OFFSITE GROUNDWATER SULFOLANE PLUME MONITORING PLAN

City of North Pole and Fairbanks Borough

June 2017

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City of North Pole and Fairbanks Borough

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CONTENTS

TABLES

ATTACHMENTS

1 BACKGROUND

A groundwater plume of sulfolane contamination ("Sulfolane Plume") that originated from the North Pole Refinery (the NPR Site) has migrated from the NPR Site to the City of North Pole and Fairbanks Borough. A settlement between the State of Alaska, the City of North Pole and Flint Hills Resources Alaska, LLC was agreed to in February 2017 and submitted in litigation in the case captioned *State of Alaska et al v. Williams Alaska Petroleum, Inc et al* (Case Nos. 4FA-14-0154 CI and 4FA-10-01123 CI, Fourth Judicial District Superior Court of Alaska at Fairbanks.). Among other things, the settlement agreement provides for the supply of potable drinking water through the construction and operation of a piped water system. Exhibit C to that settlement agreement is the "Offsite Sulfolane Potable Water Plan" (PWS) which outlines the elements of the PWS including a requirement that there be monitoring of the Sulfolane Plume until the plume meets a cleanup level to be set by the State of Alaska.

The PWS remedy is based on sampling, analysis and interpretation of the extensive amount of data collected regarding the offsite Sulfolane Plume since the fall of 2009. Reports containing the historical data and analysis can be found on the State of Alaska Contaminated Site Program Web Page at http://dec.alaska.gov/spar/csp/sites/north-pole-refinery/documents.htm#site.

2 GROUNDWATER SAMPLING PLAN OBJECTIVES

The objective of the groundwater monitoring defined in this Offsite Sulfolane Plume Monitoring Plan (Plan) is to monitor and track plume migration as necessary to protect residences and businesses located outside of the area to be served by the PWS. The primary consideration in the design of the Plan's monitoring program is to track the location of the leading edge of the Sulfolane Plume relative to the areas covered by the PWS. The Plan is also designed to track sub-areas within the plume with relatively high and increasing sulfolane concentrations to inform an understanding of potential plume migration which will ensure protection of areas outside of the PWS.

Since the discovery of offsite sulfolane groundwater contamination, temporary alternative water has been provided to residences and businesses within the plume and to buffer zone properties. During construction of the PWS, alternative water will continue to be provided to these properties. Some of the properties have a water filtration system installed which allows the continued use of groundwater for drinking water (these systems are known as point of entry systems, or "POE" systems). The water entering the POE system is sampled prior to treatment (raw water) and after treatment during carbon filtration change out. This sampling will continue until the construction of the PWS is complete. After completion of construction, the temporary alternative water supply systems will be phased out. Buffer zone monitoring will continue using this Plan after activation of the PWS.

POE sampling provides a substantial volume of monitoring data that will cease once the POE systems are no longer in use. When cessation of POE sampling is imminent, an evaluation of the nature and extent of the sulfolane plume and concentration trends will be undertaken to determine the need for additional monitoring locations in lieu of the POE samples.

3 GROUNDWATER SAMPLING FREQUENCY AND SCHEDULE

The groundwater monitoring schedules and frequencies outlined in this Plan in Table 1 supersede those presented in all previous work plans and sampling plans. Procedures for conducting the activities included in this Plan, such as groundwater level gauging and monitoring well purging, are outlined in the attached Offsite Sampling and Analysis Plan (SAP, Attachment A) unless otherwise amended. The groundwater elevation monitoring network and the revised sample schedule are summarized in Table 1.

4 MONITORING PROGRAM

Periodic monitoring will be conducted using Offsite monitoring wells and Offsite private wells. Monitoring wells retained for long-term monitoring are summarized in Table 1. Private wells identified for long-term monitoring are shown on Table 1 and are subject to modification in future monitoring events based on concentration detections and trends. Actual private wells that will be monitored are subject to change based on potential access limitations. The wells listed in Table 1 are representative for the geographical area to be sampled. If access cannot be secured for a selected well, a proximate well with similar construction features (depth and screen) will be identified when feasible as a replacement.

The groundwater monitoring network and sampling frequencies are based on the extensive investigation efforts and resulting data that characterized the nature and extent of sulfolane in the Offsite area. The Plan is designed to support sufficient data trend analysis to ensure that properties outside the area of the piped PWS remain protected. Sulfolane concentration trends will be prepared and evaluated in annual reports. Periodic (5 year) reviews of the offsite monitoring program will be performed, in addition to annual evaluation of the monitoring network.

4.1 Groundwater Elevation Monitoring

The groundwater elevation monitoring well network will be monitored in the third quarter every five years. Historical gauging data indicate that the overall groundwater gradient and flow direction are generally consistent. The monitoring well network is summarized in Table 1.

4.2 Sulfolane Plume Monitoring

The Sulfolane Plume will be monitored using key monitoring wells and private monitoring wells on a periodic (annual to every five year) basis. Sampling locations include the following areas:

- Monitoring wells and private wells located along the detectable boundary of the current sulfolane plume
- Monitoring wells and private wells located beyond the extent of the proposed PWS
- Select monitoring wells and private wells located in the sulfolane plume interior to augment interpretation of boundary well data trends

Monitoring wells and private wells selected for sulfolane monitoring and the monitoring frequency are shown in Table 1. Monitoring at the above locations will meet the Plan’s objective to track plume migration to the degree necessary to protect people outside the area to be served by the PWS.

5 REPORTING SCHEDULE

Monitoring results will be conveyed in annual groundwater monitoring reports on or before January 31 of each year. Groundwater monitoring as described in this Plan will be revaluated periodically and no later than in 2027 and modifed or discontinued as deemed appropriate.

6 MONITORING WELL DECOMMISSIONING

One year after the construction of the PWS is complete, monitoring wells not used for monitoring or sampling as part of this Plan will be decommissioned, upon concurrence by ADEC. Wells that are no longer required will be decommissioned in accordance with the ADEC Monitoring Well Guidance (ADEC 2013). Planned well decommissioning will be presented in the annual groundwater monitoring reports or in separate correspondence, as appropriate.

TABLE 1

Table 1
Sulfolane Monitoring Network - Offsite

Offsite Long Term Monitoring Plan
North Pole Refinery Site
North Pole, Alaska

Well ID	Gauging Frequency	Sampling Frequency	Zone or Well Depth[1, 2]
MW-150A-10	every 5 years	Annual	Water Table
MW-150B-25	every 5 years	every 2 years	10-55
MW-165A-15	every 5 years	every 2 years	Water Table
MW-165B-50	every 5 years	every 2 years	10-55
MW-166B-30	every 5 years	Annual	10-55
MW-167B-35	every 5 years	Annual	10-55
MW-171BR	every 5 years	Annual	10-55
MW-181A-15	every 5 years	Annual	Water Table
MW-181B-50	every 5 years	Annual	10-55
MW-181C-150	every 5 years	Annual	90-160
MW-185B-50	every 5 years	Annual	10-55
MW-185C-120	every 5 years	Annual	90-160
MW-190BR-60	every 5 years	Annual	10-55
MW-190-150	every 5 years	Annual	90-160
MW-191A-15	every 5 years	Annual	Water Table
MW-191B-60	every 5 years	Annual	10-55
MW-311-15	every 5 years	Annual	Water Table
MW-311-46	every 5 years	Annual	10-55
MW-313-15	every 5 years	every 5 years	Water Table
MW-313-150	every 5 years	every 5 years	90-160
MW-314-15	every 5 years	Annual	Water Table
MW-314-150	every 5 years	Annual	90-160
MW-322-150	every 5 years	---	90-160
MW-327-15	every 5 years	every 5 years	Water Table
MW-327-150	every 5 years	every 5 years	90-160
MW-328-15	every 5 years	Annual	Water Table
MW-328-151	every 5 years	Annual	90-160
MW-332-41	every 5 years	Annual	10-55
MW-332-110	every 5 years	Annual	90-160
MW-332-150	every 5 years	Annual	90-160
MW-346-15	every 5 years	Annual	Water Table
MW-346-65	every 5 years	Annual	10-55
MW-346-150	every 5 years	Annual	90-160
MW-347-65	every 5 years	Annual	10-55
MW-347-150	every 5 years	Annual	90-160
MW-349-45	every 5 years	Annual	10-55
MW-352-40	every 5 years	Annual	10-55
MW-353-15	every 5 years	Annual	Water Table
MW-353-65	every 5 years	Annual	10-55
MW-353-100	every 5 years	Annual	55-90
MW-356-65	every 5 years	every 2 years	10-55
MW-356-90	every 5 years	every 2 years	55-90
MW-357-65	every 5 years	Annual	10-55
MW-357-150	every 5 years	Annual	90-160
PW-0250	---	Annual	80
PW-0262	---	Annual	200

Table 1
Sulfolane Monitoring Network - Offsite

Offsite Long Term Monitoring Plan
North Pole Refinery Site
North Pole, Alaska

Well ID	Gauging Frequency	Sampling Frequency	Zone or Well Depth[1, 2]
PW-0265	---	Annual	35
PW-0266	---	Annual	40
PW-0267	---	Annual	60
PW-0268	---	Annual	unknown
PW-0270	---	Annual	unknown
PW-0271	---	Annual	48
PW-0272	---	Annual	220
PW-0273	---	Annual	170
PW-0274	---	Annual	158
PW-0275	---	Annual	57
PW-0276	---	Annual	49
PW-0277	---	Annual	45
PW-0280	---	Annual	40
PW-0281	---	Annual	40
PW-0282	---	Annual	41
PW-0283	---	Annual	230
PW-0284	---	Annual	63
PW-0285	---	Annual	63
PW-0286	---	Annual	160
PW-0287	---	Annual	186
PW-0288	---	Annual	200
PW-0289	---	Annual	40
PW-0290	---	Annual	205
PW-0291	---	Annual	218
PW-0345	---	Annual	100
PW-0358	---	every 2 years	105
PW-0365	---	Annual	unknown
PW-0366	---	Annual	unknown
PW-0367	---	Annual	unknown
PW-0368	---	Annual	unknown
PW-0369	---	Annual	unknown
PW-0370	---	Annual	unknown
PW-0371	---	Annual	unknown
PW-0372	---	Annual	unknown
PW-0373	---	Annual	unknown
PW-0374	---	Annual	unknown
PW-0379	---	Annual	unknown
PW-0464	---	every 2 years	8
PW-0508	---	Annual	80
PW-0512	---	Annual	300
PW-0512	---	Annual	300
PW-0513	---	Annual	45.6
PW-0531	---	Annual	unknown
PW-0546	---	Annual	unknown
PW-0547	---	Annual	40
PW-0548	---	Annual	40

Table 1
Sulfolane Monitoring Network - Offsite

Offsite Long Term Monitoring Plan
North Pole Refinery Site
North Pole, Alaska

Well ID	Gauging Frequency	Sampling Frequency	Zone or Well Depth[1, 2]
PW-0555	---	Annual	36
PW-0587	---	Annual	unknown
PW-0589	---	Annual	unknown
PW-0591	---	Annual	unknown
PW-0594	---	Annual	unknown
PW-0612	---	Annual	unknown
PW-0623	---	Annual	unknown
PW-0624	---	Annual	27
PW-0627	---	Annual	unknown
PW-0628	---	Annual	30
PW-0629	---	Annual	unknown
PW-0630	---	Annual	unknown
PW-0749	---	Annual	32
PW-0750	---	Annual	unknown
PW-0751	---	Annual	60
PW-0752	---	Annual	unknown
PW-0753	---	Annual	55
PW-0759	---	every 2 years	42
PW-0760	---	Annual	35
PW-0761	---	Annual	30
PW-0762	---	Annual	40
PW-0763	---	Annual	70
PW-0769	---	Annual	unknown
PW-0770	---	Annual	unknown
PW-0771	---	Annual	unknown
PW-0772	---	Annual	unknown
PW-0774	---	Annual	unknown
PW-0775	---	Annual	55
PW-0776	---	Annual	40
PW-0777	---	Annual	unknown
PW-0778	---	Annual	unknown
PW-0790	---	every 2 years	120
PW-0859	---	Annual	unknown
PW-0860	---	Annual	40
PW-0863	---	Annual	65
PW-0864	---	Annual	42
PW-0865	---	Annual	40
PW-0866	---	Annual	42
PW-0867	---	Annual	unknown
PW-0868	---	Annual	57
PW-0869	---	Annual	42
PW-0870	---	Annual	42
PW-0871	---	Annual	50
PW-0872	---	Annual	unknown
PW-0905	---	Annual	40
PW-0906	---	Annual	34

Table 1
Sulfolane Monitoring Network - Offsite

Offsite Long Term Monitoring Plan
North Pole Refinery Site
North Pole, Alaska

Well ID	Gauging Frequency	Sampling Frequency	Zone or Well Depth[1, 2]
PW-0907	---	Annual	45
PW-0908	---	Annual	50
PW-0909	---	Annual	50
PW-0910	---	Annual	80
PW-0911	---	Annual	unknown
PW-0912	---	every 2 years	42
PW-0914	---	Annual	unknown
PW-0972	---	Annual	236
PW-0973	---	Annual	70
PW-0974	---	Annual	40
PW-0974	---	Annual	40
PW-0976	---	Annual	38
PW-0977	---	Annual	unknown
PW-0978	---	Annual	218
PW-0979	---	Annual	unknown
PW-0998	---	Annual	unknown
PW-1087	---	Annual	unknown
PW-1088	---	Annual	60
PW-1093	---	Annual	220
PW-1181	---	Annual	unknown
PW-1185	---	Annual	unknown
PW-1230	---	Annual	231
PW-1333	---	Annual	unknown
PW-1433	---	Annual	unknown
PW-1450	---	Annual	unknown
PW-1454	---	Annual	unknown
PW-1458	---	Annual	30
PW-1473	---	Annual	42
PW-1608	---	Annual	60
PW-1812	---	every 2 years	150
PW-1930	---	Annual	unknown
PW-2205	---	Annual	unknown
PW-2211	---	every 2 years	180

Notes:
[1]Monitoring wells are indicated by screened zone. Private wells are indicated by depth, when known
[2] Private well network may vary based on access
--- - not applicable
Monitoring wells will be sampled in the third quarter. Private wells will be sampled in second or third quarter.

ATTACHMENT A

Offsite Sampling and Analysis Plan

OFFSITE SAMPLING AND ANALYSIS PLAN

North Pole Refinery Site
North Pole, Alaska
DEC File Number 100.38.090

June 6, 2017

OFFSITE SAMPLING AND ANALYSIS PLAN

North Pole Refinery Site
North Pole, Alaska
DEC File Number 100.38.090

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CONTENTS

TABLES

FIGURES

FORMS

ATTACHMENT

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AHL	Arctic Home Living
COC	chain of custody
COV	coefficient of variation
DC	direct current
DO	dissolved oxygen
DTW	depth to water
GAC	granular activated carbon
L/min	liters per minute
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MAROS	Monitoring and Remediation Optimization System
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
mV	millivolts
NPR Site	North Pole Refinery Site
Offsite SAP	Offsite Sampling and Analysis Plan
Offsite PMP	Offsite Groundwater Sulfolane Plume Monitoring Plan
ORP	oxidation reduction potential
Pace	Pace Analytical Services, Inc.
POE	point of entry
PQL	practical quantitation limit
QA	quality assurance
QC	quality control
SGS	SGS Environmental Services
SOP	Standard Operating Procedure
Sulfolane Plume	a groundwater plume of sulfolane that originated from the North Pole Refinery

SWI	Shannon and Wilson, Inc.
USEPA	United States Environmental Protection Agency
UV	ultraviolet
YSI	YSI ProPlus or YSI 556 MPS
°C	degrees Celsius

1 INTRODUCTION

A groundwater plume of sulfolane contamination (Sulfolane Plume) that originated from the North Pole Refinery (the NPR Site) has migrated from the NPR Site to the City of North Pole and Fairbanks Borough. The general area and NPR Site details are shown on Figures 1 and 2.

This Offsite Sampling and Analysis Plan (Offsite SAP) provides sampling and analysis procedures to be used in implementation of the Offsite Groundwater Sulfolane Plume Monitoring Plan (Offsite PMP).

It is acknowledged that in 18 Alaska Administrative Code (AAC) 75.990(115), the Alaska Department of Environmental Conservation (ADEC) defines the term “site” as an “area that is impacted, including areas impacted by the migration of hazardous substances from a source area, regardless of property ownership.” For this Offsite Sampling and Analysis Plan (Offsite SAP), the term “offsite” is the area located outside the NPR property boundary, primarily in the downgradient north-northwest direction, based on the approximate extent of the dissolved-phase sulfolane plume detected at concentrations above the detection limit (approximately 3.1 micrograms per liter).

Offsite groundwater monitoring wells are shown on Figure 2 of this Offsite SAP. Well construction details for offsite monitoring wells are included in Table 1 of this Offsite SAP. Well identification was updated for monitoring wells installed prior to 2013 to include the well depth at the end of the well name.

This Offsite SAP discusses the following activities:

- Conducting monitoring-well integrity inspections and repairs
- Measuring groundwater levels in groundwater monitoring wells
- Collecting groundwater samples from monitoring wells for field and laboratory measurement
- Collecting water samples from private wells and point of entry (POE) systems for laboratory analysis
- Preservation and handling of samples collected for laboratory analyses
- Analytical procedures, parameters, and sampling frequencies
- Methods of sample documentation, including chain of custody protocol
- Field quality assurance (QA) and quality control (QC).

Table 2 of this Offsite SAP summarizes analytical methods, quantitation limits, containers, preservation, and holding times for water samples.

The sampling methods summarized in this Offsite SAP will be used by environmental contractors performing sampling activities as set out in the Offsite PMP. Field activities will be completed by a Qualified Environmental Professional as defined by 18 AAC 75.355(a). POE sampling methods summarized herein will be used by Arctic Home Living (AHL), under oversite by a Qualified Environmental Professional.

1.1 Data Analysis Objectives

The objective of the Offsite PMP and this Offsite SAP is to monitor and track plume migration as necessary to protect residence and businesses outside the area to be served a soon-to-be constructed Public Water Supply (see Offsite PMP discussion).

1.2 Deviations from this Offsite Sampling and Analysis Plan

Deviations from the procedures discussed in this Offsite SAP may be required due to circumstances that may arise during a given sampling event. In general, deviations will be handled by field staff. If a major deviation from this Offsite SAP is required, ADEC may be notified prior to the continuation of work. Deviations from the specified program and the purpose for the deviation will be clearly documented in the field log.

Reports submitted to ADEC will include a discussion of deviations from procedures outlined in this Offsite SAP.

1.3 Modifications to this Offsite Sampling and Analysis Plan

Modifications to this Offsite SAP may be required to update existing methods or include new methods for upcoming work. This Offsite SAP will be revised as needed to capture routine modifications to field operations at the NPR Site (e.g., monitoring well network revisions). If a new field method is proposed, this Offsite SAP may be revised and submitted with the work plan summarizing the proposed scope of work.

The modifications and updates will be logged and summarized in Attachment 1 – Log of Revisions to the Offsite SAP. Updated versions of the Offsite SAP will be submitted as needed to ADEC.

1.4 Well Security Policy

Environmental well casings will be kept locked to ensure the security and integrity of the wells.

2 SAMPLE COLLECTION METHODS

Samples will be discrete grab samples and not composited. Field staff will wear a new pair of disposable nitrile gloves during the collection and handling of each sample to prevent cross-contamination. Analytical samples will be collected and handled in general accordance with the Field Sampling Guidance (ADEC 2016). Sample collection and monitoring well work activities will be completed in general accordance with the Monitoring Well Guidance (ADEC 2013).

2.1 Groundwater Monitoring

The following subsections describe procedures for groundwater sample collection.

2.1.1 Well Inspection and Fluid-Level Measurements

2.1.1.1 Monitoring Well Integrity Inspections

Field staff will conduct monitoring well integrity inspections prior to collecting any fluid-level measurements or sampling activity during each sampling event. A well inspection will consist of documenting the physical condition of the monitoring well to be sampled. Integrity will be documented with respect to the condition of the well monument, measuring the distance between the top of the casing and the ground surface (to determine if the well is being frost-jacked), checking that the well lock is operational, observing signs of surrounding soil erosion, and confirming that the name is legible on the well. These observations will be documented on the Monitoring Well Sampling Log.

2.1.1.2 Groundwater-Level Measurements

The groundwater level will be measured in each well prior to sampling. The static water level will be measured in each well equipped with a dedicated pump using a water level meter prior to purging water or sampling water from the well. For wells not equipped with dedicated pumps, the depth to water (DTW) will be measured before the pump is lowered into the well. Groundwater gauging events will be conducted according to the monitoring schedule included in the Offsite PMP.

The probe must be decontaminated prior to each use and between each well to prevent the addition of external contamination or artifacts into a well. The decontamination will consist of cleaning the probe with a non-phosphate detergent wash followed by tap and distilled water rinse. Decontamination rinsate will be collected and disposed of in the same manner as purge water. Following decontamination, the probe will be slowly lowered down the well until it produces the distinct tone indicating contact with the water surface interface. The DTW will be measured from the surveyed datum located at the top of the well casing and will be read to the nearest 0.01 foot. The datum is indicated with a black mark at the top of the casing.

2.1.1.3 Well Depth Measurements

In addition to depth-to-fluid measurements, the depth to the bottom of each well casing will also be measured to determine whether there has been an appreciable change in well depth. Depth to bottom measurements will be made annually in wells to be sampled per the Offsite PMP. Well depth will be measured using a stainless-steel depth sounder or equivalent measuring device from the datum located at the top of the well casing.

The measured depth will then be compared to the original depth documented on the well completion or boring log. If the difference between the well completion log depth and current depth measurement is greater than 2 inches, the total depth will be re-measured immediately to rule out a faulty measurement. If the difference between the two field measurements is greater than ½ inch, this may indicate a substantial amount of sediment in the bottom of the well. If the sediment accumulation is deep enough to extend into the screened interval, it will be removed to ensure representative sampling results.

Silt and sediment can be removed from the bottom of most well casings by using a diaphragm pump. Removal can also occur by bailing and surging the well. This is done by lowering a bailer to the bottom of the well and gently surging to fluidize and collect the sediment. If these methods do not work, it may be necessary to obtain the services of a drill rig for a more robust evacuation of sediment.

2.1.1.4 Field Records

Well-integrity inspections and fluid and well-depth measurements will be recorded on a Monitoring Well Sampling Log. Units of measurement and the reference points used to collect measurements will be identified on the log.

2.1.2 Purging and Sampling Equipment

Monitoring wells will be purged and sampled using a dedicated, battery-operated pump or portable pump capable of continuous operation during sampling at a pumping rate of 3.5 liters per minute (L/min), or approximately 1 gallon per minute, consistent with historical sampling methods that have been previously accepted by ADEC.

2.1.3 Monitoring Well Purging

Monitoring wells will be purged prior to sampling, according to the sampling schedule presented in Table 1 of the Offsite PMP. Purging will consist of removing water until certain physiochemical parameters have stabilized. When these parameters have stabilized, or after three well volumes have been purged, well purging will be discontinued and sampling will begin.

Purging and sampling equipment coming into contact with groundwater will be documented on the Monitoring Well Sampling Log.

The purge rate will be established as soon as practical after pumping begins. The purging rate will be measured by catching the discharge from the pump in a quantified volumetric container and measuring the time required to reach a specific volume. The operator will regulate the discharge rate of the pump so that no more than 3.5 L/min are evacuated.

2.1.4 Measurement of Field Parameters

Conductivity, pH, dissolved oxygen (DO), and oxidation reduction potential (ORP) will be measured to determine the point at which sampling of monitoring wells can begin. Temperature is also measured and recorded during purging activities. Field technicians trained in the use of a YSI ProPlus, YSI 556 MPS (YSI), or equivalent, will collect the field parameter measurements. Measuring devices will be calibrated daily during sampling events, or as needed according to the manufacturer's recommendations. Calibration methods are summarized below:

- Calibrate the YSI for conductivity, pH, and ORP by placing the probe in a standard solution of known conductivity, pH, or ORP, wait for the reading to stabilize, then press "Enter."
- For DO calibration, obtain a local barometric pressure reading, place the probe in the calibration bottle with ⅛ inch of water, allow equilibrium to be reached, then press "Enter." Calibration will be conducted using the manufacturer's recommended calibration procedures.
- Record calibration records (standards, date, time, and calibration readings) in the dedicated log book for the meter.

Field parameters will be measured through a flow-through cell attached to the pump-discharge line. The YSI will be placed in the flow-through cell and readings for each parameter will be recorded approximately every 3 minutes. Measurements will be recorded on the Monitoring Well Sampling Log. Unusual odor, color, or other apparent physical characteristics of the groundwater will also be documented on the log, as appropriate.

Each monitoring well will be purged until three consecutive readings of pH, conductivity (microSiemens), DO (in milligrams per liter [mg/L]), and ORP (millivolts [mV]) have stabilized, or after three well casing volumes are purged. The following values are used to indicate stability: ±0.1 pH, ±3 percent conductivity, ±10 mV ORP, and ± 0.1 mg/L DO. Temperature is measured and recorded, but is not used as a purging indicator, because temperature can be insensitive in distinguishing between formation water and stagnant casing water (ADEC 2016) The stabilization criterion for DO deviates from the ADEC Field Sampling Guidance (ADEC 2016). Due to the low levels of DO in the aquifer, stabilization of DO to within the 10 percent tolerance suggested by ADEC (2016) guidance is difficult and sometimes impossible to achieve (i.e., the accuracy and resolution of the field meter cannot reliably measure 10 percent of 0.1 mg/L DO). Therefore, the DO stabilization criterion will be modified to accommodate sampling under these conditions. Sampling will begin when stabilization is reached. The total volume of water purged prior to sampling will be recorded on the Monitoring Well Sampling Log.

2.1.5 Monitoring Well Sampling

Each monitoring well will be sampled immediately after purging is completed. The wells will be sampled for determination of sulfolane concentration. Equipment and procedures for sampling monitoring wells are detailed below. New nitrile gloves will be worn during sample collection and new gloves will be donned at each sample location.

Monitoring wells will be purged and sampled using a portable, submersible plastic pump and new, disposable tubing. Portable pumps typically used at the NPR Site include the Proactive, Whale, and Geotech lines of 12-volt direct current (DC), submersible, centrifugal, pumps. For deep wells, a portable

S.S. Geosub pump, or equivalent, may be used. The portable pump must be capable of a sustained flow rate.

The portable pump will be slowly lowered into the well to the specified depth (generally within the top half of the well screen [e.g., 5 to 10 feet for a 15-foot well]) to avoid agitating the water. The depth of each pump setting will be accurately measured and repeated for subsequent pump settings. The pump will be connected to the pump controller and the pumping rate will be regulated for minimum agitation of groundwater in the well.

At the completion of sampling, the pump will be disconnected from the pump controller and discharge line, and the pump will be slowly removed from the well. The pump will be visually inspected for any signs of physical or chemical damage and will be decontaminated as described in Section 6.1. Indications of problems will be reported on the Monitoring Well Sampling Log.

The portable pump and any other non-dedicated equipment will require decontamination as described in Section 6.1. Equipment blanks will be collected following the sampling event, described in Section 5.1, whenever non-dedicated sampling equipment is used.

The sampling technician will keep a log of each day's events during sample collection. Pertinent information, including the time and date of sample collection, will be recorded on the Monitoring Well Sampling Log.

2.2 Mann-Kendall Trend Analysis

An evaluation of concentration trends for sulfolane in groundwater samples collected from monitoring and private wells will be completed using a Mann-Kendall statistical analysis of groundwater analytical data and visual inspection of the concentration graphs.

Monitoring and Remediation Optimization System (MAROS) software was developed by the Air Force Center for Engineering and the Environment to evaluate concentration trends; however, a limitation of the MAROS software is that it cannot analyze datasets with greater than 40 data points. To evaluate larger datasets, like those present for some wells at the NPR Site, Shannon and Wilson, Inc. (SWI) developed a computer program capable of performing the Mann-Kendall test and calculating each dataset's coefficient of variation (COV) to assess temporal trends of data stored in the NPR Site analytical database.

The MAROS evaluation of concentration trends depends on the result of a Mann-Kendall trend analysis, coupled with information about the COV. A statistically significant increasing or decreasing trend will be identified by the Mann-Kendall analysis if the probability of a false-negative assessment is less than 5 percent (i.e., $p < 0.05$); MAROS refers to this condition as a "confidence in trend" above 95 percent.

MAROS discriminates between "no trend" and a "stable" contaminant concentration by evaluating the COV of a given well's data set. The COV is defined as the ratio of a data set's standard deviation to its mean. COV values less than or near one indicate that data form a relatively close group around the mean value; values larger than one indicate data exhibit a greater degree of scatter around the mean. The MAROS decision matrix is presented in the table below.

Mann-Kendall Statistic	Confidence in Trend	Concentration Trend
S > 0	> 95 percent	Increasing
S > 0	90 to 95 percent	Probably increasing
S > 0	< 90 percent	No trend
S ≤ 0	< 90 percent and COV ≥ 1	No trend
S ≤ 0	< 90 percent and COV < 1	Stable
S < 0	90 to 95 percent	Probably decreasing
S < 0	> 95 percent	Decreasing

Only wells with a minimum of four sampling events (the minimum for the statistical test) will be analyzed. The standard practice for this statistical analysis is to assign one value to all results below the reporting limit, as long as it is below the lowest reporting limit. For these statistical analyses, results below the reporting limit will be represented numerically by a value equal to the lowest analytical detection limit for each well's data set. This approach will be used to be consistent with standard practice and to avoid erroneous identification of trends related to variations in the Practical Quantitation Limits (PQLs).

2.3 Monitoring Well Repairs

Repairs to well casings and monuments may be necessary to protect the integrity of active monitoring wells. Routine maintenance is performed during a visit to a well, when necessary. Maintenance activities include inspecting locking mechanisms, and replacing well plugs, monument seals, and monument lid bolts, as necessary. Intensive well repairs such as monument replacement and/or concrete footers repair will be scheduled as soon as practicable. Wells will be evaluated for decommissioning and/or replacement if an obstruction or other defect impedes monitoring activities.

Well casings may need to be cut or lengthened to maintain well integrity. Frost-jacked well casings will be cut if the casing interferes with closing the protective well monument. Conversely, casing may be added if the well casing has subsided below the annular fill within the monument.

2.4 Monitoring Well Decommissioning

Monitoring wells will be decommissioned in accordance with the parameters defined in the Offsite PMP. Monitoring wells extending less than 20 feet bgs will be decommissioned using the standard procedures outlined in the ADEC Monitoring Well Guidance (ADEC 2013). This includes breaking out the bottom cap, pulling the casing from the ground while filling with bentonite grout using a tremie pipe. At least the top 2 feet of the borehole will be filled with gravel to prevent hydrated bentonite from expanding out of the borehole at the surface.

Deeper wells will be decommissioned by excavating the area around the casing to a depth of about 2 feet bgs. The upper-most section of the casing will be unscrewed or the casing cut off below the ground; a tremie tube with grout slurry will be used to fill the casing. The area around the well will be backfilled with gravel.

Upon completion, the decommissioning of the wells will be documented.

3 PRIVATE WELL SAMPLES

Water samples will be collected from private water wells (without POE systems) for sulfolane analysis. If possible, water samples will be collected upstream of any treatment system that may be installed in the plumbing, assuming that well-pump systems are operational. Field staff will allow the water to run for several minutes until temperature and water parameters (pH, conductivity) stabilize, then will collect the sample directly into the laboratory-provided sample containers.

4 POE SYSTEM SAMPLES

POE treatment refers to treatment of water at the point where it enters a residence, as opposed to treatment at a centralized facility prior to distribution to individual residences. Each system is installed in series and includes; one 2.5 cubic foot carbon vessel (simplex system), or two 2.5 cubic foot carbon vessels (duplex system). Both of these options are followed by a 2.5 cubic foot redundant vessel. Some locations may require several systems to run in parallel due to water usage; individual systems are referred to as a "unit" during sampling.

POE treatment systems include four separate sample ports A, B, C and D:

- Sample port A is situated before the treatment process and is considered the influent or raw water sample.
- Sample port B is located after water is transported through sediment and ultraviolet (UV) filtration as well as a water softener.
- Sample port C is situated after the first carbon vessel in a simplex system or after the second carbon vessel in a duplex system.
- Sample port D is located after the redundant carbon vessel and second UV filtration, and is considered the effluent water sample.

A copy of the Private Well Sampling Log is included with the forms attached to this Offsite SAP.

4.1 Pre-Sample Collection

Field personnel will confirm the treatment system has undergone regular use by checking the volume of water processed through the treatment system during the past seven days to avoid collecting a sample from stagnant conditions (less than 50 gallons within one day prior to arrival). Where stagnant conditions are present, a backwash cycle will be completed on the redundant tank until at least 50 gallons are removed. Prior to sample collection, approximately two and a half gallons of water will be purged from each test port.

4.2 Sample Collection

All sample bottles will be supplied by the laboratory. Grab samples will be collected by placing the mouth of the sample bottle into the water stream from each sample port. If tubing is used during the purge, it will be removed prior to sample collection. New nitrile gloves will be worn during sample collection and new gloves will be donned at each sample port.

Multiple sample ports (A, B, C & D) are located on the POE system and are used, depending on the activity and data need, to confirm the POE system is operating as designed. Prior to conducting maintenance service on the treatment system including granular activated carbon (GAC) tank change-out and routine water softener maintenance, a sample is collected from sample port B to test iron and hardness using a field test kit. If needed the softener is adjusted to ensure it is adequately treating the water. The first sulfolane sample at each location will be collected from sample port D, which is considered the effluent sample and is the least likely to contain sulfolane. The sample is labeled D1 on the COC, indicating it was collected prior to maintenance activities. However, samples collected from the D port during maintenance activities (prior to GAC vessel change out) are recorded as “D” samples in the project database for simplicity. Next, a sample from sample port C will be collected and labeled as C1 to indicate the sample was collected prior to a primary GAC vessel change out. A sample will then be collected from sample port A, which is considered the “raw water” sample and is likely to contain the highest sulfolane concentration.

Individual ports may be sampled, as needed, to evaluate the POE system during non-routine events. Samples collected in the absence of maintenance activities will be labeled with the port letter (e.g. “C” or “D”). Additional samples may be collected after maintenance activities (that is, following changeout of a GAC vessel). These samples are designated with the number 2 (e.g. “C2” or “D2”). The laboratory typically does not analyze these samples unless there is an issue with the sample collected prior to maintenance (e.g., “C1” or “D1”).

5 FIELD QUALITY ASSURANCE/QUALITY CONTROL

The field QA/QC program includes collection of duplicate samples and equipment blanks. Descriptions of QA/QC samples are presented below.

5.1 Equipment Blanks

The purpose of the equipment blank sample is to determine the validity of sampling results for wells without dedicated pumping equipment by establishing the efficiency of the decontamination procedures. A minimum of one equipment blank will be collected for every 20 groundwater samples.

Equipment blanks will be collected at the specified frequency if non-dedicated purging and sampling equipment is used. The equipment blank will be used to identify organic artifacts originating from the sampling equipment.

To collect an equipment blank from a non-dedicated pump, the pumping equipment will be decontaminated as described in Section 6.1. Immediately following decontamination, distilled water will be placed into a clean container. The volume of the container and of the distilled water will be sufficient for the pump to operate and collect the volume of sample necessary to fill the sample jars. The pump will be placed into the distilled water and operated at a similar rate to the sampling rate for monitoring wells. The water discharged from the discharge tube or hose will be collected into appropriate sample containers. Sample handling and preservation of equipment blank samples will be the same as those for groundwater samples.

The distilled water comprising the blanks will be provided by a commercial source. The equipment blanks will be analyzed by the same methods as groundwater samples. The concentration levels of any artifact found in any equipment blank will be noted and compared to the groundwater sample results.

5.2 Duplicate Samples

Duplicate samples will be collected during each groundwater sampling event. Selection of wells for duplicate-sample collection will be based on the historical data; duplicate samples will be collected from wells with detectable historical data for the target analyte. To collect a monitoring well or private well (without POE) duplicate, two complete sets of sample bottles will be filled with groundwater from the selected well. One set will be labeled as the “sample” (i.e., normal labeling procedure will be followed) and the other set will be labeled as a “dummy sample” using the normal labeling procedure, with the addition of a “dummy” number that can be tied to the well by sampling personnel but not by laboratory personnel. The location of the duplicate sample(s) will be entered on the Monitoring Well Sampling Log.

The duplicate sample will be analyzed using the same analytical methods used for the primary sample. Results of the analysis from this duplicate will be used as a check for repeatability in the analytical procedures. Duplicates will be collected at a rate of one per 10 field samples with a minimum of one per day for monitoring well sampling. Duplicates will be collected at a rate of one per 10 samples for private well sampling. Locations known to be impacted, based on historical concentrations, are preferred for collection of duplicate samples.

During sampling at POE systems, duplicate samples will be collected at a rate of approximately one per ten samples or one per day. If more than two POE treatment systems are sampled in one day, a second duplicate sample will be required once the number of samples collected exceeds ten. The raw water sample from sample port A at locations known to be impacted based on historical concentrations, are preferred for collection of duplicate samples. Selection of POE systems for duplicate-sample collection will be based on the historical data and logistics; ideally, duplicate samples will be collected from POE treatment system sample port A with detectable historical data for the target analyte.

To collect the POE sample duplicate, two complete sets of sample bottles will be filled with groundwater from the treatment system sample port. One set will be labeled as the “sample” (i.e., normal labeling procedure will be followed) and the other set will be labeled as a “dummy sample” using the normal labeling procedure but with a “X” suffix (example: “address_X”) and sample time (i.e. five minutes prior to initial sample). If ports B or C are sampled as the duplicate sample, the duplicates will be denoted with Y and Z, respectively. Duplicate samples are typically not collected from the D port.

The location of the duplicate sample(s) will be entered into the POE Service Checklist. This duplicate will be analyzed using the same analytical methods used for the primary sample. Results of the analysis from this duplicate will be used as a check for repeatability in the analytical procedures and the sampling technique.

5.3 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike (MS)/matrix spike duplicate (MSD) samples are prepared by the analytical laboratory after samples have been collected and submitted. A known concentration of the target analyte or similar compound is added to the sample prior to sample preparation and analysis. The recovery of the MS/MSD sample will indicate if matrix interference effects are occurring in the sample, potentially biasing the analytical result determined for the sample. In this way, the MS/MSD sample is used to determine the analytical accuracy of the sample for a given method and matrix. For monitoring well samples, or samples from private wells without a POE, MS/MSD samples are typically prepared by the laboratory on groundwater samples at a rate of one per 20 samples.

During POE system sampling, field personnel will collect additional sample volume from the raw water sample collected at sample port A at one POE treatment system sampled each day to supply the laboratory with the appropriate sample volume to conduct MS/MSD analyses. If more than 20 samples are collected in a single day, additional volume will be collected from a second POE treatment system. MS/MSD samples may be submitted at a frequency greater than required by the laboratory method; the laboratory will choose which sample to include in the analytical batch and disregard the excess samples. The same sample location should not be used for collection of both the sample duplicate and the MS/MSD.

5.4 Sample Numbers

Sample numbers will consist of unique identification numbers.

5.5 Sample Containers

Containers used to transport samples for laboratory analyses will be provided by the laboratory performing the analyses. The bottles will be prepared by the laboratory according to the method used for analysis. The bottles will be opened immediately before collecting the samples.

5.6 Sample Preservation and Handling

Sample preservation is intended to retard biological action, retard hydrolysis, and reduce absorption effects. Preservation methods include refrigeration and protection from light. Table 2 lists the analytical parameters, analytical methods, sample container requirements, and preservative requirements for groundwater samples.

Samples will be preserved in the field by placing the samples in an insulated cooler containing frozen “gel ice” immediately after sample collection and maintained at the required temperature range. Upon receipt of the samples, authorized laboratory personnel will store and/or prepare the samples for analysis, considering the sample holding times for the analytical parameter of interest.

5.7 Sample Shipping

Sample bottles will be wrapped in “bubble wrap,” placed into the cooler, and packed with frozen gel ice. Packing material will be used as necessary to prevent bottle breakage. A temperature blank will be placed in the cooler prior to shipment. Samples will be labeled for shipment or transfer to the appropriate laboratory and dispatched at the end of each work day. Samples may be held by the field technician at the required storage temperature prior to shipment, if necessary.

If shipment directly to the laboratory is necessary, each cooler will be custody-sealed. If the cooler is to be transferred to the laboratory receiving office, the custody seal will be added by the shipper before shipment. When custody is to be relinquished to a shipper, field personnel will contact the laboratory sample custodian to inform the laboratory of the expected time of shipment arrival and any special requirements or time constraints on sample analysis. Any special conditions or requirements will be noted on the chain of custody record.

6 EQUIPMENT DECONTAMINATION AND INVESTIGATION-DERIVED WASTE MANAGEMENT

6.1 Decontamination

Reusable equipment introduced into a monitoring well, or coming in contact with water from a well, must be decontaminated prior to use and reuse. Wells that are fitted with dedicated pumping systems will not require the introduction of sampling equipment into the well. Only the water-level indicator will require decontamination for these wells.

The decontamination procedures for nondedicated sampling equipment will consist of:

1. Nonphosphate detergent wash
2. Tap water rinse
3. Three final distilled-water rinses

When pump decontamination is required, the pump will be run in both the detergent wash solution and initial tap water rinse for at least 1 minute, then rinsed with distilled water three times. Rinse water will be collected in the purge buckets or barrels. Equipment that cannot be decontaminated, such as rope or plastic, will be disposed of at the Fairbanks North Star Borough Solid Waste Division landfill facility, located at 455 Sanduri Street in Fairbanks.

6.2 Investigation-Derived Waste

Investigation-derived waste will include solid waste, equipment decontamination fluids, and purge water from monitoring wells and POE systems.

6.2.1 Sampling Investigation-Derived Waste

While performing sampling offsite used disposable nitrile gloves, sampling spoons, baggies, and other disposable sampling equipment will be placed in a garbage bag and disposed of at the Fairbanks North Star Borough Solid Waste Division landfill facility, located at 455 Sanduri Street in Fairbanks as ordinary solid waste.

6.2.2 Development and Purge Water

Buckets, drums, water tanks, or other suitable containers will be used to collect purge water from monitoring wells. The collected water then will be disposed of in accordance with applicable laws and requirements.

Buckets or other suitable containers will be used to collect purge water from each private well and POE treatment system prior to sample collection. The collected water then will be disposed into the nearest sink or drain at each residence, where applicable. POE purge water will be discarded onto the ground at residences with no sink or drain available. Private well purge water will be discharged to the residents' septic system, discharged to the ground surface, or will be collected and taken offsite for disposal in accordance with applicable laws and requirements.

6.2.3 Decontamination Fluids

Used soapy and rinse water from decontaminating sampling equipment used to collect offsite samples will be placed in 5-gallon buckets or other suitable containers and disposed of in the City of North Pole wastewater system through an offsite manhole. This procedure and disposal location have been coordinated and approved through the City of North Pole staff.

6.2.4 Rinse Water

Glass sleeves from UV lights and used carbon tanks will require washing/rinsing at the AHL facility, located at 3651 Royal Road in Fairbanks, Alaska. Rinse water collected during these activities and other similar maintenance activities will be processed through a carbon filtration system at the AHL facility prior to discharge to the septic system.

6.2.5 Spent Carbon

Spent carbon from GAC tanks will be transported to Organic Incineration Technology, Inc. in North Pole, Alaska, for treatment.

6.2.6 Sediment Filters

Used sediment filters have been determined to be characteristically non-hazardous and will be managed as non-hazardous waste. The used filters will be collected by AHL and will be taken to the Fairbanks North Star Borough Solid Waste Division landfill facility, located at 455 Sanduri Street in Fairbanks.

6.2.7 UV Lights

UV lights are replaced approximately once per year. Each treatment system contains two bulbs, each within glass sleeves that prevent bulbs from coming into contact with sulfolane-impacted water. Used UV lights will be placed into an Ecolights recycling lamp kit, and taken to North Coast Electrical Supply who ships them to Total Reclaim Ecolights for proper disposal. A certificate of disposal will be obtained after disposal is completed.

7 SAMPLE AND FIELD DOCUMENTATION

A sample documentation program will be implemented to document possession and handling of samples from field collection through laboratory analysis. The program will include:

- Sample labels that clearly identify samples.
- Sample-cooler custody seal to preserve the integrity of the samples from the time it is packed for shipment until it is opened in the laboratory.
- Field Activities Daily Log and/or Monitoring Well Sampling Log to record information about each sample collected during the monitoring program.
- Chain of custody record to establish sample possession from the time of collection to the time of analysis, serve as official communication to the laboratory of the particular analysis required for each sample and provide further evidence that the chain of custody is complete.
- Documentation by the laboratory of pertinent information about the sample on the sample receipt form.

7.1 Sample Labels

To prevent misidentification of samples, legible labels will be affixed to each sample container. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Sample point identification name/number
- Name or initials of collector
- Date and time of collection
- Analysis required.

7.2 Chain of Custody Seals

If samples will be shipped offsite by commercial carrier, a chain of custody (security) seal will be placed on the sample shipping container to ensure the samples are not disturbed during transport. Two seals will be placed on the front and two on the back of the cooler, across the closure. If samples will be hand delivered and signed over to the laboratory's Fairbanks office prior to shipment, the seals will be signed and dated by sampling personnel or laboratory staff.

7.3 Monitoring Well Sampling Log

A Monitoring Well Sampling Log will be maintained for groundwater sample collection activities. The following specific data will be documented on the log where applicable:

- Name of collector
- Identification of sampling point
- DTW in wells (referenced from top of casing)

- Well total depth
- Well purging/sampling method
- Volume of water in well purged
- Method of measuring immiscible layer
- Thickness of immiscible layer
- Analytical methods requested
- Weather conditions including air temperature
- Sequence and time of field activities conducted
- Groundwater parameters
- Observations of monitoring well conditions (e.g., broken lock, cracked casing)
- Sample observations (e.g., color, odor).

7.4 Daily Field Logs

Daily logs are used to record field observations and other pertinent information that is not otherwise documented on field forms. Daily field logs are turned in at the end of each day and stored with the other field logs from the quarterly sampling. Information included on the logs may include:

- Date
- Weather and other salient observations
- Sampling team members
- Documentation of instrument calibration
- Location of activity and site conditions
- Field observations and comments
- Changes to sampling protocol
- Site photographs
- Site sketches
- Survey and location of sampling points
- Global positioning system coordinates.

7.5 Point-of-Entry Service Checklist

A POE Service Checklist will be maintained for all maintenance activities as well as water sample collection activities. The following specific data will be documented where applicable:

- Name of collector

- Owner/occupant address
- Date
- Treatment system model/type
- Meter Number
- Water meter reading
- Field water test results
- Analytical methods requested
- Sequence and time of field activities conducted
- Changes in general condition of the system, including odors, noises, or other complaints

7.6 Chain of Custody Records

Evidence of collection, shipment, laboratory receipt, and laboratory custody until completion of analyses will be documented via a chain of custody record containing the signature of the individuals collecting, shipping, and receiving each sample. The chain of custody record must be signed and dated by a member of the sampling team. An example of the chain of custody record is included as an attachment.

A sample is considered to be in custody if it is:

- In a person's actual possession
- In view after being in physical possession
- Sealed so no one can tamper with it, after having been in physical custody
- In a secured area, restricted to authorized personnel.

A chain of custody record will be used by personnel to record collection and shipment of samples. A qualified laboratory will not accept samples for analysis without a correctly prepared chain of custody record. The chain of custody procedure is as follows:

- A chain of custody record will be initiated by the sampler/s and will accompany each set of samples shipped to the laboratory.
- Each sample will be assigned a unique identification number entered on the chain of custody record. Samples can be grouped for shipment on a common form.
- Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and denote the date and time.
- If the samples are shipped to the laboratory by commercial carrier, the chain of custody record will be sealed in a watertight bag, placed in the shipping container, and the shipping container will be sealed prior to giving it to the carrier. The carrier waybill will serve as an extension of the chain of custody record between the final field custodian and receipt in the laboratory.
- Upon receipt in the laboratory, a designated individual will open the shipping containers, compare the contents with the chain of custody record, and sign and date the record. Any discrepancies will be noted on the chain of custody record or the laboratory's sample receipt form.

- If discrepancies occur, the samples in question will be segregated from normal sample storage and the field personnel will be notified for clarification.
- The chain of custody record will be considered complete after sample disposal. Samples that are not consumed during analysis will be kept for 6 months or as otherwise established by the laboratory.
- Chain of custody records, including waybills, will be maintained as part of the project records.

8 ANALYTICAL METHODS AND SAMPLING FREQUENCIES

8.1 Laboratory Selection

The laboratory selected to analyze groundwater samples collected at the facility will maintain a written QA/QC program that conforms, as a minimum standard, with the QA/QC protocol set forth in the United States Environmental Protection Agency's (USEPA's) Test Methods for Evaluating Solid Waste, SW-846 (USEPA 1986), or any subsequent approved versions of this testing protocol. The laboratory will provide a copy of the QA/QC plan for review upon request by ADEC or Flint Hills Resources Alaska, LLC. The laboratory will be certified by ADEC for analyses performed for this monitoring program, where such certifications exist.

SGS Environmental Services (SGS) in Anchorage, Alaska, or Pace Analytical Services, Inc. (Pace), in Minneapolis, Minnesota, will typically be used for analysis of groundwater samples. In general, SGS is used for analysis of monitoring well samples and private well samples (where no POE system is present), and Pace is used for analysis of samples collected from POE systems. SGS and Pace are ADEC-approved laboratories for contaminated sites analysis. The laboratories will use USEPA Modified Method 1625 or 8270D with isotope dilution for sulfolane analysis.

Laboratory analysis will be specified on the chain of custody record. In most cases, standard turnaround time (10 to 14 working days for most analyses) will be requested. SGS has the capability to expedite turnaround times to 48 hours, depending upon availability of analytical equipment. Pace has the capability to expedite turnaround times to 30 hours, also depending upon availability of analytical equipment.

8.2 Methods and Sample Requirements

Analytical parameters, appropriate test method for each parameter, and test method detection limit to be applied to samples collected from the NPR Site are identified in Table 2. Test methods listed in Table 2 are taken from the USEPA Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846 (USEPA 1986) and Methods for Chemical Analysis of Water and Wastes, USEPA-600/4-79-020 (USEPA 1983).

Table 2 lists the limits of quantitation, as well as the container and preservative requirements and holding time for the analyses to be used.

8.3 Use of Alternate Method

Any deviation from a USEPA-approved method must be adequately justified to ensure that the quality of the results meets the performance specification of the reference method. The method used must be fully documented to show that the method is accurate, reproducible, free of interferences, and sensitive. The limit of detection for the method will also be established with both clean standards and by spiking samples to determine the effect of the sample matrix. If a method is selected instead of an existing USEPA-approved method, approval will be obtained from ADEC.

8.4 Sample Collection

Water samples to be submitted to SGS for analysis of sulfolane will be placed in two 1-liter amber glass bottles without preservative. Sample bottles for sulfolane will be filled to the shoulder of the bottle. Water samples to be submitted to Pace for analysis will be collected in three 40-mililiter amber-glass VOA vials without preservative. Samples bottles for sulfolane will be filled completely without headspace. Sulfolane samples for groundwater will be submitted for analysis by USEPA Modified Method 1625/8270D with isotope dilution.

8.5 Groundwater Sampling Frequency and Methods

Groundwater sampling networks and frequency are provided in the Offsite PMP. Collected samples will be analyzed using USEPA Modified Method 1625 or 8270D with the sulfolane isotope-dilution method for sulfolane quantitation.

8.6 Laboratory Analysis and Notification Process for POE Samples

Typically, samples collected from POE systems will be submitted to Pace for analysis. The laboratory will prepare the samples collected from POEs using a modified method based upon SW-846 Method 3510C. The sample is extracted in a 60 mL glass VOA vial with methylene chloride in accordance with the current revision of the Pace's Standard Operating Procedure (SOP) S-MN-O-569. Each extraction batch is prepared with a method blank, a laboratory fortified blank, and a sample duplicate (if < 10 samples) or a matrix spike (MS)/MS duplicate (MSD) (if ≥ 10 samples). If insufficient sample is provided to perform the MS/MSD, then a sample duplicate is prepared.

The sample extracts are analyzed by GC/MS using SW-846 Method 8270D modified to include isotope dilution. The sample analysis is performed in accordance with the current revisions of the laboratory SOP S-MN-O-569 and the ADEC Sulfolane Key Elements Document (ADEC 2013).

The following criteria will be followed as part of the review process for sample results:

- If a C2 sample is collected and contains a detection (greater than method detection limit [MDL]) for sulfolane, the following will occur.
    - The client must be notified immediately by the laboratory, within 3 hours if normal business hours.
    - The sample extract must be reanalyzed for confirmation if a duplicate sample is not included in the sample set.
    - The sample must be reextracted and analyzed for confirmation if a duplicate sample is not included in the sample set.
    - If a D2 sample was collected for this location, it must be extracted and analyzed to confirm that the final treated water does not contain sulfolane greater than the MDL.
- If a D sample (D, D1, or D2) contains a detection for sulfolane, the following will occur.
    - The client must be notified immediately by the laboratory, within 3 hours if normal business hours.

  - The sample extract must be reanalyzed for confirmation if a duplicate sample is not included in the sample set.
  - The sample must be reextracted and analyzed for confirmation if a duplicate sample is not included in the sample set.
  - If sulfolane is detected in a D1 sample and a D2 sample was collected for this location, the D2 sample must be extracted and analyzed to confirm that the final treated water does not contain sulfolane greater than the MDL.
- For the MS/MSD, if the native sample result is ≤ 4× the spike amount (i.e., ≤ 60 µg/L), the percent recovery and the precision shall both be evaluated. If the native sample result is > 4 × the spike amount, only the precision shall be evaluated. If the sample duplicate or MS/MSD do not meet the acceptance criteria, all samples in the batch must be evaluated to determine if a possible sample switch occurred. If the acceptance criteria are not met, the laboratory must perform the corrective action as noted in the ADEC Key Elements Document (ADEC 2013).

The client should be provided with preliminary reports for all samples in the extraction batch to review sample results against historical data.

9 EVALUATION OF DATA QUALITY

QA and QC are important components of an environmental site investigation. QA is the integrated program for measuring the reliability of the data. QC is the routine use of specific procedures set forth to meet defined standards of sampling and analysis. This section describes specific procedures to be followed so the laboratory data are effective and do not detract from the quality or reliability of the results.

9.1 Quality Control Samples

QA/QC samples, including field-duplicate samples, will be submitted for laboratory analysis. At least one field duplicate sample will be collected at a minimum rate of 10 percent of the samples submitted for laboratory analysis. Duplicates will be assigned a separate, "dummy" sample number and submitted "blind" to the laboratory. Duplicate sample results will be used to test the comparability of analytical data.

Also, equipment blank samples will be collected at a minimum rate of 5 percent of wells with non-dedicated pumps. Equipment blanks will be labelled to reflect the location of the well sampled prior to taking the blank. Equipment blank results will be used to establish the efficiency of decontamination procedures for non-dedicated pump wells.

Temperature blanks, while not QA/QC samples, will enable the receiving laboratory to determine the temperature at which the samples arrive at the lab. Temperature blanks will consist simply of a jar filled with water and packed with the other samples in each cooler. The water temperature in the blank is measured at the laboratory. Sample temperature should range from 0 to 6 degrees Celsius (°C). As specified in the USEPA publication SW-846, temperatures within this range are considered acceptable; this range has been approved by ADEC. The laboratory will document cooler conditions, including measuring temperature blanks upon arrival at each laboratory location, and any occurrence of broken sample containers.

9.2 Data Quality Objectives

The QA objective for measurement data is to ensure that environmental monitoring data are known and of acceptable quality. For analytical data, the objective is to meet acceptable QA standards of analytical sensitivity, precision, accuracy, representativeness, comparability, and completeness. These terms are defined below:

- *Analytical sensitivity*. The laboratory objective for sensitivity is to achieve a limit of quantitation of 10 µg/L and a MDL of 5 µg/L.
- *Precision*. A measure of mutual agreement among replicate or duplicate measurements of the same analyte. The laboratory objective for precision is to equal or exceed the precision demonstrated for similar samples, and will be within the established control limits for the methods as published by the USEPA. Precision will be measured as the relative percent difference between the project primary and duplicate samples.
- *Accuracy*. A measure of bias in a measurement system. Accuracy will be expressed as the percent recovery of an analyte from a surrogate or laboratory control sample (LCS), laboratory control sample duplicate (LCSD), MS, or MSD samples, or from a standard reference material. The laboratory

objective for accuracy is to equal or exceed the accuracy demonstrated for these analytical methods on similar samples, and will be within the established control limits for the method as detailed in the ADEC Key Elements document (ADEC 2013).

- *Representativeness*. A quality characteristic attributable to the type and number of samples to be taken to be representative of the environment. Sample locations will be selected in the field to be representative of the water at that sample location.
- *Comparability*. A qualitative parameter expressing the confidence with which one data set can be compared to another. The sampling method employed, methods used to transfer the samples to the analytical laboratory, and analytical techniques implemented at the laboratory will be performed in a uniform manner.
- *Completeness*. A measure of the number of valid measurements obtained in relation to the total number of measurements planned. The objective of completeness is to generate an adequate database to successfully achieve the goals of the investigation.

9.3 Reporting

Each laboratory data packet will be reviewed for QA, as described above. ADEC Data Review Checklists and a report case narrative describing data quality will be completed and submitted with groundwater monitoring reports.

Elevated reporting limits (i.e., reporting limits greater than QC objectives or regulatory limits; Table 2) may occur when:

- An insensitive analytical technique is used.
- The chemical matrix of the sample interferes with the analytical technique.
- High concentrations of some constituents cause the laboratory to dilute the sample, thus affecting the detection limit for other constituents.

Where detection limits are high, the limit will be reduced in future samples, if practical, by using alternate laboratory procedures that remove or control interfering constituents.

9.4 Missing Data Values

Care will be taken to complete all analyses to provide a complete data set for statistical comparison.

9.5 Outliers

An observation that is very different from all other observations in a group of observations is called an outlier. Outliers in groundwater samples may be caused by:

- Catastrophic occurrence such as a spill
- Inconsistent sampling or analysis procedures
- Errors in transcription of the data values.

Any outliers in the reported data will be evaluated for cause and will be corrected if possible. Documentation of the cause of the outlier will be provided prior to correcting or excluding data values from evaluations. If the cause of the outlier cannot be explained by an identifiable error, the value will not be excluded from the database.

9.6 Units of Measure

Units of measure will be specified by the laboratory after each quantity reported for the specific analyte.

10 HEALTH AND SAFETY

SWI, Barr Engineering Company, ARCADIS U.S., Inc, and other contractors will conduct offsite field activities in accordance with their respective corporate health and safety programs.

11 REFERENCES

ADEC. 2013. Monitoring Well Guidance. ADEC Division of Spill Prevention and Response Contaminated Sites Program. September.

ADEC, 2013. Sulfolane Key Elements Document, Version 4. July 22.

ADEC. 2016. Field Sampling Guidance. ADEC Division of Spill Prevention and Response Contaminated Sites Program. March.

Pace, 2013. Standard Operating Procedure, Sulfolane Extraction and Analysis in Liquid Matrices by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique. December 18.

USEPA. 1983. Methods for Chemical Analysis of Water and Wastes, USEPA-600/4-79-020.

USEPA. 1986. Test Methods for Evaluating Solid Waste, SW-846.

TABLES

Table 1
Well Construction Details

Offsite Sampling and Analysis Plan
North Pole Refinery Site
North Pole, Alaska

Well	New Well Name	LocationNdx	Proximity	Boring Completion Date	Survey Date	Riser Elevation*	Riser Stickup	Ground Surface Elevation	Well Depth	Well Length	Well Bottom Elevation	Depth to Top of Permafrost	Well Diameter	Well Screen Depth to Top	Well Screen Top Elevation	Well Screen Depth to Bottom	Well Screen Bottom Elevation	Well Screen Length	Well Screen Screen Slot	Well Screen Material	Riser Material	Filter Pack Depth to Top	Filter Pack Depth to Bottom	Water Table Approx Depth	Water Table In Screen	Water Table Feet Above Top of	Alaska State Plane NAD83, ZONE 3 Northing	Alaska State Plane NAD83, ZONE 3 Easting
						(feet MSL)	(feet)	(feet MSL)	(feet BGS)	(feet)	(feet MSL)	(feet BGS)	(inches)	(feet BGS)	(feet MSL)	(feet BGS)	(feet MSL)	(feet)	(inches)			(feet BGS)	(feet BGS)	(ft BGS)				
MW-150A	MW-150A-10	bb50bc4d-6401-41d3-9861-696370680d01	Off-site	10/2/2009	Jul-16	487.33	0.12	487.21	11.58	11.70	475.63	—	2.00	6.70	480.51	11.10	476.11	4.40	0.01	PVC	PVC	5.5	17.0	8.0	Y	-1.3	3930163.44	1426522.55
MW-150B	MW-150B-25	83c37284-76b4-4384-bb48-333ec07b1a23	Off-site	10/2/2009	Jul-16	487.42	0.21	487.21	24.64	24.85	462.57	—	2.00	20.60	466.61	24.50	462.71	3.90	0.01	PVC	PVC	18.0	26.5	8.0	N	12.6	3930162.06	1426527.97
MW-150C	MW-150C-60	744ba0c5-b6fd-45dd-af82-8e44bb0c445c	Off-site	5/12/2012	Jul-16	486.70	-0.51	487.21	60.51	60.00	426.70	63.5	2.00	55.43	431.78	60.08	427.13	4.65	0.01	PVC	PVC	Natural pack		8.0	N	47.4	3930159.85	1426535.91
MW-151A	MW-151A-15	6472319f-ab90-4ae5-a9f6-aec78497a44d	Off-site	10/7/2009	Nov-16	486.92	-0.96	487.88	15.50	14.54	472.38	—	2.00	10.00	477.88	15.00	472.88	5.00	0.01	PVC	PVC	4.0	17.0	8.0	N	2.0	3930152.81	1427042.16
MW-151B	MW-151B-25	cde41833-053d-4233-9371-074d867381f9	Off-site	10/2/2009	Mar-16	487.43	-0.35	487.78	23.60	23.25	464.18	—	2.00	18.50	469.28	23.10	464.68	4.60	0.01	PVC	PVC	17.0	26.5	8.0	N	10.5	3930154.30	1427034.87
MW-151C	MW-151C-60	1370ecf0-782c-472f-87fe-16464098f678	Off-site	2/18/2010	Mar-16	490.92	3.14	487.78	57.70	60.84	430.08	65.0	2.00	52.55	435.23	57.15	430.63	4.60	0.01	PVC	PVC	50.0	63.3	8.0	N	44.6	3930151.93	1427038.65
MW-152A	MW-152A-15	dbff8efb-8352-4146-93a0-05ff923ce646	Off-site	10/7/2009	Jul-16	488.50	-0.12	488.62	16.00	15.88	472.62	—	2.00	10.60	478.02	15.00	473.62	4.40	0.01	PVC	PVC	8.0	17.0	8.0	N	2.6	3930112.63	1427987.59
MW-152B	MW-152B-25	0eb80aa1-7d5a-40c0-8a91-a8070d8a7eb9	Off-site	10/7/2009	Jul-16	488.21	-0.41	488.62	25.40	24.99	463.22	—	2.00	19.90	468.72	24.40	464.22	4.50	0.01	PVC	PVC	19.0	27.0	8.0	N	11.9	3930112.89	1427983.05
MW-152C	MW-152C-65	131fa3db-b2f5-4a20-af1d-102e754c79a6	Off-site	9/28/2011	Jul-16	488.16	-0.46	488.62	65.17	64.71	423.45	67.5	2.00	60.13	428.49	64.57	424.05	4.44	0.01	PVC	PVC	55.0	65.5	11.3	N	48.8	3930113.17	1427992.07
MW-153A	MW-153A-15	f7edf3d9-f361-4bdb-9fd5-2314b04bff4c	Off-site	10/7/2009	Jul-16	490.34	-0.11	490.45	16.00	15.89	474.45	—	2.00	10.60	479.85	14.50	475.95	3.90	0.01	PVC	PVC	8.5	17.0	8.0	N	2.6	3928749.86	1427720.55
MW-153B	MW-153B-55	3d1d3c74-cfca-42a5-9592-3d1c1d22bf7f	Off-site	4/20/2010	Jul-16	489.86	-0.59	490.45	56.65	56.06	433.80	59.0	2.00	51.60	438.85	56.10	434.35	4.50	0.01	PVC	PVC	45.0	59.0	9.0	N	42.6	3928741.21	1427721.08
MW-155A	MW-155A-15	19457422-9ed5-4d15-9e3d-c648f8a46f1e	Off-site	11/11/2009	Jul-16	488.60	-0.24	488.84	15.50	15.26	473.34	—	2.00	5.35	483.49	15.08	473.76	9.73	0.01	PVC	PVC	3.5	15.5	7.5	Y	-2.2	3930320.08	1425509.58
MW-155B	MW-155B-65	ac168cd7-f9ef-440c-811e-71b85463dd3b	Off-site	9/11/2010	Jul-16	488.64	-0.20	488.84	65.80	65.60	423.04	67.0	2.00	60.78	428.06	65.20	423.64	4.42	0.02	PVC	PVC	45.0	70.0	9	N	51.8	3930314.75	1425510.07
MW-156A	MW-156A-15	d6afa1bc-65e8-441c-8962-d93590ea2511	Off-site	11/11/2009	Jul-16	485.88	-0.49	486.37	15.50	15.01	470.87	—	2.00	5.35	481.02	15.09	471.28	9.74	0.01	PVC	PVC	3.5	15.5	7.0	Y	-1.7	3931955.04	1425536.52
MW-156B	MW-156B-50	f0ea807b-3999-4835-b358-766fdef01961	Off-site	2/17/2010	Jul-16	489.26	2.89	486.37	50.40	53.29	435.97	51.5	2.00	45.20	441.17	50.00	436.37	4.80	0.01	PVC	PVC	35.0	51.5	8.0	N	37.2	3931949.92	1425537.02
MW-157A	MW-157A-15	cba4e6c6-dba6-438b-b519-39772d4ea37a	Off-site	11/13/2009	Nov-16	484.98	-0.36	485.34	15.50	15.14	469.84	—	2.00	5.36	479.98	15.09	470.25	9.73	0.01	PVC	PVC	3.5	15.5	7.0	Y	-1.6	3932561.84	1426870.93
MW-157B	MW-157B-30	26ec3cf5-cb09-40b7-96bf-1947c5fbfa5b	Off-site	9/30/2011	Jul-16	484.79	-0.62	485.41	30.73	30.11	454.68	40.0	2.00	25.71	459.70	30.14	455.27	4.43	0.01	PVC	PVC	20.0	31.0	10.3	N	15.4	3932567.15	1426874.11
MW-158A	MW-158A-15	c1b5076c-8e3e-4b4a-bf4e-80b6fe6f8fef	Off-site	11/13/2009	Jun-16	487.68	-0.53	488.21	15.60	15.07	472.61	—	2.00	5.50	482.71	15.20	473.01	9.70	0.02	PVC	PVC	3.0	16.5	8.5	Y	-3.0	3931120.60	1426869.14
MW-158B	MW-158B-60	29aea756-0983-4744-9696-d1ca2057e2ec	Off-site	9/23/2010	Jul-16	487.53	-0.50	488.03	60.61	60.11	427.42	65.0	2.00	55.62	432.41	60.14	427.89	4.52	0.02	PVC	PVC	43.0	67.0	10.0	N	45.6	3931119.26	1426874.85
MW-159A	MW-159A-15	d81c04b3-15c3-4d1b-841e-93795e73becf	Off-site	11/13/2009	Jul-16	488.42	-0.74	489.16	15.60	14.86	473.56	—	2.00	5.50	483.66	15.20	473.96	9.70	0.02	PVC	PVC	3.0	16.5	8.0	Y	-2.5	3931101.34	1427690.57
MW-159B	MW-159B-45	b8ef50c5-4697-4b23-9257-a96b6226c20a	Off-site	10/12/2011	Jul-16	488.28	-0.88	489.16	46.20	45.32	442.96	—	2.00	41.16	448.00	45.60	443.56	4.44	0.01	PVC	PVC	35.0	46.5	8.0	N	33.2	3931101.12	1427679.28
MW-159C	MW-159C-70	ee856537-f0a8-404b-b2db-af9983b67093	Off-site	9/29/2011	Jul-16	488.71	-0.45	489.16	72.30	71.85	416.86	72.5	2.00	67.13	422.03	71.84	417.32	4.71	0.01	PVC	PVC	60.0	72.5	8.0	N	59.1	3931100.83	1427684.86
MW-160AR-15	MW-160AR-15	757debee-b964-479d-812e-45ed3f32201a	Off-site	4/16/2013	Mar-16	485.62	-0.34	485.96	15.27	14.93	470.69	—	2.00	4.91	481.05	14.77	471.19	9.86	0.01	PVC	PVC	3.0	15.27	7.0	Y	-2.1	3932566.91	1427454.76
MW-160B	MW-160B-90	80debeec-8345-4d7f-af15-85a351ce7095	Off-site	2/19/2010	Mar-16	485.28	-0.68	485.96	90.73	90.05	395.23	91.0	2.00	85.58	400.38	90.18	395.78	4.60	0.01	PVC	PVC	80.0	91.5	8.0	N	77.6	3932566.90	1427459.68
MW-161A	MW-161A-15	83a1130f-71d5-4a40-9d37-3917df391445	Off-site	12/9/2009	Nov-16	479.21	-0.90	480.11	15.60	14.70	464.51	—	2.00	5.50	474.61	15.20	464.91	9.70	0.02	PVC	PVC	3.8	16.5	8.0	Y	-2.5	3935554.06	1421680.78
MW-161B	MW-161B-50	b2616abb-dfd0-424d-9a00-edd16bfac373	Off-site	9/10/2010	Jul-16	479.78	-0.11	479.89	50.44	50.33	429.45	54.0	2.00	46.02	433.87	50.44	429.45	4.42	0.02	PVC	PVC	35.0	51.5	6.5	N	39.5	3935553.83	1421678.29
MW-161-30	MW-161-30	8bdd00d1-c1b4-4b5d-9441-861cd6c8ace2	Off-site	4/23/2013	Jul-16	479.65	-0.24	479.89	30.19	29.95	449.70	—	2.00	25.18	454.71	29.73	450.16	4.55	0.01	PVC	PVC	Natural pack		8.0	N	17.2	3935553.69	1421673.97
MW-162A	MW-162A-15	858392a1-38eb-4f06-a0e5-82ff1d909661	Off-site	11/25/2009	Nov-16	484.09	-0.55	484.64	15.60	15.05	469.04	—	2.00	5.50	479.14	15.20	469.44	9.70	0.02	PVC	PVC	3.8	16.5	7.5	Y	-2.0	3934831.10	1425571.90
MW-162B	MW-162B-65	9457f288-c784-4216-8d18-0c365d5d579e	Off-site	11/25/2009	Mar-16	483.95	-0.75	484.70	65.38	64.63	419.32	67.5	2.00	60.18	424.52	64.73	419.97	4.55	0.01	PVC	PVC	50.0	66.5	7.5	Y	52.7	3934825.07	1425574.08
MW-163A	MW-163A-15	b910d35b-c2f0-45ac-986d-fd8b1b17795c	Off-site	12/9/2009	Jul-16	484.89	-0.64	485.53	15.60	14.96	469.93	—	2.00	5.50	480.03	15.20	470.33	9.70	0.02	PVC	PVC	3.6	16.5	9.0	Y	-3.5	3935430.75	1426901.11
MW-163B	MW-163B-40	438df18a-ab13-4309-a5b1-3331fa88f2af	Off-site	9/13/2010	Jul-16	485.25	-0.28	485.53	39.55	39.27	445.98	40.0	2.00	34.53	451.00	38.96	446.57	4.43	0.02	PVC	PVC	30.0	41.5	9.5	N	25.0	3935430.72	1426906.78
MW-164A	MW-164A-15	7cbec488-f8f7-4eec-ad8b-6858cba234c6	Off-site	12/10/2009	Sep-16	479.91	-0.60	480.51	15.60	15.00	464.91	—	2.00	5.50	475.01	15.20	465.31	9.70	0.02	PVC	PVC	3.8	16.5	9.0	Y	-3.5	3938026.16	1425651.07
MW-164B	MW-164B-50	bc4b92c6-94c9-49ce-8af7-37bb4eb8d8ea	Off-site	9/9/2010	Jun-16	479.62	-0.68	480.30	50.67	49.99	429.63	—	2.00	45.62	434.68	50.06	430.24	4.44	0.02	PVC	PVC	35.0	51.5	9.0	N	36.6	3938027.01	1425654.08
MW-164C	MW-164C-60	85dc25cb-443f-4f85-a00c-d70112552fc1	Off-site	8/17/2011	Mar-16	479.59	-0.98	480.57	62.44	61.46	418.13	63.0	2.00	57.34	423.23	61.99	418.58	4.65	0.01	PVC	PVC	52.0	63.5	8.0	N	49.3	3938023.06	1425652.19
MW-165A	MW-165A-15	73dd9d61-5434-4b1a-921e-9f07f0fce24a	Off-site	1/18/2010	Jul-16	475.02	-0.45	475.47	15.40	14.95	460.07	—	2.00	5.19	470.28	14.90	460.57	9.71	0.01	PVC	PVC	4.0	15.5	7.5	Y	-2.3	3938692.18	1416849.70
MW-165B	MW-165B-50	7aacb690-eca4-4beb-ab2a-e12427ba7fe6	Off-site	9/28/2010	Jul-16	474.87	-0.60	475.47	50.88	50.28	424.59	—	2.00	45.87	429.60	50.35	425.12	4.48	0.02	PVC	PVC	35.0	51.5	8.0	N	37.9	3938690.33	1416854.17
MW-166A	MW-166A-15	206d095c-1583-4c5a-81fb-673ce91fdef6	Off-site	1/8/2010	Jul-16	474.84	2.72	472.12	15.60	18.32	456.52	—	2.00	5.44	466.68	15.15	456.97	9.71	0.01	PVC	PVC	4.0	16.0	7.5	Y	-2.1	3940972.27	1419512.27
MW-166B	MW-166B-30	c1c48e00-7fde-465f-bfa8-d929db2f4301	Off-site	3/15/2010	Jul-16	475.09	2.97	472.12	32.10	35.07	440.02	33.0	2.00	27.15	444.97	31.35	440.77	4.20	0.01	PVC	PVC	21.0	33.5	7.0	N	20.2	3940967.37	1419509.53
MW-167A	MW-167A-15	e1ff3df0-be30-4411-ae47-689fcaf01bb8	Off-site	1/7/2010	Nov-16	475.79	-0.37	476.16	15.80	15.43	460.36	—	2.00	5.65	470.51	15.35	460.81	9.70	0.01	PVC	PVC	4.0	16.0	9.0	Y	-3.4	3942809.92	1423092.52
MW-167B	MW-167B-35	5bfc3b82-de6b-4d32-89c4-a35b7ad24ceb	Off-site	3/23/2010	Jul-16	475.66	-0.45	476.11	33.27	32.82	442.84	33.5	2.00	28.17	447.94	33.15	442.96	4.98	0.01	PVC	PVC	25.0	34.0	6.5	N	21.7	3942813.73	1423092.51
MW-168A	MW-168A-15	10b43fff-61db-483a-a9fa-10f28b4597c7	Off-site	1/8/2010	Jul-16	478.27	-0.37	478.64	15.50	15.13	463.14	—	2.00	5.36	473.28	15.06	463.58	9.70	0.01	PVC	PVC	4.0	16.0	9.0	Y	-3.6	3941284.64	1425723.88
MW-168B	MW-168B-50	fb777856-a6f9-458d-819b-3c12e5ac82bb	Off-site	10/1/2011	Jul-16	478.34	-0.30	478.64	51.45	51.15	427.19	55.0	2.00	46.29	432.35	51.00	427.64	4.71	0.01	PVC	PVC	40.0	52.0	10.9	N	35.4	3941289.40	1425724.13
MW-169A	MW-169A-15	e711bc9e-2ba8-484b-8156-66db4530d16f	Off-site	2/25/2010	Nov-16	486.19	2.49	483.70	15.15	17.64	468.55	—	2.00	5.27	478.43	15.06	468.64	9.79	0.01	PVC	PVC	4.0	15.5	8.0	Y	-2.7	3931955.69	1423035.08
MW-169B	MW-169B-50	9aa9bf82-4e2f-460f-9cfb-7edb6f51e92c	Off-site	10/21/2010	Jul-16	486.32	3.33	482.99	49.20	52.53	433.79	—	2.00	44.09	438.90	48.72	434.27	4.63	0.02	PVC	PVC	35.0	51.5	10.0	N	34.1	3931960.39	1423037.49
MW-169C	MW-169C-60	11c1f256-db61-406a-bed8-9e984c9d438e	Off-site	9/1/2011	Mar-16	483.05	0.03	483.02	59.94	59.97	423.08	69.0	2.00	54.82	428.20	59.47	423.55	4.65	0.02	PVC	PVC	50.0	60.0	8.0	N	46.8	3931966.50	1423042.84
MW-170A	MW-170A-15	5399b88d-fac3-419a-a9a6-3b42b9ff8b56	Off-site	2/24/2010	Jun-16	490.70	-0.36	491.06	14.90	14.54	476.16	—	2.00	4.60	486.46	14.40	476.66	9.80	0.01	PVC	PVC	4.6	16.0	8.0	Y	-3.4	3930005.65	1429184.98
MW-170B	MW-170B-75	c6116c19-04a8-4ab7-9457-1447a1f6aad3	Off-site	3/6/2010	Jul-16	490.71	-0.34	491.05	74.79	74.45	416.26	—	4.00	69.70	421.35	74.06	416.99	4.36	0.01	PVC	PVC	65.0	75.6	8.0	N	61.7	3930000.43	1429187.53
MW-170C	MW-170C-130	ab1f0c2b-3785-4d7f-aad5-950c9e2b18ee	Off-site	3/4/2010	Jul-16	490.48	-0.57	491.05	130.90	130.33	360.15	135.0	2.00	125.90	365.15	130.20	360.85	4.30	0.01	PVC	PVC	120.0	135.0	8.0	N	117.9	3929995.96	1429188.84
MW-170D	MW-170D-50	b977bbde-8c66-4fcf-8938-2181173fb50b	Off-site	10/13/2010	Jul-16	490.44	-0.61	491.05	50.62	50.01	440.43	—	2.00	45.52	445.53	50.14	440.91	4.62	0.02	PVC	PVC	35.0	51.5	8.0	N	37.5	3929991.96	1429189.27
MW-172A	MW-172A-15	cc74169f-0255-4386-8627-180ad05b89da	Off-site	3/24/2010	Jul-16	475.61	-0.64	476.25	15.47	14.83	460.78	—	2.00	5.33	470.92	15.04	461.21	9.71	0.01	PVC	PVC	3.5	16.0	8.0	Y	-2.7	3942632.06	1427431.58
MW-172B	MW-172B-150	b4e68ce9-85df-48eb-83d6-fe7ef818032a	Off-site	3/27/2010	Jul-16	475.64	-0.61	476.25	150.37	149.76	325.88	150.5	2.00	145.35	330.90	149.78	326.47	4.43	0.01	PVC	PVC	135.0	151.5	8.0	N	137.4	3942631.33	1427425.63
MW-181A	MW-181A-15	7053e244-ccfe-4057-a506-7828df70218b	Off-site	10/6/2010	Jul-16	475.92	-0.54	476.46	15.16	14.62	461.30	—	2.00	5.05	471.41	14.75	461.71	9.70	0.02	PVC	PVC	4.0	16.5	10.0	Y	-5.0	3944095.46	1425755.04
MW-181B	MW-181B-50	1d082ba1-2360-4893-9032-492b917dbab9	Off-site	10/6/2010	Jul-16	475.85	-0.61	476.46	50.78	50.17	425.68	—	2.00	45.77	430.69	50.30	426.16	4.53	0.02	PVC	PVC	35.0	51.5	10.0	N	35.8	3944099.95	1425752.10
MW-181C	MW-181C-150	31cedc29-9d51-462a-aff1-95986d865a33	Off-site	10/3/2011	Jul-16	475.98	-0.48	476.46	150.45	149.97	326.01	—	2.00	145.43	331.03	149.86	326.60	4.43	0.01	PVC	PVC	140.0	150.5	10.3	N	135.1	3944089.21	1425759.17
MW-182A	MW-182A-15	a5ce3813-d458-44e3-b355-abd4d23fea7f	Off-site	10/8/2010	Jul-16	475.30	-0.45	475.75	15.83	15.38	459.92	—	2.00	5.70	470.05	15.42	460.33	9.72	0.02	PVC	PVC	4.0	16.5	7.0	Y	-1.3	3941132.12	1423038.13
MW-182B	MW-182B-45	a342983d-d059-4008-bd45-34cda85bb499	Off-site	8/22/2011	Jul-16	475.24	-0.51	475.75	44.67	44.16	431.08	46.0	2.00	39.57	436.18	44.27	431.48	4.70	0.02	PVC	PVC	30.0	50.5	7.0	N	32.6	3941136.42	1423037.29
MW-183A	MW-183A-15	e5d68eb2-b393-4f15-af05-75786ca4a927	Off-site	10/8/2010	Jul-16	478.15	-0.53	478.68	15.88	15.35	462.80	—	2.00	5.77	472.91	15.47	463.21	9.70	0.02	PVC	PVC	4.0	16.5	7.0	Y	-1.2	3937529.71	1420159.70
MW-183B	MW-183B-60	d252e661-b594-4ae6-90ab-f8e5fa82360f	Off-site	8/29/2011	Jul-16	478.42	-0.26	478.68	59.74	59.48	418.94	59.0	2.00	54.64	424.04	59.34	419.34	4.70	0.02	PVC	PVC	45.0	60.0	7.0	N	47.6	3937532.14	1420157.14
MW-184	MW-184-45	0cbc893c-b05a-45d2-a842-665464c4c404	Off-site	10/1/2010	Jul-16	486.52	-0.27	486.79	45.23	44.96	441.56	45.0	2.00	40.12	446.67	44.75	442.04	4.63	0.02	PVC	PVC	30.0	45.5	7.0	N	33.1	3932560.61	1428756.36
MW-185A	MW-185A-15	9e97ae62-a8b1-43d6-8a00-4427bad73915	Off-site	10/12/2010	Jul-16	478.07	-0.44	478.51	15.57	15.13	462.94	—	2.00	5.48	473.03	15.10	463.41	9.62	0.02	PVC	PVC	4.0	16.5	7.0	Y	-1.5	3940802.50	1428251.19
MW-185B	MW-185B-50	43642a11-8039-43f5-880e-5f48fd5e6b95	Off-site	10/12/2010	Jul-16	478.09	-0.42	478.51	51.41	50.99	427.10	—	2.00	46.30	432.21	50.93	427.58	4.63	0.02	PVC	PVC	35.0	51.5	7.0	N	39.3	3940797.61	1428251.05
MW-185C	MW-185C-120	2e90d00a-1f1f-47f0-abfd-62758da35a4e	Off-site	10/2/2011	Jul-16	478.11	-0.40	478.51	120.99	120.59	357.52	121.0	2.00	115.96	362.55	120.40	358.11	4.44	0.01	PVC	PVC	110.0	121.0	9.5	N	106.5	3940806.68	1428250.19
MW-187	MW-187-15	31742dc2-af90-4c87-8b2f-a8dd8fabfc2f	Off-site	10/21/2010	Sep-16	485.38	2.98	482.40	17.38	20.36	465.02	—	2.00	7.28	475.12	16.91	465.49	9.63	0.02	PVC	PVC	4.0	16.5	10.5	Y	-3.2	3934464.24	1420335.62
MW-188A	MW-188A-15	5ddda5b9-4293-4bbe-8d06-5a526ab397d3	Off-site	4/28/2012	Jul-15	461.52	-0.11	461.63	15.33	15.22	446.30	—	2.00	5.20	456.43	14.98	446.65	9.78	0.01	PVC	PVC	3.0	15.3	10.0	Y	-4.8	3951510.80	1410365.41
MW-188B	MW-188B-40	1508d9ed-465d-468e-a259-4359a973ccd2	Off-site	11/24/2010	Jul-15	461.44	-0.19	461.63	40.90	40.71	420.73	45.5	2.00	35.40	426.23	40.40	421.23	5.00	0.02	PVC	PVC	35.5	42.5	4.5	N	30.9	3951521.76	1410365.52
MW-189A	MW-189A-15	0075df3e-6a72-41ef-ba90-0232d80fd953	Off-site	8/19/2011	Jul-16	470.42	-0.68	471.10	16.54	15.86	454.56	—	2.00	6.49	464.61	16.16	454.94	9.67	0.01	PVC	PVC	4.0	17.5	7.0	Y	-0.5	3945399.36	1424696.44
MW-189B	MW-189B-60	46c3ba4b-71ff-473c-88aa-c18365631d92	Off-site	8/19/2011	Jul-16	470.75	-0.35	471.10	60.52	60.17	410.58	—	2.00	55.42	415.68	60.07	411.03	4.65	0.01	PVC	PVC	45.0	61.5	7.0	N	48.4	3945396.24	1424692.19
MW-190A	MW-190A-15	74ad20c5-718a-4973-b527-be30857b750e	Off-site	8/23/2011	Nov-16	481.31	-0.90	482.21	15.59	14.69	466.62	—	2.00	5.49	476.72	15.20	467.01	9.71	0.01	PVC	PVC	4.0	16.0	7.0	Y	-1.5	3938370.17	1429592.43

Acronyms and Abbreviations on Page 3.

Table 1
Well Construction Details

Offsite Sampling and Analysis Plan
North Pole Refinery Site
North Pole, Alaska

Well	New Well Name	LocationNdx	Proximity	Boring Completion Date	Survey Date	Riser Elevation* (feet MSL)	Riser Stickup (feet)	Ground Surface Elevation (feet MSL)	Well Depth (feet BGS)	Well Length (feet)	Well Bottom Elevation (feet MSL)	Depth to Top of Permafrost (feet BGS)	Well Diameter (inches)	Well Screen: Depth to Top (feet BGS)	Well Screen: Top Elevation (feet MSL)	Well Screen: Depth to Bottom (feet BGS)	Well Screen: Bottom Elevation (feet MSL)	Well Screen: Length (feet)	Well Screen: Screen Slot (inches)	Well Screen: Material	Riser Material	Filter Pack: Depth to Top (feet BGS)	Filter Pack: Depth to Bottom (feet BGS)	Water Table: Approx Depth (ft BGS)	Water Table: In Screen	Water Table: Feet Above Top of	Alaska State Plane NAD83, ZONE 3: Northing	Alaska State Plane NAD83, ZONE 3: Easting
MW-190B	MW-190B-60	51bfae39-4c9e-42db-a9e2-a55efbf01d9e	Off-site	8/23/2011	May-14	481.72	-0.41	482.13	60.71	60.30	421.42	—	2.00	55.62	426.51	60.28	421.85	4.66	0.01	PVC	PVC	45.0	61.5	7.0	N	48.6	3938370.16	1429596.16
MW-190BR-60	MW-190BR-60	62d96ce9-8ff1-41c8-9ff3-4fc9d8810f3f	Off-site	5/21/2013	Jul-16	481.97	-0.31	482.28	59.87	59.56	422.41	—	2.00	54.85	427.43	59.41	422.87	4.56	0.01	PVC	PVC	Natural pack		7.0	N	47.9	3938370.43	1429589.58
MW-190-150	MW-190-150	3f45bf84-d557-4243-8421-643b35e9b0e5	Off-site	4/19/2013	Jul-16	482.01	-0.27	482.28	150.38	150.11	331.90	—	2.00	145.35	336.93	149.91	332.37	4.56	0.01	PVC	PVC	Natural pack		7.0	N	138.4	3938370.21	1429582.69
MW-191A	MW-191A-15	6dac08f9-6dad-4a62-a22a-a1f38877305b	Off-site	8/24/2011	Jul-16	475.82	-0.71	476.53	15.28	14.57	461.25	—	2.00	5.18	471.35	14.90	461.63	9.72	0.01	PVC	PVC	4.0	16.0	8.0	Y	-2.8	3937781.57	1417713.87
MW-191B	MW-191B-60	804f62a2-513e-437e-b657-16bb498c3370	Off-site	8/24/2011	Jul-16	475.64	-0.89	476.53	60.29	59.40	416.24	—	2.00	55.22	421.31	59.84	416.69	4.62	0.01	PVC	PVC	45.0	61.5	8.0	N	47.2	3937777.89	1417714.18
MW-193A	MW-193A-15	34ee4657-5706-4dde-9749-f1c11455c8ca	Off-site	8/30/2011	Jul-16	488.36	-0.25	488.61	15.68	15.43	472.93	—	2.00	5.00	483.61	15.50	473.11	10.50	0.02	PVC	PVC	5.0	15.5	6.8	Y	-1.8	3930483.21	1424590.71
MW-193B	MW-193B-60	68779b3c-2b08-4919-8b9b-409460f468c0	Off-site	8/30/2011	Jul-16	488.04	-0.57	488.61	59.88	59.31	428.73	61.0	2.00	54.72	433.89	59.41	429.20	4.69	0.02	PVC	PVC	45.0	60.0	6.5	N	48.2	3930481.25	1424593.75
MW-194A	MW-194A-15	4d0f5a2f-475d-4263-8797-b5c21c213819	Off-site	8/31/2011	Jun-16	475.33	-0.68	476.01	15.76	15.08	460.25	—	2.00	6.00	470.01	15.36	460.65	9.36	0.02	PVC	PVC	4.0	15.0	6.5	Y	-0.5	3939634.55	1418923.90
MW-194B	MW-194B-40	f4955aea-57fd-4d16-8471-19392b1d7051	Off-site	8/31/2011	Jul-16	475.98	-0.33	476.31	39.45	39.12	436.86	39.0	2.00	34.38	441.93	38.96	437.35	4.58	0.02	PVC	PVC	24.0	40.0	6.5	N	27.9	3939630.80	1418924.87
MW-308-15	MW-308-15	0c011cf5-791c-44a6-afcd-e9964827443f	Off-site	4/13/2012	Jul-16	476.12	3.09	473.03	14.95	18.04	458.08	—	2.00	4.91	468.12	14.36	458.67	9.45	0.01	PVC	PVC	3.5	15.0	9.0	Y	-4.1	3943105.50	1420578.30
MW-308-30	MW-308-30	c891037a-7eb6-4720-95d2-6eeea2713613	Off-site	4/12/2012	Jul-16	474.44	3.09	471.35	30.42	33.51	440.93	41.0	2.00	25.21	446.14	30.02	441.33	4.81	0.01	PVC	PVC	Natural pack		10.0	N	15.2	3943026.01	1420453.62
MW-311-15	MW-311-15	96cf1943-8b19-4ac6-8c3b-bfe333ba1728	Off-site	4/26/2012	Jul-16	466.87	-0.48	467.35	15.43	14.95	451.92	—	2.00	5.24	462.11	15.04	452.31	9.80	0.01	PVC	PVC	3.2	15.4	4.5	N	0.7	3946536.13	1415602.20
MW-311-46	MW-311-46	c1f358c0-e749-46e4-8100-c67cf94e2e2b	Off-site	4/28/2012	Jul-16	466.85	-0.50	467.35	45.74	45.24	421.61	48.0	2.00	40.60	426.75	45.26	422.09	4.66	0.01	PVC	PVC	Natural pack		4.5	N	36.1	3946534.99	1415612.86
MW-312-15	MW-312-15	a9168da7-1e76-475c-971f-62cc864f15bf	Off-site	4/26/2012	Jul-16	464.17	-0.26	464.43	15.52	15.26	448.91	—	2.00	5.34	459.09	15.13	449.30	9.79	0.01	PVC	PVC	2.7	15.5	5.7	Y	-0.4	3951394.25	1415642.38
MW-312-50	MW-312-50	a2203a2c-75d9-4d10-8f11-e3f118423b19	Off-site	5/2/2012	Jul-16	464.19	-0.24	464.43	50.36	50.12	414.07	50.0	2.00	44.90	419.53	49.56	414.87	4.66	0.01	PVC	PVC	Natural pack		7.0	N	37.9	3951399.72	1415642.19
MW-313-15	MW-313-15	697987d2-cfb8-43e5-9e2a-a322b687717d	Off-site	4/30/2012	Jul-15	465.80	-0.38	466.18	15.18	14.80	451.00	—	2.00	4.99	461.19	14.79	451.39	9.80	0.01	PVC	PVC	3.0	15.2	9.5	Y	-4.5	3951374.78	1423235.06
MW-313-150	MW-313-150	8d01c1b4-fa8c-4149-a991-0db598130175	Off-site	5/8/2012	Jul-15	465.88	-0.30	466.18	149.94	149.64	316.24	—	2.00	144.69	321.49	149.34	316.84	4.65	0.01	PVC	PVC	Natural pack		9.5	N	135.2	3951370.40	1423237.65
MW-314-15	MW-314-15	5b440c33-7fb7-4c58-b5de-7e6f8ec1d251	Off-site	4/30/2012	Sep-16	476.07	-0.36	476.43	15.56	15.20	460.87	—	2.00	5.38	471.05	15.16	461.27	9.78	0.01	PVC	PVC	3.0	15.6	7.0	Y	-1.6	3943869.90	1427115.02
MW-314-150	MW-314-150	50cf8875-9722-4c46-b7dc-d2549cc4220f	Off-site	5/11/2012	Sep-16	476.05	-0.38	476.43	150.51	150.13	325.92	—	2.00	145.31	331.12	150.13	326.30	4.82	0.01	PVC	PVC	Natural pack		7.0	N	138.3	3943874.84	1427119.27
MW-315-15	MW-315-15	9dc6b7b5-77ef-485e-ba88-dbe8d31cf0e8	Off-site	5/1/2012	Jul-15	458.17	-0.74	458.91	15.83	15.09	443.08	—	2.00	5.70	453.21	15.49	443.42	9.79	0.01	PVC	PVC	3.0	15.8	7.0	Y	-1.3	3949804.15	1403467.06
MW-315-150	MW-315-150	16df1370-4b76-4900-96d6-9582c4714ce4	Off-site	5/2/2012	Jul-15	458.66	-0.25	458.91	150.63	150.38	308.28	—	2.00	145.58	313.33	150.23	308.68	4.65	0.01	PVC	PVC	Natural pack		7.0	N	138.6	3949809.75	1403467.06
MW-316-15	MW-316-15	c6b9be25-8018-464e-ac4c-9382f78d8931	Off-site	5/1/2012	Jul-16	486.27	-0.41	486.68	15.67	15.26	471.01	—	2.00	5.46	481.22	15.26	471.42	9.80	0.01	PVC	PVC	3.0	15.0	7.0	Y	-1.5	3932950.20	1428372.65
MW-316-56	MW-316-56	581bbb7e-7429-47cc-aeb0-46400c2adabd	Off-site	5/16/2012	Jul-16	486.35	-0.33	486.68	56.00	55.67	430.68	57.0	2.00	50.95	435.73	55.59	431.09	4.64	0.01	PVC	PVC	Natural pack		7.0	N	44.0	3932950.03	1428377.41
MW-317-15	MW-317-15	21139c52-38cd-48ae-9907-9fb388e87616	Off-site	5/3/2012	Jul-16	488.87	-0.45	489.32	15.66	15.21	473.66	—	2.00	5.46	483.86	15.25	474.07	9.79	0.01	PVC	PVC	3.0	15.7	9.0	Y	-3.5	3930184.86	1428701.63
MW-317-71	MW-317-71	18d4b2f7-1e78-43ba-8fb2-ce19ca08d7b3	Off-site	5/21/2012	Jul-16	488.75	-0.75	489.50	71.23	70.48	418.27	—	2.00	66.10	423.40	70.73	418.77	4.63	0.01	PVC	PVC	Natural pack		9.0	N	57.1	3930185.90	1428666.62
MW-318-20	MW-318-20	3d83d8c0-cd5e-43d7-a486-b9aa6be4456b	Off-site	5/3/2012	Jun-16	492.87	2.61	490.26	20.48	23.09	469.78	—	2.00	10.29	479.97	20.08	470.18	9.79	0.01	PVC	PVC	8.0	20.5	10.0	Y	0.3	3928866.23	1424726.43
MW-318-135	MW-318-135	79723bfb-2fe6-4e18-8c9b-fd6d3fc7f20e	Off-site	5/10/2012	Mar-16	492.92	3.31	489.61	135.29	138.60	354.32	—	2.00	130.15	359.46	134.80	354.81	4.65	0.01	PVC	PVC	Natural pack		7.0	N	123.2	3928883.99	1424703.15
MW-319-15	MW-319-15	ecabf49a-cf31-49cf-8176-8aff5d9e8d5b	Off-site	5/4/2012	Sep-16	456.12	-0.40	456.52	15.28	14.88	441.24	—	2.00	5.08	451.44	14.89	441.63	9.81	0.01	PVC	PVC	3.0	15.3	7.0	Y	-1.9	3953109.18	1404197.93
MW-319-45	MW-319-45	efab58b1-7d6b-4d41-9c7d-5c30ed547c06	Off-site	5/7/2012	Sep-16	455.94	-0.58	456.52	45.52	44.94	411.00	45.5	2.00	40.44	416.08	45.10	411.42	4.66	0.01	PVC	PVC	Natural pack		7.0	N	33.4	3953109.18	1404192.73
MW-320-130	MW-320-130	30e340e6-c23d-4a92-a98f-f7c6386f9e45	Off-site	5/9/2012	Jul-16	450.87	-0.49	451.36	131.38	130.89	319.98	—	2.00	126.32	325.04	130.97	320.39	4.65	0.01	PVC	PVC	Natural pack		10.0	N	116.3	3963539.90	1402678.14
MW-320-20	MW-320-20	237bb483-53a9-42fd-9e36-cd053f8e7d3c	Off-site	5/4/2012	Jul-16	450.79	-0.57	451.36	20.15	19.58	431.21	—	2.00	9.96	441.40	19.76	431.60	9.80	0.01	PVC	PVC	7.9	20.2	10.2	Y	-0.2	3963542.54	1402682.33
MW-322-15	MW-322-15	2ace5eba-137c-47db-9ee9-8148e617355d	Off-site	5/8/2012	Jun-16	471.90	2.55	469.35	15.73	18.28	453.62	—	2.00	5.55	463.80	15.34	454.01	9.79	0.01	PVC	PVC	3.0	15.7	7.0	Y	-1.5	3940670.73	1410082.02
MW-322-150	MW-322-150	204f3aa1-271a-4d9c-a645-8c362d712311	Off-site	10/9/2012	Jun-16	471.68	2.28	469.40	151.07	153.35	318.33	—	2.00	145.94	323.46	150.59	318.81	4.65	0.01	PVC	PVC	Natural pack		7.0	N	138.9	3940646.94	1410074.03
MW-323-15	MW-323-15	1461d9c6-5f85-47fa-88d8-87ee5ad6ec53	Off-site	5/7/2012	Jul-16	485.54	3.63	481.91	15.55	19.18	466.36	—	2.00	5.42	476.49	15.21	466.70	9.79	0.01	PVC	PVC	3.0	15.6	7.0	Y	-1.6	3931840.58	1422094.72
MW-323-50	MW-323-50	4aeb9f82-7881-4430-a53e-5c04413639da	Off-site	10/8/2012	Jul-16	484.68	2.77	481.91	49.93	52.70	431.98	55.0	2.00	44.90	437.01	49.46	432.45	4.56	0.01	PVC	PVC	Natural pack		7.0	N	37.9	3931846.38	1422088.29
MW-324-15	MW-324-15	b221462d-f08b-4cbd-b35b-4e9938978f3d	Off-site	5/8/2012	Jul-16	463.68	0.19	463.49	15.35	15.54	448.14	—	2.00	5.17	458.32	14.96	448.53	9.79	0.01	PVC	PVC	3.0	15.4	7.0	Y	-1.8	3945444.19	1404965.19
MW-324-151	MW-324-151	2b6d46e7-1c2a-4af7-acb2-5b338830c8cd	Off-site	5/23/2012	Jul-16	462.84	-0.65	463.49	150.92	150.27	312.57	—	2.00	145.78	317.71	150.44	313.05	4.66	0.01	PVC	PVC	Natural pack		7.0	N	138.8	3945445.95	1404958.62
MW-325-150	MW-325-150	5ea1c21f-747c-4846-83c3-a7c5841e1a63	Off-site	5/14/2012	Jul-16	486.83	-0.42	487.25	150.54	150.12	336.71	—	2.00	145.48	341.77	150.13	337.12	4.65	0.01	PVC	PVC	Natural pack		12.0	N	133.5	3937085.15	1430633.64
MW-325-18	MW-325-18	5250a963-07f5-43ea-b2c3-e7c8a2f5c807	Off-site	5/18/2012	Jul-16	486.43	-0.82	487.25	18.68	17.86	468.57	—	2.00	8.53	478.72	18.33	468.92	9.80	0.01	PVC	PVC	6.5	18.7	12.0	Y	-3.5	3937079.28	1430639.29
MW-326-150	MW-326-150	3af2a25d-733d-4ccc-b74a-96d10b24edbe	Off-site	5/15/2012	Mar-16	500.51	2.88	497.63	150.51	153.39	347.12	—	2.00	145.45	352.18	150.10	347.53	4.65	0.01	PVC	PVC	Natural pack		7.0	N	138.5	3921145.09	1430276.63
MW-326-20	MW-326-20	3c04ce8d-44d1-44ca-be6a-f71fc1292191	Off-site	6/8/2012	Nov-16	500.62	3.08	497.54	20.75	23.83	476.79	—	2.00	10.61	486.93	20.40	477.14	9.79	0.01	PVC	PVC	7.0	20.8	7.0	N	3.6	3921150.73	1430277.63
MW-327-15	MW-327-15	d4cfd7e9-b8e6-4d1d-8fd4-4758794db78b	Off-site	5/21/2012	Jul-15	467.83	-0.25	468.08	15.40	15.15	452.68	—	2.00	5.21	462.87	15.01	453.07	9.80	0.01	PVC	PVC	2.8	15.4	7.0	Y	-1.8	3951301.83	1420336.90
MW-327-150	MW-327-150	e5d4bed9-ac81-492a-b79d-e0b4edf0f053	Off-site	5/19/2012	Jul-15	467.59	-0.49	468.08	150.92	150.43	317.16	—	2.00	145.79	322.29	150.44	317.64	4.65	0.01	PVC	PVC	Natural pack		7.0	N	138.8	3951297.90	1420342.92
MW-328-15	MW-328-15	e7c54313-53d9-4c57-8445-572f06b029f6	Off-site	5/21/2012	Nov-16	472.26	-0.93	473.19	15.77	14.84	457.42	—	2.00	5.83	467.36	15.33	457.86	9.50	0.01	PVC	PVC	2.8	15.8	8.5	Y	-2.7	3945516.60	1422877.24
MW-328-151	MW-328-151	97b7b275-7988-4a4c-8a96-3d5e35bae867	Off-site	5/24/2012	Nov-16	472.57	-0.62	473.19	150.66	150.04	322.53	—	2.00	145.58	327.61	150.25	322.94	4.67	0.01	PVC	PVC	Natural pack		8.5	N	137.1	3945525.83	1422876.28
MW-329-15	MW-329-15	6f49d33c-39e0-47a6-b651-31977836225d	Off-site	4/10/2001	Jul-16	482.95	3.36	479.59	14.82	18.18	464.77	—	2.00	5.40	474.19	14.34	465.25	8.94	0.01	PVC	PVC	3.5	14.8	7.0	Y	-1.6	3937284.38	1421278.22
MW-329-66	MW-329-66	38838001-d575-47d0-ab96-ae05e1346198	Off-site	5/22/2012	Jul-16	479.36	-0.23	479.59	65.67	65.44	413.92	67.0	2.00	60.53	419.06	65.19	414.40	4.66	0.01	PVC	PVC	Natural pack		7.0	N	53.5	3937283.58	1421283.36
MW-332-15	MW-332-15	fe6b30ff-bb56-403c-9eaf-f1f53ee9fcba	Off-site	6/8/2012	Jul-16	481.93	0.43	481.50	15.67	16.10	465.83	—	2.00	5.53	475.97	15.32	466.18	9.79	0.01	PVC	PVC	3.0	15.7	7.0	y	-1.5	3937270.16	1428736.01
MW-332-41	MW-332-41	36d9465a-c222-46e2-9231-7fe2fb0ed4cb	Off-site	4/17/2013	Jul-16	481.85	0.35	481.50	41.44	41.79	440.06	—	2.00	36.34	445.16	40.89	440.61	4.55	0.01	PVC	PVC	Natural pack		7.0	N	29.3	3937270.67	1428725.15
MW-332-75	MW-332-75	358ffbbf-b720-494e-96c6-9aa2eaff4b70	Off-site	4/22/2013	Jul-16	481.34	-0.16	481.50	75.56	75.40	405.94	—	2.00	70.54	410.96	75.09	406.41	4.55	0.01	PVC	PVC	Natural pack		7.0	N	63.5	3937271.24	1428711.60
MW-332-110	MW-332-110	5ffd59d5-d653-414f-87bc-c50f6cab79e2	Off-site	4/20/2013	Jul-16	481.26	-0.24	481.50	110.53	110.29	370.97	—	2.00	105.51	375.99	110.06	371.44	4.55	0.01	PVC	PVC	Natural pack		7.0	N	98.5	3937271.08	1428718.59
MW-332-150	MW-332-150	f0e33dc9-2d49-4afa-ab1c-8c0d44e5d456	Off-site	6/7/2012	Jul-16	481.57	0.07	481.50	150.87	150.94	330.63	—	2.00	145.74	335.76	150.39	331.11	4.65	0.01	PVC	PVC	3.1	15.5	7.2	Y	138.5	3937270.37	1428731.02
MW-333-150	MW-333-150	5cfe6e93-b294-4b6c-bc83-66a63690f605	Off-site	6/11/2012	Mar-16	497.17	2.15	495.02	150.47	152.62	344.55	—	2.00	145.32	349.70	149.98	345.04	4.66	0.01	PVC	PVC	Natural pack		7.2	N	138.1	3922968.19	1430186.58
MW-333-16	MW-333-16	c19cbd08-2ec9-4dcc-a569-c05bf651c1e9	Off-site	6/12/2012	Mar-16	497.66	2.64	495.02	16.22	18.86	478.80	—	2.00	6.09	488.93	15.83	479.19	9.74	0.01	PVC	PVC	Natural pack		5.5	N	0.6	3922961.12	1430188.05
MW-335-41	MW-335-41	70687257-54ee-4e7e-86dd-07be2d04b3ee	Off-site	8/23/2012	Jul-16	469.62	-0.57	470.19	41.11	40.54	429.08	43.0	2.00	36.01	434.18	40.56	429.63	4.55	0.01	PVC	PVC	4.0	17.0	11.0	Y	25.0	3946145.20	1419928.02
MW-338-15	MW-338-15	83f5e2d6-7f53-49d6-a78e-419a0077f73c	Off-site	4/23/2013	Jul-16	483.09	-0.44	483.53	15.43	14.99	468.10	—	2.00	5.89	477.64	15.48	468.05	9.59	0.01	PVC	PVC	3.1	15.4	7.0	Y	-1.1	3933055.54	1424634.92
MW-338-50	MW-338-50	8bc2e644-d7e3-43d7-98b1-8d1abb590ff6	Off-site	4/27/2013	Jul-16	483.28	-0.25	483.53	49.95	49.70	433.58	50.5	2.00	44.84	438.69	49.40	434.13	4.56	0.01	PVC	PVC	Natural pack		7.0	N	37.8	3933056.53	1424628.77
MW-339-15	MW-339-15	af7821a6-71d2-4c4e-b2d6-0c7c314eb9e0	Off-site	5/7/2013	Jul-16	479.53	-0.44	479.97	15.45	15.01	464.52	—	2.00	5.34	474.63	14.94	465.03	9.60	0.01	PVC	PVC	5.0	15.0	10.0	Y	-4.7	3939785.23	1425645.56
MW-339-50	MW-339-50	f44f2462-a2ae-46e2-8aed-d187c3f6b5a0	Off-site	5/2/2013	Jul-16	479.38	-0.59	479.97	50.97	50.38	429.00	52.0	2.00	45.95	434.02	50.50	429.47	4.55	0.01	PVC	PVC	Natural pack		10.0	N	36.0	3939778.24	1425644.76
MW-340-18	MW-340-18	54363162-5121-4b2a-86f0-ccff86835bfd	Off-site	5/7/2013	Jul-16	478.82	-0.66	479.48	17.95	17.29	461.53	—	2.00	7.86	471.62	17.46	462.02	9.60	0.01	PVC	PVC	5.0	18.0	12.0	N	-4.1	3938036.46	1430903.62
MW-340-65	MW-340-65	b48f32fa-8839-4ad1-93f0-e4de6c9662fa	Off-site	5/8/2013	Jul-16	479.21	-0.27	479.48	65.64	65.37	413.84	—	2.00	60.53	418.95	65.09	414.39	4.56	0.01	PVC	PVC	Natural pack		12.0	N	48.5	3938051.84	1430905.94
MW-340-150	MW-340-150	30a8ba9f-5ea3-484a-9df7-d784bad04b0a	Off-site	5/3/2013	Jul-16	478.93	-0.55	479.48	150.73	150.18	328.75	—	2.00	145.70	333.78	150.26	329.22	4.56	0.01	PVC	PVC	Natural pack		12.0	N	133.7	3938045.02	1430905.51
MW-341-15	MW-341-15	4da0dbb5-d51e-4f7c-bf0f-e72586f242b6	Off-site	5/15/2013	Jul-16	480.20	-0.31	480.51	15.66	15.35	464.85	—	2.00	5.61	474.90	15.18	465.33	9.57	0.01	PVC	PVC	4.0	15.5	10.0	Y	-4.4	3936403.00	1421617.07
MW-341-40	MW-341-40	93fb699e-20b0-4a73-8f09-fcc368b8ec26	Off-site	5/15/2013	Jul-16	479.98	-0.53	480.51	40.74	40.21	439.77	42.5	2.00	35.61	444.90	40.28	440.23	4.67	0.01	PVC	PVC	Natural pack		10.0	N	25.6	3936404.33	1421613.16
MW-342-15	MW-342-15	7c6eb056-0c1d-4f19-a534-1710715b4941	Off-site	5/31/2013	Sep-16	482.35	-0.50	482.85	15.52	15.02	467.33	—	2.00	5.40	477.45	15.00	467.85	9.60	0.01	PVC	PVC	4.0	15.0	7.0	Y	-1.6	3934213.82	1422873.08
MW-342-65	MW-342-65	af447328-fc07-4a6d-aa84-7c7cc8c84e4b	Off-site	5/31/2013	Sep-16	482.50	-0.35	482.85	65.20	64.85	417.65	65.5	2.00	60.17	422.68	64.74	418.11	4.57	0.01	PVC	PVC	Natural pack		7.0	N	53.2	3934214.12	1422878.39
Acronyms and Abbreviations on Page 3.																												
MW-343-15	MW-343-15	0dce5f0b-2713-4465-84b5-4bd416794b3e	Off-site	6/28/2013	Jul-16	484.42	2.50	481.92	14.59	17.09	467.33	—	2.00	4.55	477.37	14.15	467.77	9.60	0.01	PVC	PVC	3.5	15.0	4.5	Y	N/A	3936542.14	1428026.58
MW-343-50	MW-343-50	ec0d82f6-c835-4520-ac07-9796b7cf7acf	Off-site	6/19/2013	Jul-16	484.25	2.33	481.92	50.79	53.12	431.13	52.0	2.00	45.74	436.18	50.32	431.60	4.58	0.01	PVC	PVC	Natural pack		4.5	N	41.24	3936542.50	1428031.46

Table 1
Well Construction Details

Offsite Sampling and Analysis Plan
North Pole Refinery Site
North Pole, Alaska

Well	New Well Name	LocationNdx	Proximity	Boring Completion Date	Survey Date	Riser Elevation*	Riser Stickup	Ground Surface Elevation	Well Depth	Well Length	Well Bottom Elevation	Depth to Top of Permafrost	Well Diameter	Well Screen							Riser Material	Filter Pack		Water Table			Alaska State Plane NAD83, ZONE 3	
						(feet MSL)	(feet)	(feet MSL)	(feet BGS)	(feet)	(feet MSL)	(feet BGS)	(inches)	Depth to Top (feet BGS)	Top Elevation (feet MSL)	Depth to Bottom (feet BGS)	Bottom Elevation (feet MSL)	Length (feet)	Screen Slot (inches)	Material		Depth to Top (feet BGS)	Depth to Bottom (feet BGS)	Approx Depth (ft BGS)	In Screen	Feet Above Top of	Northing	Easting
MW-346-15	MW-346-15	d89d51c2-534b-4e62-8f48-35cc71c61d71	Off-site	7/31/2013	Jul-16	473.04	0.06	472.98	15.48	15.54	457.50	—	2.00	5.37	467.61	15.00	457.98	9.63	0.01	PVC	PVC	3.0	15.5	5.7	Y	N/A	3943140.80	1425712.83
MW-346-150	MW-346-150	50e5a829-87ac-4b11-8507-45c7bdc6d196	Off-site	7/30/2013	Jul-16	472.60	-0.38	472.98	149.28	148.90	323.70	—	2.00	144.17	328.81	148.73	324.25	4.56	0.01	PVC	PVC	Natural pack		4.5	N	139.67	3943135.64	1425713.20
MW-346-65	MW-346-65	a17e37cb-653f-4bd5-bd83-57f248c44cd0	Off-site	8/1/2013	Jul-16	472.61	-0.37	472.98	64.71	64.34	408.27	—	2.00	59.60	413.38	64.16	408.82	4.56	0.01	PVC	PVC	Natural pack		5.8	N	53.80	3943130.73	1425713.68
MW-347-150	MW-347-150	bd799307-5940-4189-815a-a35add43475d	Off-site	8/5/2013	Jul-16	482.50	-0.22	482.72	151.52	151.30	331.20	—	2.00	146.48	336.24	151.05	331.67	4.57	0.01	PVC	PVC	Natural pack		9.5	N	136.98	3939728.75	1428360.93
MW-347-20	MW-347-20	fa56f426-4d31-4c78-a3f5-2387ee43331b	Off-site	9/3/2013	Jul-16	482.85	0.13	482.72	20.40	20.53	462.32	—	2.00	10.20	472.52	19.80	462.92	9.60	0.01	PVC	PVC	7.6	20.4	12.0	Y	N/A	3939722.42	1428356.90
MW-347-65	MW-347-65	3961ea26-e68e-4d5d-bace-1a2f678c9bea	Off-site	9/3/2013	Jul-16	481.71	-1.01	482.72	65.20	64.19	417.52	—	2.00	60.20	422.52	64.80	417.92	4.60	0.01	PVC	PVC	Natural pack		12.0	N	48.20	3939728.76	1428364.88
MW-349-15	MW-349-15	3f0957b8-c363-404a-b767-9be2b56c3bc0	Off-site	8/12/2013	Dec-16	484.43	-0.65	485.08	15.04	14.39	470.04	—	2.00	4.98	480.10	14.60	470.48	9.62	0.01	PVC	PVC	3.6	15.0	6.0	Y	N/A	3933772.41	1426241.57
MW-349-45	MW-349-45	80fdcbcc-164a-4636-9f34-4e1561b8c228	Off-site	8/12/2013	Dec-16	484.65	-0.43	485.08	45.50	45.07	439.58	46.5	2.00	40.40	444.68	44.95	440.13	4.55	0.01	PVC	PVC	35.0	45.5	6.0	N	34.40	3933774.54	1426236.89
MW-350-15	MW-350-15	1AD40915-8EA1-40BC-9161-2D091B9DD96C	Off-site	8/18/2013	Jul-16	484.12	-0.10	484.22	16.04	15.94	468.18	—	2.00	5.86	478.36	15.48	468.74	9.62	0.01	PVC	PVC	3.0	15.0	7.0	Y	N/A	3936446.66	1426044.58
MW-350-50	MW-350-50	9b4e1604-60af-4ac5-9882-6e40d78b88e6	Off-site	8/18/2013	Jul-16	484.14	-0.08	484.22	47.06	46.98	437.16	50.0	2.00	42.12	442.10	46.67	437.55	4.55	0.01	PVC	PVC	Natural pack		7.0	N	35.12	3936444.80	1426049.18
MW-352-15	MW-352-15	148af05b-44a8-4644-89d5-a35d6606d7b5	Off-site	9/1/2013	Jul-16	474.66	-0.67	475.33	15.59	14.92	459.74	—	2.00	5.52	469.81	15.17	460.16	9.65	0.01	PVC	PVC	2.4	15.6	9.0	Y	N/A	3943661.73	1423829.82
MW-352-40	MW-352-40	2353e899-fe52-4013-9ec7-b6eb3afc2358	Off-site	9/1/2013	Jul-16	475.01	-0.32	475.33	38.18	37.86	437.15	42.5	2.00	33.28	442.05	37.87	437.46	4.59	0.01	PVC	PVC	Natural pack		9.0	N	24.28	3943661.39	1423825.02
MW-353-100	MW-353-100	9d20daa2-b4b5-4aea-81e5-a53852c10dde	Off-site	9/5/2013	Jul-16	480.61	-0.14	480.75	100.61	100.47	380.14	110.0	2.00	95.50	385.25	100.05	380.70	4.55	0.01	PVC	PVC	Natural pack		8.0	N	87.50	3936222.41	1423377.69
MW-353-15	MW-353-15	6d15b028-469b-41a2-8e5e-b9b57bf96620	Off-site	9/6/2013	Jul-16	480.26	-0.49	480.75	15.50	15.01	465.25	—	2.00	5.50	475.25	14.50	466.25	9.00	0.01	PVC	PVC	3.0	15.5	8.0	Y	N/A	3936216.06	1423370.00
MW-353-65	MW-353-65	EF952F85-0DF2-4B43-A581-AC53F0F5348D	Off-site	9/6/2013	Jul-16	480.62	-0.13	480.75	65.50	65.37	415.25	—	2.00	60.03	420.72	64.63	416.12	4.60	0.01	PVC	PVC	Natural pack		7.8	N	52.28	3936219.34	1423374.04
MW-356-20	MW-356-20	68C02486-0FC1-4914-B84F-D176D93A10F4	Off-site	10/17/2013	Jul-16	478.72	-0.48	479.20	18.39	17.91	460.81	—	2.00	8.24	470.96	18.04	461.16	9.80	0.01	PVC	PVC	5	18.39	8.5	Y	-0.26	3941381.39	1429217.10
MW-356-65	MW-356-65	A8D8C1B1-8B3D-4FCA-AD5C-D5CCF91FA708	Off-site	10/17/2013	Jul-16	478.79	-0.41	479.20	65.77	65.36	413.43	—	2.00	60.68	418.52	65.24	413.96	4.56	0.01	PVC	PVC	54	65.77	9.0	N	51.68	3941376.90	1429218.74
MW-356-90	MW-356-90	F61F3F07-9561-445E-879C-CC4D3DD52371	Off-site	10/16/2013	Jul-16	478.77	-0.43	479.20	88.73	88.30	390.47	90.0	2.00	83.72	395.48	88.24	390.96	4.52	0.01	PVC	PVC	76	88.73	9.0	N	74.72	3941371.87	1429221.14
MW-357-15	MW-357-15	FE653987-E17B-47C2-8B3B-E1C6FAA90C91	Off-site	10/21/2013	Jul-16	487.76	2.77	484.99	15.59	18.36	469.40	—	2.00	5.49	479.50	15.27	469.72	9.78	0.01	PVC	PVC	3	15.59	8.5	Y	-3.01	3935720.90	1430665.73
MW-357-150	MW-357-150	1B6015F0-D41E-4EB7-9A6F-D26FFD273E7B	Off-site	10/18/2013	Jul-16	487.99	3.00	484.99	150.46	153.46	334.53	—	2.00	145.47	339.52	149.97	335.02	4.50	0.01	PVC	PVC	139	150.46	8.5	Y	136.97	3935727.84	1430657.06
MW-357-65	MW-357-65	DE55B20E-4DCD-4FED-B39E-568D29514E3E	Off-site	10/21/2013	Jul-16	487.89	2.90	484.99	66.00	68.90	418.99	—	2.00	60.93	424.06	65.44	419.55	4.51	0.01	PVC	PVC	8.5	66	8.5	N	52.43	3935724.61	1430661.02
PW_ID 1230	PW-1230	16C859EA-43D5-43AD-8B5B-3847E2256ECD	Off-site	10/6/1982	Dec-16	486.06	1.10	484.96	231.00	232.10	253.96	33.0	6.00	no screen- open casing			484.96	n/a	n/a	steel	steel	—	—	7.0	N	—	3933784.60	1426231.40

General Notes:

The elevations in this table are the most recent surveyed elevations as of Q4 2016. Wells may be surveyed multiple times in the reporting period to meet data quality objectives. The elevations in this table may differ from the elevations listed in other tables submitted in Q4 2016.

Acronyms and Abbreviations:

MSL = mean sea levels

BGS = below ground surface

PVC = polyvinyl chloride

Table 2
Summary of Detection Limits, Containers, Preservation and Holding Times

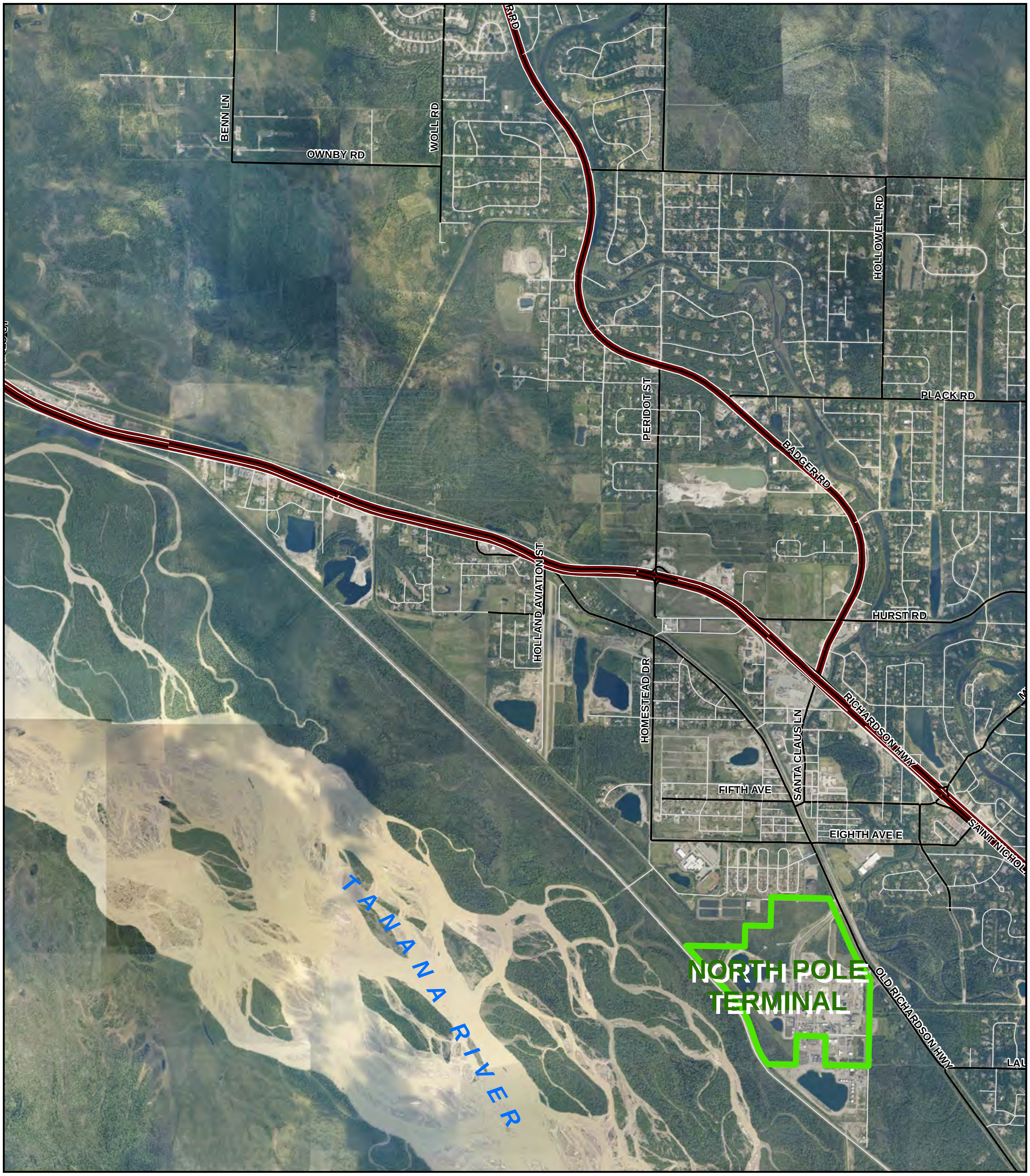
Offsite Sampling and Analysis Plan
North Pole Refinery Site
North Pole, Alaska

Parameter	Medium	Analytical Parameters	Laboratory	Anticipated PQL/LOQ[1]	Analytical Method[2]	Sample Container	Preservative	Holding Time
Semivolatile Organics	Water	Sulfolane	SGS	10 µg/L	1625B with 8260D Isotope Dilution	2 x 1 L AG	Cool to 0 °C to 6 °C	Extraction: 7 days Analysis: 40 days
			Pace	10 µg/L	8270D with Isotope Dilution	3 x 40 mL VOA	Cool to 0 °C to 6 °C	Extraction: 7 days Analysis: 40 days
Groundwater Quality Parameters	Water	Temperature	Field	0.1 °C	N/A	N/A	N/A	Measured in the Field
		pH	Field	0.1 units	N/A	N/A	N/A	Measured in the Field
		Conductivity	Field	1 µS	N/A	N/A	N/A	Measured in the Field
		Dissolved Oxygen	Field	0.1 mg/L	N/A	N/A	N/A	Measured in the Field

Footnotes:
1. The PQL/LOQ may differ from listed values.
2. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 15th Edition, 1981.

Acronyms and Abbreviations:
PQL = Practical Quantitation Limit
LOQ = Limit of Quantitation
µg/L = micrograms per liter
L = Liter
AG = Amber glass
° C = Degrees Celsius
mL = milliliter
VOA = volatile organic analysis
N/A = Not Applicable
µS = microsiemens
mg/L = milligrams per liter

FIGURES



LEGEND:

REFINERY SITE BOUNDARY

0 0.5 Miles

GRAPHIC SCALE

Note:
-Image provided courtesy of Pictometry International 2012

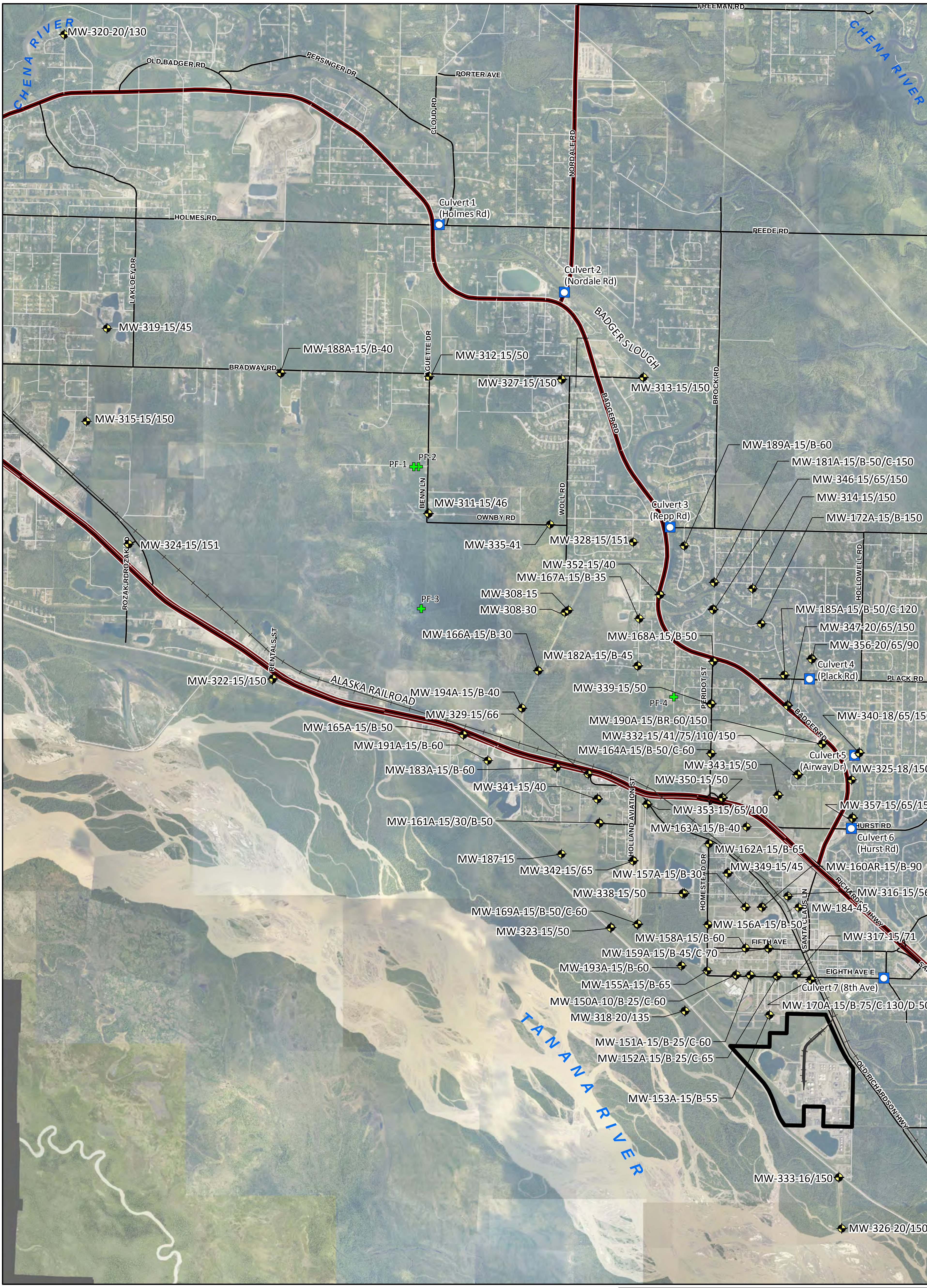
NORTH POLE REFINERY SITE
NORTH POLE, ALASKA

Offsite Sampling and Analysis Plan

SITE LOCATION

ARCADIS

FIGURE
1



Legend:

- Monitoring Well
- Permafrost Boring
- Culvert
- Refinery Site Boundary
- Highway
- Major Road
- Local Road
- Rail Line

0 3,000 6,000 Feet

GRAPHIC SCALE

Note:
-Image provided courtesy of Pictometry International 2012

NORTH POLE REFINERY SITE
NORTH POLE, ALASKA

OFFSITE SAMPLING AND ANALYSIS PLAN

OFFSITE MONITORING WELLS

ARCADIS

FIGURE
2

FORMS

FIELD ACTIVITIES DAILY LOG

Date ______________
Sheet _____ of _____
Project No. ______________

Project Name: ____
Field activity subject: ____
Description of daily activities and events: ____

Visitors on site: ____

Changes from plans/specifications and other special orders and important decisions:

Weather conditions: ____

Important telephone calls: ____

Personnel on site: ____
Signature: Date:

Groundwater Measurement Field Form

Job No.____________
Page____
Date:______________

Project Name____
Conducted by______________

Well ID	Date	Time	Depth to water (ft)	Previous Depth to Water (ft)	Notes:

Probe A description: serial number:
Probe B description: serial number:
Probe C description: serial number:

MONITORING WELL SAMPLING LOG

Owner/Client *Flint Hills Resources Alaska* Project No. ____
Location *North Pole Refinery Off-Site* Date ____
Sampling Personnel ____ Well ____
Weather Conditions ____ Air Temp. (°F) ____ Time started ____
Time completed ____

Sample No. ____ Time ____
Duplicate ____ Analysis: ____ Time ____ Depth to Water (ft.) ____
Equipment Blank (EB) ____ Analysis: ____ Time ____ Depth to LNAPL (ft.) ____
NAPL Thickness (ft.) ____
Method of NAPL Measurement ____

Pump/Controller ____
Purging Method *portable / dedicated pump* Diameter and Type of Casing ____
Pumping Start ____ Approximate Total Depth of Well Below MP (ft.) ____
Purge Rate (gal./min.) ____ Measured Total Depth of Well Below MP (ft.) ____
Pumping End ____ Depth to Water Below MP (ft.) ____
Depth to Ice (if frozen) Below MP (ft.) ____
Pump Set Depth Below MP (ft.) ____ Feet of Water in Well ____
KuriTec Tubing (ft.) ____ Gallons per foot ____
TruPoly Tubing (ft.) ____ Gallons in Well ____
Silicone Tubing (ft.) ____ Gallons in Well x3 = ____
(also enter on back) Total Gallons Purged ____
Purge Water Disposal *City of N. P. manhole near NPR Gate 1*

Monument Condition ____

Casing Condition ____

Wiring Condition ____
(dedicated pumps) ____

Measuring Point (MP) *Top of Casing (TOC)* Monument type: *Stickup / Flushmount*
Measurement method: *Tape measure*

Top-of-casing to monument (ft.) ____ Datalogger Type (circle): *RT-100* *GW WL-16*
Monument to ground surface (ft.) ____ *AT-200* *LT-700* *LT-500*
Other: ____ *HOBO*
Datalogger serial #: ____
Measured cable length (ft) ____

- ☐ Frost-jacking? Y / N Temperature Logger Present (TidBit)? Y / N
- ☐ Lock present and operational
- ☐ Well name legible on outside of well (stickup) or inside of well (flushmount)

Notes ____

WELL CASING VOLUMES

Diameter of Well [ID-inches]	CMT	1¼	2	3	4	6	8
Gallons per lineal foot	0.000253	0.08	0.17	0.38	0.66	1.5	2.6

MONITORING WELL SAMPLING LOG

Field Parameter Instrument: *Pro Plus* ___ OR *Rental #* ___ *Handheld s/n:*_______

Parameter Criteria: Circle One: *Parameters stabilized* OR *> 3 well volumes purged*

Total Gallons purged: Gallons needed for 3WV:

Water observations:

Notes:

FIELD PARAMETERS [stabilization criteria]

Time	Temp. (°C)	Dissolved Oxygen (mg/L) [± 0.10 mg/L]	Conductivity (µS/cm) [± 3%]	pH [± 0.10]	ORP (mV) [± 10 mV]	Water Clarity (visual)
	Purging start time					

Laboratory *SGS*

	Analysis	Sample Containers	Preservatives	Dup	EB
□	*Sulfolane (1625B)*	*2x 1-Liter amber bottle*	*none*	□	□
□	*BTEX (8260B)*	*3x 40-mL amber VOA vials*	*HCl*	□	□
□	*Geochem*	*Multiple (see proposal)*	*Multiple*	□	□
□	*COPC*	*Multiple (see proposal)*	*Multiple*	□	□
□				□	□
□				□	□

PRIVATE WELL SAMPLING LOG

Address ______________________ Project Number ______________
Owner/Occupant ______________________ Project Name ______________
Mailing Address ______________________ Date ______________
______________________ Time ______________
Telephone ______________________ Sampling Personnel ______________

Sample No. ______________________________ Time __________

Duplicate ______________________________ Time __________

Pumping Start Time __________
Pumping End Time __________
Tubing (ft.) __________

Diameter and Type of Casing __________
Total Depth of Well (ft.) __________
Depth to Water (ft.) __________
Feet of Water in Well __________
Gallons per foot __________
Gallons in Well __________
Purge Water Volume (gal.) __________
Boring Log/Well Depth Details ______________________

Laboratory *SGS*

	Analysis	**Sample Containers**	**Preservatives**
☐	*Sulfolane*	*2 x 1-L amber bottle*	*none*
☐			
☐			

Notes: ____

WELL CASING VOLUMES

Diameter of Well [ID-inches]	1¼	2	3	4	6	8
Gallons per lineal foot	0.08	0.17	0.38	0.66	1.5	2.6

PRIVATE WELL SAMPLING LOG

Field Parameter Instrument: YSI Pro Plus

Circle one: Parameters stabilized or >3 well volues purged

Sample Observations: ______________________________

Purge Location: ______________________________

Sample Location: ______________________________

FIELD PARAMETERS [stabilization criteria]

Time	Temp. (°C)	Dissolved Oxygen (mg/L) [± 0.1 mg/L]	Conductivity (µS/cm) [± 3%]	pH [± 0.1]	ORP (mV) [± 10 mV]	Water Clarity (visual)

WELL DEVELOPMENT LOG

Owner-Client ______________________ Well No. ______________________

Location ______________________ Project No ______________________

Weather ______________________ Date ______________________

Development Personnel ____________

Diameter and Type of Casing: ______________________

Total Depth of Well **Before** Development (feet below top of casing): ______________________

Depth to Water **Before** Development (feet below top of casing): ______________________

Depth to Screen Top and Bottom (from Construction Log): Top: Bottom:

Development Details

Feet of water in well ____________ Time pumping started ____________

Gallons per foot ____________ Flow rate (gal/min) ____________

Gallons in well ____________ Flow-rate measurement method:

Surge method ____________ ______________________

Pump used ____________ Time pumping ended ____________

Tubing used (ft)____________ Gallons Pumped ____________

Disposal: ____________

Depth to Water **After** Development (feet below top of casing): ______________________

Total Depth of Well **After** Development (feet below top of casing): ______________________

Observations

Time	Water Clarity (Visual)

Time	Water Clarity (Visual)

NOTES: ______________________

WELL CASING VOLUMES

Diameter of Well [ID-inches]	1¼	2	3	4	6	8
Gallons per lineal foot	0.08	0.17	0.38	0.66	1.5	2.6

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

CHAIN-OF-CUSTODY RECORD

Page_____ of_____
Laboratory____________________
Attn:____________________

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020

2355 Hill Road
Fairbanks, AK 99709
(907) 479-0600

2255 S.W. Canyon Road
Portland, OR 97201-2498
(503) 223-6147

2043 Westport Center Drive
St. Louis, MO 63146-3564
(314) 699-9660

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120

1321 Bannock Street, Suite 200
Denver, CO 80204
(303) 825-3800

2705 Saint Andrews Loop, Suite A
Pasco, WA 99301-3378
(509) 946-6309

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab							Total Number of Containers	Remarks/Matrix

Project Information	Sample Receipt	
Project Number:	Total Number of Containers	
Project Name:	COC Seals/Intact? Y/N/NA	
Contact:	Received Good Cond./Cold	
Ongoing Project? Yes ☐ No ☐	Delivery Method:	
Sampler:	(attach shipping bill, if any)	

Instructions
Requested Turnaround Time:
Special Instructions:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

Relinquished By: 1.	Relinquished By: 2.	Relinquished By: 3.
Signature: Time:_____	Signature: Time:_____	Signature: Time:_____
Printed Name: Date:_____	Printed Name: Date:_____	Printed Name: Date:_____
Company:	Company:	Company:

Received By: 1.	Received By: 2.	Received By: 3.
Signature: Time:_____	Signature: Time:_____	Signature: Time:_____
Printed Name: Date:_____	Printed Name: Date:_____	Printed Name: Date:_____
Company:	Company:	Company:

F-19-91/UR

No. 33052

Laboratory Data Review Checklist

Completed by:

Title: Date:

CS Report Name: Report Date:

Consultant Firm:

Laboratory Name: Laboratory Report Number:

ADEC File Number: ADEC RecKey Number:

1. Laboratory
    a. Did an ADEC CS approved laboratory receive and perform all of the submitted sample analyses?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. If the samples were transferred to another "network" laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses ADEC CS approved?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

2. Chain of Custody (COC)
    a. COC information completed, signed, and dated (including released/received by)?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. Correct analyses requested?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

3. Laboratory Sample Receipt Documentation
    a. Sample/cooler temperature documented and within range at receipt (4° ± 2° C)?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

    b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?
    ☐Yes ☐ No ☐NA (Please explain.) Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?
☐Yes ☐ No ☐NA (Please explain.) Comments:

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?
☐Yes ☐ No ☐NA (Please explain.) Comments:

e. Data quality or usability affected? (Please explain.)
Comments:

4. <u>Case Narrative</u>

a. Present and understandable?
☐Yes ☐ No ☐NA (Please explain.) Comments:

b. Discrepancies, errors or QC failures identified by the lab?
☐Yes ☐ No ☐NA (Please explain.) Comments:

c. Were all corrective actions documented?
☐Yes ☐ No ☐NA (Please explain.) Comments:

d. What is the effect on data quality/usability according to the case narrative?
Comments:

5. <u>Samples Results</u>

a. Correct analyses performed/reported as requested on COC?
☐Yes ☐ No ☐NA (Please explain.) Comments:

b. All applicable holding times met?
☐Yes ☐ No ☐NA (Please explain.) Comments:

c. All soils reported on a dry weight basis?

□Yes □ No □NA (Please explain.) Comments:

d. Are the reported PQLs less than the Cleanup Level or the minimum required detection level for the project?

□Yes □ No □NA (Please explain.) Comments:

e. Data quality or usability affected?

Comments:

6. <u>QC Samples</u>

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

□Yes □ No □NA (Please explain.) Comments:

ii. All method blank results less than PQL?

□Yes □ No □NA (Please explain.) Comments:

iii. If above PQL, what samples are affected?

Comments:

iv. Do the affected sample(s) have data flags and if so, are the data flags clearly defined?

□Yes □ No □NA (Please explain.) Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS/LCSD reported per matrix, analysis and 20 samples? (LCS/LCSD required per AK methods, LCS required per SW846)

□Yes □ No □NA (Please explain.) Comments:

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods: AK101 60%-120%, AK102 75%-125%, AK103 60%-120%; all other analyses see the laboratory QC pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits? And project specified DQOs, if applicable. RPD reported from LCS/LCSD, MS/MSD, and or sample/sample duplicate. (AK Petroleum methods 20%; all other analyses see the laboratory QC pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

☐Yes ☐ No ☐NA (Please explain.) Comments:

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

c. Surrogates – Organics Only

i. Are surrogate recoveries reported for organic analyses – field, QC and laboratory samples?

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits? And project specified DQOs, if applicable. (AK Petroleum methods 50-150 %R; all other analyses see the laboratory report pages)

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Do the sample results with failed surrogate recoveries have data flags? If so, are the data flags clearly defined?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain.)

Comments:

d. Trip blank – Volatile analyses only (GRO, BTEX, Volatile Chlorinated Solvents, etc.): <u>Water and Soil</u>

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC? (If not, a comment explaining why must be entered below)

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. All results less than PQL?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. If above PQL, what samples are affected?

Comments:

v. Data quality or usability affected? (Please explain.)

Comments:

e. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. Submitted blind to lab?

☐Yes ☐ No ☐NA (Please explain.) Comments:

iii. Precision – All relative percent differences (RPD) less than specified DQOs? (Recommended: 30% water, 50% soil)

$$RPD\ (\%) = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
R_2 = Field Duplicate Concentration

☐Yes ☐ No ☐NA (Please explain.) Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

f. Decontamination or Equipment Blank (If not used explain why).

☐Yes ☐ No ☐NA (Please explain.) Comments:

i. All results less than PQL?

☐Yes ☐ No ☐NA (Please explain.) Comments:

ii. If above PQL, what samples are affected?

Comments:

iii. Data quality or usability affected? (Please explain.)

Comments:

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

☐Yes ☐ No ☐NA (Please explain.) Comments:

Service Checklist

Address______________________________________					
Date____					
Tech____					
Port B Sampling		_____ Iron		_____ Hardness	
Simplex		**Duplex**		**Redundant**	
Soak		Soak		Soak	
BW		BW		BW	
	Tank 1	**Tank 2**		**Tank 3**	
Serial #					
Lot #					
Before service: Sampling					
Sulfolane D1		#	Time	Purge water	
Sulfolane C1		#	Time	Purge water	
Sulfolane A		#	Time	Purge water	
Sulfolane X		#	Time	Purge water	
Fill Salt		__________ Bags			
Meter #		___________________			
Gallons		___________________			
Sediment Filter 1		_________			
Sediment Filter 2		_________			
After Service: Sampling					
Sulfolane D2		#	Time		Purge water
UV Lights	Replaced	**Sleeves**	Swapped	Cleaned	Replaced
Pre		Pre			
Post		Post			

ATTACHMENT 1

Log of Revisions to the Offsite SAP

Attachment 1
Revisions to the Offsite Sampling and Analysis Plan
North Pole Refinery Site
North Pole, Alaska

Date of Revisions to the Offsite SAP	Sections Updated	Reason for Changes
1/1/2015	Tables 1 and 2; Figure 4	Well cluster MW-148 was removed from the offsite monitoring networks. This well cluster will be monitored with onsite wells as part of the Long-Term Monitoring Plan (Arcadis 2014).
4/14/2016	Section 4-5	Sample and Field Documentation moved to Section 5
1/4/2017	document-wide	Updated references of "North Pole Refinery" to "North Pole Terminal"
5/4/2017	document-wide	Incorporated elements for POE sampling from the Residential SAP.
5/4/2017	document-wide	Removed elements associated with activities no longer conducted at the site

Notes:
SAP = Sampling and Analysis Plan

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