PART 4: Hydrologic and Geologic Information

4.1 Regional Characteristics. As described in Illinois State Geological Survey Circulars 192, 198, 207, 212, 222, 225, 232, 248, Coop 1, etc., other sources or personal knowledge, provide the following required hydrogeologic information. All materials utilized in the preparation of this Part shall be clearly identified and a bibliography provided at the end of this Part. **[1780.22(b)/1784.22(b); 1779.25(a)(6)/1783.25(a)(6)]**

4.1.1 Describe/discuss the major and minor unconsolidated aquifers of the permit area, shadow area for underground proposals (if applicable), and their respective adjacent areas.

ISGS Circular No. 212 reports that Quaternary sand and gravel deposits capable of delivering water to a well bore are generally absent in area of the proposed surface effects area. Local unconsolidated materials are typically composed of clay and lacustrine silt. This material rarely exhibits sufficient permeability for development as a reliable source of potable water. No buried bedrock valleys are known to be present within or immediately adjacent to the proposed permit area. The Kaskaskia bedrock valley is located over 13 miles to the west. No major sand or gravel aquifers are known to exist within or immediately adjacent to the proposed permit area.

4.1.2 Describe/ discuss the generalized water yield, supply, existing use and potential use of the major and minor unconsolidated aquifers.

This area of Randolph County has poor unconsolidated aquifer potential with sand and gravel deposits generally absent (Pryor 1975). Shallow (<30 feet deep), excavated, large-diameter wells are sporadically present in the area. These wells are typically used as cisterns because the groundwater output is seldom capable of meeting average contemporary residential demand. Yields from wells completed in local Quaternary aged unconsolidated sediments water bearing zones in this region are generally limited to 20 gpm or more but these deposits are not located within the permit or adjacent area (USGS 82-858). Because of low yields most residents within the region are connected to public water supply. Three wells, all located on the same property tract, were identified as present within 0.5 miles of the proposed permit area. Only one of the three wells (GW100) was reported as being in use. The well, which is screened within the unconsolidated material, was reported as being used for potable water supply.

4.1.3 Describe/discuss the major and minor consolidated aquifers in the permit area, shadow area for underground proposals (if applicable), and their respective adjacent areas.

The underlying bedrock strata are primarily Pennsylvanian shales and claystones with some limited limestone intervals exhibiting permeability on the order of 10^{-6} to 10^{-11} cm/sec (Freeze and Cherry, 1979). These strata are generally considered impermeable and act as aquicludes. Pennsylvanian bedrock water bearing zones of thin sandstone and limestone beds typically yield less than 25 gpm (Smith and Stall 1975). The balance of strata within this area are composed of localized carbonate and arenite lenses exhibiting variable purity and hydrologic properties. Arenilitic strata in this area are typically fine grained and cemented (Pryor 1975). Arenilitic strata capable of storing and delivering groundwater to a well bore typically do not possess adequate reservoir volume and recharge to provide yield sufficient to meet average residential use. No major bedrock aquifers are known to be present.

4.1.4 Describe/discuss the generalized water yield, supply, existing use and potential use of the major and minor consolidated aquifers. **[1780.22(b)(1)/1784.22(b)(1)]**

ISGS Circular No. 212, reports that local Pennsylvanian sandstones are fine grained and exhibit low permeability. Most local sandstone units exhibit considerable secondary intergranular cementation which significantly impedes efficient delivery of groundwater to a well bore. Additionally, local Pennsylvanian shale, limestone, and coal strata are well known and well referenced as being generally unsuitable for development as sources of water. IWS Report of Investigation No. 55 reports that Pennsylvanian bedrock units typically exhibit transmissivity ranging from 122 to 840 gpd/ft, with hydraulic conductivity ranging from 3 to 12 gpd/ft^2. In Randolph County, wells typically obtain groundwater from the lower Pennsylvanian sandstones, but the depth to these sandstones is over 600 feet in the permit and adjacent areas.

4.2 Hydrogeologic Information.

4.2.1 Within the permit area, shadow area (if applicable), and their respective adjacent areas, assess the geologic setting, including a description of the landscape and terrain, stratigraphy, and the groundwater regime including water table depths and aquifer characteristics; using material available from sources, including, but not limited to, the Illinois State Surveys, the Illinois Environmental Protection Agency, other State and Federal organizations, water well drilling logs, and previous investigations. **[1780.21/1784.14; 1780.22(b)/1784.14(b); 1779.25/1783.25]**

REGIONAL PHYSIOGRAPHY

The surface effects area is located in Randolph County on the southwestern shelf of the Eastern Interior Coal Basin. The proposed surface effects permit area overlies the existing Permits 426, 225, 160, and 53. Prior to mining activity associated within these Permits, the area associated with Cell 5 Phase 2 was comprised of approximately 230.55 acres of rural agricultural and forested property. U.S.G.S. Open File Report 81-858, Hydrology of Area 29, reports the general area of the proposed permit as being in the Mt. Vernon Hill Country Physiographic Division, which is within the Till Plains Section of the Central Lowland Province. Landforms in the region are the result of both Illinoian Stage glaciation and recent degradation processes such as weathering, mass wasting, and stream erosion. Regional topography is characterized by generally flat ridge tops, moderately steep valley slopes and broad flat valley floors adjacent to major streams. The local surface drainage pattern is dendritic with minor influence from regional jointing patterns. The total topographic relief of the site is approximately 58.34 feet, ranging from approximately 486.1 to 544.4 feet above mean sea level (AMSL).

CLIMATE

The area has a continental climate with a mean cumulative annual precipitation of about 39 inches. Mean annual runoff is about 15 inches. Precipitation is generally greatest in the late spring and early summer. Thunderstorms provide the majority of summer precipitation. The 24-hour storm events for the area are 4.76 inches for a 10-year event, 6.02 inches for a 25-year event, and 8.21 inches for a 100-year event. The mean cumulative annual snowfall is about 14 inches. In general, the highest mean monthly stream flows in the region occur from March through May during the spring rains. The highest peak flows are typically in July resulting from thunderstorms. The mean annual air temperature is about 58°F. July is usually the warmest month (80°F) and January is usually the coldest month (36°F). Cumulative annual evapotranspiration averages about 29 inches. Prevailing winds vary seasonally, generally being from the southwest in summer and northwest in winter. The average wind speed ranges between 6 and 11 m.p.h.

GEOLOGY AND HYDROLOGY OF THE SURFICIAL UNCONSOLIDATED MATERIAL

The Handbook of Illinois Stratigraphy (Willman et al. 1975) assigns local surficial unconsolidated material to the undifferentiated member of the Pleistocene Glasford Formation. The Glasford Formation is believed to have been deposited during the Liman, Monican, and Jubileean Substages of the Illinoian glacial period and consists of till with sporadic sand and gravel lenses. Piskin and Bergstrom (1975) describe the materials as till, silt, outwash, and mixed ice-contact deposits. Recent alluvium is mappable within and immediately adjacent to local perennial and intermittent streams. Unconsolidated sand and gravel deposits suitable for storage and delivery of groundwater to a well bore are generally absent locally (Pryor 1975).

GEOLOGY AND HYDROLOGY OF LOCAL PENNSYLVANIAN BEDROCK

Consolidated Pennsylvanian bedrock of the Modesto and Carbondale Formations, consisting primarily of shale, limestone, sandstone, coal, and underclay, unconformably underlies the Quaternary unconsolidated surface material within the proposed permit area (USGS 82-858; Willman et al. 1975). The Pennsylvanian bedrock does not outcrop within the permit area and is not proposed for disturbance. The thickness and continuity of Pennsylvanian bedrock strata within the permit area vary considerably and consists of cyclic sequences of clastic and carbonate sediments indicative of near-shore marine and brackish deltaic/fluvial paleoenvironments. Sandstone lenses exhibiting sufficient intergranular porosity and permeability, and/or carbonate bodies exhibiting sufficient density of interconnected fractures to store and deliver groundwater to a well bore are known to exist sporadically and randomly in the region. However, these reservoirs are typically very limited in storage volume. Because these bodies are surrounded by low permeability strata their ability to receive recharge is minimal, typically resulting in rapid reservoir depletion when developed as water sources.

COAL REFUSE DISPOSAL CELL 5

Coal refuse disposal Cell 5 Phase 1 was constructed to facilitate the need for additional storage capacity of coarse (gob) and fine (slurry) coal refuse generated at the Gateway Mine coal preparation plant. Cell 5 was constructed west of existing Cell 4 on agricultural and wooded lands. The embankment was constructed from excavated clay soil from the interior of the impoundment and coarse coal refuse. The clay soil borrowed from the excavation pit was compacted to 95% Standard Proctor and constructed with an outside slope of 3 (run):1 (rise) and minimum 20-ft top width. The interior embankment was constructed with a 2:1 slope. Coarse refuse was placed against the inside face of the clay embankment, compacted to 95% Standard Proctor, and constructed with a 2:1 inside slope and 236 feet top width. The permeability of the site-specific compacted clay is low (arithmetic mean: 3.22×10^{-8} cm/sec) and acts as a soil liner. To ensure protection of the hydrologic balance the in-situ material beneath the embankment and impoundment interior was compacted to a depth of twelve inches and overlain by three successive lifts of twelve inches of material; all compacted to optimum density and moisture proven to achieve a permeability of no more than 1×10^{-7} cm/sec (see Part 4.10). This liner design will be augmented at final reclamation with a designed enhanced cover. The engineered cover plan will consist of twelve inches of gob (into which agricultural limestone is incorporated at a minimum rate of twice the material's potential acidity) compacted to a minimum permeability of 1×10^{-7} cm/sec, overlain by two six-inch layers of soil material compacted to a minimum permeability of 1×10^{-7} cm/sec, overlain by 27 inches of noncompacted rooting media, and topped with 9 inches of protective cover topsoil, at a minimum, which will provide the appropriate protection from infiltration. Quality control and quality assurance compaction specifications were implemented for the liner according to permit requirements. Similarly, the engineered cover will have the same quality control and quality assurance compaction specifications implemented as described in Part 4.10. This composite minimum 4 feet thick compacted clay liner prevents infiltration of water under the embankment and recharge to the underlying water table. Sandy soils encountered at the base of the cell were removed and replaced with clay soils. The completed cell height for Phase 1 will vary from 25 feet at the south end to 66 feet at the northwest corner. At its final stage of and normal pool elevation (548.2 ft AMSL) Cell 5 Phase 1 will impound 3122 acre-feet, with a surface area of 78.9 acres. Additional design details including physical properties and engineering test results of the remolded soil and refuse materials and slope stability analysis can be found in the 2011 NPN Environmental Engineers Cell 5 Slurry Impoundment Design, Gateway Preparation Plant, Mine Safety and Health Administration Permit Application.

Construction of Cell 5 Phase 2 will raise the embankment elevation from 553.2 ft AMSL to 585 ft AMSL. The south side of the embankment will extend from Cell 5, over Cell 4, and abut Cell 1. On the north side, the Phase 2 embankment will abut the Cell 3 embankment. At completion of construction to an elevation of 585 AMSL, Cell 5 will overtop the current Cell 4. At capacity, Cell 5 Phase 2 will impound 9,405 acre feet of slurry up to a pool elevation of 579.4 feet AMSL. The outer slope of the embankment will be constructed at a slope of 3.2:1 and the inner slope at a slope of 2:1, with an embankment top width of 50 feet. The Phase 2 embankment will be constructed of coarse refuse material compacted to 95% of the maximum density attainable by the Standard Proctor Compaction Method at optimum moisture content. The degree of compaction will be verified utilizing both field density testing and Standard Proctor testing.

Cell 5 is a diked impoundment and the internal drainage area consists of only the area enclosed within the cell, which is part of the overall coal refuse/makeup water circuit. External drainage will be from the embankment out slopes only and reports to lined sediment basins with permitted NPDES outfalls. The compacted clay liner at the base of the sediment basins was constructed in the same manner as the liner beneath Cell 5 and consists of in situ material compacted to a depth of twelve inches, overlain by three successive lifts of twelve inches of material. All compacted layers were compacted to optimum density and moisture proven to achieve a permeability of no more than 1×10^{-7} cm/sec (see Part 4.10). The watershed area is currently defined by the top of the dam for the Cell 5 embankments, with the eastern watershed boundary defined by the top of the Cell 4 embankment. The total watershed area is 120.6 acres at the completion of Phase 1. At completion of Phase 2, Cell 5 will encapsulate Cell 4 and will receive runoff from the reclaimed surface of Cell 3. The watershed area of cell 5 will increase to 345 acres at completion of Phase 2 (See Attachment 3.12.2.1 MSHA Application). Hydrologic inputs into Cell 5 include precipitation, runoff along the interior of the embankments, and base flow from the slurry disposal operations. Discharge will be directed to the recirculation pond at the Preparation Plant for reuse.

The Cell 5 MSHA classification for size and hazard are large and low-hazard, respectively, which has a recommended design event of 0.5 PMP. Storm duration modeling indicated that the 72-hour PMP produced the most critical conditions for total runoff, peak flood stage, and peak discharge. The 72-hour, 0.5-Probable Maximum Precipitation (PMP) event was used to evaluate peak storage capacity and drainage of the impoundment under critical conditions. Total rainfall for a 72-hour, 0.5 PMP in this region is 20.3 inches. The resulting runoff using the U.S. Army Corp of Engineers HMS program is 537.6 acre-feet. Inflow to the impoundment also includes a slurry discharge of 3450 gallons/minute (7.7 cfs) from the Preparation Plant. A normal operating level of 579.7 ft AMSL for the impoundment was determined from the stage-discharge relationship derived under various modeling scenarios. Results of the 72-hour, 0.5 PMP indicate that the flood storage capacity of the impoundment will be maintained and able to fully contain the design storm event. At the peak stage of 582.0 ft AMSL, 3.0 feet of freeboard will remain at the top of the damn, an adequate height for this area and size of impoundment. In addition, the discharge system was capable of dewatering 90% of the peak flood within a 10-day maximum, a period considered adequate for impoundments relying on flood storage capacity rather than discharge capability. Additional details concerning the modeled results and various inputs can be found in the 2020 NPN Environmental Engineers Cell 5 Phase II Slurry Impoundment, Gateway Preparation Plant, Mine Safety and Health Administration Permit Application (Attachment 3.12.2.1).

4.2.2 Within the permit area, shadow area (if applicable), and their respective adjacent areas, assess and include a general description of the hydrogeologic characteristics such as: the vertical and lateral extent of the uppermost aquifer; the hydraulic conductivities of the uppermost aquifer and all other aquifers that may be impacted by the proposed mining operation; the direction and rate* of groundwater flow; structural characteristics and distribution of underlying strata including bedrock; chemical and physical properties including, but not limited to, lithology, mineralogy, and hydraulic characteristics of underlying strata including those below the uppermost aquifer. Methods to accumulate this information may include, but are not limited to literature, borehole logs, geophysical methods, aerial photography and test pits. **[1780.21(b)/1784.14(b);1770.25/1783.25]**

**NOTE: The rate of groundwater flow may be determined via pump tests or based on an estimation using the calculated hydraulic conductivity.*

Prior to the Phase 1 construction of the refuse impoundment, thirty borings were advanced within the permit area for subsurface characterization (Attachment 4.2.2.1). The surficial unconsolidated layer ranges from 18.5 to 49.0 feet thick (mean: 27.8 feet thick), and is composed primarily of Quaternary clay and alluvium. The Quaternary clay consists of silty clay layer ranging from 4 to 15 feet thick (mean: 8.5 feet thick) underlain by a sandy clay ranging from 8 to 22 feet thick (mean: 16 feet thick). These strata generally exhibit low permeability and produce low groundwater yields. Measured conductivities for monitoring wells GWM-8, GWM-10, W3-11, W3-12, W3-13, and W3-16 ranged from 1.76×10^{-4} to 8.31×10^{-6} cm/sec (arithmetic mean: 5.95×10^{-5} cm/sec). Because of low permeability and poor recharge, yield from local surficial strata is generally insufficient to meet contemporary residential consumption requirements. Unconsolidated sandy material is reported in the southern portion of the permit area in borings B-20, B-20A, B-21, and B-22 (Map 4SF, Attachment 4.2.2.2). The horizontally and vertically discontinuous sand lenses range in thickness from 2.5 to 12.5 feet thick (median: 3.5 feet thick). Boring 13 in the central portion of the permit area also contained an interval of clayey sand with a thickness of 2.5 feet. Again, the absence of this material in surrounding borings demonstrate that this is laterally isolated. Similar to previous boring investigations (ILDNR-OMM Permit 416) in the region, all other borings drilled in the proposed permit area record no presence of sand further demonstrating that the specified bodies are limited in aerial extent and likely hydraulically isolated. Based on the limited nature of these sand bodies the applicant considers their presence to be of no consequence regarding mining activities proposed herein.

Groundwater flow direction within the unconsolidated zone near the permit area should mirror topographic drainage. There are two main drainages near this mine site, the Mary's River drainage is to the south of the mine and the Plum Creek drainage is to the west of the mine. The Gateway Mine surface facility lies on the divide between these two drainages with the proposed permit area located solely within the Plum Creek watershed. The water table onsite is shallow with the static water level generally less than 10 feet below ground surface. Groundwater flow within the proposed permit area is to the west-northwest towards Plum Creek (see Attachment 4.2.2.3).

Drillholes for underlying consolidated materials include DH-1, DH-2, DH-21, DH-CELL5, and 16892C (Attachment 4.2.2.1). As is shown in the drillholes, there are no extensive sandstone intervals within these holes, exhibiting a maximum sandstone thickness of 10 feet. This is consistent with literature of the area indicating that the Pennsylvanian bedrock typically exhibits poor aquifer potential. Field studies (Martin, et al, 1990) indicate that permeability of Pennsylvanian strata in the Illinois Basin averages about 10^{-6} cm/sec. Because of low permeability and poor recharge, yield from local bedrock aquifers is generally insufficient to meet average residential consumption requirements. In general, dissolved solids in groundwater of the Illinois Basin increase with depth and freshwater is generally found at depths of 300 feet or less (USGS 82-858; Cartwright and Hunt, 1978). The presence of public water supply providers, which source their water from surface water bodies, in the area indicates that local bedrock groundwater resources are unable to fulfill average residential demands. Drill hole boring logs and a generalized geologic column are provided in Attachment 4.2.2.1.

4.2.3 Within the permit area, shadow area (if applicable), and their respective adjacent areas, identify unusual or unpredicted geologic features, where present, including: fault zones, fracture traces, facies changes, solution channels, buried stream deposits, cross cutting structures and other geologic features that may affect the ability of the operator to monitor the groundwater or predict the impact of the facility on groundwater. **[1780.21/1784.14; 1780.22(b)/1784.14(b); 1779.25/1783.25]**

There are no unusual or unpredicted geologic features within the permit area or adjacent areas that would affect the ability to adequately monitor groundwater for potential impacts.

4.3 Area Specific Characteristics.

4.3.1 Provide a description of the areal and structural geology of the permit area, shadow area (if applicable), and their respective adjacent areas for the deeper of either the stratum immediately below the lowest coal seam to be mined, or any aquifer below the lowest coal seam to be mined which may be adversely impacted by mining. Provide logs showing the lithologic characteristics including physical properties and thickness of each stratum and the location of groundwater that could potentially be affected if encountered. Provide location and elevations of test borings or core samplings on the Hydrogeologic Map. **[1780.22(b)(1) & (b)(2)(A)/1784.22(b)(1) & (b)(2)(A)]**

Lithologic logs must be detailed enough to determine the physical characteristics of both the unconsolidated and consolidated materials present.

Provide a minimum of two geologic cross-sections, perpendicular to each other, for the proposed permit area and a minimum of two geologic cross-sections, perpendicular to each other, for the proposed shadow area, if applicable. **[1779.25/1783.25]**

At a minimum, the cross-sections should depict any water-bearing zones/formations, any local and/or regional aquifers, any impermeable zones/formations, and both the unconsolidated and consolidated formations. The core logs shall clearly identify and name the coal seams (both intended to be mined, unmined and spoiled). **[1779.25/1783/25]**

The permit application is for expansion of an existing refuse disposal facility and does not permit coal extraction within the permit area. The description of geologic characteristics is being limited to the unconsolidated and shallow consolidated materials within the permit and adjacent areas. Boreholes collected beneath the Cell 5 refuse area show that the area is dominated by fine grained sediments, primarily clay, intermixed with silty and sandy materials. The generalized composition of the unconsolidated sediments below Cell 5 consisted of an uppermost layer of silty clay underlain by a layer of sandy clay. There were isolated pockets of clayey and silty sand identified, but these were found to be limited in both thickness and lateral extent. The permeability testing completed on the soil borings had a range from 7.60×10^{-9} cm/sec to 8.10×10^{-8} cm/sec with an arithmetic mean of 3.22×10^{-8} cm/sec. Design specifications included construction of a 4 feet thick liner compacted to a maximum permeability of 10^{-7} cm/sec. Pre-construction soil boring logs are provided in Attachment 4.2.2.1. The location of the geologic cross sections of the pre-construction unconsolidated materials are provided on Map 4SF. The geologic cross sections of the unconsolidated material previously approved in permit 426 are provided in attachment 4.2.2.2.

As shown in the geologic cross sections, Cell 5 is underlain by shale. The shale surface is undulating, dipping to the southeast in the southern portion of the permit area, to the northeast in the central portion, and to the northwest in the northern portion. The shale bed is nearly flat, with a strike of N 58.02° W and a dip of 0.5° N in the center of the permit area. The shale is approximately 78 feet thick and is underlain by another 30 feet of claystone prior to encountering the Piasa Limestone at a depth of 144 feet, based on the drill log of DHCELL5. Thick shale beds make up the majority of the Modesto formation (Willman et al 1975). This shale bed acts as an aquiclude and provides further protection from the potential downward migration of seepage from the overlying compacted liner and refuse contained in Cell 5.

4.3.2 Within the permit area and its adjacent area, characterize potential pathways for contaminant migration below and around sediment ponds, disposal areas, coal storage piles and connecting ditches by identifying zones of potentially high hydraulic conductivity using correlation of stratigraphic units between borings; where applicable, information on geologic materials sorting, grain size distribution, cementation, hydraulic conductivity and the presence or absence of any confining layers shall be discussed. **[1780.21(c)(d)(e) & (f)/1784.14(c)(d) & (e)]**

Sedimentation basins 011 cell A, cell B, and 012, as well as the surface water control structures that contain runoff from the outslopes of Cell 5, were constructed with a compacted clay liner. The clay liner was constructed in four separate lifts of compacted clay, each 1 foot thick. Based on the soil borings underlying Cell 5 and the drillholes of the surrounding area, there are no known zones of high hydraulic conductivity in the permit or adjacent areas. The unconsolidated material is dominated by clay material and the underlying bedrock consists of a thick bed of shale, both of which exhibit low hydraulic conductivity and will prevent migration of groundwater offsite.

4.3.3 Provide chemical analyses of all strata, including the coal seam(s) (both intended to be mined, undisturbed or spoiled) through either the strata immediately below the lowest coal seam to be mined or any aquifer below the lowest coal seam to be mined which may be adversely impacted by mining. The analyses shall identify those strata that may contain acid or toxic-forming or alkalinity-producing materials and determine their content and the net-neutralization potential on a weighted basis. **[1780.22(b)(2)(B) & (c)/1784.22(b)(2)(B) & (c)]**

For carbon recovery operations, total sulfur and pyritic sulfur analyses must be performed on the materials to be recovered.

For waste disposal operations, chemical analysis of the fine and coarse refuse waste streams shall be provided, including the identification of acid or toxic-forming or alkalinity-producing materials and determine the content and the net-neutralization potential on a weighted basis.

This permit application is for construction and operation of a coal refuse disposal structure and does not include mining of coal within the proposed permit area. The impoundment will receive refuse from the Gateway preparation facility. The net neutralization analytical results for overburden core GWN-04E, drilled for the Gateway North Mine (Permit 416), are provided in Attachment 4.3.3.1 and the boring log can be found in Attachment 4.2.2.1. The core penetrates the interval from the ground surface to below the coal seam for extraction (Coal-6). The total sulfur, pyritic sulfur, acid generating potential and neutralization potential is provided in Table 4.3.3.1 below for the Coal-6 as well as the roof and floor material. Of those three units, only the coal seam was identified as potentially toxic (<-5.0 TKT/$CaCO_3$).

TABLE 4.3.3.1: CHEMICAL ANALYSIS OF COAL AND SURROUNDING STRATUM

GWN-04E						
Description	Top Depth (ft)	Bot. Depth (ft)	Thick. (ft)	Tons CaCO3 Equiv. Per 1000 tons Material		
				NNP = NP - AP		
				Potential Acidity (AP)	Neutralization Potential (NP)	Net Neutralization Potential (NNP)
shale	289.8	292.5	2.7	35.31	481.34	446.03

Coal-6	292.5	299.3	6.8	15	15.47	0.47
underclay	299.3	300.9	1.6	63.44	99.19	35.75

The refuse disposal operation consists of fine refuse disposal within a compacted outer berm. The chemical analyses of the fine refuse and coarse refuse are provided in Table 4.3.3.2 below and the laboratory results are included in Attachment 4.3.3.2. The fine refuse shows a slightly negative net neutralization potential. The coarse refuse has higher potential acidity and lower neutralization. However, the construction of the outer embankment includes compaction of the material in accordance with permit requirements, which prevents infiltration and subsequent leaching following precipitation events.

TABLE 4.3.3.2: CHEMICAL ANALYSIS OF REFUSE

Description	Paste pH	Total Sulfur %	Total Pyrite %	Tons CaCO3 Equiv. Per 1000 tons Material		
				NNP = NP - AP		
				AP	NP	NNP
Fine Refuse	7.8	2.44	1.23	38.44	32.81	-5.63
Coarse Refuse GP1	2.2		2.04	63.75	-10.74	-74.49
Coarse Refuse GP2	6.1		6.70	209.38	17.62	-191.70
Coarse Refuse GP3	6.4		5.60	175.00	30.92	-144.00
Coarse Refuse GP4	2.5		2.34	73.13	-13.67	-26.80
Coarse Refuse GP5	2.0		1.92	60.00	-29.51	-89.51
Coarse Refuse GP6	7.0		4.46	139.38	34.51	-104.80
Coarse Refuse GP7	6.7		4.67	145.94	25.66	-120.20
Coarse Refuse GP8	6.5		5.09	159.06	56.65	-102.40
Coarse Refuse GP9	6.6		4.55	142.19	23.56	-118.60

4.3.4 Provide coal seam(s) name and number and an analysis of the coal seam(s) as to total sulfur and pyritic sulfur. Show all coal crop lines (where applicable) and the strike and dip of the coal to be mined on the Hydrogeologic Map. **[1780.22(b)(2)/1784.22(b)(2) & (b)(3); 1779.25(a)(3) & (a)(4)/1783.25(a)(3) & (a)(4)]**

This permit application is for construction and operation of a coal refuse disposal structure and does not include mining of coal within the proposed permit area. Therefore, the coal seam crop lines and strike / dip are not shown on Map 4SF. The coal seam chemical analysis is provided in Table 4.3.4 below and the laboratory report is provided in Attachment 4.3.3.1.

TABLE 4.3.4: CHEMICAL ANALYSIS OF COAL SEAM SULFUR CONTENT

Description	Top Depth (ft)	Bot. Depth(ft)	Paste pH	Total Sulfur %	Total Pyrite %
Coal-6	292.5	299.3	7.0	2.89	0.48

4.3.5 Identify the general land uses of the watersheds upstream of the proposed permit area and any potential pollution sources which could significantly affect the surface and groundwater quality at the proposed permit area. If none exist, note here. **[1780.21(i)(1)/1784.14(h)(1)]**

The permit area is at the headwaters of the Plum Creek watershed. There is no upgradient drainage that will impact surface water quality within the permit boundary. The groundwater potentiometric surface indicates that groundwater flow is to the west-northwest towards the Plum Creek drainage.

The land use upgradient of the refuse cells is predominantly agricultural. The use of agricultural fertilizers and pesticides is a potential pollutant source for shallow groundwater. The primary components of fertilizer are nitrogen, phosphorus, and potassium. However, there are several other secondary components of fertilizer that may manifest in surface water or groundwater. For example, potassium is typically applied as potash, which is composed of potassium sulfate, potassium chloride, or potassium nitrate. These secondary components of sulfate, chloride, and nitrate would also become mobilized upon dissolution of the potash material.

There is also a paved road that bounds the northern, western, and southern boundaries of Cell 5. The use of deicing agents on paved roads during winter months can potentially affect shallow groundwater quality. Deicing agents typically consist of salts that are highly mobile in surface water and groundwater. Effects of road salt usage would be observed by an increase in chloride concentrations, which is a key component in typical road salt, as well as an associated cation (typically sodium).

Lastly, the Spartan Mine refuse disposal area lies immediately to the south of Cell 5. This is another potential source of pollutants for the shallow groundwater in this area. Evidence of pollution from the Spartan Mine refuse area would primarily be in the form of increased sulfate, chloride, and resultant TDS concentrations. There are no other potential pollutant sources identified in the vicinity of Cell 5 at this time.

4.3.6 Do surface or groundwater discharges into underground mines exist? **[1780.21(b)/1784.14(b)]**

☐ YES ☒ NO

If YES, locate on the Public Water Supply Map and discuss here.

4.3.7 Do Public Water Supply intakes for current users of surface water flowing into, out of, and/or within ten miles of the proposed permit area exist? **[1779.24(g)/1783.24(g); 1780.21/1784.14]**

NOTE: Public Water Supply intakes include groundwater wells.

☒ YES ☐ NO

If YES, complete Table 4.3.7; locate on the Public Water Supply Map; discuss the possible effects that the mining operation will have on the public water supplies and explain what precautions will be taken to prevent an adverse impact from occurring. **[1780.21(h)/1784.14(h)]**.

See Table 4.3.7 for a listing of public water supply intakes within ten miles of the proposed permit area. Runoff from the proposed operations area, which will include the out-slope embankments only, will be routed through NPDES basins and will be subject to permit limitations. Process water from inside the embankments will be routed through the preparation plant which is a closed circuit and discharge of the water will be minimized to the extent practicable. The out-slope embankments will be vegetated to reduce sheet flow runoff and suspended solids. The effluent testing requirements for the NPDES permit are more stringent than the federal limits for coal mining and should be sufficient to address potential problems and reduce the likelihood of adverse impact to public water resources. The installation and maintenance of surface and groundwater monitoring points will provide sufficient information that will alert the applicant to potential adverse impact in a timely manner. Construction of sediment control structures that are required to meet NPDES quality limits will reduce potential for offsite adverse impacts. Surface runoff from the affected areas will be routed through sediment basins with a minimum 10-hour detention time.

PROTECTIVE MEASURES TO ADDRESS ACTIVITIES IN THE SURFACE EFFECTS AREA

Measures to be taken to assure the protection of the quality of surface and groundwater systems from potential surface effects of the activities proposed within this application include:

1. Where warranted, construction of professionally designed sediment control structures, including sediment basins, overland flow diversion ditches, temporary terracing, straw dikes or rip-rap filters to control flow and routing of surface water originating from the surface effects area.

2. Chemical treatment where necessary, of water leaving sediment basins and entering state waters. This water will meet all the applicable performance standards.

3. Through final bond release, periodic monitoring of water exiting the surface effects area.

4. A compacted clay liner ($1x10^{-7}$ cm/s permeability) was constructed beneath the refuse cell embankment and interior, beneath the sediment basins, and constructed drainage ditches receiving refuse contact water. Existing clay subsoil was suitable for use as liner material and was compacted to 95% standard Proctor dry density (See Permit 426 Attachment IV.6.MSHA Appendix B). The original Construction specifications and quality assurance procedures are also included in the previous MSHA application.

No adverse effects associated with the mining operation were identified in the preceding sections on either surface water or groundwater quantity and quality. All of the measures detailed above will also act to safeguard the surface water and groundwater systems. It is concluded that the site will have a negligible impact on the adjacent surface water and groundwater systems.

4.4 Groundwater Information.

4.4.1 On the Hydrogeologic Map, provide the location and ownership of existing wells, including private water supplies and private water wells within ½ mile of the proposed permit area and shadow area (for mines with underground extraction), springs, and other groundwater resources in or within ½ mile of the proposed permit area, shadow area (if applicable), and their respective adjacent areas. If any of the existing wells are to be employed for monitoring, designate on Hydrogeologic Map and complete Table 4.4.2. **[1780.21(b)(1)/1784.14(b)(1); 1780.21(h)/1784.14(g)]**

4.4.1.1 Provide results of a Groundwater User's Survey which includes, well identification, location relative to permit, shadow and/or adjacent areas, construction details, water bearing strata well is screened in, total depth, usage and public water availability in Table 4.4.1.

The groundwater users survey was completed for Permits 426, 225, 160, and 53. Since this application does not expand these permit areas, the previously completed surveys are still valid. The results of the most recent survey (Permit 426) are summarized in Table 4.4.1.

4.4.1.2 Provide a discussion of the Groundwater User's Survey, discussing the existing and potential use of the water-bearing strata identified in 4.4.1.1 above. This information and the information required by Part 4.4.1.1 above shall be cross-referenced with the information depicted on the map required in Part 4.4.1 above.

The applicant submitted a groundwater user's survey to all land owners identified as owning property within ½ mile of Permits 426, 225, 160, and 53. The most recent Groundwater Users Survey identified a single residence utilizing groundwater within ½ mile of the permit boundary (Table 4.4.1). Three wells (GW100, GW101, and GW103), all screened within the unconsolidated material, are known to be present on property tract 1091 from previous interactions with the resident, however only one well (GW100) was reported as being on the property and in use by the resident on the groundwater survey (Map 4). The well is used for potable water supply and the applicant was not given permission to sample it. No springs were identified within ½ mile of the permit boundary. Additional information about the presence or lack thereof, of residential wells within ½ mile of the permit boundary is provided in Table 4.4.1. No commercial or municipal groundwater resources are present within the vicinity of the permit. The local municipal water supply districts all obtain water from surface sources (see Part 4.3.7).

The applicant also researched the "Illinois Geological Survey's Water and Related Wells in Illinois" website for wells within and adjacent to the proposed permit area. Three wells were identified as being present within ½ mile of the permit area on the "Illinois Geological Survey's Water and Related Wells in Illinois" website. All three of the wells were identified as being located on applicant-controlled property. One was identified as being present beneath the levee of one of the existing Gateway Refuse impoundments and the other two were identified as being associated with former residences that have since been vacated and knocked down. Therefore, none of the ILGS wells are displayed on Map 4. Additional information for the ILGS wells, including the property tracts the wells were identified on, the well ID's and their total depths, is included in Table 4.4.1 Water User's Survey.

4.4.1.3 Provide a discussion for any groundwater users downgradient, as determined through groundwater elevation, of the proposed permit area that details factors and protective measures in place to ensure these groundwater resources are not adversely impacted.

The domestic well that was reported to be in use (GW100) is located 500 feet to the northeast of the Permit 426 boundary. Groundwater monitoring well W3-11 is located approximately 800 feet to the southwest of GW100, well GWM-8R is located approximately 380 feet to the south, and well W3-07, which is associated with Permit 225, is located approximately 1020 feet to the north-northeast. These wells will be monitored according to the groundwater monitoring plan detailed in Part 4.5. The groundwater monitoring schedule and parameter list is sufficient to identify any potential impacts to groundwater quality prior to the impacted water migrating offsite and reaching the well GW100.

Numerous measures have been taken to ensure that Cell 5 and associated surface water control structures were constructed to ensure that the potential for environmental impacts has been minimized. The compacted liner and cap for these features prevents downward migration of pollutants to the shallow groundwater. The unconsolidated material is also low permeability minimizing the potential for advective transport of pollutants in the groundwater.

4.4.2 Provide a description of seasonal groundwater quality, including the following constituents (at a minimum), for each source of groundwater in the identified areas:

For Surface Mining: Within the permit area and its adjacent area: pH, total dissolved solids, hardness, alkalinity, acidity, sulfate, total and dissolved iron, total and dissolved manganese, and chloride. Please provide in Table 4.4.2. **[1780.21(b)(1)A)]**

For Underground Mining: Within the permit area and its adjacent area: pH, total dissolved solids, hardness, alkalinity, acidity, sulfate, total and dissolved iron, total and dissolved manganese, and chloride. Please provide in Table 4.4.2. [**1784.14(b)(1)(A)(i)]**

For an underground mine, within the shadow area (if applicable) and its adjacent area: pH, total dissolved solids, total iron, and total manganese. [**1784.14(b)(1)(A)(ii)]**

Groundwater quality in shallow unconsolidated aquifers often displays seasonal fluctuations in the concentration of dissolved ions. Dissolved ions result from the dissolution of minerals contained in the unconsolidated sediments. The resulting concentration is dependent on a number of factors, including pH, oxidation reduction potential, and groundwater temperature. The concentration can also be highly influenced by the recharge rate of the aquifer, which has a relatively consistent pattern in this region. Greater precipitation in the late winter and spring months leads to higher recharge and infiltration rates and increases in groundwater velocity. This provides dilution to shallow groundwater aquifers and decreases the overall residence time of the aquifer, both of which result in lower concentrations of dissolved species. During the summer and fall months, the evapotranspiration rate exceeds the precipitation, resulting in a net loss of water contained in the vadose zone and leading to an increase in dissolved ion concentration in shallow groundwater.

Water level elevations in the unconsolidated wells peak annually in the first and second quarter and decline across third and fourth quarters, which is consistent with the regional precipitation patterns. The concentration of dissolved ions are expected to be inversely proportional to this seasonal water level trend, with decreased concentrations in the spring and increased concentrations during the fall. However, these predictable patterns in groundwater elevation and dissolved ion concentration ignore the complex geochemistry of groundwater systems. Seasonal groundwater quality results are provided in Table 4.4.2. The unconsolidated wells at this facility do not exhibit consistent seasonality in dissolved ion concentrations. For example, the historical record of total dissolved solids at Well W3-11 typically shows annual maximum in January and February, annual maximums at Well W3-12 are observed in June, July, and August, and Well W3-13 does not show clearly defined annual fluctuations.

Groundwater quality statistics are provided in Attachment 4.4.2.1, which shows the overall range in concentration as well as the long-term averages. The monitoring wells associated with Cell 5 have a neutral to slightly alkaline pH and alkalinity concentrations that greatly exceed the potential acidity. Total dissolved solids concentrations in actively monitored wells range from 156 mg/L to 1,310 mg/L and the elevated hardness concentrations are indicative of waters high in dissolved calcium and magnesium. Metals concentrations are consistently low, with dissolved iron and manganese concentrations averaging below 1 mg/L. Total concentrations are somewhat elevated, although this is likely a result of suspended sediments contained in the water sample. Wells screened in glacial unconsolidated material are often susceptible to transport of clay and silt

through the well screen during purging. Seasonal concentrations within the unconsolidated wells associated with Cell 5 are typical of shallow groundwater in this region.

Nearby residential well water quality was compiled for a groundwater quality investigation requested by Illinois Environmental protection Agency. The wells showed numerous exceedances of the Class I and Class II groundwater standards in background and pre-mining data. In particular, total dissolved solids concentrations ranged up to 3,271 mg/L and sulfate concentrations reached 1,510 mg/L. Iron and manganese concentrations also exceeded standards showing concentrations up to 23.60 mg/L and 3.14 mg/L, respectively. Lastly, pH was below the allowable minimum level at one well with a reading of 6.11 standard units. Results from these residential wells are shown in Attachment 4.4.2.2.

4.4.3 Provide a description of seasonal groundwater quantity in the proposed permit, shadow and adjacent areas, including, at a minimum:

4.4.3.1 the appropriate rates of discharge or usage;

4.4.3.2 the elevation of the potentiometric surface of the coal to be mined;

4.4.3.3 the elevation of the potentiometric surface in each water-bearing stratum above the coal to be mined AND in each water-bearing stratum below the coal to be mined which may be potentially impacted. At a minimum, a potentiometric map must be provided for the uppermost aquifer, and any aquifer which may be potentially impacted by the proposed operation(s).

A general description may be given for water bearing strata with no collected data. If no known water-bearing strata that could be impacted, exist above or below the coal seam to be mined or if the coal seam is not water-bearing, state as such. **[1780.21(b)(1)(B)/1784.14(b)(1)(B)]**

As previously discussed, the yield of bedrock and unconsolidated materials in this area are minimal. The high clay content of the unconsolidated material typically prevents its use as a residential water supply. The unconsolidated aquifer in this area does not meet the Class I potable resource groundwater criteria, which is defined as groundwater 10 feet or more below the surface and within 1) the minimum setback zone of a well serving as a potable water supply, 2) unconsolidated sand or gravel 5 feet or more in thickness, 3) sandstone which is 10 feet or more in thickness or fractured carbonate with is 15 feet or more in thickness, or 4) any geologic material with sustained groundwater yield of 150 gallons per day (from a 12-inch borehole) or with a hydraulic conductivity of 10^{-4} cm/sec. With regard to requirement 1, Part 4.4.2 shows that there are existing residential wells that indicate the unconsolidated aquifer in this region often exceeds Class I standards and is unsuitable for a potable water supply. With regard to requirement 2, the soil borings that were collected prior to Cell 5 Phase 1 construction showed the unconsolidated material is primarily clay, with only one boring (B-20) with a sand lens greater than 5 feet thick identified within the permit area. Surrounding borings, including B-20A which was drilled immediately west indicate that the sand was laterally and vertically isolated. With regard to requirement 3, well logs within this area indicate the underlying bedrock is primarily low permeability shales and cemented sandstone, with only minor intervals of limestone, resulting in insufficient well yield for residential purposes. There are no known underlying bedrock strata that meet the Class I standards. As a result, the majority of residents rely upon the local municipal water supply. Lastly, with regard to requirement 4, Part 4.5.4 shows that the average

hydraulic conductivity of the shallow wells onsite is 5.95×10^{-5} cm/s and is not sufficiently permeable for the Class I criteria.

The groundwater table within the unconsolidated material is typically very shallow, ranging from 2 - 6 feet below the surface at these well locations. The wells surrounding the surface effects area demonstrate a seasonal fluctuation, with a higher water table during winter months and lower water table during the summer months. This is a typical of shallow groundwater in this area, reflecting the higher precipitation during winter months and higher evaporation during summer months. Water level elevation statistics for the water year were compiled and are presented in Attachment 4.4.3.3.1. The majority of wells show approximately 2-3 feet of seasonal fluctuation. Over the previous ten years, well W3-12 has shows the highest seasonal fluctuations, averaging 4.87 feet each year, while well W3-15 shows the lowest seasonal fluctuations, averaging 2.10 feet each year. In the 2020 water year, Well W3-08R had the highest seasonal fluctuation of 4.3 feet. The magnitude of annual fluctuations is influenced by many factors, including the permeability of the shallow unconsolidated materials, the seasonal climatic patterns, and depth to the static water level. The shallow groundwater table in this area makes it more likely that the seasonal climate will have a greater influence on the water table. Water contained with the vadose zone and shallow saturated zone will respond to prolonged periods of net evapotranspiration through a loss of soil moisture and a lowering in the water table. Additionally, the relatively thin unsaturated zone allows percolation from individual precipitation events to reach the water table and raise the water table elevation.

Baseline studies for Permit 426 indicated that the water level elevation ranged from 501.8 to 523.21 feet AMSL and the groundwater flow direction was primarily to the west-northwest towards Plum Creek. The 2020 water year showed a maximum water level of 531 feet MSL at well W3-16, located at the northeastern corner of the facility, and a minimum water level of 488 feet MSL at well W3-11, located in the northwest corner of the property. The 2020 water year water levels are still consistent with the baseline groundwater flow direction (See Attachment 4.4.3.3.2 Potentiometric Surface Map).

4.5 Groundwater Monitoring Program. [1780.21(i)/1784.14(h)]

4.5.1. Describe in detail a proposed monitoring plan based upon the PHC that will measure the amount and duration of any changes to the groundwater system resulting from the mining operation.

The proposed groundwater monitoring plan shall describe how the collected groundwater monitoring data will be used to determine if impacts are occurring and what steps will be taken by the operator.

Provide a Sampling and Analysis Plan (SAP) that includes the methods/steps of well sampling, well analysis and data reporting as an attachment to this application part.

Parameters to be monitored are given in Table 4.5.1 Monitoring shall be on a quarterly basis **unless otherwise approved by the Department**, with reports due within one month of the end of each quarter as follows:

Scheduled Period	From – To	Report Due
1st Quarter	Jan. 1 – Mar. 31	May 1
2nd Quarter	Apr. 1 – Jun. 30	Aug 1
3rd Quarter	Jul. 1 – Sept. 30	Nov 1
4th Quarter	Oct. 1 – Dec. 31	Feb 1

Where approved, annual monitoring shall be conducted during the 2nd quarter only; semi-annual monitoring shall occur during the 2nd and 4th quarters only.

NOTE: At a minimum, background data collection shall occur on a bi-monthly (every two months) basis over the course of one year (12 consecutive months). Groundwater monitoring shall continue throughout the permitting process at the same frequency at which background data collection occurred.

Monitoring wells W3-08R, W3-11, W3-12, W3-13, W3-14, W3-15, and W3-16, were installed through the base of the unconsolidated layer into the upper weathered bedrock interval. Most of these wells are located along the immediate boundaries of Permit 426: well W3-13 south-east, W3-15 south-west, W3-12 west-central, W3-14 north-west, W3-11 north-east. Additionally, well W3-08R is located 370 east of the northeastern corner of Permit 426 and well W3-16 is located at the northeastern corner of Cell 3, Permit 225, approximately 4,200 feet from Permit 426. Supplemental baseline groundwater data was also collected at monitoring wells GWM-8/W3-08 and GWM-10/W3-10, which were associated with Gateway Mine Permit 225. Both GWM-8/W3-08 and GWM-10/W3-10 were plugged and abandoned to enable construction of the embankment of Cell 5.

The established monitoring network allows for the observation of any changes to the groundwater quality and quantity along the three exposed sides of the impoundment. The groundwater monitoring network was designed to intercept any potential water migrating from the permit boundary and allow for the observation of any changes to the groundwater quantity and quality.

Baseline groundwater quality samples were collected at monitoring wells W3-08R, W3-11, W3-12, W3-13, W3-14, W3-15, and W3-16. Supplemental groundwater quality data from monitoring wells GWM-8/W3-08 and GWM-10/W3-10, which were originally associated with Gateway Mine Permit 225, has also been provided. Existing monitoring wells locations are shown on Map 4SF. All existing monitoring wells (W3-08R, W3-11, W3-12, W3-13, W3-14, W3-15, W3-16) are screened across the unconsolidated material and upper weathered bedrock. Well construction details are provided in Table 4.5.2 and Attachment 4.2.2.1. Sample parameters collected during the baseline period included static water elevation, pH, Acidity, Alkalinity, Iron (total), Iron (dissolved), Manganese (total), Manganese (dissolved), Total Dissolved Solids, Hardness, Chloride, Sulfates, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Cyanide, Fluoride, Lead, Mercury, Molybdenum, Phenols, Nickel, Selenium, Silver, Thallium, Vanadium and Zinc (See Table 4.5.1). The aforementioned monitoring wells will continue to be monitored quarterly for the same parameters during mining.

Groundwater samples will be collected by experienced personnel using standard industry practices. Sampling procedures will include taking a water level measurement prior to sampling, lowering a submersible pump or bailer into the well and then purging the well prior to sampling to ensure the sample collected is representative of the groundwater present in the water bearing strata. The samples will be collected into polyethylene containers, preservatives added as necessary, and placed into a cooler for transportation. Samples are either dropped off at the lab, shipped to the lab, or are picked up at Peabody's office by the lab, and are processed and analyzed by methods approved and listed in 40 CFR Part 136. Additional detail regarding the groundwater Sampling and Analysis Plan (SAP) is provided in Attachment 4.5.1.

4.5.2 Provide a comprehensive list of ALL existing, proposed and plugged/destroyed/damaged groundwater monitoring wells for the entire facility. Complete Table 4.5.2. **[1816.41(c)/1817.41(c)]**

Monitoring wells associated with the SAP are listed in Table 4.5.2.

4.5.3 Provide a detailed geologic boring log, well construction diagram and completion information for all existing groundwater monitoring wells and/or a diagram of each proposed well. All wells shall be surveyed (top of casing, ground elevation and location), shall have unique nomenclature and be clearly identified on the Hydrogeologic Map as existing, proposed, abandoned, etc. **[1780.22(c)/1784.22(c)]**

NOTE: The Department has created a well construction diagram *for use. See* Operator Memorandum 2017-01.

When wells are no longer needed, the applicant shall request to properly plug and abandon the well. Upon receiving approval to drop the well from the Mine's groundwater monitoring program, the well shall be sealed and the Department's plugging affidavit shall be provided within sixty (60) of the date of approval.

NOTE: See Operator Memorandum 2015-02.

See Attachment 4.2.2.1 for the well construction diagram and geologic boring logs of wells GWM-8, GWM-10, W3-08R, W3-11, W3-12, W3-13, W3-14, W3-15, and W3-16.

4.5.4 Provide the groundwater flow direction based upon the site-specific groundwater monitoring wells installed for this application. Hydraulic conductivity data shall be provided in its entirety, for each well. The field methodology of the aquifer testing shall be clearly explained (e.g., rising head vs. falling head slug testing; pump testing or constant-head testing). The results of the aquifer testing shall be included in this section and shall be discussed/explained, including any discrepant information. Groundwater flow direction may also be shown on the Potentiometric Map required in Part 4.4.3 above. **[1780.21(b)(1)(B)/1784.14(b)(1)(B)]**

Slug tests are a method for determining hydraulic conductivity of the aquifer material in the immediate vicinity of the well bore. The test involves adding or removing a known volume of water to a well bore and measuring the aquifer response, typically with a piezometer. Slug tests were conducted on the wells installed around the perimeter of Cell 5 and results are shown in Table 4.5.4 below. The slug tests were conducted under both "rising head" and "falling head" conditions. In a rising head test, a known volume of water is evacuated from the well and the recovery or rising of the water table is measured. In a falling head test, a known volume is added to (or displaced from) the well and the lowering or falling of the water table is measured. The tests were analyzed using the Bouwer Rice Slug-Test Method, which was developed for application to unconfined aquifers. The hydraulic head is plotted on a semilogarithmic axis as a function of time. The hydraulic conductivity is determined by fitting a straight line to the early-time data. Details of the slug test results are provided in Attachment 4.5.4.

TABLE 4.5.4: MONITORING WELL SLUG TEST RESULTS

Well	Slug Test Type	Solution Method	Hydraulic Conductivity (cm/s)
GWM-8	Rising	Bouwer-Rice	1.76×10^{-4}
GWM-10	Rising	Bouwer-Rice	2.17×10^{-5}
W3-11	Rising	Bouwer-Rice	1.72×10^{-5}
W3-12	Rising	Bouwer-Rice	8.31×10^{-6}
W3-13	Rising	Bouwer-Rice	3.49×10^{-5}
W3-16	Falling	Bouwer-Rice	9.97×10^{-5}

	Rising	Bouwer-Rice	9.80×10^{-5}
	Average	--	9.89×10^{-5}
Overall Average			5.95×10^{-5}

4.5.5 Discuss any reported problems of maintenance with groundwater quantity and quality which have occurred at the private wells and springs identified in 4.4.1 above or in the installed groundwater monitoring wells noted in 4.5 above. **[1780.21(h)/1784.14(g)]**

The protective casing on monitoring Well W3-12 was hit by a tractor sometime during the second quarter of 2013. Minor damage occurred to the protective casing and PVC stickup. Once fixed the wells top of casing was resurveyed in early June. Table 4.5.2 notes both the surveyed TOC elevation before and after the well was damaged.

4.5.6 Will this operation have any discharges to, or pump water from, abandoned underground mines?

☐ YES ☒ NO

If YES, submit a detailed discussion of the quality and quantity of the extracted water and a detailed plan to discharge water into the abandoned mine workings. **[1816.41(i)/1817/41(h)]**

4.6 Surface Water Information.

4.6.1 Provide the name, location, ownership, and description of all surface water bodies, lakes, streams, impoundments, and springs within and adjacent to the proposed permit area(s). The adjacent area shall be one-half mile from the proposed permit area. Provide the location of any discharge or drainage into any surface water bodies listed above on the Hydrogeologic Map. Complete Table 4.6.1. **[1780.21(b)(2)/1784.14(b)(2); 1779.24(g)/1783.24(g); 1779.25(a)(7)/1783.25(a)(7)]**

The locations of all known surface water bodies are depicted on Map 4SF. The proposed permit area is located in the headwaters of Plum Creek watershed and is drained by two unnamed tributaries to Plum Creek. Runoff from the northern half of the permit is conveyed to Plum Creek via an unnamed tributary, herein designated as the "North Tributary", that converges with Plum Creek approximately 0.4 miles northwest of the permit area. Runoff from the outslopes of Cell 5 in the northern portion of Cell 5 will report to NPDES outfall 012, which discharges to the North Tributary. Drainage from the southern half of the permit area reports to Plum Creek via a second unnamed tributary, herein designated as the "South Tributary", that converges with Plum Creek further downstream, approximately 0.9 miles northwest of the permit boundary. Runoff from the Cell 5 outslopes in the southern portion of the permit area are routed through NPDES outfall 011 to the South Tributary. Plum Creek flows to the west-southwest where it eventually joins the Kaskaskia River approximately 15 miles west of the permit boundary.

A total of 9 surface impoundments were identified within and adjacent to the proposed permit area (see Table 4.6.1 and Map 4SF). No springs were identified as being present within or adjacent to the permit area in the water user's survey or during the Wetland and Stream delineation (Attachment 4.6.1).

4.6.2 Provide for surface water bodies identified in 4.6.1. above, information on surface water quality and quantity sufficient to demonstrate seasonal variation and water usage. Surface water bodies that may be impacted by the proposed mining operation shall be clearly identified in the narrative and on the Hydrogeologic Map. Complete Table 4.6.2. **[1780.21(b)(2)/1784.14(b)(2)]**

RECEIVING STREAM HYDROLOGY SUMMARY

The highest mean monthly stream flow in southern Illinois occurs from March through May, in response to spring rains. The highest peak flow occurs in July in response to thunderstorms. The proposed permit falls within the headwaters of Plum Creek watershed and is drained by two unnamed tributaries to Plum Creek. The North Tributary subwatershed is approximately 175.7 acres at surface water sampling location 16SW-11. The South Tributary subwatershed is approximately 213.3 acres at surface water sampling location 16SW-12. At the confluence of the South Tributary with Plum Creek, located approximately one mile downstream, the total watershed areas increase significantly to 1043.9 acres for Plum Creek and 338.8 acres for the South Tributary. These streams currently receive runoff from the outslopes of Cell 3 and Cell 5. The outslopes makeup only 12.0% of the South Tributary watershed and 5.8% of the North Tributary watershed. At final reclamation, following capping and crowning of the refuse disposal area, this will increase to 14.7% of the North Tributary and 25.9% of the South Tributary. The Plum Creek watershed, HUC 0714020407, totals 89.7 square miles. The refuse disposal area makes up 0.2% of the Plum Creek watershed at the initiation of the proposed operations and will increase to 0.5% at final reclamation.

Table 4.6.2.1 below summarizes the receiving stream hydrology characteristics at the initiation of the proposed operation. Estimates of 7-day, 10-year low flow (7Q10) for the receiving streams suggest flow is poorly sustained in the unnamed tributaries to Plum Creek, a result characteristic of streams with small drainage areas located in stream headwaters. Stream assessments conducted on the tributaries within the amendment area indicate that flow is generally intermittent in the North Tributary and ephemeral in the South Tributary (see Attachment 4.6.1). This is in agreement with the low discharge (0.0 – 1.0 ft^3/sec) observed at the applicant stream monitoring sites (Table 4.6.2.2 and Table 4.6.3). The poorly sustained flow is attributed to the minimal presence of surficial aquifers and the low yields of water bearing sediments in the physiographic region.

TABLE 4.6.2.1: STREAM WATERSHED & HYDROLOGIC CHARACTERISTICS

Receiving Stream	Hydrologic Characteristics								
	Watershed Area* (ac.)	Headwater Elev. (ft.)	Outlet Elev. (ft.)	Fall (ft.)	Length (mi.)	Gradient (ft./mi.)	Q_a*** (CFS)	$7Q_{10}$*** (CFS)	Flow Class
Plum Creek	57536	543	359	184	33	5.58	72.8	0.018	Perennial
Unnamed Trib. to Plum Creek	175.7	482	521	39	0.83	33.9	0.5	0.00	Intermittent****
Unnamed Trib. to Plum Creek	213.3	471	543	72	1.35	53.3	0.5	0.00	Ephemeral****

CFS : cubic feet per second
* : Watershed measured from point of confluence with receiving stream (USGS StreamStats)
** : Percent of current permit acreage within the receiving stream watershed
*** : 7Q10 calculated from Fitzgerald et al., 1983 (USGS 82-858)
**** : Flow class determined by Wetland Services utilizing Rosgen's Stream Classification System for stream segments within the permit area. See Attachment 4.6.1

TABLE 4.6.2.2: RECEIVING STREAM FLOW DATA

Stream Name	Monitoring Site	Min. Flow (cfs)	Max. Flow (cfs)
North Tributary to Plum Creek *(west permit boundary)*	16SW-6	0.0	1.0
North Tributary to Plum Creek *(downstream of permit boundary)*	16SW-11	0.0	0.5
South Tributary to Plum Creek *(west permit boundary)*	16SW-8	0.0	0.70
South Tributary to Plum Creek *(west permit boundary)*	21SW-9	0.0	0.4
South Tributary to Plum Creek *(west permit boundary)*Creek	21SW-10	0.0	0.4
South Tributary to Plum Creek *(downstream of permit boundary)*	16SW-12	0.0	0.9

RECEIVING STREAM WATER QUALITY SUMMARY

The surface water features within the permit and adjacent area are within the Kaskaskia watershed, which has surface water quality that can be highly variable. Surface water quality within this watershed is significantly influenced by natural processes such as seasonal climate patterns, including the magnitude, duration, and frequency of precipitation, seasonal growth and decomposition of vegetation and algae, freeze / thaw cycles, antecedent soil moisture, dissolution of minerals within soils and bedrock, groundwater quality and baseflow contributions, and many others. There are also many anthropogenic influences within the Kaskaskia River watershed that contribute to water quality including agriculture, urban runoff, wastewater treatment plants, and industries such as oil and gas production and coal mining. USGS tabulated water quality from a number of sites, including sites both upstream and downstream of mining and oil and gas facilities as well as sites within the mainstem of the Kaskaskia River (Fitzgerald et al 1983). Regional water quality ranges for several major ions are shown in Table 4.6.2.3, demonstrating the wide range of water quality that can be found within the Kaskaskia River Watershed.

TABLE 4.6.2.3: REGIONAL SURFACE WATER QUALITY

Parameter	Minimum	Maximum	Mean
pH	6.2	9.1	7.66
TSS (mg/L)	7.00	1,490	--
TDS (mg/L)	37.7	5664	431
Alkalinity (mg/L)	0.00	410	145
Acidity (mg/L)	0.00	-7	--
Sulfates (mg/L)	12.00	3,500	221
Total Iron (mg/L)	0.00	54	2.5
Total Manganese (mg/L)	0.01	6.4	0.49
Chloride (mg/L)	--	--	--
Mean Discharge (ft^3/sec)[1]	6.05	3,689	696

1: Gauging station drainage areas range from 8.05-5,181 (mi^2) (mean: 833 mi^2).

Baseline water quality for the surface water bodies within the permit and adjacent area is presented in Table 4.6.2. Sites 15W-5 and 15W-6 are ponds / shallow wetlands located north of Cell 3. These sites show an overall alkaline water with low dissolved solids content, typical of headwater streams. The sites are somewhat elevated in total metals, but this is likely due to the iron and manganese contained in suspended sediments that is accounted for with the total and total recoverable analytic methods. The metals contained in suspended sediments are part of the mineral framework of the soil and rock particles and are typically not bioavailable to aquatic life. Site 21W-6, which is located on the northern side of the Spartan Mine also

demonstrated net alkaline water, although the pH was slightly depressed at 6.43 standard units. Total dissolved standards and sulfate are slightly elevated above the regional mean values, likely the result of runoff from the Spartan Mine refuse pile.

Table 4.6.3 summarizes seasonal ranges of water quality based on monitoring conducted by the applicant. Baseline samples at sites 16SW-6, 16SW-8, 21SW-9, and 21SW-10 were collected as part of the Permit 426 application. Sites 16SW-8, 21SW-9, and 21SW-10 are located in the uppermost headwaters of the South Tributary to Plum Creek and site 16SW-6 is located in the uppermost headwaters of the North Tributary to Plum Creek. Due to the limited flow at these locations, these sites have been removed from the surface water sampling plan and are not actively monitored. The sites typically exhibit low flows during the winter and early spring when groundwater levels and precipitation is high, but quickly show no flow beginning in late spring and extending through fall. Water quality is net alkaline with alkalinity greatly exceeding acidity, and pH levels above neutral. Mean dissolved solids at these sites ranges from 543 mg/L to 315 mg/, comparable to the regional mean TDS. Mean sulfate and chloride concentrations are low, displaying ranges of 38 – 166 mg/L and 28 – 64 mg/L respectively, and are in compliance with aquatic life water quality standards. Suspended solids is low overall, averaging less than 24 mg/L at all sites, although individual sample events did show concentrations as high as 69 mg/L. This is still far lower than the concentrations seen regionally, and likely underestimates potential concentrations of suspended sediment in this area that is dominated by row-crop agriculture. Total iron concentrations are again slightly elevated averaging 2.11 mg/L across these sites, due to the naturally occurring metals contained in soil particles, while total manganese remains low, averaging 0.16 mg/L. The alkaline nature of the water also indicates that these metals concentrations are not the result of acid generation and subsequent dissolution of metals from soils and unconsolidated sediments.

Stream sampling sites 16SW-11 and 16SW-12 are located on the North and South Tributary to Plum Creek, respectively. These sites were also monitored for baseline under Permit 426 but continue to be actively monitored under the current surface water monitoring plan. The streams exhibit higher flows than the upstream sites, but still regularly have no flow during late summer and fall. These sites also exhibit net alkaline water quality but display a a slightly higher TDS than the headwater stream sites and the regional average TDS presented above. The ranges of mean sulfate and chloride concentrations are 176 – 219 mg/L and 37 – 134 mg/L, again in compliance with water quality standards for aquatic life. Total suspended solids concentrations average 9 and 11 mg/L at 16SW-11 and 16SW-12, respectively, and are comparable to the regional minimum although concentrations of individual flow events have been as high as 73 and 37 mg/L. Total iron concentrations are similar to the baseline at the headwater sites, with average concentrations of 0.42 and 1.14 mg/L at sites 16SW-11 and 16SW-12 respectively, lower than the regional mean. Manganese concentrations are low, in compliance with the general use and aquatic life water quality standards.

Seasonal fluctuations in surface water quality and quantity occur primarily in response to seasonal variations in precipitation and in the ratio of runoff to base flow. Base flow generally exhibits greater mineralization; whereas increased runoff from precipitation will normally exhibit elevated suspended solids. Similarly, dissolved solids concentrations are often inversely proportional to flow, with decreased dissolved solids concentrations in spring when precipitation runoff is high and increased dissolved solids concentrations in fall when evapotranspiration is dominant and water in ephemeral and intermittent streams is pooled or stagnant. The quarterly sampling results of these stream sites does not exhibit clear seasonal fluctuations. The quarterly data also does not show any prevalent long-term trends in TDS, Sulfate, or Chloride within the stream. TSS and total metals concentrations are episodic, as a result of being driven by precipitation events and subsequent runoff.

4.6.3 Surface Water Monitoring Program. [1780.21(j)/1784.14(i)]

Describe in detail a proposed monitoring plan based upon the PHC that will measure the amount and duration of any changes to the surface water system resulting from the mining operation. Table 4.6.3.1 shall

be filled out with all current and proposed surface water monitoring points. For surface mines, upstream and downstream quality and quantity monitoring will be required throughout the life of the mine. Parameters to be monitored are given in Table 4.6.3.4 Surface water monitoring shall be on a quarterly basis with reports due within one month of the end of each quarter as follows:

Scheduled Period	From - To	Report Due
1st Quarter	Jan. 1 – Mar. 31	May 1
2nd Quarter	Apr. 1 – Jun. 30	Aug 1
3rd Quarter	Jul. 1 – Sept. 30	Nov 1
4th Quarter	Oct. 1 – Dec. 31	Feb 1

Provide a Sampling and Analysis Plan (SAP) that includes the methods/steps of in-stream sampling, data analysis and data reporting as an attachment to this application part.

Where approved, annual monitoring shall be conducted during the 2nd quarter only; semi-annual monitoring shall occur during the 2nd and 4th quarters only.

NOTE: At a minimum, background data collection shall occur on a bi-monthly (every two months) basis over the course of one year (12 consecutive months). Surface water monitoring shall continue throughout the permitting process at the same frequency background data collection occurred.

4.6.3.1 Water quality descriptions shall include, at a minimum, baseline information as follows **[1780.21(b)(2)(A)/1784.14(b)(2)(A)]**:

pH, total dissolved solids, total suspended solids, alkalinity, acidity, sulfate, total iron, total manganese, and chloride. Complete Table 4.6.3

4.6.3.2 Water quantity description shall include base information on seasonal flow rates. **[1780.21(b)(2)(B)/1784.14(b)(2)(B)]**

No surface water samples shall be collected from pooled (non-flowing) water. When no-flow conditions are observed, the applicant shall note the no-flow and include the "no-flow" notation on reports submitted to the Department.

4.6.3.3 The proposed surface monitoring plan shall describe how the collected surface monitoring data will be used to determine if impacts are occurring and what steps will be taken by the operator. **[1780.21(j)(2)/1784.14(i)(2)]**

4.6.3.4 At a minimum, surface water shall be sampled/analyzed for: pH, total dissolved solids, total suspended solids, alkalinity, acid, sulfate, iron, manganese and flow (cfs). **[1780.21(j)/1784.14(i)]**

BASELINE MONITORING:

Baseline surface water monitoring for the receiving streams was conducted as part of the Permit 426 application. In Permit 426, points were established in the two unnamed tributaries to the Plum Creek that drain the proposed permit area. Surface water monitoring point's 16SW-6 and

16SW-11 are located in the North Tributary to Plum Creek, with 16SW-6 located along the western edge of the permit boundary and 16SW-11 located further downstream near the tributaries confluence with Plum Creek. 21SW-9, 21SW-10, 16SW-8, and 16SW-12 are located in the South Tributary to Plum Creek, with 21SW-9 and 21SW-10, and 16SW-8 located along the western boundary of the permit and 16SW-12 located further downstream (see Map 4). The surface water baseline monitoring network was designed to characterize the seasonal quality and quantity of existing streams in the vicinity of the permit area. Sites were selected to be representative of the same pre-mining land uses (primarily agricultural fields, farmsteads and residences and woodlands) that are located within the proposed permit boundary and that would be likely to exhibit flow, thereby documenting any seasonal variations. Note that due to the ephemeral nature of the South Tributary, and the finite number of flow events observed, sample points 21SW-9 and 21SW-10 were dropped after approximately one year of sampling. The ephemeral nature of the two Tributaries is further evidenced by the limited number of flow events observed at downstream sample points 16SW-11 and 16SW-12. Baseline parameters included discharge rate, pH, Acidity, Alkalinity, Iron (total), Manganese (total), Chloride, Sulfate, Total Dissolved Solids (TDS), and Total Suspended Solids (TSS). Analytical data for the surface water monitoring sites is provided in Table 4.6.3.

DURING MINING AND RECLAMATION MONITORING:

Surface water monitoring point's 16SW-11 and 16SW-12, formerly baseline monitoring points, will continue to be utilized as a compliance monitoring locations. The points will be monitored quarterly during mining and reclamation parameters until their watersheds are eligible for Phase-II bond release, then semi-annually through Phase-III bond release, or earlier if approved by the appropriate regulatory authorities. During mining and reclamation, monitoring parameters include discharge rate, pH, Acidity, Alkalinity, Iron (total), Manganese (total), Chloride, Sulfate, TDS, and TSS. Sampling and analytical methods will meet industry practice and the standards of the Department of Natural Resources' Land Reclamation Division pursuant to applicable codes. Lab results will be available at the mine site and submitted quarterly to Office of Mines and Minerals. Surface water monitoring points 16SW-6, 16SW-8, 21SW-9, and 21SW-10 were sampled to adequately establish areal baseline seasonal water quality and quantity characteristics for the permit area and are not be incorporated into the during mining and reclamation surface water monitoring plan.

SAMPLING AND ANALYSIS PLAN

The surface water locations outlined above will be sampled in accordance with the sampling procedures outlined in the surface water Sampling and Analysis Plan (Attachment 4.6.3). The laboratory results are submitted to the internal water quality database via Electronic Data Deliverable (EDD) files. The data is then reported in accordance with the quarterly sampling and reporting schedule outlined above. NPDES outfalls are monitored nine times quarterly. In the event of an exceedance of NPDES effluent limits, it is identified upon receipt of the laboratory report. Options for prevention of further discharge or treatment of effluent are evaluated at that time.

4.6.4 Locate all surface water monitoring points on the Hydrogeologic Map and fill out Table 4.6.3. **[1779.25(a)(2)/1783.25(a)(2)]**

Map 4SF identifies all surface water monitoring points, including those baseline monitoring locations that are no longer monitoring under the active SAP.

4.6.5 For carbon recovery operations surface water quality of the existing discharge point or of the impounded water if no discharge point exists shall be provided, utilizing the parameters in Part 4.6.3.1 above. **[1780.21(b)(2)/1784.14(b)(2)]**

Gateway Mine is not a carbon recovery operation.

4.7 NPDES Monitoring Program. [1780.21(j)(2)(B)/1784.14(i)(2)(B)]

4.7.1 Has an NPDES permit been applied for?

☒ YES ☐ NO

4.7.2 Has an NPDES permit been obtained?

☒ YES ☐ NO

If YES, give the permit number, the date issued, the expiration date, and the number of discharge points monitored. If additional discharge points are proposed by this application, list discharge numbers. Locate on the Hydrogeologic Map and number all discharge points of the proposed permit area. Complete Schedule A for all existing and proposed NPDES Outfalls for the facility. Provide the longitude and latitude coordinates, in decimal degrees, for each outfall. **[1779.25(a)(2)/1783.25(a)(2)]**

NPDES Permit No.: IL0062189
Issue Date: May 27, 2015
Effective Date: May 27, 2015
Expiration Date: April 30, 2020
Renewal Submitted: October 24, 2019
Discharge Points Monitored: 001, 002, 003, 007, 008, 011, 012, 009 (unconstructed), and 010 (unconstructed)

Schedule A forms are provided.

4.7.3 In accordance with 35 Ill. Adm. Code 406.101(b), is the applicant requesting that monitoring and reporting be on the basis of grab samples?

☒ YES ☐ NO

If NO, explain.

4.7.4 Are NPDES reports to be submitted to satisfy the reporting requirements**? [1780.21(j)/1784.14(i)]**

☒ YES ☐ NO

If YES, provide the NPDES monitoring program including sampling method, sampling frequency and parameters to be analyzed. If not, submit a proposed monitoring and reporting program. Discharge information sheet is given in Schedule A and /or form 2C or 2D. Schedule A should be completed for all

proposed and existing discharge points. An estimate of the expected discharge concentration for each listed parameter must be indicated (or marked n/a) and a basis for that estimation provided.

Schedule A forms are provided.

4.7.5 Give a brief description of the surface water sampling and flow measurement equipment which will be used to monitor the discharges. **[1780.21(j)(2)(B)/1784.14(i)(2)(B)]**

The surface water Sampling and Analysis Plan (Attachment 4.6.3) outlines the surface water sampling and flow measuring equipment that is used to monitor NPDES discharges.

4.7.6 Is this proposed mining area covered by existing Illinois EPA (IEPA) Subtitle D permits? **[1780.21(j)(2)(B)/1784.14(i)(2)(B)]**

☒ YES ☐ NO

If YES,

4.7.6.1 List the permit number(s).

Construction authorization 8161-00 to replace Subtitle D permits:
2002-MW-6440-1
2006-MD-7331
2008-MW-0146
2010-MO-9362
2012-MD-6235
2014-MO-4343
2014-MO-4344
2014-MO-4345

4.7.6.2 Do the proposed mining boundaries exactly coincide with IEPA permitted boundaries?

☒ YES ☐ NO

If NO, delineate the IEPA Subtitle D permitted boundaries on the Hydrogeologic map. **[1779.24(l)/1783.24(l)]**

- FOR IEPA PURPOSES ONLY –
- IN COMPLIANCE WITH A JOINT NPDES/SMCRA PERMIT APPLICATION -

4.7.7 To allow the IEPA to complete the necessary Antidegradation Analysis required for public notice of the NDPES Permit for this proposed operation, provide, as an attachment to this application, the following:

4.7.7.1 A detailed discharge alternative analysis which discusses alternatives to the outfall proposed in this application.

The existing outfalls authorized by NPDES permit IL0062189 will contain all runoff from the area of the proposed operation. No new outfalls are being planned for construction as a result of the operations proposed in this application.

4.7.7.2 A detailed treatment alternative analysis which includes at a minimum, a discussion of each of the following:

- Filtration
- Reverse Osmosis
- Bioremediation
- Coagulation (chemical) Precipitation
- Ion Exchange
- Cost Effective Sulfate Removal (CESR) Process
- Supervac **[35 Ill. Adm. Code 302.105]**

The existing outfalls authorized by NPDES permit IL0062189 will contain all runoff from the area of the proposed operation. No new outfalls are being planned for construction as a result of the operations proposed in this application. The existing alternatives analysis is still applicable to the proposed operation described in this application.

- FOR IEPA PURPOSES ONLY –
- IN COMPLIANCE WITH A JOINT NPDES/SMCRA PERMIT APPLICATION -

4.7.8 To demonstrate that dissolved contaminants are minimized in runoff from the proposed refuse disposal area, Best Management Practices (BMP's) as specified in the June 2007 SIU Study, "Identification and Assessment of Best Management Practices in Illinois Mining Operations to Minimize Sulfate and Chloride Discharges" shall be implemented. Identify and discuss each BMP to be implemented from the cited study in an attachment to this application. **[35 Ill. Adm. Code 406.204, 406.205, 406.206, 406.207 and 406.208]**

The operation implements several BMPs specifically aimed at improving water quality and other BMPs that have the secondary effect of improving water quality. A subset of these BMPs are effective at minimizing concentrations of sulfate and chloride specifically. These BMPs include coarse refuse management practices, fine refuse management practices, utilization of alkaline soil amendments, minimization of long-term end dump storage areas,

Coarse refuse management practices: Coarse refuse is to be laid down and compacted in 24-inch lifts. This minimizes the exposure and oxidation of the refuse material, which prevents the generation of acid salts. The site also avoids the use of long-term end dump storage areas. Utilization of long-term storage areas prior to compaction or rehandling is avoided to the extent possible. This practice not only increases sulfate and chloride generation, but it typically requires unnecessary rehandling of material. The operation utilizes direct placement and contemporaneous compaction of fresh coarse refuse material to the extent possible. Alkaline amendments are also utilized as approved under the existing Subtitle D permits. Alkaline amendment with water treatment plant lime sludge was a common practice during reclamation of Cells 1, 2, and 3. Alkaline amendments are incorporated into the coarse refuse where it is the approved final cover. Areas which may receive alkaline amendments include, but are not limited to, coarse refuse cover of Cell 3 and the exterior embankment of Cell 5 Phase 2.

Fine refuse management practices: The operation will maintain water cover over the fine refuse within Cell 5 Phase 2 to the extent practicable. This minimizes the oxidation of the refuse material and associated sulfate and chloride generation. When coarser grained slurry material creates a deltaic buildup of materials exposed to air, the operation will evaluate alternative slurry discharge locations.

4.8 Protection of Hydrologic Balance. The delineation of the Cumulative Impact Area (CIA) for groundwater and surface water shall be included in the Probable Hydrologic Consequences (PHC). The surface and groundwater CIA(s) shall be depicted on a CIA map(s). The applicant shall describe the rationale for selecting the surface and groundwater CIA(s), concentrating on the relationship between the surface and groundwater regimes. The CIA discussion must also include consideration of aquifers in use by area residents, public water supplies, and proximity of existing mining areas which can increase impacts on the surface and groundwater areas of influence. A discussion of historic mining areas may be included where known existing water quality issues exist.

The applicant shall provide a narrative determination of the PHC of the operations on the proposed permit, shadow area and adjacent areas with respect to the hydrologic regime and water quality and quantity in surface and groundwater systems under all seasonal conditions based on the baseline information provided in Sections 4.4, 4.5 (Groundwater) and 4.6, 4.7 (Surface Water). **[1780.21(f)(1)/1784.14(e)(1)]**

POTENTIAL SURFACE WATER CUMULATIVE IMPACT AREA (SCIA)

The potential surface water cumulative impact area (SCIA) for the proposed surface effects permit area is encompassed within the Plum Creek watershed. The SCIA incorporates portions of two unnamed tributaries to Plum Creek, the "North Tributary" and the "South Tributary". The SCIA was established using a watershed-based approach and includes all drainage from the proposed permit area and currently active Gateway refuse disposal operation that falls within the Plum Creek watershed. No other active coal mining operations are known to be present within the Plum Creek watershed. Topographic and surface water drainage divides, both existing streams and man-made drainage ditches, were utilized to establish the boundaries of the SCIA. Note that the drainage ditch that runs parallel to Jean Road directs the water west/southwest, around the northern boundary of the existing Gateway operation towards sediment basin SB012B and SB012A before discharging to the North Tributary. The SCIA outlet points were established downstream of the permit at the two tributaries confluence with Plum Creek, the first stream of significant size downstream of the permit. There are several small tributaries that drain into both the North Tributary and the South Tributary. However, these tributaries were deemed insignificant due to their small drainage areas, their ephemeral nature, and the absence of an upstream discharge to the tributary.

The applicant estimates that the total areal extent of the SCIA is about 357.81 acres, or 0.56 square miles, at final reclamation (see Attachment 4.8, Supplemental CIA Map). During operation, the SCIA is smaller since the water internal to the impoundments is maintained within the preparation plant's closed system and only the outer embankment contributes runoff to Plum Creek. This proposed SCIA is small in scope relative to the size (< 1%) of the Plum Creek watershed (approximately 89.5 square miles at final reclamation). Hydrologic impact and interaction resulting from the mining operations proposed herein should be both temporary and limited in scope within the SCIA. During operation of the impoundment, all water within the impoundment will be recycled to the preparation plant and should not leave the closed loop of the refuse cell-preparation plant circuit. Only rainfall draining off the out-slopes of the Cell 5 impoundment will leave the permit area after passing through professionally designed sediment basins. The greatest impact should occur during active operations and should be temporary because of the finite life of the impoundment. Impact that may occur after mining and reclamation operations are completed should be limited in scope because of the hydrologic protections that will be utilized at the site. The cell will be capped with an engineered cover and all surface areas on the top and sides of the embankment will be vegetated and will limit erosion and sediment contributions from runoff. Surface water will be passed through professionally designed sediment basins to further limit any suspended solids contributions. The compacted liner and compacted clay cap will reduce the potential for groundwater impacts in the near and long-term and will further limit any potential impacts to the tributaries from baseflow contributions.

POTENTIAL GROUNDWATER CUMULATIVE IMPACT AREA (GCIA)

This permit application is for construction and operation of a coal refuse disposal structure and does not include mining of coal within the proposed permit area. The permit included excavation of subsoil but there was no disturbance of the bedrock. The applicant estimates that any potential impact to groundwater will be limited to the shallow, Quaternary unconsolidated interval within the permit boundary. The upper bedrock units consist primarily of a low permeable shale (hydraulic conductivity: 10^{-7} to 10^{-11} cm/sec (Freeze and Cherry, 1979)) that inhibits vertical groundwater movement. A compacted clay liner with a permeability of 1X 10^{-7} cm/sec separates the interior of the impoundment under Cell 5 and prevents infiltration and recharge of water from within the impoundment to the underlying water table. Additionally, the local unconsolidated interval exhibits high clay content and low permeability, also reducing groundwater migration.

The potential groundwater cumulative impact area (GCIA) of the proposed permit area falls within the headwaters of the Plum Creek watershed. The GCIA was established using a watershed-based approach and encompasses the proposed permit area and the currently active Gateway refuse disposal area that is located within the Plum Creek Watershed. The watershed-based approach was chosen because groundwater flow in the unconsolidated zone typically parallels surface topography with recharge areas located in the topographic highs and discharge areas located in topographic lows were the groundwater table intersects the ground surface. The water level survey conducted at the sites monitoring wells indicates that groundwater mimics the surface topography and flows from the topographic high in the east-southeast toward the topographic low in the north-northwest (see Attachment 4.2.2.3).

The applicant estimates that the total areal extent of the GCIA is 284.0 acres, or 0.44 square miles (see Attachment 4.8, Supplemental CIA Map). The proposed refuse cell raise GCIA will be limited to the surface effects area because of the compacted clay liner underlying Cell 5prevents infiltration and recharge of water from within the impoundment to the underlying water table. The installation of a compacted engineered cover to the impoundment upon final reclamation will further reduce the potential for groundwater impacts in the long-term and will improve upon the currently approved plan for Cell 4. Likewise, the current Gateway Mine GCIA mirrors the extent of its existing surface effects area within the Plum Creek watershed. As noted above, hydrologic impact should generally be limited to the shallow, Quaternary unconsolidated interval within the watershed. Magnitude of impact within the GCIA should be further limited because locally the unconsolidated interval exhibits high clay content, and poor permeability. Sand lenses encountered in the southern half of the permit area were discontinuous and were removed and backfilled with clay when encountered during the liner instillation at the base of the impoundment; therefore the applicant believes they are to be of no consequence to the mining activity.

Hydrologic impact and interaction resulting from the project proposed herein should be both temporary and relatively limited in scope within the GCIA. The greatest impact should occur during active operations and should be temporary because of the finite life of the project, the hydrologic protections proposed (both the liner and engineered cover), and the low permeability of the bedrock and unconsolidated material. Impacts that may occur after mining and reclamation operations are completed should be limited because of the small aerial extent of the proposed project, the hydrologic protections proposed, and the infrequent utilization of the limited local groundwater resource.

The determination of PHC shall include findings on the following:

4.8.1 Will the proposed coal mining and reclamation operations have adverse impacts to the hydrologic balance? **[1780.21(f)(3)(A)/1784.14(e)(3)(A)]**

☐ YES ☒ NO

Explain:

Effects normally associated with surface disturbance include slight increases in base flow in adjacent receiving streams, slight decreases in mean runoff and peak flow in local receiving streams proximal to disturbed areas, temporary lengthening of watershed response time to precipitation events, changed relationships between surface and groundwater divides, and impacts to water quality. Such effects should remain limited to disturbed and the immediately adjacent areas.

Because large-scale overburden displacement is not proposed, impact to the hydrologic balance resulting from the operations described herein should be negligible. Sediment basin installation should attenuate any hydrologic impact associated with disturbance of the proposed surface effects area. The NPDES permit effluent limits and the surface water and groundwater Sampling and Analysis Plans provide a comprehensive sampling, analysis, and reporting schema to validate that adverse impacts to the hydrologic balance will not occur. During construction of the refuse impoundment a temporary lowering of the water table in the unconsolidated zone likely occurred. However, this was limited to the initial period of liner and embankment construction and limited in lateral extent due to the low hydraulic conductivity of the surrounding unconsolidated material, with hydraulic conductivity of surrounding wells averaging 10^{-5} cm/sec. The current pollutant controls in place and the final reclamation plans also provide significant protection against impacts to the hydrologic balance. The liner beneath the embankment and impoundment interior was constructed of compacted clay (minimum 4-foot composite thickness) to a permeability of no more than 10^{-7} cm/sec which restricts water from both exiting and entering the impoundment. The engineered cap, which will cover Cell 5 and Cell 4, provides a barrier against infiltration and subsequent mineralization within the refuse materials.

4.8.2 Are acid forming or toxic forming materials (AFM) present that could result in contamination of surface and/or groundwater supplies? This shall include the handling and placement of AFM in the overburden during mining and reclamation ~~of~~ for surface mining and during construction of all shaft and slopes for underground mining. **[1780.21(f)(3)(B)/1784.14(e)(3)(B)]**

☐ YES ☒ NO

Explain:

Planned operations include the construction of the Phase 2 embankment on an existing impoundment. This will involve raising the outer embankment to increase the capacity of the fine coal refuse disposal site. Slurry from the preparation plant is pumped into the impoundment and allowed to settle. Decant water is pumped back to the preparation plant to complete the cycle. The process water is contained in a closed loop system and is treated as necessary to maintain the proper alkalinity. In the event a discharge is necessary, additional alkalinity treatment occurs prior to discharge from NPDES Outfall 008.

The clay liner beneath the embankment and impoundment interior (minimum four-foot composite thickness) was compacted and has a permeability no greater than 1×10^{-7}cm/sec. This prevents migration of water from within the impoundment into the local groundwater. The existing clay subsoil was utilized for both the embankment and clay liner and was compacted to 95% standard Proctor dry density and then tested to ensure the required density upon completion. The groundwater protection will be further enhanced at final reclamation when the engineered cover (minimum 24-inch composite thickness) compacted to a minimum permeability of 1×10^{-7} cm/sec is installed to prevent infiltration into the impoundment. This engineered cover is currently approved for Cell 5 Phase 1. The same engineered cover is proposed for Cell 5 Phase 2. This incorporates the engineered cover over both Cell 5 and Cell 4. The engineered cover will provide greater protection to the hydrologic balance than the currently approved cover plan for Cell 4. Further details of the compaction procedures and quality control methods for both the liner and designed cover were originally provided in Permit 426 Attachment III.2.D.1.b and are included hereto in Attachment 9.4.1.

Runoff from the proposed operations area, which will include the out-slope embankments only, will be routed through professionally designed sediment basins and all outfalls will be subject to NPDES permit limitations. Management of these outfalls, including neutralization and/or treatment with approved, industry-standard water treatment chemicals when warranted, should reduce frequency, magnitude, and duration of off-site impact. In addition, the sediment basins and ditches that hold or convey contact runoff from the Cell 5 refuse disposal area were lined with a compacted clay liner. The liner beneath the sediment basins will be comprised of twelve inches of compacted in-situ material overlain by three successive twelve-inch lifts compacted to a minimum permeability of $1x10^{-7}$ cm/sec. Drainage ditches receiving refuse contact water have a liner comprised of eight inches of compacted in-situ material overlain by three successive eight-inch lifts compacted to a minimum permeability of $1x10^{-7}$ cm/sec. Additional construction specifications and quality control measures were originally provided in Permit 426 Attachment III.2.D.1.b and are described here in Attachment 9.4.1.

Once the slurry storage volume within Cell 5 Phase 2 has been completely utilized and the engineered cover completed and revegetated, potential impact from acid- or toxic-forming materials will be attenuated or eliminated. Capping the potentially acid- or toxic-forming materials with the engineered cover (minimum 24-inch composite thickness) overlain by a 27-inch layer of non-compacted rooting media and a 9-inch layer of protective cover topsoil will minimize exposure of the refuse materials to infiltration and atmospheric oxygen. This is the primary method of preventing the formation of acid mine drainage.

POTENTIAL ACID-FORMING MATERIALS

Materials used on the Phase 1 external embankment (out slope) was compacted coarse refuse material covered by 4-feet of material suitable for revegetation. An exterior A compacted clay liner was constructed at the base of the impoundment as well as beneath the embankment. The compaction of this clay liner and above grade clay embankment to a permeability of no greater than 1×10^{-7}cm/sec restricts the migration of water that has contacted refuse material within the impoundment into the local groundwater.

Phase 2 construction will utilize coarse refuse material to construct the outer embankment. The coarse refuse will be spread and compacted in 12-inch lifts. The material is placed to use the heavy equipment travel as the means of compaction. Additional compaction equipment will be used only as necessary. The outer embankment will maintain the compaction level of 1×10^{-7}cm/sec, minimizing infiltration and subsequent acid generation. The refuse material will be placed and compacted contemporaneously, preventing buildup of acid salts on the refuse material. An outer berm will be utilized to maintain runoff from the top of the embankment within the closed-loop preparation plant circuit. Lastly, a minimum of two feet of soil will be placed, seeded, and mulched as soon as practicable after exposure.

Acid-base accounting analysis was conducted on both the coarse and fine coal refuse. Results of these analysis were presented in Table 4.3.3.1, Table 4.3.3.2, and Attachment 4.3.3.2.

4.8.3 Will the proposed surface coal mining and reclamation operations result in contamination, diminution or interruption of an underground or surface source of water within the proposed permit, shadow or adjacent areas which is used for legitimate purposes? **[1780.21(f)(3)(C)/1784.14(e)(3)(D)]**

☐ YES ☒ NO

Explain:

Potential contamination, diminution, or interruption of any surface source of water is unlikely due to its limited use and the pollutant prevention measures in place. First, there is limited use of the groundwater and surface water in this area. The unconsolidated and bedrock materials within and adjacent to the permit area have low permeability and are typically unable to supply groundwater volumes sufficient support residential or agricultural water supply needs. There is no known usage of the surface water adjacent to the

permitted area. Additionally, several pollutant minimization and control measures are in place to prevent offsite impacts. Sediment basins are designed and constructed to meet regulatory requirements and are monitored and reported in accordance with the NPDES permit. These measures minimize potential for impacts to surface water. Potential impacts to groundwater are minimized through the construction of the compacted clay liner beneath the existing Cell 5 Phase 1 area and all associated surface water control structures and sediment basins. Further, the underlying undisturbed materials are also low permeability, creating a natural barrier to groundwater migration offsite.

In the event the proposed operations result in a substantiated case of contamination, diminution, or interruption of a surface water or groundwater source within or directly contiguous to the subject permit site, the applicant will develop or utilize an alternative water source as replacement for the disrupted source, including providing an interim source between water loss and replacement. Alternative sources of water include but are not limited to the following:

1. Surface water impoundments.
2. Local municipal or rural water supplies.
3. Construction of replacement well(s) to formations suitable for water withdrawal and use.
4. Treatment of water to attain usable quality.
5. Haulage of water.
6. Other.

4.8.4 Explain what impact(s) to surface water and groundwater the proposed coal mining and reclamation operations may have on, including but not limited to, the following parameters:

- Sediment yield from the disturbed area; **[1780.21(f)(3)(D)(i)/1784.14(e)(3)(C)(i)]**
- Acidity; **[1780.21(f)(3)(D)(ii)/1784.14(e)(3)(C)(ii)]**
- Total suspended solids; **[1780.21(f)(3)(D)(ii)/1784.14(e)(C)(ii)]**
- Total dissolved solids; **[1780.21(f)(3)(D)(ii)/1784.14(e)(C)(ii)]**
- Flooding or stream flow alterations; **[1780.21(f)(3)(D)(iii)/1784.14(e)(3)(C)(iii)]**
- Availability of surface and groundwater. **[1780.21(f)(3)(D)(iv)/1784.14(e)(3)(C)(iv)]**

IMPACTS TO SURFACE WATER

Construction of Cell 5 Phase 2 will not disturb any additional area outside of the current surface effects area. The surface effects area is located solely within Plum Creek watershed and constitutes less than 0.2% of the total watershed. The minimal surface area associated with Cell 5 Phase 2 is expected to have no measurable impact on the overall discharge rate and quality of Plum Creek. Runoff from disturbed areas is all routed through sediment basins with NPDES outfalls to ensure suitable discharge quality to the receiving streams. The NPDES requirements of Permit IL0062189 are more stringent than the Federal Effluent Limitation Guidelines for Coal Mining and ensure protection of the designated uses of the receiving stream. The sediment basins that discharge to Plum Creek are Outfalls 011 and 012, which receive runoff from the outslopes of the Cell 5 embankment.

The proposed Cell 5 Phase 2 will have negligible impacts to the water quality of Plum Creek. The sediment yield of the receiving stream will be reduced overall. The adjacent area is dominated by agricultural land uses, which are susceptible to significant soil erosion. The potential suspended sediment levels of streams in this type of environment are shown in Table 4.6.2.3. The design and construction requirements of sediment basins and the technology based effluent limits for suspended sediment that are applied will lead to a a significant reduction in the suspended sediment and settleable solids concentrations immediately downstream of these outfalls. Schedule A contains the five-year average concentration at these outfalls, demonstrating compliance with the NPDES effluent limits and falling at the lower end of the range shown in Table 4.6.2.3. The acidity is expected to remain at baseline levels, again ensured by

NPDES effluent limitations requiring that alkalinity levels be greater than acidity in all discharges. The outfalls that discharge to Plum Creek have minimal potential for acidity generation. Several controls are in place to ensure that acidic runoff is maintained and treated within the preparation plant's closed loop system. The Phase 1 construction of the embankment consisted of a clay exterior that had no potential for acidity generation. The Phase 2 construction will utilize coarse refuse throughout the embankment. However, constructed berms will be utilized to control runoff from the exposed areas and will maintain this runoff within the preparation plant's closed loop system. Five-year average acidity concentrations show net-alkaline conditions at all outfalls. TDS generation is typically a result of oxidation of the refuse materials and subsequent mineral dissolution. Because runoff that is discharged to Plum Creek will not be in prolonged contact with refuse materials, mineral dissolution will be minimized and TDS concentrations are expected to be low. Although TDS is not regularly analyzed for these outfalls, two primary components, sulfate and chloride, show five-year averages in compliance with water quality standards of the receiving streams (Schedule A). Additionally, the maximum concentrations observed at these outfalls over the previous five year period is in compliance with the water quality standards for sulfate and chloride. Overall, the pollutant control measures that are in place and the best management practices that are implemented to control water quality will be sufficient to protect the existing uses of the received stream. In the event that addition controls or treatment is needed, chemical treatment can be used as allowed by the NPDES permit.

The sediment basins that are utilized are also expected to have negligible effect on runoff quantity to Plum Creek. The sediment basins are constructed to the regulatory requirements for treatment and storage volume. This will decrease the magnitude of peak flows and will prolong the discharge of baseflow to downstream reaches. Overall, these changes will likely be beneficial to aquatic life and aquatic habitat downstream of the site. At the scale of the Plum Creek watershed however, the potential changes to downstream flow rates and volumes will be insignificant. Chemical treatment of water will be conducted when warranted. Sediment yield is addressed in detail in the sediment basin design documentation.

Seasonal variations in surface water quality under post-mining conditions are estimated in Table 4.8.4.1.

TABLE 4.8.4.1: ESTIMATED POST-MINING SURFACE WATER QUALITY

Parameter	Range
pH	6.5 - 9.0
Acidity (mg/l)	<10
Alkalinity (mg/l)	0 – 334
TDS (mg/l)	150 – 1500
Total Fe (mg/l)	0.5 – 6.0
Total Mn (mg/l)	0.5 – 4.0
Chloride (mg/l)	50 – 500
Sulfate (mg/l)	100 – 1,500

These ranges are based upon USGS Water Resources Investigations Report 82-858, on archival data acquired by the applicant, and in consideration of NPDES effluent limits and state water quality standards. Effluent quality statistics over the previous 5-year period are provided in Attachment 4.8.4.1 and demonstrate consistent and continued compliance with effluent limits. Surface water use downstream of the permit area should remain unaffected by the proposed operation.

IMPACTS TO GROUNDWATER

The area adjacent and within the proposed permit area is sparsely populated. One resident located within ½ mile of the permit boundary reported using the groundwater within the surficial Quaternary aged unconsolidated material for their domestic supply. Shallow wells located in close proximity to the permit boundary may have experienced a slight decrease in water level or dewatering during the initial phase of construction. However, these conditions should have been short-lived and the water level in a state of equilibrium now that the clay liner and outer slopes are complete. Any temporary lowering of the water table would have been limited in lateral extent due to the low hydraulic conductivity of the unconsolidated

materials in the area (mean: 10^{-5} cm/sec). Limited impacts to groundwater quantity were observed during the construction phase of the site previous slurry impoundments, even for groundwater users in close proximity to the project areas. Water quality should not be impacted because the clay liner will restrict the process water from migrating outside of the impoundment. Because of the low yields, as evidenced by measured hydraulic conductivity on the order of 10^{-5} cm/sec within the local unconsolidated material, and the observed manganese concentrations in excess of Class I standards as well as the numerous residential wells within ½ mile of the adjacent operations that have historically shown water quality in excess of Class I and Class II standards (Attachment 4.4.2.2); classification of the sites unconsolidated zone groundwater should be considered no better than Class II (General Resource Groundwater). Water quality in the unconsolidated zone groundwater after capping and fully reclaiming the proposed refuse impoundment is estimated to be near the average noted in Table 4.8.4.2.

The estimates within Table 4.8.4.2 below are based on USGS Water Resource Investigations Report 82-858, unpublished analysis of groundwater from the Illinois Basin, and local baseline water quality data. No water wells within ½ mile of the proposed operation were identified as being screened within the bedrock. Regardless, there should be no impacts to groundwater quality or quantity within the bedrock as the proposed activities does not include disturbance to the bedrock material. Deep aquifers are primarily recharged off site and should be isolated from downward migration of potential pollutants by thick sequences of clay, shale, and siltstone units that exhibit low porosity and permeability.

TABLE 4.8.4.2: ESTIMATED POST RECLAMATION GROUNDWATER QUALITY

PARAMETER	ESTIMATED AVERAGE*
pH	6.5 – 9.0
acidity (mg/l)	<1
alkalinity (mg/l)	400
TDS (mg/l)	1250
chloride (mg/L)	200
sulfate (mg/l)	400
total Fe (mg/l)	≤5
total Mn (mg/l)	≤2

4.8.5 If this application is for a Significant Permit Revision, the applicant shall describe any relevant updates to the PHC originally provided under Part 4.8. **[1774.13]**

4.8.6 If the PHC determination indicates that the proposed mining operation may proximately result in the contamination, diminution, or interruption of an underground or surface water source within the proposed permit area, shadow area or adjacent areas used for domestic, agricultural, industrial or other legitimate use, the application shall provide information on water availability and alternative water sources. The alternative water source information shall address the suitability of the alternative water source for existing pre-mining and approved post-mining land uses. **[1780.21(e)/1784.14(b)(3)]**

NOTE: Provide a narrative summary of Parts 4.8.1 through 4.8.6 utilizing the data and information provided and gathered for Part 4 of this application. ***[1780.21/1784.14]***

In the event the proposed operations result in a substantiated case of contamination, diminution, or interruption of a surface water or groundwater source within or directly contiguous to the subject permit site, the applicant will develop or utilize an alternative water source as replacement for the disrupted

source, including providing an interim source between water loss and replacement. Alternative sources of water include but are not limited to the following:

1. Surface water impoundments.
2. Local municipal or rural water supplies.
3. Construction of replacement well(s) to formations suitable for water withdrawal and use.
4. Treatment of water to attain usable quality.
5. Haulage of water.
6. Other.

4.9 Preventative and Remedial Measures Plan. For proposed surface mining, provide a plan, as an attachment to this application, including maps and descriptions, for meeting the relevant requirements of Sections 1816.41 through 1816.43. Discussion of preventative and remedial measures shall be included. **[1780.21(h)]**

For proposed underground mining, provide a plan, including maps and descriptions, for meeting the relevant requirements of Sections 1817.41 through 1817.43. Discussion of preventative and remedial measures shall be included. **[1784.14(g)]**

Each plan shall address the following:

- The specific local hydrologic conditions
- The steps to be taken during mining and reclamation through final bond release to minimize disturbance to the hydrologic balance within the permit and adjacent areas
- The steps to be taken to prevent material damage outside the permit area
- The steps to be taken to meet the applicable Federal and State water quality laws and regulations
- The steps to be taken to protect the rights of present water users and replacement, if necessary
- The measures to prevent acid or toxic drainage
- The measures to prevent additional contributions of suspended solids to stream flow to the extent possible using the best technology currently available
- The measures to be taken to provide for water treatment facilities when necessary
- The measures to be taken to provide to control drainage
- The measures to be taken to restore approximate pre-mining recharge capacity
- The measures to be taken to address any potential adverse hydrologic consequences identified in the PHC determination.

The preventative and remedial measures plan is included as Attachment 4.9.

4.10 Liners. Construction details and specifications, as well as a Quality Assurance/Quality Control (QA/QC) Plan for the proposed compacted clay liners shall be provided, as an attachment to this application, if a compacted clay liner is proposed for this operation. The QA/QC Plan should include, at a minimum:

- The loose soil thickness of each lift
- The methodology for replacing soft areas encountered during construction
- Frequency of permeability testing, and
- Means of protecting the constructed liner from damage.
- The location of all compacted clay liners throughout the proposed permit area.

If a geosynthetic liner is proposed in lieu of a compacted clay liner, provide an appropriate, relevant QA/QC Plan to ensure proper installation and maintenance of the geosynthetic liner is achieved. **[1816.41/1817.41]**

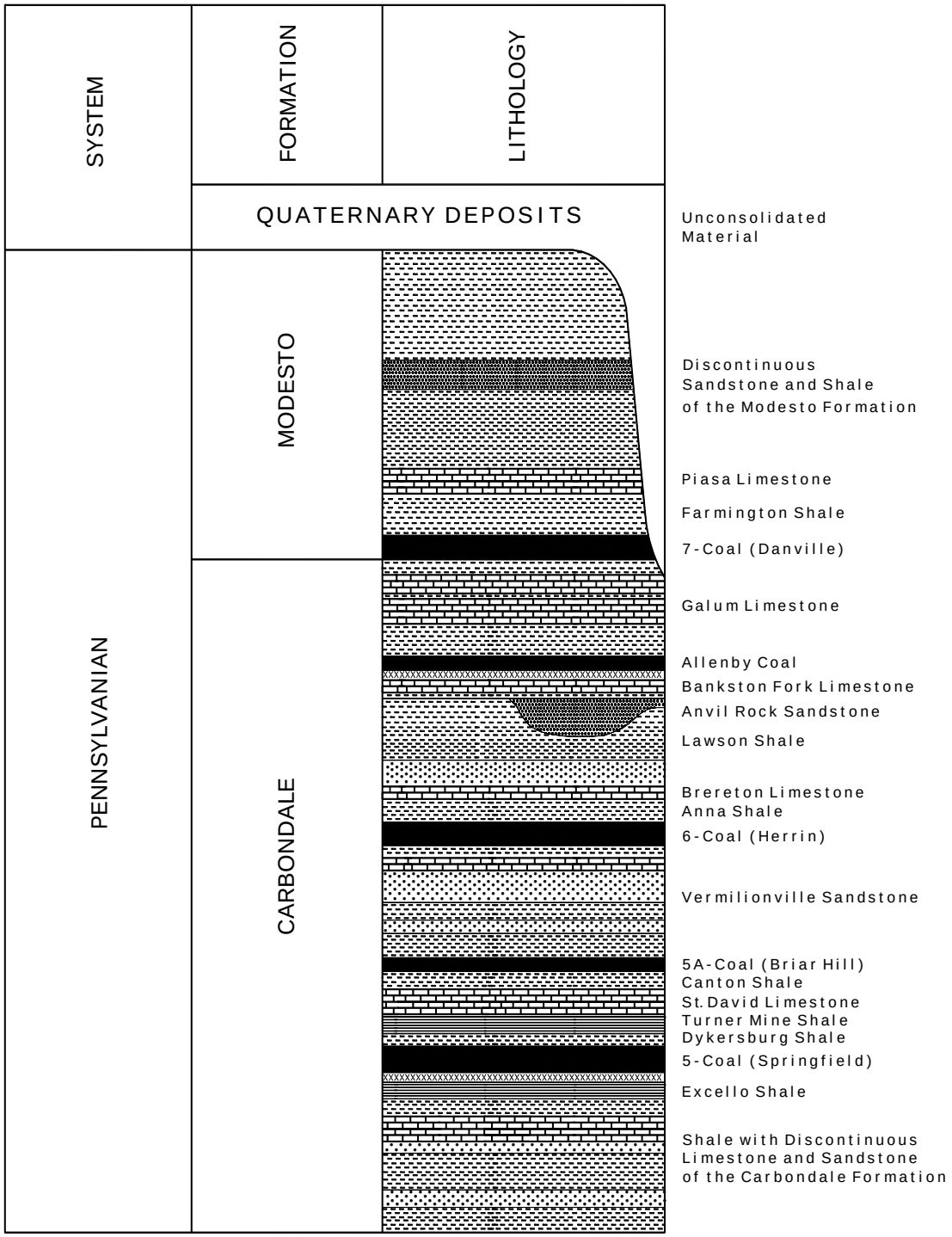
Cell 5 Phase 1 included construction of a liner beneath the refuse area as well as the ditches and sediment basins that received drainage from the refuse area. The quality assurance and quality control plan of the compaction procedures and quality control methods for the underlying liner were originally provided in Permit 426 Attachment III.2.D.1.b and are described here in Attachment 9.4.1. Cell 5 Phase 2 includes expansion of the Cell 5 area over Cell 4 and a portion of Cell 3. The enhanced cap that was approved as part of Cell 5 Phase 1 is being extended over the entire Cell 5 impounded area. This provides additional protections to the Cell 4 and exterior of Cell 3 that are not currently in the approved permit. The quality assurance / quality control plan for the previously approved enhanced cover for Cell 5 was also provided originally in Permit 426 Attachment III.2.D.1.b and is included here in Attachment 9.4.1.

4.11 Coal Combustion Materials. Provide a discussion of any existing or proposed operation to disposal of Coal Combustion Waste (CCW) or to beneficially use Coal Combustion By-products (CCB) within the proposed permit area as described in this application. Include a discussion of how the CCW/CCB materials may interact and/or impact the groundwater and surface waters in and around the proposed permit, shadow (if applicable) and adjacent areas. A surface water and groundwater monitoring plan shall also be provided. **[**415 ILCS 5/3.135**;** 415 ILCS 5/3.140**]**

NOTE: Also, see Part 15 of this application.

Onsite usage of coal combustion materials is in accordance with Subtitle D Permits 2008-MW-0146 and 2002-MW-6440-1. This application does not propose any new uses of coal combustion materials.

SOUTHERN ILLINOIS
GENERALIZED STRATIGRAPHIC COLUMN



(Adapted from Illinois Geological Survey Bulletin 95, H.B. Willman, et al, 1975)

WATER WELL LOG DATA

Owner: Zeigler Coal Company
Address: No. 11 Mine
Coulterville, IL.

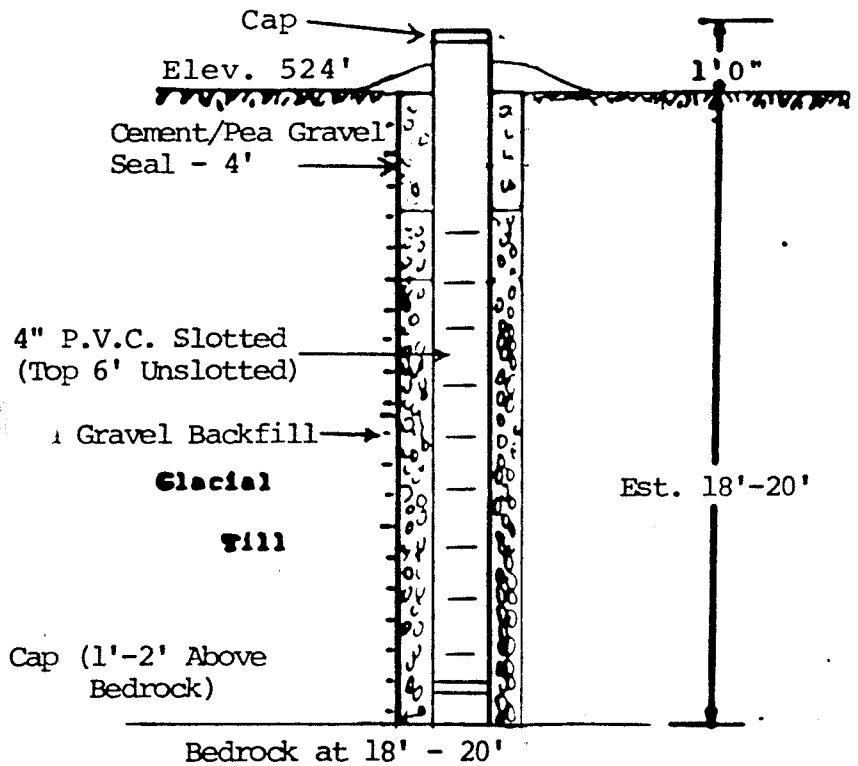
Date Inventoried To Be Installed

Sheet 1 **of** 1

Item: **Well** 03-4

Location: **Sec** 15 **T** 4S **R** 5W

940' South & 25' West of NE Corner, SW¼, SE¼.



Auger Hole: 8" Min. Dia.

Well Construction:

Pump:

None

Motor:

None

Accessories:

None

Date	*			
Static Level - FT	*			
Pumping Level - FT				
Pumping Rate - GPM				
Specific Capacity				

* To Be Determined.

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-5

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-07-93

LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

VISUAL SOIL CLASSIFICATION GROUND SURFACE: ELEVATION 531.5	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
Brown and Gray Silty CLAY, Moist		1-AU		--				
Gray and Light Gray Clayey SILT, Damp		2-SS	21	4.0				EL. 526.7
	5	3-SS	6	--				STATIC WATER LEVEL
Gray Mottled Brown Clayey SILT, little Sand, Moist		4-SS	83	1.5				
Brown Mottled Gray Silty CLAY, little Sand, Moist	10	5-SS	8	1.5				
		6-SS	11	3.5				
	15	7-SS	10	3.5				
Brown Silty CLAY, little Sand, Moist		8-SS	18	4.0				During Drilling
	20	9-SS	21	4.5				
		10-SS	33	4.5				
	25	11-SS	41	4.5				504.5
Brown SILTSTONE to Weathered SHALE, Damp		12-SS	30/60 for 4"	4.5+				
	30	13-SS	100 for 6"	4.5+				
End of Boring @ 31' Boring drilled and sampled with 3¼" ID Augers Hole reamed with 6¼" ID Augers 4" dia. PVC Monitoring Well installed through 6¼" ID Hollow Stem Augers See Well Construction Details	35 40							

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill-to-natural soil zone transitions.

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-6 (1 of 2

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-06-93

LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

VISUAL SOIL CLASSIFICATION GROUND SURFACE: ELEVATION 525.0	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
Gray Silty CLAY, trace Sand, Moist		1-AU						
Brown and Gray Silty CLAY, trace Sand Moist		2-SS	7	1.0				EL. 321.72 Static Water Level
	5	3-SS	8	1.5				
		4-SS	8	1.5				
	10	5-SS	8	1.5				
		6-SS	8	1.0				During Drilling
Brown Silty CLAY, little to some Sand, Moist	15	7-SS	10	1.0				
Brown and Gray Silty CLAY, little Sand and Gravel, Moist		8-SS	21	4.0				525
	20	9-SS	20	4.0				42
		10-SS	17	2.5				483
	25	11-SS	15	2.5				
		12-SS	16	2.5				
	30	13-SS	21	4.0				
Gray Silty CLAY, little Sand, Moist		14-SS	14	1.5				
	35	15-SS	13	2.0				
		16-SS	21	3.0				
	40	17-SS	35	4.5+				
Gray Weathered SHALE, Damp	483	18-SS	47/6" for 6"	4.5+				

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill to natural soil zone transitions.

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-6 (2 of

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-06-93

LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

VISUAL SOIL CLASSIFICATION GROUND SURFACE: ELEVATION	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
		17-SS	35	4.5+				
Gray Weathered SHALE, Damp		18-SS	47/60 for 3"	4.5+				
	45	19-SS	60 for 6"--					
End of Boring @ 46' Boring drilled and sampled with 3¼" ID Augers Hole reamed with 6¼" ID Augers 4" dia. PVC Monitoring Well installed through 6¼" ID Hollow Stem Augers See Well Construction Details								

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill, [illegible]

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-7 (1 of 2

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-05-93

LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

Feb07 GPS survey

VISUAL SOIL CLASSIFICATION (GROUND SURFACE: ELEVATION 514.5; 520.3)	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
Brown Silty CLAY, trace Sand, Moist		1-AU						EL. 516.15
Gray Mottled Brown Clayey SILT, little Sand, Moist		2-SS	15	2.5				Static Water Level
	5	3-SS	13	3.0				
		4-SS	13	2.0				
Brown Clayey SILT, some Sand, Wet	10	5-SS	6	.5				
Brown Mottled Gray Silty CLAY, little Sand, Moist		6-SS	20	4.0				
	15	7-SS	26	4.5+				
Brown and Gray Silty CLAY, some Sand and Gravel, Moist		8-SS	21	3.0				
	20	9-SS	46	4.0				
495.3		10-SS	16	3.0				
Gray Silty CLAY, trace Sand, Moist to Wet	25	11-SS	16	2.5				
		12-SS	6	.5				
490.3								
Gray SILT, trace Sand, Wet	30	13-SS	5	--				
Gray to Brown Silty CLAY, trace Sand, Moist		14-SS	23	3.5				
	35	15-SS	24	3.5				
		16-SS	18	3.0				
	40	17-SS	27	4.5+				
Brown Streaked Gray SILTSTONE, Damp (473.5)		18-SS	82	4.5+				

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill to natural soil zone [illegible]

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-7 (2 of

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-05-93

LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

VISUAL SOIL CLASSIFICATION GROUND SURFACE: *ELEVATION*	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
Brown Streaked Gray SILTSTONE, Damp		17-SS	27	4.5+				
		18-SS	82	4.5+				
	45	19-SS	50 for 6"	4.5+				
End of Boring @ 46' Boring drilled and sampled with 3¼" ID Augers Hole reamed with 6¼" ID Augers 4" dia. PVC Monitoring Well installed through 6¼" ID Hollow Stem Augers See Well Construction Details								

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill to natural soil contact (Ragg)

SOIL BORING LOG

midwest engineering services, inc.

BORING NO. GWM-8

PROJECT NO. 7-33006

PROJECT NAME: Slurry Cell Expansion

DATE OF BORING: 1-05-93

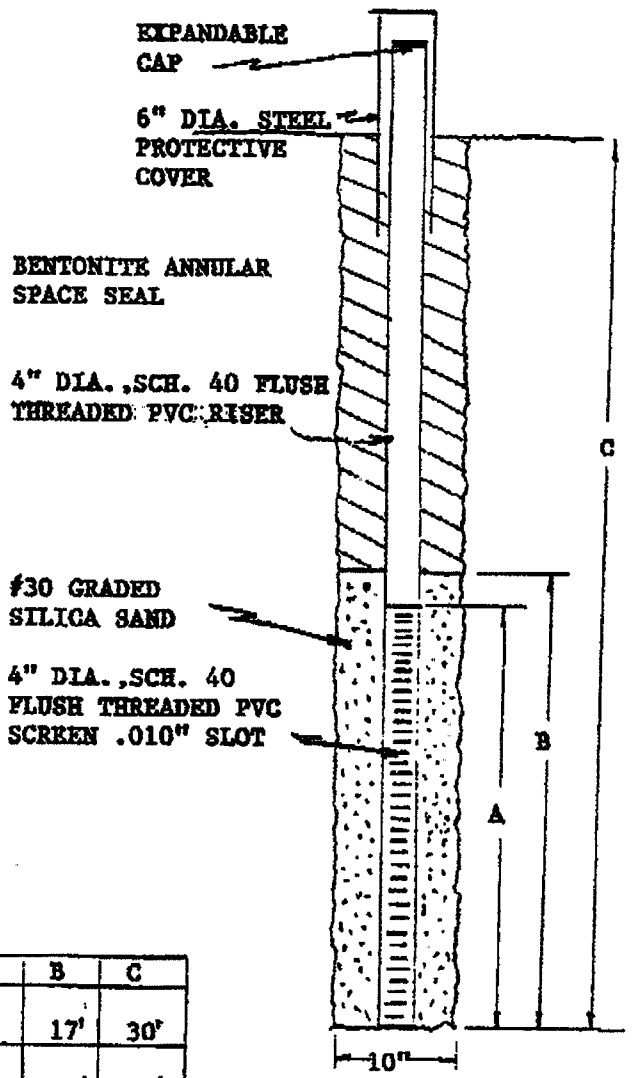
LOCATION: Central Cleaning Plant
Coulterville, Illinois

FIELD REPRESENTATIVE: Tracy Bartholomew

VISUAL SOIL CLASSIFICATION GROUND SURFACE: *ELEVATION* 519.5	DEPTH (feet)	SAMPLE NO.	N	Qp (tsf)	Qu (tsf)	MC (%)	PID (ppm)	REMARKS
Brown Silty CLAY, trace Sand, Moist		1-AU						El. 519.00
Gray Mottled Brown Clayey SILT, little Sand, Moist		2-SS	13	2.5				Static Water Level
	5	3-SS	9	1.5				
Gray Mottled Brown Silty CLAY, little Sand, Moist		4-SS	13	2.5				
	10	5-SS	15	2.5				
Brown Mottled Gray Clayey SILT, little Sand, Wet		6-SS	10	2.0				While Drilling
Gray Mottled Brown Silty CLAY, little Sand, Moist	15	7-SS	10	2.0				
		8-SS	28	2.0				
Note A								
Gray Silty CLAY, little to some Sand and Gravel, Moist	20	9-SS	15	2.5				
Brown and Gray SILTSTONE, Damp		10-SS	36	4.5+				
	25	11-SS	60 for 5"	4.5+				Upon Completion
Gray SHALE, Damp		12-SS	100 for 2"	4.5+				
End of Boring @ 28.5'	30							
Boring drilled and sampled with 3¼" ID Augers Hole reamed with 6¼" ID Augers 4" dia. PVC Monitoring Well installed through 6¼" ID Hollow Stem Augers See Well Construction Details	35							519.5 27 492.5
Note A: Brown Fine SAND, Wet	40							

Lines of demarcation represent an approximate boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes, such as fill-to-natural soil zone transition.

MONITORING WELL CONSTRUCTION DIAGRAM



Well No.	A	B	C
GWM-5	15'	17'	30'
GWM-6	20'	22'	43'
GWM-7	20'	22'	43'
GWM-8	15'	17'	27.5'

GWM-8 521.2' top of casing

midwest engineering services, inc.

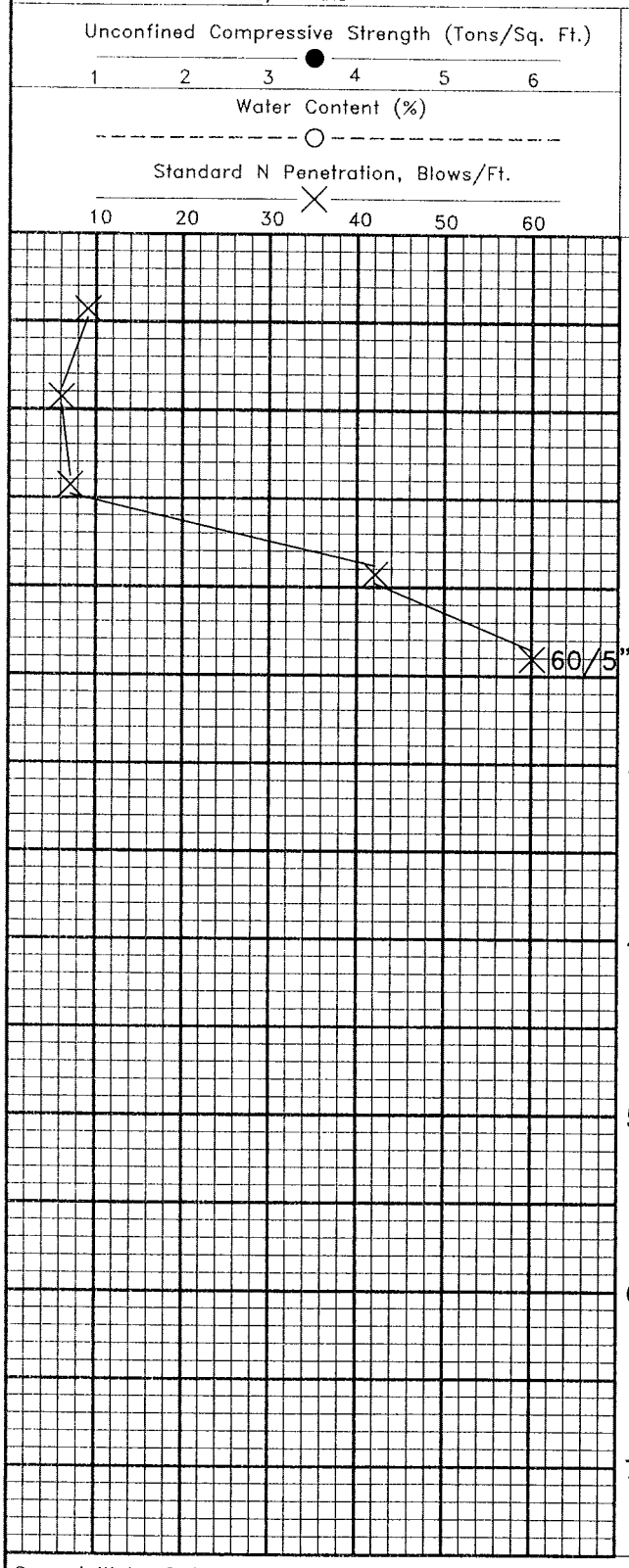
FIGURE 1
MONITORING WELL CONSTRUCTION DIAGRAM
Slurry Pond Expansion
Central Cleaning Plant
Coulterville, Illinois

PROJECT NUMBER: 7-33006

DATE: 1-11-93

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-8R



Sample No.	Type Sample	Sample Distance	Description of Material
			Surface Elevation
			3" Topsoil with crushed stone
1	ss		Brown Mottled Gray Silty CLAY (CL)
2	ss		Brown Mottled Gray Sandy CLAY(CL)
3	ss		Brown Fine to Medium SAND (SP)
			Brown Sandy CLAY (CL)
4	ss		Brown-Gray Wethered SHALE
5	ss		Gray Mottled Brown SHALE
			End of Boring @ -24.5'

Ground Water Data
Ground Water Encountered @ -12.0' During Drilling and @ -7.0' Upon Completion.

Project: **Gateway Mine Monitoring Well Installation Coulterville, Illinois**	**Date of Boring** **August 24, 2016**
Client: **Peabody Coulterville Mining, LLC Coulterville, Illinois**	**Project No.** **H-14222**

Holcomb Foundation Engineering Company

Monitoring Well Completion Report

Site # H-14222 County Randolph Well # W3-8R

Site Name Gateway Mine Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 8/24/2016

Driller B. Schwartz Geologist Tim Holcomb Date Completed: 8/24/2016

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags _____ lbs. per bag _____

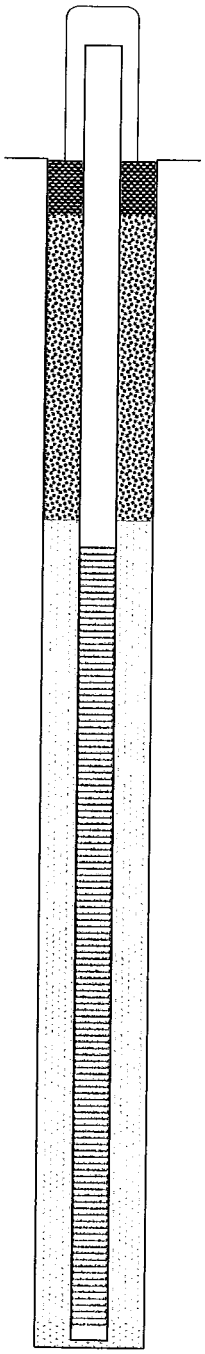
Type of Bentonite Seal (Granular, Pellet): Bentonite Chips

Amount of Bentonite: # of bags 3 lbs. per bag 50

Type of Sand Pack: FilterSil WG1

Source of Sand: Unimin - Junction City, GA

Amount of Sand: # of bags 6 lbs. per bag 50



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

2 ft. Concrete Seal

9 ft. Bentonite

-11.0 ft. Top of Sand

-12.0 ft. Top of Screen

11.5 ft. Total Screen Interval

-23.5 ft. Bottom of Screen

-24.5 ft. Bottom of Borehole

Well Construction Materials

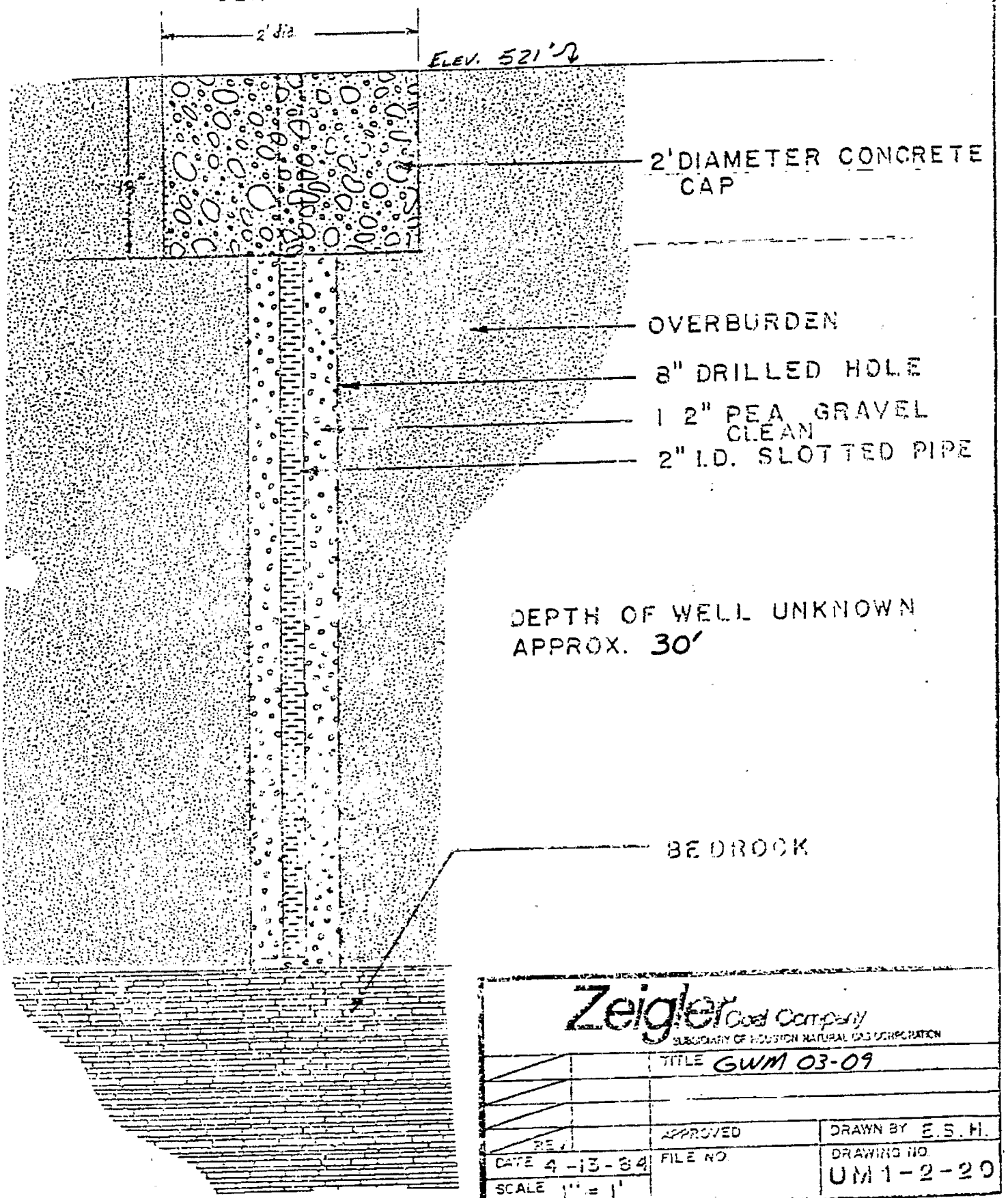
	Stainless Steel Specify Type		PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing			Steel	

Measurements to .1 ft. (where applicable)

Riser pipe length			15'	
Protective casing length				
Screen length			11.5'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	

Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

03-09 GROUNDWATER MONITORING WELL
CENTRAL CLEANING PLANT

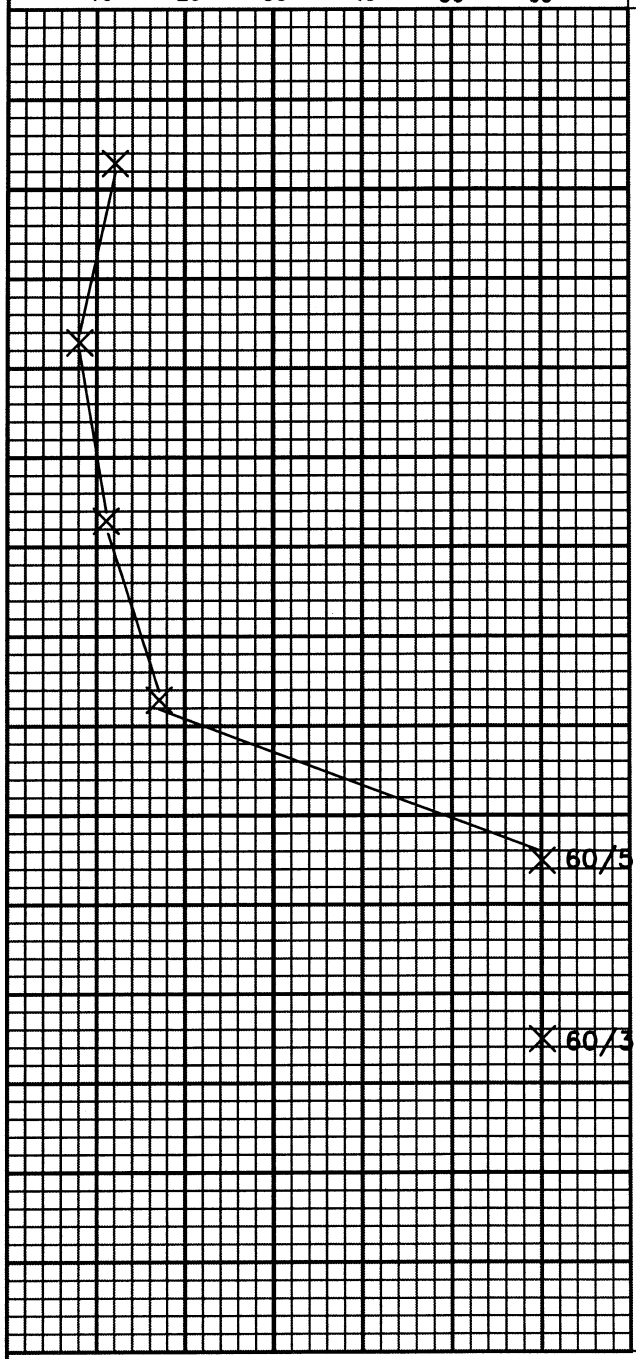


Zeigler Coal Company
SUBSIDIARY OF HOUSTON NATURAL GAS CORPORATION

	TITLE GWM 03-09	
REV	APPROVED	DRAWN BY E.S.H.
DATE 4-13-84	FILE NO.	DRAWING NO. UM 1-2-20
SCALE 1" = 1'		

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING MW10



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 507.0 FEET
				4" Topsoil
				Gray Mottled Brown Silty CLAY (CL) with fine sand
5	1	ss		
10	2	ss		Brown Mottled Gray Silty CLAY to CLAY(CL) with sand and pebbles
15	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
20	4	ss		
25	5	ss		Gray Sandy Shale 483 feet top of rock
30	6	ss		End of Boring @ −29.0'
35				

Ground Water Data
No Ground Water Encountered During Drilling.

Project: Gateway Mine Monitoring Well Installation Coulterville, Illinois	Date of Boring October 24, 2006
Client: Black Beauty Coal Company Coulterville, Illinois	Project No. H−06288

Holcomb Foundation Engineering Company

Monitoring Well Completion Report

Site # H-06288 County Randolph County Well # MW-10

Site Name Black Beauty Coal Gateway Mine Grid Coordinate Northing 30d10m36s 550267.37 Easting -89d38m50s 649346.61

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 10/24/2006

Driller Dan Russell Geologist Tim Holcomb Date Completed: 10/24/2006

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Soil

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags ____ lbs. per bag ____

Amount of bentonite: # of bags 2 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): N/A

Amount of bentonite: # of bags ____ lbs. per bag ____

Type of Sand Pack: 15-30

Source of Sand: FilterSil

Amount of Sand: # of bags 8 lbs. per bag 50

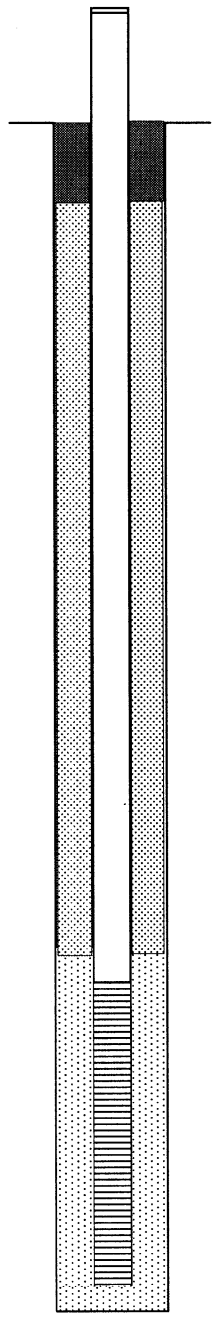
Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
**Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing				

Measurements to .1 ft. (where applicable)

Riser pipe length			10	
Protective casing length				
Screen length			19.8'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	

**Screen is prepacked with sand



509.6 MSL Top of Riser Pipe

507.0' MSL Ground Surface

1' Concrete Seal

-1.0 Top of Bentonite

4 ft.Bentonite Seal

-5.0' ft. Top of Sand

-7.0' ft. Top of Screen

20.0' ft. Total Screen Interval

-27.0 ft. Bottom of Screen

-27.0' ft. Bottom of Borehole

Completed by: T. Holcomb Surveyed by: G.White Ill. registration # 035-002808

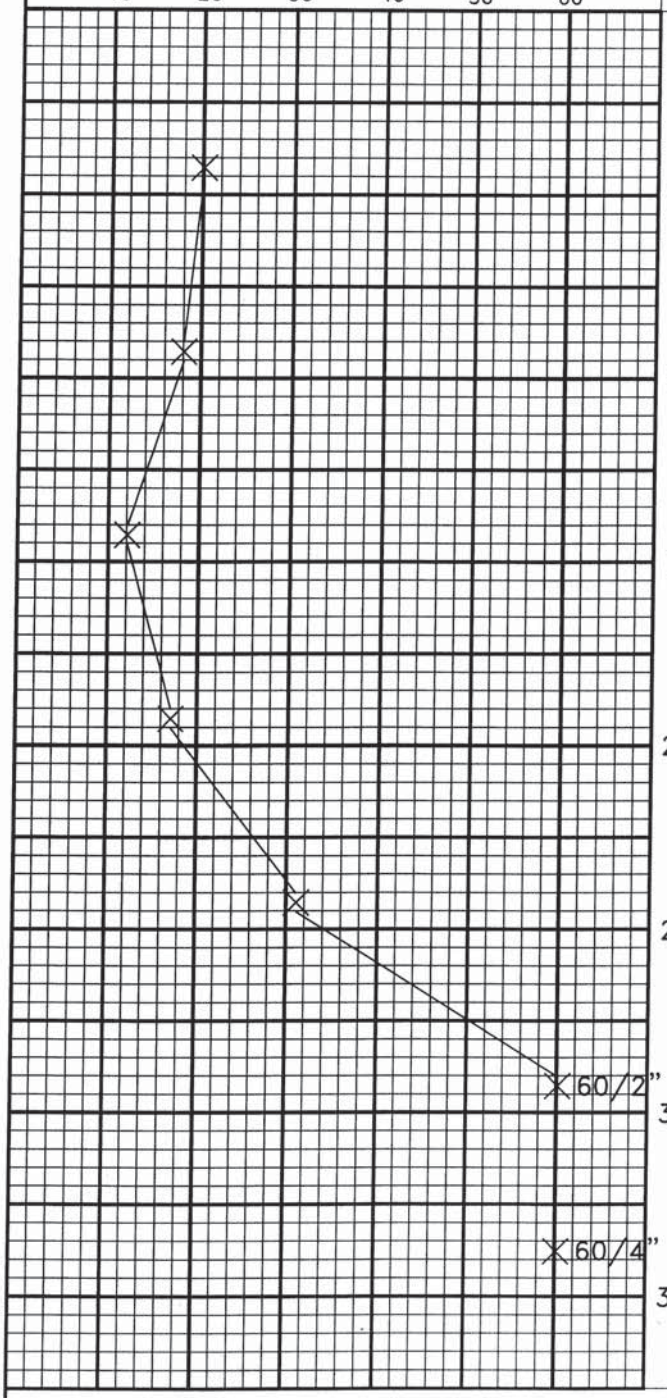
NAD27 Illinois State Plane West Zone in feet

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-11

Attachment 4.2.2.1
Revised 04/21/2021

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				4" Topsoil
				Gray Mottled Brown Silty CLAY (CL)
5	1	ss		
10	2	ss		
15	3	ss		Brown Mottled Gray Sandy CLAY(CL)
20	4	ss		Brown Mottled Gray Silty CLAY (CL)
25	3	ss		Brown Mottled Gray Weathered SHALE
30	6	ss		
35	7	ss		Gray SHALE
				End of Boring @ -34.0'

Ground Water Data
Ground Water Encountered @ -3.5' During Drilling.

Project: Monitoring Wells Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
November 28, 2011

Client: Peabody Energy
St. Louis, Missouri

Project No.
H-11043

Holcomb Foundation Engineering Company

Monitoring Well Report

Site # H-11043 Location Coulterville, Illinois Well # W3-11

Site Name Gateway Mine Slurry Cell 5 Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 11/28/2011

Driller Jeff Carter Geologist _____ Date Completed: 11/28/2011

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags 1 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): _____

Type of Sand Pack: FilterSil #1 10-20

Source of Sand: FilterSil Junction City, GA

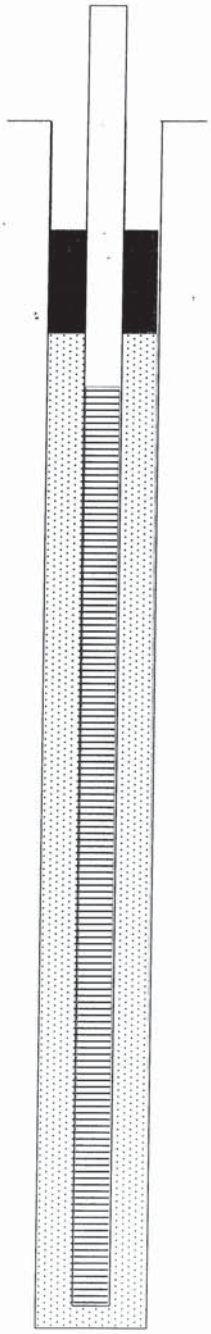
Amount of Sand: # of bags 12 lbs. per bag 50

Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
**Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing				Steel

Measurements to .1 ft. (where applicable)

Riser pipe length			7'	
Protective casing length			3'	
Screen length			30'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

2 ft. Concrete Seal

-2.0 ft. Top of Bentonite

1 ft. Bentonite Seal

-3.0 ft. Top of Sand

-4.0 ft. Top of Screen

30.0 ft. Total Screen Interval

-34.0 ft. Bottom of Screen

-34.0 ft. Bottom of Borehole

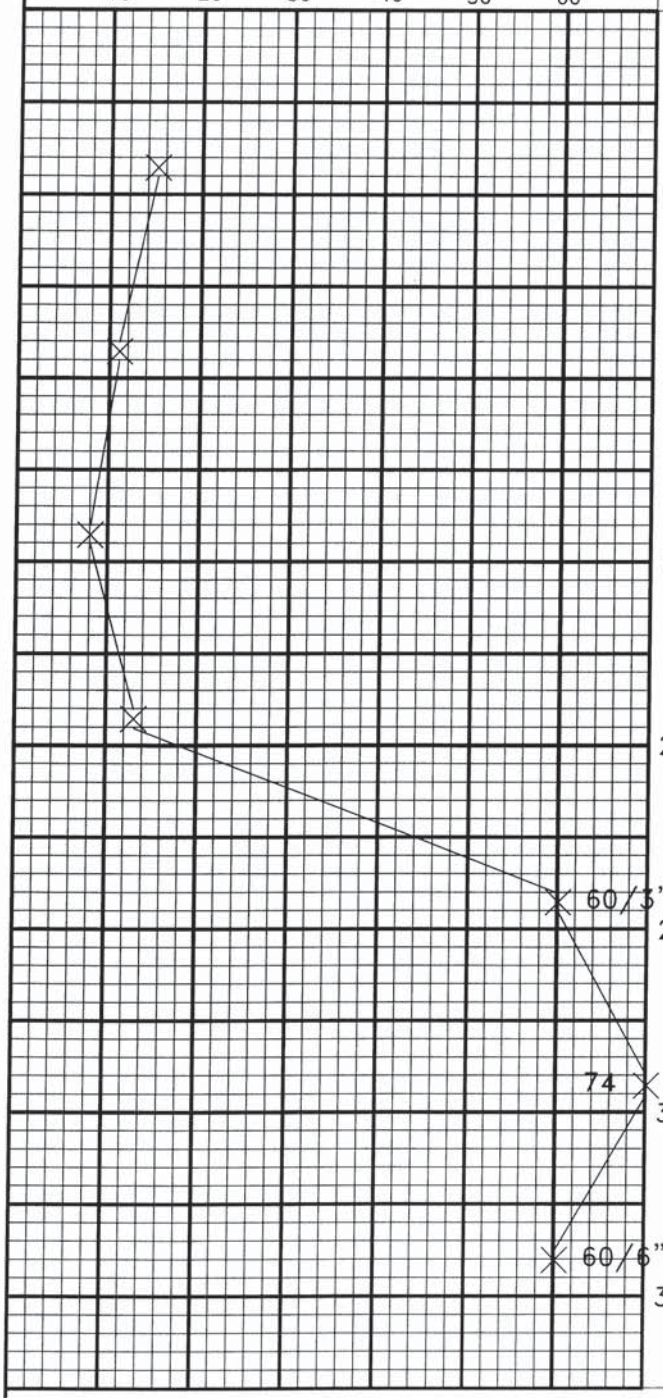
Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-12

Attachment 4.2.2.1
Revised 04/21/2021

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				4" Topsoil
				Gray Mottled Brown Silty CLAY (CL)
5	8.5	ss		
10	2	ss		
15	3	ss		Brown Mottled Gray Silty CLAY (CL)
20	4	ss		Brown Mottled Gray Silty CLAY (CL)
25	5	ss		Brown Mottled Gray Weathered SHALE
30	6	ss		
	7	ss		Gray SHALE
35				End of Boring @ -34.5'

Ground Water Data
Ground Water Encountered @ -21.0' During Drilling.

Project: Monitoring Wells Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
November 28, 2011

Client: Peabody Energy
St. Louis, Missouri

Project No.
H-11043

Holcomb Foundation Engineering Company

Monitoring Well Report

Site # H-11043 Location Coulterville, Illinois Well # W3-12

Site Name Gateway Mine Slurry Cell 5 Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 11/28/2011

Driller Jeff Carter Geologist _____ Date Completed: 11/28/2011

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags 1 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): _____

Type of Sand Pack: FilterSil #1 10-20

Source of Sand: FilterSil Junction City, GA

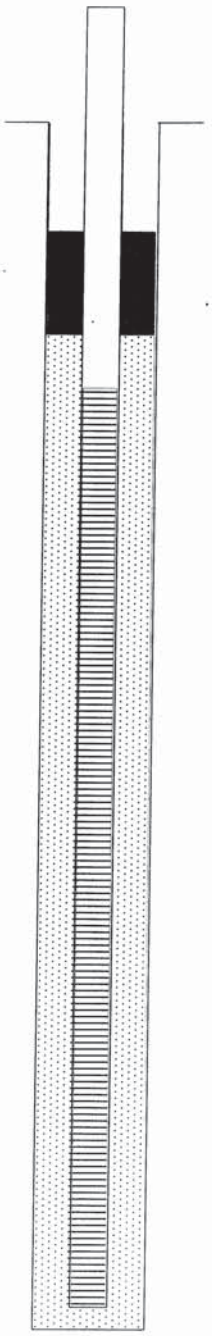
Amount of Sand: # of bags 13 lbs. per bag 50

Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
**Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing				Steel

Measurements to .1 ft. (where applicable)

Riser pipe length			7.5'	
Protective casing length			3'	
Screen length			30'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

1.5 ft. Concrete Seal

-1.5 ft. Top of Bentonite

1 ft. Bentonite Seal

-2.5 ft. Top of Sand

-3.0 ft. Top of Screen

30.0 ft. Total Screen Interval

-33.0 ft. Bottom of Screen

-34.5 ft. Bottom of Borehole

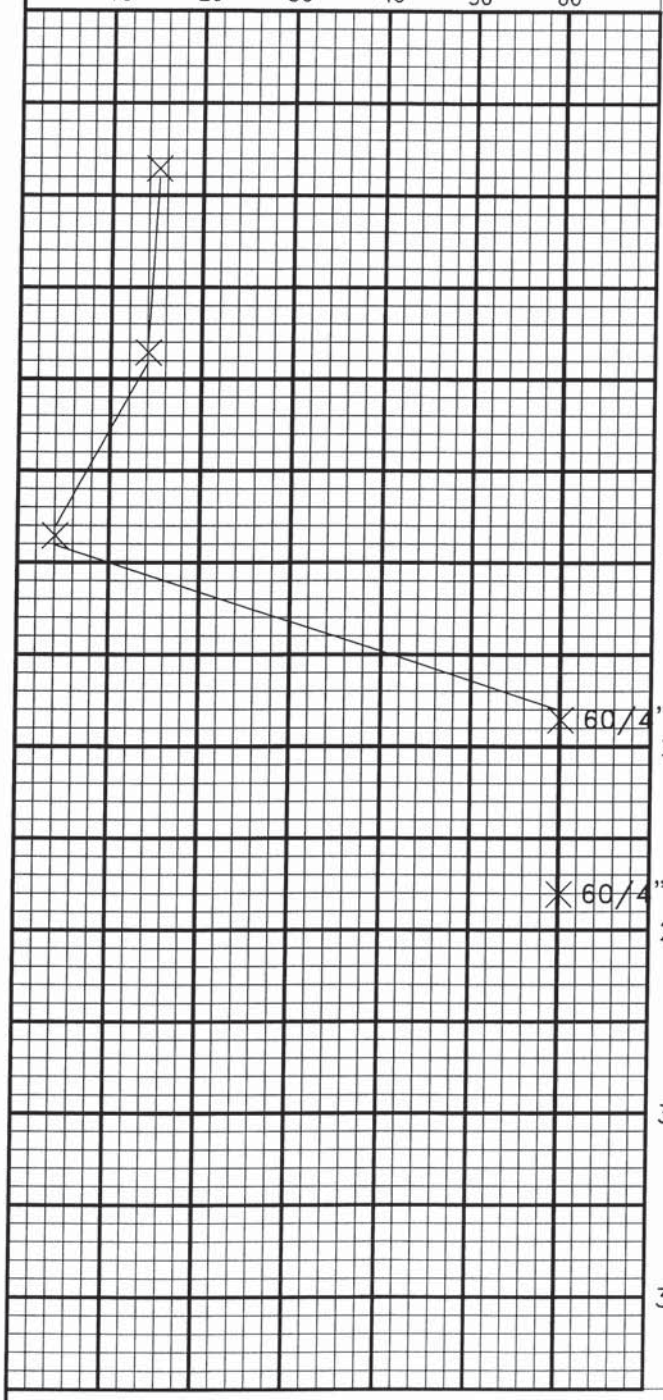
Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-13

Attachment 4.2.2.1
Revised 04/21/2021

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				Gray Mottled Brown Silty CLAY (CL)
5	1	ss		
10	2	ss		
15	3	ss		
20	4	ss		Gray Mottled Brown Weathered SHALE
25	5	ss		End of Boring @ −27.5'
30				
35				

Ground Water Data
Ground Water Encountered @ −13.5' During Drilling.

Project: Monitoring Wells Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
November 28, 2011

Client: Peabody Energy
St. Louis, Missouri

Project No.
H-11043

Holcomb Foundation Engineering Company

Monitoring Well Report

Site # H-11043 Location Coulterville, Illinois Well # W3-13

Site Name Gateway Mine Slurry Cell 5 Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 11/28/2011

Driller Jeff Carter Geologist _____ Date Completed: 11/28/2011

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags 1 lbs. per bag 50

Type of Bentonite Seal (Granular, Pellet): _____

Type of Sand Pack: FilterSil #1 10-20

Source of Sand: FilterSil Junction City, GA

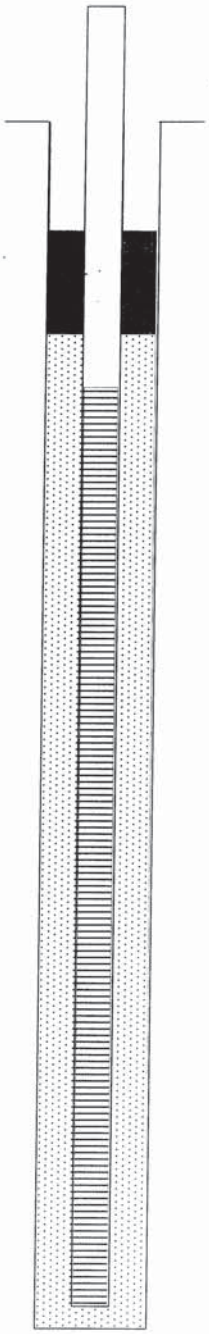
Amount of Sand: # of bags 9 lbs. per bag 50

Well Construction Materials

	Stainless Steel Specify Type	Teflon Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
**Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing				Steel

Measurements to .1 ft. (where applicable)

Riser pipe length			10.0'	
Protective casing length			3'	
Screen length			30'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

1.5 ft. Concrete Seal

-2.0 ft. Top of Bentonite

3 ft. Bentonite Seal

-5.0 ft. Top of Sand

-7.0 ft. Top of Screen

20.0 ft. Total Screen Interval

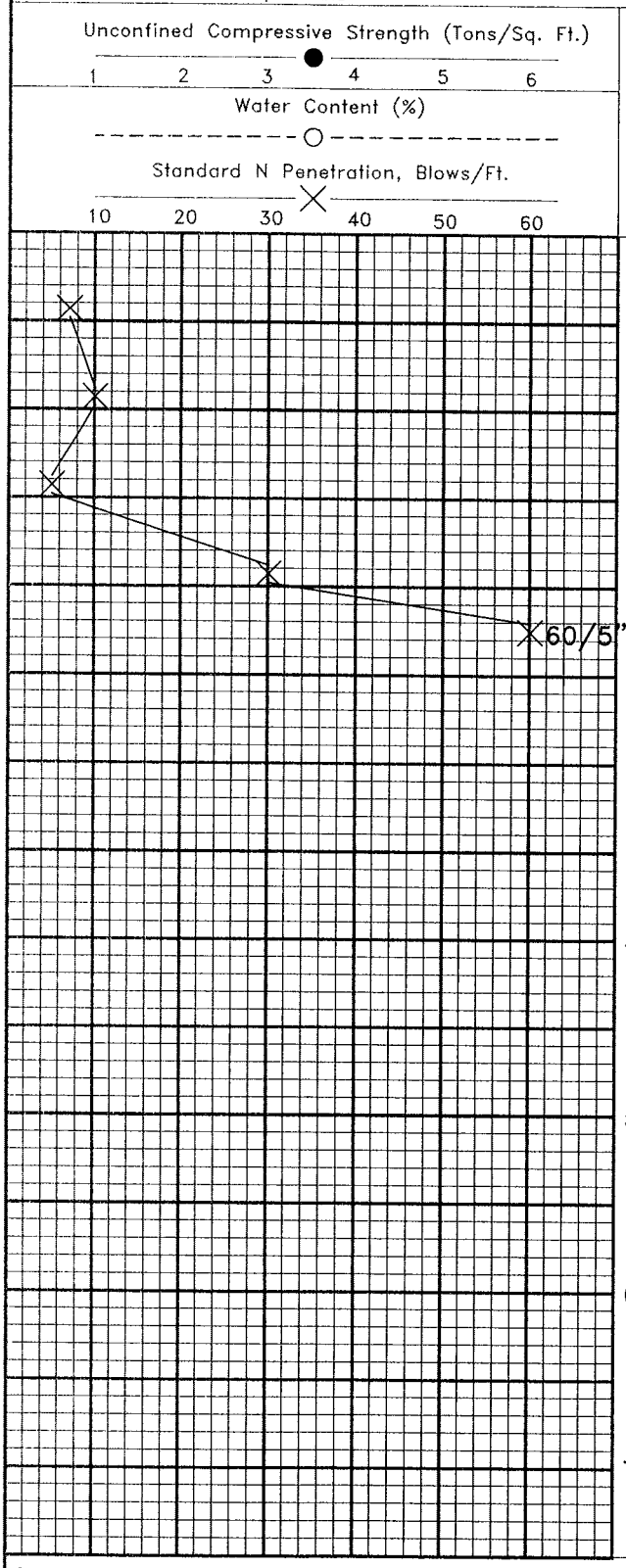
-27.0 ft. Bottom of Screen

-27.5 ft. Bottom of Borehole

Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-14



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				5" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
10	2	ss		Brown Mottled Gray Silty CLAY (CL) with trace sand
	3	ss		
20	4	ss		Brown Mottled Gray Sandy CLAY(CL)
				Brown-Gray Weathered SHALE
	5	ss		Brown SHALE
				End of Boring @ -23.5'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -13.5' During Drilling and @ -12.0' Upon Completion.

Project: **Gateway Mine Monitoring Well Installation Coulterville, Illinois**	**Date of Boring** **August 24, 2016**
Client: **Peabody Coulterville Mining, LLC Coulterville, Illinois**	**Project No.** **H-14222**

Holcomb Foundation Engineering Company

Monitoring Well Completion Report

Site # H-14222 County Randolph Well # W3-14

Site Name Gateway Mine Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 8/24/2016

Driller B. Schwartz Geologist Tim Holcomb Date Completed: 8/24/2016

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags _____ lbs. per bag _____

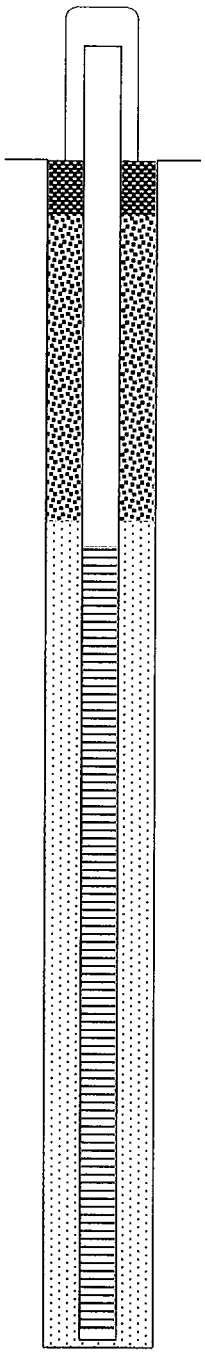
Type of Bentonite Seal (Granular, Pellet): Bentonite Chips

Amount of Bentonite: # of bags 3 lbs. per bag 50

Type of Sand Pack: FilterSil WG1

Source of Sand: Unimin - Junction City, GA

Amount of Sand: # of bags 6 lbs. per bag 50



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

2 ft. Concrete Seal

9 ft. Bentonite

-11.0 ft. Top of Sand

-12.0 ft. Top of Screen

11.5' ft. Total Screen Interval

-23.5 ft. Bottom of Screen

-23.5 ft. Bottom of Borehole

Well Construction Materials

	Stainless Steel Specify Type		PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing			Steel	

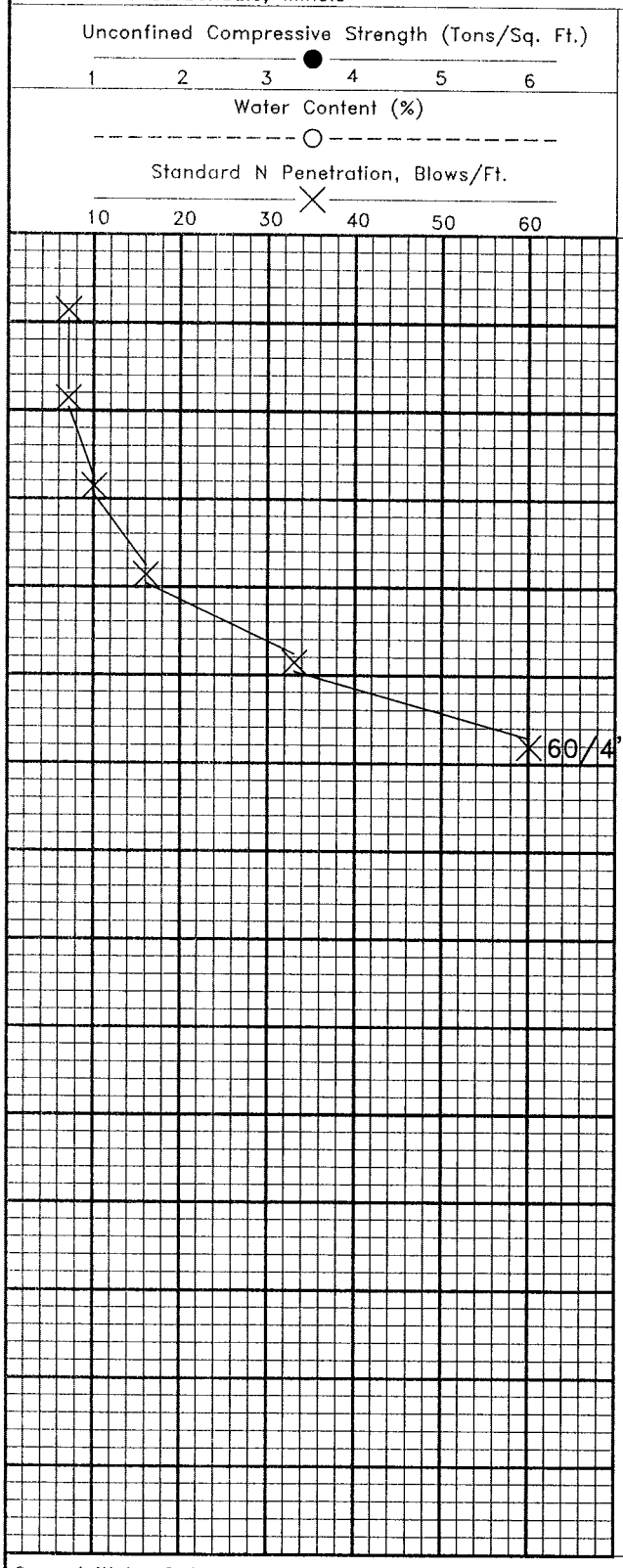
Measurements to .1 ft. (where applicable)

Riser pipe length			15'	
Protective casing length				
Screen length			11.5'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	

Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-15



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				4" Topsoil
				Gray Mottled Brown Silty CLAY (CL)
	1	ss		
10	2	ss		
	3	ss		Brown Mottled Gray Sandy CLAY(CL)
20	4	ss		Brown Sandy CLAY (CL)
	5	ss		
	6	ss		Brown Mottled Gray SHALE
30				End of Boring @ -30.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -13.0' During Drilling and @ -14.0' Upon Completion.

Project: **Gateway Mine Monitoring Well Installation Coulterville, Illinois**	**Date of Boring** **August 24, 2016**
Client: **Peabody Coulterville Mining, LLC Coulterville, Illinois**	**Project No.** **H-14222**

Holcomb Foundation Engineering Company

Monitoring Well Completion Report

Site # H-14222 County Randolph Well # W3-15

Site Name Gateway Mine Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 8/24/2016

Driller B. Schwartz Geologist Tim Holcomb Date Completed: 8/24/2016

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags _____ lbs. per bag _____

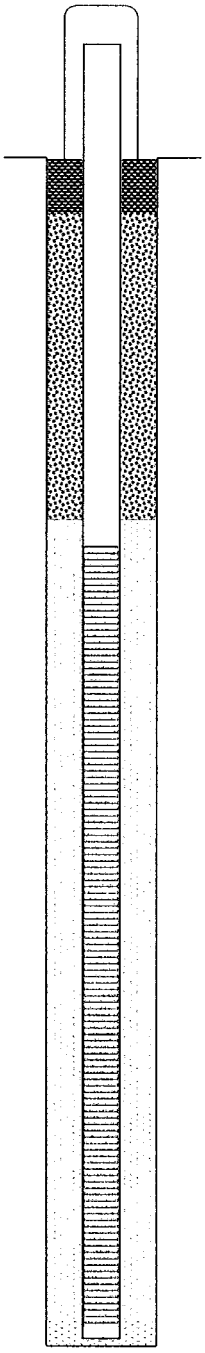
Type of Bentonite Seal (Granular, Pellet): Bentonite Chips

Amount of Bentonite: # of bags 3 lbs. per bag 50

Type of Sand Pack: FilterSil WG1

Source of Sand: Unimin - Junction City, GA

Amount of Sand: # of bags 6 lbs. per bag 50



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

2 ft. Concrete Seal

9 ft. Bentonite

-11.0 ft. Top of Sand

-12.0 ft. Top of Screen

18.0 ft. Total Screen Interval

-30.0 ft. Bottom of Screen

-30.0 ft. Bottom of Borehole

Well Construction Materials

	Stainless Steel Specify Type		PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing			Steel	

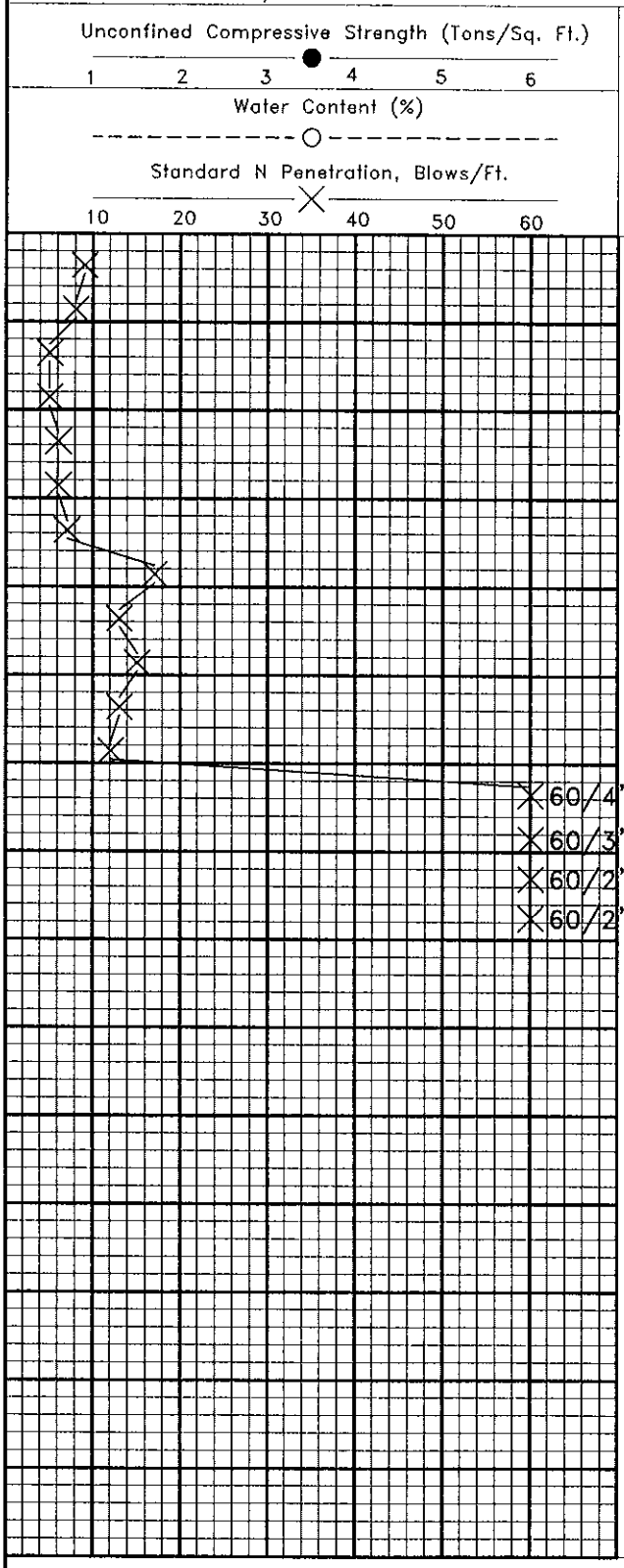
Measurements to .1 ft. (where applicable)

Riser pipe length			15'	
Protective casing length				
Screen length			18'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	

Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING W3-16



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		6" Topsoil
	2	ss		Brown Silty CLAY (CL)
	3	ss		Gray Silty CLAY (CL)
	4	ss		Brown Mottled Gray Silty CLAY (CL)
10	5	ss		
	6	ss		
	7	ss		
20	8	ss		Brown Silty CLAY (CL) with sand and pebbles
	9	ss		
	10	ss		
	11	ss		
30	12	ss		Gray Silty CLAY (CL) with sand
	13	ss		Brown Weathered SHALE
	14	ss		
	15	ss		Gray SHALE
40	16	ss		End of Boring @ -40.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -26.0' During Drilling and @ -13.0' Upon Completion.

Project: **Gateway Mine Slurry Cell Piezometers Coulterville, Illinois**	**Date of Boring** **April 23, 2015**
Client: **Peabody Coulterville Mining, LLC Coulterville, Illinois**	**Project No.** **H-14222**

Holcomb Foundation Engineering Company

Monitoring Well Completion Report

Site # H-14222 County Randolph Well # W3-16

Site Name Gateway Mine Grid Coordinate Northing _____ Easting _____

Drilling Contractor Holcomb Foundation Engineering Date Drilled Start: 4/23/2015

Driller J. Carter Geologist Tim Holcomb Date Completed: 4/23/2015

Drilling Method Hollow Stem Augers

Annular Space Details

Type of Surface Seal: Concrete

Type of Annular Sealant: Bentonite

Amount of Cement: # of bags _____ lbs. per bag _____

Amount of Bentonite: # of bags _____ lbs. per bag _____

Type of Bentonite Seal (Granular, Pellet): Bentonite Chips

Amount of Bentonite: # of bags 3 lbs. per bag 50

Type of Sand Pack: FilterSil Junction City, GA

Source of Sand:

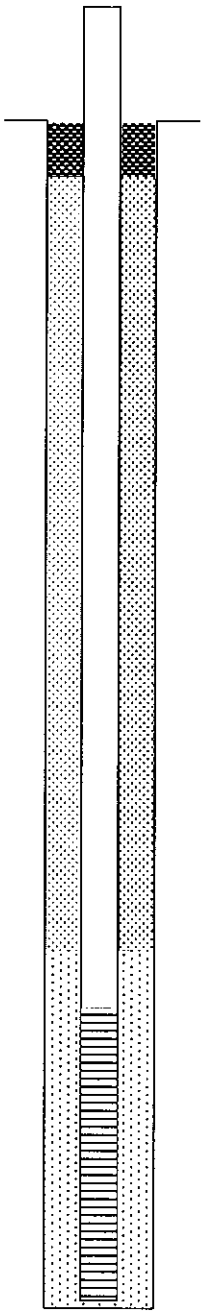
Amount of Sand: # of bags 19 lbs. per bag 50

Well Construction Materials

	Stainless Steel Specify Type		PVC Specify Type	Other Specify Type
Riser coupling joint			Sch 40	
Riser pipe above wt			Sch 40	
Riser pipe below wt			Sch 40	
Screen			Sch 40	
Coupling joint screen to riser			Sch 40	
Protective Casing			Steel	

Measurements to .1 ft. (where applicable)

Riser pipe length			15'	
Protective casing length				
Screen length			26'	
Bottom of screen to end cap			0.1'	
Top of screen to first joint			0.1'	
Total length of casing			---	
Screen slot size			0.010"	
% of openings in screen			---	
Diameter of borehole (in)			8.0"	
ID of riser pipe (in)			2.0"	



+3.0 MSL Top of Riser Pipe

0.0 MSL Ground Surface

2 ft. Concrete Seal

2 ft. Bentonite

-10.0 ft. Top of Sand

-12.0 ft. Top of Screen

26.0 ft. Total Screen Interval

-38.0 ft. Bottom of Screen

-40.0 ft. Bottom of Borehole

Northing	Easting	Elevation	Description
552559.6723	2449763.8334	537.31	Top W3-16
552558.2207	2449763.2871	534.54	Surface W3-16

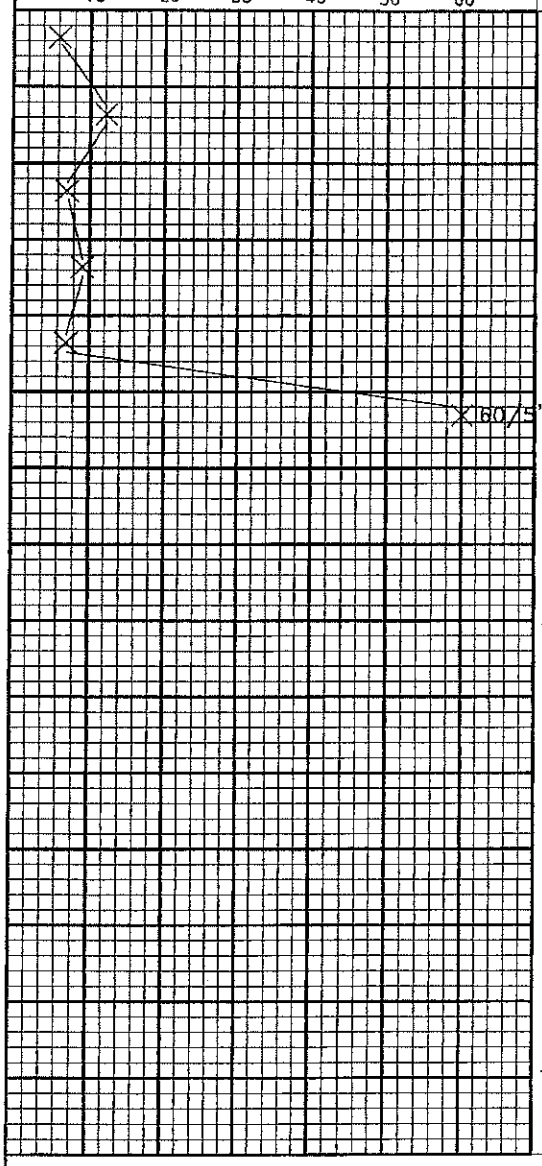
Completed by: T. Holcomb Surveyed by: _____ Ill. registration # _____

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 1

2,444,834 E
551,053 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 497.56
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown Silty CLAY(CL)
	3	ss		Gray Mottled Brown Sandy CLAY(CL)
	4	st		
10	5	ss		
	6	st		
	7	ss		Brown Sandy CLAY (CL) with pebbles
	8	st		
20	9	ss		Gray Mottled Brown Sandy CLAY(CL)
	10	st		
	11	ss		Gray SHALE
30				End of Boring @ −27.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −19.0' During Drilling and @ −17.0' Upon Completion.

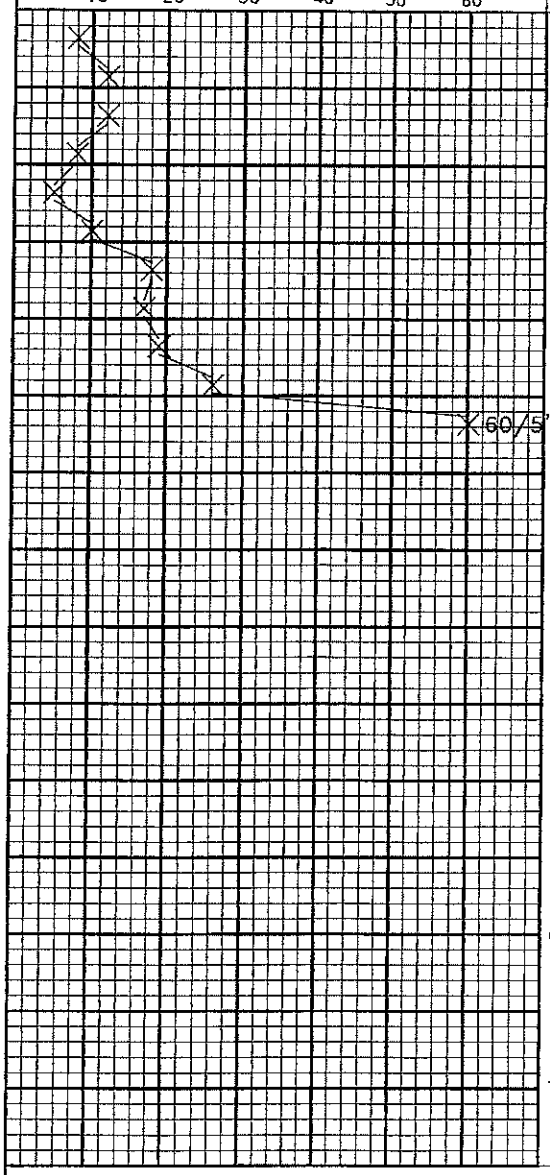
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 17, 2010
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 2

2,444,376 E
551,032 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 505.00
	1	ss		4" Topsoil
				Gray Mottled Brown Silty CLAY (CL)
	2	ss		Brown Mottled Gray Sandy CLAY(CL)
	3	ss		
10	4	ss		
	5	ss		
	6	ss		Gray Mottled Brown Sandy CLAY(CL)
	7	ss		Brown Mottled Gray Silty CLAY (CL) with sand
20	8	ss		
	9	ss		
	10	ss		Brown-Gray Weathered SHALE
	11	ss		Brown Mottled Gray SHALE
30				End of Boring @ -27.5'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ 12.0' During Drilling and @ -19.0' Upon Completion.

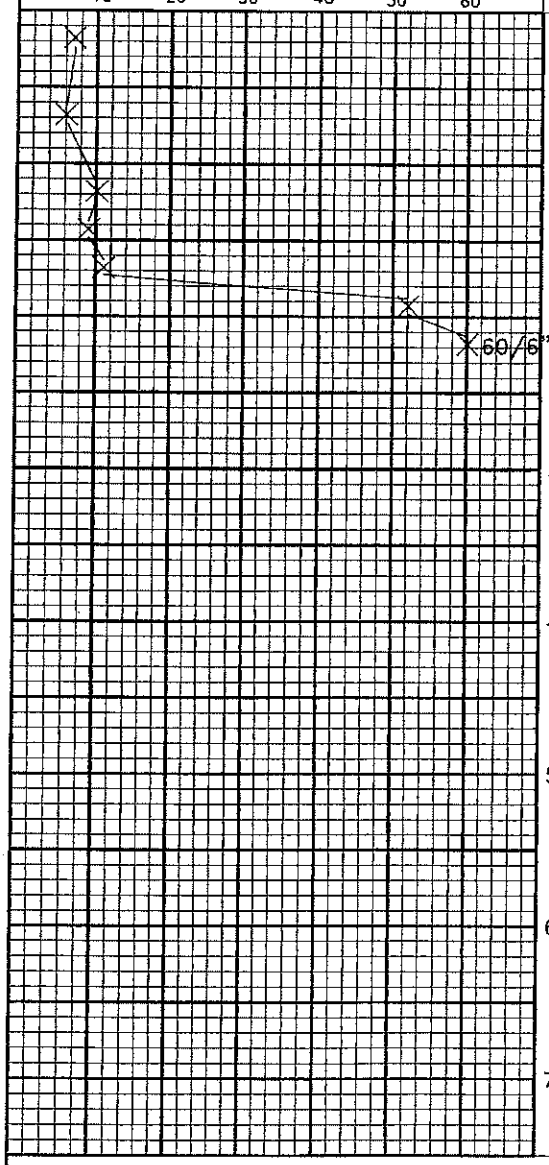
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring February 28, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 3

2,446,031 E
551,026 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 514.63
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	st		
	3	ss		
	4	st		
10				Gray Mottled Brown Sandy CLAY(CL)
	5	ss		Brown Mottled Gray Sandy CLAY(CL)
	6	ss		Gray Mottled Brown Sandy CLAY(CL)
	7	ss		
	8	ss		Brown Weathered SHALE
20	9	ss		Brown Mottled Gray SHALE
				End of Boring @ −22.5'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ 9.0' During Drilling and @ −14.0' Upon Completion.

Project: Proposed Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring: March 17, 2010

Client: Peabody Energy
St. Louis, Missouri

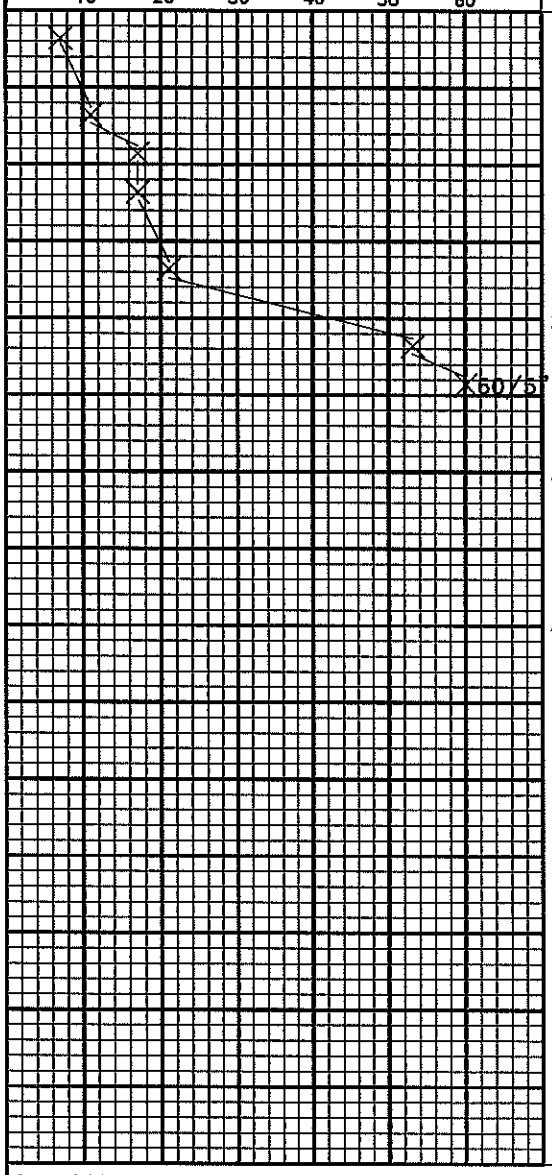
Project No.: H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 4

2,444,622 E
550,734 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 496.02
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown Silty CLAY(CL)
	3	ss		Brown Mottled Gray Sandy CLAY(CL)
10	4	ss		
	5	ss		Brown Sandy CLAY (CL) with gravel
	6	st		
	7	ss		
	8	st		
20				
	9	ss		
	10	ss		Brown-Gray Weathered SHALE
	11	rc		
30				Gray SHALE
				End of Boring @ -30.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -9.0' During Drilling.

Project: Proposed Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
March 18, 2010

Client: Peabody Energy
St. Louis, Missouri

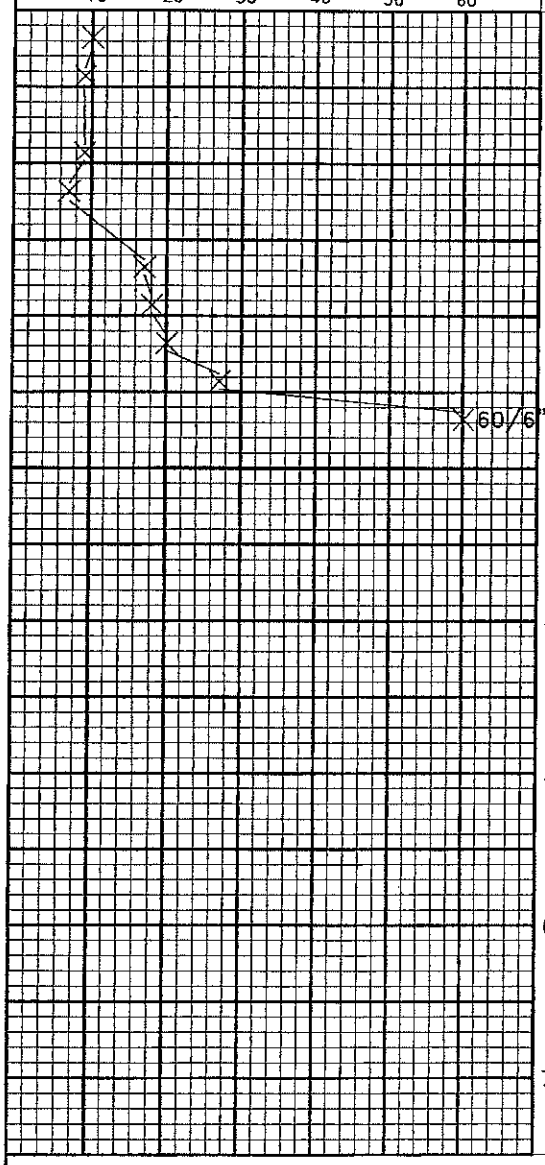
Project No.
H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 6

2,445,602 E
550,740 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 508.41
	1	ss		4" Topsoil
	2	ss		Brown Mottled Gray Silty CLAY (CL)
	3	st		Gray Mottled Brown Silty CLAY (CL)
	4	ss		Gray Mottled Brown Sandy CLAY(CL)
10	5	ss		
	6	st		
	7	ss		Brown Sandy CLAY (CL) with pebbles
20	8	ss		
	9	ss		
	10	ss		Brown-Gray Weathered SHALE
	11	ss		Brown Mottled Gray SHALE
30				End of Boring @ -27.5'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ 14.0' During Drilling and @ -12.0' Upon Completion.

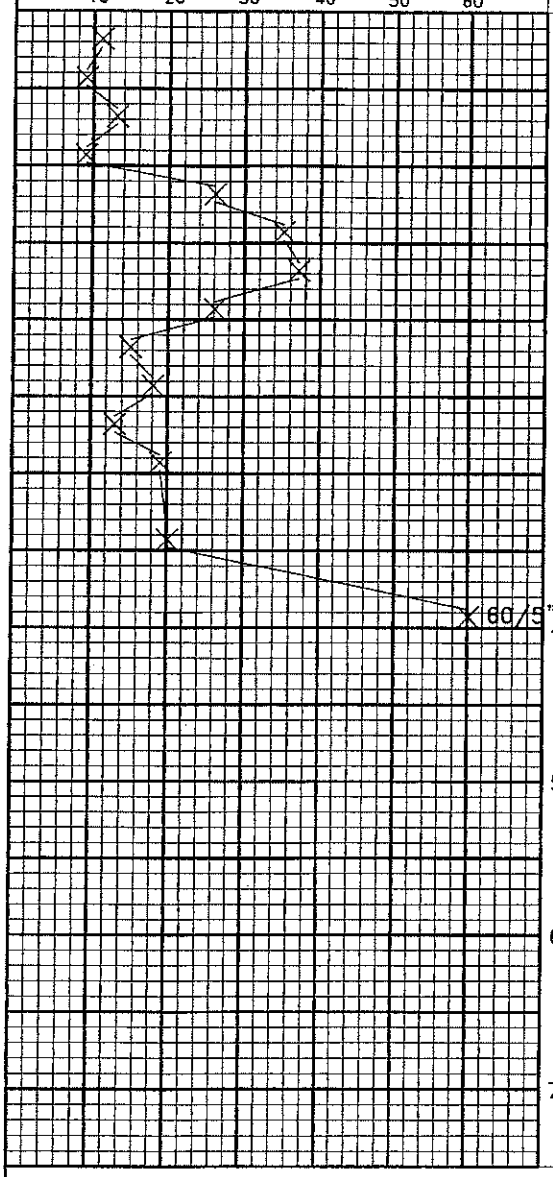
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 17, 2010
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 7

2,444,656 E
550,363 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 509.34
	1	ss		4" Topsoil
	2	ss		Brown Mottled Gray Silty CLAY (CL)
	3	ss		Brown Mottled Gray Sandy CLAY(CL)
10	4	ss		
	5	ss		Brown Mottled Gray Sandy CLAY(CL) with pebbles
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
30	12	ss		
	13	ss		
40	14	ss		Brown Mottled Gray SHALE
				End of Boring @ −40.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ 12.0' During Drilling and @ −17.0' Upon Completion.

Project: Proposed Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
February 28, 2011

Client: Peabody Energy
St. Louis, Missouri

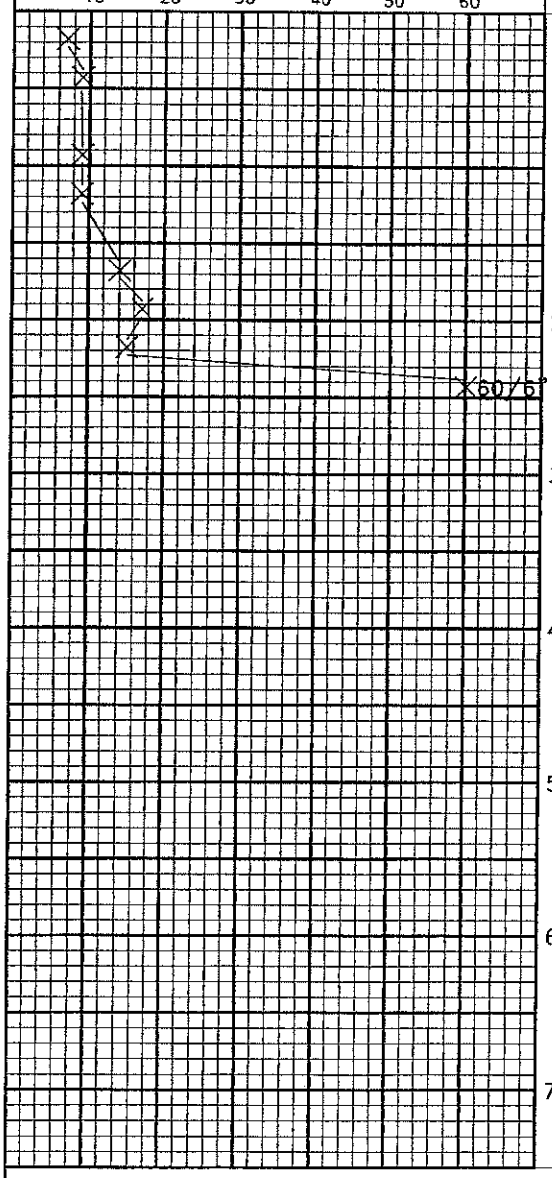
Project No.
H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 8

2,445,063 E
550,351 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 499.81
	1	ss		4" Topsoil
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	st		Brown Mottled Gray Sandy CLAY(CL)
	4	ss		Gray Mottled Brown Sandy CLAY(CL)
10	5	ss		Brown Sandy CLAY (CL)
	6	st		Brown Mottled Gray Sandy CLAY(CL)
	7	ss		
	8	ss		
20	9	ss		Brown Sandy CLAY (CL)
	10	ss		
				Brown Mottled Gray SHALE
				End of Boring @ −25.0'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −13.0' During Drilling and @ −15.0' Upon Completion.

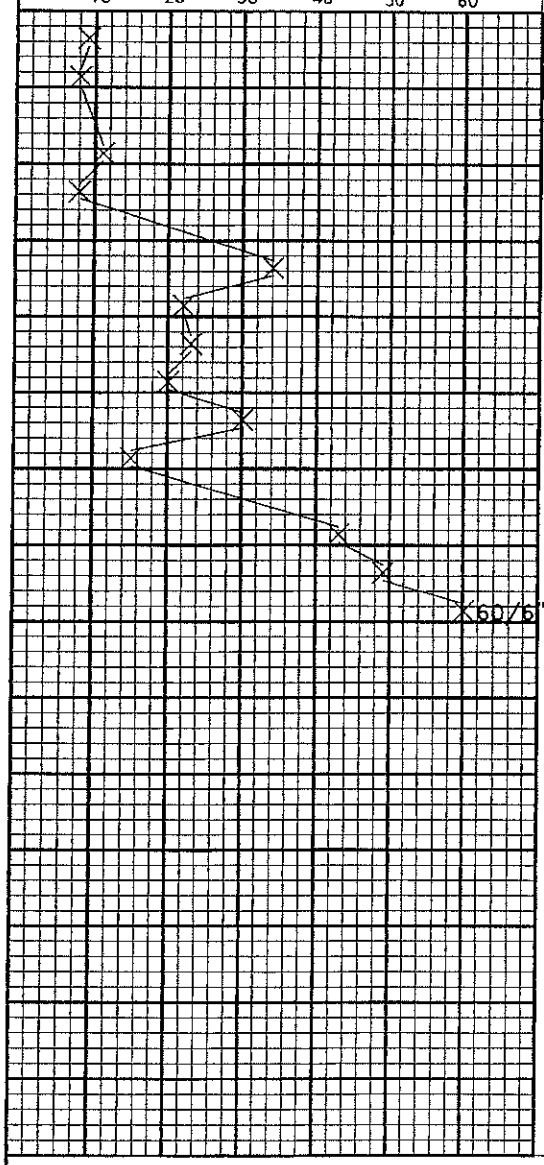
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 9

2,444,672 E
550,143 N

Unconfined Compressive Strength (Tons/Sq. Ft.) 1 2 3 4 5 6
Water Content (%)
Standard N Penetration, Blows/Ft. 10 20 30 40 50 60



Depth in Feet	Sample No	Type Sample	Sample Distance	Description of Material
				Surface Elevation 511.71
	1	ss		4" Topsoil
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	st		Gray Mottled Brown Sandy CLAY(CL)
10	4	ss		
	5	ss		
	6	st		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		
	11	ss		
30	12	ss		Brown Sandy CLAY (CL) with pebbles
	13	ss		Brown-Gray Weathered SHALE
	14	ss		
40	15	ss		Brown Mottled Gray SHALE
				End of Boring @ -40.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -14.0' During Drilling and Plugged Upon Completion.

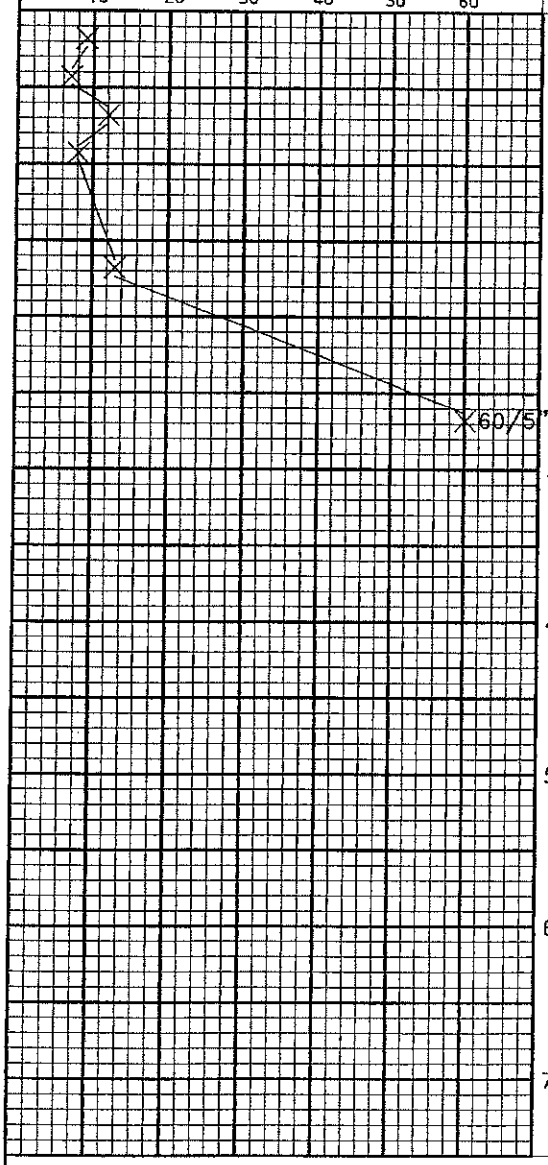
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 17, 2010
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 10

2,445,063 E
550,156 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 507.09
	1	ss		4" Topsoil
	2	ss		Brown Mottled Gray Silty CLAY (CL)
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
10	4	ss		
	5	st		
	6	st		
	7	ss		
20	8	st		Gray Silty CLAY (CL) with sand and pebbles
	9	st		Brown Mottled Gray Weathered SHALE
	10	st		
	11	ss		
30				End of Boring @ −27.5'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −11.0' During Drilling and Dry Upon Completion.

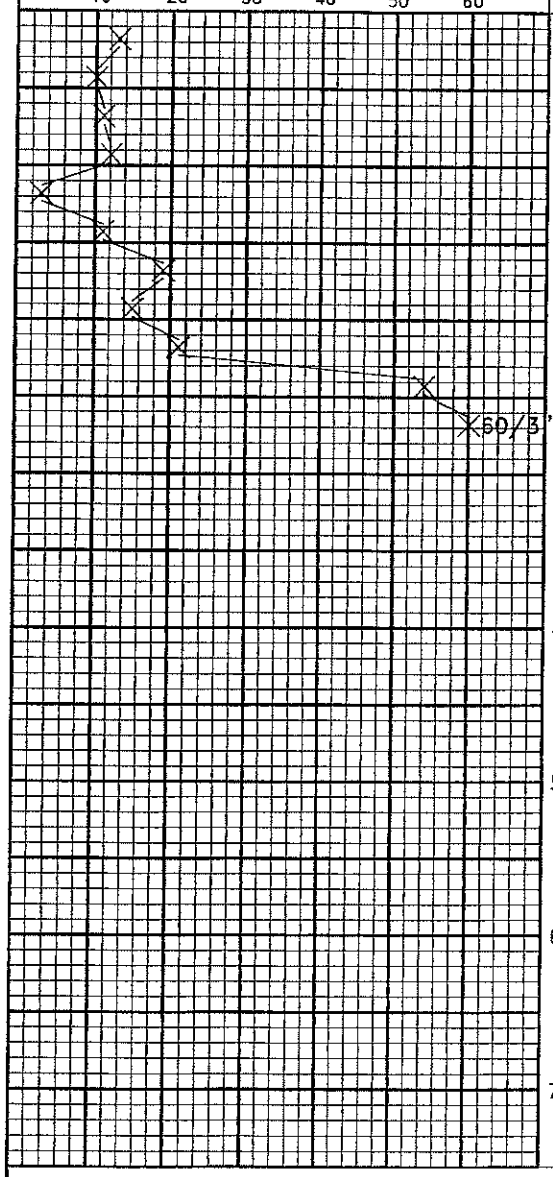
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring May 9, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 11

2,445,613 E
550,034 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 512.88
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		Brown Mottled Gray Sandy CLAY(CL)
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
20	8	ss		
	9	ss		
	10	ss		Brown-Gray Weathered SHALE
	11	ss		Brown Mottled Gray SHALE
30				End of Boring @ -27.5'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ 13.0' During Drilling and @ -16.0' Upon Completion.

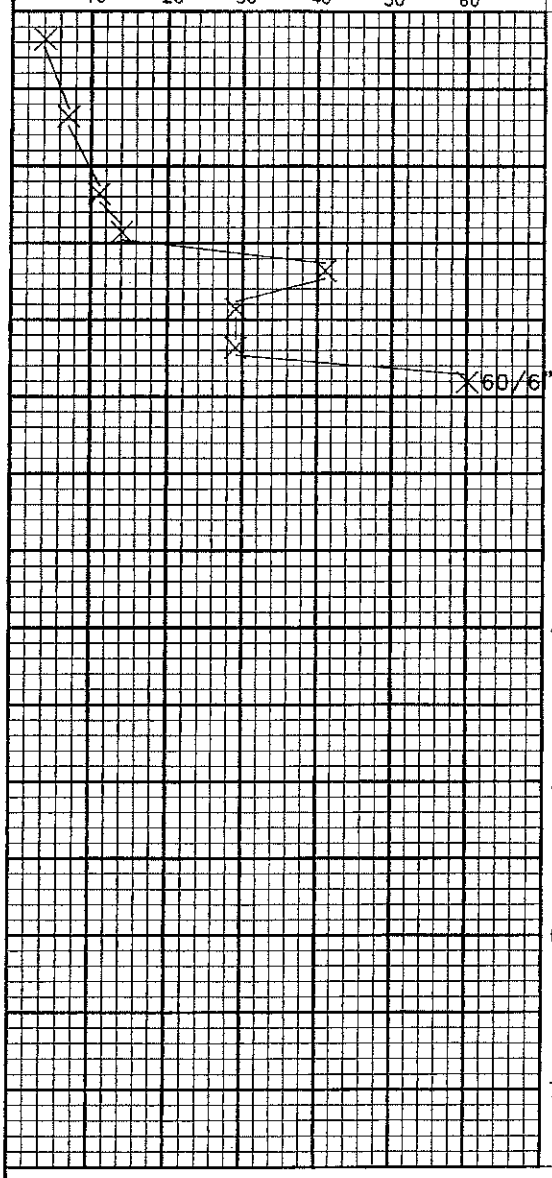
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring February 28, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 12

2,444,736 E
549,192 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



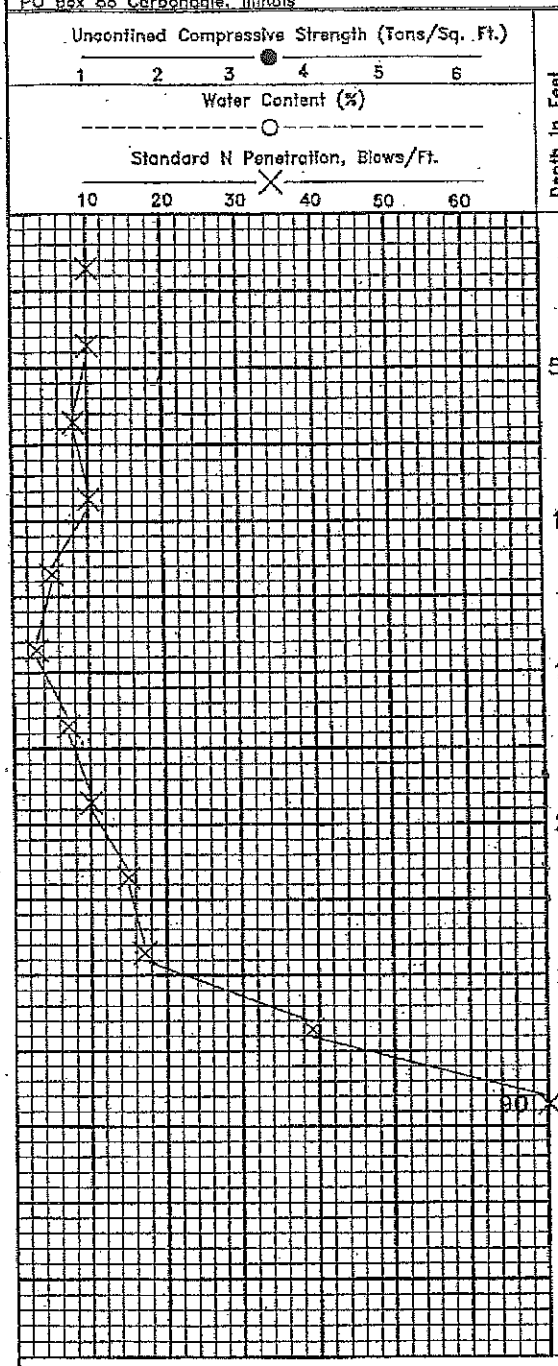
Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 515.72
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	st		
	3	ss		Brown Mottled Gray Silty CLAY (CL)
	4	st		Brown Mottled Gray Sandy CLAY(CL)
10	5	ss		
	6	ss		
	7	ss		
	8	ss		Brown Weathered SHALE
20	9	ss		Brown Mottled Gray SHALE
	10	ss		
				End of Boring @ −24.5
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −14.0' During Drilling and Plugged Upon Completion.

Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 12R



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 521.86
	1	ss		Gray Mottled Brown Silty CLAY (CL) with fine sand
5	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY to CLAY (CL) with sand and pebbles
10	4	ss		
	5	ss		
	6	ss		
15				Gray Sandy CLAY (CL)
	7	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
20	8	ss		
	9	ss		Gray Mottled Brown Silty CLAY to CLAY (CL) with sand and pebbles
25	10	ss		
	11	ss		Brown Mottled Gray Weathered Shale
30	12	ss		End of Boring @ -30.0'
35				

Ground Water Data
Ground Water Encountered @ -14.5' During Drilling.

Project: Proposed Impoundment Cell No. 4
Gateway Mine Coulterville, Illinois

Date of Boring: March 15, 2006

Client: Peabody Energy
Coulterville, Illinois

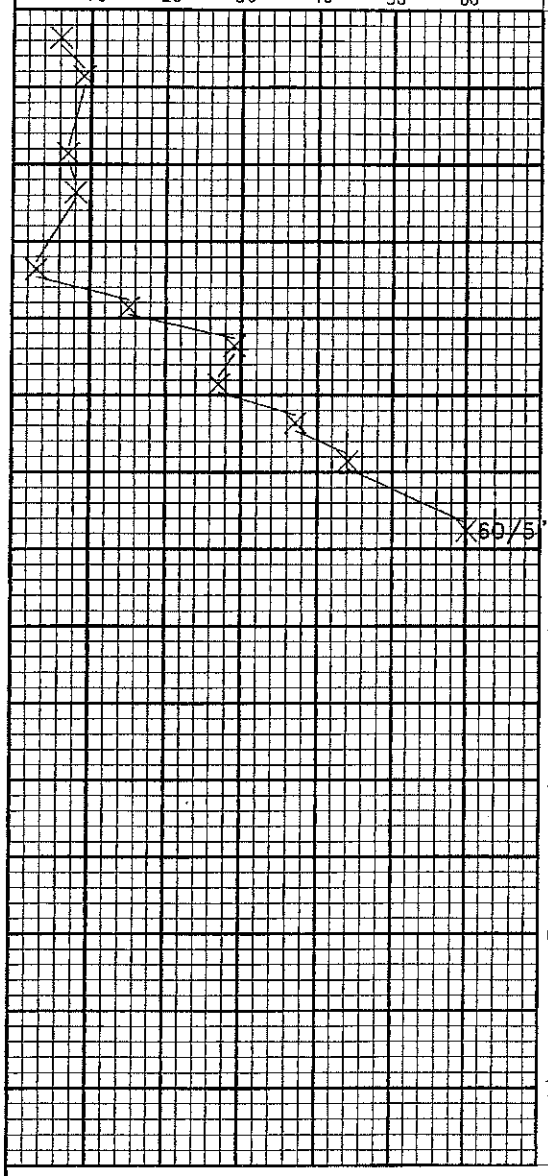
Project No. H-06050

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 13

2,445,182 E
549,189 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 523.35
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		
	3	st		
10	4	ss		Brown Mottled Gray CLAY (CL) with sand
	5	ss		
	6	st		Brown Mottled Gray Sandy CLAY(CL)
	7	ss		Brown Clayey SAND (SC)
20	8	ss		Brown Sandy CLAY (CL)
	9	ss		Gray Sandy CLAY (CL)
	10	ss		
	11	ss		Gray Mottled Brown SHALE
30	12	ss		
	13	ss		Gray SHALE
				End of Boring @ −34.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −16.0' During Drilling and None Upon Completion.

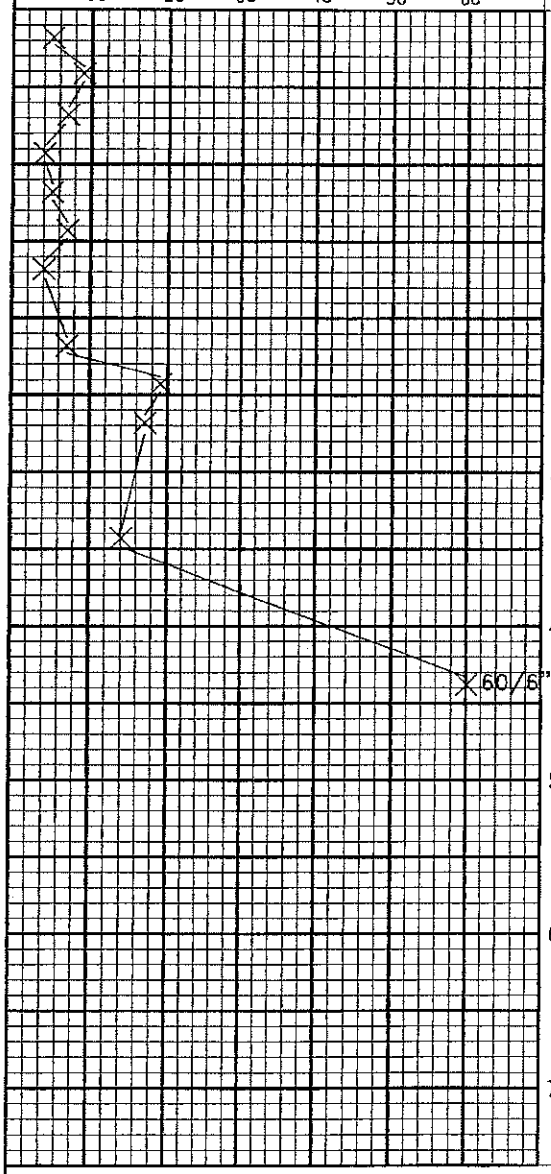
Project: Proposed Sturry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 15, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 14

2,445,648 E
549,182 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 535.59
				4" Topsoil
	1	ss		Brown Mottled Gray Silty CLAY (CL)
	2	ss		
	3	ss		
10	4	ss		Brown Sandy CLAY (CL)
	5	ss		
	6	ss		
	7	ss		
20	8	st		
	9	ss		
	10	ss		Gray Sandy CLAY (CL)
	11	ss		
30	12	st		
	13	ss		
40	14	st		
	15	ss		Gray SHALE
				End of Boring @ −44.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −14.0' Upon Completion.

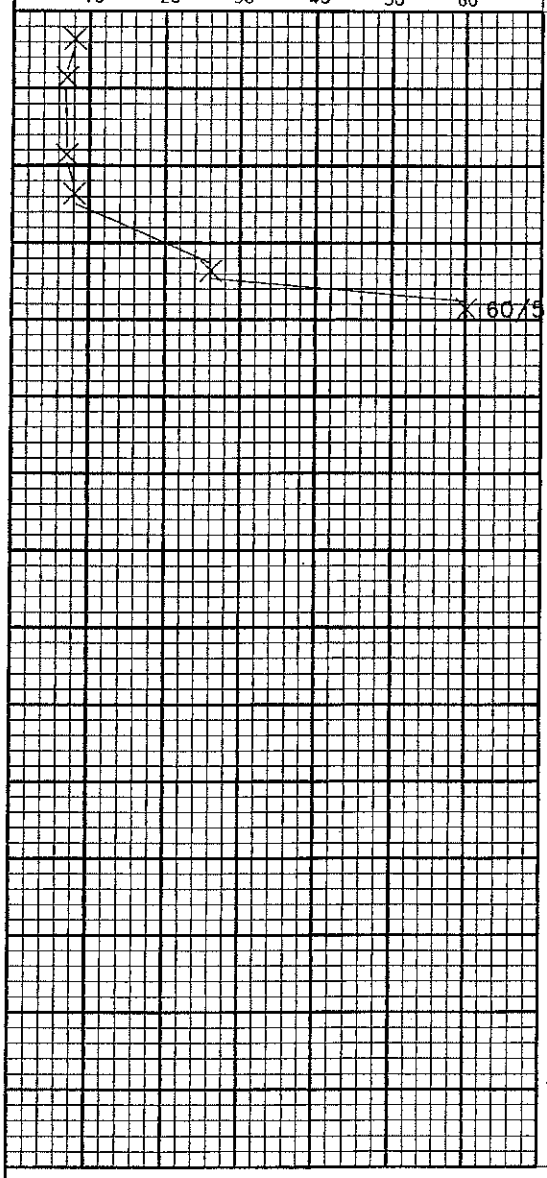
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 15, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 15

2,444,741 E
548,747 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 514.11
	1	ss		4" Topsoil
				Gray Silty CLAY (CL)
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	st		
10	4	ss		
	5	ss		
	6	st		
	7	ss		Brown–Gray Weathered SHALE
20	8	ss		Brown Mottled Gray SHALE
				End of Boring @ –20.0'

Ground Water Data
Ground Water Encountered @ –12.0' During Drilling and @ –7.0' Upon Completion.

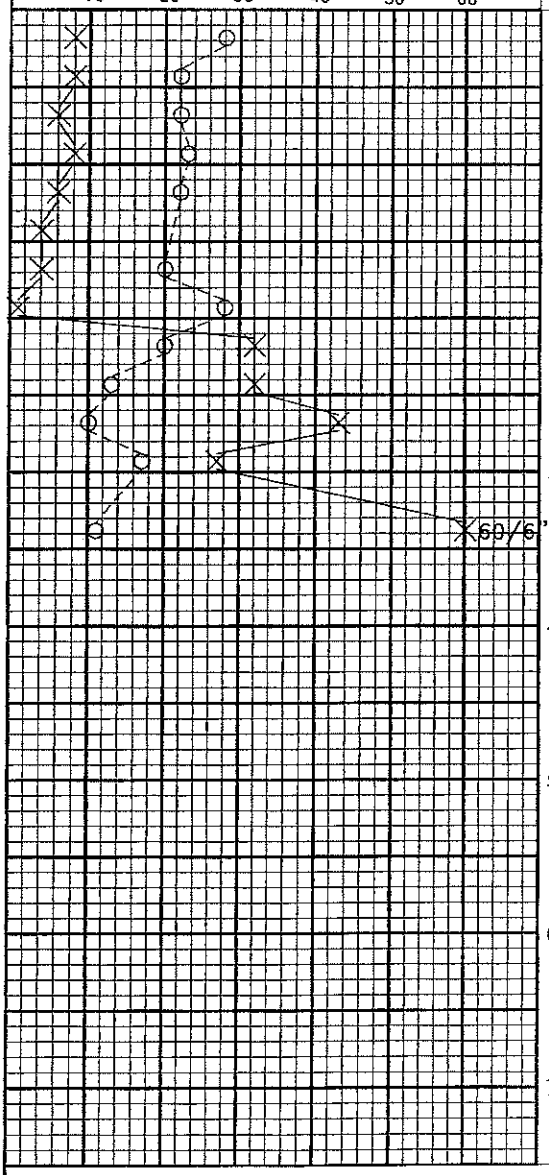
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H–11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 16

2,445,213 E
548,689 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 528.10
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		
	3	ss		Brown Mottled Gray Silty CLAY (CL)
	4	ss		Brown Sandy CLAY (CL)
10	5	ss		
	6	ss		
	7	ss		
	8	ss		Brown Clayey SILT (ML)
20	9	ss		
	10	ss		Brown Sandy CLAY (CL)
	11	ss		
	12	ss		Gray Silty CLAY (CL)
30	13	ss		Gray SHALE
				End of Boring @ −34.0'
40				
50				
60				
70				

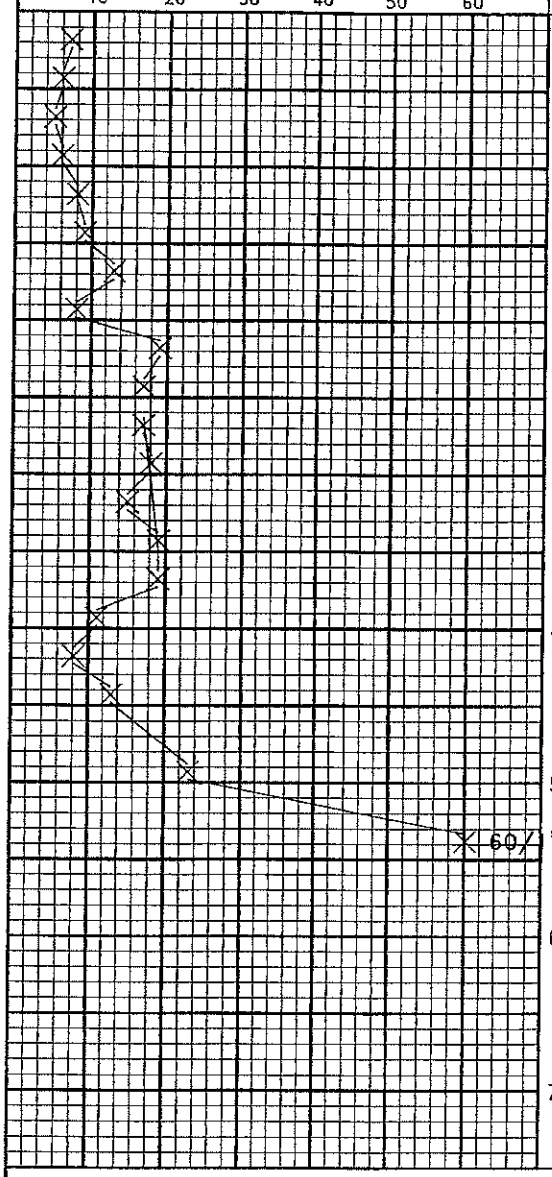
Ground Water Data
Ground Water Encountered @ −16.0' During Drilling and @ −29.0' Upon Completion.

Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring April 5, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 17

2,445,676 E
548,773 N



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 549.10
	1	ss		4" Topsoil
	2	ss		Brown Silty CLAY (CL)
	3	ss		Brown Sandy CLAY (CL)
10	4	ss		
	5	ss		
	6	ss		
	7	ss		Brown Mottled Gray Sandy CLAY(CL) with pebbles
20	8	ss		
	9	ss		Gray Mottled Brown Sandy CLAY(CL) with pebbles
	10	ss		
	11	ss		
30	12	ss		
	13	ss		
	14	ss		
	15	ss		
40	16	ss		
	17	ss		
	18	ss		
50	19	ss		Brown–Gray Weathered SHALE
	20	ss		Gray LIMESTONE
				End of Boring @ −54.0'
60				
70				

Ground Water Data
Ground Water Encountered @ 19.0' During Drilling and @ −22.0' Upon Completion.

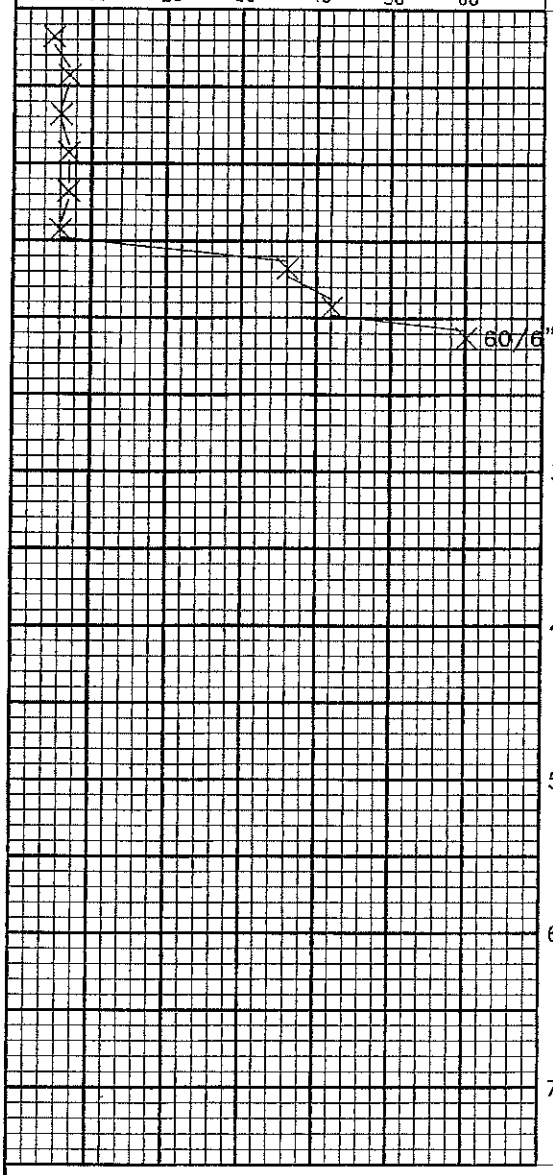
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring February 25, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 18

2,444,761 E
548,311 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 517.93
	1	ss		4" Topsoil
				Brown Mottled Gray Silty CLAY (CL)
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	ss		Gray Mottled Brown Sandy CLAY(CL)
10	4	ss		
	5	ss		Brown Mottled Gray Sandy CLAY(CL)
	6	ss		
	7	ss		Brown Mottled Gray Weathered SHALE
20	8	ss		
	9	ss		Gray SHALE
				End of Boring @ −22.0'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −4.0' Upon Completion.

Project: Proposed Slurry Cell No. 5
Gateway Mine Coulterville, Illinois

Date of Boring
February 28, 2011

Client: Peabody Energy
St. Louis, Missouri

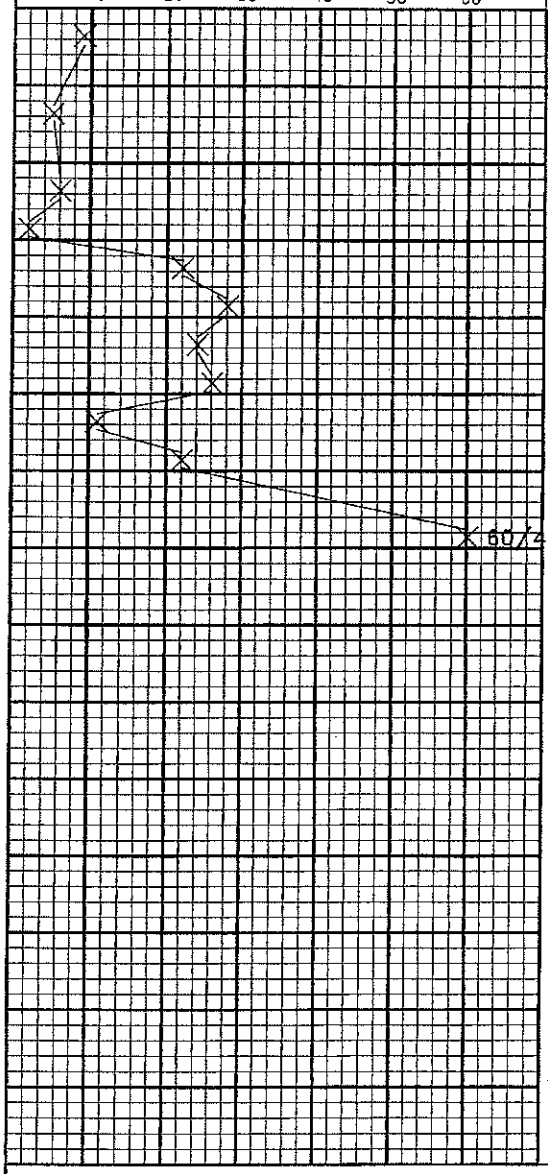
Project No.
H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 19

2,445,229 E
548,323 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth In Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 535.50
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown Silty CLAY (CL)
	3	ss		Brown Mottled Gray Silty CLAY (CL) with sand
10	4	st		
	5	ss		Brown Sandy CLAY (CL)
	6	ss		
	7	ss		Brown Silty CLAY (CL) with sand
20	8	ss		
	9	ss		Brown Sandy SILT (ML)
	10	ss		
	11	ss		Gray Sandy CLAY (CL)
30	12	ss		
	13	ss		Gray SHALE
				End of Boring @ −35.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −6.0' Upon Completion.

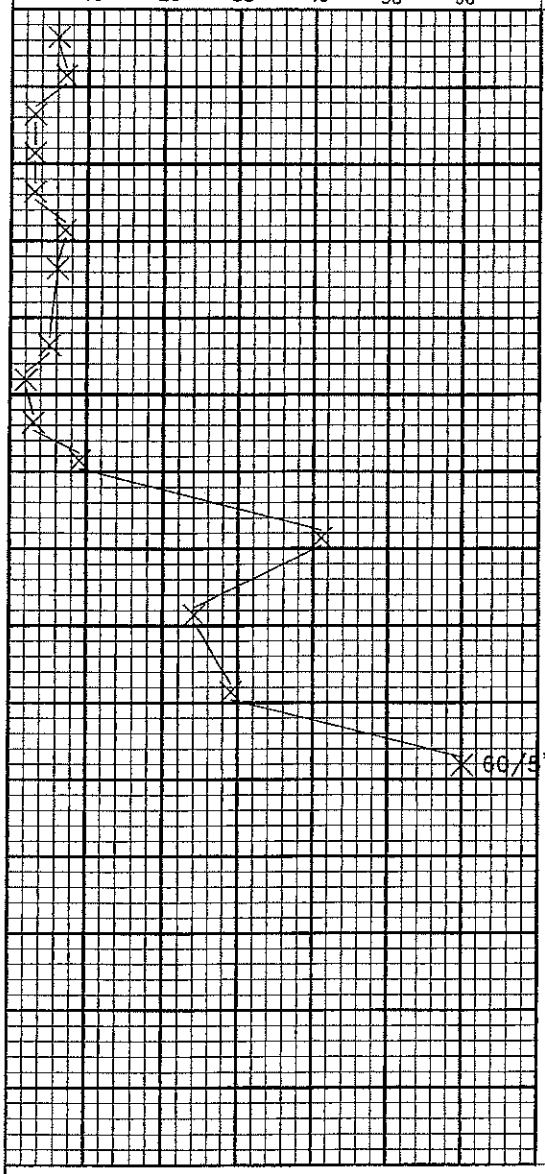
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 20

2,445,690 E
548,318 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 549.87
				4" Topsoil
	1	ss		Brown Silty CLAY (CL)
	2	ss		
	3	ss		
10	4	ss		Brown Sandy CLAY (CL)
	5	ss		
	6	ss		
	7	ss		
20	8	st		
	9	ss		Brown Fine to Medium SAND (SP)
	10	ss		Brown Fine to Medium SAND (SP) with gravel
	11	ss		
30	12	ss		Brown Clayey SAND (SC) with grave
	13	ss		Gray Sandy CLAY (CL) with pebbles
40	14	ss		
	15	ss		
50	16	ss		Gray SHALE
				End of Boring @ −49.5'
60				
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −8.0' Upon Completion.

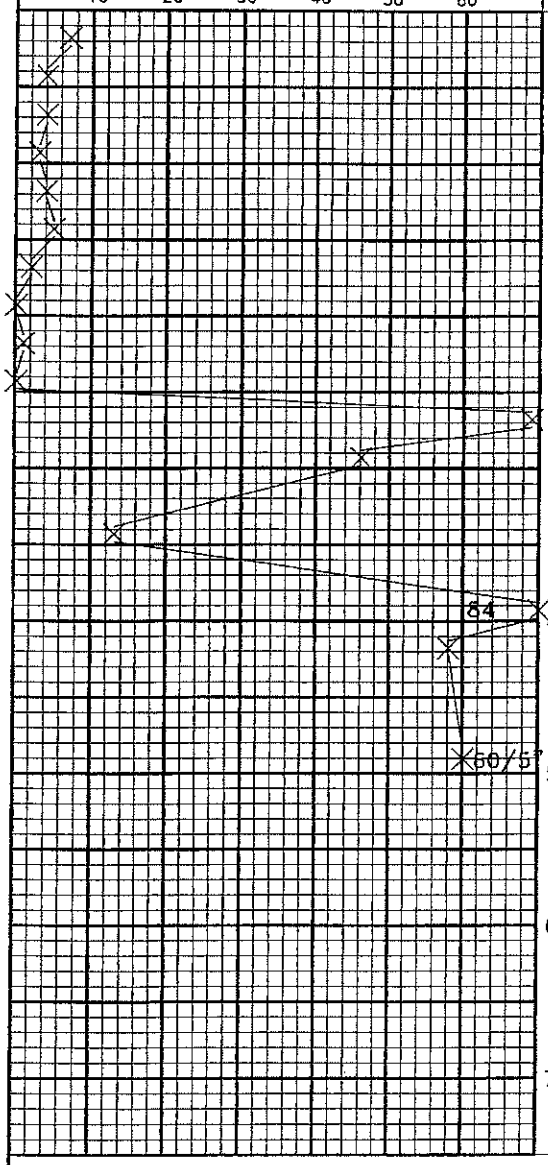
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 15, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 20A

2,445,673 E
548,315 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 549.41
				4" Topsoil
	1	ss		Brown Silty CLAY (CL)
	2	ss		
	3	ss		
	4	ss		Brown Silty CLAY (CL) with sand
10	5	ss		
	6	ss		
	7	ss		Brown Sandy CLAY (CL)
20	8	ss		Brown Mottled Gray Sandy CLAY(CL)
	9	ss		Brown Mottled Gray Sandy CLAY(CL) with pebbles
	10	ss		
	11	ss		Gray Mottled Brown Silty CLAY (CL) with sand pebbles
30	12	ss		
				Brown Clayey SAND (SC) with silt
	13	ss		Brown Silty CLAY (CL) with sand and pebbles
40	14	ss		
	15	ss		Gray Silty CLAY (CL) with sand and pebbles
	16	st		
	17	st		
50	18	ss		Gray SHALE
				End of Boring @ −49.5'
60				
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −5.0' Upon Completion.

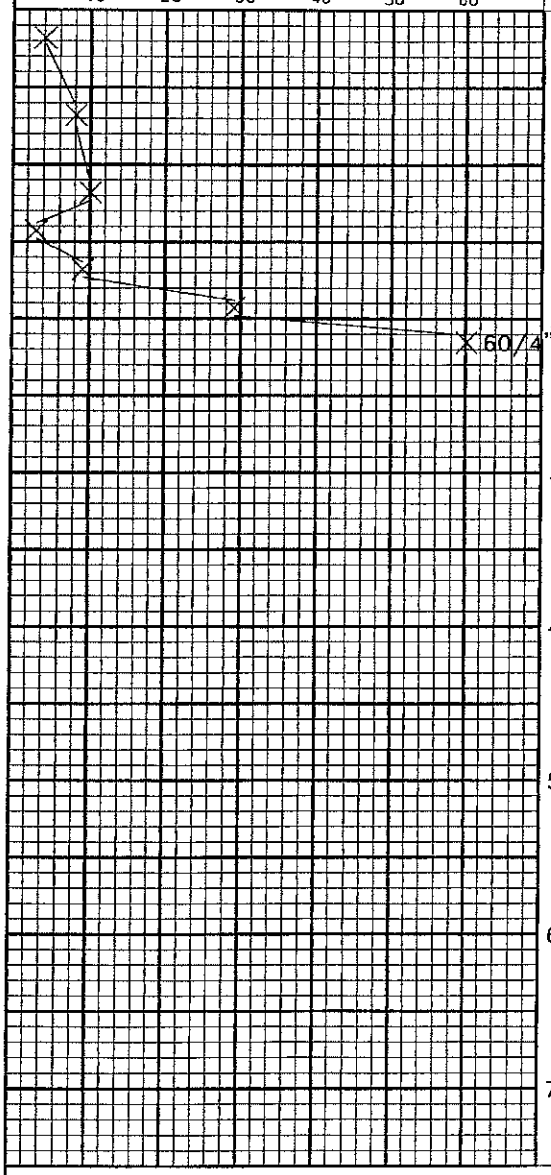
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring May 9, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Corbondale, Illinois

LOG of BORING 21

2,444,787 E
547,825 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 521.46
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown CLAY (CL)
	3	ss		
	4	st		
10	5	ss		Brown Mottled Gray Sandy CLAY(CL)
	6	ss		Brown Clayey SAND (SC)
	7	ss		Gray-Brown Sandy CLAY (CL)
20	8	ss		Gray Fine to Medium SAND (SP)
	9	ss		Gray SHALE
				End of Boring @ -22.0'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -14.0' During Drilling and @ -10.0' Upon Completion.

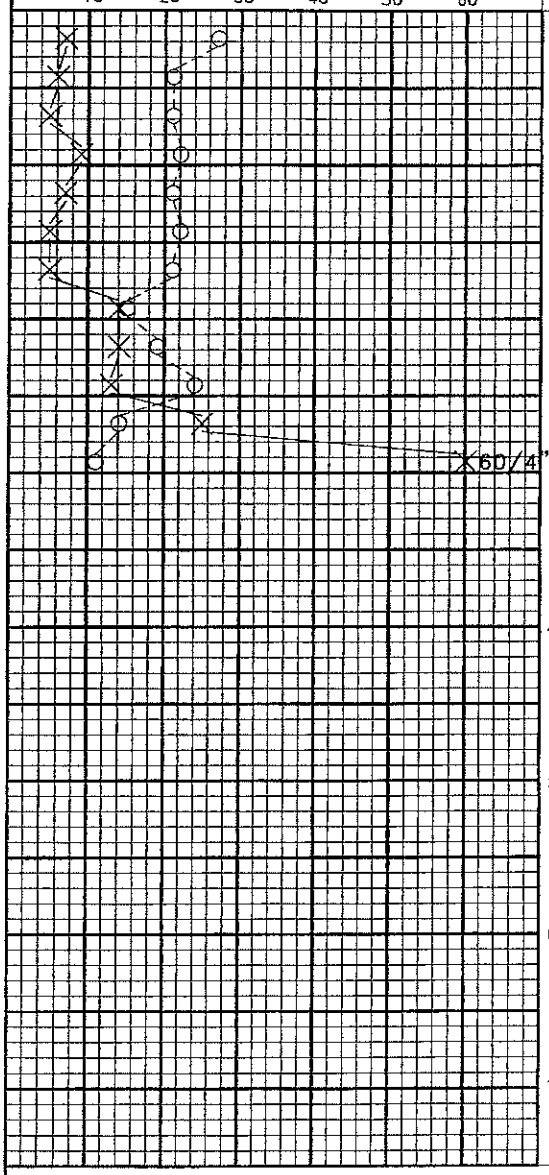
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 22

2,445,248 E
547,825 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 533.60
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		Brown Mottled Gray Sandy CLAY(CL)
	3	ss		
	4	ss		Brown Sandy CLAY (CL) with pebbles
10	5	ss		
	6	ss		Brown Clayey SAND (SC)
	7	ss		Brown Mottled Gray Silty CLAY (CL) with sand
20	8	ss		
	9	ss		Brown Mottled Gray Silty CLAY (CL) with pebbles
	10	ss		
	11	ss		Gray Silty CLAY (CL) with gravel
30	12	ss		Gray SHALE
				End of Boring @ −30.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −14.0' During Drilling and @ −26.0' Upon Completion.

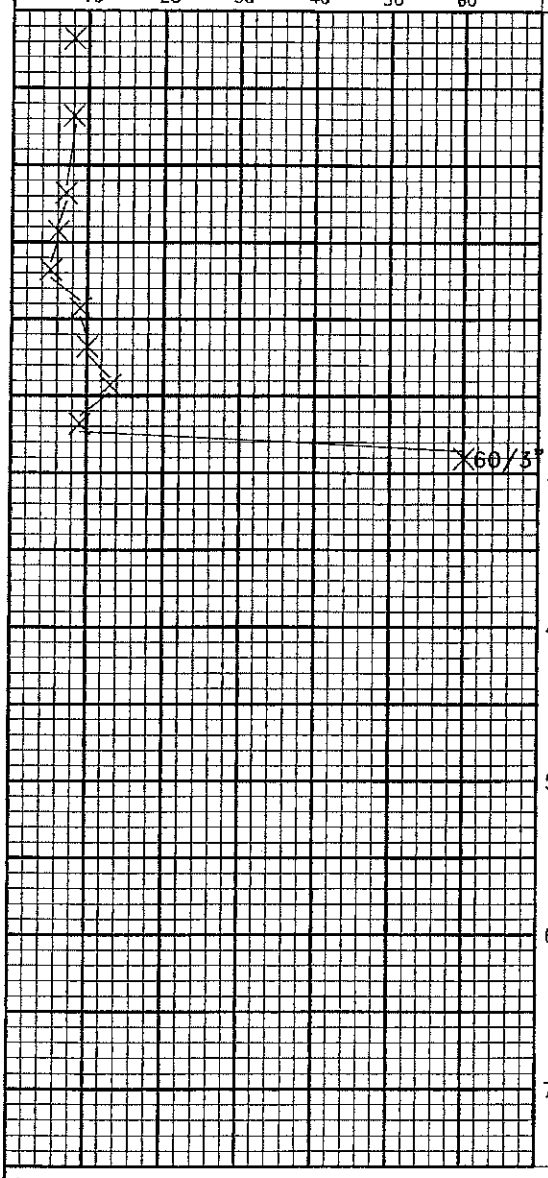
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring April 5, 2010
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 23

2,445,706 E
547,815 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 534.76
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown Silty CLAY (CL)
	3	ss		
10	4	st		
	5	ss		
	6	ss		Gray Mottled Brown Sandy CLAY(CL)
	7	ss		Brown Mottled Gray Sandy CLAY(CL)
20	8	ss		
	9	ss		Gray Mottled Brown to Gray Sandy CLAY (CL) with pebbles
	10	ss		
	11	ss		
	12	ss		Gray SHALE
30				End of Boring @ −29.5'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −14.0' During Drilling and @ −15.0' Upon Completion.

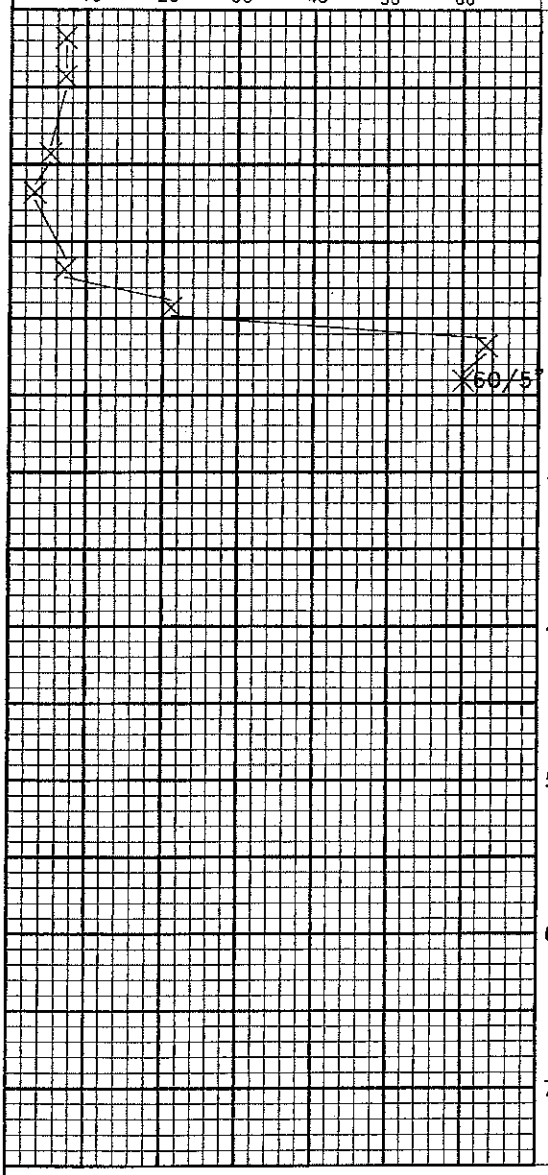
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 15, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 24

2,444,682 E
547,391 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 521.88
	1	ss		Brown Mottled Gray CLAY (CL)
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	st		
	4	ss		
10	5	ss		Gray Mottled Brown Sandy CLAY(CL)
	6	st		
	7	ss		Brown Mottled Gray Sandy CLAY(CL)
20	8	ss		Brown-Gray Weathered SHALE
	9	ss		Brown Mottled Gray SHALE
	10	ss		End of Boring @ -24.5'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -13.0' During Drilling and @ -8.0' Upon Completion.

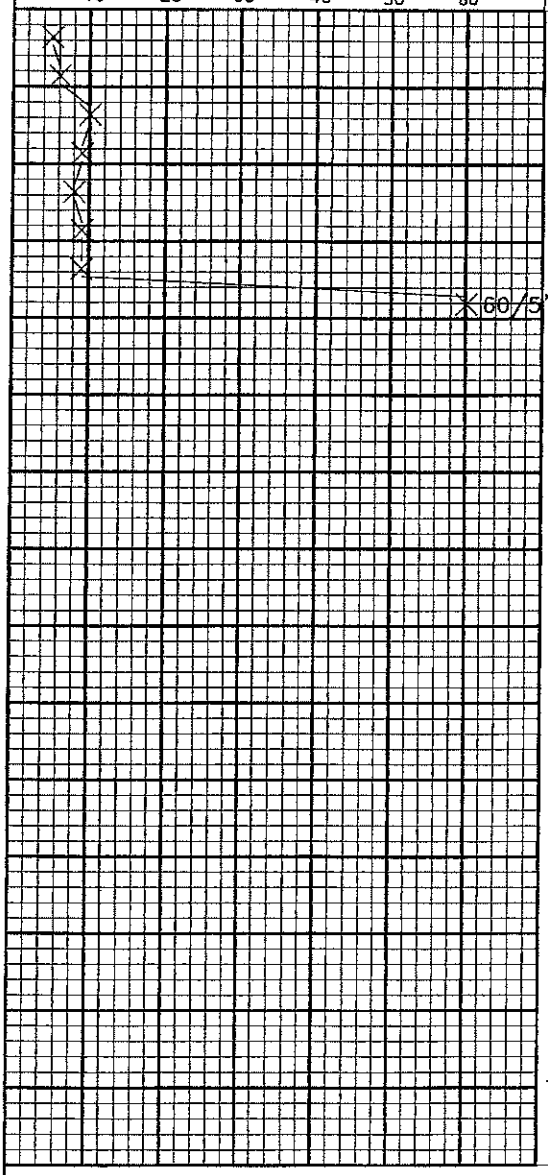
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 16, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 25

2,445,246 E
547,401 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 524.49
	1	ss		4" Topsoil
				Brown Mottled Gray Silty CLAY (CL)
	2	ss		Gray Silty CLAY (CL)
	3	ss		
	4	ss		
10	5	ss		Gray Mottled Brown Sandy CLAY(CL)
	6	ss		
	7	ss		
	8	ss		Brown Mottled Gray SHALE
20				End of Boring @ −19.5'
30				Note: 1" Diameter PVC Piezometer Set in Boring to 19' Deep
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −19.0' During Drilling and @ −9.5' Upon Completion.

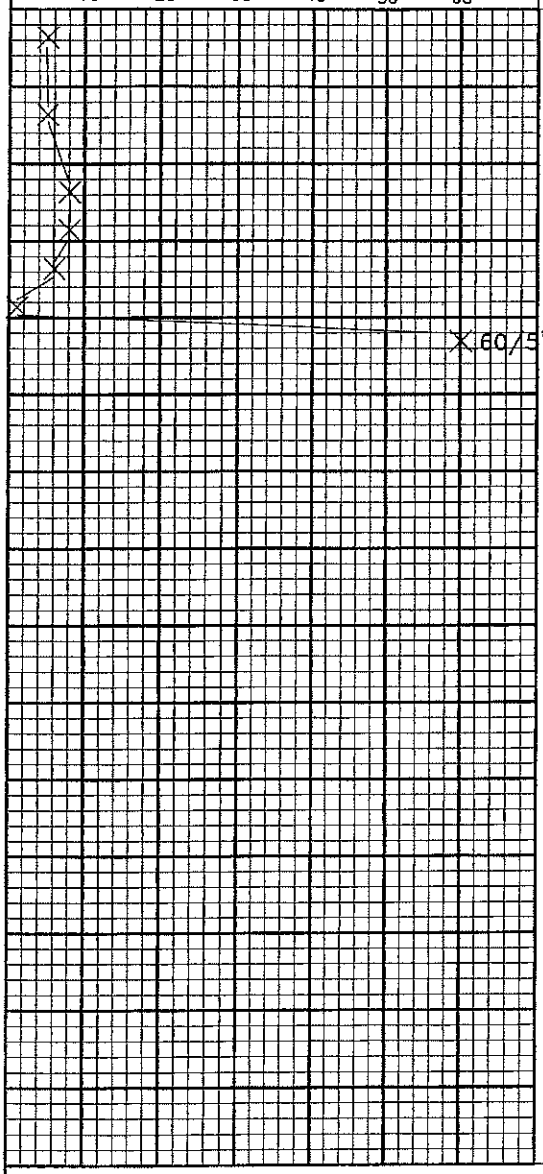
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring February 28, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 26

2,445,709 E
547,388 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 527.58
	1	ss		4" Topsoil
	2	st		Gray Mottled Brown CLAY (CL)
	3	ss		Gray CLAY (CL)
	4	st		
10	5	ss		Gray Mottled Brown Silty CLAY (CL)
	6	ss		Gray Sandy CLAY (CL)
	7	ss		Brown Sandy CLAY (CL)
	8	ss		
20	9	ss		Gray Mottled Brown SHALE
				End of Boring @ −22.0'
30				
40				
50				
60				
70				

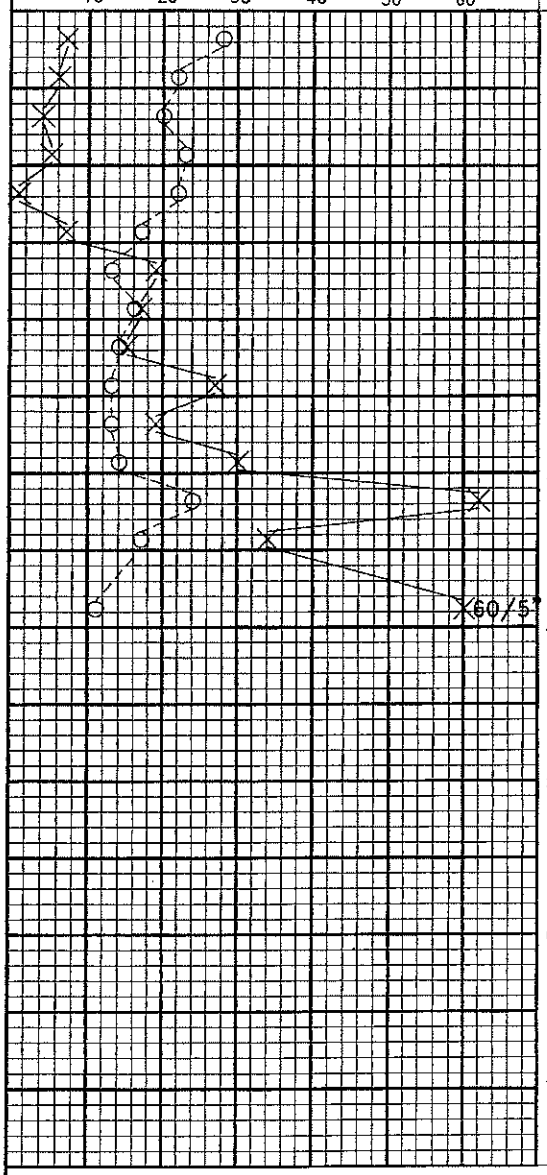
Ground Water Data
Ground Water Encountered @ −19.0' During Drilling and @ −17.0' Upon Completion.

Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring March 15, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 27

2,445,012 E
548,069 N



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 530.80
	1	ss		4" Topsoil
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	ss		Brown Silty CLAY (CL)
10	4	ss		Brown Silty CLAY (CL) with pebbles
	5	ss		Brown Sandy CLAY (CL)
	6	ss		Brown Sandy CLAY (CL) with gravel
	7	ss		Gray Mottled Brown Silty CLAY (CL) with pebbles
20	8	ss		
	9	ss		Gray Silty CLAY (CL) with pebbles
	10	ss		
	11	ss		
30	12	ss		Dark Gray SHALE
	13	ss		COAL
	14	ss		Gray Silty CLAY (CL)
40	15	ss		Gray SHALE
				End of Boring @ −39.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −15.0' During Drilling and @ −33.0' Upon Completion.

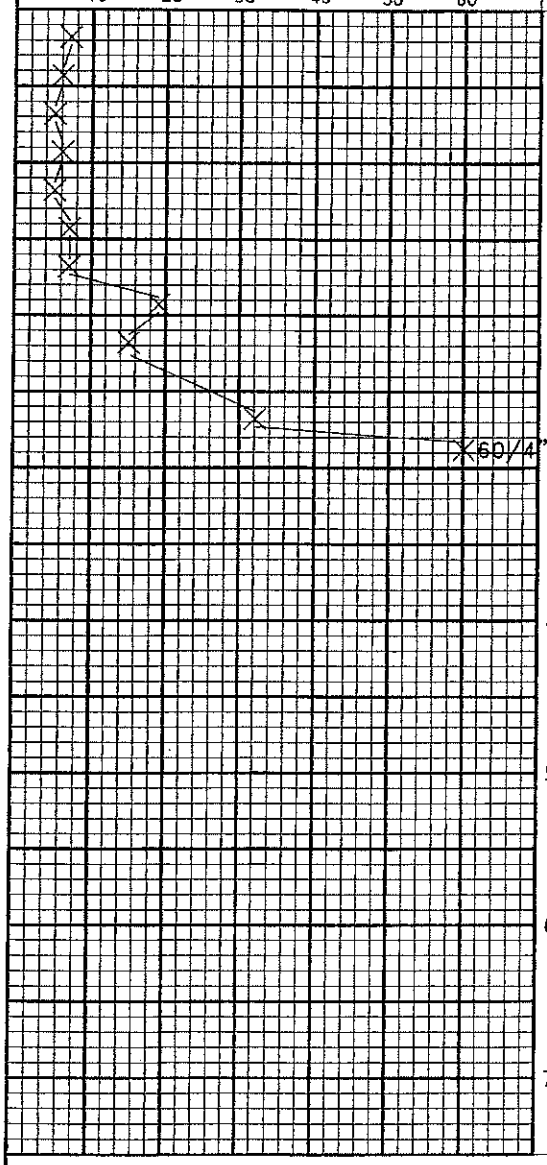
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring April 5, 2010
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 28

2,445,235 E
548,536 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. X 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 529.35
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		Brown Mottled Gray Silty CLAY (CL)
	3	ss		
10	4	ss		Brown Mottled Gray Sandy CLAY(CL)
	5	ss		
	6	ss		Brown Mottled Gray Silty CLAY (CL) with sand and pebbles
	7	ss		
20	8	ss		Gray Silty CLAY (CL) with pebbles
	9	ss		
	10	st		
	11	ss		
	12	ss		Gray SHALE
30	13	ss		
				Coal
				Fireclay SHALE
				End of Boring @ −33.0'
40				
50				Note: Redrilled boring to 26' deep and pushed a shelby tube from 26−28'. Unable to retireve tube due to dense subsoils bending tube.
60				
70				

Ground Water Data
Ground Water Encountered @ −6.5' During Drilling and @ −4.0' Upon Completion.

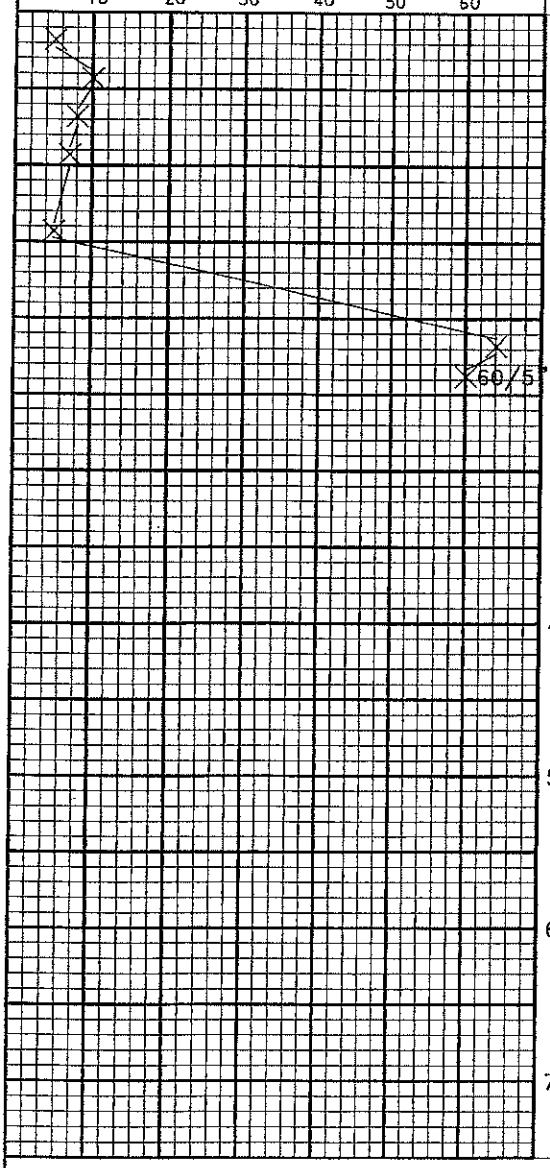
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring May 9, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 29

2,445,253 E
547,611 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. × 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 527.43
	1	ss		4" Topsoil
	2	ss		Gray Mottled Brown Silty CLAY (CL)
	3	ss		
	4	ss		Gray Mottled Brown Sandy CLAY(CL)
10	5	st		
	6	ss		Brown Silty CLAY (CL) with pebbles
	7	st		
	8	st		
20	9	ss		Gray-Brown Weathered SHALE
	10	ss		Gray SHALE
	11	rc		
30				End of Boring @ -30.0'
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -10.0' During Drilling and @ -6.0' Upon Completion.

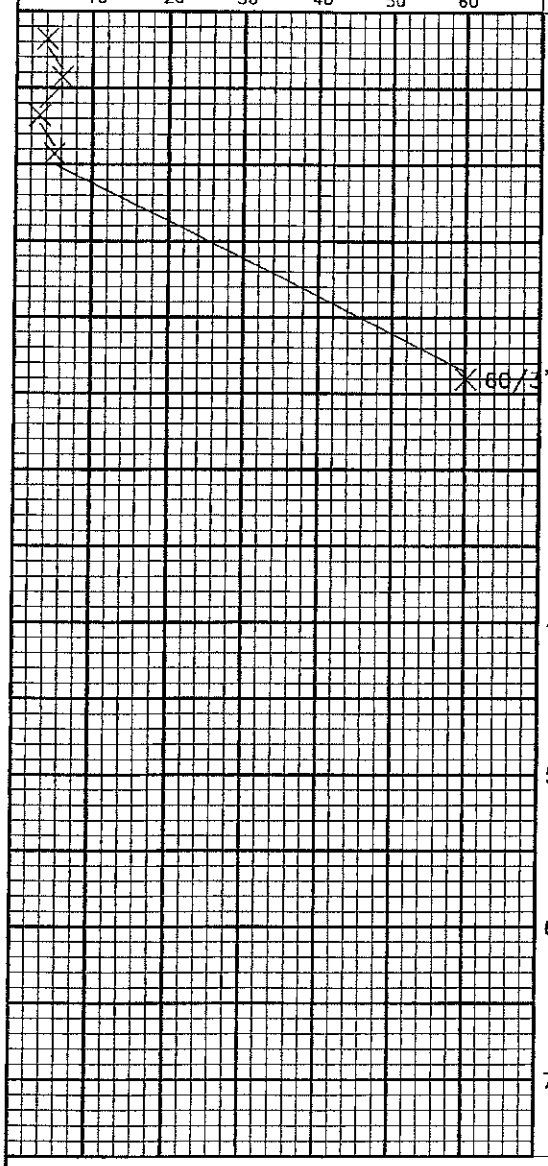
Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring May 9, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H-11043

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 30

2,445,702 E
547,615 N

Unconfined Compressive Strength (Tons/Sq. Ft.) ● 1 2 3 4 5 6
Water Content (%) ○
Standard N Penetration, Blows/Ft. ╳ 10 20 30 40 50 60



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation 530.69
				4" Topsoil
	1	ss		Gray Mottled Brown Silty CLAY (CL)
	2	ss		
	3	ss		
10	4	ss		
	5	st		Brown to Gray Sandy CLAY (CL)
	6	st		Brown Mottled Gray Silty CLAY (CL) with pebbles
	7	st		
20	8	st		
	9	st		
	10	ss		Gray SHALE
				End of Boring @ −24.5'
30				
40				
50				
60				
70				

Ground Water Data
Ground Water Encountered @ −3.5' During Drilling and @ −5.0' Upon Completion.

Project: Proposed Slurry Cell No. 5 Gateway Mine Coulterville, Illinois	Date of Boring May 9, 2011
Client: Peabody Energy St. Louis, Missouri	Project No. H−11043

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
16892C	550534.6	645905.5	499.5	80	1	1 1

Description
STATE=IL
MINE=0275
CNTY=157
DRILLER=BH
DRILL_DATE=10/26/1991
DRILL_EQUIP=ROT

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
Clay	UNC	0	499.5	41.2	N	DESC1=CL
Shale	PL	41.2	458.3	3.8	N	DESC1=GRY, DESC2=SFT
Sandstone	PL	45	454.5	5.6	N	DESC1=GRY
Shale	PL	50.6	448.9	2.2	N	DESC1=SDY, DESC2=Limestone, DESC3=STK
Shale	PL	52.8	446.7	11.4	N	DESC1=GRY
Limestone	PL	64.2	435.3	11.2	N	
Shale	BFLU	75.4	424.1	8.5	N	DESC1=GRY, DESC2=SFT
Limestone	BFLU	83.9	415.6	1	N	
Shale	BFL	84.9	414.6	4.7	N	DESC1=GRY, DESC2=Limestone, DESC3=NOD
Shale	BFL	89.6	409.9	0.5	N	DESC1=DRK
Limestone	BFL	90.1	409.4	3.6	N	
Shale	BL	93.7	405.8	8.5	N	DESC1=DRK, DESC2=HRD
Shale	BL	102.2	397.3	1.4	N	DESC1=DRK, DESC2=Limestone
Limestone	BL	103.6	395.9	6	N	
Shale	AS	109.6	389.9	1.9	N	DESC1=DRK
Coal	6	111.5	388	7.4	Y	
Fire Clay	6FC	118.9	380.6	1.1	N	
Shale	HGL	120	379.5	2.7	N	DESC1=DRK, DESC2=Limestone, DESC3=NOD
Limestone	HGL	122.7	376.8	4.8	N	DESC1=Shale, DESC2=BDD
Shale	HGL	127.5	372	0.8	N	DESC1=GRY
Limestone	HGL	128.3	371.2	2.7	N	DESC1=Shale, DESC2=BDD
Shale		131	368.5	2.7	N	DESC1=GRY, DESC2=LC
Sandstone		133.7	365.8	3.4	N	
Shale		137.1	362.4	3.9	N	DESC1=GRY

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
DH-1	547045	649700	542.5	80	0	5 5

Description
STATE=IL
MINE=0178
CNTY=157
DRILL_DATE=03/14/1950

Strata	Bed		Depth	Elevation	Thick.	Key	Attributes
SO_UNC	UNC		0	542.5	49	N	DESC1=CL
Limestone		8	49	493.5	0.83	N	
ST		8	49.83	492.67	2.67	N	DESC1=SFT
Coal		8	52.5	490	1	Y	
FC	PL		53.5	489	8.5	N	
Shale	PL		62	480.5	16	N	DESC1=GRN
Limestone	PL		78	464.5	0.5	N	
Shale	PL		78.5	464	6.5	N	DESC1=DRK, DESC2=Limestone, DESC3=BND
Shale	PL		85	457.5	3.5	N	DESC1=SDY
Shale	PL		88.5	454	67.5	N	DESC1=DRK
Shale	PL		156	386.5	22.17	N	DESC1=DRK, DESC2=ST
Sandstone	PL		178.17	364.33	1	N	
Shale	PL		179.17	363.33	0.33	N	DESC1=DRK
Shale	PL		179.5	363	4.5	N	DESC1=SFT
Sandstone	PL		184	358.5	9	N	DESC1=Limestone
Shale	PL		193	349.5	12	N	
Limestone	PL		205	337.5	11	N	
Shale		7	216	326.5	1.42	N	
Coal		7	217.42	325.08	1	Y	
Fire Clay	BFLU		218.42	324.08	8.58	N	
Limestone	BFLU		227	315.5	3.5	N	
Shale	BFL		230.5	312	5.58	N	DESC1=Limestone, DESC2=BND
Limestone	BFL		236.08	306.42	3.09	N	
Black Shale	AS		239.17	303.33	4.83	N	DESC1=BLK
Shale	AS		244	298.5	2.5	N	DESC1=Limestone, DESC2=BND
Black Shale	AS		246.5	296	2.5	N	DESC1=BLK
Black Shale	AS		249	293.5	4.83	N	DESC1=BLK
Lost Core	ENS		253.83	288.67	3.09	N	
Coal		6	256.92	285.58	7.67	Y	
Fire Clay	6FC		264.59	277.91	1.58	N	

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
DH-2	551546	649390	516.48	80	0	5 5

Description
STATE=IL
MINE=0178
CNTY=157
DRILL_DATE=03/14/1950

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
Clay	UNC	0	516.48	18	N	DESC1=SD, DESC2=GV
Clay	UNC	18	498.48	12	N	
Limestone	PL	30	486.48	0.08	N	
Shale	PL	30.08	486.4	27.92	N	DESC1=LGT, DESC2=GRY
Shale	PL	58	458.48	25.5	N	DESC1=HRD
Limestone	PL	83.5	432.98	0.17	N	
Shale	PL	83.67	432.81	20.5	N	DESC1=DRK
Shale	PL	104.17	412.31	4.33	N	DESC1=GRY
Shale	PL	108.5	407.98	5.5	N	DESC1=DRK, DESC2=ST
Sandstone	PL	114	402.48	9.5	N	DESC1=Limestone
Shale	PL	123.5	392.98	11.92	N	DESC1=BND
Limestone_PL	PL	135.42	381.06	9.83	N	
Black Shale	7	145.25	371.23	2.42	N	DESC1=BLK
Coal	7	147.67	368.81	1.66	Y	
Fire Clay	BFLU	149.33	367.15	6.67	N	
Limestone	BFLU	156	360.48	3.17	N	
Limestone	BFL	159.17	357.31	3.83	N	DESC1=Shale
Limestone	BFL	163	353.48	3.17	N	
Shale	CL	166.17	350.31	4.16	N	DESC1=DRK
Limestone	CL	170.33	346.15	1.84	N	
Shale	BL	172.17	344.31	1.58	N	DESC1=HRD
Limestone	BL	173.75	342.73	8.25	N	
Black Shale	AS	182	334.48	3.17	N	DESC1=BLK
Coal	6	185.17	331.31	6.5	Y	
Fire Clay	6FC	191.67	324.81	1.33	N	

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
DH-21	549879	647823	514.27	80	0	5 5

Description STATE=IL
MINE=0178
CNTY=157
DRILL_DATE=12/01/1965

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
Clay	UNC	0	514.27	23.33	N	
Shale	LONL	23.33	490.94	11.17	N	DESC1=SFT, DESC2=GV
Shale	LONL	34.5	479.77	82.17	N	DESC1=MED, DESC2=HRD, DESC3=GRY
Limestone	LONL	116.67	397.6	4.33	N	DESC1=HRD
Shale_LONL	LONL	121	393.27	1.83	N	DESC1=GRY, DESC2=LMY
Limestone	LONL	122.83	391.44	0.83	N	DESC1=HRD
Shale	PL	123.66	390.61	11.83	N	DESC1=GRY, DESC2=LMY
Limestone	PL	135.49	378.78	9.5	N	DESC1=HRD
Shale	7	144.99	369.28	1.5	N	DESC1=DRK, DESC2=GRY
Shale	7	146.49	367.78	3.17	N	DESC1=GRY
Coal	7	149.66	364.61	2.33	Y	
Fire Clay	BFLU	151.99	362.28	3.25	N	DESC1=GRY
Shale	BFLU	155.24	359.03	3.08	N	DESC1=GRY, DESC2=LMY
Limestone	BFLU	158.32	355.95	2.5	N	DESC1=HRD
Shale	BFL	160.82	353.45	6.5	N	DESC1=GRY, DESC2=LMY
Limestone	BFL	167.32	346.95	2.33	N	DESC1=HRD, DESC2=GRY
Shale	CL	169.65	344.62	4.33	N	DESC1=SFT, DESC2=DRK, DESC3=GRY
Limestone	CL	173.98	340.29	3	N	DESC1=HRD
Coal	JS	176.98	337.29	0.33	Y	
Shale	BL	177.31	336.96	0.92	N	DESC1=SFT
Limestone	BL	178.23	336.04	3.25	N	DESC1=HRD, DESC2=DRK, DESC3=GRY
Shale	AS	181.48	332.79	0.67	N	DESC1=SFT, DESC2=GRY
Slate	AS	182.15	332.12	1.67	N	DESC1=HRD, DESC2=BLK
Shale	ENS	183.82	330.45	2	N	DESC1=GRY
Coal	6	185.82	328.45	7	Y	
Fire Clay	6FC	192.82	321.45	1.17	N	

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
DHCELL5	549572.1	648196.5	512.93	80	1	1 1

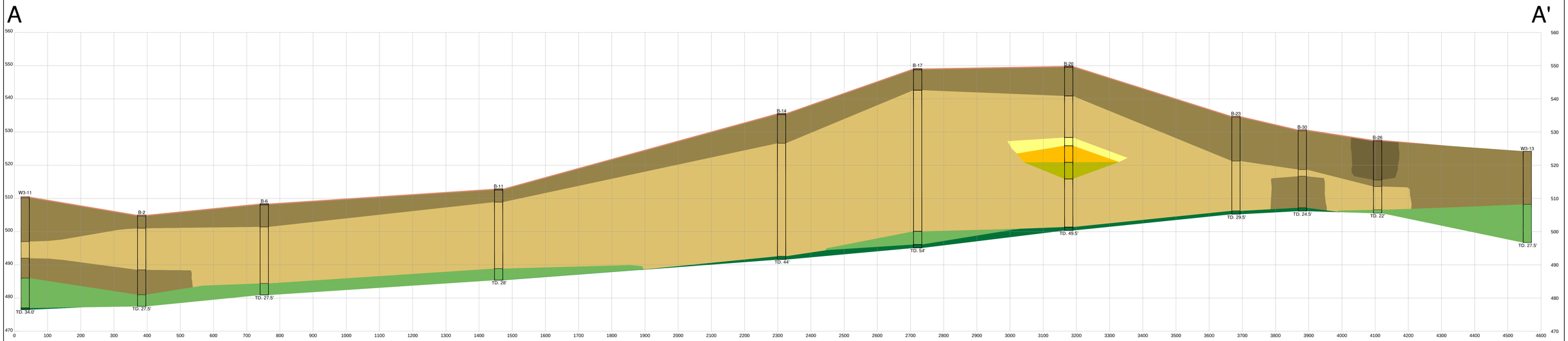
Description
STATE=IL
MINE=0173
CNTY=157
DRILLER=JOS
DRILL_DATE=07/20/2011
DRILL_EQUIP=ROTA
DRILL_CO=MAG

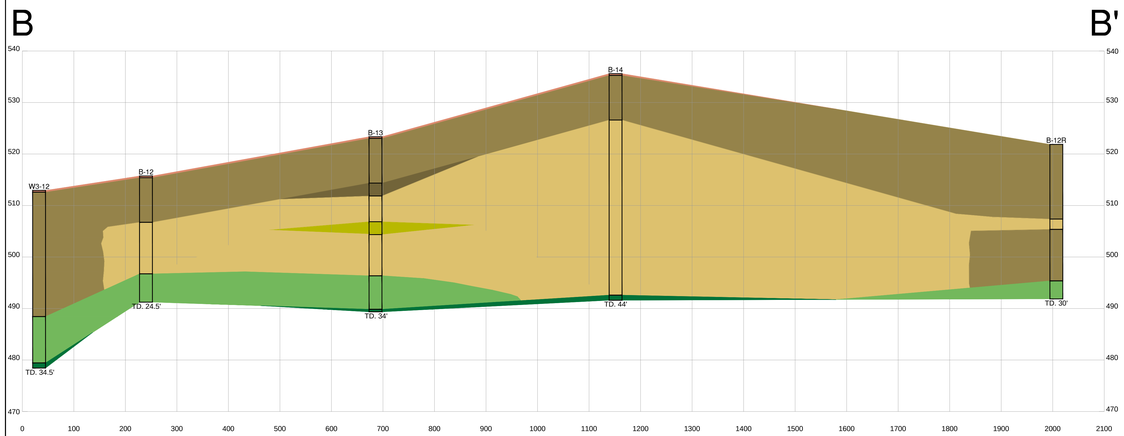
Strata	Bed		Depth	Elevation	Thick.	Key	Attributes
Clay	UNC		0	512.93	18	N	DESC1=SLY, DESC2=SDY, DESC3=TAN
Silt	UNC		18	494.93	8	N	DESC1=WIT, DESC2=GV, DESC3=RBRN
Sandstone	PL		26	486.93	10	N	
Shale	PL		36	476.93	38	N	
Shale	PL		74	438.93	2	N	
Shale	PL		76	436.93	17	N	
Shale	PL		93	419.93	5	N	
Shale	PL		98	414.93	16	N	
Claystone	PL		114	398.93	2	N	
Claystone	PL		116	396.93	13	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Claystone	PL		129	383.93	12	N	
Claystone	PL		141	371.93	3	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Limestone	PL		144	368.93	8	N	
Fire Clay		7	152	360.93	1	N	
Black Shale		7	153	359.93	2	N	
Coal		7	155	357.93	2.7	Y	
Claystone	BFLU		157.7	355.23	6.3	N	
Claystone	BFLU		164	348.93	2	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Limestone	BFLU		166	346.93	1	N	
Claystone	BFL		167	345.93	7	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Limestone	BFL		174	338.93	2.8	N	
Shale	CL		176.8	336.13	4.4	N	
Limestone	CL		181.2	331.73	2	N	
Shale	BL		183.2	329.73	2.1	N	
SandstoneH	BL		185.3	327.63	1.7	N	DESC1=LMY, DESC2=MAS, DESC3=MGY
Limestone	BL		187	325.93	6.2	N	
Black Shale	AS		193.2	319.73	2.6	N	
Coal		6	195.8	317.13	6.8	Y	
Claystone	6FC		202.6	310.33	0.1	N	
Claystone	6FC		202.7	310.23	1.2	N	DESC1=LMY
Limestone	HGL		203.9	309.03	3.6	N	
Claystone			207.5	305.43	3.4	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Limestone			210.9	302.03	1.8	N	

Drillhole	Northing	Easting	Surf.Elv.	Density	Type	Quality
GWN-04E	554542.7	656854.9	561.13	82		1 1 1

Description
STATE=IL
MINE=0173
CNTY=157
DRILLER=JOE
DRILL_DATE=03/23/2010
DRILL_EQUIP=60B
DRILL_CO=MAG

Strata	Bed	Depth	Elevation	Thick.	Key	Attributes
Clay	UNC	0	561.13	12	N	DESC1=SLY, DESC2=SDY, DESC3=TAN, DESC4=BUF
Clay	PL	12	549.13	2	N	DESC1=RED, DESC2=BRN, DESC3=FIN
Clay	PL	14	547.13	3	N	DESC1=SDY, DESC2=RED, DESC3=BRN
Clay	PL	17	544.13	3	N	
Shale	PL	20	541.13	1.5	N	DESC1=MED, DESC2=GRY, DESC3=SS, DESC4=STK
Shale	PL	21.5	539.63	4.1	N	DESC1=SDY, DESC2=MED, DESC3=GRY, DESC4=SS, DESC5=STK
Shale	PL	25.6	535.53	3	N	DESC1=SDY, DESC2=ITB, DESC3=MED, DESC4=GRY
Shale	PL	28.6	532.53	25.4	N	DESC1=SDY, DESC2=MED, DESC3=GRY
Shale	PL	54	507.13	2	N	
Shale	PL	56	505.13	32.3	N	DESC1=SDY, DESC2=MED, DESC3=GRY
Shale	PL	88.3	472.83	4.8	N	DESC1=SDY, DESC2=MED, DESC3=GRY, DESC4=SI, DESC5=NOD
Shale	PL	93.1	468.03	0.7	N	DESC1=LMY, DESC2=SDY, DESC3=SH, DESC4=WIT, DESC5=FOS
Shale	PL	93.8	467.33	3.2	N	DESC1=DGY
De Graff Coal	PL	97	464.13	1	N	
Claystone	PL	98	463.13	2.6	N	DESC1=SDY, DESC2=MGY
Claystone	PL	100.6	460.53	8.5	N	DESC1=LMY, DESC2=SDY
Shale	PL	109.1	452.03	1.4	N	DESC1=SDY, DESC2=MGY, DESC3=SI, DESC4=NOD
Shale	PL	110.5	450.63	8.8	N	DESC1=SDY, DESC2=MGY
Shale	PL	119.3	441.83	6.2	N	DESC1=SDY, DESC2=MGY, DESC3=WIT, DESC4=SS, DESC5=STK
Shale	PL	125.5	435.63	4.4	N	DESC1=SDY, DESC2=MGY, DESC3=SS, DESC4=LIME, DESC5=NOD
Shale	PL	129.9	431.23	0.5	N	DESC1=SHY, DESC2=MGY, DESC3=FOS
Shale	PL	130.4	430.73	62	N	DESC1=SDY, DESC2=MGY
Shale	PL	192.4	368.73	11.5	N	DESC1=SDY, DESC2=MGY, DESC3=WIT, DESC4=SI, DESC5=NOD
Shale	PL	203.9	357.23	0.5	N	DESC1=LMY, DESC2=SDY, DESC3=DGY, DESC4=WIT, DESC5=FOS
Claystone	PL	204.4	356.73	0.5	N	DESC1=MGY, DESC2=WIT, DESC3=SH, DESC4=STK
Claystone	PL	204.9	356.23	1.4	N	DESC1=MGY
Claystone	PL	206.3	354.83	3.6	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=LIME, DESC5=NOD
Claystone	PL	209.9	351.23	4.2	N	DESC1=SDY, DESC2=MGY
Claystone	PL	214.1	347.03	0.3	N	DESC1=SDY
Underclay	PL	214.4	346.73	3.1	N	DESC1=MGY
Claystone	PL	217.5	343.63	3.3	N	DESC1=RED, DESC2=BRN
Claystone	PL	220.8	340.33	2.5	N	DESC1=LMY, DESC2=SDY
Claystone	PL	223.3	337.83	4.5	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=LIME, DESC5=NOD
Sandy Shale	PL	227.8	333.33	1.9	N	DESC1=SH, DESC2=ITB, DESC3=MGY
Shale	PL	229.7	331.43	3.3	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=LIME, DESC5=NOD
Shale	PL	233	328.13	0.5	N	DESC1=SDY, DESC2=DGY, DESC3=WIT, DESC4=SS, DESC5=STK
Claystone	PL	233.5	327.63	6.8	N	DESC1=SDY, DESC2=MGY
Limestone_PL	PL	240.3	320.83	10	N	
Claystone	7	250.3	310.83	0.5	N	DESC1=SDY, DESC2=MGY
Claystone	7	250.8	310.33	1.3	N	DESC1=DGY
Coal 7	7	252.1	309.03	1.3	Y	
Shale	BL	253.4	307.73	1.7	N	DESC1=SDY, DESC2=MGY
Claystone	BL	255.1	306.03	7.4	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=LIME, DESC5=NOD
Limestone	BL	262.5	298.63	4	N	DESC1=CL, DESC2=BND
Claystone	BL	266.5	294.63	3.8	N	DESC1=LMY, DESC2=SS, DESC3=MGY, DESC4=LIME, DESC5=NOD
Limestone	BL	270.3	290.83	1.7	N	DESC1=SHY
Shale	BL	272	289.13	0.5	N	DESC1=LMY, DESC2=SDY, DESC3=MGY
Limestone	BL	272.5	288.63	1.5	N	
Claystone	BL	274	287.13	0.6	N	DESC1=SDY, DESC2=MGY
Shale	BL	274.6	286.53	3.5	N	DESC1=SDY, DESC2=DGY
Shale	BL	278.1	283.03	0.7	N	DESC1=SDY, DESC2=DGY, DESC3=FOS
Limestone	BL	278.8	282.33	1.2	N	DESC1=SHY, DESC2=WIT, DESC3=FOS
Shale	BL	280	281.13	7.7	N	DESC1=SDY, DESC2=DGY, DESC3=WIT, DESC4=FOS
Shale	BL	287.7	273.43	4.7	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=WIT, DESC5=FOS
Shale	6	292.4	268.73	0.1	N	DESC1=SDY, DESC2=DGY, DESC3=WIT, DESC4=CO, DESC5=STK
Coal 6	6	292.5	268.63	6.8	Y	
Underclay	6FC	299.3	261.83	1.6	N	DESC1=MGY
Claystone		300.9	260.23	0.4	N	DESC1=LMY, DESC2=SDY, DESC3=MGY, DESC4=LIME, DESC5=NOD
Limestone		301.3	259.83	5.5	N	





PEABODY COULTERVILLE MINING, LLC.

Evansville, Indiana

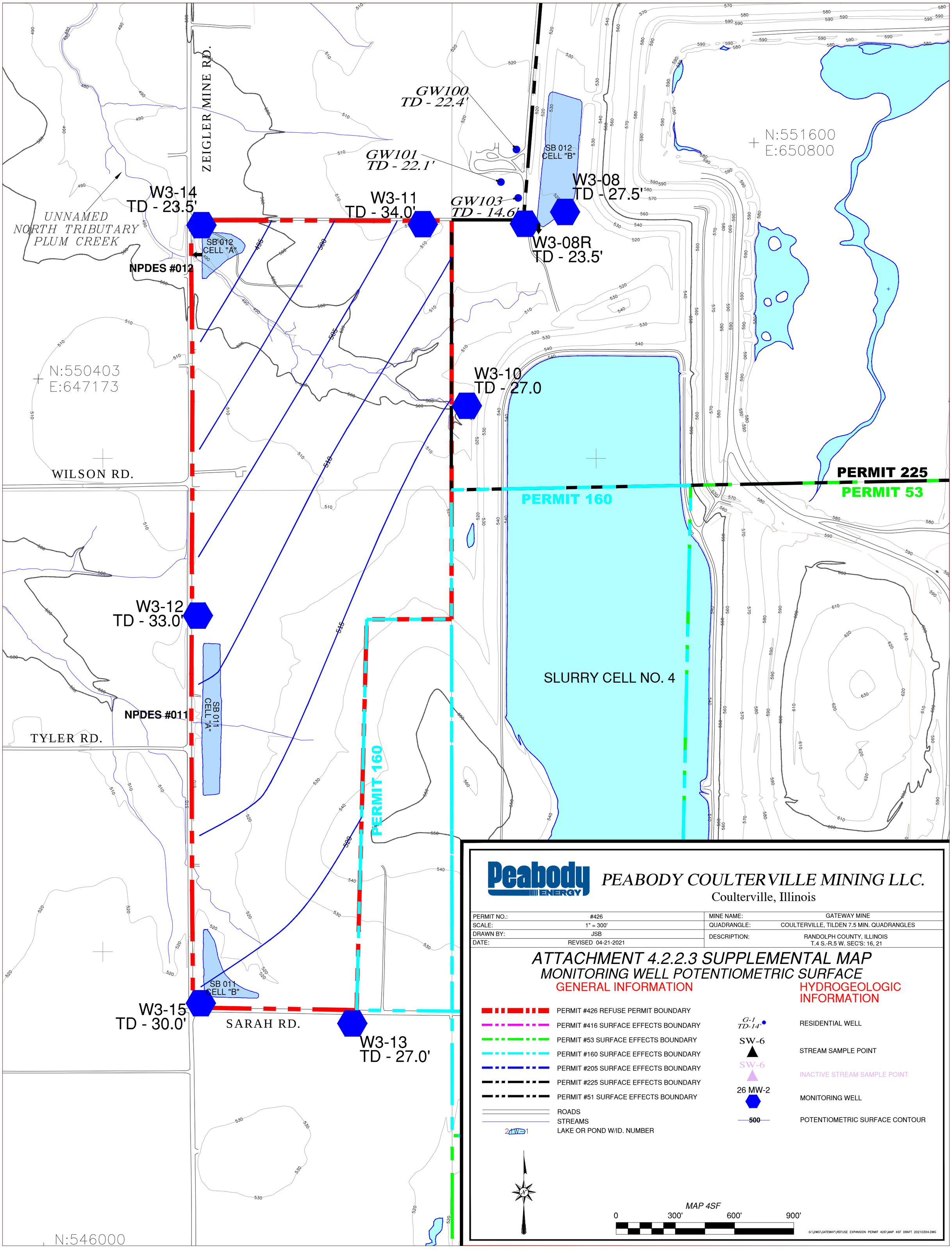
PERMIT NO.:	426	MINE NAME:	GATEWAY MINE
SCALE:	SHOWN BELOW	QUADRANGLE:	COULTERVILLE, TILDEN 7.5 MIN USGS QUADRANGLES
DRAWN BY:	DEM	DESCRIPTION:	RANDOLPH COUNTY, ILLINOIS T.8 S., R. 6 W. SECS. 16, 21
DATE:	04/21/2021		

ATTACHMENT 4.2.2.2.
UNCONSOLIDATED CROSS-SECTION
A-A' & B-B'
(HYDROGEOLOGIC INFORMATION)

- TOPSOIL
- CLAY
- SILTY CLAY
- SANDY CLAY
- SAND
- SAND WITH GRAVEL
- CLAYEY SAND
- SHALE
- WEATHERED SHALE

Vertical Scale: 1"=10'
Horizontal Scale: 1"=100'

G:\DWG\GATEWAY\REFUSE EXPANSION PERMIT 426\SOIL BORINGS LOCATIONS DRAFT 2021\0304.DWG


ZEIGLER MINE RD.
GW100
TD - 22.4'
GW101
TD - 22.1'
GW103
TD - 14.6'
SB 012
CELL "B"
W3-08
TD - 27.5'
W3-08R
TD - 23.5'
W3-14
TD - 23.5'
W3-11
TD - 34.0'
UNNAMED
NORTH TRIBUTARY
PLUM CREEK
SB 012
CELL "A"
NPDES #012
N:551600
E:650800
N:550403
E:647173
W3-10
TD - 27.0
WILSON RD.
PERMIT 225
PERMIT 53
PERMIT 160
W3-12
TD - 33.0'
SLURRY CELL NO. 4
NPDES #011
SB 011
CELL "A"
TYLER RD.
PERMIT 160
SB 011
CELL "B"
W3-15
TD - 30.0'
SARAH RD.
W3-13
TD - 27.0'
N:546000
Peabody ENERGY
PEABODY COULTERVILLE MINING LLC.
Coulterville, Illinois
PERMIT NO.: #426
SCALE: 1" = 300'
DRAWN BY: JSB
DATE: REVISED 04-21-2021
MINE NAME: GATEWAY MINE
QUADRANGLE: COULTERVILLE, TILDEN 7.5 MIN. QUADRANGLES
DESCRIPTION: RANDOLPH COUNTY, ILLINOIS
T.4 S.-R.5 W. SEC'S: 16, 21
ATTACHMENT 4.2.2.3 SUPPLEMENTAL MAP
MONITORING WELL POTENTIOMETRIC SURFACE
GENERAL INFORMATION
PERMIT #426 REFUSE PERMIT BOUNDARY
PERMIT #416 SURFACE EFFECTS BOUNDARY
PERMIT #53 SURFACE EFFECTS BOUNDARY
PERMIT #160 SURFACE EFFECTS BOUNDARY
PERMIT #205 SURFACE EFFECTS BOUNDARY
PERMIT #225 SURFACE EFFECTS BOUNDARY
PERMIT #51 SURFACE EFFECTS BOUNDARY
ROADS
STREAMS
LAKE OR POND W/ID. NUMBER
HYDROGEOLOGIC INFORMATION
G-1
TD-14'
RESIDENTIAL WELL
SW-6
STREAM SAMPLE POINT
SW-6
INACTIVE STREAM SAMPLE POINT
26 MW-2
MONITORING WELL
500
POTENTIOMETRIC SURFACE CONTOUR
MAP 4SF
0
300'
600'
900'
G:\DWG\GATEWAY\REFUSE EXPANSION PERMIT 426\MAP 4SF DRAFT 20210304.DWG

OVERBURDEN CORE ACID BASE ANALYSIS

GWN-04E							
Description	Top Depth (ft)	Bot. Depth (ft)	Thick. (ft)	Tons CaCO3 Equiv. Per 1000 tons Material			
				NNP = NP - AP		Weighted NNP	
				Amt Needed	Amt Excess	Amt Needed	Amt Excess
shale	**20**	**21.5**	**1.5**	**-7.5**		-11.25	
shale	21.5	23.55	2.05		24.06		49.32
shale	23.55	25.6	2.05		39.34		80.65
shale	25.6	28.6	3		29.37		88.11
shale	28.6	31.7	3.1		24.5		75.95
shale	31.7	34.8	3.1		26.76		82.96
shale	34.8	37.9	3.1		23.22		71.98
shale	37.9	40.95	3.05		23.04		70.27
shale	40.95	44	3.05		28.83		87.93
shale	44	47.3	3.3		24.12		79.60
shale	47.3	50.6	3.3		26.97		89.00
shale	50.6	56	5.4		21.59		116.59
shale	56	59.23	3.23		23.46		75.78
shale	59.23	62.46	3.23		20.49		66.18
shale	62.46	65.69	3.23		15.17		49.00
shale	65.69	68.92	3.23		14.11		45.58
shale	68.92	72.15	3.23		19.05		61.53
shale	72.15	75.38	3.23		26.97		87.11
shale	75.38	78.61	3.23		26.15		84.46
shale	78.61	81.84	3.23		28.6		92.38
shale	81.84	85.07	3.23		24.62		79.52
shale	85.07	88.3	3.23		27.21		87.89
shale	88.3	90.7	2.4		38.32		91.97
shale	90.7	93.1	2.4		31.79		76.30
shale	93.1	93.8	0.7		139.91		97.94
shale	**93.8**	**97**	**3.2**	**-82.83**		-265.06	
De Graff Coal	**97**	**98**	**1**	**-54.21**		-54.21	
claystone	98	100.6	2.6		8.77		22.80
claystone	100.6	103.4	2.8		18.38		51.46
claystone	103.4	106.2	2.8		11.83		33.12
claystone	106.2	109.1	2.9		13.87		40.22
shale	109.1	112.5	3.4		21.91		74.49
shale	112.5	115.9	3.4		8		27.20
shale	115.9	119.3	3.4		24.33		82.72
shale	119.3	122.4	3.1		42.55		131.91
shale	122.4	125.5	3.1		90.63		280.95
shale	125.5	127.7	2.2		10.36		22.79
shale	127.7	129.9	2.2		22.48		49.46
shale	129.9	130.4	0.5		322.52		161.26
shale	130.4	133.5	3.1		12.09		37.48
shale	133.5	136.6	3.1		24.72		76.63
shale	136.6	139.7	3.1		20.3		62.93
shale	139.7	142.8	3.1		20.85		64.64

Table continues following page

OVERBURDEN CORE ACID BASE ANALYSIS (Continued)

GWN-04E							
Description	Top Depth (ft)	Bot. Depth (ft)	Thick. (ft)	Tons CaCO3 Equiv. Per 1000 tons Material			
				NNP = NP - AP		Weighted NNP	
				Amt Needed	Amt Excess	Amt Needed	Amt Excess
shale	142.8	145.9	3.1		11.42		35.40
shale	145.9	149	3.1		21.55		66.81
shale	149	152.1	3.1		28.12		87.17
shale	152.1	155.2	3.1		11.66		36.15
shale	155.2	158.3	3.1		0.63		1.95
shale	158.3	161.4	3.1		2.64		8.18
shale	161.4	164.5	3.1		15.51		48.08
shale	164.5	167.6	3.1		22.75		70.53
shale	167.6	170.7	3.1		13.94		43.21
shale	170.7	173.8	3.1		20.88		64.73
shale	173.8	176.9	3.1		17.75		55.03
shale	176.9	180	3.1		22.97		71.21
shale	180	183.1	3.1		15.84		49.10
shale	183.1	186.2	3.1		22.06		68.39
shale	186.2	189.3	3.1		31.41		97.37
shale	189.3	192.4	3.1		31.78		98.52
shale	192.4	195.2	2.8		18.46		51.69
shale	195.2	198.1	2.9		13.06		37.87
shale	198.1	201	2.9		36.19		104.95
shale	201	203.9	2.9		30.83		89.41
shale	203.9	204.4	0.5		115.17		57.59
claystone	204.4	204.9	0.5		269.01		134.51
claystone	204.9	206.3	1.4		11.1		15.54
claystone	206.3	209.9	3.6		187.79		676.04
claystone	209.9	212.2	2.3		44.13		101.50
claystone	212.2	214.4	2.2		41.9		92.18
underclay	214.4	217.5	3.1		6.75		20.93
claystone	217.5	220.8	3.3		66		217.80
claystone	220.8	223.3	2.5		60.43		151.08
claystone	223.3	225.5	2.2		19.39		42.66
claystone	225.5	227.8	2.3		40.01		92.02
sandy shale	227.8	229.7	1.9		48.86		92.83
shale	229.7	233	3.3		16.35		53.96
shale	233	233.5	0.5		65.67		32.84
claystone	233.5	236.9	3.4		4.72		16.05
shale	236.9	240.3	3.4		0.35		1.19
limestone	240.3	243.6	3.3		811.73		2678.71
limestone	243.6	246.9	3.3		829.6		2737.68
limestone	246.9	250.3	3.4		895.18		3043.61
claystone	250.3	250.8	0.5		134.21		67.11
claystone	250.8	252.1	1.3		13.09		17.02
Coal-7	**252.1**	**253.4**	**1.3**	**-126.69**		-164.70	
shale	**253.4**	**255.1**	**1.7**	**-8.9**		-15.13	
claystone	255.1	257.5	2.4		226.03		542.47
claystone	257.5	260	2.5		130.46		326.15

OVERBURDEN CORE ACID BASE ANALYSIS (Continued)

GWN-04E							
Description	Top Depth (ft)	Bot. Depth (ft)	Thick. (ft)	Tons CaCO3 Equiv. Per 1000 tons Material			
				NNP = NP - AP		Weighted NNP	
				Amt Needed	Amt Excess	Amt Needed	Amt Excess
claystone	260	262.5	2.5		18.34		45.85
limestone	262.5	264.5	2		433.68		867.36
limestone	264.5	266.5	2		649.49		1298.98
claystone	266.5	270.3	3.8		731.8		2780.84
limestone	270.3	272	1.7		418.74		711.86
shale	272	272.5	0.5		346.17		173.09
limestone	272.5	274	1.5		845.84		1268.76
claystone	274	274.6	0.6		341.45		204.87
shale	**274.6**	**278.1**	**3.5**	**-96.32**		-337.12	
shale	278.1	278.8	0.7		344.14		240.90
limestone	278.8	280	1.2		868.01		1041.61
shale	280	282.5	2.5		346.39		865.98
shale	282.5	285.1	2.6		407.17		1058.64
shale	285.1	287.7	2.6		204.5		531.70
shale	287.7	289.8	2.1		411.67		864.51
shale	289.8	292.5	2.7		446.03		1204.28
Coal-6	**292.5**	**299.3**	**6.8***		**0.47***		
underclay	299.3	300.9	1.6		35.75		57.20
shale	300.9	301.3	5.9		448.07		2643.61
		Total	280	-376.45	13125.86	-847.46	31365.27

Note
*Coal-6 not included in NNP calculations because it will be mined and removed.

OVERBURDEN CORE PROVENANCE SUMMARY

Core No.	Sample Collector	Collection Date	Analytical Laboratory	Lab Report Date	Collection Method
GWN-04E	Magnum Drilling	03-23-10	Standard Labs, Freeburg, IL	06-11-10	rotary core

SAMPLE ANALYTICAL METHODS

Parameter	Analytical Method
paste pH	EPA-600/2-78-054 3.2.2
total sulfur	ASTM D4239C
pyritic sulfur	ASTM D2492
potential acidity	EPA-600/2-78-054 1.3.1
net neutralization	
neutralization potential	EPA-600/2-78-054 3.2.3
moisture at saturation	EPA-600/2-78-054 3.2.18
TDS	EPA-600/2-78-054 3.2.18 mod
calcium	EPA-600/2-78-054 3.2.19
magnesium	
sodium	
SAR	
iron	EPA-600/2-78-054 3.2.19 mod
manganese	
aluminum	

STANDARD LABORATORIES,INC.
8451 River King Drive, Freeburg, Illinois 62243 (618) 539-5836

MINE: 1825 - COULTERVILLE COAL CO.,LLC
CORE NO: GWN-04E
DATE CORED: 03/18/10
DATE REPORTED: 06/11/10
UPDATED: 09/23/10
Page 1 of 3

*DRY BASIS

Method==>			21a	D4239	D2492		TONS CACO3 EQUIV. per 1000 TONS MATERIAL 600/2-78-054				2540C	600/2-	PARTICLE SIZE ASA#9		
Lithology	Lab No.	Depth	Paste pH	Total* Sulfur %	Pyr.* Sulfur %		Amount Reqd. From S	Amount Present (Titr.)	Amount Needed	Amount Excess	P.Ext. TDS mg/l	78-054 FIZZ	Sand %	Silt %	Clay %
SO	100501001	0.00	6.6	0.04	0.04		1.25	5.29		4.04					
SO	100501002	6.00	6.7	0.05	0.05		1.56	3.87		2.31					
SO	100501003	12.00	8.0	0.14	0.14		4.38	7.61		3.23					
SH	100501004	20.00	8.0	0.57	0.57		17.81	10.31	7.50						
SH	100501005	21.50	7.9	0.35	0.35		10.94	35.00		24.06					
SH	100501006	23.55	7.9	0.26	0.26		8.13	47.47		39.34					
SH	100501007	25.60	7.7	0.67	0.59		18.44	47.81		29.37					
SH	100501008	28.60	8.0	0.32	0.32		10.00	34.50		24.50					
SH	100501009	31.70	8.3	0.13	0.13		4.06	30.82		26.76					
SH	100501010	34.80	8.3	0.10	0.10		3.13	26.35		23.22					
SH	100501011	37.90	8.3	0.10	0.10		3.13	26.17		23.04					
SH	100501012	40.95	8.5	0.12	0.10		3.13	31.96		28.83					
SH	100501013	44.00	8.7	0.14	0.14		4.38	28.50		24.12					
SH	100501014	47.30	8.7	0.10	0.10		3.13	30.10		26.97					
SH	100501015	50.60	8.8	0.10	0.10		3.13	24.72		21.59					
SH	100501016	56.00	8.8	0.11	0.11		3.44	26.90		23.46					
SH	100501017	59.23	8.9	0.09	0.09		2.81	23.30		20.49					
SH	100501018	62.46	8.9	0.12	0.12		3.75	18.92		15.17					
SH	100501019**	65.69	8.7	0.14	0.14		4.38	18.49		14.11					
SH	100501020	68.92	8.8	0.15	0.15		4.69	23.74		19.05					
SH	100501021	72.15	8.4	0.12	0.12		3.75	30.72		26.97					
SH	100501022	75.38	8.5	0.14	0.14		4.38	30.53		26.15					
SH	100501023	78.61	8.5	0.13	0.13		4.06	32.66		28.60					
SH	100501024	81.84	8.7	0.11	0.11		3.44	28.06		24.62					
SH	100501025	85.07	8.7	0.11	0.11		3.44	30.65		27.21					
SH	100501026	88.30	8.8	0.16	0.16		5.00	43.32		38.32					
SH	100501027	90.70	8.7	1.09	1.03		32.19	63.98		31.79					
SH	100501028	93.10	8.3	2.30	2.02		63.13	203.04		139.91					
SH	100501029	93.80	6.3	4.64	2.91		90.94	8.11	82.83						
CO	100501030	97.00	6.5	3.95	2.15		67.19	12.98	54.21						
CS	100501031	98.00	8.7	1.28	1.27		39.69	48.46		8.77			7.0	53.2	39.8
CS	100501032	100.60	9.2	0.57	0.57		17.81	36.19		18.38					
CS	100501033	103.40	9.2	0.27	0.27		8.44	20.27		11.83					
CS	100501034	106.20	9.3	0.03	0.03		0.94	14.81		13.87					
SH	100501035	109.10	9.1	0.14	0.14		4.38	26.29		21.91					
SH	100501036	112.50	8.9	0.48	0.48		15.00	23.00		8.00					
SH	100501037	115.90	9.2	0.11	0.11		3.44	27.77		24.33					
SH	100501038	119.30	8.3	1.09	1.07		33.44	75.99		42.55					
SH	100501039	122.40	8.7	0.66	0.65		20.31	110.94		90.63					

** LAB NO.100501019 DEPTH CHANGED FROM 62.46 TO 65.69 DUE TO TYPO.

STANDARD LABORATORIES, INC.
8451 River King Drive, Freeburg, Illinois 62243 (618) 539-5836

MINE: 1825 - COULTERVILLE COAL CO.,LLC
CORE NO: GWN-04E
DATE CORED: 03/18/10
DATE REPORTED: 06/11/10

*DRY BASIS

Method==>			21a	D4239	D2492		TONS CACO3 EQUIV. per 1000 TONS MATERIAL 600/2-78-054				2540C	600/2-78-054	PARTICLE SIZE ASA#9		
Lithology	Lab No.	Depth	Paste pH	Total* Sulfur %	Pyr.* Sulfur %		Amount Reqd. From S	Amount Present (Titr.)	Amount Needed	Amount Excess	P.Ext. TDS mg/l	FIZZ	Sand %	Silt %	Clay %
SH	100501040	125.50	8.2	1.09	1.03		32.19	42.55		10.36					
SH	100501041	127.70	8.4	0.63	0.63		19.69	42.17		22.48					
SH	100501042	129.90	8.6	0.51	0.51		15.94	338.46		322.52					
SH	100501043	130.40	9.2	0.61	0.61		19.06	31.15		12.09					
SH	100501044	133.50	9.2	0.42	0.42		13.13	37.85		24.72					
SH	100501045	136.60	9.1	0.34	0.34		10.63	30.93		20.30					
SH	100501046	139.70	9.2	0.41	0.41		12.81	33.66		20.85					
SH	100501047	142.80	9.0	0.45	0.45		14.06	25.48		11.42					
SH	100501048	145.90	9.2	0.19	0.19		5.94	27.49		21.55					
SH	100501049	149.00	9.2	0.18	0.18		5.63	33.75		28.12					
SH	100501050	152.10	9.1	0.33	0.33		10.31	21.97		11.66					
SH	100501051	155.20	9.2	0.67	0.67		20.94	21.57		0.63					
SH	100501052	158.30	9.3	0.64	0.64		20.00	22.64		2.64					
SH	100501053	161.40	9.2	0.31	0.31		9.69	25.20		15.51					
SH	100501054	164.50	9.2	0.17	0.17		5.31	28.06		22.75					
SH	100501055	167.60	9.2	0.20	0.20		6.25	20.19		13.94					
SH	100501056	170.70	9.2	0.17	0.17		5.31	26.19		20.88					
SH	100501057	173.80	9.2	0.18	0.18		5.63	23.38		17.75					
SH	100501058	176.90	9.2	0.11	0.11		3.44	26.41		22.97					
SH	100501059	180.00	9.2	0.24	0.24		7.50	23.34		15.84					
SH	100501060	183.10	9.2	0.11	0.11		3.44	25.50		22.06					
SH	100501061	186.20	9.0	0.23	0.23		7.19	38.60		31.41					
SH	100501062	189.30	9.1	0.22	0.22		6.88	38.66		31.78					
SH	100501063	192.40	9.2	0.27	0.27		8.44	26.90		18.46					
SH	100501064	195.20	9.2	0.32	0.32		10.00	23.06		13.06					
SH	100501065	198.10	8.9	0.21	0.21		6.56	42.75		36.19					
SH	100501066	201.00	9.1	0.22	0.22		6.88	37.71		30.83					
SH	100501067	203.90	9.2	0.30	0.30		9.38	124.55		115.17					
CS	100501068	204.40	9.2	0.19	0.19		5.94	274.95		269.01					
CS	100501069	204.90	9.6	0.16	0.16		5.00	16.10		11.10					
CS	100501070	206.30	9.4	0.12	0.11		3.44	191.23		187.79					
CS	100501071	209.90	9.4	0.05	0.05		1.56	45.69		44.13					
CS	100501072	212.20	9.5	0.04	0.04		1.25	43.15		41.90					
UC	100501073	214.40	9.8	0.13	0.13		4.06	10.81		6.75					
CS	100501074	217.50	9.6	0.08	0.08		2.50	68.50		66.00					
CS	100501075	220.80	9.6	0.04	0.04		1.25	61.68		60.43					
CS	100501076	223.30	9.6	0.04	0.04		1.25	20.64		19.39					
CS	100501077	225.50	9.5	0.04	0.04		1.25	41.26		40.01					
SS-SH	100501078	227.80	9.4	0.02	0.02		0.63	49.49		48.86					

STANDARD LABORATORIES, INC.
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MINE: 1825 - COULTERVILLE COAL CO.,LLC
CORE NO: GWN-04E
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DATE REPORTED: 06/11/10

*DRY BASIS

Method==>			21a	D4239	D2492		TONS CACO3 EQUIV. per 1000 TONS MATERIAL 600/2-78-054				2540C	600/2-78-054	PARTICLE SIZE ASA#9		
Lithology	Lab No.	Depth	Paste pH	Total* Sulfur %	Pyr.* Sulfur %		Amount Reqd. From S	Amount Present (Titr.)	Amount Needed	Amount Excess	P.Ext. TDS mg/l	FIZZ	Sand %	Silt %	Clay %
SH	100501079	229.70	9.4	0.03	0.03		0.94	17.29		16.35					
SH	100501080	233.00	9.1	0.09	0.09		2.81	68.48		65.67					
CS	100501081	233.50	9.4	0.09	0.09		2.81	7.53		4.72					
CS	100501082	236.90	9.6	0.15	0.15		4.69	5.04		0.35					
LS	100501083	240.30	9.2	0.02	0.02		0.63	812.36		811.73					
LS	100501084	243.60	9.2	0.03	0.03		0.94	830.54		829.60					
LS	100501085	246.90	8.8	0.04	0.04		1.25	896.43		895.18					
CS	100501086	250.30	8.9	0.62	0.59		18.44	152.65		134.21					
CS	100501087	250.80	8.7	0.66	0.58		18.13	31.22		13.09					
CO	100501088	252.10	6.0	6.89	4.23		132.19	5.50	126.69						
CS	100501089	253.40	7.4	0.76	0.57		17.81	8.91	8.90				54.7	34.8	10.5
CS	100501090	255.10	9.2	1.48	1.34		41.88	267.91		226.03					
CS	100501091	257.50	9.8	0.91	0.91		28.44	158.90		130.46					
CS	100501092	260.00	9.8	0.93	0.93		29.06	47.40		18.34					
LS	100501093	262.50	9.7	0.48	0.48		15.00	448.68		433.68					
LS	100501094	264.50	9.5	0.30	0.30		9.38	658.87		649.49					
CS	100501095	266.50	9.5	0.20	0.20		6.25	738.05		731.80					
LS	100501096	270.30	9.6	1.40	1.38		43.13	461.87		418.74					
SH	100501097	272.00	9.5	1.10	1.09		34.06	380.23		346.17					
LS	100501098	272.50	9.5	0.10	0.10		3.13	848.97		845.84					
CS	100501099	274.00	9.5	1.01	0.95		29.69	371.14		341.45					
SH	100501100	274.60	8.8	4.34	3.86		120.63	24.31	96.32						
SH	100501101	278.10	9.1	0.97	0.89		27.81	371.95		344.14					
LS	100501102	278.80	9.4	0.18	0.18		5.63	873.64		868.01					
SH	100501103	280.00	8.9	1.32	1.22		38.13	384.52		346.39					
SH	100501104	282.50	8.6	1.41	1.34		41.88	449.05		407.17					
SH	100501105	285.10	8.8	1.84	1.77		55.31	259.81		204.50					
SH	100501106	287.70	8.8	1.42	1.29		40.31	451.98		411.67					
SH	100501107	289.80	8.7	1.31	1.13		35.31	481.34		446.03					
CO	100501108	292.50	7.0	2.89	0.48		15.00	15.47		0.47					
UC	100501109	299.30	7.8	2.18	2.03		63.44	99.19		35.75			17.9	57.3	24.8
CS	100501110	300.90	8.6	0.95	0.85		26.56	474.63		448.07					

Respectfully Submitted by: _____

Lab No. 201501322-001

Date Rec'd. 4/16/2015

Date Sampled 4/15/2015

Sampled By Mwayland

STANDARD LABORATORIES, INC.

8451 River King Drive
Freeburg, IL 62243

Report Date: 5/1/2015 1:50:05 PM

COULTERVILLE COAL COMPANY, LLC
GATEWAY MINE
P.O. BOX 369
COULTERVILLE, IL 62237
ATTN: GRADY WHITE

Sample ID 201501322-001
P.O. #:

Remark: Slurry Solids Only
1825
GW GCP

TEST	Result	UNITS	METHOD	D.F.	MDL	DATE	TIME	TECH
Net Neut. Pot.	-5.63	CCET/KT	EPA 600/2-7	1	-9999	04/27/15	18:00	RDV
Neutralization Potential	32.81	CCET/KT	EPA 600/2-7	1	-9999	04/21/15	11:00	LAM
Paste pH	7.80	S.U.	USDA60 21	1		04/21/15	10:00	LAM
Pot. Acid.	38.44	CCET/KT	EPA 600/2-7	1	0.31	04/27/15	18:00	RDV
Sulfur, Pyritic, Dry Basis	1.23	%	ASTM D249	1	0.01	04/23/15	16:00	NRJ
Sulfur, Total, Dry Basis	2.44	%	ASTM D423	1	0.01	04/20/15	16:44	HS

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Respectfully Submitted, Robert D Pets

Lab No. 201501321-001

Date Rec'd. 4/16/2015

Date Sampled 4/16/2015

Sampled By Mwayland

STANDARD LABORATORIES, INC.

8451 River King Drive
Freeburg, IL 62243

Page 1 of 1

Report Date: 5/1/2015 1:52:34 PM

COULTERVILLE COAL COMPANY, LLC
GATEWAY MINE
P.O. BOX 369
COULTERVILLE, IL 62237
ATTN: GRADY WHITE

Sample ID 201501321-001
P.O. #:

Remark: Slurry Liquid Phase Only
1825
GW GCP

TEST	Result	UNITS	METHOD	D.F.	MDL	DATE	TIME	TECH
Acidity	-104	mg/L as CaCO3	SM 2310 B	1	-99999	04/17/15	12:48	LAM
Alkalinity @ pH 4.5 as CaCO3	142	mg/L as CaCO3	SM 2320 B	1	0	04/17/15	12:48	LAM
Flow GPM	DIP	gpm	Estimated	1	1	04/15/15	16:00	XXX
pH @ 25℃	8.27	S.U.	SM 4500 B	1	0.1	04/17/15	12:48	LAM
pH, Field	8.48	SU	SM 4500 B	1	0.1	04/15/15	16:00	XXX

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Respectfully Submitted, Robert D Peto

STANDARD LABORATORIES, INC.
8451 River King Drive, Freeburg, Illinois 62243 (618) 539-5836

MINE: 1825 - COULTERVILLE COAL CO.,LLC
SAMPLE TYPE: COARSE REFUSE
DATE SAMPLED: 11/05/08
DATE REPORTED: 11/18/08

*Dry Basis

							TONS CACO3 EQUIV. per 1000 TONS MATERIAL*							PASTE EXT	
Lithology	Lab No.	Depth	P1* lb/A	P2* lb/A	<* lb/A	Pyritic Sulfur* %	Amount Reqd. from S	Amount Present (Titr.)	Amount Needed	Amount Excess		SMP pH	Paste pH	E.C. mmho/cm	Al mg/l
GP1	081100101					2.04	63.75	-10.74	74.49				2.2		
GP2	081100102					6.70	209.38	17.62	191.70				6.1		
GP3	081100103					5.60	175.00	30.92	144.00				6.4		
GP4	081100104					2.34	73.13	-13.67	86.80				2.5		
GP5	081100105					1.92	60.00	-29.51	89.51				2.0		
GP6	081100106					4.46	139.38	34.51	104.80				7.0		
GP7	081100107					4.67	145.94	25.66	120.20				6.7		
GP8	081100108					5.09	159.06	56.65	102.40				6.5		
GP9	081100109					4.55	142.19	23.56	118.60				6.6		

Respectfully Submitted by: _____

Location Information					Acidity / Alkalinity			Major Ions				Metals			
Location	Date Range	Statistics	Water Level Elevation	Water Level Range (Max - Min)	pH, Field	Acidity	Alkalinity as CaCO3, @ pH 4.5	Total Dissolved Solids, Lab	Sulfates	Chloride	Hardness	Iron	Iron	Manganese	Manganese
					N	N	N	N	N	N	N	T	D	T	D
					S.U.	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
W311	11/30/11 - 11/09/20	Average	506.93	5.80	7.35	-296	372	1,044	313	75	442	3.71	0.11	0.33	0.09
		Maximum	509.23		9.50	1	428	1,310	503	107	568	62.40	3.78	1.69	0.69
		Minimum	503.43		6.70	-358	284	760	81	29	350	0.14	0.01	0.03	0.00
		St. Dev.	1.56		0.41	61	33	119	86	14	45	9.76	0.58	0.29	0.14
		Count	43		43	43	43	43	43	43	42	43	43	43	43
W312	11/30/11 - 11/09/20	Average	507.84	9.85	7.01	-219	294	687	204	38	361	3.10	0.19	0.18	0.09
		Maximum	512.99		7.60	1	452	1,230	403	70	721	10.60	1.99	1.03	0.59
		Minimum	503.14		6.34	-384	95	156	7	5	88	0.25	0.01	0.02	0.00
		St. Dev.	2.44		0.29	104	112	316	122	19	175	2.56	0.43	0.18	0.12
		Count	42		42	42	42	42	42	42	41	42	42	42	42
W313	11/30/11 - 11/09/20	Average	522.18	5.80	7.13	-361	529	824	180	19	579	30.37	0.23	1.18	0.28
		Maximum	524.61		7.60	118	802	975	242	74	3,300	734.00	1.18	30.00	1.03
		Minimum	518.81		6.52	-504	484	690	145	7	439	0.22	0.01	0.04	0.02
		St. Dev.	1.59		0.22	111	50	83	24	20	441	120.76	0.39	4.65	0.26
		Count	42		41	42	42	42	42	42	41	42	42	42	42
W314	09/07/16 - 11/09/20	Average	489.06	3.50	7.21	-233	268	860	87	242	446	0.69	0.02	0.04	0.04
		Maximum	490.78		7.48	-144	282	1,085	99	284	496	2.20	0.15	0.10	0.10
		Minimum	487.28		6.87	-247	184	735	70	72	406	0.26	0.01	0.01	0.00
		St. Dev.	1.19		0.18	23	22	70	9	48	23	0.45	0.04	0.03	0.03
		Count	17		19	18	18	18	18	18	18	18	18	18	18
W315	09/07/16 - 11/09/20	Average	520.19	3.10	7.25	-269	323	562	109	32	356	1.15	0.01	0.16	0.11
		Maximum	521.31		7.65	-158	340	715	119	50	385	3.20	0.02	0.49	0.46
		Minimum	518.21		6.95	-295	312	430	99	22	332	0.25	0.01	0.03	0.00
		St. Dev.	0.98		0.20	33	8	57	6	9	15	0.73	0.00	0.14	0.13
		Count	16		17	17	17	17	17	17	17	17	17	17	17
W316	05/15/15 - 11/10/20	Average	529.66	3.32	7.29	-236	305	640	180	7	247	2.24	0.12	0.19	0.14
		Maximum	531.31		7.62	-164	400	1,195	242	57	451	13.00	0.74	0.39	0.31
		Minimum	527.99		6.80	-343	272	530	131	4	197	0.01	0.01	0.00	0.01
		St. Dev.	1.04		0.25	36	30	128	25	10	49	2.57	0.22	0.09	0.08
		Count	23		23	25	25	25	25	25	25	25	25	25	25
W38R	09/07/16 - 11/09/20	Average	511.50	6.20	7.33	-347	396	1,142	310	169	458	0.85	0.01	0.05	0.04
		Maximum	514.97		7.54	-307	416	1,295	384	222	506	2.21	0.05	0.20	0.18
		Minimum	508.77		7.07	-371	361	1,045	282	131	404	0.36	0.01	0.02	0.00
		St. Dev.	2.18		0.14	24	19	69	24	29	27	0.53	0.01	0.05	0.04
		Count	17		18	18	18	18	18	18	18	18	18	18	18
WEGWM-10	11/28/06 - 04/22/15	Average	503.60	4.70	7.21	-325	397	728	165	56	466	5.40	0.04	0.35	0.04
		Maximum	505.80		8.00	-159	450	885	240	72	697	55.20	0.33	1.20	0.22
		Minimum	501.10		6.20	-376	215	205	20	4	100	0.08	0.01	0.02	0.00
		St. Dev.	1.41		0.39	46	46	132	41	14	92	10.59	0.08	0.27	0.05
		Count	25		24	31	31	31	31	31	31	31	27	31	27

Location Information					Acidity / Alkalinity			Major Ions				Metals			
Location	Date Range	Statistics	Water Level Elevation	Water Level Range (Max - Min)	pH, Field	Acidity	Alkalinity as CaCO3, @ pH 4.5	Total Dissolved Solids, Lab	Sulfates	Chloride	Hardness	Iron	Iron	Manganese	Manganese
					N	N	N	N	N	N	N	T	D	T	D
					S.U.	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
WEGWM-8	08/31/93 - 04/22/15	Average	516.18	10.17	7.16	-271	409	1,057	265	231	792	49.79	0.01	3.45	0.01
		Maximum	520.07		8.06	27	6,680	3,010	642	581	6,500	1,035.00	0.06	62.20	0.03
		Minimum	509.90		6.34	-4,020	184	480	130	24	226	0.00	0.01	0.00	0.00
		St. Dev.	2.20		0.36	540	945	545	148	181	1,059	164.62	0.01	10.06	0.01
		Count	42		39	53	47	58	56	58	58	58	27	52	32

Table 2: Table showing residential wells that exceed Class I water quality standards in the vicinity of Gateway Mine. Exceedances of Class 1 standards are shown in **blue**. Exceedances of both Class 1 and Class 2 are shown in **red**.

Residential Well	Description	Sample Date	Total Dissolved Solids	Acidity	Alkalinity	Chloride	Hardness	Iron	Manganese	pH	Sulfates	Water Level Depth
			(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(S.U.)	(mg/L)	(ft.)
Mulholland	SE 1/4 of SE 1/4 of Sec. 3, T. 4S, R. 5W. Approximately 1.7 miles north of the permit boundary.	03/14/1973	**3153**	--	474	40.0	2020	0.00	--	--	--	--
Zeigler Coal 3-01	860' West and 770' south of center of Sec. 22, T. 4S, R. 5W	06/17/1982	**1399**	77	410	18.0	1143	1.20	**0.62**	7.10	**580**	12.00
Kingsten / Miller	Elmer Kingsten. East 1/2 of the SE 1/4 of Section 26, T. 4S, R. 5W	06/18/1982	**2329**	93	369	122.0	1874	0.16	0.14	7.00	**950**	24.00
		01/30/2012	**1690**	-290	342	36.2	1010	0.77	0.13	6.95	**821**	--
Knope	Located approximately 0.4 miles east of the permit boundary.	11/13/1975	**3271**		636	95.0	1225	**6.30**	--	--	--	--
		01/18/2012	**3100**	-356	570	84.4	1281	0.11	0.03	7.45	**1510**	
133 23W1	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	1166	<1	90	12.3	160	0.69	**0.82**	7.52	21	--
383 21GW1	Associated with Permit 416 well inventory. Not located on map.	10/06/2011	**1472**	<1	401	178.0	1000	0.02	0.06	6.85	**468**	16.00
241 25W13	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	112	10	42	1.6	90	0.57	**0.54**	7.72	1	--
356 19W1	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	60	<1	54	2.4	130	1.40	**1.03**	7.23	4	--
49 11W1	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	230	-18	54	6.7	51	0.26	**0.76**	7.25	13	--
492 31W2	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	20	<1	59	3.9	140	0.21	**0.48**	7.66	9	--
525 5GW6	Associated with Permit 416 well inventory. Not located on map.	10/06/2011	854	<1	400	43.6	195	**23.60**	**3.14**	7.86	281	9.00
636 2GW2A	Associated with Permit 416 well inventory. Not located on map.	10/06/2011	152	19	50	11.6	94	0.02	0.14	**6.11**	44	7.00
663 1W9	Associated with Permit 416 well inventory. Not located on map.	09/15/2011	295	-75	100	12.2	115	0.55	**0.16**	7.97	34	--

Well		2011 Water Year	2012 Water Year	2013 Water Year	2014 Water Year	2015 Water Year	2016 Water Year	2017 Water Year	2018 Water Year	2019 Water Year	2020 Water Year	Average Annual Fluctuation	Maximum Annual Fluctuation	Minimum Annual Fluctuation
	Start Date	10/1/2010	10/1/2011	10/1/2012	10/1/2013	10/1/2014	10/1/2015	10/1/2016	10/1/2017	10/1/2018	10/1/2019			
	End Date	9/30/2011	9/30/2012	9/30/2013	9/30/2014	9/30/2015	9/30/2016	9/30/2017	9/30/2018	9/30/2019	9/30/2020			
W311	Max	--	509.2	509.0	508.8	508.3	507.6	506.3	506.8	507.3	508.2	2.93	5.60	1.20
	Min	--	503.9	503.4	505.2	505.5	506.1	505.1	504.5	505.6	505.8			
	Δ	--	5.3	5.6	3.6	2.8	1.5	1.2	2.3	1.7	2.4			
W312	Max	--	513.0	511.5	509.8	510.1	509.0	506.9	508.3	509.3	508.7	4.87	9.40	1.90
	Min	--	503.6	503.1	503.5	505.0	504.8	505.0	504.9	506.5	506.3			
	Δ	--	9.4	8.3	6.3	5.1	4.2	1.9	3.4	2.8	2.4			
W313	Max	--	524.2	523.2	521.9	522.8	521.9	522.2	523.5	524.5	524.6	2.27	4.00	0.50
	Min	--	520.7	519.2	518.8	519.9	520.2	520.4	521.2	523.9	524.1			
	Δ	--	3.5	4.0	3.1	2.9	1.7	1.9	2.3	0.6	0.5			
W314	Max	--	--	--	--	--	--	490.0	490.2	490.3	490.8	2.47	2.70	2.30
	Min	--	--	--	--	--	--	487.3	487.9	488.0	488.2			
	Δ	--	--	--	--	--	--	2.7	2.3	2.3	2.6			
W315	Max	--	--	--	--	--	--	521.2	521.1	520.9	521.3	2.10	2.90	1.30
	Min	--	--	--	--	--	--	518.8	518.2	519.6	519.5			
	Δ	--	--	--	--	--	--	2.4	2.9	1.3	1.8			
W316	Max	--	--	--	--	--	--	530.6	530.1	530.8	531.0	2.18	2.50	1.90
	Min	--	--	--	--	--	--	528.5	528.0	528.3	529.1			
	Δ	--	--	--	--	--	--	2.2	2.1	2.5	1.9			
W38R	Max	--	--	--	--	--	--	510.4	513.5	514.5	515.0	3.45	4.70	1.40
	Min	--	--	--	--	--	--	509.0	508.8	511.1	510.7			
	Δ	--	--	--	--	--	--	1.4	4.7	3.4	4.3			
WEGWM-10	Max	505.6	504.4	505.4	504.9	504.4	--	--	--	--	--	2.80	3.10	2.50
	Min	501.1	501.6	502.6	501.8	501.9	--	--	--	--	--			
	Δ	4.5	2.8	2.8	3.1	2.5	--	--	--	--	--			
WEGWM-8	Max	518.9	517.5	518.6	518.9	516.4	--	--	--	--	--	3.85	5.30	1.50
	Min	515.4	514.1	513.3	513.7	514.9	--	--	--	--	--			
	Δ	3.5	3.4	5.3	5.2	1.5	--	--	--	--	--			

Average	4.00	4.88	5.21	4.25	2.96	2.48	1.95	2.86	2.09	2.27
Max	4.50	9.40	8.35	6.25	5.10	4.23	2.70	4.70	3.40	4.30
Min	3.50	2.80	2.80	3.10	1.50	1.50	1.20	2.15	0.60	0.50

PEABODY ENERGY - MIDWEST

SAMPLING AND ANALYSIS PLAN
Groundwater

Revised: January 2021

GROUNDWATER SAMPLING METHODS

This section describes the general procedures and methodologies used when conducting groundwater sampling.

1.0 GROUNDWATER LEVEL MEASUREMENTS

The depth to the water (DTW) level will be measured within the monitoring well before any purging and sampling. Groundwater level measurements can provide information on lateral and vertical head distribution and hydraulic gradients within individual aquifers and between aquifers in layered aquifer systems. Long-term groundwater level measurement provides information on the temporal trends in groundwater levels (and therefore flow direction and rates) due to the effects of drought, high rainfall events, and groundwater pumping. The depth to water and the total depth of each monitoring well are also used to determine the volume of groundwater to be removed from the monitoring well as part of the purging activity. Groundwater level elevations will be calculated from water levels relative to top of casing elevations. The top of casing elevation relative to mean sea level will be measured by a surveyor.

1.1 MEASURING DEPTH TO WATER TABLE

The depth to the water level (DTW) in the monitoring well is also referred to as depth to groundwater or static water level (SWL), if the water level has not been altered from pumping. Depth to the water table will be measured and recorded before every groundwater sampling event. Upon arrival, the well cap should be removed allowing the barometric pressure to equilibrate within the well. The water level will then be measured in hundredths of feet with an electronic water level indicator. The water level indicator consists of a probe that detects the presence of a conductive liquid between its two electrodes and is powered by a standard 9 volt battery. When contact is made with water, the circuit is closed, sending a signal back to the reel which activates a buzzer and or light. The water level is then determined by taking a reading directly from the tape, at the surveyor mark on the top of the well casing. If no mark is present, mark a location with a metal file or indelible marker on the north side of the casing for future reference. The depth to water level from the ground surface can be determined by subtracting the well casing stickup (length of well casing extending above the surface of the ground) from the water level measured from the top of the monitoring well casing.

Procedure

1. Remove well cap allowing barometric pressure to equilibrate within the well.
2. Measure the water level by lowering the indicator into the well.
3. Record the water level measurement in hundredths of a foot from the surveyor mark at the top of the casing.
    a. If no mark is present, mark the location with a metal file or marker on the north side of the well casing.
4. Calculate and record water level elevation either by:
    a. Subtracting the water level measured from the top of casing from the previously determined top of casing elevation.
    b. Subtracting the water level measured from the top of casing from the previously determined ground surface elevation, then adding the well casing stickup height from ground surface.

2.0 PURGING

Prior to collecting a sample the monitoring well will be purged, either by pump or bailer, of one to three well volumes ensuring water from the formation is sampled (USGS, 2006; Knobel, 2006). The volume of water present in the well casing (gallons) can be calculated using the following formula:

$$V = 0.04d^2h$$

Where V = volume of water in the well (gal)
d = diameter of well (in)
h = column of water, well total depth – water level (ft)

Note: the units for the diameter of the monitoring well are in inches and the height of the column of water are in feet. Do not change the units, the built in conversion factor accommodates this variation.

Procedure

1. Measure the inner diameter of the bore casing in inches.
2. Measure the total depth of the monitoring well in feet, or obtain this from the relevant database or owner.
3. Measure the depth to water level in feet (see section 1.1).
4. Calculate the length of the water column (well total depth – water level).
5. Calculate the volume of water using the formula above.

2.1 Purging using a bailer

A bailer is a simple mechanical device that can be used to draw water from the monitoring well. It consists of a length of tubing (polyethylene, polyvinyl chloride, Teflon®, stainless steel, etc.) with a one-way check valve at the bottom. When the bailer is lowered into the well casing below the water level, it fills with water. The check valve closes once the bailer containing the water sample is lifted to the surface. Bailers come in various lengths and widths therefore it is required to determine the total volume of water each bailer can remove. The bailers volume in gallons can be calculated using the same equation used to calculate the volume of water in a well casing above by substituting the length of the bailer in feet for the height of the column of water in the well casing and the inner diameter of the bailer in inches for the inner diameter of the well casing (see Section 2.0). The volume of water in the well (gal) is then divided by the volume of water removed in each bail (gal) to determine the number of bails required to remove the one to three well volumes.

Procedure

1. Lower the bailer into the water trying not to cause excessive splashing which may result in disturbance of the sediment at the base of the water column.
    a. Similarly also avoid hitting the bailer on the bottom of the well.
2. Withdraw the bailer smoothly, limiting excessive splashing.
3. Use a bucket of known volume to record the volume of water being discharged or calculate the volume removed based on the size of the bailer.
4. Remove the calculated volume of water (see Section 2.0).

2.2 Purging using a pump

A wide range of groundwater pumps employing different operating methods, available on the market. There are pneumatic pumps that require a compressed air/gas source, electric pumps that require 240 volt AC or 12–24 volt DC, and mechanical pumps, which use linkages to provide the lift mechanism. The pump used will depend on the cost of the equipment, depth of the monitoring well screen interval, the depth of the water table, diameter of the monitoring well

casing, amount of water to be evacuated. Regardless of the type of pump used, the pump will be deployed by slowly lowering the head of the pump to within the screen interval of the monitoring well. The pump will then be turned on, the pumping rate estimated by recording the time required to fill a known volume (ex: half gallon bottle), and the time to purge the one to three well volumes will be calculated by dividing the water volume required to be purged by the average pumping rate.

Procedure

1. Lower the pump slowly to within the monitoring well screen interval taking care not to hit the base of the well, which can stir up particulate matter.
2. After starting the pump, attempt to achieve the highest flow rate possible without causing the monitoring well to stop yielding.
3. Estimate the flow rate by recording the time required to fill a known volume, converting units into gallons.
4. Determine the time required to purge the one to three well volumes by dividing the water volume required to be purged by the average pumping rate.
5. Pump for calculated length of time needed to remove the one to three well volumes of water.

3.0 SAMPLING MONITORING WELLS

Monitoring well samples will be collected using either a bailer or pump.

3.1 Bailing

Equipment will consist of a bailer with the appropriate length of bailer twine. Care should be taken to lower the bailer slowly into the water limiting disturbance to the water column that can result in sediment being re-suspended in the water column from a plunger effect. In addition, care should also be taken to not let the base of the bailer hit the bottom of well which also can result in re-suspension of sediment at the bottom of the well.

Procedure

1. Upon completion of purging the well, lower the bailer slowly and gently into the water column of the well until it is submerged. Do not allow the bailer to come into contact with the bottom of the well.
2. Slowly remove the bailer from the water column.
3. Carefully remove the water sample, pouring it from the bailer into a prepared sample container.
4. Repeat steps 1-3 until all sample containers are filled to within at least one inch of the top of the sample container.

3.2 Pumping

Equipment will consist of a pump selected based on cost of the equipment, depth of the monitoring well screen interval, the depth of the water table, diameter of the monitoring well casing, amount of water to be evacuated. The pump should be deployed slowly to within the monitoring well screen interval. Changes in the depth of pump within the well column should be avoided as it can disturb sediment settled within the well casing. The water sample should be collected immediately after completion of the purging.

Procedure

1. Upon completion of purging the well, the groundwater sample should be collected into a prepared sample bottle.

2. Fill all sample containers to within at least one inch of the top of the sample container.

3.3 Low Yielding Wells

In some instances the monitoring wells may be installed in very low yielding materials resulting in rapid drawdown and complete dewatering. If this occurs wait for sufficient water level recovery, ~75% of pre-purging water level or within 24 hours, before collecting the sample. In all instances the sample should be collected within 24 hours of the initial purging event.

4.0 FIELD PARAMETERS

Using the multi-parameter water quality sensor (EUTECH Instruments PTTester 35 or equivalent), in accordance with the user's manual, measure field pH, total dissolved solids (TDS), and temperature (^{o}C) from groundwater collected at the same time as the analyte samples. The field measurements should be taken immediately after collection to ensure their accuracy.

Procedure

1. Calibrate the multi-parameter water quality sensor prior to each sampling event, if it's a single day event, or each morning of a multiple day sampling event. Use 3-point calibration process (ph of 4.0, 7.0, 10.0). See manual for calibration procedure.
2. Purge the well of the required number of well volumes
3. For parameters that do not require filtering:
   a. Lower pumping rate
   b. Fill appropriate container with raw (unfiltered) water
4. For parameters that require filtering:
   a. Lower pumping rate
   b. Attach in-line 0.45 µm to the pump tubing
   c. Hold filter upright (discharge up) while filter is saturating
   d. Fill appropriate container
5. Collect one additional bottle or beaker of water to conduct field measurement.
6. Immediately after collection, place the multi-parameter water quality sensor into water and begin measuring.
7. Allow values to stabilize and record the measurements on the field sheet and chain of custody.

5.0 SAMPLE PREPARATION

The sample water will be collected into appropriately labeled bottles based on the sites required analyses. The necessary samples will then be preserved before being placed on ice and cooled to approximately 4° C. The samples will then either be picked up by a courier or delivered to the laboratory following chain-of-custody procedures. A list of commonly sampled parameters, preservation requirements, and maximum laboratory holding times are provided in the table below. A list of laboratory sample classifications, analytes, required sample volumes, bottle types, and required preservative are provided in the attached tables.

Parameters	Preservative	Temp	Max Holding Time
Metals*, Hardness	HNO_3 to pH <2	≤ 6 °C	6 months
Phenol, Nitrate-N, Phosphorous, Total Organic Carbon	H_2SO_4 to pH <2	≤ 6 °C	28 days
Cyanide	NaOH to pH >10	≤ 6 °C	14 days
Sulfide	NaOH w/ ZnAc to pH >9	≤ 6 °C	7 days
Acidity, Alkalinity	-	≤ 6 °C	14 days
Sulfate	-	≤ 6 °C	28 days

Total Suspended Solids, Total Dissolved Solids	-	≤ 6 °C	7 days
Low level Mercury	Lab Preserves	≤ 6 °C	48 hrs**

Note:
* Dissolved Metals Require Field Filtration
**Time to transport to laboratory

6.0 CHAIN OF CUSTODY

The Chain of Custody (COC) is a written legal document used to track the transfer of a sample from person to person. It is utilized to guarantee the identity and integrity of a sample from collection through reporting of the test result. Thus the COC is formatted to record field information, laboratory information, and the people who handle each individual sample. A COC is created for each sampling event and is typically a one page document. An individualized COC has been created for each of the Midwest mines and includes applicable facility codes, sample location codes, and Peabody sample location identification numbers. Additionally, required field parameters, lab parameters, bottle types, and preservatives are included in the box located on the bottom right corner. The COC contains fields to enter calibration information for the multi parameter field water quality meter, the sample date/time, and all relevant field measurements (ph, TDS, Temp, etc). The COC also contains several signatory lines for the relinquishment of custody of the samples and for the receipt of custody of the samples.

Procedure

Fill out the appropriate monitoring well COC prior to submittal of samples to the laboratory. Note that because of variation between state regulatory agency monitoring requirements not all column headers are relevant to every sample type. Where applicable the specific state, or states (IL, IN, KY), requiring the parameter is identified.

1. pH and TDS/Conductivity Meter Calibrated Row
    - **a.** Sample Date and Time
        - i. Enter the date and time the meter was calibrated.
        - ii. Note: The meter must be calibrated prior to collecting any samples.
2. Sample Location Row
    - **a.** Sample Date and Time
        - i. Enter the date and time of sample collection.
    - **b.** Grab
        - i. This column denotes the sample collection methodology and is utilized to denote that a sample was collected.
        - ii. If a sample was collected mark an “x” in the cell, if sample was not collected leave the cell blank.
    - **c.** # Containers
        - i. This column identifies the number of bottles that are shipped/delivered to the lab. This cell is utilized by the laboratory to ensure the receipt of all samples.
            1. Mark the number of sample bottles collected at each sample location that will be shipped to the lab for analysis.
    - **d.** SWL
        - i. Record the measured depth to water from the specified measurement point, top of well casing (toc).
        - ii. Note: Make sure measurement point used for the measurement matches the measurement point identified on the COC.
    - **e.** pH
        - i. Record the field measured pH in the cell.
    - **f.** Temp
        - i. Record the field measured Temperature in the cell.
    - **g.** TDS
        - i. Record the measured field TDS in this cell

h. Top of Casing Elevation
  i. Top of well casing measurement point elevation
    1. Used to calculate the measured static water level elevation if measurement was taken from TOC.

i. Surface Elevation
  i. Ground surface elevation at well measurement point
    1. Used to calculate the measured static water level elevation if measurement was taken from ground surface measurement point.

j. Total Depth
  i. Total depth of well.
    1. Reference point is typically from ground surface.

k. Static Water Elevation
  i. Static water level elevation. Calculated by subtracting measured water level from reference point (i.e. top of well casing) from reference point elevation (i.e. top of casing elevation).

l. Sample Type
  i. The required sample type for the sample location is identified in this column
    1. Details of the required field measurements, number of bottles to collect, type and size of bottle to use, the necessary preservative, and the laboratory analysis required are found in the bottom right corner of the COC.

m. Comments
  i. Any relevant comments should be included here.
  ii. Note: In some instances the screened interval and well stickup (well casing extending above ground surface) are provided here.

n. Gray Cells
  i. Do not record or mark anything in these cells. This acts as a reminder that the subject sample point does not require this information.

o. Signature Row
  i. Relinquished by
    1. Sign, date, and time the COC upon relinquishing the samples to the laboratory technician, laboratory courier, or Peabody personnel.
  ii. Received by
    1. The laboratory technician, laboratory currier, or Peabody personnel must sign, date, and time these cells upon receipt of the samples.

Note

1. **Details of the required field parameters, lab parameters, and bottles for the sample types are noted on the bottom right corner of the COC.**
2. **Make sure measured units match units listed on the COC**
3. **No erroneous information may be erased from the COC. Errors must be lined out with a single dash, initialed, and the correction written in.**
4. **Review the COC for accuracy prior to relinquishing it.**

References:

U.S. Geological Survey, 2006, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, available at http://pubs.water.usgs.gov/twri9A.

Knobel, L.L., 2006, Evaluation of well-purging effects on water-quality results for samples collected from the Eastern Snake River Plain Aquifer underlying the Idaho National Laboratory: U.S. Geological Survey Scientific Investigations Report 2006-5232 (DOE/ID-22200), 62 p.

Data Set: K:\AQTESOLV\Slug tests\Gateway GWM-8 Rising.aqt
Title: Gateway Mine GWM-8 Rising
Date: 04/04/14
Time: 15:18:54

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 23.84 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: GWM-8

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 9.63 ft
Static Water Column Height: 23.84 ft
Casing Radius: 0.1667 ft
Well Radius: 0.4167 ft
Well Skin Radius: 0.4167 ft
Screen Length: 15. ft
Total Well Penetration Depth: 27.5 ft

No. of Observations: 26

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	9.63	210.	6.29
30.	8.97	225.	6.1
45.	8.75	240.	5.94
60.	8.49	255.	5.75
75.	8.19	270.	5.59
90.	7.97	285.	5.45
105.	7.72	300.	5.28
120.	7.5	450.	4.02
135.	7.28	600.	3.07
150.	7.07	750.	2.38
165.	6.86	900.	1.87
180.	6.67	1200.	1.16
195.	6.46	1500.	0.78

SOLUTION

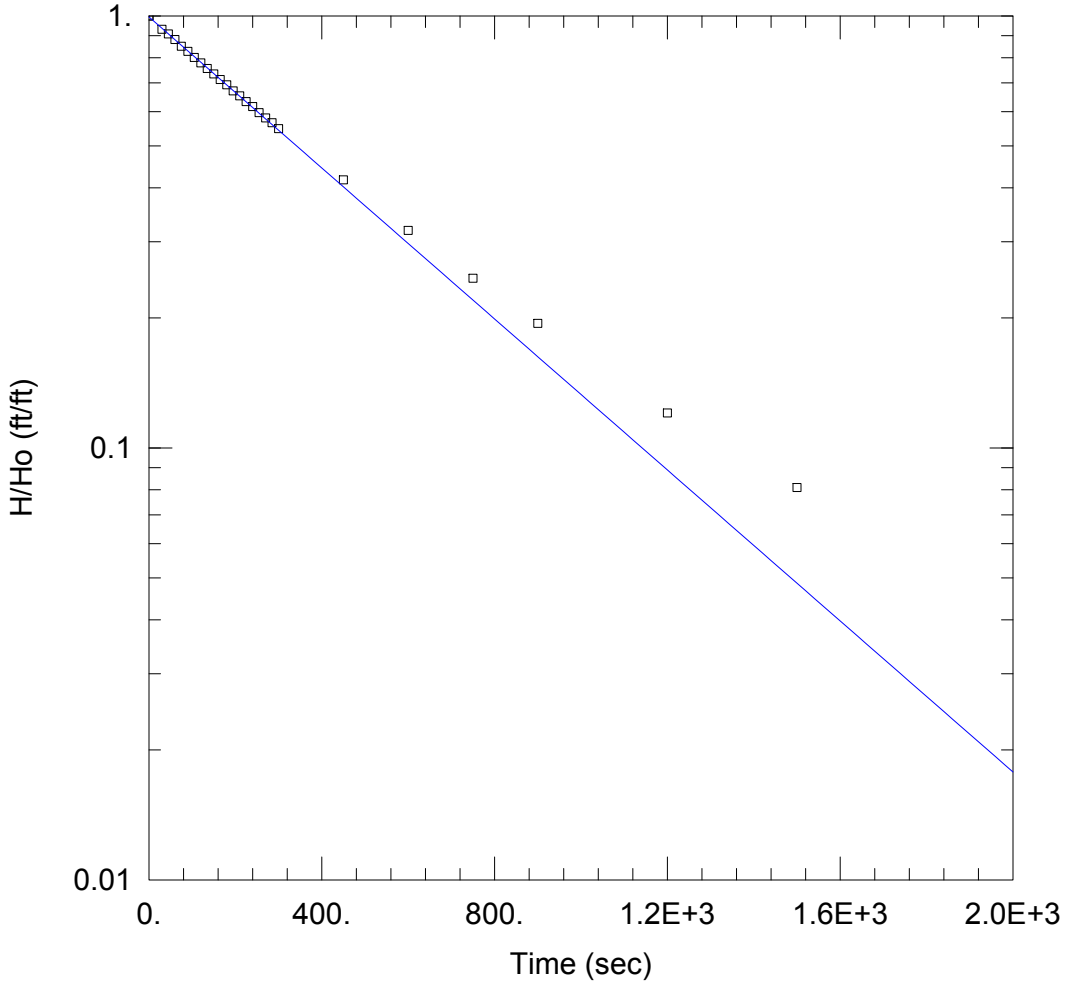
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.099

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.000176	cm/sec
y0	9.576	ft

T = K*b = 0.1279 cm²/sec



GATEWAY MINE GWM-8 RISING

Data Set: K:\AQTESOLV\Slug tests\Gateway GWM-8 Rising.aqt
Date: 04/04/14 Time: 15:18:06

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 23.84 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GWM-8)

Initial Displacement: 9.63 ft Static Water Column Height: 23.84 ft
Total Well Penetration Depth: 27.5 ft Screen Length: 15. ft
Casing Radius: 0.1667 ft Well Radius: 0.4167 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.000176 cm/sec y0 = 9.576 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

1. Enter Test Data
   Choose options from the Edit menu to enter or modify test data.
2. Perform Diagnostic Analyses (Optional)
   Choose diagnostic flow plot and derivative plot options from the View menu.
3. Perform Curve Matching or Prediction
   Choose the Solution or Toolbox options from the Match menu to perform forward solution analyses (prediction).
   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 26
Range of time readings in obs. well(s): 0 to 1500 sec
Range of displacement readings in obs. well(s): 0.78 to 9.63 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway GWM-10 Rising.aqt
Title: Gateway Mine GWM-10 Rising
Date: 04/04/14
Time: 15:24:48

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 25.19 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: GWM-10

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 11.74 ft
Static Water Column Height: 25.19 ft
Casing Radius: 0.08333 ft
Well Radius: 0.3333 ft
Well Skin Radius: 0.3333 ft
Screen Length: 20. ft
Total Well Penetration Depth: 27. ft

No. of Observations: 30

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	11.74	225.	8.78
15.	11.49	240.	8.64
30.	11.25	255.	8.5
45.	11.04	270.	8.35
60.	10.79	285.	8.22
75.	10.59	300.	8.11
90.	10.37	360.	7.64
105.	10.18	420.	7.15
120.	9.99	480.	6.75
135.	9.79	540.	6.35
150.	9.61	606.	5.73
165.	9.41	900.	3.23
180.	9.27	1200.	2.12
195.	9.09	1500.	1.74
210.	8.94	1800.	1.52

SOLUTION

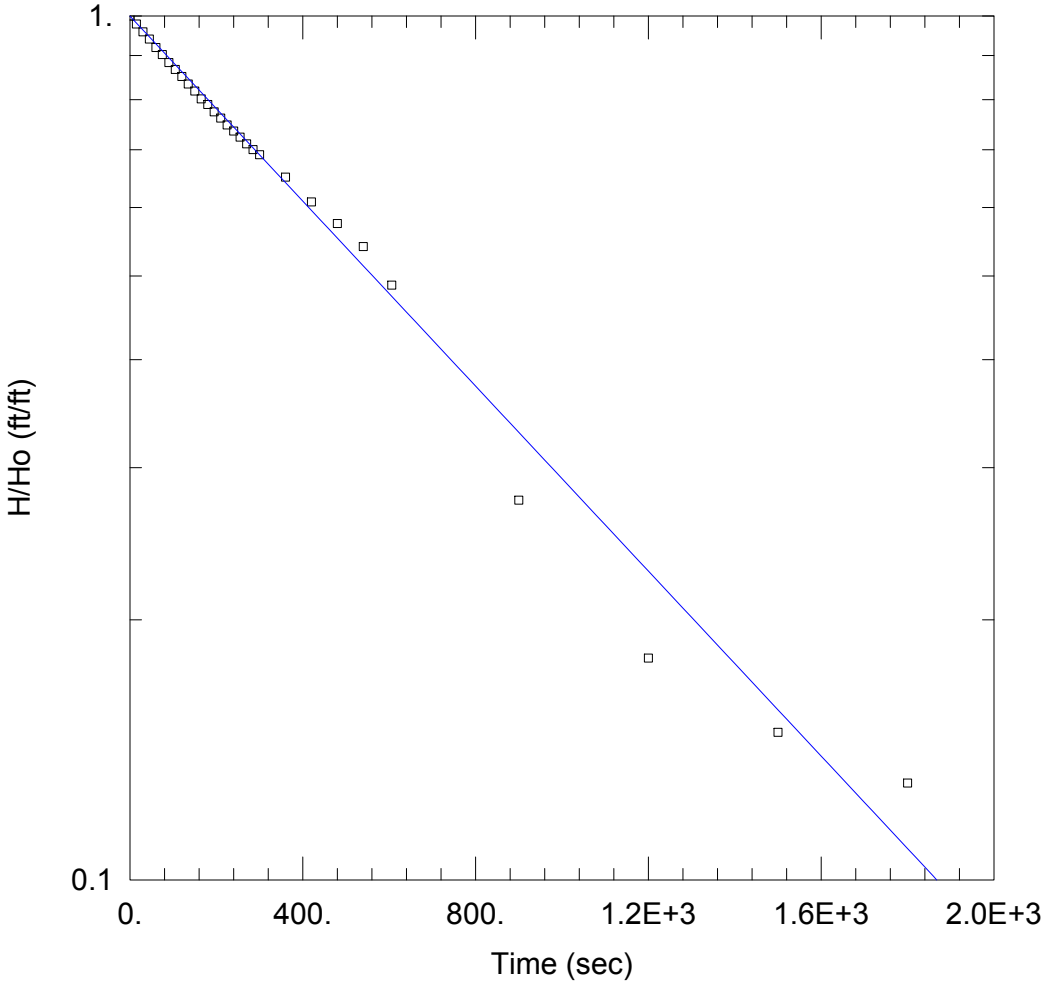
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.332

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.173E-5	cm/sec
y0	11.73	ft

T = K*b = 0.01668 cm²/sec



GATEWAY MINE GWM-10 RISING

Data Set: K:\AQTESOLV\Slug tests\Gateway GWM-10 Rising.aqt
Date: 04/04/14 Time: 15:24:17

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 25.19 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GWM-10)

Initial Displacement: 11.74 ft Static Water Column Height: 25.19 ft
Total Well Penetration Depth: 27. ft Screen Length: 20. ft
Casing Radius: 0.08333 ft Well Radius: 0.3333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.173E-5 cm/sec y0 = 11.73 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

1. Enter Test Data
   Choose options from the Edit menu to enter or modify test data.
2. Perform Diagnostic Analyses (Optional)
   Choose diagnostic flow plot and derivative plot options from the View menu.
3. Perform Curve Matching or Prediction
   Choose the Solution or Toolbox options from the Match menu to perform forward solution analyses (prediction).
   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 30
Range of time readings in obs. well(s): 0 to 1800 sec
Range of displacement readings in obs. well(s): 1.52 to 11.74 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-11 Rising.aqt
Title: Gateway Mine W3-11 Rising Head
Date: 05/03/13
Time: 15:10:06

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 32.95 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: W3-11

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 13.17 ft
Static Water Column Height: 32.95 ft
Casing Radius: 0.083 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 30. ft
Total Well Penetration Depth: 34. ft

No. of Observations: 35

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	13.17	270.	9.48
15.	12.94	285.	9.29
30.	12.69	300.	9.13
45.	12.39	315.	8.93
60.	12.21	330.	8.75
75.	12.06	345.	8.57
90.	11.87	360.	8.36
105.	11.68	390.	7.94
120.	11.49	420.	7.66
135.	11.27	450.	7.41
150.	11.06	480.	7.24
165.	10.83	540.	6.88
180.	10.63	600.	6.46
195.	10.41	900.	2.73
210.	10.23	1200.	1.49
225.	10.03	1500.	1.02
240.	9.86	1800.	0.79
255.	9.65		

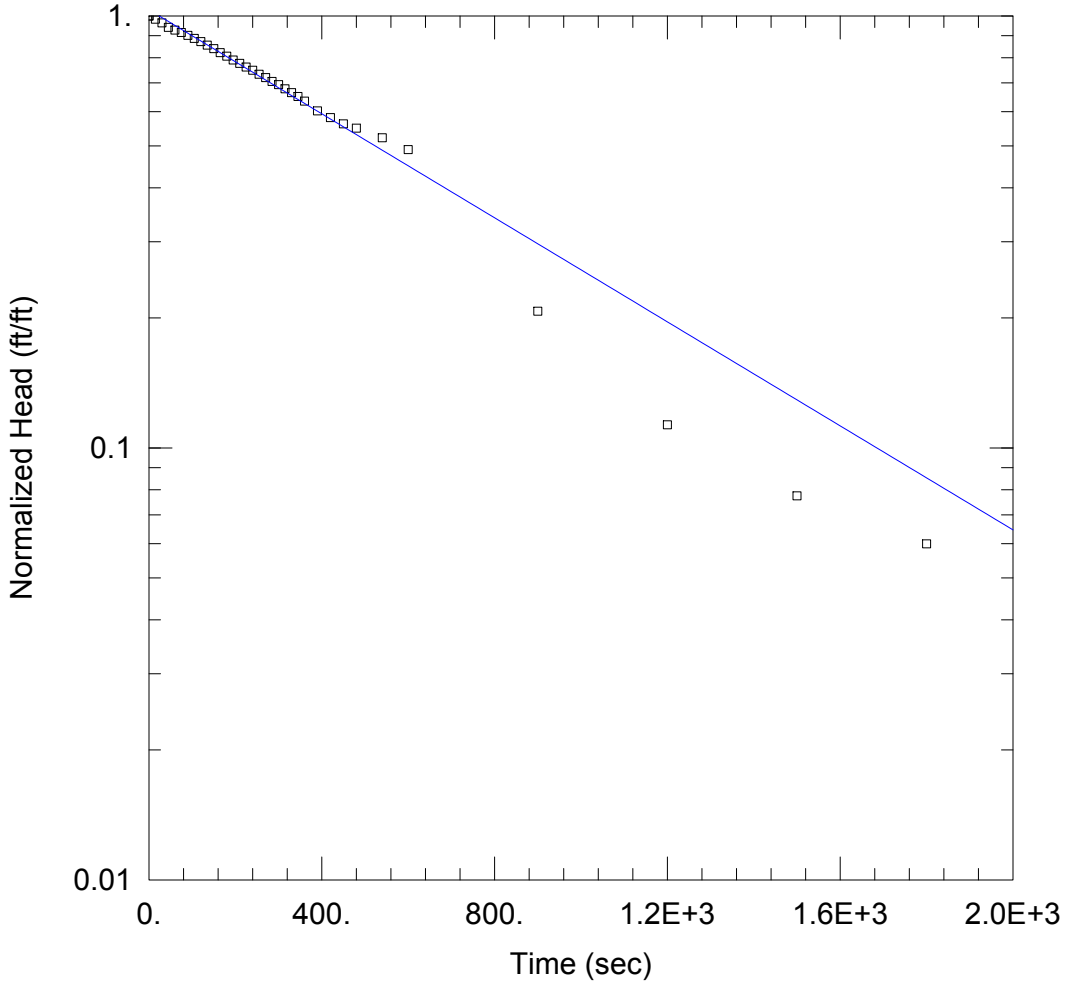
SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.542

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.718E-5	cm/sec



GATEWAY MINE W3-11 RISING HEAD

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-11 Rising.aqt
Date: 05/03/13 Time: 15:10:35

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 32.95 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W3-11)

Initial Displacement: 13.17 ft Static Water Column Height: 32.95 ft
Total Well Penetration Depth: 34. ft Screen Length: 30. ft
Casing Radius: 0.083 ft Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.718E-5 cm/sec y0 = 13.61 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

1. Enter Test Data
   Choose options from the Edit menu to enter or modify test data.
2. Perform Diagnostic Analyses (Optional)
   Choose diagnostic flow plot and derivative plot options from the View menu.
3. Perform Curve Matching or Prediction
   Choose the Solution or Toolbox options from the Match menu to perform forward solution analyses (prediction).
   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 35
Range of time readings in obs. well(s): 0 to 1800 sec
Range of displacement readings in obs. well(s): 0.79 to 13.17 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-12 Rising.aqt
Title: Gateway Mine W3-12 Rising
Date: 05/03/13
Time: 15:19:01

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 29.66 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: W3-12

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 10.2 ft
Static Water Column Height: 29.66 ft
Casing Radius: 0.083 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 30. ft
Total Well Penetration Depth: 33. ft

No. of Observations: 31

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	10.2	270.	8.39
15.	10.03	285.	8.3
30.	9.94	300.	8.24
45.	9.84	315.	8.14
60.	9.7	330.	8.05
75.	9.57	345.	7.97
90.	9.45	360.	7.91
105.	9.33	420.	7.61
120.	9.26	480.	7.36
135.	9.17	540.	7.09
180.	8.92	600.	6.86
195.	8.82	900.	5.8
210.	8.73	1215.	4.86
225.	8.64	1800.	3.62
240.	8.56	2700.	2.36
255.	8.46		

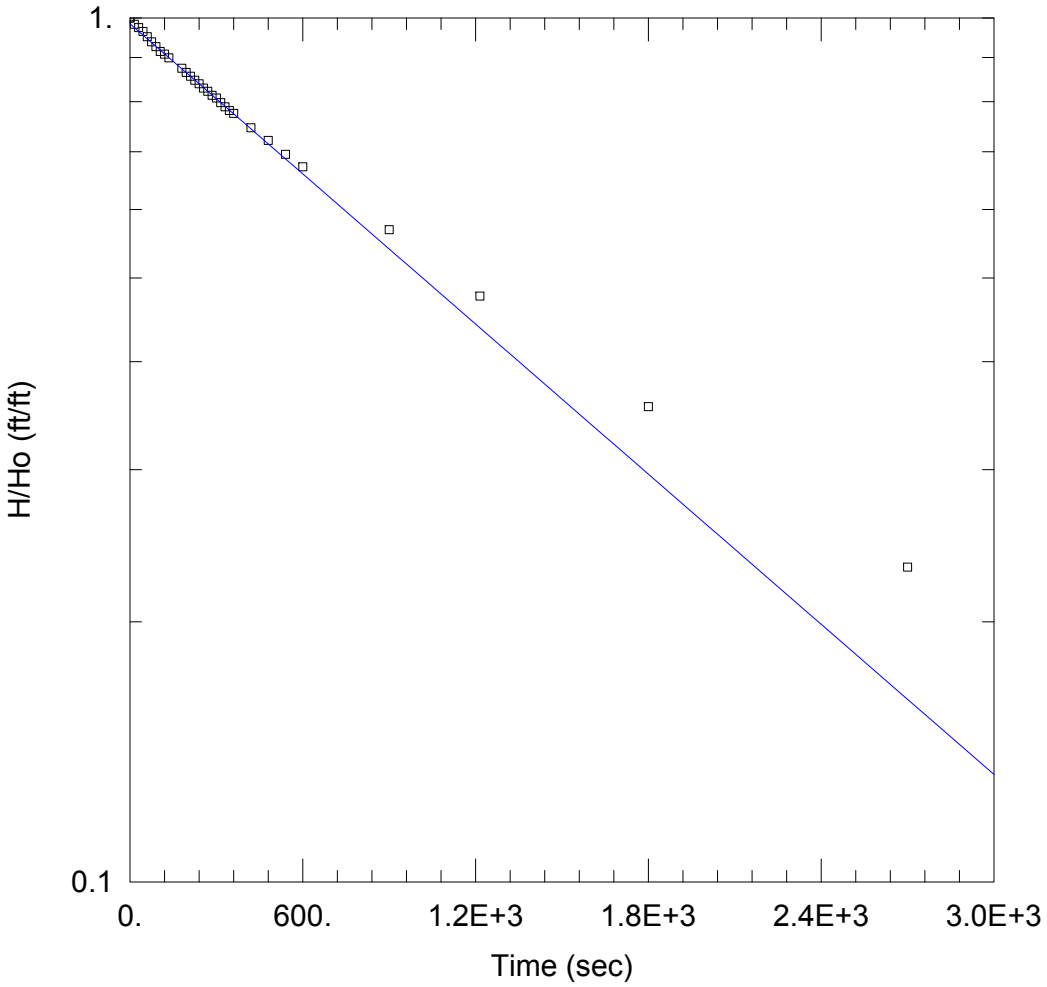
SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.521

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	8.312E-6	cm/sec
y0	10.04	ft



GATEWAY MINE W3-12 RISING

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-12 Rising.aqt
Date: 05/03/13 Time: 15:19:26

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 29.66 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W3-12)

Initial Displacement: 10.2 ft Static Water Column Height: 29.66 ft
Total Well Penetration Depth: 33. ft Screen Length: 30. ft
Casing Radius: 0.083 ft Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 8.312E-6 cm/sec y0 = 10.04 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

1. Enter Test Data
   Choose options from the Edit menu to enter or modify test data.
2. Perform Diagnostic Analyses (Optional)
   Choose diagnostic flow plot and derivative plot options from the View menu.
3. Perform Curve Matching or Prediction
   Choose the Solution or Toolbox options from the Match menu to perform forward solution analyses (prediction).
   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 31
Range of time readings in obs. well(s): 0 to 2700 sec
Range of displacement readings in obs. well(s): 2.36 to 10.2 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-13 Rising.aqt
Title: Gateway Mine W3-13 Rising
Date: 05/03/13
Time: 15:20:46

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 26.27 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: W3-13

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 9.67 ft
Static Water Column Height: 26.27 ft
Casing Radius: 0.083 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 20. ft
Total Well Penetration Depth: 27. ft

No. of Observations: 39

Observation Data

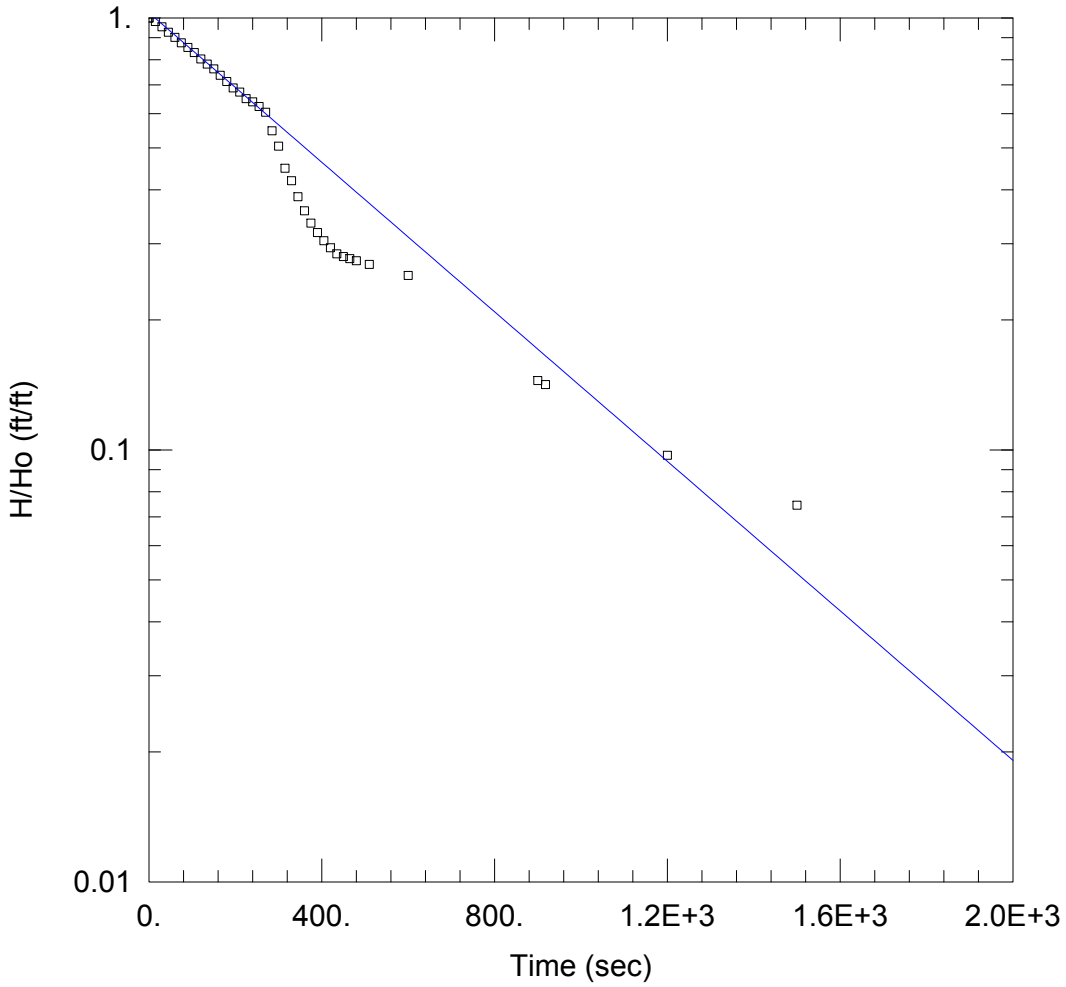
Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	9.67	300.	4.88
15.	9.49	315.	4.34
30.	9.22	330.	4.06
45.	8.96	345.	3.73
60.	8.72	360.	3.46
75.	8.47	375.	3.24
90.	8.26	390.	3.08
105.	8.04	405.	2.95
120.	7.77	420.	2.84
135.	7.56	435.	2.75
150.	7.37	450.	2.71
165.	7.12	465.	2.68
180.	6.89	480.	2.65
195.	6.66	510.	2.6
210.	6.51	600.	2.45
225.	6.29	900.	1.4
240.	6.18	918.	1.37
255.	6.03	1200.	0.94
270.	5.85	1500.	0.72
285.	5.3		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.333

VISUAL ESTIMATION RESULTS

Estimated Parameters



GATEWAY MINE W3-13 RISING

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-13 Rising.aqt
Date: 05/03/13 Time: 15:21:05

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 3/20/2012

AQUIFER DATA

Saturated Thickness: 26.27 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W3-13)

Initial Displacement: 9.67 ft Static Water Column Height: 26.27 ft
Total Well Penetration Depth: 27. ft Screen Length: 20. ft
Casing Radius: 0.083 ft Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 3.486E-5 cm/sec y0 = 9.941 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

1. Enter Test Data
   Choose options from the Edit menu to enter or modify test data.
2. Perform Diagnostic Analyses (Optional)
   Choose diagnostic flow plot and derivative plot options from the View menu.
3. Perform Curve Matching or Prediction
   Choose the Solution or Toolbox options from the Match menu to perform forward solution analyses (prediction).
   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 39
Range of time readings in obs. well(s): 0 to 1500 sec
Range of displacement readings in obs. well(s): 0.72 to 9.67 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-16 Falling.aqt
Title: Gateway Mine W3-16 Falling Head
Date: 05/18/15
Time: 14:14:18

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 5/14/2015

AQUIFER DATA

Saturated Thickness: 36.69 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: W3-16

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.25 ft
Static Water Column Height: 36.69 ft
Casing Radius: 0.083 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 26. ft
Total Well Penetration Depth: 38. ft

No. of Observations: 49

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	1.25	250.	0.22
10.	1.15	260.	0.21
20.	1.06	270.	0.19
30.	0.98	280.	0.19
40.	0.9	290.	0.17
50.	0.84	300.	0.16
60.	0.78	310.	0.15
70.	0.73	320.	0.15
80.	0.67	330.	0.14
90.	0.63	340.	0.13
100.	0.58	350.	0.12
110.	0.54	360.	0.12
120.	0.51	370.	0.11
130.	0.47	380.	0.11
140.	0.43	390.	0.1
150.	0.41	400.	0.1
160.	0.38	410.	0.1
170.	0.36	420.	0.09
180.	0.34	430.	0.09
190.	0.31	440.	0.09
200.	0.3	450.	0.08
210.	0.28	460.	0.08
220.	0.26	470.	0.08
230.	0.24	480.	0.07
240.	0.23		

SOLUTION

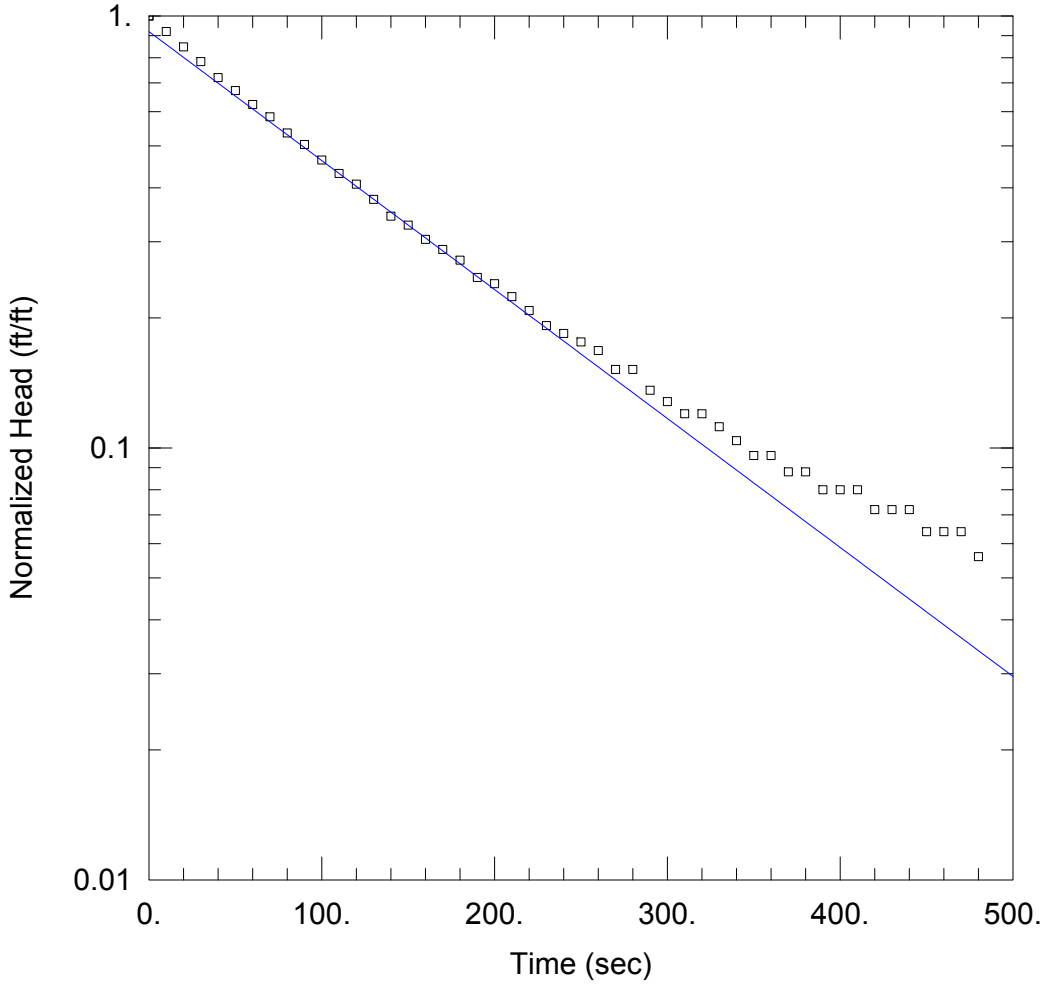
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.591

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	9.968E-5	cm/sec
y0	1.15	ft

T = K*b = 0.1115 cm²/sec



GATEWAY MINE W3-16 FALLING HEAD

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-16 Falling.aqt
Date: 05/18/15 Time: 14:14:01

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 5/14/2015

AQUIFER DATA

Saturated Thickness: 36.69 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W3-16)

Initial Displacement: 1.25 ft Static Water Column Height: 36.69 ft
Total Well Penetration Depth: 38. ft Screen Length: 26. ft
Casing Radius: 0.083 ft Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 9.968E-5 cm/sec y0 = 1.15 ft

The Error Log identifies errors detected in your data set.
Choose this view when you see the "Check Errors" indicator on the status bar.

No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

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   Choose the Automatic, Visual or Toolbox options from the Match menu to perform curve matching.
4. Analysis of Residuals (Optional)
   Choose residual plot and diagnostic report options from View menu to evaluate automatic curve fit.
5. Reporting
   Choose Format option from View menu to customize appearance of plots and reports.
   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 49
Range of time readings in obs. well(s): 0 to 480 sec
Range of displacement readings in obs. well(s): 0.07 to 1.25 ft

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-16 Rising.aqt
Title: Gateway Mine W3-16 Rising Head
Date: 05/18/15
Time: 14:12:47

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 5/14/2015

AQUIFER DATA

Saturated Thickness: 36.69 ft
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: W3-16

X Location: 0. ft
Y Location: 0. ft

Initial Displacement: 1.4 ft
Static Water Column Height: 36.69 ft
Casing Radius: 0.083 ft
Well Radius: 0.333 ft
Well Skin Radius: 0.333 ft
Screen Length: 26. ft
Total Well Penetration Depth: 38. ft

No. of Observations: 47

Observation Data

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
1.	1.4	240.	0.27
10.	1.31	250.	0.26
20.	1.21	260.	0.24
30.	1.12	270.	0.23
40.	1.04	280.	0.21
50.	0.96	290.	0.2
60.	0.89	300.	0.2
70.	0.83	310.	0.18
80.	0.78	320.	0.17
90.	0.72	330.	0.16
100.	0.67	340.	0.15
110.	0.63	350.	0.14
120.	0.58	360.	0.14
130.	0.55	370.	0.13
140.	0.51	380.	0.12
150.	0.48	390.	0.12
160.	0.45	400.	0.11
170.	0.42	410.	0.11
180.	0.39	420.	0.11
190.	0.37	430.	0.1
200.	0.35	440.	0.09
210.	0.32	450.	0.09
220.	0.31	460.	0.09
230.	0.29		

SOLUTION

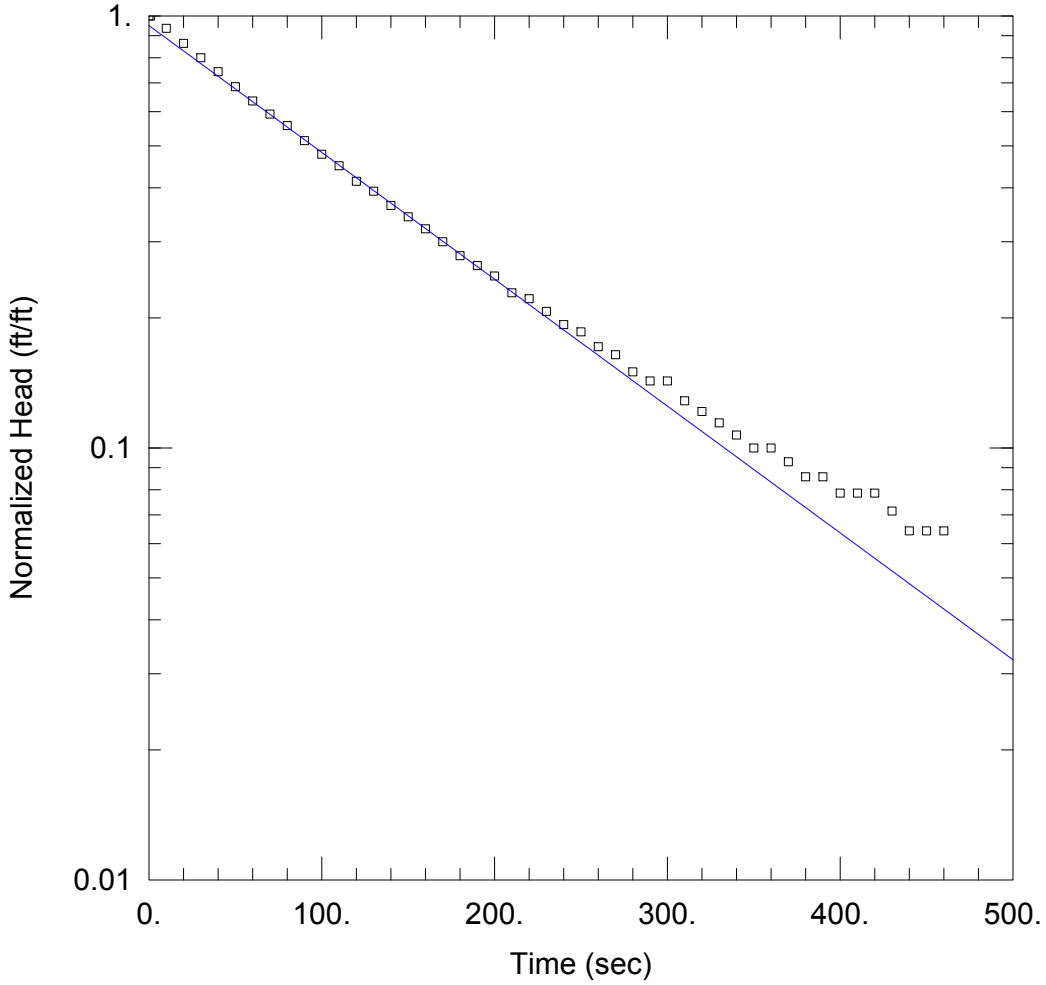
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.591

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	9.804E-5	cm/sec
y0	1.33	ft

T = K*b = 0.1096 cm²/sec



GATEWAY MINE W3-16 RISING HEAD

Data Set: K:\AQTESOLV\Slug tests\Gateway W3-16 Rising.aqt
Date: 05/18/15 Time: 14:12:29

PROJECT INFORMATION

Company: Peabody Coulterville Mining
Location: Coulterville, IL
Test Date: 5/14/2015

AQUIFER DATA

Saturated Thickness: 36.69 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (W3-16)

Initial Displacement: 1.4 ft Static Water Column Height: 36.69 ft
Total Well Penetration Depth: 38. ft Screen Length: 26. ft
Casing Radius: 0.083 ft Well Radius: 0.333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 9.804E-5 cm/sec y0 = 1.33 ft

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No errors detected in data set.

Tips for Analyzing Aquifer Tests with AQTESOLV for Windows

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3. Perform Curve Matching or Prediction
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5. Reporting
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   Choose Print Preview and Print options from File menu to obtain hardcopy output.

Data Set Summary

Slug Test
Total no. of observations: 47
Range of time readings in obs. well(s): 1 to 460 sec
Range of displacement readings in obs. well(s): 0.09 to 1.4 ft

Attachment V.3.B.3

Appendix I

U.S. EPA Rapid Bioassessment Worksheets

Gateway Mine Refuse Cell 5

Permit #426

Project ID: Gateway Refuse Expansion	Stream Class: Intermittent
Stream ID: 1MS2	Location; COULTERVILLE IL
Lat: 38.17800 Long: -89.65048	River Basin Kaskaskia
Investigators: Cody Thayer,Kyle Brell	
Signature:	Date: 18-Oct-11 / Time: 7:33 PM / Reason for Survey: / 404 functional Assessment:

WEATHER CONDITIONS

Current: ☐ Storm (Heavy Rain) ☐ Rain Steady ☑ Showers (Intermittent) ☐ Cloud Cover % 0 ☐ Clear/Sunny

Past 24 Hour: ☐ Storm (Heavy Rain) ☐ Rain Steady ☐ Showers (Intermittent) ☑ Cloud Cover % 70 ☐ Clear/Sunny

Heavy rain in last 7 days: ☐ No ☑ Yes

Air Temp F 50
Air Temp C 10
Other

STREAM CHARACTERIZATION

Stream Subsystem: ☐ Perennial ☑ Intermittent ☐ Ephemeral

Stream Type: ☐ Coldwater ☑ Warmwater

Stream Origin: ☐ Upland Runoff ☑ Mixture of Origin ☐ Spring-fed/Ground Water ☐ Wetland ☐ Other

Catchment Area: Mile ^{2} 0.12; Km ^{2} 0.31

WATERSHED FEATURES

Surrounding Land Use & Percentag:
☑ Forest 30 ☐ Commercial 0
☐ Field/Pasture 0 ☑ Other 30
☑ Agriculture 40 Mine land
☐ Residential 0

Local Watershed NPS Pollution: ☐ No evidence ☑ Some potential source ☐ Obvious sources

Local Watershed Erosion: ☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present: ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbs ☐ None

Dominant Species: Mixed hard and soft mast forest

INSTREAM FEATURES

Est Reach Length	ft	100	m	30
Est Stream Width	ft	8.7	m	2.7
Sampling Reach Area	ft ^{2}	870.0	m ^{2}	80.8
Sampling Area	mile^2	0.000032	km^2	0.000081
Est Water Depth	in	5.0	m	0.1
Surface Velocity	ft/s	0.1	m/s	0.0

Channelized: ☐ Yes ☑ No
Dam Present: ☐ Yes ☑ No

Canopy Cover: ☐ Open ☐ Partly Open ☑ Shaded ☐ Partly Shaded

High Water Mark ft 0.40
High Water Mark m 0.12

% of Stream Morphology: ☑ Riffle % 15 ☑ Run % 65 ☑ Pool % 20 ☐ Glide Pool ☐ Step Pool Series

LARGE WOODY DEBRIS

LWD 0.5 m ^{2} 5 ft ^{2}
Density of LW m ^{2} /km ^{2} 0.0000004645 ft ^{2} /mile ^{2} 0.0000001794

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present: ☐ Rooted Emergent ☐ Rooted Submergent ☐ Rooted Floating ☑ None ☐ Free Floating ☐ Attached Algae ☐ Floating Algae

Portion of the reach with aquatic vegetation present: 0

WATER QUALITY

☐ No Water Present ☐ No Flow Present

Temperature 11 ^oC 52 ^oF
Conductivity µs/cm 397
Total Disolved Solids 283 mg/l
pH 8.19

Water Odors: ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic

Turbidity: ☐ Clear ☐ Slightly Turbid ☑ Turbid ☐ Opaque ☐ Stained ☐ Other

Water Surface Oils: ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐ Other

SEDIMENT/ SUBSTRATE	
	Odors: ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other
	Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells ☐ Other
	Oils: ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse
	Looking at stones which are not deeply embedded, are undersides black in color? ☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS

Substrate Type	Diameter	% Composite in Sampling Reach
Bedrock		0
Boulder	>10"	0
Cobble	2.5 - 10"	0
Gravel	0.1 - 2.5"	30
Sand	gritty	30
Silt	gooey	30
Clay	slick	10

ORGANIC SUBSTRATE COMPONENTS

Substrate Type	Characteristic	% Composition in Sampling Reach
Detritus	Sticks, wood, coarse plant material	0
Muck-Mud	Black, very fine organic matter	0
Marl	Grey, shell fragments	0

HABITAT ASSESSMENT - LOW GRADIENT STREAMS

Habitat Parameter	Optimal	SubOptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% for low gradient streams) of substrate favorable for epifaunal colonization & fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat & at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	10% for low gradient streams)stable habitat; lack of habitat is obvious;substrate unstable or lacking.
Score 10	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☑10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom: little or no root mat: no submerged vegetation.	Hardpan clay or bedrock: no root mat or vegetation.
Score 8	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☑8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
3. Pool Variability	Even mix of large shallow, large-deep, small shallow, small-deep pools present.	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
Score 9	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☑9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 17	☐20 ☐19 ☐18 ☑17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0

5. Channel Flow Status	Water reaches base of both lower banks, and mimimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score 10	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☑10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score 16	☐20 ☐19 ☐18 ☐17 ☑16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered coastal plains and other normal low-lying areas. this parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score 6	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☑6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream.**	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
Score (LB) 7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB) 6	☐10 ☐9	☐8 ☐7 ☑6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream.**	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well represented disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
Score (LB) 7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB) 7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
10. Riparian Vegetative Zone Width (score each bank riparian zone) **Note: determine left or right side by facing downstream.**	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Score (LB) 8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB) 8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Total Score 119				

Project ID: Gateway Refuse Expansion	Stream Class: Intermittent
Stream ID: 1MS2F	Location; COULTERVILLE IL
Lat: 38.17756 Long: -89.64813	River Basin Kaskaskia
Investigators: Cody Thayer,Kyle Brell	
Signature:	Date: 18-Oct-11 / Time: 7:11 PM / Reason for Survey: 404 functional Assessment:

WEATHER CONDITIONS

Current: ☐ Storm (Heavy Rain) ☐ Rain Steady ☑ Showers (Intermittent) ☐ Cloud Cover % 0 ☐ Clear/Sunny

Past 24 Hour: ☐ Storm (Heavy Rain) ☐ Rain Steady ☐ Showers (Intermittent) ☑ Cloud Cover % 70 ☐ Clear/Sunny

Heavy rain in last 7 days: ☐ No ☑ Yes

Air Temp F 50
Air Temp C 10
Other

STREAM CHARACTERIZATION

Stream Subsystem: ☐ Perennial ☑ Intermittent ☐ Ephemeral

Stream Type: ☐ Coldwater ☑ Warmwater

Stream Origin: ☐ Upland Runoff ☑ Mixture of Origin ☐ Spring-fed/Ground Water ☐ Wetland ☐ Other

Catchment Area: Mile ^{2} 0.02; Km ^{2} 0.05

WATERSHED FEATURES

Surrounding Land Use & Percentag:

☑ Forest	40	☐ Commercial	0
☐ Field/Pasture	0	☑ Other	20
☑ Agriculture	40	Reclaim land	
☐ Residential	0		

Local Watershed NPS Pollution: ☐ No evidence ☑ Some potential source ☐ Obvious sources

Local Watershed Erosion: ☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present: ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbs ☐ None

Dominant Species: Soft mast forest

INSTREAM FEATURES

Est Reach Length	ft	100	m	30
Est Stream Width	ft	6.0	m	1.8
Sampling Reach Area	ft ^{2}	600.0	m ^{2}	55.7
Sampling Area	mile^2	0.000022	km^2	0.000056
Est Water Depth	in	2.0	m	0.1
Surface Velocity	ft/s	0.5	m/s	0.2

Canopy Cover: ☐ Open ☐ Partly Open ☑ Shaded ☐ Partly Shaded

High Water Mark ft 0.40
High Water Mark m 0.12

% of Stream Morphology: ☑ Riffle % 20 ☑ Run % 60 ☑ Pool % 20 ☐ Glide Pool ☐ Step Pool Series

Channelized: ☐ Yes ☑ No
Dam Present: ☐ Yes ☑ No

LARGE WOODY DEBRIS

LWD 0.5 m ^{2} 5 ft ^{2}
Density of LW m ^{2} /km ^{2} 0.0000004645 ft ^{2} /mile ^{2} 0.0000001794

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present: ☐ Rooted Emergent ☐ Rooted Submergent ☐ Rooted Floating ☑ None ☐ Free Floating ☐ Attached Algae ☐ Floating Algae

Portion of the reach with aquatic vegetation present: 0

WATER QUALITY

☐ No Water Present ☐ No Flow Present

Temperature 11 ^oC 52 ^oF
Conductivity µs/cm 788
Total Disolved Solids 563 mg/l
pH 8.75

Water Odors: ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic

Turbidity: ☐ Clear ☐ Slightly Turbid ☑ Turbid ☐ Opaque ☐ Stained ☐ Other

Water Surface Oils: ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐ Other

SEDIMENT/ SUBSTRATE	
	Odors: ☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other
	Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells ☐ Other
	Oils: ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse
	Looking at stones which are not deeply embedded, are undersides black in color? ☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS			ORGANIC SUBSTRATE COMPONENTS		
Substrate Type	Diameter	% Composite in Sampling Reach	Substrate Type	Characteristic	% Composition in Sampling Reach
Bedrock		0	Dietritus	Sticks, wood, coarse plant material	0
Boulder	>10"	0			
Cobble	2.5 - 10"	0	Muck-Mud	Black, very fine organic matter	0
Gravel	0.1 - 2.5"	0			
Sand	gritty	40	Marl	Grey, shell fragments	0
Silt	gooey	40			
Clay	slick	20			

Habitat Parameter	HABITAT ASSESSMENT - LOW GRADIENT STREAMS			
	Optimal	SubOptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% for low gradient streams) of substrate favorable for epifaunal colonization & fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat & at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	10% for low gradient streams)stable habitat; lack of habitat is obvious;substrate unstable or lacking.
Score 9	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☑9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom: little or no root mat: no submerged vegetation.	Hardpan clay or bedrock: no root mat or vegetation.
Score 8	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☑8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
3. Pool Variability	Even mix of large shallow, large-deep, small shallow, small-deep pools present.	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
Score 7	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☑7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 16	☐20 ☐19 ☐18 ☐17 ☑16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0

5. Channel Flow Status		Water reaches base of both lower banks, and mimimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score	11	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☑11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
6. Channel Alteration		Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score	16	☐20 ☐19 ☐18 ☐17 ☑16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
7. Channel Sinuosity		The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered coastal plains and other normal low-lying areas. this parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score	7	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☑7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream.**		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
Score (LB)	5	☐10 ☐9	☐8 ☐7 ☐6	☑5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	5	☐10 ☐9	☐8 ☐7 ☐6	☑5 ☐4 ☐3	☐2 ☐1 ☐0
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream.**		More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well represented disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
Score (LB)	8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
10. Riparian Vegetative Zone Width (score each bank riparian zone) **Note: determine left or right side by facing downstream.**		Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Score (LB)	8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Total Score	115				

Project ID: Gateway Refuse Expansion	Stream Class: Intermittent
Stream ID: 1MS2F-1	Location; COULTERVILLE IL
Lat: 38.17803 Long: -89.64710	River Basin Kaskaskia
Investigators: Cody Thayer	
Signature:	Date: 18-Oct-11 / Time: 1:55 PM / Reason for Survey: 404 functional Assessment:

WEATHER CONDITIONS

Current: ☐ Storm (Heavy Rain) ☐ Rain Steady ☑ Showers (Intermittent) ☐ Cloud Cover % 0 ☐ Clear/Sunny

Past 24 Hour: ☐ Storm (Heavy Rain) ☐ Rain Steady ☐ Showers (Intermittent) ☐ Cloud Cover % 70 ☐ Clear/Sunny

Heavy rain in last 7 days: ☐ No ☑ Yes

Air Temp F 50
Air Temp C 10
Other

STREAM CHARACTERIZATION

Stream Subsystem: ☐ Perennial ☑ Intermittent ☐ Ephemeral

Stream Type: ☐ Coldwater ☑ Warmwater

Stream Origin: ☐ Upland Runoff ☑ Mixture of Origin ☐ Spring-fed/Ground Water ☐ Wetland ☐ Other

Catchment Area: Mile ^{2} 0.01; Km ^{2} 0.03

WATERSHED FEATURES

Surrounding Land Use & Percentag:
☑ Forest 30 ☐ Commercial 0
☐ Field/Pasture 0 ☑ Other 40
☑ Agriculture 30 Mine Land
☐ Residential 0

Local Watershed NPS Pollution: ☐ No evidence ☑ Some potential source ☐ Obvious sources

Local Watershed Erosion: ☐ None ☑ Moderate ☐ Heavy

RIPARIAN VEGETATION (18 meter buffer)

Indicate the dominant type and record the dominant species present: ☑ Trees ☐ Shrubs ☐ Grasses ☐ Herbs ☐ None

Dominant Species: Soft mast forest

INSTREAM FEATURES

Est Reach Length	ft	100	m	30
Est Stream Width	ft	4.5	m	1.4
Sampling Reach Area	ft ^{2}	450.0	m ^{2}	41.8
Sampling Area	mile^2	0.000017	km^2	0.000042
Est Water Depth	in	1.0	m	0.0
Surface Velocity	ft/s	0.5	m/s	0.2

Channelized: ☐ Yes ☑ No
Dam Present: ☐ Yes ☑ No

Canopy Cover: ☐ Open ☐ Partly Open ☐ Shaded ☑ Partly Shaded

High Water Mark ft 0.30
High Water Mark m 0.09

% of Stream Morphology: ☑ Riffle % 20 ☑ Run % 60 ☑ Pool % 20 ☐ Glide Pool ☐ Step Pool Series

LARGE WOODY DEBRIS

LWD 0.0 m ^{2} 0 ft ^{2}
Density of LW m ^{2} /km ^{2} 0.0000000000 ft ^{2} /mile ^{2} 0.0000000000

AQUATIC VEGETATION

Indicate the dominant type and record the dominant species present: ☑ Rooted Emergent ☐ Rooted Submergent ☐ Rooted Floating ☐ None ☐ Free Floating ☐ Attached Algae ☐ Floating Algae

Portion of the reach with aquatic vegetation present: 5

WATER QUALITY

☐ No Water Present ☐ No Flow Present

Temperature 12 ^oC 53 ^oF
Conductivity µs/cm 1200
Total Disolved Solids 853 mg/l
pH 8.1

Water Odors: ☑ Normal/None ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic

Turbidity: ☐ Clear ☐ Slightly Turbid ☑ Turbid ☐ Opaque ☐ Stained ☐ Other

Water Surface Oils: ☐ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐ Other

SEDIMENT/ SUBSTRATE	Odors	Deposits
	☑ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None ☐ Other	☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells ☐ Other
	Oils: ☑ Absent ☐ Slight ☐ Moderate ☐ Profuse	Looking at stones which are not deeply embedded, are undersides black in color? ☐ Yes ☑ No

INORGANIC SUBSTRATE COMPONENTS

Substrate Type	Diameter	% Composite in Sampling Reach
Bedrock		0
Boulder	>10"	0
Cobble	2.5 - 10"	0
Gravel	0.1 - 2.5"	0
Sand	gritty	0
Silt	gooey	100
Clay	slick	0

ORGANIC SUBSTRATE COMPONENTS

Substrate Type	Characteristic	% Composition in Sampling Reach
Detritus	Sticks, wood, coarse plant material	0
Muck-Mud	Black, very fine organic matter	0
Marl	Grey, shell fragments	0

HABITAT ASSESSMENT - LOW GRADIENT STREAMS

Habitat Parameter	Optimal	SubOptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% for low gradient streams) of substrate favorable for epifaunal colonization & fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat & at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in form of new fall, but not yet prepared for colonization (may rate at high end of scale).	10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	10% for low gradient streams)stable habitat; lack of habitat is obvious;substrate unstable or lacking.
Score 7	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☑7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom: little or no root mat: no submerged vegetation.	Hardpan clay or bedrock: no root mat or vegetation.
Score 7	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☑7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
3. Pool Variability	Even mix of large shallow, large-deep, small shallow, small-deep pools present.	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
Score 4	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☑4 ☐3 ☐2 ☐1 ☐0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
Score 15	☐20 ☐19 ☐18 ☐17 ☐16	☑15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0

5. Channel Flow Status		Water reaches base of both lower banks, and mimimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
Score	8	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☑8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
6. Channel Alteration		Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
Score	18	☐20 ☐19 ☑18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☐7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
7. Channel Sinuosity		The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered coastal plains and other normal low-lying areas. this parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
Score	7	☐20 ☐19 ☐18 ☐17 ☐16	☐15 ☐14 ☐13 ☐12 ☐11	☐10 ☐9 ☐8 ☑7 ☐6	☐5 ☐4 ☐3 ☐2 ☐1 ☐0
8. Bank Stability (score each bank) **Note: determine left or right side by facing downstream.**		Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequently along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
Score (LB)	7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
9. Vegetative Protection (score each bank) **Note: determine left or right side by facing downstream.**		More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well represented disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
Score (LB)	6	☐10 ☐9	☐8 ☐7 ☑6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	6	☐10 ☐9	☐8 ☐7 ☑6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
10. Riparian Vegetative Zone Width (score each bank riparian zone) **Note: determine left or right side by facing downstream.**		Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
Score (LB)	8	☐10 ☐9	☑8 ☐7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Score (RB)	7	☐10 ☐9	☐8 ☑7 ☐6	☐5 ☐4 ☐3	☐2 ☐1 ☐0
Total Score	107				

PEABODY ENERGY - MIDWEST

SAMPLING AND ANALYSIS PLAN
Surface Water

Revised: January 2021

SURFACE WATER SAMPLING METHODS

This section describes the general procedures and methodologies used when conducting surface water sampling.

1.0 GRAB SAMPLING METHOD

Grab sampling involves lowering the sample bottle directly into the water body when collecting the sample and is effective for still water (ponds, lakes) and flowing water (streams) sites. The sample may be collected from within the water body or from the bank of the water body, provided the collector can reach the main flow of the stream or far enough within the still water body to completely lower the bottle beneath the water surface. A telescoping rod with a clean sample bottle affixed to it may be used to extend the collectors reach.

1.1 STREAM AND SEDIMENT BASIN OUTFALL SAMPLING

When sampling stream or sediment basin outfalls an effort will be made to collect the sample from within the main flow of the channel. When sampling from within the water body the sample bottle will be lowered to just beneath the surface of the water while facing upstream (i.e. stand downstream of the sampling point). Care must be taken to avoid collecting particulates re-suspended as a result of wading into position or bumping the sample bottle on the streambed. Under low flow conditions where discharge is to low to safely sample without disturbing the streambed sediment, boulders or rocks may be excavated allowing for sample collection from the remaining depression. Sufficient time must be allowed for the disturbed sediments to settle before sample collection within the newly formed depression. Many of the chemical constituent's analyzed for sorb onto suspended materials, thus collection of re-suspended particles will likely result in falsely elevated analyte concentrations.

Procedure

1. Obtain bottles to be used at site.
2. Approach sampling site. If required to enter stream for sample, wade into stream downstream of site in order to not stir up stream bed sediments.
3. While facing upstream remove bottle cap and insert bottle into the main flow of the channel just below the surface of the water, making sure to avoid surface debris and to fill the bottle completely.
4. Recap the sample bottle and repeat as necessary until all bottles are filled.

1.2 PONDS AND LAKES

Surface water body samples may be collected from within the water body or from the bank using a telescoping rod with a clean sample bottle affixed to it. When sampling from within the water body lower the bottle to just under the surface of the water filling the bottle completely. Care must be taken to avoid collecting particulates re-suspended as a result of wading into position or bumping the sample bottle on the pond/lake water bottom. Many of the chemical constituent's analyzed for sorb onto suspended materials, thus collection of re-suspended particles will likely result in falsely elevated analyte concentrations.

Procedure

1. Obtain bottles to be used at site.

2. Approach sampling site. If required to enter water body for sample, take care not to stir up sediments on pond/lake bottom.
3. Remove bottle cap and insert bottle into the water body just below the surface of the water, making sure to avoid surface debris and to fill the bottle completely.
4. Recap the sample bottle and repeat as necessary until all bottles are filled.

2.0 FIELD MEASUREMENTS

Using the multi-parameter water quality sensor (EUTECH Instruments PTTester 35 or equivalent), in accordance with the users manual, measure field pH and temperature at outfalls and field pH, temperature, and total dissolved solids (TDS) or Specific Conductivity at stream sites and ponds depending on permit requirements. Field measurements from surface water bodies should be made insitu at the location of the water quality sample or from an additional sample container if it is not possible to safely enter the stream or water body. Temperature of the water can change rapidly therefore if it is not possible to measure the field parameters insitu then it is important the measurements be made immediately after removal from the water body. Discharge measurement procedures for sediment basin outfalls and streams are found below in section 3.0.

Procedure

1. Calibrate the multi-parameter water quality sensor prior to each sampling event, if it's a single day event, or each morning of a multiple day sampling event (see manual).
2. Collect field measurement of pH, TDS, and temperature by placing meter into the same channel of flow or from an additional sample bottle immediately after collection.
3. Allow values to stabilize and record the measurements.

3.0 STREAM DISCHARGE

An estimate of stream discharge must be made during all stream and outfall sampling events. Stream discharge can be measured using the float method or by relating the river stage on an installed staff gage to a previously determined, location specific, rating curve.

3.1 FLOAT METHOD

Discharge is calculated by multiplying the cross-sectional area of the stream by the streams velocity at the sampling location.

Procedure

1. Measure the width of the channel at the sampling location (in feet).
2. Measure the average depth of the channel at the sampling location (in feet).
3. Measure two points equal distance upstream and downstream of the sample location.
4. Deploy a buoyant object into the stream channel (such as apple core) and record the time (in seconds) it takes for the object to float the distance measured in number 3.
5. Multiply the stream width (ft), average depth (ft), and velocity (ft/sec)
6. Record value on field sheet and chain of custody.

3.2 RATING CURVE

A visual observation of the stream stage relative to an installed staff gage is made by recording the height of the water level on the staff gage. A rating curve, previously developed by measuring stream discharge under various flow regimes, is then used to estimate the

current discharge by relating the current gage height water level to the estimated discharge determined from the curve.

Procedure

1. Locate installed staff gauge.
2. Stretch a measuring tape across the width of the channel, keeping it perpendicular to flow.
   a. Anchor tape to ensure it's taught.
3. Using a staff and rod establish the reference point on the left bank. The left bank is the edge of the water when facing downstream.
4. Starting on the left bank measure the depth of the stream channel (ft) at previously determined increments and any breaks (depth changes) within the channel.
   a. Make sure to identifying the location of the left edge of water, the location of the installed staff gauge, and the location of the right edge of water.
5. Using a wading rod with attached current meter measure the flow velocity at several intervals across channel (see manufacturers owners manual for operation of meter).
   a. If water level is less than 2.5 ft then measure velocity at 60% of the total depth, when measured from the surface of the water.
   b. If water level is greater than 2.5 ft then measure velocity at 20% and 80% of the total depth, when measured from the surface of the water.
6. At each interval record the distance from left edge of the water, depth of water, observation depth (0.6 or 0.2 and 0.8) and measured flow.

4.0 SETTLEABLE SOLIDS ANALYSIS

Settleable solids analysis will be conducted by field personnel and will follow EPA Method 160.5. The settleable solids test is the measurement of the volume of solids that will settle to the bottom of an Imhoff cone over a one hour time period. The test indicates the volume of solids removed by settling in the sedimentation ponds and provides information on how this process is functioning within the system. An, unfiltered, one liter sample will be collected from the sampling point following the appropriate sampling protocol (see Section 1.0). The analysis should be conducted upon returning to the office and must be completed within the 48 hours maximum holding time. A list of the required equipment and methods follows:

Equipment

1. Imhoff cone
2. Stirring rod
3. Imhoff cone rack
4. Timer

Procedure

1. Fill the Imhoff cone to the one-liter mark with the well mixed sample previously collected.
2. Allow sample to settle in Imhoff cone for 45 minutes
3. Gently stir the sample with the stirring rod to release suspended matter clinging to the sides of the Imhoff cone.
4. Let sample settle for an additional 15 minutes.
5. At the one hour mark, record the volume of settleable solids (in milliliters) in the Imhoff cone.

Note

1. **Do not include any floating solids or any voids in the settled solids as settleable matter.**
2. **The lower limit of reportable concentration is 0.2 ml/l, not 0.4 ml/l. Thus all values over 0.2 ml/l must be reported as a number, not as <0.4 ml/l. A table of proper reporting under varying concentrations follows:**

Measured Value ml/l	Reported Value ml/l
0 – 0.19	<0.2
0.2	0.2
0.3	0.3
0.4	0.4
0.5	0.5

5.0 LOW-LEVEL MERCURY

Sampling for low-level mercury requires the use of the clean hands/dirty hands method, as established by EPA Method 1669, to limit sample contamination. In this method one sampler acting as clean hands conducts all operations involving contact with the sample bottle and sample collection while the other acting as dirty hands is responsible for the preparation of all activities that do not involve direct contact with the sample container. Because of the potential for contamination it is recommended that the sampling team collect the sample upwind if possible and avoid (as much as possible) airborne particles such as dust, dirt, particulate matter, vapors from automobile exhaust and cigarette smoke, and nearby corroded or rusted bridges, pipes, poles, or wires. If sampling near a road attempt to sample during low traffic hours. Avoid breathing on the sample. Attempt to sample during low traffic hours if near road. Also avoid areas nearby with bare soil that are subject to wind erosion.

Procedure

1. Samplers must wear talc free gloves.
2. Dirty Hands removes the sampling kit from the cooler, then opens and holds the outer bag
3. First collect the field blank.
   a. Clean hands retrieves and removes the field blank bottle and distilled water bottle from their inner bags.
   b. Clean hands then fills the field blank container with the deionized water, taking care not to overfill it.
   c. Clean hands then closes the field blank bottles lid, returns the bottle to the inner bag, reseals the bag, and then inserts the sealed bag into the outer bag being held by dirty hands.
4. Second collect the sample
   a. Clean hands retrieves and removes the sample from its inner bag.
   b. Clean hands then fills the sample container by completely submerging bottle beneath the water, then inverting the bottle and capping it underneath the water to limit exposure to air.
   c. Clean hands then returns the bottle to the inner bag, reseals the bag, and then inserts the sealed bag into the outer bag being held by dirty hands.
5. Dirty Hands then seals the outer bag, labels it accordingly and inserts it into the cooler.
6. The lab will preserve samples and filter dissolved species as necessary.

7. Samples must be delivered to the lab within 48 hours of collection.

6.0 SAMPLE PREPARATION

The sample water will be collected into appropriately labeled bottles based on the sites required analyses. The necessary samples will then be preserved and filtered within 15 minutes of collection, before being placed on ice and cooled to approximately 4° C. The samples will then either be picked up by a courier or delivered to the laboratory following chain-of-custody procedures. A list of commonly sampled parameters, preservation requirements, and maximum laboratory holding times are provided in the table below. A list of laboratory sample classifications, analytes, required sample volumes, bottle types, and required preservative are provided in the attached tables.

Parameters	Preservative	Temp	Max Holding Time
Metals*, Hardness	HNO_3 to pH <2	≤ 6 °C	6 months
Phenol, Nitrate-N, Phosphorous, Total Organic Carbon	H_2SO_4 to pH <2	≤ 6 °C	28 days
Cyanide	NaOH to pH >10	≤ 6 °C	14 days
Sulfide	NaOH w/ ZnAc to pH >9	≤ 6 °C	7 days
Acidity, Alkalinity	-	≤ 6 °C	14 days
Sulfate	-	≤ 6 °C	28 days
Total Suspended Solids, Total Dissolved Solids	-	≤ 6 °C	7 days
Low level Mercury	Lab Preserves	≤ 6 °C	48 hrs**

Note:
* Dissolved Metals Require Field Filtration
**Time to transport to laboratory

7.0 FIELD OBSERVATIONS

Field observations will be recorded in either a field notebook or in the comments or notes section of the Chain of Custody (COC). Observations will include information about conditions that could impact the results of the sampled water quality. These include, but are not limited to, items such as wildlife activity, beaver dams, flooding or backwater, and algae. Discharges from the site shall not cause excessive foam, a visible film or sheen, or contain any substance in significant enough quantities to be unsightly or deleterious or produce color, odor, or other conditions to such a degree as to create a nuisance within the receiving waters. An observation of these conditions in the field will be noted.

8.0 CHAIN OF CUSTODY

The Chain of Custody (COC) is a written legal document used to track the transfer of a sample from person to person. It is utilized to guarantee the identity and integrity of a sample from collection through reporting of the test result. Thus the COC is formatted to record field information, laboratory information, and the people who handle each individual sample. A COC is created for each sampling event and is typically a one page document. An individualized COC has been created for each of the Midwest mines and includes applicable facility codes, sample location codes, and Peabody sample

location identification numbers. Additionally, required field parameters, lab parameters, bottle types, and preservatives are included in the box located on the bottom right corner. The COC contains places to enter calibration information for the multi parameter field water quality meter, the sample date/time, and all relevant field measurements (ph, TDS, Temp, etc). The COC also contains several signatory lines for the relinquishment of custody of the samples and for the receipt of custody of the samples.

Procedure

Fill out the appropriate NPDES outfall or stream sample point COC prior to submittal of samples to the laboratory. Note that because of variation between state regulatory agency monitoring requirements not all column headers are relevant to every sample type. Where applicable the specific sample type (i.e. NPDES outfall or stream) or state (IL, IN, KY) requiring the parameter is identified.

1. pH and TDS/Conductivity Meter Calibrated Row
    a. Sample Date and Time
        i. Enter the date and time the meter was calibrated.
        ii. Note: The meter must be calibrated prior to collecting any samples.
2. Sample Location Row
    a. Sample Date and Time
        i. Enter the date and time of sample collection.
    b. Grab
        i. This column denotes the sample collection methodology and is utilized to denote that a sample was collected.
        ii. If a sample was collected mark an “x” in the cell, if sample was not collected leave the cell blank.
    c. # Containers
        i. This column identifies the number of bottles that are shipped/delivered to the lab. This cell is utilized by the laboratory to ensure the receipt of all samples.
            1. Mark the number of sample bottles collected at each sample location that will be shipped to the lab for analysis.
            2. DO NOT record bottles that will not be shipped to the lab (i.e. settleable solids which must be analyzed by the sampler).
    d. Flow Condition **(NPDES Outfalls Illinois)**
        i. Record the flow condition (1 - 4) in this cell.
        ii. Note: If sample is collected under precipitation conditions (i.e. condition 2 or 3) then the precipitation event statistics (Date ppt event started and ended, Rainfall total) must be recorded. Event statistics should be recorded in the designated section located in the box on the bottom right corner of the COC.
    e. Flow
        i. Record the measured flow at the outfall of the basin or the stream sampling point in the cell. If there is no flow record a zero in the cell.
        ii. Note: Make sure units used for the measurement match the units identified on the COC. If not convert units prior to recording the flow in the cell.
    f. pH
        i. Under flowing condition record the field measured pH in the cell.
        ii. Under no flow conditions leave the cell blank.
    g. Temp
        i. Under flowing condition record the field measured Temperature in the cell.
        ii. Under no flow conditions leave the cell blank.
    h. TDS
        i. Under flowing conditions record the measured TDS in this cell
        ii. Under no flow conditions leave the cell blank.

i. Settleable Solids **(NPDES Outfalls and Stormwater)**
    i. If settleable solids are required for the sample type, record the measured value in the cell.
    ii. If settleable solids are not required for the sample type, leave the cell blank.
    iii. Note: Signature on COC is verification that the sampler conducted the field test following EPA Method 160.5 and affirms the result.

j. Sample Type
    i. The required sample type for the sample location is identified in this column
        1. Details of the required field measurements, number of bottles to collect, type and size of bottle to use, the necessary preservative, and the laboratory analysis required are found in the bottom right corner of the COC.

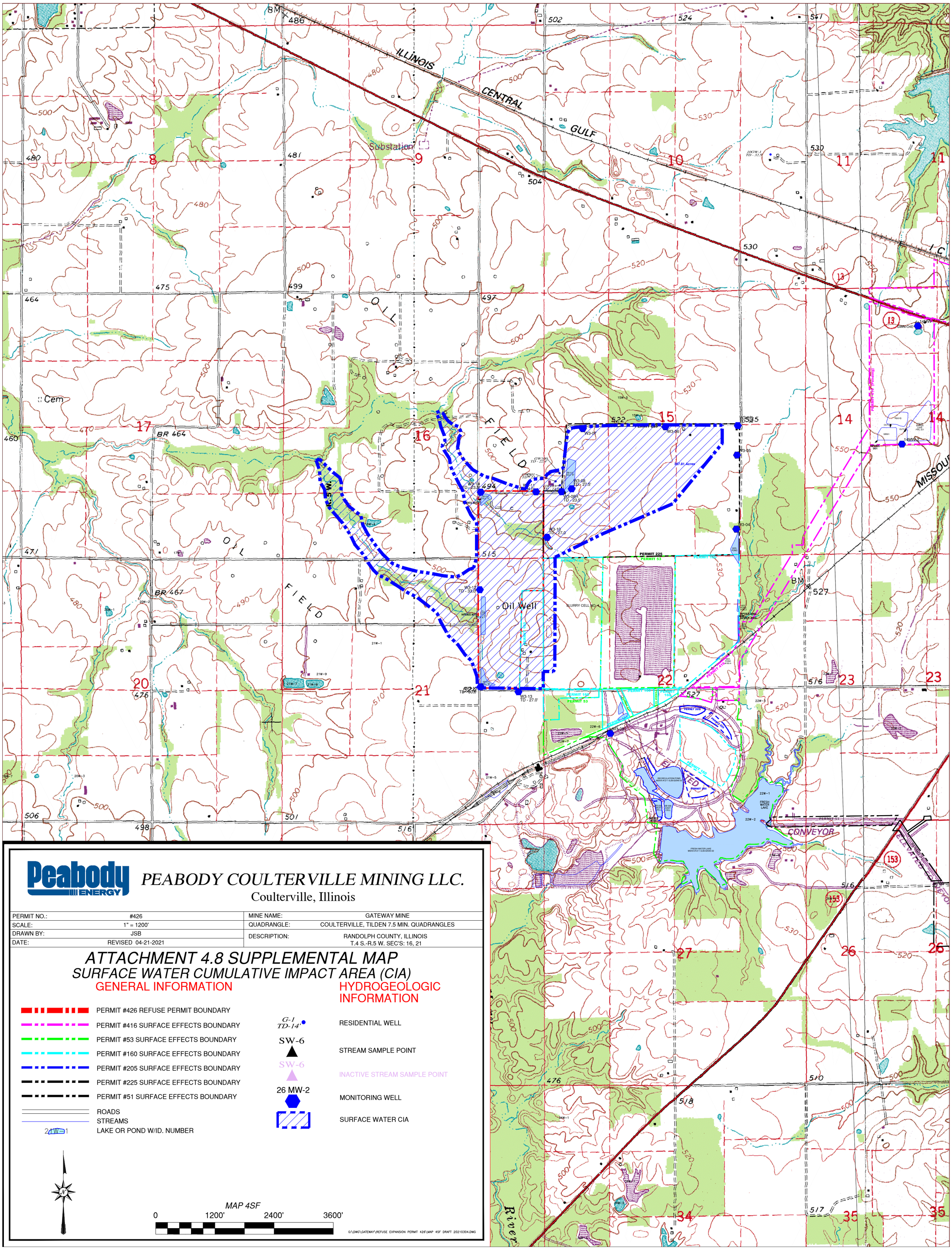
k. Comments
    i. Any relevant comments should be included here. See Section 7 Field Observations.
    ii. Note: If an unconstructed comment is included in the cell then a sample date and time must be included for the relevant sample row. This documents that that outfall was not constructed on that date.

l. Gray Cells
    i. Do not record or mark anything in these cells. This acts as a reminder that the subject sample point does not require this information.

m. Signature Row
    i. Relinquished by
        1. Sign, date, and time the COC upon relinquishing the samples to the laboratory technician, laboratory courier, or Peabody personnel.
    ii. Received by
        1. The laboratory technician, laboratory courier, or Peabody personnel must sign, date, and time these cells upon receipt of the samples.

Note

1. **Details of the required field parameters, lab parameters, and bottles for the sample types are noted on the bottom right corner of the COC.**
2. **Make sure measured units match units listed on the COC**
3. **No erroneous information may be erased from the COC. Errors must be lined out with a single dash, initialed, and the correction written in.**
4. **Review the COC for accuracy prior to relinquishing it.**



PEABODY COULTERVILLE MINING LLC.

Coulterville, Illinois

PERMIT NO.:	#426	MINE NAME:	GATEWAY MINE
SCALE:	1" = 1200'	QUADRANGLE:	COULTERVILLE, TILDEN 7.5 MIN. QUADRANGLES
DRAWN BY:	JSB	DESCRIPTION:	RANDOLPH COUNTY, ILLINOIS T.4 S.-R.5 W. SEC'S: 16, 21
DATE:	REVISED 04-21-2021		

ATTACHMENT 4.8 SUPPLEMENTAL MAP

SURFACE WATER CUMULATIVE IMPACT AREA (CIA)

GENERAL INFORMATION

- PERMIT #426 REFUSE PERMIT BOUNDARY
- PERMIT #416 SURFACE EFFECTS BOUNDARY
- PERMIT #53 SURFACE EFFECTS BOUNDARY
- PERMIT #160 SURFACE EFFECTS BOUNDARY
- PERMIT #205 SURFACE EFFECTS BOUNDARY
- PERMIT #225 SURFACE EFFECTS BOUNDARY
- PERMIT #51 SURFACE EFFECTS BOUNDARY
- ROADS
- STREAMS
- 21W-1 LAKE OR POND W/ID. NUMBER

HYDROGEOLOGIC INFORMATION

- G-1 TD-14' RESIDENTIAL WELL
- SW-6 STREAM SAMPLE POINT
- SW-6 INACTIVE STREAM SAMPLE POINT
- 26 MW-2 MONITORING WELL
- SURFACE WATER CIA

MAP 4SF

0 1200' 2400' 3600'

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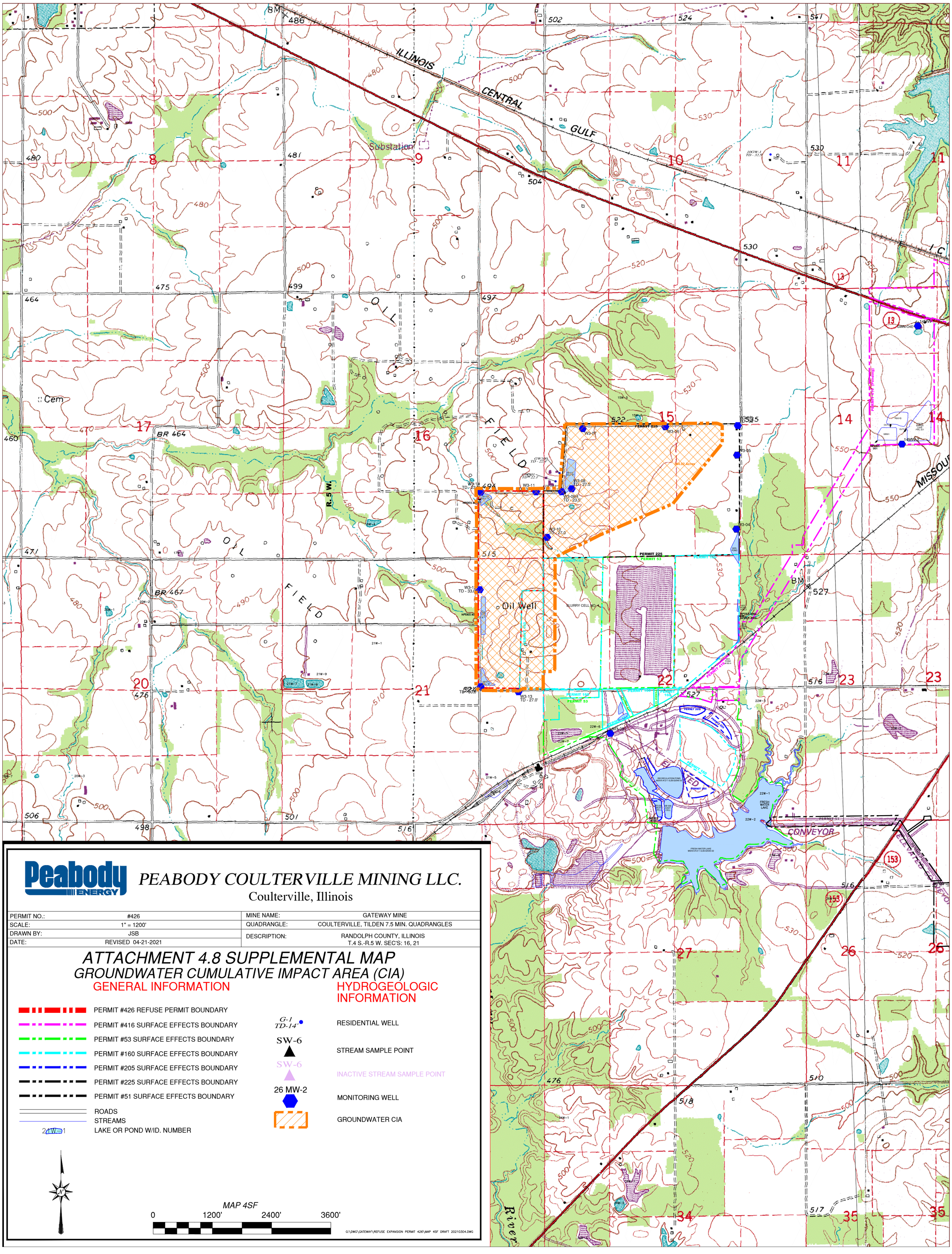

Peabody ENERGY

PEABODY COULTERVILLE MINING LLC.

Coulterville, Illinois

PERMIT NO.:	#426	MINE NAME:	GATEWAY MINE
SCALE:	1" = 1200'	QUADRANGLE:	COULTERVILLE, TILDEN 7.5 MIN. QUADRANGLES
DRAWN BY:	JSB	DESCRIPTION:	RANDOLPH COUNTY, ILLINOIS T.4 S.-R.5 W. SEC'S: 16, 21
DATE:	REVISED 04-21-2021		

ATTACHMENT 4.8 SUPPLEMENTAL MAP
GROUNDWATER CUMULATIVE IMPACT AREA (CIA)

GENERAL INFORMATION

- PERMIT #426 REFUSE PERMIT BOUNDARY
- PERMIT #416 SURFACE EFFECTS BOUNDARY
- PERMIT #53 SURFACE EFFECTS BOUNDARY
- PERMIT #160 SURFACE EFFECTS BOUNDARY
- PERMIT #205 SURFACE EFFECTS BOUNDARY
- PERMIT #225 SURFACE EFFECTS BOUNDARY
- PERMIT #51 SURFACE EFFECTS BOUNDARY
- ROADS
- STREAMS
- 21W-1 LAKE OR POND W/ID. NUMBER

HYDROGEOLOGIC INFORMATION

- G-1 TD-14' RESIDENTIAL WELL
- SW-6 STREAM SAMPLE POINT
- SW-6 INACTIVE STREAM SAMPLE POINT
- 26 MW-2 MONITORING WELL
- GROUNDWATER CIA

MAP 4SF

0 1200' 2400' 3600'

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Location	Start Date	End Date	Statistics	Flow	Acidity	Alkalinity as CaCO3, @ pH 4.5	Lead	Iron	Manganese	pH, Field	Zinc	Solids, Total Suspended	Sulfates	Total Dissolved Solids, Lab	Chloride
				N	N	N	T	T	T	N	T	N	N	N	N
				CFS	MG/L	MG/L	MG/L	MG/L	MG/L	S.U.	MG/L	MG/L	MG/L	MG/L	MG/L
DA0001	01/01/15	12/31/20	Average	0.01	-63.40	87.80	--	0.28	0.29	7.69	--	6.40	197.62	--	21.18
			Range	0.33 - 0	-40 - -85	118 - 68	--	0.426 - 0.123	1.15 - 0.004	8.24 - 6.96	--	14 - 2	390 - 35.7	--	47.2 - 6.8
			Count	185	5	5	0	5	5	21	0	5	17	0	17
DA0002	01/01/15	12/31/20	Average	0.05	-79.60	113.79	0.0013	2.12	0.19	7.66	0.012	14.57	105.86	--	53.19
			Range	0.56 - 0	-38 - -177	222 - 68	0.0025 - 0.0007	8.26 - 0.414	0.648 - 0.021	8.82 - 6.48	0.017 - 0.005	46 - 3	245 - 19.8	--	127 - 10.1
			Count	222	47	47	10	46	46	89	10	47	85	0	85
DA0003	01/01/15	12/31/20	Average	0.00	--	--	--	--	--	6.92	--	--	41.75	--	17.75
			Range	0.1 - 0	--	--	--	--	--	7.26 - 6.11	--	--	55.1 - 28.4	--	22.3 - 13.2
			Count	223	0	0	0	0	0	4	0	0	2	0	2
DA0007	01/01/15	12/31/20	Average	0.04	-53.66	77.03	0.0007	0.31	0.06	8.00	0.007	5.70	21.98	--	26.03
			Range	0.76 - 0	-38 - -69	99 - 60	0.0007 - 0.0007	0.823 - 0.029	0.224 - 0.004	8.97 - 7	0.022 - 0.004	14 - 2	59.7 - 4.09	--	59.4 - 2
			Count	191	29	29	6	30	31	50	6	30	49	0	49
DA0008	01/01/15	12/31/20	Average	0.30	-82.91	104.88	0.0009	0.75	0.24	7.90	0.047	12.88	930.58	--	252.81
			Range	11 - 0	-36 - -122	146 - 46	0.0023 - 0.0007	1.97 - 0.055	0.669 - 0.056	8.65 - 6.5	0.135 - 0.004	29 - 2	1530 - 91.7	--	460 - 37.4
			Count	293	32	32	9	32	37	58	9	32	59	0	59
DA0011	01/01/15	12/31/20	Average	0.09	-55.67	80.67	0.0008	1.48	0.10	8.05	0.009	23.45	39.97	235.00	13.96
			Range	1.3 - 0	-14 - -99	118 - 26	0.0013 - 0.0007	5.94 - 0.255	0.451 - 0.018	8.97 - 6.47	0.02 - 0.004	102 - 4	205 - 0.3	235 - 235	74.8 - 0.5
			Count	213	60	60	10	60	60	101	11	60	102	1	102
DA0012	01/01/15	12/31/20	Average	0.13	-81.76	115.70	0.0009	1.12	0.30	8.17	0.007	20.83	112.07	380.00	68.07
			Range	3.3 - 0	40 - -127	172 - 59	0.0024 - 0.0007	4.19 - 0.007	8.02 - 0.004	9.04 - 7.12	0.012 - 0.004	57 - 2	386 - 15.1	380 - 380	277 - 11.2
			Count	209	66	66	11	66	67	111	12	66	113	1	113

Gateway Mine Cell 5 Phase 2 Application
Preventative and Remedial Measures Plan

Geologic conditions at Gateway Mine are described in detail in Parts 4.1 – 4.3. In summary, the unconsolidated materials within and adjacent to Permit 426 are fine grained, low-permeability silts and clays. Isolated deposits of sandy material are present but are limited in lateral extent and geologically isolated. Shallow bedrock material consists predominantly of shales, siltstones, and sandstones of low-permeability. Due to the absence of significant aquifers in this geologic setting, there is limited use of local groundwater and surface water by adjacent residents. Municipal water supplies are relied upon for residential use.

The design and construction of Cell 5 Phases 1 & 2 includes several pollution control and minimization measures, including a liner and enhanced cover. Details of the liner and enhanced cover is provided in Attachment 9.4.1. These measures will ensure protection of the hydrologic balance within and adjacent to the permit area. Additional protections are provided through refuse handling practices discussed in Part 4.7.8. Proper refuse handling minimizes generation of acid or toxic drainage. Runoff from the refuse area is directed through the network of surface water control structures to the sediment basins designed, constructed and maintained in accordance with regulatory requirements. The surface water control structures and sediment basins minimize contributions of suspended sediment and other pollutants to receiving streams. The extensive surface water, groundwater, and NPDES sampling plans offer the final level of protection that minimizes impacts to the hydrologic balance onsite and prevents material damage to the hydrologic balance in adjacent areas and offsite. Monitoring and reporting practices also ensure compliance with Federal and State water quality laws and regulations. Details of the sampling, analysis, and reporting procedures are outlined in Attachments 4.5.1 and 4.6.3.

In the event that contamination or interruption of a surface water or groundwater source has occurred, it will be addressed through replacement with an alternative source of water or treatment, as described in Parts 4.8.3 and 4.8.6. Similarly, in the event that onsite discharges exceed regulatory limits and discharge cannot be practicably prevented, treatment of surface water will be evaluated. Primary methods of surface water treatment include pH control and flocculants to aid in settling suspended sediment. Treatment chemicals may include, but are not limited to, sodium hydroxide, hydrated lime, soda ash briquettes, and alum. Any treatment of surface water discharges that will occur will be conducted in compliance with NPDES regulations. The protection of the hydrologic balance and the probably hydrologic consequences analysis is described in detail in Part 4.8.