MEMORANDUM

Project No.: 110207-004-08

February 25, 2014

To: Andy Kallus and Pete Adolphson, Department of Ecology

cc: Cindy Jernigan and Bryan Lust, K-C

From: Steve Germiat, LHG
Senior Associate Hydrogeologist

Re: **RI/FS Work Plan Addendum for Sediment Porewater Sampling and Analysis**
K-C Worldwide Site Upland Area RI/FS

This addendum to the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Upland Area of the Kimberly-Clark Worldwide Site (Aspect, 2013) proposes sampling and analysis of sediment porewater along the shoreline. Upland Area groundwater discharges to the marine environment of the East Waterway. Groundwater sampling and analysis in Upland Area shoreline monitoring wells to date identifies concentrations of un-ionized ammonia and selected metals at concentrations greater than groundwater screening levels based on protection of the marine environment. Figure 1 depicts the groundwater constituent concentrations exceeding screening levels in Upland Area monitoring wells positioned within 200 feet of the East Waterway. On Figure 1, the listed concentrations for each well location are the highest detected concentrations, including total or dissolved metals, detected during the multiple groundwater sampling events to date. Not every constituent displayed for a location exceeded its screening level there in each sampling event.

At any marine waterfront cleanup site, the tidally influenced subsurface groundwater-surface water transition zone is physically and chemically dynamic, which results in attenuation of groundwater constituent concentrations prior to groundwater reaching the sediment bioactive zone[1] and then the marine water column. The magnitude of groundwater concentration attenuation within this zone increases with proximity to the sediment mudline (groundwater-surface water interface) because the magnitude of both tidally induced physical mixing and geochemical transformation (esp. oxidation) increases closer to mudline. Therefore, the quality of groundwater entering the sediment bioactive zone, prior to discharge to the water column, provides a more accurate measure for marine protection than data from shoreline monitoring wells located up to 100 feet upgradient of mudline.

We therefore propose to directly monitor groundwater quality in intertidal sediment just beneath the bioactive zone (i.e., sediment porewater). Porewater sampling will be conducted during the second round of RI groundwater sampling in nearshore monitoring wells, scheduled for the week of February 24 through 28, 2014. The February 2014 data will be reviewed with Ecology. If Ecology requires a second round of sampling to address seasonal variability, it would be conducted in summer 2014 (e.g., mid-June or after). In that case, and depending on the schedule for preparation

[1] Top 10 centimeters (cm) below the sediment mudline.

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of the RI, the first round of data can suffice for preparation of the draft RI, and the second round of data could be incorporated into the final RI.

The data from paired upland well-porewater sample locations also allows empirical evaluation of concentration attenuation over the groundwater flowpath distance between the locations. The approach for paired monitoring of sediment porewater with groundwater from upland shoreline wells is consistent with that applied to assess marine protection at the Former Scott Paper Mill site in Anacortes (GeoEngineers, AMEC, and Anchor Environmental, 2008).

Porewater Sampling and Analysis Methods

Figure 1 depicts the seven proposed porewater sample locations (PW-1 through PW-7), positioned downgradient of upland shoreline wells where the highest groundwater concentrations of metals and/or un-ionized ammonia have been detected. The porewater samples will be collected during lower low tides on the exposed intertidal beach, but, at each location, sampling is contingent upon finding accessible beach sand at elevations below the shoreline armoring (rip rap). The samples will be collected during the last 3 hours of the ebb tide and up to 1 hour past the lower low water slack tide.

The porewater samples will be collected using a single-use, stainless steel drive point piezometer (Solinst Model 615S) with a 6-inch (15 cm)-long stainless steel mesh screen. During advancement of the piezometer, the screen will be covered by a removable stainless steel shield that helps prevent clogging of the screen by fine sediments. The piezometer will be equipped with sufficient dedicated polyethylene tubing to extend from the bottom of well screen, through the tubing bypass, to several feet above mudline when the piezometer is at its full depth for sampling. Attachment A provides the manufacturer's information regarding the piezometer construction and installation method.

Each porewater sample will be collected from as shallow a depth below the upper 10 cm of sediment as possible, subject to encountering adequate saturation to yield water for sampling. Adjacent to each sample location, a hand-augered boring will initially be advanced to confirm the depth of saturation below mudline. The drive point piezometer, with shield in place, will then be manually driven to a depth approximately 18 inches below the observed depth of saturation. Once at depth, the piezometer assembly will be lifted approximately 6 inches, withdrawing the screen from the shield and exposing the screen directly to the saturated sediment. If water yield is insufficient to pump continuously at 0.1 liter per minute, the piezometer will be driven approximately 6 inches deeper and the process repeated. The location of each sample will be documented using GPS.

Porewater from the piezometer will be purged and sampled using the groundwater sampling methods described in the Sampling and Analysis Plan (Appendix A) of the RI/FS Work Plan (Aspect, 2013). A sample of East Waterway surface water will also be collected just offshore of the PW-5 location for reference. Sample bottles for ammonia and sulfide will be preserved and filled to provide negligible headspace. The water samples will be placed in a cooler with ice/blue ice and will be transmitted under chain of custody protocol to ALS analytical laboratory in Kelso, Washington[2]. The water samples will be analyzed for total ammonia, dissolved sulfide, total and dissolved metals[3] (arsenic, copper, mercury, nickel), and salinity, using analytical methods

[2] Analytical laboratory conducting these analyses for all RI groundwater samples.
[3] Metals that exceeded screening levels in one or more shoreline monitoring wells to date (see Figure 1).

specified in the Quality Assurance Project Plan (QAPP) of Aspect (2013) and, for salinity, Standard Method SM 2520B (not defined in QAPP). The water samples will not be centrifuged prior to analysis. Field parameters (temperature, pH, specific conductance, oxidation-reduction potential, dissolved oxygen, and turbidity) will also be measured during purging (with closed flow-through cell) for each porewater sample.

The porewater analytical data quality will be validated consistent with the QAPP, and will be reported as part of the Upland Area RI.

References

Aspect Consulting, 2013, Work Plan for Remedial Investigation/Feasibility Study, Kimberly-Clark Worldwide Site Upland Area, Everett, Washington, November 22, 2013 Final.

GeoEngineers, AMEC Geomatrix, and Anchor Environmental, 2008, Draft Final Remedial Investigation Report, Port Uplands Area, MJB North Area, and Marine Area, Former Scott Paper Company Mill Site, Anacortes, Washington, August 14, 2008.

Attachments

Figure 1 – Proposed Porewater Sampling Locations
Attachment A – Solinst Drive-Point Piezometer Instructions

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FIGURES

PW-1
PW-2
PW-3
PW-4
PW-5
PW-6
PW-7

REC7-MW-4
Nickel: **40** (ug/L)

REC1-MW-9
Ul NH3: **0.056** (mg/L)

REC1-MW-5
Arsenic: **10.3** (ug/L)
Copper: **4.23** (ug/L)

MW-2
Nickel: **13.1** (ug/L)

MW-1
Copper: **4.51** (ug/L)
Nickel: **23** (ug/L)

PM-MW-7
Nickel: **10.5** (ug/L)

REC3-MW-1
Nickel: **83.3** (ug/L)

PM-MW-6
Nickel: **9.4** (ug/L)

REC3-MW-1R
Arsenic: **6.6** (ug/L)

REC7-MW-3
Nickel: **19.4** (ug/L)

OMS-MW-1
Nickel: **18.6** (ug/L)

BA-MW-7
Nickel: **8.66** (ug/L)

BA-MW-6
Arsenic: **7.62** (ug/L)

UST70-MW-2
Arsenic: **5.23** (ug/L)
Copper: **4.56** (ug/L)
Nickel: **308** (ug/L)
Zinc: **116** (ug/L)

SHB-MW-1
Arsenic: **13.5** (ug/L)

LP-MW-2
Copper: **4.5** (ug/L)
Mercury: **0.132** (ug/L)

REC6-MW-2
Arsenic: **5.91** (ug/L)
Copper: **6.52** (ug/L)
Ul NH3: **0.207** (mg/L)

MW-6
Arsenic: **7.8** (ug/L)
Copper: **5.29** (ug/L)
Nickel: **10.5** (ug/L)
Ul NH3: **0.129** (mg/L)

MW-5
Arsenic: **6.67** (ug/L)
Copper: **15.9** (ug/L)

NRP-MW-3
Copper: **12** (ug/L)
Mercury: **0.0271** (ug/L)
Nickel: **14.4** (ug/L)

REC7-MW-1
Copper: **4.41** (ug/L)

Monitoring Well
Decommisioned Monitoring Well
Wells with Screening Level Exceedances of Metals or Un-ionized Ammonia in Groundwater
200-Foot Shoreline Buffer

Upland Area Boundary

Interim Action Areas
Completed
In Process
Not Started

Well ID → **REC6-MW-2**
Arsenic: **5.91** (ug/L)
Copper: **6.52** (ug/L)
Ul NH3: **0.207** (mg/L)

Maximum concentration in groundwater for each analyte exceeding the screening level ("Ul NH3" = Un-Ionized Ammonia as Nitrogen) Metals concentrations are higher of total or dissolved concentrations.

PW-6
Proposed Porewater Sample Location

N

0 200 400
Feet

Proposed Porewater Sampling Locations

K-C Worldwide Site Upland Area
Everett, Washington

Aspect CONSULTING	FEB-2014	BY: PPW	FIGURE NO. 1
	PROJECT NO. 110207-08	REV BY: ---	

ATTACHMENT A

Solinst Drive-Point Piezometer Instructions

Drive-Point Piezometer Instructions

Model 615, 615C, 615N, 615S & 615SN (with Slide Hammer)

WARNING: Before driving into the ground, be sure you have underground service clearance to avoid cables, gas lines, pipes, etc.

Component List

- Drive-Point Piezometer Tip
- Extensions (suitable to reach the required depth)
- Couplings (one required for each extension)
- Manual Slide Hammer
- Piezometer tubing (suitable to reach the required depth)
- Drive Head Assembly (3 parts)

  Includes: Drive Head, Drive Extension & Tubing Bypass
- Stainless Steel Cap (101057)

Installation with a Manual Slide Hammer

Note: Drive-Points are designed for single use installations (temporary or permanent). They are not meant for removal and reuse.

1. Ensure that all components are clean prior to use.
2. If using piezometer tubing, cut it to the depth of the proposed installation plus an additional 5 ft (1.5 m).
3. If using a 615 or 615S, Connect the piezometer tubing to barbed fitting on the Drive-Point Piezometer Tip by pushing firmly until the tubing reaches the base of the fitting.

   Or, if using a 615C, loosen the compression fitting and insert the 1/4" piezometer tubing. Tighten 1 and 1/4 turns past finger tight to properly secure the tubing in the fitting.
4. Slide a length of extension pipe over the tubing, and thread it firmly onto the Drive-Point Piezometer Tip. Tighten with a pipe wrench.

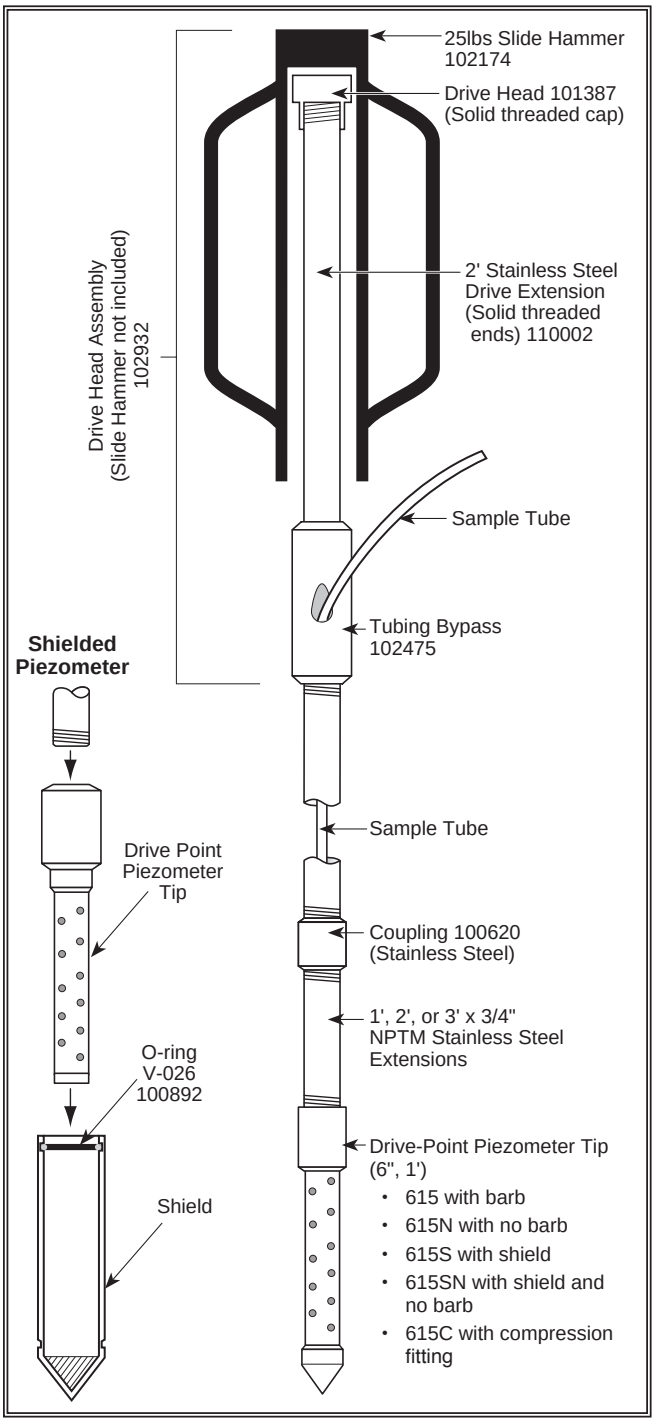
   If using a 615N or 615SN, then you will not be working with tubing. Simply thread the extension pipe onto the Piezometer Tip.

   WARNING: When connecting or removing the Tubing Bypass, it is very important to hold the tubing to prevent it from turning. Failure to do so may result in the tube being dislodged from the Drive-Point Tip.
5. Hold the tubing to prevent it from turning, then slide the Tubing Bypass over the tubing and tighten it firmly onto the extension pipe, with the tubing extending through the side hole.

   You do not need the Tubing Bypass with the 615N or 615SN. Thread the Drive Extension and Drive Head to the extension pipe.
6. Thread the Drive Extension and the Drive Head onto the Tubing Bypass and tighten firmly.
7. Slide the Slide Hammer over the Drive Head and operate the hammer to drive the device until only about 6" (15 cm) of the extension pipe below the Tubing Bypass remains above the ground.

WARNING: For health and safety reasons, it is strongly suggested that only a suitable slide hammer be used for Drive-Point Piezometer installations. Sledge hammers are not suitable and can cause serious physical injury.

8. Remove the hammer, then holding the tubing to prevent it from turning, remove the Drive Head Assembly.
9. Slide a coupling over the tubing and tighten firmly onto the previous extension pipe. Slide the next extension pipe over the tubing and tighten it securely.
10. Repeat steps 5 through 10 until the desired sampling depth is reached.
11. Cut the piezometer tubing to fit flush to the top of the extension pipe. Attach a cap to the top of the piezometer to complete the installation.



Important Notes about Shielded Piezometers

1. Before driving into the ground, ensure that the shield is on firmly and the o-ring seats properly.
2. Drive the Piezometer an equal length past the desired depth, then pull back/up to expose the inlet.
3. 1ft (102412) and 6" (104370) Replacement Shields are available when re-using the Drive-Point Piezometer.

Continued overleaf...

Monitoring Options

The 615 has a barbed fitting to attach 5/8" x 1/2" LDPE or Teflon tubing. These piezometers are suitable for water sampling using Solinst 429 Point-Source Bailers, Model 404 Inertial Pumps, or the Model 410 Peristaltic Pump. Water level measurements can be taken using the Model 102 or 102M Water Level Meters.

The 615N does not have a tubing barb. The open 3/4" (20mm) piezometer pipe is ideal for water level measurements using the Model 102 or 102M Water Level Meters or Model 101 Water Level Meter, and provides more access to sample with Model 404 Inertial Pumps, or Model 429 Point-Source Bailers.

The **615S** is a shielded version of the 615. It has the same monitoring options as the standard 615. The shield prevents the screen from smearing during installation in soft soils and clay.

The **615SN** is a shielded version of the 615N. It has the same monitoring options as the standard 615N. The shield prevents the screen from smearing during installation in soft soils and clay.

The 615C comes with a compression fitting to attach 1/4" x 0.170" LDPE or Teflon tubing. The 615C is suitable for water and soil vapor sampling using the Solinst Model 410 Peristaltic Pump.

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