachment A – Well Gauging Data Sheet

Table 1
Well Gauging
Arc Terminals
5501 NW Front Avenue
Portland, Oregon

Sump or Monitoring Well No.	Sample Date	Casing Elevation (feet msl) ¹	Depth to Water (feet) ²	Depth to LNAPL (feet) ²	LNAPL Thickness in Well (feet)	Groundwater Elevation (feet msl)	Corrected Groundwater Elevation ³ (feet msl)
A-4	5/20/2013	37.25	8.12	--	0.01	29.13	29.13
	10/14/2013		7.48	--		29.77	29.77
	2/3/2014		8.49	--		28.76	28.76
	5/16/2014		6.31	--		30.94	30.94
	9/29/2015		10.39	--		26.86	26.86
	12/15/2015		4.80	--		32.45	32.45
	3/16/2016		3.65	--		33.60	33.60
	6/29/2016		8.24	--		29.01	29.02
	9/28/2016		10.10	--		27.15	27.15
	12/29/2016		5.62	--		31.63	31.63
	3/14/2017		3.94	--		33.31	33.31
W-31	12/15/2015	37.08	5.69	5.41	0.28	31.39	31.61
	3/16/2016		3.55	3.46	0.09	33.53	33.60
	6/29/2016		12.69	12.40	0.29	24.39	24.62
	9/28/2016-Note 8		12.95	12.46	0.49	24.13	NM
	12/29/2016		5.26	5.24	0.02	31.82	31.84
	3/14/2017		3.20	--	--	33.88	33.88
W-32	5/20/2013	34.56	5.34	--		29.22	29.22
	10/14/2013		5.03	--		29.53	29.53
	2/3/2014		5.78	--		28.78	28.78
	5/16/2014		3.66	--		30.90	30.90
	9/29/2015		7.81	--		26.75	26.75
	12/15/2015		3.43	--		31.13	31.13
	3/16/2016		2.32	--		32.24	32.24
	6/29/2016		5.45	--		29.11	29.11
	9/28/2016		7.28	--		27.28	27.28
	12/29/2016		3.30	--		31.26	31.26
	3/14/2017		1.72	--		32.84	32.84
W-33	5/20/2013	34.66	5.69	--		28.97	28.97
	10/14/2013		5.24	--		29.42	29.42
	2/3/2014		6.12	--		28.54	28.54
	5/16/2014		4.07	--		30.59	30.59
	9/29/2015		7.58	--		27.08	27.08
	12/15/2015		3.07	--		31.59	31.59
	3/16/2016		2.03	--		32.63	32.63
	6/29/2016		5.82	--		28.84	28.84
	9/28/2016		7.50	--		27.16	27.16
	12/29/2016		3.49	--		31.17	31.17
	3/14/2017		1.85	--		32.81	32.81
W-34	5/20/2013	34.13	4.88	--		29.25	29.25
	10/14/2013		4.32	--		29.81	29.81
	2/3/2014		5.26	--		28.87	28.87
	5/16/2014		3.32	--		30.81	30.81
	9/29/2015		7.34	--		26.79	26.79
	12/15/2015		1.56	--		32.57	32.57
	3/16/2016		0.70	--		33.43	33.43
	6/29/2016		5.01	--		29.12	29.12
	9/28/2016		6.76	--		27.37	27.37
	12/29/2016		2.55	--		31.58	31.58
	3/14/2017		0.97	--		33.16	33.16
S-1	5/20/2013	36.25	6.10	6.05	0.05	30.15	30.19
	10/14/2013		5.38	--	0.03	30.87	30.87
	2/3/2014		6.17	--		30.08	30.08
	5/16/2014		4.08	--		32.17	32.17
	9/29/2015		9.03	9.00	0.00	27.22	27.24
	12/15/2015		4.10	4.10		32.15	32.15
	3/16/2016		2.42	--		33.83	33.83
	6/29/2016		6.00	--	0.08	30.25	30.25
	9/28/2016		8.56	8.48		27.69	27.75
	12/29/2016		3.81	--		32.44	32.44
	3/14/2017		2.39	--		33.86	33.86
S-2	5/20/2013	35.87	5.88	--	0.02	29.99	29.99
	10/14/2013		5.67	--		30.20	30.20
	2/3/2014		6.23	--		29.64	29.64
	5/16/2014		4.18	--		31.69	31.69
	9/29/2015		8.23	8.21		27.64	27.66
	12/15/2015		4.07	--	0.01	31.80	31.80
	3/16/2016		2.40	--		33.47	33.47
	6/29/2016		5.90	--		29.97	29.97
	9/28/2016		7.83	7.82		28.04	28.05
	12/29/2016		3.95	--		31.92	31.92
	3/14/2017		2.50	--		33.37	33.37

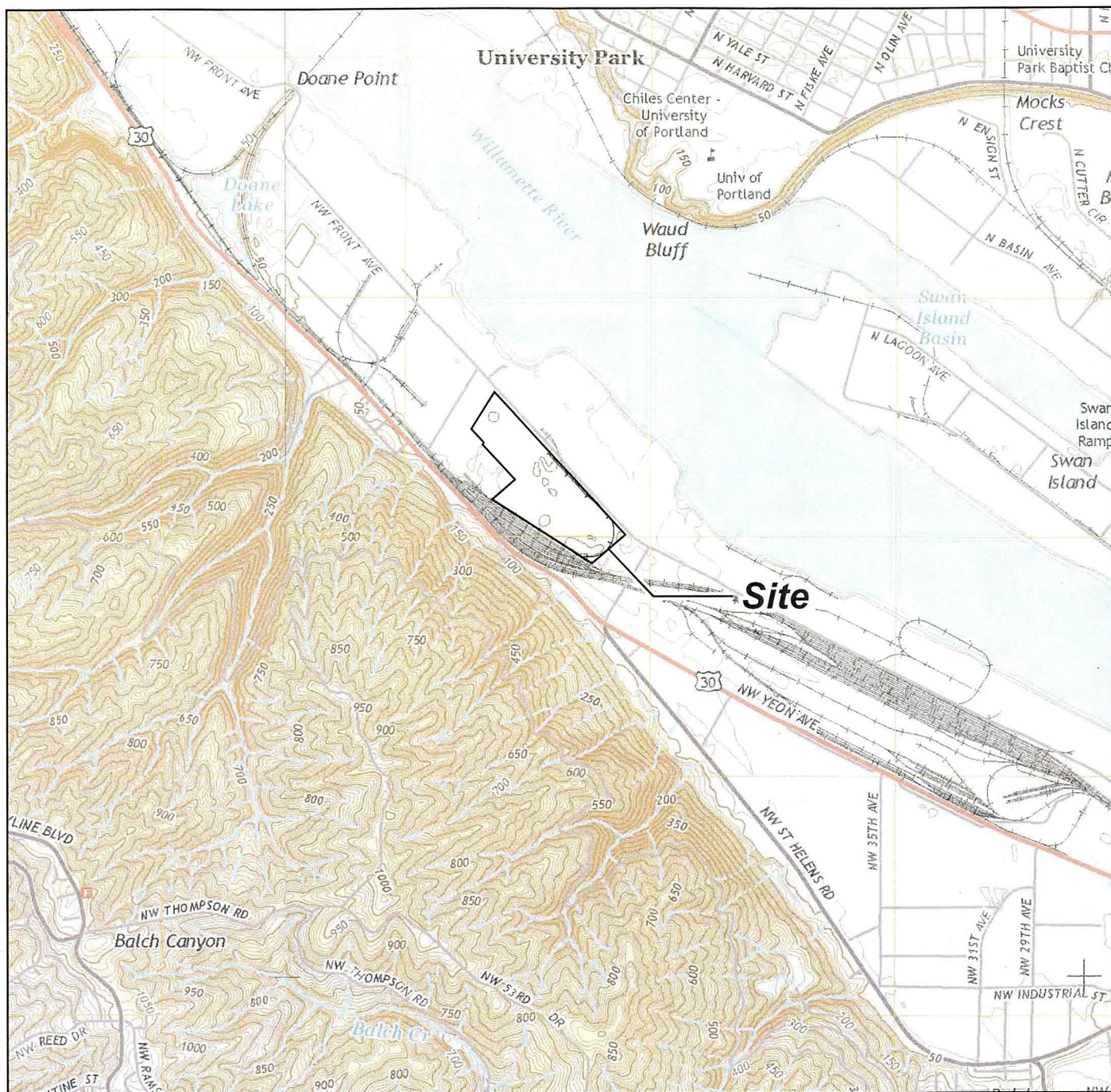
Please see notes at end of table.

Table 1
Well Gauging
Arc Terminals
5501 NW Front Avenue
Portland, Oregon

Sump or Monitoring Well No.	Sample Date	Casing Elevation (feet msl) ¹	Depth to Water (feet) ²	Depth to LNAPL (feet) ²	LNAPL Thickness in Well (feet)	Groundwater Elevation (feet msl)	Corrected Groundwater Elevation ³ (feet msl)
S-3	5/20/2013	35.73	5.83	5.83	0.00	29.90	29.90
	10/14/2013		5.55	5.54	0.01	30.18	30.19
	2/3/2014		6.19	6.19	0.00	29.54	29.54
	5/16/2014		4.05	4.03	0.02	31.68	31.70
	9/29/2015		8.28	8.25	0.03	27.45	27.47
	12/15/2015		3.84	--		31.89	31.89
	3/16/2016		2.21	--		33.52	33.52
	6/29/2016		5.89	5.87	0.02	29.84	29.86
	9/28/2016		7.80	7.79	0.01	27.93	27.94
	12/29/2016		3.76	--		31.97	31.97
	3/14/2017		2.56	--		33.17	33.17
S-4	5/20/2013	35.80	6.45	--		29.35	29.35
	10/14/2013		5.92	--		29.88	29.88
	2/3/2014		6.81	--		28.99	28.99
	5/16/2014		4.53	4.53	0.00	31.27	31.27
	9/29/2015		8.43	8.42	0.01	27.37	27.38
	12/15/2015		4.00	4.00	0.00	31.80	31.80
	3/16/2016		2.37	Trace		33.43	33.43
	6/29/2016		6.51	6.48	0.03	29.29	29.31
	9/28/2016		8.40	8.39	0.01	27.40	27.41
	12/29/2016		4.12	--		31.68	31.68
	3/14/2017		2.77	--		33.03	33.03
S-5	5/20/2013	35.63	6.54	6.54	0.00	29.09	29.09
	10/14/2013		5.92	--		29.71	29.71
	2/3/2014		6.92	--		28.71	28.71
	5/16/2014		4.52	--		31.11	31.11
	9/29/2015		8.91	8.87	0.04	26.72	26.75
	12/15/2015		3.60	--		32.03	32.03
	3/16/2016		2.16	--		33.47	33.47
	6/29/2016		6.55	6.52	0.03	29.08	29.10
	9/28/2016		8.47	8.40	0.07	27.16	27.22
	12/29/2016		3.99	--		31.64	31.64
	3/14/2017		2.52	--		33.11	33.11
S-6	5/20/2013	35.30	6.35	6.34	0.01	28.95	28.96
	10/14/2013		5.99	5.98	0.01	29.31	29.32
	2/3/2014		6.71	6.70	0.01	28.59	28.60
	5/16/2014		4.32	--		30.98	30.98
	9/29/2015		8.76	8.73	0.03	26.54	26.56
	12/15/2015		3.09	--		32.21	32.21
	3/16/2016		1.78	--		33.52	33.52
	6/29/2016		6.35	--		28.95	28.95
	9/28/2016		8.35	8.17	0.18	26.95	27.09
	12/29/2016		3.65	--		31.65	31.65
	3/14/2017		2.05	--		33.25	33.25
S-7	5/20/2013	36.23	7.25	7.19	0.06	28.98	29.03
	10/14/2013		6.43	6.42	0.01	29.80	29.81
	2/3/2014		7.46	7.42	0.04	28.77	28.80
	5/16/2014		5.14	5.14	0.00	31.09	31.09
	9/29/2015		9.35	9.27	0.08	26.88	26.94
	12/15/2015		3.95	--		32.28	32.28
	3/16/2016		2.66	--		33.57	33.57
	6/29/2016		7.18	--		29.05	29.05
	9/28/2016		9.01	8.94	0.07	27.22	27.28
	12/29/2016		4.55	--		31.68	31.68
	3/14/2017		2.90	--		33.33	33.33
S-8	5/20/2013	36.88	6.28	6.27	0.01	30.60	30.61
	10/14/2013		6.48	6.47	0.01	30.40	30.41
	2/3/2014		6.83	6.82	0.01	30.05	30.06
	5/16/2014		4.76	4.63	0.13	32.12	32.22
	9/29/2015		9.80	9.74	0.06	27.08	27.13
	12/15/2015		6.87	--		30.01	30.01
	3/16/2016		3.00	--		33.88	33.88
	6/29/2016		6.39	6.31	0.08	30.49	30.55
	9/28/2016		9.29	9.01	0.28	27.59	27.81
	12/29/2016		4.52	--		32.36	32.36
	3/14/2017		2.97	--		33.91	33.91

Notes:

- "Depth to Water" and "Depth to LNAPL" are measured from a surveyed reference elevation at the top of the sump or well casing.
- Where LNAPL was present, a groundwater elevation correction was calculated using a specific gravity of 0.80 for the LNAPL.
- feet bgs = feet below ground surface.
- msl = mean sea level
- LNAPL = light non-aqueous phase liquid
- NM = not measured.
- = Not applicable, or no measurable LNAPL present.
- No groundwater indicated during gauging to total depth (TD) of W-31. "Depth to Groundwater" is well TD. Consequently, there is no corrected groundwater elevation.



Note: Base map prepared from USGS 7.5-minute quadrangles of Linnton and Portland, OR, dated 2014 as provided by USGS.gov.

0 2,000 4,000
Approximate Scale in Feet



Site Location Map

Groundwater and LNAPL Gauging
Arc Terminals - 5501 NW Front Avenue
Portland, Oregon



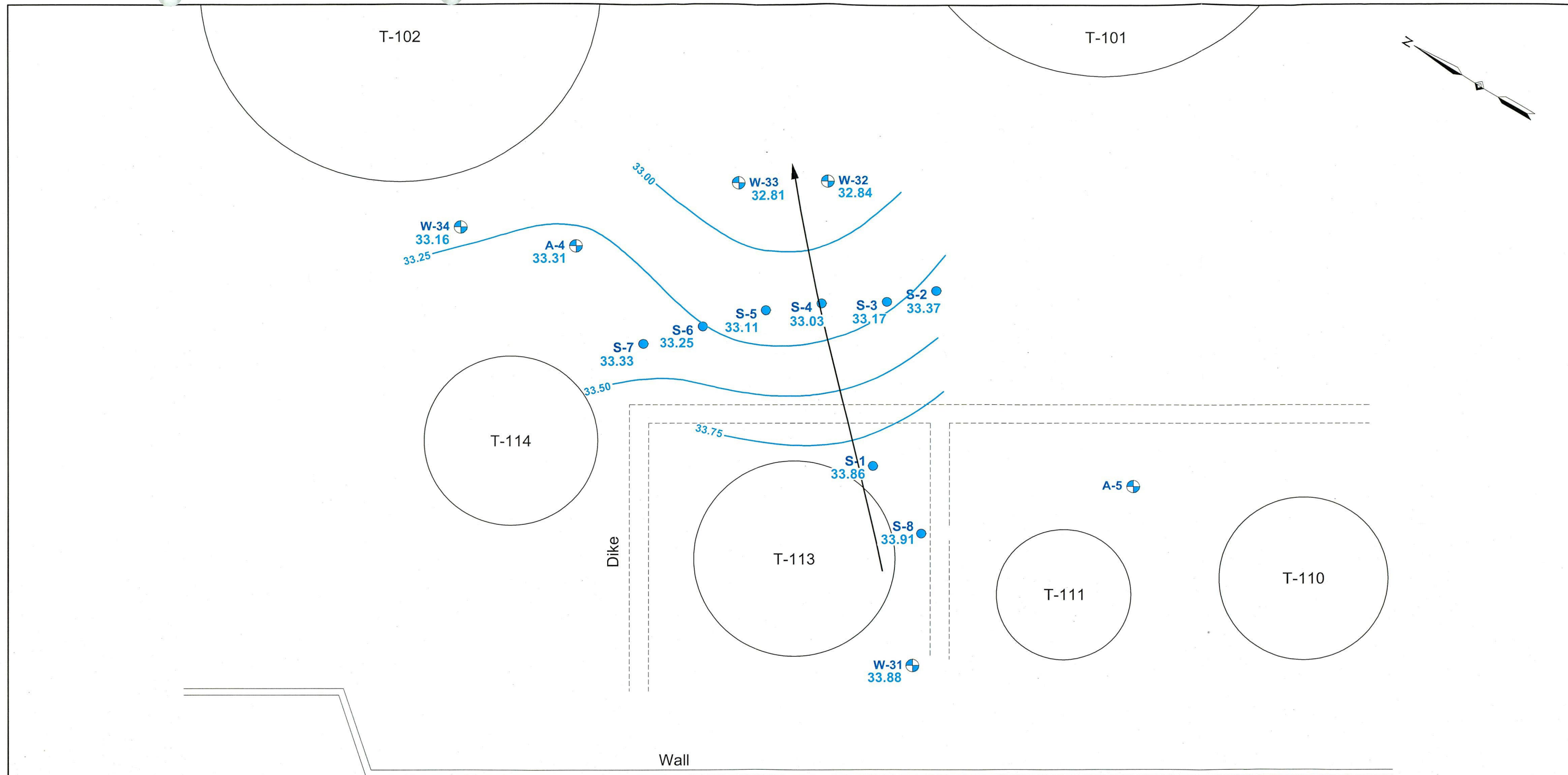
Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number 2291-02

April 2017

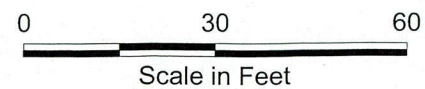
Figure

I



Legend:

- S-3 ● Sump Location
- W-34 ⊕ Monitoring Well Location
- 33.16 Groundwater Elevation in Feet Above Mean Sea Level (MSL)
- 31.25 — Groundwater Elevation Contour in Feet MSL
- Inferred Groundwater Flow Direction



Base map prepared from a Paramount Petroleum, Inc. Site Plan L-WBA-0200 (6/5/2006).

Groundwater Elevations (March 14, 2017)

Groundwater and LNAPL Gauging
Arc Terminals - 5501 NW Front Avenue
Portland, Oregon

APEX Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number **2291-02**

April 2017

Figure

3

Attachment A

Well Gauging Data Sheet



3015 SW First Avenue
Portland, Oregon 97201-4707
(503) 924-4704 Phone
(503) 943-6357 Fax

PROJECT NUMBER

2291-02

FIELD REPORT NUMBER

PAGE

OF

DATE

3/14/17

PROJECT	Stormwater Sampling	ARRIVAL TIME	1045
LOCATION	Portland	DEPARTURE TIME	1245
CLIENT	Arc Terminals	WEATHER	Rain
PURPOSE OF OBSERVATIONS	SWV samples		
APEX REPRESENTATIVE	Kyle Kline	APEX PROJECT MANAGER	Gary Walvatne
CONTRACTOR	—	PERMIT NO.	—
CONTRACTOR REP.	—	H&S REVIEW	yes

Our firm's professionals are represented on site solely to observe operations of the contractor identified, to form opinions about the adequacy of those operations, and to report those opinions to our client. The presence and activities of our field representative do not relieve any contractor from its obligation to meet contractual requirements. The contractor retains sole responsibility for site safety and the methods, operations, and sequence of construction. Unless signed by the Ash Creek Associates Project Manager, this report is preliminary. A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those included in a preliminary report.

1045 - On site, sign in

Start at SWV-33

1100 - Take samples pH = 7.63

move to SWV-39

1130 Take samples pH = 6.92

1145 - Finish taking samples

1155 - Start gauging wells, 13 wells gauged.

1245 - OFF site

BY


APEX REPRESENTATIVE

REVIEWED BY

APEX PROJECT MANAGER

APEX

Weather:	Kan
----------	-----

Time In/Out:

[illegible]