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Geological Consulting • Environmental Restoration • Regulatory Compliance

Evaluation of Groundwater Quality
August-September, 2009
Eklutna Gravel Extraction Project

Prepared for:
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Report Date:
October 9, 2009

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1.0 SUMMARY

TERRASAT, Inc (TERRASAT) was contracted by Alaska Interstate Construction LLC (AIC) to develop and sample four new monitoring wells at the Eklutna gravel extraction facility. Additionally, TERRASAT sampled one public water supply well up gradient from the facility and a previously installed monitoring well to the southwest of the current gravel extraction area. The wells were sampled to establish baseline groundwater quality. TERRASAT conducted the sampling effort in accordance with procedures established by the US EPA for the collection, storage, and analysis of water samples.

Well development was conducted over a two day period, August 18-19, 2009. Wells were considered developed when water clarity remained constant and the visual estimate of turbidity was low to none. Samples were taken on August 31, 2009 and September 3, 2009. Sample locations are shown in Figure 1.

Laboratory analytical results were compared with Alaska Water Quality Standards listed in 18 AAC 80 and 18 AAC 75.

2.0 INTRODUCTION

2.1 Purpose of Investigation

TERRASAT, Inc. evaluated baseline ground water conditions in an area permitted for gravel extraction. This area, designated for expansion, is adjacent to an on-going gravel extraction operation controlled by AIC. The purpose is to establish pre-existing site conditions, developing a basis for ground water monitoring of the proposed gravel extraction. This investigation also evaluates the similarities and differences in water quality between the shallow water table aquifer and the deeper, confined drinking water aquifer.

2.2 Scope of Services

TERRASAT, INC was contracted to:

- Develop and sample four, newly installed, monitoring wells.
- Sample one up gradient well and one public water system well.
- Statistically evaluate the constituents and create a reduced suite of analytes for quarterly sampling. This reduced suite of analytes will indicate if a release has occurred in the area.
- Create a report summarizing the findings and recommendations.

3.0 SITE DESCRIPTION

Figure 1 shows the locations of the monitoring wells and the public water supply well. The four, newly installed, monitoring wells are located to the west of the current gravel extraction site. MW-5 is located to the southwest of the current gravel extraction project and the public water well is located to the northeast, off

of Haricot Dr. The Eklutna Gravel extraction project is located approximately 15 miles north of Anchorage.

4.0 SAMPLING DISCUSSION

During the August-September 2009 sampling event, samples were collected up, down, and cross gradient to the existing gravel extraction project. Samples were collected in accordance with ASTM Standard D 4448-01 guidelines for monitoring well sampling. Disposable bailers were used to purge three well volumes from each well, when possible, before collecting ground water samples.

When purging three well volumes was not possible, an alternative method, low flow sampling, was used in accordance with the ASTM Standard D 4448-01 guidelines for monitoring well sampling. Recharge was known to be low in MW-4 and MW-2 from previous development of the wells. This approach suggests that purging at rates less than one liter/min provides more reproducible VOC and metals results, than purging at high rates, according to the research of Barcelona, Wehrmann, and Varlien, Puls, and Powell (ASTM Standards, Designation: D 4448-01, page 3).

Sampling in this manner is based on the premise that at very low purge rates, there is little mixing of the stagnant water column and the laminar ground water flow through the screen. Therefore, this produces a consistent sample that can be more easily duplicated (ASTM Standards, Designation: D 4448-01, page 3).

Low flow sampling reduces the turbidity of the sample. Because metals can adsorb to the surface of soil particulates, a less turbid sample is desired, keeping the dissolved portion of the metals suspended in solution. The low sampling rate allows disruption of the water to be kept to a minimum. This is desirable when collecting VOCs, because gases in solution are less likely to volatilize when under stable conditions.

Well sampling forms are shown in Appendix A.

5.0 Results

TERRASAT, Inc (TERRASAT) compared results from the August-September, 2009 sampling of five monitoring wells and one public water supply well to Alaska Quality Standards listed in 18 AAC 80 and 18 AAC 75. Refer to Table 1 for analytical results and Alaska Water Quality Standards.

Results for Gasoline Range Organics (GRO) and Benzene, Ethylbenzene, Toluene, and total Xylenes (BTEX) are below detection limits for all wells tested during this sampling effort.

Wells MW-3 (0.14 mg/L) and MW-4 (0.47 mg/L), the farthest down gradient wells, show the presence of Diesel Range Organics (DRO) concentrations that are below the Alaska Water Quality Standard listed in 18 AAC 75, at 1.5 mg/L.

Wells MW-2 (0.419 mg/L), MW-3 (1.13 mg/L), and MW-4 (0.306 mg/L) show Iron results that exceed secondary Alaska Drinking Water Standards listed in 18 AAC 80, at 0.3 mg/L.

Wells MW-3 (1460 µg/L) and MW-4 (254 µg/L) show Aluminum results that exceed Alaska Drinking Water Standards listed in 18 AAC 80, at 50-200 µg/L.

Wells MW-3 (110 µg/L), MW-4 (1480 µg/L), and MW-5 (468 µg/L) show Manganese results that exceed secondary Alaska Drinking Water Standards listed in 18 AAC 80, at 50 µg/L.

5.1 Summary and Discussion of Detection Analyte Statistics

A suite of analytes was selected for future detection monitoring of five monitoring wells. These analytes include: Phosphorus, Chloride, Zinc, pH, and Conductivity. The analytes were selected based on their statistical significance. Detection monitoring, following ASTM and EPA standards will provide a 95% confidence level to determine if a release occurs.

Upper Prediction Limits (UPL) for release detection will be calculated after level the next sampling event. For a prediction limit to be statistically valid with a 90% confidence level, a minimum of eight comparisons are needed.

Table 1. Laboratory Results for Five Monitoring Wells and One Public Water Supply Well.

Analyte	Sample Concentration						[1]18 AAC 80 Alaska Drinking Water Standards
	MW-1	MW-2	MW-3	MW-4	MW-5	Public Well	
Nitrate – Method SM4500-NO3E (mg/L)							
Nitrate/Nitrite as N	7.6	5.55	0.835	0.749	0.130	ND	10
Phosphorus – Method SM4500-PE (mg/L)							
Phosphorus (total)	0.66	3.9	2.4	4.8	5.9	ND	NR
Dissolved Metals – Method 200.7 (mg/L)							
Calcium	80.2	77.2	65.3	81.7	62.7	66.0	NR
Iron	ND	0.419	1.13	0.306	0.134	ND	0.3
Magnesium	30.7	29.6	21.3	48.2	19.6	15.8	NR
Potassium	1.44	ND	1.22	9.52	1.29	1.22	NR
Silicon	4.44	6.50	6.64	5.81	4.03	4.88	NR
Sodium	29.0	5.08	7.70	40.0	7.28	3.45	250
Strontium	1.08	0.818	0.773	0.986	0.588	0.389	NR
Tin	ND	ND	ND	ND	ND	ND	NR
Secondary Parameters							
Conductivity (µS)	489	368	320	58	304	245.3	NR

Analyte	Sample Concentration						[1]18 AAC 80 Alaska Drinking Water Standards
	MW-1	MW-2	MW-3	MW-4	MW-5	Public Well	
pH	7.80	7.78	7.43	7.52	7.77	8.06	6.5-8.5
Dissolved Metals– Method 200.8 (ug/L)							
Aluminum	9.52	395	1460	254	121	1.46	50-200
Antimony	0.141	0.132	0.150	0.305	0.888	ND	6
Arsenic	1.13	0.745	0.717	0.427	2.33	4.66	10
Barium	41.1	38.0	39.4	107	46.5	14.5	200
Beryllium	ND	ND	ND	ND	ND	ND	4
Boron	66.7	45.3	35.9	79.5	44.4	36.9	NR
Cadmium	ND	ND	ND	ND	ND	ND	5
Chromium	5.35	8.70	5.78	3.11	1.03	1.36	100
Cobalt	ND	0.864	1.52	2.54	1.22	ND	NR
Copper	2.02	1.66	2.90	2.15	0.867	0.214	1000
Lead	ND	0.334	0.409	ND	0.108	ND	NR
Manganese	18.9	22.1	110	1480	468	41.7	50
Molybdenum	1.31	ND	1.19	14.8	1.02	ND	NR
Nickel	11.2	9.17	15.0	16.8	14.2	3.32	NR
Selenium	1.57	1.45	0.715	1.28	0.501	ND	50
Silver	ND	ND	ND	ND	ND	ND	NR
Zinc	0.785	2.81	3.61	3.41	2.35	7.22	5000
Inorganic Anions – Method 300.0 (mg/L)							
Chloride	63	13	15	12	1.5	12	250
Sulfate	24	16	35	39	89	14	250
Total Alkalinity – SM2320B (mg/L CaCO3)							
Bicarbonate	240	270	200	450	172	180	NR
Low Level Mercury – 1631E (ug/L)							
Mercury	0.130	0.488	0.985	0.647	1.110	0.00015	2
Diesel Range Organics (DRO) – Method Ak102 (mg/L)							
[1]DRO	NT	ND	0.14	0.47	NT	NT	1.5
Gasoline Range Organics (GRO) – Method Ak101 (ug/L)							
[1]GRO	NT	ND	ND	ND	NT	NT	2200
BTEX – Method 8021B (ug/L)							
Benzene	NT	ND	ND	ND	NT	NT	5
Ethylbenzene	NT	ND	ND	ND	NT	NT	700
Toluene	NT	ND	ND	ND	NT	NT	1000
Xylenes (total)	NT	ND	ND	ND	NT	NT	10000

Shaded cell indicates a concentration level above the Alaska Drinking Water Standards
ND denotes a constituent with a concentration below the analytical method-reporting limit (MRL).
Blue font = secondary water quality parameters
NR denotes an analyte or parameter that is not regulated under 18 AAC 80
NT denotes an analyte was not tested
[1]Analytes are not regulated by 18 AAC 80, but are regulated under 18 AAC 75

6.0 CONCLUSIONS

The 18 AAC 80 and 18 AAC 75 standards are used as a comparison, only, for Eklutna monitoring well results. This study was to gather baseline water quality data of the area, and was not sampled for compliance.

Four monitoring wells: MW-2. MW-3, MW-4, and MW-5 have concentration levels of some constituents that exceed Alaska Water Quality Standards listed in the 18 AAC 80 and the 18 AAC 75.

Analytes that exceed the 18 AAC 80, Fe, Al, and Mn, are likely at natural levels in the aquifer system. Glacial-fluvial deposits, which make up the strata of the Anchorage bowl area, often have high concentrations of these analytes.

The likely source of the diesel range organics found in MW-3 and MW-4 is from a previous military installation in the area, referred to as Camp Mohawk. MW-4 and MW-3 are northeast of a previous military vehicle parking area and are directly on a previous helicopter landing strip. Figure 2 shows the Camp Mohawk facilities in relation to the current monitoring well locations.

Diesel range organic hydrocarbons are typically not very mobile in aquifers. Studies in California of more than 200 plumes of fuel releases showed that less than 2% of the plumes reached 1,000 feet in length. Since gasoline range organics and other volatile organic compounds are below laboratory detection levels, TERRASAT concludes that the diesel range organic hydrocarbons are weathered and relatively old. TERRASAT concludes that the source of diesel range contamination is likely within 200 feet of monitoring wells MW-3 and MW-4. TERRASAT cautions that a public water supply well is approximately 1,000 feet east of monitoring wells MW-3 and MW-4.

The water quality of the deeper local drinking water aquifer is different than the upper unconfined aquifer. This is shown by the relative concentration of some analytes between the two aquifers. The deeper aquifer is higher in zinc, arsenic, and pH and is lower in mercury, nickel, and aluminum than the shallow water table aquifer.

The water table aquifer is separated from the deeper, confined aquifer by approximately 123 feet of impermeable silt and clay. The deeper local drinking water aquifer showed static water at 29 feet below the ground surface. During drilling, water was encountered at approximately 158 feet below the ground surface, meaning that the ground water moves upward approximately 129 feet from the deeper aquifer.

Because of these findings TERRASAT believes that there is no interaction between the upper aquifer and the deeper local drinking water aquifer. Therefore, the drinking water is safe and will remain safe from past, present, and future activity in the area.

7.0 RECOMMENDATIONS

TERRSAT recommends quarterly detection monitoring of these five monitoring wells with the reduced suite of analytes of: Phosphorous, Chloride, Zinc, conductivity, and pH. Due to the presence of DRO in MW-3 and MW-4, we recommend that these wells continue to be monitored for DRO. We also recommend that MW-2, the cross gradient and closest monitoring well to the Eklutna Gate Well, be monitored for DRO. Additional sampling is needed for higher confidence in statistical results, as well as a better understanding of seasonal trends in ground water analyte concentrations.

TERRASAT recommends notifying the ADEC regarding the detection of diesel range organics in the ground water at MW-3 and MW-4. ADEC current 2009 regulations state:

> **18 AAC 75.300. Discharge or release notification; reporting requirements.** (a) Subject to (b), (c), and (g) of this section, a person in charge of a facility or operation shall notify the department by telephone, and immediately afterwards send the department a written notice by facsimile, hand delivery, or first class mail, informing the department about a discharge or release of a hazardous substance at or from the facility or operation as follows:
> (1) as soon as the person has knowledge of a
> (A) discharge or release of a hazardous substance other than oil;
> **(B) discharge or release of oil to water**;

We further recommend developing a release investigation strategy to identify the source of contamination so that the source can be mitigated. ADEC should be allowed to review and approve the release investigation plan before the plan is implemented.

Please contact us at (907) 344-9370 if you have any questions or would like further information.

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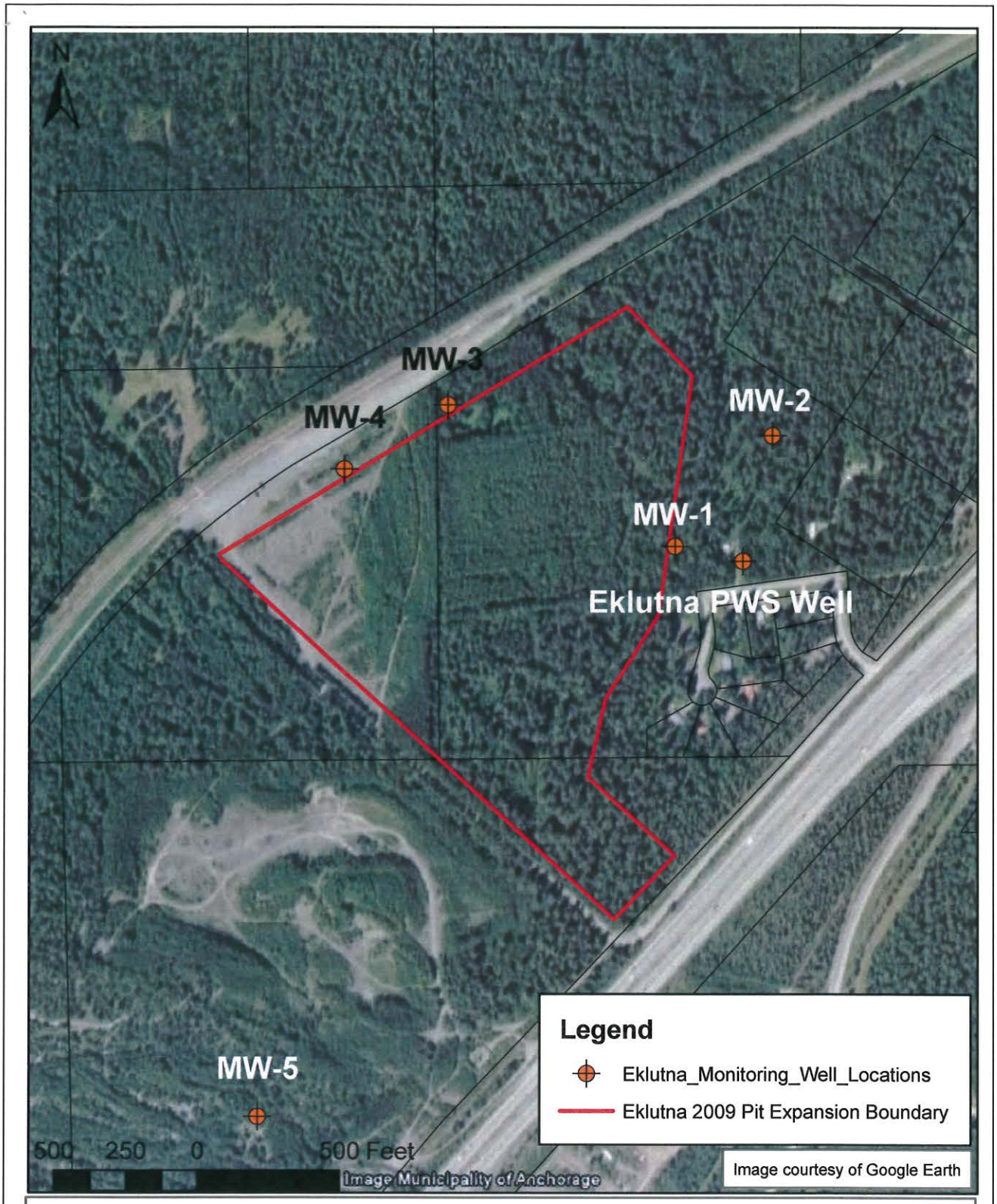

Figure 1 - Eklutna Well Locations

Prepared By: TERRSAT, Inc.	Prepared For: Alaska Interstate Construction LLC.	Date: 10/7/09

Figure 2 - Camp Mohawk Facility 1975 and Current Monitoring Well Locations

Prepared By: TERRASAT, Inc.	Prepared For: Alaska Interstate Construction, LLC.	Date: 10/8/09