STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Remediation and Solid Waste Management
Division of Technical Services

MEMORANDUM

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TO: Wayne Paradis, ES III, Division of Remediation

FROM: Troy Smith, Geologist, Technical Services

DATE: April 29, 2009

PROGRAM: Uncontrolled Sites Program

SUBJECT SITE: Robbins Property Site, Ellsworth

SUBJECT: Revised Estimated Bedrock Plume Delineation

The purpose of this memo is to provide the reasoning for the estimated extent of the VOC plume emanating from the subject site within the underlying bedrock fractures. It should be understood that this estimate is based on very limited data collected from the site and on-going monitoring of several area water supplies. Therefore, it should be viewed as a best guess with limited information. The bedrock hydrogeology has not been investigated and the conceptual understanding of contaminant transport has not been fully developed. Therefore, the statements in this memo are preliminary at best and the recommendations for plume delineation are conservative in nature. If you have any questions or comments, please contact me.

This memo is a revision of my February 18, 2009 memo that presented a preliminary estimate. Since I wrote the memo it has come to our attention that extending the waterline along Route 1A to the extent of the proposed restricted bedrock well installation area would require the City of Ellsworth to install a pumping station due to the elevation change. Therefore, the proposed area has been modified to allow the use of point-of-entry treatment (POET) in lieu of connection to the water line within certain areas of the February

2009 proposed areas. On properties where POET is utilized a Declaration of Environmental Covenant that meets the Uniform Environmental Covenants Act (UECA) will be required to assure all future property owners will be properly notified. The revised map shows a proposed bedrock well treatment area and a smaller proposed bedrock well restricted area. Due to limited data and the presence of one water supply within the February 2009 restricted area that was not contaminated in limited sampling the proposed bedrock well restricted area was reduced. However, wells outside the proposed bedrock well restricted area, but within the proposed bedrock well treatment area need to be supplied with POET to assure site related contaminants will not be ingested, discharged into the septic system, or discharged to the ground via a water supply well. This is based on the water quality results from a water supply well located at a commercial property on the north side of Route 1A. However, it should be understood that this assumes that water usage will be limited to a typical residential well for a family of five people at a rate of 55 gallons/day/person (*Ground Water Handbook for the State of Maine*, by W. B. Caswell ,Maine Geological Survey, Bulletin 39, 1987). Properties within the proposed water treatment area that exceed the typical residential water usage scenario should be connected to the waterline to prevent unanticipated spreading of the plume.

Given that there will be active wells pumping within the February 2009 proposed restricted bedrock well installation area, more consideration should be given to maintaining the artesian well located at the Hancock County Vocational Center as a bedrock drain to help capture the plume.

Bedrock Geology

According to the Bedrock Geology of the Ellsworth Quadrangle, Maine published by the Maine Geological Survey, Open File No. 08-88, 2008 (Pollock, 2008), the Robbins Site is underlain by the Cambrian Age Ellsworth Schist. This formation is described as a “dark green, light gray to green weathering, quartz-feldspar-muscovite-chlorite schist. Contains numerous disrupted fine-grained quartz veins showing multiple deformation. Layers of greenstone 20 centimeters to 1 meter in thickness, representing metamorphosed fine-grained mafic volcanic rocks, are present throughout the formation. Locally contains folded, meter-scale beds of metamorphosed felsic tuff and mafic flows. Intruded by mafic dikes up to 3 meters in thickness that postdate the main fabric in the schist but are folded by a later deformation” (Pollock, 2008).

The complex structure of the Ellsworth Schist will influence the direction of groundwater flow within the bedrock fractures. Based on outcrop mapping to the north and south of the Robbins Property Site, the strike of the main phase metamorphic foliation is generally northeast-southwest and dips steeply between 80 and 85 degrees to the northwest and southeast depending on the proximity to the Lucerne Granite present approximately 1,200 feet west of the site. According to the geologic mapping, the fold hinge of the folded schist is oriented more east-west and plunges to the east. The structure of the rock is further complicated by second and third generation folding and by steep dipping crenulation cleavage that is not parallel to the main phase metamorphic cleavage.

Bedrock Hydrogeology

The hydrogeology of the area is influenced by Graham Lake located northeast of the site, the Union River located east of the site, and Leonard Lake located southeast of the Robbins Property Site. The water levels in Graham and Leonard Lakes are controlled by dams which also control the flow of the Union River between the two lakes. According to the USGS topographic map, the level in Graham Lake is maintained at an elevation of approximately 32 meters and the elevation in Leonard Lake is approximately 20 meters. The Union River elevation is maintained at approximately 24 meters and flows from Graham Lake to Leonard Lake. The dams maintain unnatural surface water levels in the lakes and in the Union River. Without the influence of the dams, under natural conditions, groundwater in the bedrock would be expected to flow within the fractures and generally follow the surface topography to the east and eventually south along the Union River. However, the presence of the dam on Leonard Lake reduces natural discharge of groundwater to the surface water and thus controls groundwater flow in the area. Gilpatrick Brook, located between the Robbins Property and the Hancock County Technical Center School (HCTCS), is a shallow brook that provides surface drainage for the uplands to the north and west of the Robbins Property. The brook has little influence on the bedrock groundwater flow and likely does not influence bedrock groundwater flow nor does it represent a significant discharge for bedrock groundwater. The elevation of the brook is at approximately 40 meters between the site and the HCTCS and is less than a meter deep. Given that Graham Lake provides a constant head at approximately 32 meters and Leonard Lake controls the discharge at approximately 20 meters, the presence of bedrock wells is significant within this area because they act as drains within the hydrogeologic system. The effect of the wells on the bedrock plume will depend on the fabric of the metamorphosed schist. To date, the data suggests that the foliation, plunge, and

steeply dipping nature of these features is controlling the migration of the plume.

The surface elevation of the Robbins Site is approximately 52.5 meters and the Hancock County Vocational School surface elevation is 41 meters. According to the 2000 borehole investigations at the Robbins Site, the former Robbins Water Supply Well has three contaminated transmissive fracture zones at elevation 5 meters, 9 meters, and 13 meters. The fracture zone at elevation 13 meters (the highest elevation) has the highest PCE concentrations (1,400 ug/L), the highest yield (2 gpm), and the highest water level measured in the transmissive packered zones. This is significant because it indicates a downward head from the most contaminated zone with the highest transmissivity. This would cause contamination in the shallow fracture zones to drain downward as the fracture system drains outward. According to the 1995 borehole investigations at the HCVC, the deepest contaminated fracture in the HCTCS well is between elevation -9 and -10. This fracture zone has the highest PCE concentration detected in the borehole at 86 ug/L. This fracture zone is under artesian pressure and provides approximately 0.6 gallons per minute (gpm) of continuous flow into the borehole. Under non-pumping conditions, the water from the well flows over the top of the casing at approximately 1.3 gpm of which approximately 0.6 gpm is derived from the deepest fracture. Fractures at elevation 3 meters, 23 meters, and 31 meters supply the rest of the 1.3 gpm artesian flow. This indicates that continuous flow in the relatively deep bedrock fractures intercepted by the HCVS well is capturing and discharging the VOC plume. The well is located northeast of the Robbins Property Site along the strike of the main phase metamorphic foliation measured in area outcrops. The deep contaminated fracture may be the result of the steeply dipping foliation. The artesian conditions may be the result of the surface water dams that reduce natural discharge.

The Robbins well is approximately 25 meters deep and the HCTCS well is approximately 65 meters deep. The depths of the Comstock and Dietrich wells are unknown.

Proposed Water Line Extension

The planned water line extension will eliminate several active wells in the area including the HCTCS well and the two contaminated residential wells (former Comstock and Dietrich). Eliminating the discharge of groundwater from the bedrock will change the current water budget in the bedrock aquifer. Therefore, efforts should be

taken to control or limit drilling bedrock water supplies in the future that could intercept and drain contaminated fractures. The greatest risk appears to be those that would be drilled along the strike of the foliation and that would intercept fractures between elevation 40 and -10 meters. Given that the PCE concentration in the bedrock at the site is 1,400 ug/L and the concentration at HCVC 2,000 feet away is 86 ug/L, the dilution (attenuation) rate is approximately 0.65 ug/L per lateral foot. The MEG for PCE is 7 ug/L, therefore another 120 feet of distance would be required to arrive at the MEG if the attenuation rate remains constant without a degradation to TCE or other daughter compounds. Therefore, a distance of 2,500 feet along the strike and down the plunge of the foliation appears to be a reasonably conservative distance. In the other directions normal to the strike and plunge, a distance of 1,500 feet appears to be a good starting point. This appears to be consistent with the current pattern of migration. The HCVC well is along the strike of the foliation and has seen the highest off-site concentrations while the Comstock and Dietrich wells appear to be in the direction of the foliation dip and regional plunge. These wells have seen much lower concentrations. The HCVC well is 2,000 feet from the site and the Dietrich and Comstock wells are approximately 1,200 feet from the site. It should be understood that these distances are based on regional geologic mapping and observations of widely spaced monitoring data points. Therefore, these distances are best guesses with limited data, but likely represent conservative distances from the source.

Properties that obtain water from the overburden or a surface water spring may do so without needing to meet the setback distances. However, water tests are recommended for any well within 2,500-feet to be sure they are clean.

Additional Recommendations

Once sampling at Robbins Property is completed in the Spring of 2009, all monitoring wells should be properly abandoned including the former Robbins Bedrock Water Supply. Special attention should be given to grouting the upper fractures of the well to reduce migration within the borehole or along fractures outside the borehole.

Once the water supply line is installed and properties are connected, all bedrock wells should be pressure grouted to prevent them from being used as migration conduit for contamination. The only possible exception might be to allow the bedrock well at the HCVC to continue to flow as a drain that captures the plume. This will need

additional thought and sampling if this is going to be used as a bedrock drain. Otherwise it should also be grouted after the school is connected to the waterline.