Annual 2021 Offsite Sulfolane Plume Monitoring Report

City of North Pole and Surrounding Area

Prepared for
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July 22, 2022

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
DEC	Department of Environmental Conservation
bgs	below ground surface
FHRA	Flint Hills Resources Alaska
Integral	Integral Consulting Inc.
SGS	SGS North America, Inc.
Williams	Williams Alaska Petroleum, Inc.
WTZ	Water Table Zone

EXECUTIVE SUMMARY

On behalf of Williams Alaska Petroleum, Integral Consulting Inc. has prepared this Offsite Sulfolane Plume Monitoring Report (2021 Report) for the former Flint Hills Resources Alaska North Pole Refinery, located on H and H Lane in North Pole, Alaska (Site). This 2021 Report was prepared to document the 2021 annual monitoring of sulfolane in groundwater located downgradient of the Site, which was conducted as described in the scope of work (Duncan 2020) approved by the Alaska Department of Environmental Conservation (DEC) on August 3, 2020 (Mulder 2020). The final work plan, Offsite Sulfolane Plume Monitoring Plan (2020 Plan), was submitted to DEC on August 19, 2020.

An evaluation of historical data trends and 2021 sample results has shown that overall, the observed 2021 concentrations and trend analysis of sulfolane are consistent with previous groundwater trends and show a stable plume footprint.

1 INTRODUCTION

On behalf of Williams Alaska Petroleum, Inc. (Williams), Integral Consulting Inc. (Integral), has prepared this Offsite Sulfolane Plume Monitoring Report (2021 Report) for groundwater situated downgradient of the former Flint Hills Resources Alaska (FHRA) North Pole Refinery, which is located on H and H Lane in North Pole, Alaska (Site; Figure 1).

This report satisfies annual reporting requirements for the Alternative Water Solutions Program and provides results of sampling activities completed in 2021. The completed sampling activities included 47 monitoring wells and 16 private wells. The locations of monitoring wells and private wells sampled as part of the 2021 monitoring program are presented on Figure 2. A list of monitoring well and private well locations is included as Table 1.

The objective of the groundwater monitoring described in this report is to monitor and track sulfolane plume stability and plume migration, if any. This report is intended to report on newly collected groundwater data to evaluate the nature and extent of the sulfolane plume.

Field activities described in this report were completed by Shannon & Wilson between September and December 2021, by qualified persons as defined by 18 Alaska Administrative Code (AAC) 75.990. All samples were collected and analyzed in accordance with 18 AAC 75.355(a).

2 CURRENT GROUNDWATER MONITORING PROGRAM AND METHODS

Activities completed as part of this reporting cycle include sampling of monitoring wells, sampling of private wells, surveying of monitoring wells, and maintenance activities.

2.1 PLUME MONITORING—MONITORING WELL SAMPLING

The objective of annual groundwater monitoring at and near the Site is to monitor sulfolane concentrations present within the aquifer system. As part of the 2021 field activities, groundwater elevation readings were collected from all accessible monitoring wells prior to sampling. Readings were collected from a total of 39 monitoring wells; two monitoring wells (MW-332-110 and MW-332-150) were destroyed and eight monitoring wells were inaccessible during the gauging period. Groundwater samples were then collected from a total of 47 monitoring wells. A list of the wells sampled is included as Table 1 and presented on Figure 2.

2.2 PLUME MONITORING PLAN—PRIVATE WELL SAMPLING

In addition to sample collection from monitoring wells, private well sampling was also completed in September and October 2021. A total of 16 private wells were sampled, and an additional 10 wells were targeted for sampling but were not sampled due to limited access associated with the sampling schedule (time of year, resident declined, no response, etc.). A list of the private wells sampled in 2021 is included as Table 1, and locations are presented on Figure 2.

2.3 MONITORING WELL MAINTENANCE ACTIVITIES

Offsite monitoring wells were resurveyed in December 2021 by Design Alaska, Inc., a licensed surveyor, to determine if the monitoring wells had been affected by permafrost freezing and thawing (Appendix A). The information from this survey was used to determine groundwater flow direction, as described in Section 3.1.

Additionally, minor maintenance activities were performed as needed during this reporting period.

3 GROUNDWATER SAMPLING RESULTS

A summary of the 2021 groundwater monitoring results is provided in the sections below.

3.1 GROUNDWATER ELEVATION

Prior to sampling, a synoptic water level event was completed at all accessible monitoring wells (39 out of the 47 sampled). A licensed surveyor was also present to collect elevation data for the monitoring wells that were suspected to have been affected by permafrost melt and freezing patterns. These revised survey results were used to determine groundwater elevation and flow direction.

The monitoring wells are divided into four depth zones: the Water Table Zone (WTZ); Zone 1, consisting of wells screened at depths between 10 and 55 ft below ground surface (bgs); Zone 2, consisting of wells screened at depths between 55 and 90 ft bgs; and Zone 3, consisting of wells screened at depths between 90 and 150 ft bgs.

In all zones, groundwater flow was to the north-northwest, as presented in Figures 3 through 6. A summary of synoptic gauging results is included as Appendix B, and the surveyor report is included as Appendix A.

3.2 MONITORING WELL SAMPLING

On September 14-23, 2021 and December 10, 2021, qualified persons as defined by 18 AAC 75.990 mobilized to the offsite monitoring wells to collect groundwater samples for sulfolane analysis. Field parameters were collected at the time of sampling, including temperature, dissolved oxygen, conductivity, pH, oxidation reduction potential, and water clarity. A summary of field parameters and monitoring well sampling logs completed by Shannon & Wilson are included in Appendix C.

Samples were sent to SGS North America, Inc. (SGS), for sulfolane analysis. SGS is a certified laboratory that has historically been used as part of annual monitoring of sulfolane concentrations in this area. Six duplicate samples were submitted and analyzed for quality assurance purposes: sample IDs MW-250A-10, MW-266B-30, MW-285C-120, MW-414-150, MW-447-150, and MW-449-45. The parent samples and duplicate had consistent concentrations, suggesting that data quality was not impacted as a result of sampling. Monitoring well results provided by SGS were determined usable to meet the objectives of sampling.

Sulfolane was reported in monitoring wells at concentrations ranging between not detected and 70.4 µg/L or parts per billion (ppb) (MW-346-65). Twenty-seven of the 49 monitoring wells sampled reported no detections, and 19 contained detections of sulfolane below 20 µg/L. Eight

monitoring wells reported concentrations of sulfolane that ranged between 20 and 70.4 µg/L. Historically sulfolane concentrations exceeded 100 µg/L at 35 wells in 20 locations (multiple wells at 1 location screened in different zones). In 2020 and 2021, no monitoring wells exceeded 100 µg/L, with a maximum concentration of 97.5 µg/L in 2020 decreasing by over 27 µg/L to a maximum of 70.4 µg/L in 2021. The monitoring well data indicate that the plume's maximum observed concentration is decreasing over time as the plume attenuates.

A summary of monitoring well analytical results is presented in Table 2, and laboratory analytical data packages are included in Appendix D. Figure 7 shows monitoring well results in the suprapermafrost aquifer. Figure 8 shows monitoring well results in the subpermafrost aquifer as well as the mixing zone between the suprapermafrost and subpermafrost aquifers, identified as such due to the absence of permafrost beneath Badger Slough. Concentrations from monitoring wells in the mixing zone have been included with subpermafrost aquifer wells because historical concentrations have been representative of the subpermafrost aquifer.

3.3 PRIVATE WELL SAMPLING

Samples were collected from a total of 16 residential properties between September and October 2021 for sulfolane analysis.

Samples were sent to SGS for sulfolane analysis. Two duplicate samples were submitted and analyzed for quality assurance purposes. The parent samples and duplicates had consistent concentrations, suggesting that data quality was not impacted as a result of sampling. Results provided by SGS were determined usable to meet the objectives of sampling.

Sulfolane was reported in private wells at concentrations ranging between not detected and 86 µg/L (PW-0561). PW-0561 was the only private well sample that had detections of sulfolane greater than 20 µg/L. The concentration in this well was consistent with those reported in 2020.

A summary of private well analytical results is presented in Table 3, and laboratory analytical data packages are included in Appendix D. A summary of the residential well network, 2020 sampling dates, and justification for missed sample locations, as applicable, as well as field sampling forms for all residential wells, are included in Appendix E.

4 CONCLUSIONS AND RECOMMENDATIONS

The following presents the conclusions of the 2021 monitoring event:

- Groundwater gradient and flow are consistent with historical trends (see Figures 3 through 6), indicating that the proposed well network is appropriate for analysis.
- Evaluation of 2021 data as depicted on Figures 7 and 8 have shown that the overall plume footprint is stable and the maximum observed concentration is decreasing as the plume attenuates over time.
- No additional monitoring locations are required to meet the objectives of the 2020 Plan.

Sampling of the monitoring well network will continue in 2022 with no modifications (48 wells). Modifications to the private well sampling list are anticipated as wells are decommissioned or rendered unusable for sampling as residential properties are connected to the municipal water supply system. The final list of wells to be sampled will be determined in consultation with DEC.

5 REFERENCES

Arcadis. 2017. Offsite Groundwater Sulfolane Plume Monitoring Plan. Arcadis, U.S., Inc, Seattle Washington, June 2017.

Arcadis. 2020. Annual 2019 Offsite Plume Monitoring Report. Arcadis, U.S., Inc., Seattle, Washington. January 2020.

Duncan, T. 2020. Response to State of Alaska's Requested Long-Term Offsite Monitoring of the Sulfolane Plume in North Pole, Alaska. Shook, Hardy, and Bacon. July.

Mulder, S. 2020. Long-Term Offsite Monitoring of the Sulfolane Plume in North Pole North Pole Refinery Litigation (Flint Hills) Case No. 4FA-14-01544 CI – Consolidated, AGO No. AN2014100495. Alaska Department of Law. August 3.

Integral. 2020. 2020 Offsite Sulfolane Plume Monitoring Plan, City of North Pole and Surrounding Area, Integral Consulting Inc, Cherry Hill, New Jersey, August 2020.

Figures

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Figure 1.
Site Location

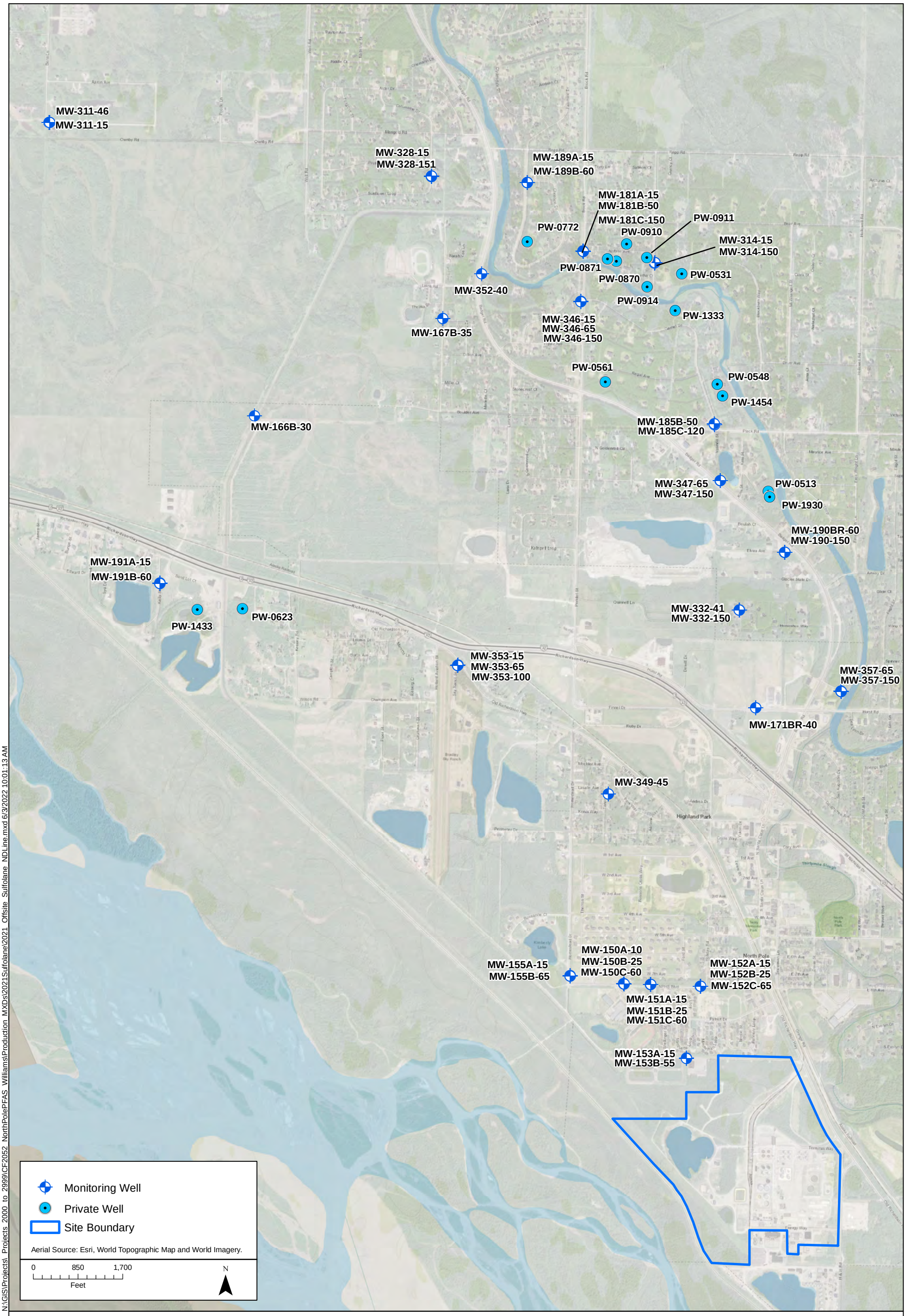

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Figure 2.
Sample Locations

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Figure 3.
Groundwater Contour Map (Offsite Wells)
Water Table Zone
December 2021

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Figure 4.
Groundwater Contour Map (Offsite Wells)
Zone 1 (10-55 ft)
December 2021

MW-189B-60
465.67

466

MW-346-65
467.65

468

470

MW-347-65
472.17

472

MW-190BR-60
473.79

MW-191B-60
469.18

474

MW-357-65
475.82

MW-353-65
474.01

476

478

480

MW-150C-60
481.07

MW-155B-65
480.93

MW-152C-65
481.76

482

MW-153B-65
482.9

Monitoring Well

Groundwater Contour (ft msl)

Site Boundary

Aerial Source: Esri, World Imagery

0 850 1,700
Feet

N

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Figure 5.
Groundwater Contour Map (Offsite Wells)
Zone 2 (55-90 ft)
December 2021

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Figure 6.
Groundwater Contour Map (Offsite Wells)
Zone 3 (90-150 ft)
December 2021

MW-328-151
3.16U

MW-181C-150
3.16U

MW-314-150
3.21U

MW-346-15
19.2 J

MW-346-65
70.4

MW-346-150
6.87 J

MW-185B-50
3.18U

MW-185C-120
3.85 J

MW-347-65
7.27 J

MW-347-150
18.3 J

MW-190-150
3.18U

MW-332-41
3.15U

MW-332-150
39.8

MW-357-150
3.16U

Concentrations of Sulfolane

- Not Detected
- Less than 20 µg/L
- Between 20 and 72 µg/L
- 2021 Approximate Sulfolane Non-Detect Isopleth
- Approximate Mixing Zone
- Approximate Permafrost
- Site Boundary

Note: Approximate extents of permafrost and mixing zones have been defined using the CSM completed by Arcadis.

Aerial Source: Esri, World Topographic Map and World Imagery.

0 850 1,700
Feet

N

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Figure 7.
2021 Monitoring Well Results
(Subpermafrost and Mixing Zone)

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Figure 8.
2021 Monitoring Well Results
(Suprapermafrost)