Appendix C CDM Installation and Testing Procedures for TVW Gas Venting Wells

The approach used to probe for the top of the gravel and to look for free gas pockets follows. The CPT 1-inch diameter hollow geoprobe rods, with an expendable drive point was pushed into the subsurface sediments using a cone penetrometer (CPT) direct-push technology rig. Coarse-grained materials such as thick layers of sand and gravel generally increase the resistance pressures to a point of refusal with direct-push technology. The resistance pressure, measured in pounds per square inch (psi), was recorded as the rod's were pushed into the ground and the top of the "50-foot Gravel" aquifer interpreted to be the depth where a significant increase in resistance pressure was measured, or where a point of refusal occurred. In order to insure that the probe rods were below any gas/water interface, the rods were pushed to a depth that was approximately ten feet below the interpreted top of the "50-foot Gravel" aquifer, or to refusal. Upon reaching the total depth of the boreholes the probe rod was filled with potable water to prevent a sudden drop of pressure that could cause the formation to heave and clog the probe rod when the rods were backed off of the point. In addition, an airtight flush-threaded steel rod cap, connected to a ¾inch diameter hosing with an inline pressure gauge and ball valve, with ¼inch Teflon tubing was attached to the top of the rods and connected to a nitrogen tank. After the gas monitoring apparatus was connected and leak tested, the probe rod was retracted a few inches, releasing the drive point. The length of retraction and actual depth of the bottom of the probe rod was recorded.

With the valve on the monitoring apparatus closed, the reading on the pressure gauge was recorded. If no backpressure was observed, then the valve was opened and "air-lifting" was initiated by "bubbling" compressed nitrogen through the water column via the ¼inch tubing fitted within the apparatus hosing, reducing the apparent density of the column of water within the rod and potentially initiating gas flow from depth. Any gas observed was analyzed on site using a Landtec IR instrument to measure the presence of methane. All results were recorded in a field notebook by CDM. If no gas was observed, the drill rods were retracted a short distance (e.g. six inches to one foot), and the testing procedure was repeated. Gas testing was generally terminated once the probe rods had been retracted to a minimum of two feet above the top of the "50-foot Gravel" aquifer, although in some cases the testing for gas was continued nearly to the

surface.

Whenever gas was observed, the flow rate was measured, either by water displacement, or flow meter. If a gas flow rate of approximately 30 L/min or greater was measured, the probe rods were left in place and monitoring apparatus that included a 30 psi pressure gauge and a 30-50 psi backpressure regulator was fitted to the top of the rods. For lower flow rates, the probe rods were removed and replaced with a temporary venting well, which consisted of a ¾inch diameter 0.010 slot Schedule 40 PVC screen and either ½inch or ¾inch diameter Schedule 40 PVC casing. The ½inch casing was fitted to a ¾inch well-screen with a PVC reducer. The screen length was selected based on the depth to gas; estimated depth of the top of gravel; local lithologic data; and the depth at which gas was observed at nearby locations. Prior to installation of the temporary venting well, the probe rods were removed from the borehole and refitted with a new expendable point. The probe rod was then pushed to the desired depth and the PVC casing and screen was installed through the center of the probe rods. The rods were then removed from around the PVC casing and the formation was allowed to expand and fill the annular space. The top of the PVC well was fitted with a monitoring apparatus similar to that for the probe rods, including a 30-psi pressure gauge and a 30-50 psi back pressure regulator.

Upon completion of the gas lift and pressure testing in each borehole, if no gas was observed, the monitoring apparatus and drill rods were removed from the borehole. The drill rods were fitted with a new expendable drive point and the probe rods reinstalled to the total depth of the original boring. The drill rod was then filled with water and a ½inch grout tube inserted through the center of the drill rods, and the rods removed. The hole was then pressure grouted with a bentonite slurry to ground surface. Once filled, the grout tube was removed and any remaining annular space filled.

The flow rate and pressure at each well location was typically monitored twice a day after installation. The following methods or instruments were used to measure or estimate the flow rates: Al-tech®, DC-Lite®, rotameter, and/or water displacement based on measured flow. The water displacement method and rotameter were primarily used at wells with flow rates greater than 12 L/rnin. The Al-tech® flow meter was calibrated for rates less than 0.010 L/min. The DC-Lite® flow meter was calibrated for

rates between 0.10 and 12 L/min and was used to measure the majority of the wells. The pressure reading was measured from the pressure gauge fitted to each of the wells, and the flow rate was measured from an exhaust port on the back flow regulator.

Monitoring wells were maintained with 18 to 19 psi of back pressure in the wellbore, where possible, in order to maximize gas flow from the “50-foot Gravel” aquifer. The back pressure prevented groundwater at 50 feet bgs from uplifting into the well space and hindering gas flow. Well maintenance also included periodic water redevelopment and/or gas lifting of the water in the well bore to allow gas to flow if the well became silted or water blocked. At some locations, leaks in the system did not allow for pressures to sustain at 18 to 19 psi. However, flow data from these locations was still recorded in an attempt to assess the potential volume of gas present in the “50-foot Gravel” aquifer.