

Report on Adaptive Management Process for Four Points Shaft Groundwater Loss February 2012

Summary of Issue

On November 15, 2011 a drop in groundwater elevation was noted in wells JT-128 and JT-112. These wells are located in close proximity to the Four Points access shaft for the Jollyville Transmission Main, approximately 10' and 120' away, respectively. Excavation of the Four Points shaft intercepted the water table at the Edwards/Walnut contact at this same time. There was an initial drop of approximately 1.5 feet over 24 hours in JT-128 and somewhat less in JT-112. Beginning on November 19 the rate of decline significantly slowed to approximately .02 to .03 feet per day (see figure 1).

The initial rapid decline in the local water table was anticipated during design of the shaft due to the shaft excavation reaching the groundwater bearing zone at the interface of the Edwards and Walnut geological formations. The contractor excavated quickly through this zone and installed a permeable ring intended to route groundwater from one side of the shaft to the other to preserve original groundwater flow paths. After installation of the permeable ring it was anticipated that groundwater levels would begin to recover to levels near those in nearby background wells. Minor reduction in groundwater levels in the area in close proximity to the shaft is expected until the shaft is backfilled..

Water was observed seeping into the shaft at and just below the elevation of the recently installed permeable ring. Environmental protection measures included in the specifications for shaft constructions provided maximum allowable water inflows into the shaft of 10 gallons per minute (gpm).

Reason for Initiation of Adaptive Management

Monitoring of groundwater inflows into the shaft after liner plate installation and grouting across the permeable ring horizon indicated inflows of 0.5 gpm to 2.0 gpm. These inflows were well below thresholds established in shaft specifications. EC monitoring documented an unexpected continued decline in groundwater elevations in two monitoring wells near the shaft over several weeks after ring installation. The EC team expressed concern regarding a loss of groundwater that could eventually impact springs in the vicinity. The nearest spring is approximately 2,200' from the shaft and is believed to be habitat for the Jollyville Plateau salamander (JPS). After consultation with the Project Team consensus was reached that an adaptive management process should be initiated.

Adaptive Management Process

The EC and Project Teams met to discuss the situation. As noted earlier, contract specifications provided an allowable inflow of up to 10 gpm for the shaft liner, which indicated that the permeable ring and liner installation was performing within contract tolerances. However, comparison of estimated shaft inflow versus the rate of decline in groundwater levels indicated that shaft inflow was the likely cause of the decline.

Based on calculations by EC hydrogeologists the area of impact to groundwater levels would be expected to slowly expand and might eventually impact flow at area springs. Initial projections indicated that the soonest impacts might occur was 3 months and possibly as long as 12 months. Given that the shaft would not be backfilled for 2 years or more the decision was made to

develop a solution to further reduce the inflow with the goal of stabilizing groundwater levels in affected wells (JT-128 and JT-112) and eventually recovering to near the levels in area background monitoring wells and to implement the solution as soon as practicable within construction constraints.

Water was injected into the ring to test the integrity of the permeable ring and to determine whether flow into the ring would provide groundwater recovery. Test water was observed to flow into the shaft through the liner plates and no water built up in the ring. The construction contractor cut holes in the liner plate in the area of leakage and found a seam in the shaft grout at the “cold joint” between two grout pours approximately 1.5’ below the permeable ring. It was believed that groundwater was entering the ring as intended but flowing down the shaft wall to the cold joint and through the liner plate and into the shaft rather than traveling around the ring and back into the surrounding rock as intended.

Resolution

The Project Team proposed an enhanced grouting program to inject grout around the shaft circumference below the permeable ring to seal off the cold joint and other void spaces that might be providing a path for groundwater to flow into the shaft. A hydrophobic, polyurethane based grout was proposed that could be injected into a drilled port on the liner plates. The injection of grout would fill any crevices, joints, or voids in the line plate grout system and immediately expand and cure to provide a more efficient seal.

The EC Team evaluated the proposal and agreed that it was a reasonable approach. Since a polyurethane grout was to be used the EC Team evaluated the material and determined that a component of the grout, di-n-butyl phthalate, was a potentially harmful contaminant that could detrimentally impact the Jollyville Plateau salamander (JPS). EC Team personnel conducted a contaminant fate and transport analysis which found that the maximum possible concentrations at the shaft were .026 mg/l, well below the lowest effects concentration of 0.1 mg/l. The lowest effects concentration was based on published data for a surrogate amphibian species, *Xenopus laevis* (Lee and veeramachaneni 2005) since toxicity data was not available for the JPS or any other salamander. After completing this analysis, the EC Team approved the enhanced grouting program and it was implemented beginning on January 18, 2012.

The enhanced grouting program was completed on January 27, 2012 and testing of the ring was conducted on the same day by injecting 6,000 gallons of water into the ring. This test was similar to what had been done shortly after the permeable ring had been installed. Only minimal seepage was observed inside of the shaft and water levels in the closest well, JT-128, showed a sharp rise. Over the next week water levels began slowly recovering. These preliminary results indicate that the ring is conveying water as intended and all indications are that the enhanced grouting program is a success. As of February 14, 2012, water levels in JT-128 are within 0.8 feet (64%) of pre-excavation levels and continue to rise. It is anticipated that groundwater will continue to recover until it reaches a level close to that of background wells and monitoring of these wells will continue until the project is completed.

Lee, S. K., and D. N. R. Veeramachaneni. 2005. Subchronic Exposure to Low Concentrations of Di-n-Butyl Phthalate Disrupts Spermatogenesis in *Xenopus laevis* Frogs. *Toxicological Sciences* 84:394 -407. doi: 10.1093/toxsci/kfi087.