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PART IV

OPERATIONS PLAN

1) Proposed Operational Procedures and Methods for the Mine Over Its Projected Life

Describe the type and method of mining procedures and proposed engineering techniques to be employed in the operation of the proposed mine. Describe the major equipment to be employed and how such equipment will be used in the different aspects of the mining operation. Provide an estimation of the anticipated annual coal production and anticipated coal production by tonnage once the mine is at full operational capacity.

RESPONSE: ***This significant revision is being submitted to extend the mining operations of the Deer Run Mine. Underground mining at the Deer Run Mine consists of continuous miner sections developing mains with a non-subsidence room and pillar mining system. Off of the mains, headgate and tailgate entries are developed by the continuous miner sections. A longwall set-up face is developed on the eastern end of the longwall panels to facilitate the installation of the longwall system. Adjacent to the longwall set-up face are the bleeder entries. The bleeder entries are designed for long term support and evaluation of the mine ventilation system. The mine ventilation system is engineered to adequately ventilate the active mining faces as well as worked out areas of the mine that require examinations. Longwall mining will result in planned, predictable surface subsidence. A total of eleven additional longwall panels are being proposed. Panels 7-17 will be located south of the projected Panel No. 6. The southern edge of Panel 6 as depicted on the maps lies outside of the currently approved shadow area. This revision to expand the shadow area is required to be approved prior to development and longwall extraction of Panel 6 outside of the current approved mining area. Refer to <u>Map 6 – Underground Operations Map</u> for revised longwall panel layout following MSHA approval to eliminate district barriers from the mine plan. Currently, the Deer Run Mine is at its full planned operational capacity. Annual clean coal production capacity from the Deer Run Mine within the proposed shadow boundary area is estimated between 6 and 8 million tons.***

2) Mining Operations Plan for the Proposed Permit Area

Describe the proposed mining operations plan for the permit area in terms of the mining sequence, the employment of facilities, establishment and maintenance of erosion control facilities, air pollution control facilities, coal storage, cleaning and loading areas, location and placement of topsoil, spoil, coal waste, or other storage facilities.

A) 1) Describe how each type of overburden (soil horizons, glacial drift and consolidated material) will be handled with regards to shaft excavations.

RESPONSE: ***N/A. No additional shaft construction is proposed by this application.***

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2) If toxic materials have been identified as occurring in the overburden, describe how these materials will be handled to insure proper disposal.

<u>RESPONSE:</u> ***N/A. No additional shaft construction is proposed by this application.***

B) 1) Locate on the operations map all soil horizon storage areas and/or root medium stockpiles. Identify each storage area as to its content.

<u>RESPONSE:</u> ***N/A. No additional soil storage areas are proposed by this application.***

2) Describe measures to be employed to prevent or minimize exposure of soil stockpiles to excessive water and wind erosion, unnecessary compaction and contamination by undesirable materials.

<u>RESPONSE:</u> ***N/A. No additional soil storage areas are proposed by this application.***

3) Describe methods and treatment measures to be used on exposed areas where topsoil has been removed to prevent excess air and water pollution.

<u>RESPONSE:</u> ***N/A. No topsoil is proposed to be removed by this application.***

C) The permit map and plans shall show the lands proposed to be affected within the proposed permit through the operation, according to the sequence of mining and reclamation and any change in a facility or feature to be caused by the proposed operations if the facility or feature was shown under 62 Ill. Adm. Code Sections 1783.24 through 1783.25.

<u>RESPONSE:</u> ***N/A.***

D) Show on the permit map or other designated map each area of land for which a performance bond will be posted under 62 Ill. Adm. Code 1800.

<u>RESPONSE:</u> ***N/A.***

E) Mining Operations Plan for the Proposed Shadow Area

1) Provide a map at a scale of 1 inch to 1,000 feet or other scales as approved by the Department identifying the limits of the proposed shadow area (area from which coal is proposed to be extracted by underground mining methods).

<u>RESPONSE:</u> ***Refer to <u>Map 6 - Underground Operations Map</u> for the approved and proposed shadow areas. It is important to note that there are some minor changes to the longwall panel layout from the layout shown in Insignificant Permit Revision No. 11 which was approved on July 30, 2012. Longwall Panel No. 3 has been***

shortened to approximately 12,700 feet in length. The width of Panel No. 3 has also been narrowed to from 1,400' to approximately 1,000 feet wide. The original Longwall Panel No. 4 as projected on the maps in IPR No. 11 is to be skipped. The skipped width is approximately 1,300'. Panel 4 will be mined immediately south of the skipped panel. The applicable maps within this permit revision reflect this change.

2) Within the limits of the proposed shadow area identify all areas projected to be mined, at a minimum, during the term of the permit showing the proposed size, sequence and yearly projections for the development of underground workings.

RESPONSE: ***Refer to Map 7 – Underground Timing Map for the approximate yearly development of underground workings.***

3) Subsidence Control Plan

A) General Requirements

1) Within the permit, shadow and adjacent areas are there structures or renewable resource lands?

Yes ___***X***___ No _________

If yes, on the shadow area map described in 2,E, above, or other designated map, provide survey information which identifies all structures and renewable resource lands. Include all topographic features at a maximum contour interval of 10 feet. Identify all surface and subsurface man made features within, passing through, or passing over the area in which underground mining operations are located or will be projected to be located. Such features shall include but are not limited to all buildings, facilities, roads, bridges, major electric transmission lines, pipelines, agricultural drainage tile fields, gas and oil wells and water wells.

If no, provide evidence and support documentation that no structures or renewable resource lands exist as a result of a survey conducted within these areas.

RESPONSE: ***Refer to Map 2 – Identification of Interests for the location of all structures within the proposed shadow boundary area. Refer to Attachment II.10.A – Identification of Structures for a listing of all structures currently within the proposed shadow boundary area.***

Refer to Map 3 – Pre-Mining Land Use Map for pre-mining contours on 2-foot intervals as well as topographic features passing over the area in which underground mining operations are located. These features include all buildings, facilities, roads, bridges, major electric transmission lines, pipelines, oil wells, and water wells. Existing field drainage tiles are not shown on the map.

Refer to the response to Part II.12.A for a discussion detailing how field drainage tiles will be dealt with in the mining area.

2) Within the proposed permit, shadow or adjacent areas does the applicant intend to adopt mining technologies which provide for planned subsidence in a predictable and controlled manner?

Yes __***X***__ No _______

If yes, provide information requested under "Planned Subsidence", Subsection B.

If no, provide information requested under "Subsidence Unplanned", Subsection C.

If the applicant intends to conduct both planned and unplanned subsidence mining operations, both subsections B and C must be addressed.

3) Provide geologic descriptions characterizing the thickness and lithology of the coal and overburden geological units throughout the shadow area. Provide stratigraphy test boring and core sampling log descriptions from the shadow area. Include the elevation and locations of the boring logs.

RESPONSE: ***Refer to Map 4 – Hydro-Geological Map for the location of core borings and Attachment III.2.A.1 Boring Logs for the stratigraphic geological logs characterizing the thickness and lithology of the coal and overburden geological units throughout the shadow area. Also included in this attachment are the log description, the coordinates, and the elevation at each boring location.***

B) Planned Subsidence

1) Provide a detailed description of the mining technology used to produce planned and predictable subsidence?

RESPONSE: ***Planned subsidence will occur using the longwall mining method. Longwall mining creates an almost complete excavation of the coal seam, which allows the overburden to subside in a controlled and predictable manner. The longwall shields support the mine roof and provide protection for the mining equipment and the miners. As the mining shearer removes the coal, each shield will advance behind the shearer and will allow the overburden to fall in the void left by the removal of the coal. This advancement of the mining equipment and the subsidence of the overburden results in the movement of the surface, which is predictable and uniform and allows for the protection of surface structures.***

2) Provide a description of factors (i.e. drift thickness variations, expected variations in extraction height, or presence of faults and their direction (strike & dip) in relation to mine panels, etc.) with supporting documentation which may influence the magnitude, extent and predictability of planned subsidence. Include data on predicted subsidence profiles and post- subsidence contours, including calculations on the predicted angle of draw. Provide a description of measures taken in the field to confirm the accuracy and reliability of predicted subsidence profiles.

RESPONSE: ***The total depth from the coal seam to be mined below the surface as well as surface topography is a factor to be considered when predicting subsidence. Coal depth from the surface in the proposed shadow boundary area ranges from 460 feet to 540 feet. This is shown on Map 9 – Overburden thickness. The surface elevations over the proposed shadow boundary area range from a low of 600' to a high of 660' mean sea level. The topography on the surface is relatively flat with gently rolling areas. Refer to Map 3 – Pre-Mining Land Use Map for pre-mining contours on 2-foot intervals. The subsidence prediction model does take into account the total depth of overburden as well as the surface topography. This is accomplished by creating a surface topography grid as well as a 3D polyline of the longwall panel boundary that is correlated to a coal seam elevation grid and inputting them into the model.***

Overburden materials are another factor that can affect the magnitude of planned subsidence created by longwall mining. The overburden in this area consists of glacial deposits of up to 200 feet in thickness, with shales, sandstones, claystones, and limestones comprising the rest of the overburden material thickness. The angle of draw can vary slightly depending on the Glacial Drift and bedrock thicknesses for each location. The glacial drift, shales, claystones, and sandstones in this area are considered weak for the purposes of subsidence prediction modeling. The limestones are considered the hard rock within the overburden strata. The total percent of limestone within the total overburden is taken into account in the subsidence model. Due to the low total thickness of the limestones in the overburden in relation to the total overburden thickness, the magnitude of the subsidence is relatively high compared to the extraction height.

Planned subsidence may also be impacted by minor differences in the extraction height at the longwall face. The longwall mining system employed at the Deer Run Mine typically operates within the confines of the coal seam being mined. The Herrin No. 6 Coal seam thickness in the proposed shadow boundary area ranges from approximately seven feet to over nine feet. Due to equipment height restrictions, the minimum mining height is approximately eight feet. Since the longwall has been in operation at the Deer Run Mine, the mining height is typically between eight and ten feet. Depending on the geologic conditions in the immediate area of the face, the mining height can reach heights of twelve feet in certain areas. Minor variations in the geologic conditions within certain portions

of the longwall face at any given time that could lead to a higher extraction height are impossible to precisely predict. Therefore, the subsidence prediction model assumes an average cutting height of nine feet four inches. The average extraction height was developed by correlating the actual subsidence monitoring data gathered from the mine subsidence in Panel No. 1 with the subsidence prediction model.

The modeling software used to model the subsidence of the Deer Run Mine is the SDPS (Surface Deformation Prediction System) version 6.0. This software was developed by the Department of Mining and Minerals Engineering, and the Virginia Center for Coal and Energy Research, Virginia Polytechnic Institute and State University. This software provides an integrated approach to subsidence prediction. It is very useful to mine planning engineers for calculating and predicting ground deformations above mined areas. The software has proven to be extremely accurate and an invaluable tool for predicting surface deformations over the Deer Run Mine. The accuracy of the models has been verified by extensive in-field survey monitoring over two longwall panels at the mine. The information is used to develop drainage enhancements to the valuable farm ground that overlies the longwall areas. Due to the number of parameters that contribute to the ultimate subsidence model calculated by the SDPS software, the angle of draw is variable. This software develops a higher degree of accuracy when predicting the minor fluctuations of the zero-subsidence line versus using a constant angle of draw. The angle of draw utilizing the software (refer to Map 8, Post Subsidence Contour Map) varies from 34.5 degrees on the east end of Panel 10 to 36.8 degrees on the west end of Panel 7. The settings inputted into the SDPS model involved extraction thickness of 9.32 feet, subsidence factor of 76.6, tangent of influence 2.31, strain coefficient of 0.35, percent hardrock of 50 and time coefficient of 0.075. The surface movement along this outer edge is negligible and can only be measured by using surveying equipment.

A subsidence monitoring program was established at the Deer Run Mine upon the initial start-up of the longwall mining system in 2012. Subsidence monitoring was conducted over certain areas of the first two longwall panels. The monitoring was performed by using surface surveying methods to compare pre-subsidence conditions with post subsidence movements. Survey stations were established along several lines running parallel to, perpendicular with, and diagonally across the longwall panel(s). Monitoring occurred at different times depending on the location of the retreating longwall face as required by the subsidence control plan in Permit 399. The information that was collected from the subsidence monitoring program indicated the amount of surface movement as well as the duration that the movement occurred.

Refer to <u>Attachment IV.3.B.2 – Subsidence Monitoring and Prediction Analysis</u> for details of the comparisons between the subsidence prediction model as developed from the SDPS software and the actual monitoring data gathered from

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the first two longwall panels at the Deer Run Mine. Post subsidence contours over the proposed shadow boundary area are shown on <u>Maps 8a & 8b – Post Subsidence Contour Map</u>. Map 8c shows enlarged scale of the post subsidence impact on coves of Coffeen Lake.

3) On a plan base map(s), at a map scale of 1 inch to 400 feet provide a map of underground workings which locates all areas where planned subsidence mining operations are to be conducted. Include detailed information in regard to the location, length, width and height of projected panel development and extraction areas. Give typical percentage of coal removed in planned subsidence extraction areas.

<u>RESPONSE:</u> Refer <u>Map 6 – Underground Operations Map</u> for the locations of the longwall panels in which planned subsidence mining operations are to be conducted. Total percentage of coal to be removed in the longwall extraction area is 90%. The panels will typically be 1,400 feet wide and approximately 15,000 feet in length. The longwall typically has an average extraction height of approximately ± 9.0 feet.

4) On the 1-inch to 400 feet plan base map(s) the information regarding the location of features required in Parts a-d below is to be provided in relation to areas of planned subsidence.

a) Identify all topographic features at a maximum contour interval of 10 feet.

<u>RESPONSE:</u> ***Contours and topographic features are shown on <u>Map 6 – Underground Operations Map</u>. These contours have been mapped at 2-feet intervals.***

b) Identify and label all impoundments with a storage capacity of 20 acre-feet or more, or bodies of water with a volume of 20 acre feet or more. In a written narrative, provide information which assures compliance with the requirement of Title 62 Ill. Adm. Code 1817.121(d) to permit such proposed mining operations. If no such features exist, provide a specific statement indicating such.

<u>RESPONSE:</u> The physical ground survey of the shadow area as well as the review of aerial photographs of the area indicates that one impoundment of more than 20-acre feet is located over the area planned for subsidence. The water reservoir, known as Coffeen Lake, is located over the Eastern edge of the projected mine panels. Refer to <u>Map 6 – Underground Operations Map</u> and <u>Map 3 Pre-Mining Land Use Map</u>. In accordance with 62 Illinois Administrative Code 1817.121(d), subsidence will not cause material damage to, or reduce the reasonably foreseeable use of the water body. The functionality of the lake will be maintained by reasonably keeping the lake within the confines of its current pre-mining boundaries. Encroachment onto adjacent surface owners from planned

subsidence other than Vistra Energy, Inc. is dependent on the actual subsidence which will occur. The predicted post-subsidence projection shows a potential to inundate portions of adjacent property owners over Panels 16 and 17. Extraction of Panel 16 projects impact to the Brackett property (PIN 21-09-400-00)and Panel 17 predicts effects on land owned by Wasson (PIN 21-09-400-006 & 009) and Thacker (PIN 21-09-400-014). Negotiations to acquire ownership of these land tracts or portions to be inundated shall be conducted prior to mining of the proposed panels. If purchase agreements cannot be reached with these owners, permit revisions may be submitted to reconfigure the mine plan to avoid subsidence effects on these properties. Panel #16 is not projected to be mined until 2034, providing time for negotiations and knowledge of actual subsidence effects of the prior panel extractions. Refer to Map 8c – Post Subsidence Coffeen Lake for post-mining impact on the lake shoreline.

The depth of the Glacial Drift in this location acts as a physical barrier between the lake and bedrock layers beneath. The Glacial Drift, or till, consists of unconsolidated materials deposited by glaciation during the last Ice Age that are virtually impermeable. Permeability testing was conducted on the unconsolidated till by Hurst-Rosche Engineers, Inc. to calculate hydraulic conductivity through the Glacial Drift. Laboratory testing on an undisturbed Shelby tube sample from approximately 7 ft. in depth in a boring located near the surface facilities of the mine site resulted in a permeability of $2x10^{-8}$ ***cm/sec. Refer to Attachment IV.3.B.4.b. – Hydrogeologic Investigation Report for the lab data permeability data being referenced. An analysis of the drilling logs reveals that the unconsolidated materials are approximately 130 feet in thickness in the location of Coffeen Lake. Refer to Map 10 –Bedrock Thickness Map for the depths of the unconsolidated materials measured at the drilling locations.***

It is anticipated that no stability issues would occur as a result of the settlement and deformation of the ground surface caused by mine subsidence. The Coffeen Lake Reservoir is completely incised with the exception of the earthen embankment located on the downstream (South) end of the lake. This embankment is not being proposed to be undermined in this permit application. Surface cracks in the upper soils caused by tensile strains induced by mine subsidence are common. However, the depth of the surface cracking resulting from the maximum surface tensile strains induced by the mine subsidence will be mitigated by the depth of the glacial till. The plasticity of the clay in the glacial till allows the material to bend instead of crack.

The lake is utilized as a cooling reservoir for the nearby Coffeen Power Station. This body of water does not serve as a significant water source for any public water supply system.

The presence of additional impoundments of 20 acre-feet capacity is unlikely over the area planned for subsidence. If, however, during the mining of the area impoundments of this capacity are identified, the subsidence control plan will be

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modified to assure the planned subsidence will not cause material damage to, or reduce the reasonably foreseeable use of such structures or facilities.

c) Identify and label all public road right-of-ways and cemeteries located within 100 feet measured horizontally of surface areas of predicted planned subsidence. In a written narrative, provide information which assures compliance with the requirements of Title 62 Ill. Adm. Code 1761.11 and 12 as may be necessary to permit planned subsidence mining operations within the prohibited area. If no such features exist, provide a specific statement indicating such.

<u>RESPONSE</u>: Refer to <u>Map 3 – Pre-Mining Land Use Map</u> for the location of public roadways within 100 feet horizontally of surface areas of planned subsidence. Prior to such planned mining, the requirements of the referenced Code 1761.11 will be complied with, including the measures to minimize inconvenience to the users of such public roadways, and necessary waivers from the authority governing the use of these roads. Consultation and agreement with road authorities concerning traffic patterns and requirements for road closures will be agreed upon prior to subsidence occurring.

Also refer to <u>Map 3 – Pre-Mining Land Use Map</u> for known cemeteries. Three cemeteries known as Woods, Aydelot and Old Bear Creek lie within the shadow boundary. Predicted post subsidence effects will impact Woods and Aydelot cemeteries. Woods Cemetery located along the eastern edge of panel #14 is projected to be affected between -3 to -7 feet. Aydelot Cemetery lays within panel #16 is projected to subside 7 feet. Old Bear Creek lays approximately 600 feet outside of the predicted zero effected boundary. For these cemeteries which will be affected by subsidence, where subsidence rights are not obtained, an agreement will be reached with the respective cemetery trustees or responsible party or parties, prior to subsidence occurring. Where subsidence rights have been obtained, an agreement will be reached with the respective cemetery trustees or responsible party or parties, prior to subsidence occurring or a detailed damage minimization plan, approved by the Department, will be obtained prior to subsiding a cemetery. In order to minimize possible damage to monuments, a professional monument company will be contracted to prepare the cemetery for subsidence. After mining, all damages to the cemeteries and monuments will be repaired.

Other places denoted by 1761.11 have not been identified within the shadow area of the permit.

d) Identify and label all occupied dwellings, public buildings and facilities, schools, churches, hospitals, community or institutional buildings, or public parks located within 300 feet measured

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horizontally of surface areas of predicted planned subsidence. If no such features exist, provide a specific statement indicating such. If such features do exist, include the following information as may be necessary:

RESPONSE: ***Refer to Map 8a & 8b – Post Subsidence Contour Map for the location and types of all structures located within 300 feet measured horizontally of the surface areas of predicted planned subsidence. Also refer to Attachment II.10.A – Identification of Structures for a listing and identification of all structures currently within the proposed shadow boundary area.***

i) Provide a written narrative with support documentation which assures compliance with the requirements of Title 62 Ill. Adm. Code 1761.11 and 12 as may be necessary to permit planned subsidence mining operations within the prohibited area.

RESPONSE: ***Planned subsidence in areas designated by Title 62 Illinois Administrative Code 1761.11 (Areas Where Mining is Prohibited or Limited) will occur within 100 feet measured horizontally of the outside right of way line of public roads. The necessary waivers from the public authority governing these roads will be obtained or a detailed damage minimization plan approved by the Department prior to subsiding a public road.***

Planned subsidence is also anticipated within 300 feet of occupied dwellings. Where the right to subside does not exist, the necessary rights will be obtained prior to subsidence occurring.

Refer to Map 3 – Pre-Mining Land Use Map for known cemeteries. In the event that cemeteries are to be affected by subsidence, where subsidence rights are not obtained, an agreement will be reached with the respective cemetery trustees or responsible party or parties, prior to subsidence occurring. Where subsidence rights have been obtained, an agreement will be reached with the respective cemetery trustees or responsible party or parties, prior to subsidence occurring or a detailed damage minimization plan, approved by the Department, will be obtained prior to subsiding a cemetery. In order to minimize possible damage to monuments, a professional monument company will be contracted to prepare the cemetery for subsidence. After mining, all damages to the cemeteries and monuments will be repaired.

Other places denoted by 1761.11 have not been identified within the area of planned subsidence of the permit.

There are no public buildings and facilities, schools, churches, hospitals, community or institutional buildings located within 300 feet measured horizontally of surface areas of predicted planned subsidence.

The Illinois Department of Natural Resources controls and manages property around the Coffeen Lake reservoir. This property can be identified on <u>Map 3 – Pre-Mining Land Use Map</u> as well as <u>Map 2 – Identification of Interests</u>, which includes the applicable parcel numbers and acreage.

ii) Provide a written narrative which assures compliance with the requirements of Title 62 Ill. Adm. Code 1817.121(d) as may be necessary to permit such proposed mining operations in relation to public buildings and facilities, schools, churches and hospitals.

<u>RESPONSE</u>: There are no public buildings and facilities, schools, churches, hospitals, community or institutional buildings located within 300 feet measured horizontally of surface areas of predicted subsidence.

5) Describe the anticipated effects of planned subsidence.

a) Using the predicted magnitude, extent of planned subsidence profiles, post-subsidence contours and angle of draw provided in response to 4.B, above, provide a list of all structures and facilities located within the projected area of influence of the planned subsidence. The list provided must correspond to each panel or extraction area to be mined by planned subsidence mining methods and must cross-reference with surface structures and feature map(s).

<u>RESPONSE</u>: Structures identified within the Revision No. 2 shadow area are identified on <u>Map 2 – Identification of Interests</u>. Refer to <u>Attachment I.2.A – Surface and Coal Ownership Within and Adjacent to Shadow Area</u> of this revision application for the landowners of structures within the Revision No. 2 area.

b) Using the predicted magnitude, extent of planned subsidence profiles and post-subsidence contours provided in response to B, 2, above, locate and identify all areas of where surface subsidence impacts are projected to cause disruptions of surface drainage or drainage problems on a map(s) at a 1" to 400' scale.

<u>RESPONSE</u>: Refer to <u>Map 8 - Post Subsidence Contour Map</u>. Shown on this map are areas where there are expected impacts caused by surface subsidence that could result in temporary surface drainage disruptions. The post mining contours were developed by the subsidence prediction modeling software (SDPS) and imported into a computer aided design (CAD) software package. Certain precipitation events developed by regional precipitation histories can then be simulated over

the re-contoured area. This indicates where probable pooling will occur during the subsidence process. A generalized plan can then be developed to correct drainage disruptions. Upon subsidence occurring, common surveying methods, such as global positioning system (GPS), traverses, and/or the use of construction grade laser levels can be used to develop a site-specific drainage correction plan. The plan can then be implemented to correct any drainage disruptions caused by surface subsidence.

c) Describe any other anticipated effects of planned subsidence.

RESPONSE: ***As previously discussed in this application, planned subsidence will cause the surface areas located within the angle of draw and above the proposed longwall panels to change elevation. The amount of vertical and horizontal movement, as well as the degree of compressive and tensile strains induced by the subsidence can be accurately predicted. This prediction model has been correlated to actual surface subsidence monitoring that was conducted on the first two mined longwall panels at the Deer Run Mine. The monitoring was performed by using surface surveying methods to compare pre-subsidence conditions with post subsidence movements. Survey stations were established along several lines running parallel to, perpendicular with, and diagonally across the longwall panel(s). Monitoring occurred at different times depending on the location of the retreating longwall face as required by the subsidence control plan in Permit 399. The information that was collected from the subsidence monitoring program indicated the amount of surface movement as well as the duration that the movement occurred.***

Planned subsidence can also be expected to have an effect on water bearing sandstones or limestones within the subsidence zone. Typically, the subsidence can have a positive effect on the sandstones by increasing the porosity of the rock units. This Fracture Porosity will increase well yields if wells were drilled into these zones. With the generous amount of shales surrounding these zones, groundwater can be expected to migrate horizontally but not vertically. Potential impacts to the water bearing sandstones located within the area of planned subsidence are covered in the response to Part III.2.D of this application.

The uniform subsidence that occurs with longwall mining will give a predictable pattern. Structures within the subsidence area will experience movement. This movement will occur uniformly and predictably.

6) Describe, if any, measures to be taken on the surface to prevent or minimize the effects of planned subsidence.

RESPONSE: ***Measures to be taken on the surface to prevent or minimize the effects of planned subsidence may include the following:***

- ***Recontouring and drainage correction in agricultural areas. See response to Part IV.3.B.5.b above. Upon subsidence occurring, common***

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surveying methods, such as global positioning system (GPS), traverses, and/or the use of construction grade laser levels can be used to develop a site-specific drainage correction plan. The plan can then be implemented to correct drainage disruptions caused by surface subsidence.

- ***Temporary support for surface structures, flexible utility connections***
- ***Exposure of pipelines***
- ***Regrading and re-ditching for roadways***

Specific actions will be determined for each structure prior to subsidence occurring.

As required by 1817.121(a)(3), Hillsboro Energy, LLC will implement damage minimization to all surface structures unless a pre-mining agreement with the structure owner is reached that precludes the need to minimize drainage.

7) Describe measures to be taken to mitigate or remedy any subsidence-related material damages.

a) Provide a description of mitigation measures to be taken to repair or compensate the owners of structures or facilities which sustain material damage caused by subsidence, including but not limited to the following:

i) Compensate the owner of structures or facilities in the full amount of the diminution in value resulting from the subsidence.
ii) Repair, restore, rehabilitate or replace damaged structures or facilities.
iii) Compensation may be accomplished by the purchase prior to mining of a noncancelable premium prepaid insurance policy payable to the surface owner in the full amount of the possible material damage. Documentation of the purchase of such qualifying insurance must be provided.

<u>RESPONSE</u>: ***Hillsboro Energy, LLC will pursue premining agreements with owners of all structures potentially impact by planned subsidence. The agreements will detail measures designed to prevent or minimize subsidence damages and/or to outline an orderly procedure for the repair or replacement of damaged structures following subsidence. Hillsboro Energy, LLC may also pursue a written waiver from the structure Owner to not perform minimization procedures per 62 Illinois Administrative Code 1817.121(a)(3).***

Regardless of the existence of premining agreements with structure Owners, Hillsboro Energy, LLC will propose a presubsidence condition survey on all structures to determine the current condition. The condition surveys will be performed a minimum of 120 days in advance of projected subsidence impacts

unless a shorter time frame is justified and approved by IDNR. A certified condition survey will be repeated to document all material damage caused by planned subsidence. A contractor will then be employed to provide estimates of the total cost of repair to presubsidence conditions. Hillsboro Energy, LLC will then propose a plan to repair or replace the structure to presubsidence condition or compensate the Owner for the amount of repair up to the presubsidence appraised value. All costs associated with condition surveys, appraisals and repair estimates will be the responsibility of Hillsboro Energy, LLC.

Refer to Addendum No. 1 to the UCM-1 Application covered in Part VI of this permit application, for additional information concerning damage minimization, repair, replacement or compensation of structures impacted by subsidence.

b) Provide a description of measures adopted to control and correct material damage resulting from subsidence caused to surface lands, to the extent technologically and economically feasible, by restoring the land to a condition capable of maintaining the value and reasonable foreseeable uses which it was capable of supporting before subsidence. Also provide descriptions of specific repair measures recommended to remedy anticipated material damages detailed in 7.a above.

<u>RESPONSE</u>: Longwall mining provides predictable and uniform subsidence patterns. Pre-mining contours have been developed by aerial mapping. This mapping provides a basis to determine the extent of subsidence to the lands. The post mining contours were developed by the subsidence prediction modeling software (SDPS) and imported into a computer aided design (CAD) software package. Certain precipitation events developed by regional precipitation histories can then be simulated over the re-contoured area. This indicates where probable pooling will occur during the subsidence process. A generalized plan can then be developed to correct drainage disruptions. Upon subsidence occurring, common surveying methods, such as global positioning system (GPS), traverses, and/or the use of construction grade laser levels can be used to develop a site-specific drainage correction plan. The plan can then be implemented to correct any drainage disruptions caused by surface subsidence. Any impacts that may impair the value or use of the lands will be mitigated to ensure the land reaches a condition capable of maintaining the value and reasonable foreseeable uses which it was capable of supporting prior to subsidence.

Hillsboro Energy, LLC, or an agent thereof, will promptly inspect the lands affected by subsidence in order to determine the extent of the subsidence impacts. Hillsboro Energy, LLC will take the necessary measures to restore proper field drainage including, but not limited to, the installation of new field drainage tile around and through subsided areas to eliminate pooling, repairing and/or resizing and replacing existing field drainage tiles, deepening and repairing existing drainage ways, and installing new drainage ways where necessary. In

many cases, the current drainage of the existing farm fields can be improved upon after the subsidence occurs. This is due to the fact that within the Shadow Area, a regional drainage system does not exist. This results in many areas that currently pool water in wet periods because the landowners do not have downstream locations to drain water without getting approval from several other landowners affected by the drainage correction. The subsidence allows a comprehensive drainage plan to be developed by requiring drainage corrections. Current drainage issues not caused by surface subsidence can be corrected by Hillsboro Energy, LLC and the agents thereof, by involving all landowners in whom subsidence rights are obtained. This can result in crop yield increases in certain areas that were not previously possible prior to subsidence occurring.

Hillsboro Energy, LLC will develop appropriate mitigation plans for all necessary drainage repairs on a site-specific basis. This will be accomplished by utilizing the subsidence prediction modeling software prior to subsidence occurring and by using surveying techniques and field evaluations after the subsidence has occurred. Drainage restoration plans will typically be made in consultation with the landowners and/or the respective tenant farmers. This allows the landowners and/or tenant farmers input on the drainage corrections and improvements to be made on their respective properties. For farm production lands where subsidence impacts crop production, Hillsboro Energy, LLC will compensate the landowner for acreage temporarily taken out of production or any crop loss resulting from subsidence, until such time that the land's drainage is restored and the land returned to its pre-mining use. Crop losses will be compensated for based on the average yields the property has provided historically, the land area disturbed, and the price of the crop that was lost.

Lands taken out of production due to creation of newly designed drainage ways will be minimized wherever practical by working with existing drainage ways. Where this is not practical, for any area taken out of production to facilitate placement of permanent drainage ways, compensation will be made to the landowner at an agreed upon value.

Similar to crop land, any wooded areas impacted by subsidence will be properly drained to preserve the pre-mining land use and prevent tree damage.

c) In conjunction with subsidence control plans to mitigate subsidence-related material damage to land and structures, provide a description of measures to be taken to determine the degree of material damage or diminution of value or reasonable foreseeable use of the surface.

RESPONSE: ***FOR LAND: The land will be restored to the extent that the land was capable of supporting prior to subsidence. The restoration plan may include drainage correction to restore drainage patterns.***

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***FOR STRUCTURES:** A pre-subsidence survey will be performed on structures prior to subsidence occurring. This survey will include photographic and sketched documentation of the condition of the structures in a pre-subsidence condition. The survey will be performed by a person trained and experienced in performing such surveys.*

A report will be generated including a description of the structure including photographs and documentation of the physical condition of the structure. A copy will be provided to the structure owner and any comments to the survey will be addressed.

After subsidence has occurred, a post subsidence survey will be performed in the same manner and procedures as the pre-subsidence survey. Any changes to the structure due to subsidence will be noted and will provide a basis to determine the extent of material damage to the structure.

If a dispute between the landowner and permittee occurs over the existence, amount, level or degree of material damage, then the following procedures will be sought:

- ***i.*** ***Permittee will obtain the services of a licensed appraiser.***
- ***ii.*** ***The Landowner will obtain the services of a licensed appraiser.***
- ***iii.*** ***Each appraiser shall perform an independent review of the property to determine the existence, amount, level or degree of material damage;***
- ***iv.*** ***If an agreement cannot be reached, then both appraisers shall agree on a third licensed appraiser. If an agreement cannot be made on a third appraiser; then a referee, who need not be a licensed appraiser would be sought through the local Judicial Authority.***
- ***v.*** ***Each appraiser shall provide his/her appraisal to the third appraiser/referee and upon receipt of the appraisals, the third appraiser and/or referee shall promptly select one or the other of the appraisals, without modification, as the final determination of the existence, amount, level or degree of material damage.***

FOR STREAM SUBSIDENCE: Specific actions will be determined for each stream channel prior to subsidence occurring.

Drainage corrective measures will be coordinated with the landowners as necessary.

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A post subsidence inspection will be performed on affected stream channels for damage and stream loss. Stream loss is not anticipated due to low permeability of the clayey till and underlying shales. Surface cracks in the upper soils caused by tensile strains induced by mine subsidence are common. However, the depth of the surface cracking resulting from the maximum surface tensile strains induced by the mine subsidence will be mitigated by the depth of the glacial till. The plasticity of the clay in the glacial till allows the material to bend instead of crack.
If loss occurs, a plan will be prepared and communicated to the USACOE to determine if the corrective measures are located within jurisdictional waters. If they are jurisdictional, a USACOE Permit will be obtained. Upon approval of any necessary USACOE permit, the drainage corrective activities will be performed.

As stated in the affidavit contained herein in <u>Attachment I.10.A – Mining Affidavits</u> in this application, the applicant has or will possess, prior to subsidence, all necessary rights to correct drainage problems associated with subsidence.

FOR ROADWAYS, PIPELINES, TRANSMISSION LINES, UTILITIES: The Permittee will pursue agreements with governmental bodies and utility companies responsible for all public roadways, utility lines, and buried pipelines expected to be affected by subsidence. Such agreements, to be negotiated well in advance of subsidence, will allow the implementation of measures designed to prevent or minimize subsidence damage and/or outline a timely procedure for the repair or replacement of damaged facilities following subsidence. These agreements will vary in scope and will be site specific for each such facility.

In accordance with 62 ILL. Adm. Code 1784.20 b) 8), the convenience and safety of the public will be a high priority in the development and implementation of such cooperative agreements. Consultation and agreements for road closures will be conducted with the proper road authorities prior to mining individual panels.

Refer to <u>Attachment IV.3.B.7.c – Utilities Agreements Status</u> for additional information concerning the owners of Roadways, Pipelines, Transmission Lines and Utilities and the current status of the agreements for Permit 399.

C) Subsidence Unplanned (Maximize Mine Stability)

1) Describe the method of coal removal which is designed consistent with known technology to maximize mine stability to prevent or minimize subsidence and subsidence related damage so that if subsidence does occur it cannot be considered planned subsidence.

<u>RESPONSE</u>: The majority of the mining employed at the Deer Run Mine is planned subsidence mining using the longwall mining method. There is a small portion

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of the mine, however, that is room and pillar mining. The room and pillar mining method is used at the Deer Run Mine to develop Mains, Gate, and Bleeder Entries for the longwall mine that extracts coal from the Herrin No. 6 Coal Seam. The Mains Entries are typically developed with six entries on 100-foot centers. The maximum entry and crosscut width is 20 feet. The Gate Entries are typically developed three entries wide and are mined the length of the longwall panel. The crosscut centers are typically 120 feet and the entry width is 18 to 20 feet wide. The Bleeder Entries are utilized for long term ventilation and examination airways at the back end of the longwall panels. The Bleeder Entries typically consist of five entries and are heavily supported with standing roof support for long term protection. A coal barrier pillar is left between the end of the longwall panel and the Mains Entries. The average extraction height in the continuous miner development units typically ranges between 9 and 12 feet depending on the immediate geology of the area being mined.

The room and pillar mining method, as described, is intended to provide protection against unplanned surface subsidence. Mine stability is assessed using site-specific strength values of the coal seam. Accurate surveying of the mine workings, as required by law, assures that the plans implemented are carried out in the operation. Pillar centers are selected to provide adequate safety factors to maintain roof stability. In addition, adequate sizing of pillars prevent the pillar from failing under load, or undue settlement into the underlying strata; all of which could lead to surface damage. Analysis of Retreat Mining Pillar Stability (ARMPS) Software was used to determine the safety factor of the room and pillar mining. Factors of Safety were calculated on the smallest pillar size, and the largest crosscut and entry widths. Refer to <u>Attachment IV.3.C.1 – Geotechnical Information</u> for pillar stability calculations.

2) On the shadow area map(s) describe in 2,E, above, or other designated map show all areas where coal extraction as described above in 3,C,1 is to occur. Include the following detailed information:

   a) Provide the location of mains, submains and extraction panels giving geometric sizes, dimensions and orientation including lengths, widths, and extraction heights of each.

<u>RESPONSE</u>: Refer to <u>Map 6 – Underground Operations Map</u> for the locations of proposed mains, submains, and extraction panels giving sizes, dimensions, and orientations. Refer to the response located in Part IV.3.C.1 above and the response located in Part IV.3.B.2 for explanations on the typical widths and extraction heights utilized in the mining process.

   b) Identify and label all impoundments with a storage capacity of 20 acre-feet or more, or bodies of water with a volume of 20 acre feet or more, public buildings and facilities, churches, schools and hospitals. In a written narrative, provide information which assures compliance with the requirements of Title 62 Ill. Adm. Code 1817.121(d) as may be necessary to permit such proposed mining operations. If no such features exist, provide a specific statement indicating such.

RESPONSE: ***Refer to <u>Map 2 - Identification of Interests</u> and <u>Map 3 – Pre-Mining Land Use Map.</u> Coffeen Lake is the only impoundment having a storage capacity of 20 acre-feet or more located above the areas of unplanned subsidence mining. A portion of Coffeen Lake is also located above the area of planned subsidence. In accordance with 62 Illinois Administrative Code 1817.121(d), unplanned subsidence will not cause material damage to, or reduce the reasonably foreseeable use of the water body. The functionality of the lake will be maintained by reasonably keeping the lake within the confines of its current pre-mining boundaries. Refer to <u>Map 8 – Post Subsidence Contour Map</u> for the post-mining extents of the lake. The lake is utilized as a cooling reservoir for the nearby Coffeen Power Station. Unplanned subsidence would only deepen the water reservoir in that specific location increasing the functionality of the lake as a cooling pond. The more total water volume in the lake, the more cooling ability it will have.***

The depth of the Glacial Drift in this location acts as a physical barrier between the lake and bedrock layers beneath. The Glacial Drift or till consists of unconsolidated materials deposited by glaciation during the last Ice Age that are virtually impermeable. Permeability testing was conducted on the unconsolidated till by Hurst-Rosche Engineers, Inc. to calculate hydraulic conductivity through the Glacial Drift. Laboratory testing on an undisturbed Shelby tube sample from approximately 7 ft. in depth in a boring located near the surface facilities of the mine site resulted in a permeability of $2x10^{-8}$ cm/sec. Refer to <u>Attachment IV.3.B.4.b. – Hydrogeologic Investigation Report</u> for the lab data permeability data being referenced. An analysis of the drilling logs reveals that the unconsolidated materials are approximately 130 feet in thickness in the location of Coffeen Lake. Refer to <u>Map 10 –Bedrock Thickness Map</u> for the depths of the unconsolidated materials measured at the drilling locations.

It is anticipated that no stability issues would occur as a result of the settlement and deformation of the ground surface caused by mine subsidence. The Coffeen Lake Reservoir is completely incised with the exception of the earthen embankment located on the downstream (South) end of the lake. This embankment is not being proposed to be undermined in this permit application. Surface cracks in the upper soils caused by tensile strains induced by mine subsidence are common. However, the surface cracking resulting from the maximum surface tensile strains induced by the mine subsidence will be mitigated by the depth of the glacial till. The plasticity of the clay in the glacial till allows the material to bend instead of crack.

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Coffeen Lake also does not serve as a significant water source for any public water supply system.

c) Provide calculations for the estimated potential angle of draw.

<u>RESPONSE:</u>* *Refer to <u>Attachment IV.3.B.2 – Subsidence Monitoring and Prediction Analysis</u> for details of the comparisons between the subsidence prediction model as developed from the SDPS software and the actual monitoring data gathered from the first two longwall panels at the Deer Run Mine. Also included in this attachment are angle of draw calculations to verify the accuracy of the model. Post subsidence contours over the proposed shadow boundary area are shown on <u>Map 8a & b – Post Subsidence Contour Map</u>.

3) Provide information regarding proposed mining extraction geometries, including information on the dimensions of pillars, extraction widths of rooms, entries, and crosscuts, etc., for all mains, submains, panel entries and all development areas. Provide information regarding the highest extraction percentage for each of the mining geometries proposed by the operator, if variations are proposed. Information is to include specific details of the effects of any proposed second mining operations on final mining geometries and extraction percentages. Map(s) at a scale of 1 inch to 400 feet (other scales as approved by the Department) are to be provided representing all proposed extraction geometries, including any proposed second mining.

Provide information regarding the design engineering of the various mining geometries proposed in 3,C,3 above in maximizing mine stability to prevent subsidence. Include the following:

i) Detailed information regarding the specific methodology used to calculate mine stability with support documentation and design calculations.

ii) Data concerning actual coal strengths typical of the coal to be mined and as this information relates to pillar design and stability.

iii) Data regarding the strength and geotechnical characteristics of the actual mine floor and subfloor as it relates to mine design and stability. Information is to be included describing the thickness and lithology of the floor and subfloor units.

<u>RESPONSE:</u>* *Refer to <u>Attachment IV.3.C.1 – Geotechnical Information</u> for pillar stability calculations and for additional information regarding the mining extraction geometries.

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4) Provide detailed descriptions of subsidence control measures that will be taken to prevent or minimize subsidence and subsidence-related damage which includes, but is not limited to the following:

a) Backstowing or backfilling, include map locations;

RESPONSE: ***Backstowing or backfilling is not proposed at this operation.***

b) Leaving areas in which no coal is removed within the shadow area, including a description of the overlying area to be protected by solid coal blocks left in place. Identify any such areas by map locations;

RESPONSE: ***Besides barrier pillars and mains development, all other areas are planned subsidence.***

c) Surface measures taken to prevent material damage or lessening of the value of reasonably foreseeable uses of the surface;

RESPONSE: ***Refer to the response in Part IV.3.C.5.a below.***

d) Monitoring, if any, to determine the commencement and degree of subsidence so that other appropriate measures can be taken to prevent or reduce material damage. Include map locations of any proposed monitoring sites.

RESPONSE: ***No monitoring is proposed on areas of unplanned subsidence.***

5) Describe measures to be taken to mitigate or remedy any subsidence-related material damages.

a) Provide a description of mitigation measures taken to repair or compensate the owners of structures or facilities which may be materially damaged by subsidence, including but not limited to the following:

i) Compensate the owner of structures or facilities in the full amount of diminution in value resulting from the subsidence.

ii) Repair, restore, rehabilitate or replace damaged structures or facilities.

iii) Compensation may be accomplished by the purchase prior to mining of a noncancelable premium prepaid insurance policy payable to the surface owner in the full amount of the possible material damage. Documentation of the purchase of such qualifying insurance must be provided.

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RESPONSE: ***Subsidence related material damage is not anticipated in the South Mains area shown in Map 6 – Underground Operations Map. Adequate pillar blocks will be designed for long term stability which will prohibit overburden movement from occurring.***

However, if subsidence related material damage is identified, the Permittee will repair or reimburse the owner for identified damages, if any, which occur to the surface and to any improvements located on the surface owned by others which are caused by subsidence resulting from its mining activities. Pre-subsidence surveys will be the basis of damage assessment. Coordination with applicable owners, utilities and governmental agencies will be established to ensure restoration, repair or reinstallation of infrastructure features to the capability and condition of such features prior to subsidence. Restoration, repair or reinstallation of such features will be initiated in a timely matter after subsidence occurs. Structure and facility owners will be reimbursed for actual out-of-pocket expenses after subsidence is complete. A post-subsidence survey and/or appraisal will be performed to determine the extent of subsidence damage. Mitigation measures with respect to surface structures and facilities will be undertaken at Hillsboro Energy, LLC's expense where material damage has incurred as a result of subsidence. Mitigation of material damages due to subsidence could include one of the following: restoration to its pre-subsidence capability and condition; replacement with a structure having the same capability and in the full amount of any diminution in value of the original structure; purchase of the structure at its pre-subsidence appraised value; or compensation to the owner of the structure for any loss or damage incurred.

b) Provide a description of measures adopted to control and correct material damage resulting from subsidence caused to surface lands, to the extent technologically and economically feasible, by restoring the land to a condition capable of maintaining the value and reasonably foreseeable uses which it was capable of supporting before subsidence.

RESPONSE: ***Where structures are not involved, a method capable of supporting the foreseeable use of the surface land affected by subsidence will be utilized. Such methods may drain a subsided area by re-contouring the surface, filling the subsided area to permit drainage, and/or develop an underground agricultural drainage system to drain the area.***

c) In conjunction with the requirements to mitigate subsidence-related material damage to land, and structures provide a description of measures to be taken to determine the degree of material damage or diminution of value or reasonable foreseeable uses of the surface.

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RESPONSE: ***Pre-mining contours have been documented by 2-foot incremental aerial mapping. This mapping is shown on Map 3 – Pre-Mining Land Use Map and Map 6 - Underground Operations Map. This will provide a baseline to determine the extent of any subsidence impacts to surface lands.***

When Hillsboro Energy, LLC (Permittee) is contacted regarding potential surface subsidence damage, a representative will arrange a personal meeting to respond to the inquiry and make a visual inspection documenting the details of the claimed damage. In areas of alleged damages not clearly defined, a structural engineer or other qualified person will be retained to inspect and evaluate the property and provide a written report, stating conditions of the alleged damages as well as probable causes. Once the details of the damage have been identified and documented, representatives of the Permittee will appraise the alleged claim and propose a resolution or compensation.

If the property owner is dissatisfied with the proposed resolution, differences will be resolved through arbitration or litigation.

4) Existing Structures

A) Provide a description of each existing structure proposed to be used in connection with or to facilitate the surface coal mining and reclamation operations. The description shall include the following:

1) Locate the structure on the operations map or other designated map,

2) Provide plans of the structure detailing its current, pre-mining condition,

3) Provide approximate dates, beginning and completion for construction of the structure, and

4) Provide a showing that the structure meets the performance standards of either 62 Ill. Adm. Code Sections 1810 through 1828 or 62 Ill. Adm. Code Sections 280-300 (Interim Regulation Program). The showing shall monitor data or other substantiating evidence.

RESPONSE: ***No Existing Structures are proposed to be used in connection with or to facilitate the surface coal mining and reclamation operations.***

B) For each structure proposed to be modified or reconstructed for use in connection with or to facilitate the surface coal mining and reclamation operations a compliance plan is required which shall include the following:

1) Design specifications for reconstruction or modification of the structure to meet the design and performance standards of 62 Ill. Adm. Code Sections 1810 through 1828.

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2) A schedule for reconstruction or modification of the structure showing dates for beginning and completing interim steps as well as final reconstruction,

3) Provisions for monitoring the structure during and after modification to ensure that the performance standards of 62 Ill. Adm. Code Sections 1810 through 1828 are met, and

4) A showing that the risk of harm of the environment or to public health or safety is not significant during the period of modification or reconstruction.

RESPONSE: ***No Existing Structures are proposed to be used in connection with or to facilitate the surface coal mining and reclamation operations.***

5) Support Facilities

A) Locate on a mining operations map each of the areas to be permitted for surface disturbance to facilitate the mining operation. Map shall include all support facilities including buildings, structures, conveyors, parking areas, coal preparation plants, yards, railroad spurs, on-site rail yards, each air pollution collection and control facility, each facility to be used to protect and enhance fish and wildlife and related environmental values, and each explosive storage and handling facility.

RESPONSE: ***N/A. No additional surface facilities are being proposed by this revision.***

B) Indicate acreage of each type of facility within permit area such as: buildings, roads, railroads, parking areas, pavements, loading and unloading facilities, sanitary facilities, and undeveloped areas. (Summation of above areas should equal total support facility area.)

RESPONSE: ***N/A. No additional surface facilities are being proposed by this revision.***

SUPPORT AREA		ACRES
Mine Buildings		
Mine Office Parking		
Mine Yard		
Preparation Plant Buildings		
Prep Plant Parking		
Prep Plant Yard		
Refuse Area		
Railroad		
Access Roads (Roads and Shoulders)		
Topsoil Storage		
Dirt Stockpile		
Drainage Facilities		
Coal Storage		

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Mine Support Areas		
Plant Support Areas		
Other		
Undeveloped Areas		
TOTAL		

C) Transportation Facilities

1) Provide a detailed description on mining operations map or other map and show location of the following:

a) Proposed road(s), conveyor system(s), or rail system.

b) Related sediment control facilities.

c) Earth borrow locations and/or locations for deposition of excess excavation.

RESPONSE: ***N/A. No additional transportation facilities are proposed by this revision***.

2) Provide specifications and plan-profiles of existing gradeline, proposed road centerline, ditch flow lines, road cut, fill embankment, culvert, bridge and drainage structures. Provide typical cross sections where appropriate.

RESPONSE: ***N/A. No additional transportation facilities are proposed by this revision.***

3) For all transportation facilities to be constructed, provide construction details for all sediment control facilities to be constructed to prevent additional contributions of suspended solids to streamflow or to runoff outside the permit area.

RESPONSE: ***N/A. No additional transportation facilities are proposed by this revision.***

4) Discuss the revegetation of ditch and borrow areas involved in construction.

RESPONSE: ***N/A. No ditches or borrow areas are proposed by this revision.***

5) Discuss the estimated life of each facility and how materials will be removed when the facility becomes inactive.

RESPONSE: ***N/A. No additional transportation facilities are proposed by this revision.***

6) Provide a report of appropriate geo-technical analysis where approval from the Department is required for alternative specifications or steep cut slopes under 62 Ill. Adm. Code 1817.150.

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<u>RESPONSE:</u> ***N/A. No additional transportation facilities are proposed by this revision.***

7) Provide a description of measures to be taken to protect the inlet end of a ditch relief culvert, other than use of a rock headwall, and for alteration or relocation of a natural drainageway for approval by the Department under 62 Ill. Adm. Code 1817.150.

<u>RESPONSE:</u> ***N/A.***

6) Waste Material

A) Identify the nature of all waste material including shaft excavation material and non-coal waste to be disposed of within the permit area. Give the net neutralization potential.

<u>RESPONSE:</u> ***N/A. This application is to address expansion of the approved shadow area.***

B) Coal processing waste bank dams shall be designed to comply with requirements of 62 Ill. Adm. Code 1817.81 through 1817.84. For coal processing waste dams and embankments each plan shall comply with the requirements of MSHA, 30 CFR 77.216-1 and 77.216-2, and shall contain the results of a geo-technical investigation as prescribed under 62 Ill. Adm. Code 1784.16(e).

<u>RESPONSE:</u> ***N/A. This application is to address expansion of the approved shadow area.***

C) Indicate location of all areas in which such materials including shaft excavation material and non-coal waste (including those under Subtitle C of RCRA) are to be disposed of on the mining operations map. Indicate all streams, creeks, and surface water impoundments within such areas or which receive runoff from such areas. Provide acreage of disposal area and borrow areas. Indicate location of borrow area on mining operations map.

<u>RESPONSE:</u> ***N/A. This application is to address expansion of the approved shadow area.***

D) Provide construction details for all impoundments and structures to contain such waste material. Provide typical cross-sections of all proposed levees, dams and excavations.

<u>RESPONSE:</u> ***N/A. This application is to address expansion of the approved shadow area.***

E) Indicate location and provide details for diversions as necessary to divert surface water around such areas on the mining operations map.

<u>RESPONSE:</u> ***N/A. This application is to address expansion of the approved shadow area.***

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F) Provide details of diversions or other devices designed to collect surface runoff from waste disposal sites and transport same to appropriate treatment facility.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

G) Provide details of such treatment facilities and identify points of discharge.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

H) For disposal areas explain measures to be taken to avoid pollution of surface or groundwater due to leaching through levees or dams and through underlying soil.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

I) Describe estimated life of each area.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

J) Coal preparation:

1) Give a general description of the coal processing operation at this facility.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

2) Describe the fresh water (makeup) and slurry circuits for this operation and indicate if a discharge occurs. If a discharge does occur, it should be included on Schedule A. If a discharge does not occur, a detailed description of how this will be accomplished must be submitted.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

3) What safeguards are provided to prevent the discharge of slurry fines and untreated slurry water during emergency situations (e.g. power outages, mechanical equipment breakdown, plant shutdowns, etc.)? Also indicate where the slurry would go by gravity flow in the event of an emergency discharge, and the environmental impact this would have.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

7) Surface Drainage Control

A) 1) Locate on the mining operations map or on a separate drainage map all proposed drainage control systems. Show drainage patterns of all affected mining areas.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

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2) Will all surface drainage from the affected mining area be collected and treated prior to leaving the permit area?

Yes _________ No _________

If yes, delineate how and where surface drainage will be collected and treated, and list permit numbers and type of permit that the drainage control systems are operated under. If above answer is no, explain how regulatory compliance will be achieved without treatment, i.e., address the requirements of Section 1817.46(e).

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

B) Will all surface drainage from unaffected areas be intercepted and diverted around the affected mining area?

Yes _________ No _________

If no, please discuss.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

C) Describe the timing in which all construction of the sediment ponds and surface drainage control structures will be complete. Include a discussion of the vegetation stabilization of these structures.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

D) Overland Flow Diversions

For all diversions of overland flow, shallow groundwater flow, and ephemeral streams which divert surface water around the mining area, and all collection drains that transport affected area runoff into water-treatment facilities, provide the following:

1) Typical cross sections bottom width, side slopes and depth.

2) Proposed flow line slopes.

3) Runoff and diversion capacity calculations.

4) Details of proposed erosion and sediment control measures to be employed.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

For permanent diversion also include:

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5) Watershed limits upstream from the diversions.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

6) Plan profile drawings of the proposed diversion showing existing gradeline, proposed diversion bottom gradeline and water surface at design storm.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

E) Sediment pond Design:

NPDES
MSHA#
Total Drainage Area (Acres)
Total Disturbed Drainage Area (Acres)
Total Calculated Inflow From Design Storm (AC-FT)
Sediment Storage Volume (AC- FT)
Total Volume Below Primary Spillway Elevation (AC-FT)
Total Volume Below Emergency. Spillway Elevation (AC-FT)

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

NPDES	MSHA #	Total Drainage Area (ac.)	Total Disturbed Area (ac.)	Total Calculated Inflow from Design Storm (ac-ft)	Sediment Storage Volume (ac-ft)	Total Volume Below Primary Spillway (ac-ft)	Total Volume Below Emergency Spillway (ac-ft)	Embankment Height from Upstream Toe to Emergency Spillway (ft)

F) 1) Discuss the design basis for the sediment pond(s) calculations.

Submit calculations used in spillway designs and determination of inflow volume and pond volume.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

2) Submit a typical section of the embankment(s), details of the principal and emergency spillways and a plan view of each pond at a scale of 1 inch = 200 ft. or larger showing pond bottom contours and points of inflow.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

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3) For all sedimentation ponds provide design information showing compliance with the requirements of 62 Ill. Adm. Code 1817.46. Each plan shall, at minimum, comply with the requirements of MSHA, 30 CFR 77.216-1 and 77.216-2.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

G) If sediment removal becomes necessary, explain how the sediment will be removed, where it will be disposed of, and what disposal methods will be used.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

H) Will pH adjustment be necessary on any of the discharges in order to meet the applicable State and Federal Standards?

Yes _________ No _________

If yes, a discussion of the situation is necessary, along with a detailed basis of design. The basis should include a detailed description of the proposed treatment facilities, process flow diagrams, and design calculations.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

I) Does a perennial or intermittent stream occur within the proposed permit area?

Yes _________ No _________

If yes, is an exception to the 100-foot buffer zone being requested or is a stream diversion being proposed. For exception to the 100-foot buffer zone, indicate how compliance with Section 1817.57 will be assured. For a stream diversion, complete Part V 6) of the application form.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

J) Permanent and Temporary Impoundments, Ponds, Banks, Dams and Embankments

1) All temporary and permanent impoundments must meet the requirements of 62 Ill. Adm. Code 1817.49. Will the mining operation involve the construction of any impoundments other than those waste retention?

Yes _________ No _________

If yes, include the following information:

a) Locate on mining operations map all impoundments, dam locations, and watershed limits, indicate which impoundments are proposed to be permanent and complete Part V 3)D) of the application.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

b) Provide construction and maintenance details of dams, spillways, seepage control measures, and erosion control measures for inlets and outlets. Employ maps and cross sections where necessary. Where design plans for proposed structures are not provided, submit a certification statement providing a schedule for submission of detailed design plans for each structure.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

2) Describe proposed reclamation plans for each structure, including a time table and plans for removal and disposal of material. Each plan shall:

a) Be prepared by or under the direction of, and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act,

b) contain a description, map, and cross-section of the structure and its location,

c) contain preliminary hydrologic and geologic information required to assess the hydrologic impact of the structure,

d) if underground mining has occurred, the plan shall contain a survey describing the potential effect on the structure from subsidence of the subsurface strata resulting from the post underground mining operations,

e) for structures where the detailed design plans are not submitted to the Department with the general plan, the plan shall contain a certification statement which includes a schedule setting forth the dates that detailed design plans are to be submitted. For these structures, the detailed design plans must be submitted to the Department and approved in writing prior to the beginning of construction.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

3) For each structure that meets or exceeds the size or other criteria of MSHA, 30 CFR 77.216(a), the detailed design plan shall:

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a) Be prepared by or under the direction of and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act,

b) include any design and construction requirements for the structure, including any required geo-technical information,

d) describe the operation and maintenance requirements for each structure, and

e) describe the timetable and plans for removal of each structure if appropriate.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

4) For each structure that does not meet the size or other criteria of MSHA, 30 CFR 77.216(a), the detailed plan shall:

a) Be prepared by or under the direction of and sealed by a qualified registered professional engineer licensed under the Illinois Professional Engineering Act,

b) include any design and construction requirements for the structure, including any required geo-technical information,

b) describe the operation and maintenance requirements for each structure, and

c) describe the timetable and plans for removal of each structure if appropriate.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

K) If any of the following questions are answered yes, a permit may be needed from Illinois Department of Natural Resources, Office of Water Resource Management.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

1) Will the mining operation involve the construction of any levees, dikes, haul roads or other similar structures or the placement of any fill along or in the flood plain of any stream serving a drainage area of ten (10) square miles or greater at the point of construction?

Yes _________ No _________

2) Will the mining operation involve any relocation or diversion of or any construction activity in, over, under or along the banks of any stream

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serving a drainage area of ten (10) square miles or greater at the point of construction?

Yes _________ No _________

3) Is there any urban development (residential, commercial or industrial uses) in the areas immediately surrounding the mining operation?

Yes _________ No _________

(If yes, please re-answer questions 1 and 2 above applying a one (1) square mile drainage area limit.)

4) Will the mining operation involve the construction, major modification, or removal of any dam which in the event of failure would have probability for loss of life or additional economic loss in excess of that which would occur downstream of the dam in the absence of the dam?

Yes _________ No _________

5) Will the mining operation involve the construction, major modification, or removal of any dam 25 feet or more in height?

Yes _________ No _________

6) Will the mining operation involve construction, major modification, or removal of any dam which would have an impounding capacity of 50 acre feet or more?

Yes _________ No _________

8) Provide a plan detailing fugitive dust control practices to be employed during proposed surface coal mining and reclamation operations as required under 62 Ill. Adm. Code 1817.95.

RESPONSE: ***N/A. This application is to address expansion of the approved shadow area.***

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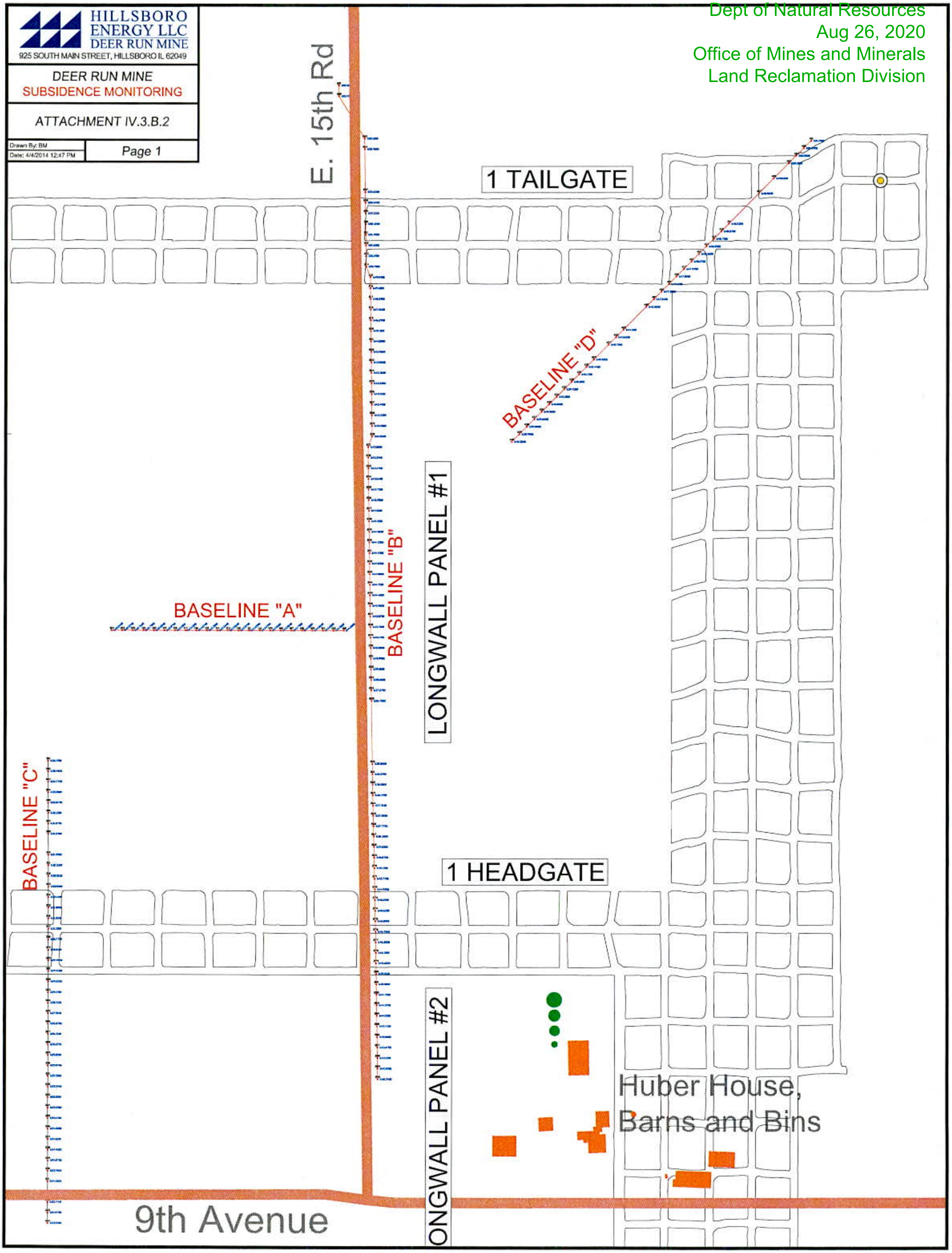
ATTACHMENT IV.3.B.2
SUBSIDENCE MONITORING AND PREDICTION ANALYSIS


HILLSBORO
ENERGY LLC
DEER RUN MINE
925 SOUTH MAIN STREET, HILLSBORO IL 62049
DEER RUN MINE
SUBSIDENCE MONITORING
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Date: 4/4/2014 12:47 PM
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LONGWALL PANEL #1
BASELINE "B"
BASELINE "A"
BASELINE "C"
1 HEADGATE
LONGWALL PANEL #2
Huber House,
Barns and Bins
9th Avenue

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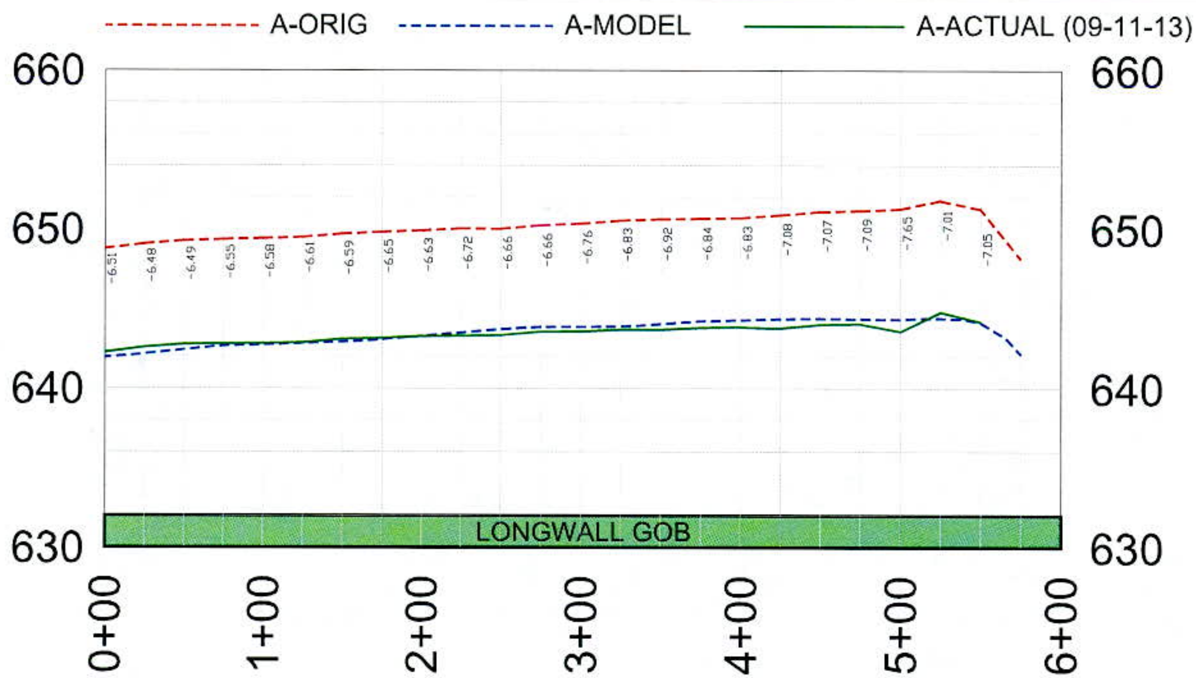

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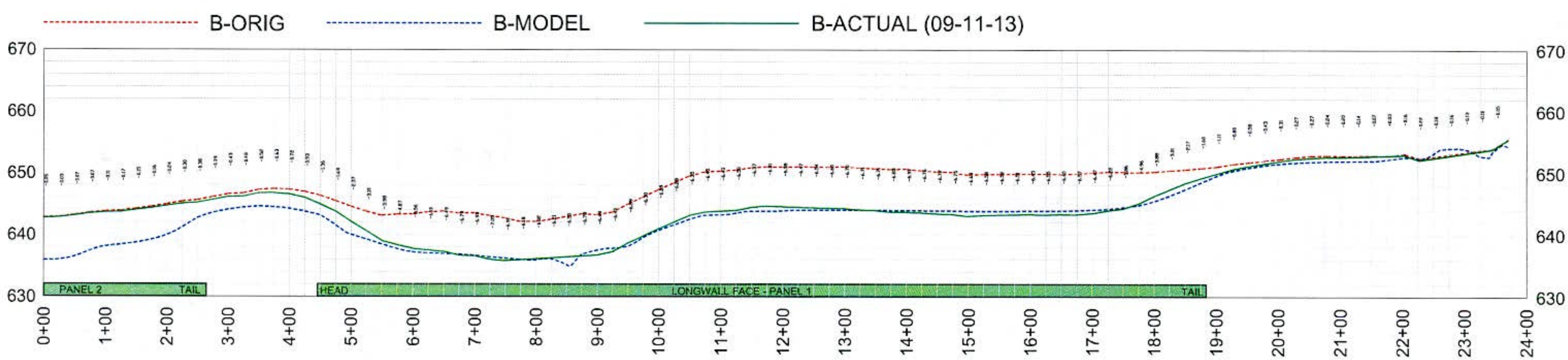
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B-ACTUAL (09-11-13)
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TAIL
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BASELINE "B"

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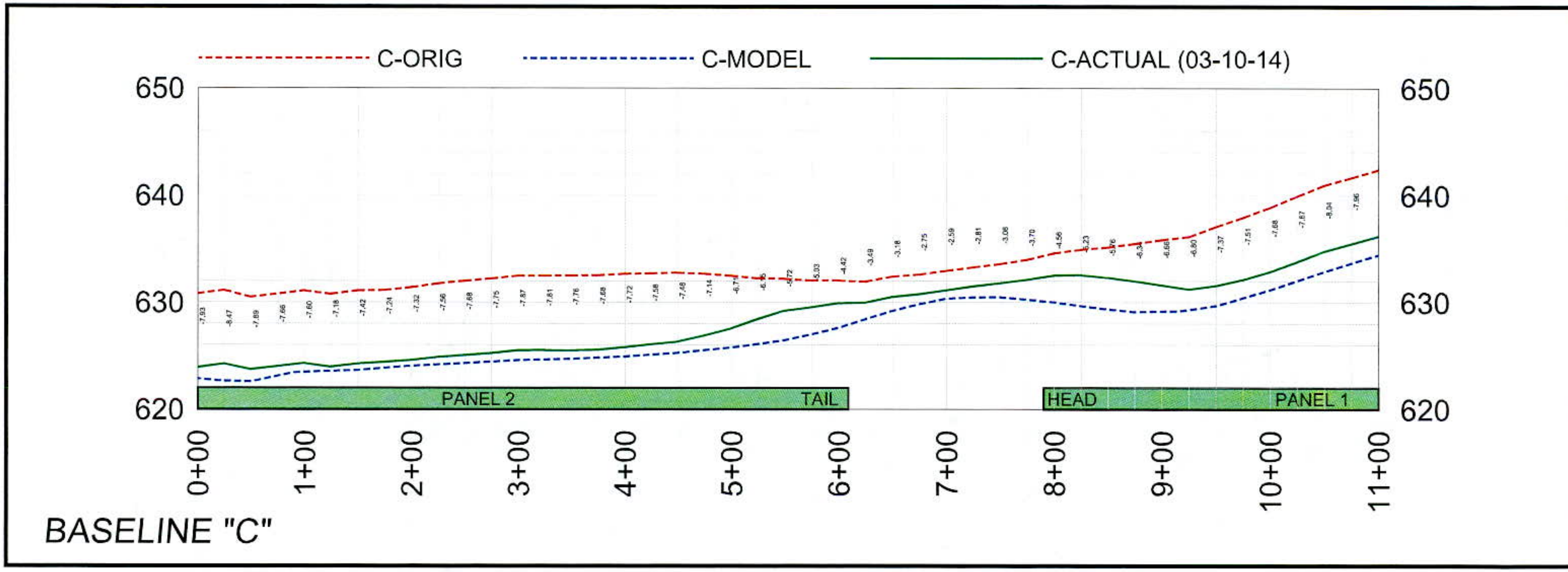

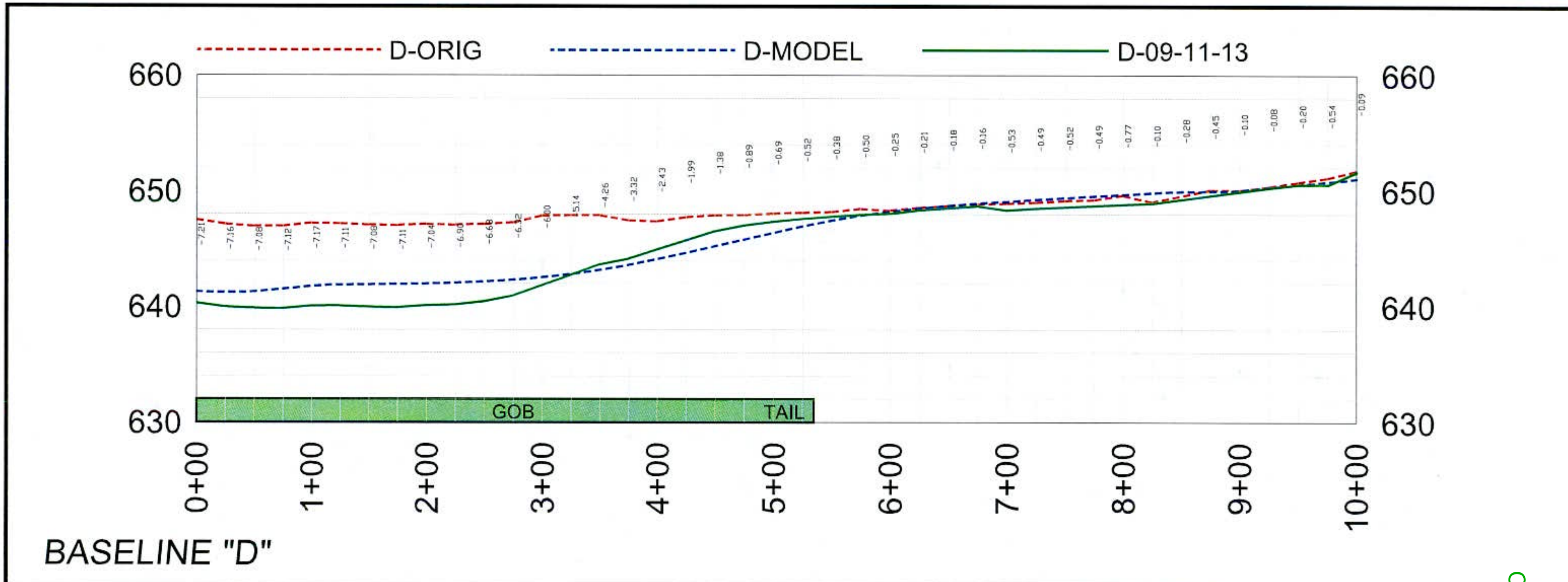

Att. IV.3.B.2 - Page 5

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ATTACHMENT IV.3.B.4.b
HYDROGEOLOGIC INVESTIGATION REPORT

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Hydrogeologic Investigation
Portions of Sections 7 and 18
East Fork Township (North Half)
Montgomery County, Illinois

Prepared for

Hillsboro Energy, LLC
Hillsboro, Illinois

February 4, 2009

TABLE OF CONTENTS

I. INTRODUCTION

Hurst-Rosche Engineers, Inc. has completed a hydrogeologic investigation for an approximate 290 acre parcel of property to be added to the permit area for Deer Run Mine (Permit No. 399). The investigation included the completion of four subsurface borings, and installation of two piezometer/monitoring wells. In addition, soil samples have been collected at selected locations and these samples have been analyzed for classification and remolded permeability characteristics. A process of monthly groundwater sampling and analysis has also been implemented. These activities have been completed with the purpose of identifying subsurface conditions and characterizing hydrogeologic conditions within the added permit area.

The added permit area is to be used for mine waste disposal. A map identifying the specific project area has been presented in Appendix A. The 290 acre parcel is located in Sections 7 and 18, T8N, R9W (North Half of East Fork Township), Montgomery County, Illinois. This parcel is intended to be added to the original 803.5 acre mine permit area.

Hydrogeologic investigations have been completed in conjunction with the original mine permitting process. These investigations also included the completion of subsurface borings, installation of shallow and deep piezometer/monitoring wells, laboratory testing, and analytical analyses. The results of these investigations have been presented in the following reports:

- Hydrogeologic Investigation, Portions of Sections 7, 8, 17, and 18, East Fork Township, Montgomery County, Illinois, Prepared by Hurst-Rosche Engineers, Inc., September 14, 2007, Revised November 15, 2007.

- Supplemental Hydrogeologic Investigation, Portions of Sections 7, 8, 17, and 18, East Fork Township, Montgomery County, Illinois, Prepared by Hurst-Rosche Engineers, Inc., December 10, 2008.

These reports have been referenced throughout this report. Information gathered from the previous investigations, in conjunction with more recent information, has been used collectively to characterize hydrogeologic conditions in the added permit area and adjacent areas.

II. FIELD INVESTIGATION

Four borings (Nos. 35 through 38) were completed at selected locations within the added permit area. These borings were completed using hollow stem augering techniques, and split-spoon samples were collected at 2.5 ft. intervals at each boring location. Each boring was extended to a 30 ft. depth. Boring locations have been identified on a site map presented in Appendix A, and logs of the borings have been presented in Appendix B. The locations of borings completed in the mine permit area in conjunction with previous investigations have also been identified on the map in Appendix A.

Two piezometer/monitoring wells were installed in conjunction with the recent investigation. One well was installed adjacent to the Boring 35 location, and the second well was installed adjacent to a previous boring location (Boring 4). Each well was screened within the uppermost aquifer. Well installations were completed in accordance with industry recognized procedures. Two inch diameter pre-manufactured PVC well screens and risers were utilized. A sand pack was placed around each well screen, and the well screen was sealed with a bentonite plug. The well anulus above the bentonite plug was filled with a cement/bentonite slurry. Following well installation, each well was developed by removing a minimum of five gallons of water from the well. Water was removed using a stainless steel bailer. The well locations have been identified on the map in Appendix A. Well completion reports have been presented in Appendix B.

In addition to completion of borings and well installations, Shelby tube samples were collected at selected depths at selected boring locations. Collected samples were used to complete classification and permeability testing. Testing procedures and results have been discussed in Section III below. Bail tests were completed at the two well locations for the purpose of identifying in-situ permeability of the shallow aquifer. Results of this testing have been presented in Appendix D, and the results have been discussed in Section VI below.

Two geologic cross sections have been developed from the boring information. These cross sections present anticipated subsurface conditions within the added permit area. Stratigraphic horizons have been delineated on the cross sections based on the geologic history of Montgomery County, site topographic features, and subsurface conditions encountered at the boring locations. The cross sections (Sections D-D and E-E) have been presented in Appendix A.

III. LABORATORY TESTING

Samples recovered from the Boring 36 (2 ft.-5 ft. depth) and Boring 38 (6 ft.-10 ft. depth) locations have been used to complete classification and permeability testing. Specifically, mechanical analysis (ASTM D422) has been completed and index properties (ASTM D4318) have been determined to classify the samples; and permeability testing (ASTM D5084) has been completed to determine conductivity characteristics of in situ and remolded samples. The samples were remolded to approximately 90% and 95% standard Proctor density at a moisture content near optimum prior to conductivity testing. Also, permeability testing has been completed on a Shelby tube sample collected from the 7 ft. depth at the Boring 38 location. Laboratory test results have been summarized and presented in Appendix C, and test results have been discussed in Sections V and IX below.

As indicated in Section II above, groundwater samples were collected from the installed wells. These samples were delivered to Teklab, Inc. in Collinsville, Illinois for analysis of total metals and other selected parameters. Analytical results have been presented in Appendix F. Monthly sampling and analysis of groundwater is to continue.

IV. PHYSIOGRAPHIC LOCATION AND SITE TOPOGRAPHY

The project site is located in the Springfield Plain of the Till Plains Section, Central Lowland Province. The Springfield Plain generally consists of flat to gently rolling plains which were formed during glacial advancements into Illinois. The glacial advancements left behind large amounts of glacial remnants and have produced extensive till plains. Subsequent or later glacial activity produced morainic ridges and outwash plains. Most of the steep and long ridges as originally deposited have been reduced by erosion to rounded hills. The moronic topography is characteristic of the immediate Hillsboro area, and other areas throughout the county.

The site topography is generally described as flat, with overall relief in the added permit area less than 10 ft. Surface water runoff from the site is generally westward via surface flow and drainage ditches toward a pond identified as Shoal Creek Watershed Structure No. 5. This

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water body is located approximately ¼ mile west of the added permit area. Surface water runoff in the northeastern corner of the site is northeastward toward a tributary to the Big Four Reservoir. This reservoir, or lake, is approximately 1/2 mile north of the project site. A majority of the site is tillable, with timber and brushy areas immediately adjacent to local drainageways.

V. GEOLOGIC CHARACTERISTICS

Geologic maps suggest that unconsolidated deposits in the project area are expected to be in excess of 100 ft. thick. The primary subsurface soils are identified as Vandalia Till. These soils are characteristically compact, hard, silty till with intercolated sand and gravel. Due to depositional history, the till may contain intermittent and discontinuous sand seams. Loessial soils up to approximately 5 ft. thick may be present at ground surface.

Reference to the boring logs and geologic cross sections suggest that subsurface conditions are generally characterized as a medium stiff to stiff, clay to silty clay (ablation till) being present down to approximately 15 ft. below ground surface. The compact, very stiff to hard Vandalia till (basal till) was present beneath the ablation till soils. The Vandalia till extends down to bedrock. Depth to bedrock in the project area varies from approximately 100 ft. to 150 ft. below ground surface.

A saturated sand seam(s) was encountered at the base of the ablation till at the north end of the added permit area. Sand thickness varied from approximately 2.5 ft. to 5.5 ft. thick. The sand was absent at the boring locations at the south end of the added permit area. An intermittent sand seam was also encountered within the Vandalia till at the Boring 36 location. The thickness of the isolated sand seam was approximately 2.5 ft.

Classification testing of collected soil samples suggests the fine grained ablation till soils within the added permit area classify as a lean clay (CL), and generally contained approximately 25% clay, 60% silt, and 15% sand, with a liquid limit of 35 and a plasticity index of 15. Laboratory testing on an undisturbed sample from the approximate 7 ft. depth at the Boring 38 location resulted in a permeability of $2x10^{-8}$ cm/sec. Soil samples remolded to approximately 95% standard Proctor density at a moisture content near optimum resulted in permeabilities of $2x10^{-7}$ cm/sec (Boring 36) and $3x10^{-7}$ cm/sec (Boring 38). Soil samples remolded to a lesser compactive effort resulted in significantly greater permeabilities. Further discussion of soil suitability for recompacted soil liner construction has been presented in Section IX below.

The geologic characteristics described above for the added permit area are consistent with geologic characteristics throughout the mine permit area.

VI. HYDROGEOLOGIC CHARACTERISTICS

As indicated in Section V above, a saturated sand seam was encountered within 15 ft. to 20 ft. of ground surface at the north end of the added permit area, and groundwater was evidenced as being present within 15 ft. at the southern end of the site. Accordingly, the uppermost aquifer at the site appears to be associated with the sand seam and/or the upper ablation till soils. Shallow piezometer/monitoring wells installed in conjunction with this investigation (Wells 4 and 35) and wells installed within the original permit area, have been screened within the sand seam, and screened to intercept the surface of the apparent water table.

As indicated in Section V above, an intermittent and discontinuous granular outwash deposit was encountered within the Vandalia till at the Boring 36 location. Intermittent and discontinuous outwash deposits have been encountered throughout the mine permit area. The depth and thickness of the outwash units does not suggest the sand was uniformly deposited throughout the area in a manner to form a consistent aquifer.

Although detailed and supporting information has not been presented within this report, any bedrock aquifers which may exist within or adjacent to the mine permit area are not consistently used as a domestic water source. There are no water wells within the mine permit area, including the added permit area, and a majority of the domestic water wells within or near the mine shadow area are shallow wells screened within unconsolidated deposits.

A. Uppermost Aquifer

As indicated above, the uppermost aquifer is identified as being associated with saturated sand seams located within 15 ft. to 20 ft. of ground surface, and/or the upper ablation till soils where sand seams are not present.

1. Flow Direction, Gradient, and Discharge Rate

Water level measurements taken in January 2009 in piezometer wells suggest the direction of groundwater flow across the added permit area is generally east to west. Based primarily on site topography, flow in northeastern areas of the site is anticipated to flow northeasterly. The flow gradient across the site is estimated to be less than 0.005 ft/ft. A summary of recorded water level measurements and a piezometric surface map have been presented in Appendix E.

Reference to the summary table in Appendix E will indicate water level measurements have been recorded for piezometer wells associated with the mine permit area since September 2007. Reference to the table will also indicate the groundwater level throughout the mine permit area has generally been approximately 10 ft. below ground surface, with fluctuations from well to well. Further, seasonal fluctuations have been experienced, with higher water levels being recorded in late winter. These trends are expected to be representative of groundwater level fluctuations anticipated within the added permit area.

Groundwater discharge is briefly defined as the removal of water from the saturated area. Discharge can be accomplished through exfiltration; direct discharge to surface via springs, rivers, or lakes; or induced removal of groundwater through means of production wells, field tiles, underground water works, etc. In a balanced system, the rate of discharge is essentially equivalent to the rate of recharge. In reality, transient flow is likely, especially for shallow aquifers. Considering these conditions, the rate of discharge for the shallow aquifer in the added permit area cannot be identified with certainty, however can be discussed generally. Given the ephemeral nature of the drainageways/ditches within the added permit area, discharge to these areas is expected only during seasonal high groundwater periods. Similarly, discharge to water bodies, such as Structure No. 5 to the west, is also expected to be seasonal with longer duration. As indicated above, there are no domestic water wells within the permit area, therefore induced removal of groundwater is not expected.

In-situ conductivity testing resulted in permeabilities of $7x10^{-5}$ cm/sec and $6x10^{-4}$ cm/sec. at the Well 4 and Well 35 locations, respectively. Test results have been presented in Appendix D.

2. Water Quality

Groundwater monitoring wells installed within or adjacent to the permit area have been sampled on a monthly basis since September 2007. Collected groundwater samples have been analyzed for specific parameters, including pH, TDS, hardness, alkalinity, acidity, sodium, sulfate, iron, manganese, nitrate and chloride. Two additional wells have been installed within or immediately adjacent to the added permit area. These wells were sampled in January 2009, and the collected groundwater samples have been analyzed for the noted parameters. The recent test results have been presented in Appendix F.

Based on the initial analytical results, parameter concentrations at the Well 4 and Well 35 locations are generally consistent with parameter concentrations at other wells within the mine permit area, however specific concentrations (sodium, sulfate, nitrate, and chloride) were noted to be somewhat elevated at the Well 35 location. Monthly sampling and analysis is to continue at these well locations. Additional data can be used to assess seasonal trends in groundwater quality.

Reference to the water quality data presented in Appendix F will indicate that parameter concentrations for iron, manganese, and nitrate are above Class I groundwater standards established in 35 IAC 620.410.

B. Herrin Coal (No. 6 Seam)

To assess the presence of water associated with the coal seam to be mined, at Deer Run Mine three piezometer wells have been installed within the mine shadow area, and the wells were screened within the coal seam. Well installations were completed using rotary drilling methods, whereby an 8-5/8 inch diameter steel casing was set to bedrock. The borehole was then drilled to a depth just above the coal seam, and a 5-1/2 inch diameter steel casing was set inside the larger diameter casing. Both casings were grouted with cement, including the interstitial space between the casings. Drilling fluid was then removed from the well, and the borehole was advanced into the coal seam using potable water as the drilling fluid. This water was also removed from the borehole, with exception of a few feet of water at the base of the borehole. A 3-inch diameter PVC well screen and riser pipe were then set within the steel casing. The riser pipe was extended to ground surface, thereby allowing continuous access to the screened area.

Following well installations as described above, each coal seam well was developed by bailing a specified quantity of water from the well. This was done to insure potable water previously introduced to the well was removed, and to propogate flow to the well. The coal seam wells were installed in Sections 17, 19, and 28 of East Fork

Township (North Half). Well construction logs have been presented in the December 2008 supplemental hydrogeologic report.

1. Flow Direction, Gradient, and Discharge Rate

Following well development, water level measurements were recorded for the coal seam wells, and bailing operations were continued. This process was repeated to insure water entering the well was indeed seepage from the coal seam, and to assess well recovery and/or stabilization. Also, slug or bail tests were completed to assess infiltration and/or permeability of the coal seam. Results of in-situ conductivity testing suggest the permeability of the coal seam varies from 1×10^{-6} cm/sec to 2×10^{-8} cm/sec.

Water was present within the coal seam, and based on static water levels within the wells, the water appears to be present under confined conditions. Well installations were completed in October and November 2008. Water levels within the wells have been measured on a routine basis, and water levels within Wells 2 and 3 apparently have not yet stabilized. Accordingly, flow direction and gradient within the coal seam cannot yet be determined with confidence. Water level measurements will continue to be recorded at all three well locations until stabilized conditions are achieved. A summary of water level measurements to date has been presented in Appendix G.

Due to the impermeable nature of the coal seam, the rate of groundwater discharge from the coal seam is expected to be minimal.

2. Water Quality

Water samples were collected from each coal seam well following well development activities. Collected samples were analyzed for selected parameters. Results of these analyses have been presented in the December 2008 supplemental hydrogeologic report.

Reference to the water quality data will indicate that parameter concentrations were generally consistent from well to well, with slightly higher concentrations noted at the Well 1 location for selected parameters (e.g. lead, chromium, etc.). Salinity concentrations suggest the water is highly saline.

3. Potential as Potable Water Source

Information generated from the coal seam investigation suggests the Herrin No. 6 seam has very limited potential as a potable water source. This conclusion is based on the apparent low permeability of the coal seam and associated ability to produce reliable quantities of water for consumption or production use. Further, results of sampling and analyses suggest the water quality is not suitable for consumption. Specifically, parameter concentrations for barium, chloride, chromium, iron, lead, manganese, and TDS are above water quality standards established in 35 IAC 620.410 for Class I (potable resource) groundwater. Also, the water is highly saline.

VII. CUMULATIVE IMPACT AREAS

The cumulative impact area (CIA) is defined as the area, including the added and original permit areas, within which impacts resulting from the proposed mining operation may interact with the impacts of all anticipated mining on surface and groundwater systems. The cumulative impact areas as described below, have been identified on a topographic map presented in Appendix H.

A. Surface Water

As described in Section IV above, drainage from the added permit area is primarily directed westward to a water body known as Shoal Creek Watershed No. 5 Structure. This water body discharges to an unnamed tributary to the Middle Fork of Shoal Creek, known locally as Central Park Creek. Discharge to the Middle Fork of Shoal Creek is approximately 2 miles downstream of Structure No. 5. Central Park Creek migrates through the City of Hillsboro, and a majority of surface water drainage within the city is directed to this creek. The drainage basin for Central Park Creek is estimated to be approximately 2,400 acres. The watershed of the Middle Fork of Shoal Creek, including the Central Park Creek basin, encompasses approximately 88 square miles (56,320 acres). Considering a total mine permit area of 1,094 acres, the combined permit area represents approximately 45% of the Central Park Creek drainage basin, and less than 2% of the Middle Fork of Shoal Creek basin upstream of the confluence with Central Park Creek. The drainage basins for Structure No. 5 and Central Park Creek have been identified on the topographic map in Appendix H.

Following site development, it is understood all surface water having contact with coal refuse is to be directed to the Structure No. 5 drainage basin. Considering this, it is recommended the surface water CIA for the total mine permit area be established as the drainage area associated with the unnamed tributary to the Middle Fork of Shoal Creek (Central Park Creek). This area has been identified on the topographic map in Appendix H. Areas 1 and 2 combined represent the limits of the proposed surface water CIA.

No active mining operations are known to exist within the surface water CIA, and no future mining operations within the surface water CIA are known to be proposed, with exception of possibly expanding the Deer Run Mine permit area to contiguous property(ies). Past mining did occur within the surface water CIA. Specifically, Hillsboro Coal Company Mine No. 1 operated an underground mine from 1888 to 1941, and mined the Herrin No. 5 seam. The former hoisting shaft location is shown on the topographic map presented in Appendix H. The shaft has been sealed, and no refuse piles associated with the mine are reported to be present within the surface water CIA (reference 1).

B. Groundwater

Groundwater recharge for the shallow aquifer within the added and original permit areas is primarily through surface water percolation. Piezometric mapping suggests groundwater flow within the upper aquifer generally conforms with topographic conditions, and as such shallow groundwater flow in the added and original permit areas and adjacent areas is expected to generally conform with surface drainage conditions. Accordingly, it is recommended the groundwater CIA for the total mine permit area be established to coincide with the drainage area associated with Shoal Creek Watershed

No. 5 Structure (Area 1), along with small areas to the east. These additional areas (identified as Areas 3 and 4 on the topographic map in Appendix H) encompass approximately 151 acres, and represent areas whereby shallow groundwater beneath the added permit area could flow northeastward and impact these areas. Following site development, the extent of the groundwater CIA will encompass approximately 1,462 acres. Considering a permit area of 1,094 acres, the permit area will represent approximately 75% of the groundwater CIA.

No other active mining operations are known to exist within the groundwater CIA, and no future mining operations within the groundwater CIA are known to be proposed, with exception of possibly expanding the Deer Run Mine permit area to contiguous property(ies). Underground mining associated with the former Hillsboro Coal Company Mine No. 1 progressed into northwestern areas of the groundwater CIA, however no surface facilities associated with this former mine are located within the groundwater CIA.

The combined (groundwater and surface water) cumulative impact areas have been identified on the topographic map presented in Appendix H. Areas 1, 3, and 4 on the map, when combined, represent the limits of the proposed groundwater CIA; and Areas 1 and 2 combined represent the limits of the proposed surface water CIA.

VIII. GROUNDWATER MONITORING PROGRAM

Given the hydrogeologic conditions described herein, it is recommended the groundwater monitoring program for site development activities be focused on monitoring the uppermost aquifer. Accordingly, it is recommended site monitoring wells be screened within the upper ablation till soils, and specifically the upper sand units. The well screens should be positioned at least 10 ft. below ground surface. A minimum of one monitoring well should be located hydraulically upgradient of impoundment and disposal areas. Remaining wells should be located downgradient and/or sidegradient of impoundment and disposal areas to assess facility impacts. An interwell monitoring program is recommended, however, it is also suggested adequate background data be assimilated at monitoring well locations to assess future intrawell trends if necessary. Well locations and spacing should be based on final facility configurations and associated hydrogeologic conditions.

IX. RECOMPACTED SOIL LINER

As indicated in Sections III and V above, fine-grained soil expected to be excavated from the added permit area in conjunction with development of coal refuse disposal cells is generally classified as a lean clay (CL) with a liquid limit of approximately 35, and a plasticity index of 15. Permeability testing has been completed on soil samples remolded to approximately 90% and 95% standard Proctor density at a moisture content near optimum. The samples remolded to approximately 95% compaction resulted in permeabilities of 2×10^{-7} cm/sec (Boring 36) and 3×10^{-7} cm/sec (Boring 38), while the samples remolded to approximately 90% compaction resulted in significantly greater permeabilities. Recompacted soil liners used to line coal refuse disposal cells are to maintain a permeability of 1×10^{-7} cm/sec or less.

Considering the noted test results, it is recommended that additional testing be completed to verify the suitability of site soils for construction of recompacted soil liners. It is further recommended that a proto-type test liner be constructed using anticipated construction equipment and construction procedures. Samples from the test liner can then be collected and tested to identify permeabilities resulting from actual liner construction.

X. LIMITATIONS OF REPORT

This assessment and report have been completed with the intent of determining hydrogeologic characteristics at the project site, and presenting analyses and recommendations based on those characteristics. The information presented in this report is based on data obtained from site reconnaissance, borings completed at the site, laboratory test results, well and water level data, published information, and other pertinent information presented in this report. Information presented is not intended to be a guarantee that all geologic and hydrogeologic conditions described herein will be consistent. There may be, and often is, a considerable variation in subsurface conditions within the same general area.

XI. REFERENCES

References: 1. Information from Mr. Joseph Pelc, IDNR Abandoned Mines Land Reclamation Division, Springfield, Illinois.

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APPENDIX A

Boring Location Map and Cross Sections

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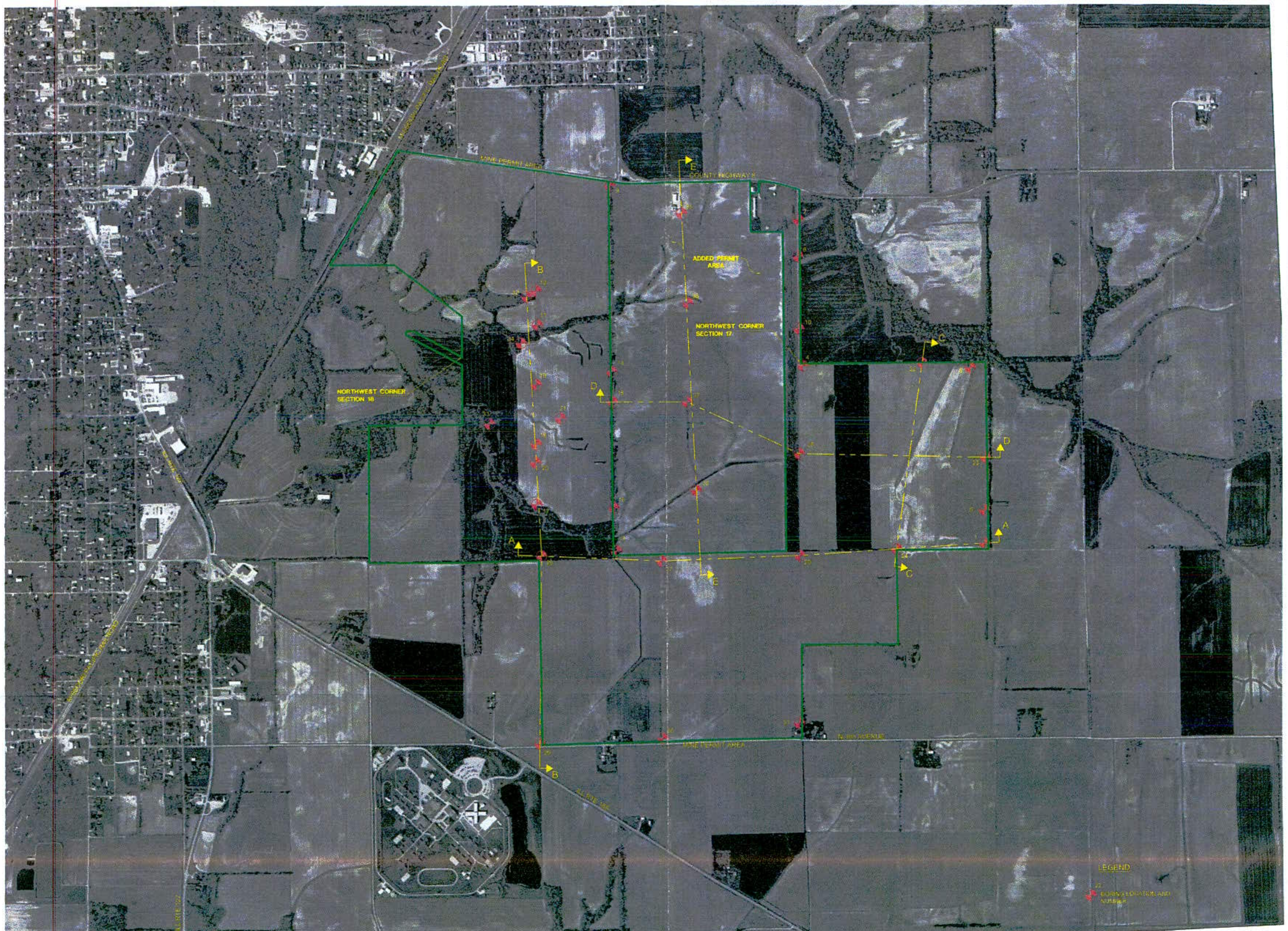
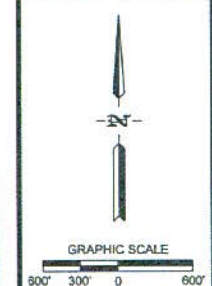
Land Reclamation Division



HR
HURST–ROSCHE ENGINEERS INC.
1400 EAST TREMONT ST.
HILLSBORO, IL 62049
PH: 217.532.3959
F: 217.532.3212
MARION, IL
EAST ST. LOUIS, IL
SPRINGFIELD, IL



DEER RUN MINE
HILLSBORO ENERGY, LLC
MONTGOMERY COUNTY, ILLINOIS

MARK	DATE	DESCRIPTION
	FEB. 2009	

PROJECT NO: 180-4298

DESIGN:	DRAWN:	CHECK:
D.H.K.	M.L.K.	D.H.K.

BORING LOCATION MAP

1

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APPENDIX B

Boring Logs and Well Completion Reports

Hillsboro Energy Borings
Section 17, East Fork Township
Northwest Corner White Property
Project # 180-3366

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: January 2-3, 2007
BORING TECH.: D. Jenkins / C. Greenwood
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 4 (08-03-17-02)
COORDINATES: N903013.3 E2498019.6
SURFACE ELEV.: 633.5 ft.

GROUNDWATER ELEV.
COMP.: - -
AFTER 48 HRS.: 0.0 ft.; Bridge at -8.6 ft.

Description	Depth (ft)	N Value	Qu (tsf)	W (%)	REC (%)
SILTY CLAY LOAM (CL-ML), Brown, Moist	0				
Brown, Gray, Mottled, Stiff			P		
	5	20	2.0	--	70
			P		
CLAY (CL), Brown, Gray, Mottled, Stiff, Little Sand & Gravel	10	41	2.3	--	100
With Saturated Sand Seams			P		
	15	11	0.5	--	100
			P		
SILTY LOAM TILL (ML), Gray, Dry To Moist, Hard, Trace Gravel	20	100/4.5"	1.5	--	75
	20				
CLAY TILL (CL), Gray, Moist, Hard, Little Sand			P		
Coarse Sand Seam At 25 Ft.	25	100/2"	>4.5	--	90
			P		
Gray, Dry, Hard, Trace Sand & Gravel	30	100/2"	>4.5	--	90
			P		
	35	80	>4.5	--	85
			P		
	40	55	>4.5	--	100

N: Blows per ft. to Drive 2" O.D. Split Spoon Sampler 12" with 140 lb. Hammer falling 30" (Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Hillsboro Energy Borings
Section 17, East Fork Township
Northwest Corner White Property
Project # 180-3366

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: January 2-3, 2007
BORING TECH.: D. Jenkins /
C. Greenwood
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 4 (08-03-17-02)
COORDINATES: N903013.3
E2498019.6
SURFACE ELEV.: 633.5 ft.

GROUNDWATER ELEV.
COMP.: - -
AFTER 48 HRS.: 0.0 ft.;
Bridge at -8.6 ft.

Description	Depth	N Value	Qu (tsf)	W (%)	REC (%)
CLAY TILL (CL), Gray, Dry, Hard, Trace Sand & Gravel	40				
			P		
	45	43	>4.5	--	100
			P		
	50	37	>4.5	--	100
			P		
Very Stiff	55	29	>4.5	--	95
			P		
	60	29	3.8	--	100

Description	Depth	N Value	Qu (tsf)	W (%)	REC (%)
	60				
	65	19	- -	--	35
			P		
	70	17	3.0	--	100
Hard			P		
	75	35	>4.5	--	100
			P		
	80	56	>4.5	--	100

N:Blows per ft. to Drive 2" O.D. Split Spoon Sampler
12" with 140 lb. Hammer falling 30"
(Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Hillsboro Energy Borings
Section 17, East Fork Township
Northwest Corner White Property
Project # 180-3366

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: January 2-3, 2007
BORING TECH.: D. Jenkins / C. Greenwood
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 4 (08-03-17-02)
COORDINATES: N903013.3 E2498019.6
SURFACE ELEV.: 633.5 ft.

Description	Depth	N Value	Qu (tsf)	W (%)	REC (%)
CLAY TILL (CL), Brown, Dry, Hard, Trace Sand & Gravel	80				
			P		
	85	45	>4.5	--	100
			P		
Gray, Little Sand	90	52	>4.5	--	100
Fine Sand Seam At 94 Ft.			P		
	95	46	>4.5	--	80
			P		
	100	47	>4.5	--	100

GROUNDWATER ELEV.
COMP.: - -
AFTER 48 HRS.: 0.0 ft.;
Bridge at -8.6 ft.

Notes:
1) Borehole backfilled with soil cuttings intermixed with bentonite chips after completion of final water table measurement.
2) Precipitation and/or surface water may have impacted final groundwater reading.

Description	Depth	N Value	Qu (tsf)	W (%)	REC (%)
	100				
			P		
	105	32	>4.5	--	100
Very stiff			P		
	110	19	2.5	--	90
Hard			P		
Thin Gravel Seam At 115 Ft.	115	33	2.0	--	100
		100/1"	--	--	--
Auger Refusal at 117.0'					
	120				

N: Blows per ft. to Drive 2" O.D. Split Spoon Sampler 12" with 140 lb. Hammer falling 30" (Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Well Completion Report

Well No.: 4

Site Name: Deer Run Mine

Date Started January 2, 2009

Drilling Contractor: Atlas Soils, Inc.

Date Completed: January 2, 2009

Driller: Mike Hough

Boring Tech: Andrew Kimmle

Drilling Method: Hollow Stem Auger

Drilling Fluids (type): None

Annular Space Details

Type of Surface Seal: Cement

Type of Annular Sealant: Cement/Bentonite

Type of Bentonite Seal (Granular, Pellet): Pellet

Type of Sand Pack: Industrial Quartz #1

Well Construction Materials

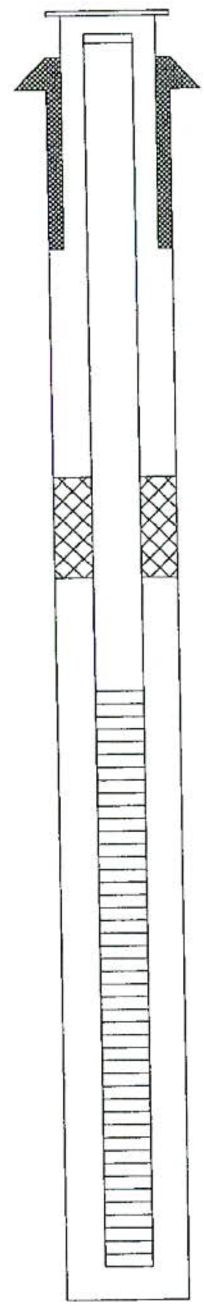
	Stainless Steel Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint		Sch 40	
Riser pipe above w.t.		Sch 40	
Riser pipe below w.t.		Sch 40	
Screen		Sch 40	
Coupling joint screen to riser		Sch 40	
Protective casing			None

Measurements (ft.)

Riser pipe length	10.0
Screen length	10.0
Screen slot size	0.01
Protective casing length	N/A
Depth to water (from riser)	6.89
Elevation of water	628.7
Gallons removed (develop)	6.4
Gallons removed (purge)	- -
Other	- -

Completed by: D. Jenkins

Elevations (ft.)



635.58 Top of Riser Pipe

633.5 Ground Surface

633.2 Top of Annular Sealant

626.6 Top of Seal

2.0 Total Seal Interval

624.6 Top of Sand

625.6 Top of Screen

10.0 Total Screen Interval

615.6 Bottom of Screen

615.5 Bottom of Borehole

Deer Run Mine
Kunz Property
Hillsboro, Montgomery County, Illinois
Project # 180-4298

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: December 3, 2008
BORING TECH.: J. Weiser
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 35
COORDINATES: N905167.0 E2496320.9
SURFACE ELEV.: 632.6

GROUNDWATER ELEV.
COMP.: Dry
AFTER 24 HRS.: --

Depth (ft)	Description	N Value	P (tsf)	W (%)	REC (%)
0	SILTY CLAY(CL), Brown, Gray, Mottled, Moist, Stiff				
		8	1.3	--	100
5	SILTY CLAY LOAM (CL), Brown, Moist, Stiff	9	1.8	--	100
		14	2.5	--	100
10	CLAY (CL), Brown, Moist, Stiff	8	1.8	--	100
	SAND (SP), Brown, Saturated, Fine to Medium Coarse, Little Gravel and Clay, Very Loose	2	NP	--	100
15	Fine, Little Clay, Trace of Gravel	2	NP	--	100
	SILT (ML), Gray, Wet, Medium Stiff	5	--	--	100
20	SILTY CLAY LOAM TILL (CL), Gray, Dry, Very Stiff, Trace of Sand and Gravel	26	>4.5	--	100
	Hard	30	>4.5	--	100
25		36	>4.5	--	100
	Very Stiff	28	>4.5	--	89
30	Hard	30	>4.5	--	100
	End of Exploration at 30.0 ft.				
35					
40					

Note:
1) Borehole backfilled with soil cuttings upon completion.
2) Groundwater monitoring well installed into adjacent borehole.

N:Blows per ft. to Drive 2" O.D. Split Spoon Sampler 12" with 140 lb. Hammer falling 30" (Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Well Completion Report

Well No.: 35

Site Name: Deer Run Mine
Drilling Contractor: Atlas Soils, Inc.
Driller: Mike Hough
Drilling Method: Hollow Stem Auger

Date Started: December 3, 2008
Date Completed: December 3, 2008
Boring Tech: Jim Weiser
Drilling Fluids (type): None

Annular Space Details

Type of Surface Seal: Cement
Type of Annular Sealant: Cement/Bentonite
Type of Bentonite Seal (Granular, Pellet): Pellet

Type of Sand Pack: Industrial Quartz #1

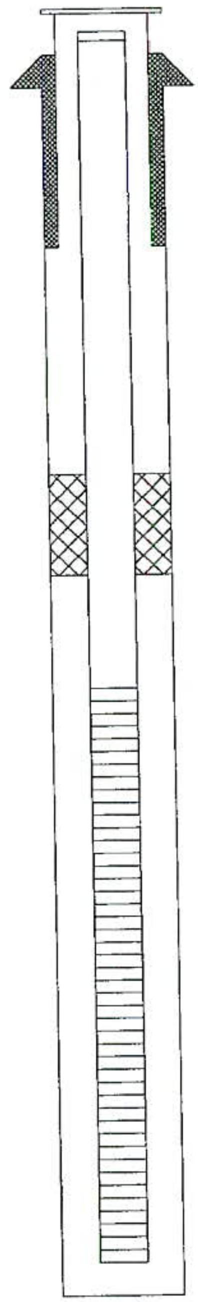
Well Construction Materials

	Stainless Steel Specify Type	PVC Specify Type	Other Specify Type
Riser coupling joint		Sch 40	
Riser pipe above w.t.		Sch 40	
Riser pipe below w.t.		Sch 40	
Screen		Sch 40	
Coupling joint screen to riser		Sch 40	
Protective casing			None

Measurements (ft.)

Riser pipe length	10.0
Screen length	10.0
Screen slot size	0.01
Protective casing length	N/A
Depth to water (from riser)	12.16
Elevation of water	624.1
Gallons removed (develop)	3.8
Gallons removed (purge)	- -
Other	- -

Elevations (ft.)



636.27 Top of Riser Pipe
632.6 Ground Surface
632.6 Top of Annular Sealant
629.3 Top of Seal
2.0 Total Seal Interval
627.3 Top of Sand
626.3 Top of Screen
10.0 Total Screen Interval
616.3 Bottom of Screen
616.2 Bottom of Borehole

Completed by: D. Jenkins

Deer Run Mine
Kunz Property
Hillsboro, Montgomery County, Illinois
Project # 180-4298

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: December 8, 2008
BORING TECH.: J. Weiser
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 36
COORDINATES: N903901.3
E2496409.1
SURFACE ELEV.: 628.8

GROUNDWATER ELEV.
COMP.: Dry
Bridge at -9.3 ft.
AFTER 24 HRS.: --

Description	Depth	N Value	P (tsf)	W (%)	REC (%)
	0				
CLAY (CL), Brown, Moist, Medium Stiff		5	2.0	- -	78
Brown, Gray, Mottled, Moist, Stiff, Trace of Sand	5	8	1.8	- -	83
SILTY CLAY (CL), Gray, Moist, Soft, Trace of Sand		3	0.5	- -	100
CLAY TILL (CL), Brown, Gray, Mottled, Moist, Soft, Little Gravel, Trace of Sand	10	3	0.5	- -	94
SANDY LOAM (SP), Brown, Saturated, Loose, Little Sand and Gravel		3	NP	- -	100
SILTY LOAM TILL (ML), Gray, Dry, Hard, Trace of Sand and Gravel	15	77	>4.5	- -	94
SAND (SP), Gray, Fine, Saturated, Very Dense		70	4.3	- -	100
SILTY LOAM TILL (ML), Gray, Dry, Hard, Trace of Sand, Little Gravel	20	100/7.5"	>4.5	- -	100
1" Sand Layer		100/10"	>4.5	- -	100
5" Sand Layer	25	100/8"	>4.5	- -	100
		87	>4.5	- -	100
	30	40	>4.5	- -	100
End of Exploration at 30.0 ft.					
	35				
	40				

Note:
1) Borehole backfilled with soil cuttings upon completion.

N:Blows per ft. to Drive 2" O.D. Split Spoon Sampler
12" with 140 lb. Hammer falling 30"
(Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Deer Run Mine
Kunz Property
Hillsboro, Montgomery County, Illinois
Project # 180-4298

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: December 8, 2008
BORING TECH.: J. Weiser
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 37
COORDINATES: N902497.3
E2496398.1
SURFACE ELEV.: 628.9

GROUNDWATER ELEV.
COMP.: Dry
Bridge at -5.5 ft.
AFTER 24 HRS.: --

Depth	Description	N Value	P (tsf)	W (%)	REC (%)
0	CLAY (CL), Gray, Moist, Medium Stiff				
		6	2.3	--	61
	Stiff				
5		8	0.8	--	78
	Medium Stiff				
		5	1.3	--	83
10	SILTY CLAY TILL (CL), Gray, Moist, Soft, Trace of Sand and Gravel	3	0.3	--	94
	CLAY (CL), Gray, Moist to Wet, Soft, Trace of Sand	3	0.1	--	56
15	SILTY CLAY LOAM TILL (CL), Gray, Moist to Wet, Soft, Little Gravel	3	0.3	--	61
	Moist, Medium Stiff				
		6	3.0	--	100
20	Dry to Moist, Very Stiff, Little Sand and Gravel	18	3.3	--	72

Depth	Description	N Value	P (tsf)	W (%)	REC (%)
20					
	Dry, Hard				
		63	>4.5	--	94
25		39	>4.5	--	100
		37	>4.5	--	100
30		31	>4.5	--	94
	End of Exploration at 30.0 ft.				
	Note: 1) Borehole backfilled with soil cuttings upon completion.				
35					
40					

N: Blows per ft. to Drive 2" O.D. Split Spoon Sampler 12" with 140 lb. Hammer falling 30" (Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

Deer Run Mine
Kunz Property
Hillsboro, Montgomery County, Illinois
Project # 180-4298

ATLAS SOILS, INC.
HILLSBORO, ILLINOIS
PHONE 217/532-3959

DATE: December 4, 2008
BORING TECH.: J. Weiser
DRILLING TECH.: M. Hough

FOUNDATION BORING LOG

BORING NO.: 38
COORDINATES: N901239.5 E2496526.4
SURFACE ELEV.: 626.5

GROUNDWATER ELEV.
COMP.: 11.6 ft.
AFTER 24 HRS.: --

Description	Depth	N Value	P (tsf)	W (%)	REC (%)
CLAY (CL), Gray, Moist, Stiff	0				
		8	1.0	--	72
Soft	5	4	0.5	--	22
SILTY CLAY TILL (CL), Gray, Moist, Medium Stiff, Trace of Sand		6	1.0	--	94
Brown, Gray, Mottled	10	7	1.0	--	100
SILTY LOAM TILL (ML), Gray, Dry to Moist, Stiff, Little Gravel		14	>4.5	--	100
Dry, Hard	15	33	>4.5	--	89
Little Sand and Gravel		134	>4.5	--	100
	20	157/10"	>4.5	--	100

Description	Depth	N Value	P (tsf)	W (%)	REC (%)
	20				
		100/5"	>4.5	--	100
	25	100/9"	>4.5	--	93
		100/10"	>4.5	--	100
	30	46	>4.5	--	94
End of Exploration at 30.0 ft.					
Note: 1) Borehole backfilled with soil cuttings upon completion.	35				
	40				

N:Blows per ft. to Drive 2" O.D. Split Spoon Sampler 12" with 140 lb. Hammer falling 30" (Standard Penetration Test)

RQD: Rock Quality Determination

Qu: Unconfined Compression Strength
NP: Non-Plastic
ST: Shelby Tube
W: Water Content

Type Failure:
B: Bulge Failure
S: Shear Failure
NS: No Sample
P: Penetrometer

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APPENDIX C

Laboratory Test Results (Soil)

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ATLAS SOILS, INC.
SOIL TEST DATA

Project: Deer Run Mine

Project No.: 180-4298

Date: January 2009

Lab. Number		1	2				
Boring No.		36	38				
Depth (ft.)		2 - 5	6 - 10				
Textural Classification (USDA)		Silty Clay Loam	Silt Loam				
Unified Soil Group Name		Lean Clay	Lean Clay w/ Sand				
Unified Soil Group Symbol		CL	CL				
Total Sample Passing 2 1/2"	(%)	100.0	100.0				
Total Sample Passing 1"	(%)	100.0	100.0				
Total Sample Passing 3/4"	(%)	100.0	100.0				
Total Sample Passing 1/2"	(%)	100.0	100.0				
Total Sample Passing 3/8"	(%)	100.0	100.0				
Total Sample Passing No. 4	(%)	99.9	99.9				
Total Sample Passing No. 8	(%)	99.8	99.4				
Total Sample Passing No. 10	(%)	99.7	99.3				
Total Sample Passing No. 16	(%)	99.6	98.6				
Total Sample Passing No. 40	(%)	99.0	95.7				
Total Sample Passing No. 100	(%)	97.8	85.6				
Total Sample Passing No. 200	(%)	97.2	81.1				
Gravel (> No. 4)	(%)	0	0				
Sand (< No. 4 > No. 200)	(%)	3	19				
Silt (< No. 200 > 0.005 mm)	(%)	67	56				
Clay (< 0.005 mm)	(%)	30	25				
Liquid Limit	(%)	40	31				
Plasticity Index	(%)	18	13				
Optimum Moisture	(%)	17.7	14.2				
Maximum Dry Density (pcf)		106.4	109.6				
Remarks:							

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Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

REPORT OF
MOISTURE - DENSITY RELATIONSHIP OF SOIL

For: Hillsboro Energy, LLC

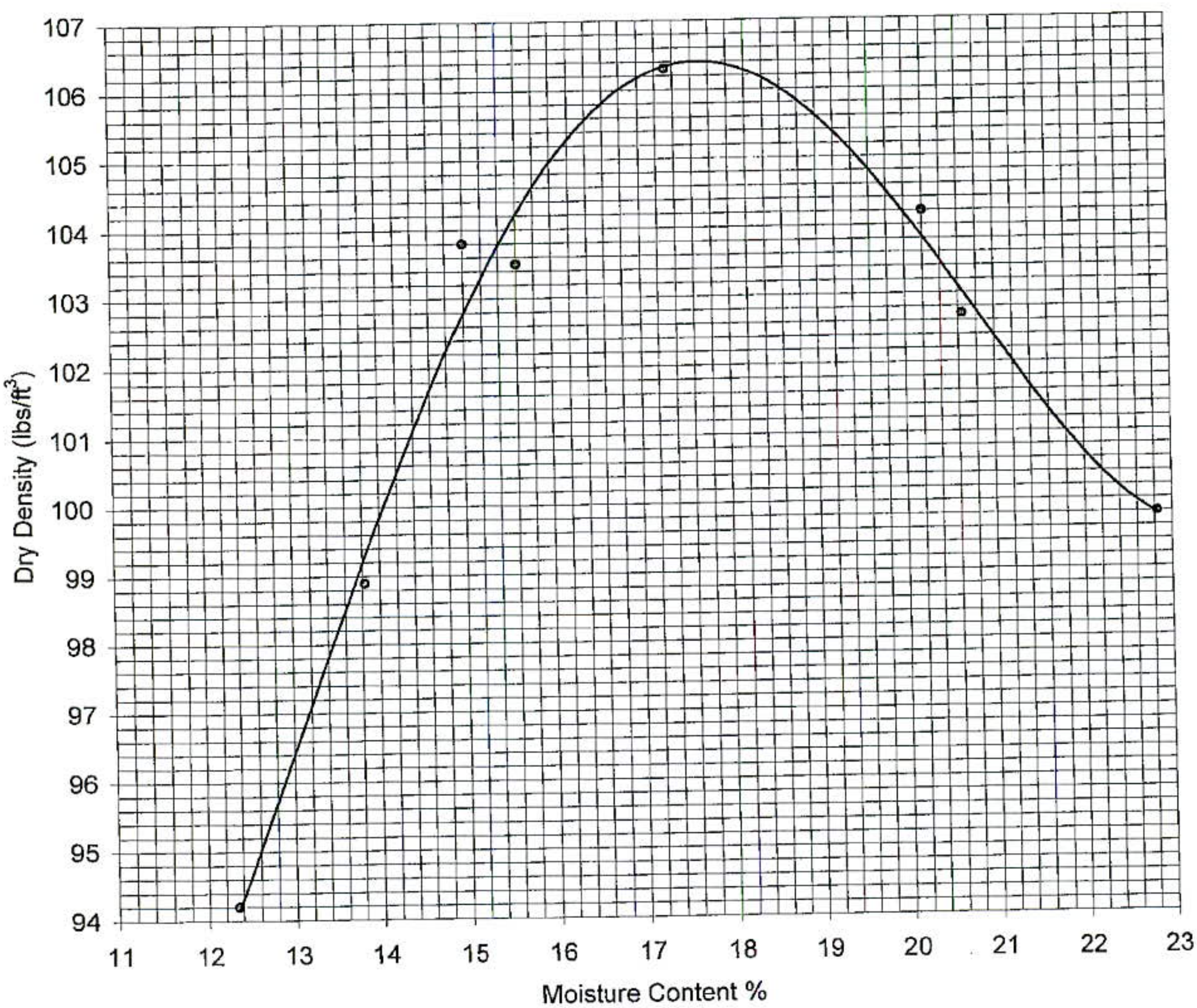
Project: Deer Run Mine (181-4298)

Location: Hillsboro, Illinois

Sample: Boring No. 36; 2 ft. to 5 ft. depth; Silty Clay Loam, Brown

Method of Test: ASTM D698, Method A

MOISTURE - DENSITY RELATIONSHIP CURVE



Optimum Moisture 17.7 %

Max. Dry Density 106.4 lbs./cu.ft.

Corrected Optimum Moisture -- %

Corrected Max. Dry Density -- lbs./cu.ft.

Natural Moisture -- %

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Land Reclamation Division

REPORT OF MOISTURE - DENSITY RELATIONSHIP OF SOIL

For: Hillsboro Energy, LLC

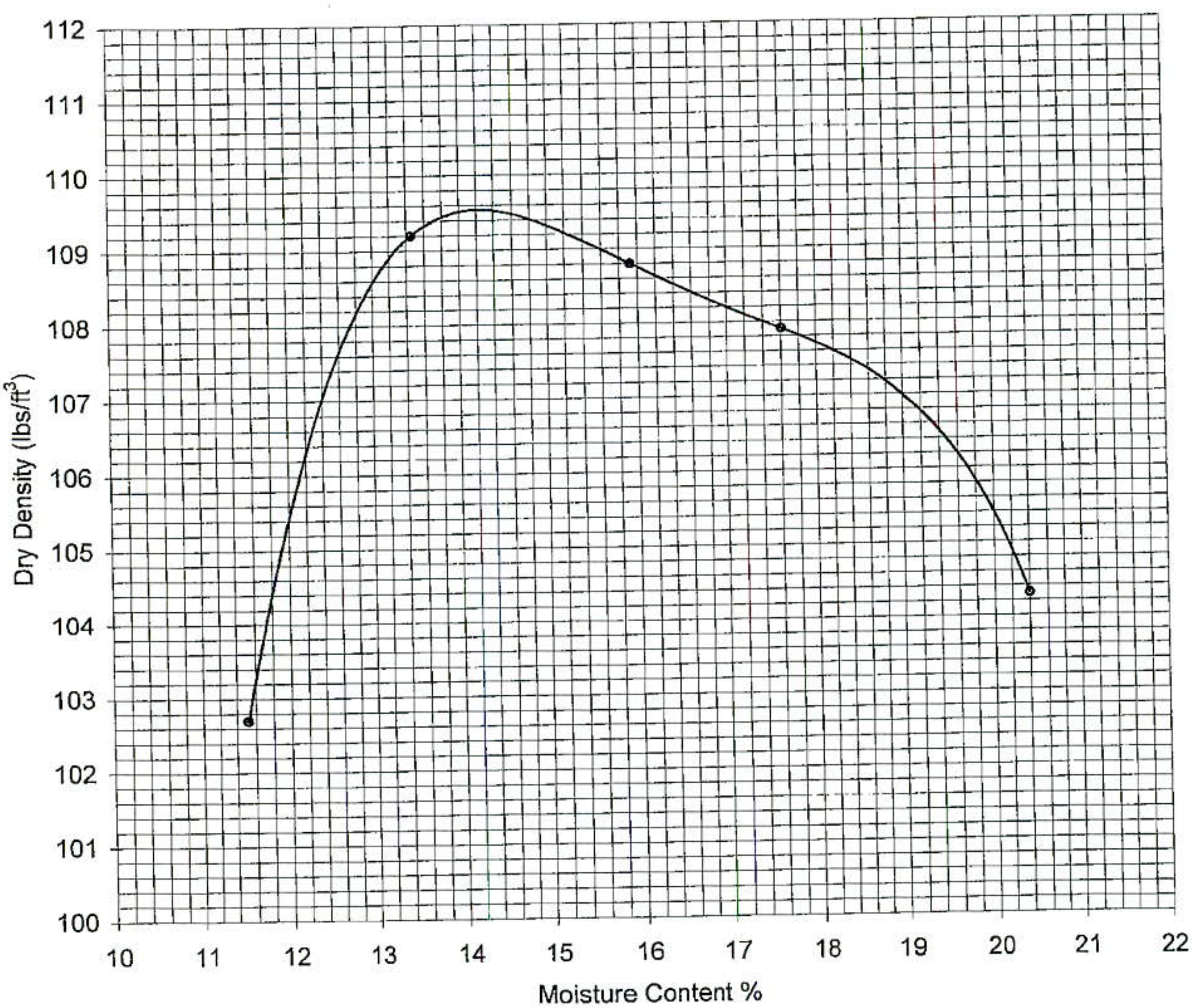
Project: Deer Run Mine (181-4298)

Location: Hillsboro, Illinois

Sample: Boring No. 38; 6 ft. to 10 ft. depth; Silt Loam, Gray, Few Sand

Method of Test: ASTM D698, Method A

MOISTURE - DENSITY RELATIONSHIP CURVE



Optimum Moisture 14.2 %

Max. Dry Density 109.6 lbs./cu.ft.

Corrected Optimum Moisture -- %

Corrected Max. Dry Density -- lbs./cu.ft.

Natural Moisture -- %

Received Electronically
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Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT DESCRIPTION

Project: Deer Run Mine

Client: Hillsboro Energy

Project No.: 180-4298

Date: January 27, 2009

SAMPLE IDENTIFICATION

Location: Boring No. 36

Re-compacted at 89.2% Compaction; +1.0% OMC

Laboratory No.: 1

Depth/Elevation: 2 ft. - 5 ft.

Classification/Description: Silty Clay Loam, Brown,

Natural Moisture: ---

Liquid Limit: ---

Plastic Limit: ---

Natural Dry Density: ---

Optimum Moisture: 17.7%

Max. Dry Density: 106.4 lb/ft^3

% Compaction: 89.2%

HYDRAULIC CONDUCTIVITY TEST DETAILS

Test No.: 1

Specimen Data:

Diameter: 7.09 cm

Length: 7.65 cm

Area: 39.48 cm^2

Volume: 302.02 cm^3

Void Ratio: --

Date of Test: January 27, 2009

Tested by: R. Comer

Initial Weight: 542.43 g

Dry Unit Weight: 95.0 lb/ft^3

Initial Moisture: 18.7%

Final Moisture: 27.4%

Test Data:

Test Apparatus: Flex. wall permeater

Permeant Liquid: $CaSO_4$

Confining Pressure: 6 psi

Back Pressure: 4 psi

Avg. Driving Pressure: 285.7 cm

Time for Saturation: 6 minutes

Flow Orientation: Vertical

Average Headwater: 73.4 cm

Average Tailwater: 69.2 cm

Hydraulic Gradient: 37.3

Time for Conductivity Measurements: 9 minutes

Total Flow In: 20.0 mL

Total Flow Out: 20.5 mL

Hydraulic Conductivity at 20° C: 1.3×10^{-5} cm/sec (time-weighted average)

Hydraulic Conductivity Calculations

Project: Deer Run Mine
Project No.: 180-4298
Sample No.: Re-compacted at 89.2% compaction, at 18.7% (+1.0% optimum moisture)
Location: Boring 36; 2 ft. - 5 ft. depth
Permeameter No.: 2

Diameter (cm): 7.09
End Area (cm^2): 39.48
Length (cm): 7.65
Back Pressure (psi): 4
Lateral Pressure (psi): 6

Date & Time	Time Increment (min)	Reading (in)	Reading (out)	Inflow (ml)	Outflow (ml)	Outflow/ Inflow Ratio	Avg. Flow (ml)	H1(in) (cm)	H2(out) (cm)	Driving Pressure	K (cm/sec)	Temp. (deg C)	Temp Factor	Cum. Time (min)	Cum. Volume (ml)	K 20 deg C (cm/sec)
1/27/09 8:05:00 AM		13.1	23.8					91.3	44.5			24	0.910			
1/27/09 8:07:00 AM	2	16.3	20.6	3.2	3.2	1.00	3.2	87.7	49.3	323.9	1.60E-05	24	0.910	2	3.20	1.45E-05
1/27/09 8:09:00 AM	2	19.2	17.6	2.9	3.0	1.03	3.0	84.5	53.8	315.8	1.51E-05	24	0.910	4	6.15	1.37E-05
1/27/09 8:11:00 AM	2	22.1	14.6	2.9	3.0	1.03	3.0	81.3	58.3	308.1	1.55E-05	24	0.910	6	9.10	1.41E-05
1/27/09 8:13:00 AM	2	24.8	11.9	2.7	2.7	1.00	2.7	78.3	62.4	300.7	1.45E-05	24	0.910	8	11.80	1.32E-05
1/27/09 8:15:00 AM	2	27.2	9.3	2.4	2.6	1.08	2.5	75.6	66.3	293.9	1.37E-05	24	0.910	10	14.30	1.25E-05
1/27/09 8:17:00 AM	2	29.6	6.8	2.4	2.5	1.04	2.5	72.9	70.0	287.4	1.38E-05	24	0.910	12	16.75	1.25E-05
1/27/09 8:20:00 AM	3	33.1	3.3	3.5	3.5	1.00	3.5	69.1	75.3	279.6	1.35E-05	24	0.910	15	20.25	1.23E-05

Time weighted average (last four readings): 1.26E-05

Received Electronically
Dept of Natural Resources
Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT DESCRIPTION

Project: Deer Run Mine

Client: Hillsboro Energy

Project No.: 180-4298

Date: January 27, 2009

SAMPLE IDENTIFICATION

Location: Boring No. 36

Re-compacted at 95.5% Compaction; +1.0% OMC

Laboratory No.: 1

Depth/Elevation: 2 ft. - 5 ft.

Classification/Description: Silty Clay Loam, Brown,

Natural Moisture: ---

Liquid Limit: ---

Plastic Limit: ---

Natural Dry Density: ---

Optimum Moisture: 17.7%

Max. Dry Density: 106.4 lb/ft^3

% Compaction: 95.5%

HYDRAULIC CONDUCTIVITY TEST DETAILS

Test No.: 1

Specimen Data:

Diameter: 7.04 cm

Length: 9.14 cm

Area: 38.93 cm^2

Volume: 355.82 cm^3

Void Ratio: --

Date of Test: January 26, 2009

Tested by: R. Comer

Initial Weight: 686.72 g

Dry Unit Weight: 101.6 lb/ft^3

Initial Moisture: 18.7%

Final Moisture: 24.9%

Test Data:

Test Apparatus: Flex. wall permeater

Permeant Liquid: $CaSO_4$

Confining Pressure: 4 psi

Back Pressure: 6 psi

Avg. Driving Pressure: 453.7 cm

Time for Saturation: 642 minutes

Time for Conductivity Measurements: 389 minutes

Total Flow In: 20.0 mL

Total Flow Out: 22.1 mL

Hydraulic Conductivity at 20° C: 1.9×10^{-7} cm/sec (time-weighted average)

Flow Orientation: Vertical

Average Headwater: 87.5 cm

Average Tailwater: 56.0 cm

Hydraulic Gradient: 49.6

Received Electronically
Dept of Natural Resources
Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

Hydraulic Conductivity Calculations

Project:	Deer Run Mine
Project No.:	180-4298
Sample No.:	Re-compacted at 95.5% compaction, at 18.7% (+1.0% optimum moisture)
Location:	Boring 36; 2 ft. - 5 ft. depth
Permeameter No.:	5

Diameter (cm):	7.04
End Area (cm^2):	38.93
Length (cm):	9.14
Back Pressure (psi):	4
Lateral Pressure (psi):	6

Date & Time	Time Increment (min)	Reading (in)	Reading (out)	Inflow (ml)	Outflow (ml)	Outflow/ Inflow Ratio	Avg. Flow (ml)	H1(in) (cm)	H2(out) (cm)	Driving Pressure	K (cm/sec)	Temp. (deg C)	Temp Factor	Cum. Time (min)	Cum. Volume (ml)	K 20 deg C (cm/sec)
1/26/09 7:49:00 AM		11.5	24.5					92.9	44.7			23	0.931			
1/26/09 9:32:00 AM	103	14.5	21.8	3.0	2.7	0.90	2.9	89.6	48.7	325.8	3.32E-07	24	0.910	103	2.85	3.06E-07
1/26/09 10:48:00 AM	76	16.3	19.9	1.8	1.9	1.06	1.9	87.7	51.5	319.8	2.98E-07	24	0.910	179	4.70	2.71E-07
1/26/09 12:50:00 PM	122	18.9	17.0	2.6	2.9	1.12	2.8	84.9	55.8	313.9	2.81E-07	24	0.910	301	7.45	2.56E-07
1/26/09 2:42:00 PM	112	21.0	14.6	2.1	2.4	1.14	2.3	82.6	59.4	307.4	2.56E-07	24	0.910	413	9.70	2.33E-07
1/26/09 4:25:00 PM	103	22.9	12.5	1.9	2.1	1.11	2.0	80.6	62.5	301.9	2.52E-07	24	0.910	516	11.70	2.29E-07
1/27/09 7:30:00 AM		10.1	24.6					94.4	44.6			24	0.910			
1/27/09 9:36:00 AM	126	12.7	21.2	2.6	3.4	1.31	3.0	91.6	49.6	327.1	2.85E-07	24	0.910	642	14.70	2.59E-07
1/27/09 11:02:00 AM	86	14.2	19.5	1.5	1.7	1.13	1.6	90.0	52.1	321.2	2.27E-07	24	0.910	728	16.30	2.06E-07
1/27/09 12:43:00 PM	101	15.7	17.7	1.5	1.8	1.20	1.7	88.3	54.8	317.0	2.02E-07	24	0.910	829	17.95	1.84E-07
1/27/09 2:35:00 PM	112	17.3	16.0	1.6	1.7	1.06	1.7	86.6	57.3	312.7	1.84E-07	24	0.910	941	19.60	1.68E-07
1/27/09 4:05:00 PM	90	18.7	14.5	1.4	1.5	1.07	1.5	85.1	59.5	308.7	2.04E-07	24	0.910	1031	21.05	1.86E-07

Time weighted average (last four readings): 1.85E-07

HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT DESCRIPTION

Project: Deer Run Mine

Client: Hillsboro Energy

Project No.: 180-4298

Date: January 26, 2009

SAMPLE IDENTIFICATION

Location: Boing No. 38

Re-compacted at 90.9% Compaction; +0.2% OMC

Laboratory No.: 1

Depth/Elevation: 6 ft. - 10 ft.

Classification/Description: Silt Loam, Gray, Few Sand

Natural Moisture: ---

Liquid Limit: ---

Plastic Limit: ---

Natural Dry Density: ---

Optimum Moisture: 14.2%

Max. Dry Density: 109.6 lb/ft^3

% Compaction: 90.9%

HYDRAULIC CONDUCTIVITY TEST DETAILS

Test No.: 1

Specimen Data:

Diameter: 7.04 cm

Length: 8.51 cm

Area: 38.93 cm^2

Volume: 331.29 cm^3

Void Ratio: --

Date of Test: January 22, 2009

Tested by: R. Comer

Initial Weight: 603.87 g

Dry Unit Weight: 99.6 lb/ft^3

Initial Moisture: 14.4%

Final Moisture: 24.4%

Test Data:

Test Apparatus: Flex. wall permeater

Permeant Liquid: $CaSO_4$

Confining Pressure: 4 psi

Back Pressure: 6 psi

Avg. Driving Pressure: 433.1 cm

Time for Saturation: 442 minutes

Time for Conductivity Measurements: 80 minutes

Total Flow In: 115.4 mL

Total Flow Out: 117.3 mL

Hydraulic Conductivity at 20° C: 3.1×10^{-6} cm/sec (time-weighted average)

Flow Orientation: Vertical

Average Headwater: 78.1 cm

Average Tailwater: 67.3 cm

Hydraulic Gradient: 50.9

Received Electronically
Dept of Natural Resources
Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

Hydraulic Conductivity Calculations

Project: Deer Run Mine
Project No.: 180-4298
Sample No.: Re-compacted at 90.9% compaction, at 14.4% (+0.2% optimum moisture)
Location: Boring No. 38; 6 ft. - 10 ft. depth
Permeameter No.: 5

Diameter (cm): 7.04
End Area (cm^2): 38.93
Length (cm): 8.51
Back Pressure (psi): 4
Lateral Pressure (psi): 6

Date & Time	Time Increment (min)	Reading (in)	Reading (out)	Inflow (ml)	Outflow (ml)	Outflow/ Inflow Ratio	Avg. Flow (ml)	H1(in) (cm)	H2(out) (cm)	Driving Pressure	K (cm/sec)	Temp. (deg C)	Temp Factor	Cum. Time (min)	Cum. Volume (ml)	K 20 deg C (cm/sec)
1/22/09 7:57:00 AM		13.7	24.0					90.5	45.5			23	0.931			
1/22/09 8:40:00 AM	43	21.9	15.9	8.2	8.1	0.99	8.2	81.6	57.5	315.9	2.19E-06	23	0.931	43	8.15	2.04E-06
1/22/09 10:42:00 AM		11.5	24.7					92.9	44.4			23	0.931			
1/22/09 11:28:00 AM	46	21.0	15.4	9.5	9.3	0.98	9.4	82.6	58.2	317.7	2.34E-06	23	0.931	89	17.55	2.18E-06
1/22/09 12:36:00 PM	68	32.8	3.1	11.8	12.3	1.04	12.1	69.9	76.4	290.2	2.22E-06	23	0.931	157	29.60	2.07E-06
1/22/09 12:56:00 PM	20	36.0	0.0	3.2	3.1	0.97	3.2	66.4	81.0	270.7	2.12E-06	23	0.931	177	32.75	1.97E-06
1/22/09 1:24:00 PM		11.3	24.4					93.1	44.9			23	0.931			
1/22/09 2:19:00 PM	55	23.0	12.5	11.7	11.9	1.02	11.8	80.5	62.5	314.4	2.49E-06	23	0.931	232	44.55	2.31E-06
1/22/09 2:52:00 PM	33	29.2	6.2	6.2	6.3	1.02	6.3	73.8	71.8	291.2	2.37E-06	23	0.931	265	50.80	2.21E-06
1/22/09 3:22:00 PM	30	34.0	1.3	4.8	4.9	1.02	4.9	68.6	79.1	277.0	2.13E-06	23	0.931	295	55.65	1.98E-06
1/23/09 9:51:00 AM		10.4	23.4					94.1	46.4			23	0.931			
1/23/09 10:25:00 AM	34	20.8	13.6	10.4	9.8	0.94	10.1	82.8	60.9	316.1	3.42E-06	23	0.931	329	65.75	3.19E-06
1/23/09 10:55:00 AM	30	27.4	6.0	6.6	7.6	1.15	7.1	75.7	72.1	294.0	2.93E-06	23	0.931	359	72.85	2.73E-06
1/23/09 11:24:00 AM	29	33.2	0.2	5.8	5.8	1.00	5.8	69.4	80.7	277.4	2.63E-06	23	0.931	388	78.65	2.45E-06
1/23/09 11:32:00 AM		3.5	23.2					101.5	46.7			23	0.931			
1/23/09 12:26:00 PM	54	19.3	7.2	15.8	16.0	1.01	15.9	84.5	70.3	315.8	3.40E-06	23	0.931	442	94.55	3.16E-06
1/23/09 12:28:00 PM		10.5	24.4					94.0	44.9			23	0.931			
1/23/09 12:45:00 PM	17	15.6	19.3	5.1	5.1	1.00	5.1	88.5	52.4	323.8	3.38E-06	23	0.931	459	99.65	3.14E-06
1/23/09 12:57:00 PM	12	19.0	15.7	3.4	3.6	1.06	3.5	84.8	57.8	312.8	3.40E-06	23	0.931	471	103.15	3.16E-06
1/23/09 1:18:00 PM	21	26.9	7.5	7.9	8.2	1.04	8.1	76.2	69.9	298.0	4.69E-06	23	0.931	492	111.20	4.36E-06
1/23/09 1:48:00 PM	30	31.9	2.2	5.0	5.3	1.06	5.2	70.8	77.7	281.0	2.23E-06	23	0.931	522	116.35	2.07E-06

Time weighted average (last four readings): 3.06E-06

HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT DESCRIPTION

Project: Deer Run Mine

Client: Hillsboro Energy

Project No.: 180-4298

Date: January 26, 2009

SAMPLE IDENTIFICATION

Location: Boing No. 38

Laboratory No.: 1

Re-compacted at 94.8% Compaction; +0.2% OMC

Depth/Elevation: 6 ft. - 10 ft.

Classification/Description: Silt Loam, Gray, Few Sand

Natural Moisture: ---

Natural Dry Density: ---

Liquid Limit: ---

Optimum Moisture: 14.2%

Plastic Limit: ---

Max. Dry Density: 109.6 lb/ft^3

% Compaction: 94.8%

HYDRAULIC CONDUCTIVITY TEST DETAILS

Test No.: 1

Date of Test: January 22, 2009

Tested by: R. Comer

Specimen Data:

- Diameter: 7.09 cm
- Length: 10.26 cm
- Area: 39.48 cm^2
- Volume: 405.06 cm^3
- Void Ratio: --

Initial Weight: 770.66 g

Dry Unit Weight: 103.9 lb/ft^3

Initial Moisture: 14.4%

Final Moisture: 24.4%

Test Data:

- Test Apparatus: Flex. wall permeater
- Flow Orientation: Vertical
- Permeant Liquid: $CaSO_4$
- Confining Pressure: 4 psi
- Average Headwater: 81.9 cm
- Back Pressure: 6 psi
- Average Tailwater: 59.8 cm
- Avg. Driving Pressure: 444.4 cm
- Hydraulic Gradient: 43.3
- Time for Saturation: 661 minutes
- Time for Conductivity Measurements: 414 minutes
- Total Flow In: 31.4 mL
- Total Flow Out: 31.3 mL
- Hydraulic Conductivity at 20° C: 3.2×10^{-7} cm/sec (time-weighted average)

Received Electronically
Dept of Natural Resources
Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

Hydraulic Conductivity Calculations

Project: Deer Run Mine
Project No.: 180-4298
Sample No.: Re-compacted at 94.8% compaction, at 14.4% (+0.2% optimum moisture)
Location: Boring No. 38; 6 ft. - 10 ft. depth
Permeameter No.: 2

Diameter (cm): 7.09
End Area (cm^2): 39.48
Length (cm): 10.26
Back Pressure (psi): 4
Lateral Pressure (psi): 6

Date & Time	Time Increment (min)	Reading (in)	Reading (out)	Inflow (ml)	Outflow (ml)	Outflow/ Inflow Ratio	Avg. Flow (ml)	H1(in) (cm)	H2(out) (cm)	Driving Pressure	K (cm/sec)	Temp. (deg C)	Temp Factor	Cum. Time (min)	Cum. Volume (ml)	K 20 deg C (cm/sec)
1/22/09 7:45:00 AM		8.3	24.9					96.6	42.9			23	0.931			
1/22/09 8:40:00 AM	55	10.5	23.3	2.2	1.6	0.73	1.9	94.1	45.3	332.6	4.50E-07	23	0.931	55	1.90	4.19E-07
1/22/09 10:43:00 AM	123	14.9	19.3	4.4	4.0	0.91	4.2	89.3	51.3	324.7	4.55E-07	23	0.931	178	6.10	4.24E-07
1/22/09 11:28:00 AM	45	16.5	17.8	1.6	1.5	0.94	1.6	87.5	53.5	317.3	4.70E-07	23	0.931	223	7.65	4.38E-07
1/22/09 12:36:00 PM	68	18.8	15.6	2.3	2.2	0.96	2.3	84.9	56.8	312.3	4.59E-07	23	0.931	291	9.90	4.27E-07
1/22/09 2:21:00 PM	105	22.1	12.4	3.3	3.2	0.97	3.3	81.3	61.6	305.2	4.39E-07	23	0.931	396	13.15	4.09E-07
1/22/09 4:56:00 PM	155	26.6	8.0	4.5	4.4	0.98	4.5	76.3	68.2	295.1	4.21E-07	23	0.931	551	17.60	3.92E-07
1/23/09 7:42:00 AM		11.6	24.6					92.9	43.3			23	0.931			
1/23/09 9:32:00 AM	110	14.7	20.6	3.1	4.0	1.29	3.6	89.5	49.3	326.2	4.29E-07	23	0.931	661	21.15	3.99E-07
1/23/09 12:29:00 PM	177	19.4	15.8	4.7	4.8	1.02	4.8	84.3	56.5	315.2	3.69E-07	23	0.931	838	25.90	3.43E-07
1/23/09 1:55:00 PM	86	21.5	13.6	2.1	2.2	1.05	2.2	81.9	59.8	306.2	3.54E-07	24	0.910	924	28.05	3.26E-07
1/23/09 3:17:00 PM	82	23.3	11.8	1.8	1.8	1.00	1.8	79.9	62.5	301.1	3.16E-07	24	0.910	1006	29.85	2.87E-07
1/23/09 4:26:00 PM	69	24.7	10.2	1.4	1.6	1.14	1.5	78.4	64.9	296.7	3.17E-07	24	0.910	1075	31.35	2.89E-07

Time weighted average (last four readings): 3.19E-07

HYDRAULIC CONDUCTIVITY TEST RESULTS

PROJECT DESCRIPTION

Project: Deer Run Mine
Client: Hillsboro Energy
Project No.: 180-4298
Date: January 27, 2009

SAMPLE IDENTIFICATION

Location: Boring No. 38
Laboratory No.: 1
Depth/Elevation: 7'2" - 7'5"
Classification/Description: Silty Loam, Gray, Few Sand
Natural Moisture: ---
Liquid Limit: ---
Plastic Limit: ---
Natural Dry Density: ---
Optimum Moisture: --
Max. Dry Density: -- lb/ft^3
% Compaction: --

HYDRAULIC CONDUCTIVITY TEST DETAILS

Test No.: 1
Specimen Data:
Diameter: 7.26 cm
Length: 7.65 cm
Area: 41.40 cm^2
Volume: 316.71 cm^3
Void Ratio: --

Date of Test: January 29, 2009
Tested by: R. Comer
Initial Weight: 623.04 g
Dry Unit Weight: 98.3 lb/ft^3
Initial Moisture: 24.9%
Final Moisture: 26.6%

Test Data:
Test Apparatus: Flex. wall permeater
Permeant Liquid: $CaSO_4$
Confining Pressure: 6 psi
Back Pressure: 4 psi
Avg. Driving Pressure: 290.6 cm
Time for Saturation: 6,256 minutes
Time for Conductivity Measurements: 3,635 minutes
Total Flow In: 30.3 mL
Total Flow Out: 30.5 mL
Hydraulic Conductivity at 20° C: 2.0×10^{-6} cm/sec (time-weighted average)

Flow Orientation: Vertical
Average Headwater: 77.1 cm
Average Tailwater: 68.0 cm
Hydraulic Gradient: 38.0

Received Electronically
Dept of Natural Resources
Aug 26, 2020
Office of Mines and Minerals
Land Reclamation Division

Hydraulic Conductivity Calculations

Project: Deer Run Mine
Project No.: 180-4298
Sample No.: Shelby Tube from 7'2" - 7'5" depth
Location: Boring No. 38
Permeameter No.: 1

Diameter (cm): 7.26
End Area (cm^2): 41.40
Length (cm): 7.65
Back Pressure (psi): 4
Lateral Pressure (psi): 6

Date & Time	Time Increment (min)	Reading (in)	Reading (out)	Inflow (ml)	Outflow (ml)	Outflow/ Inflow Ratio	Avg. Flow (ml)	H1(in) (cm)	H2(out) (cm)	Driving Pressure	K (cm/sec)	Temp. (deg C)	Temp Factor	Cum. Time (min)	Cum. Volume (ml)	K 20 deg C (cm/sec)
1/20/09 10:34:00 AM		12.5	21.0					92.1	51.3			20	1.000			
1/20/09 11:35:00 AM	61	12.6	20.8	0.1	0.2	2.00	0.1	91.9	51.6	321.8	2.35E-08	21	0.976	61	0.15	2.33E-08
1/20/09 1:24:00 PM	109	13.0	20.3	0.4	0.5	1.25	0.5	91.5	52.4	321.0	3.96E-08	22	0.953	170	0.60	3.82E-08
1/20/09 4:20:00 PM	176	13.8	19.3	0.8	1.0	1.25	0.9	90.6	53.8	319.2	4.93E-08	23	0.931	346	1.50	4.65E-08
1/21/09 7:29:00 AM	909	18.0	15.3	4.2	4.0	0.95	4.1	86.0	59.7	312.8	4.44E-08	23	0.931	1255	5.60	4.13E-08
1/22/09 7:40:00 AM	1451	24.2	9.0	6.2	6.3	1.02	6.3	79.2	68.9	299.6	4.43E-08	23	0.931	2706	11.85	4.12E-08
1/22/09 11:43:00 AM	243	24.8	8.4	0.6	0.6	1.00	0.6	78.5	69.7	290.8	2.61E-08	23	0.931	2949	12.45	2.43E-08
1/22/09 2:21:00 PM	158	25.5	7.7	0.7	0.7	1.00	0.7	77.8	70.8	289.2	4.72E-08	23	0.931	3107	13.15	4.39E-08
1/22/09 4:56:00 PM	155	25.9	7.2	0.4	0.5	1.25	0.4	77.3	71.5	287.7	3.11E-08	23	0.931	3262	13.60	2.89E-08
1/22/09 4:59:00 PM		11.2	24.4					93.5	46.4			24	0.910			
1/23/09 7:32:00 AM	873	14.4	21.3	3.2	3.1	0.97	3.2	90.0	50.9	324.3	3.43E-08	24	0.910	4135	16.75	3.12E-08
1/23/09 12:30:00 PM	298	15.4	20.3	1.0	1.0	1.00	1.0	88.9	52.4	319.0	3.24E-08	24	0.910	4433	17.75	2.95E-08
1/24/09 6:53:00 PM	1823	20.2	15.2	4.8	5.1	1.06	5.0	83.6	59.8	311.4	2.69E-08	24	0.910	6256	22.70	2.44E-08
1/26/09 7:35:00 AM	2202	25.3	10.4	5.1	4.8	0.94	5.0	78.0	66.8	298.7	2.32E-08	23	0.931	8458	27.65	2.13E-08
1/26/09 1:38:00 PM	363	26.0	9.6	0.7	0.8	1.14	0.8	77.2	68.0	291.5	2.18E-08	24	0.910	8821	28.40	2.01E-08
1/26/09 4:33:00 PM	175	26.3	9.3	0.3	0.3	1.00	0.3	76.9	68.4	290.1	1.82E-08	24	0.910	8996	28.70	1.66E-08
1/27/09 7:28:00 AM	895	28.1	7.7	1.8	1.6	0.89	1.7	74.9	70.8	287.6	2.03E-08	24	0.910	9891	30.40	1.85E-08

Time weighted average (last four readings): 2.03E-08

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APPENDIX D

In-Situ Permeability Test Results

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HILLSBORO ENERGY
HYDROGEOLOGIC INVESTIGATION
HILLSBORO, ILLINOIS

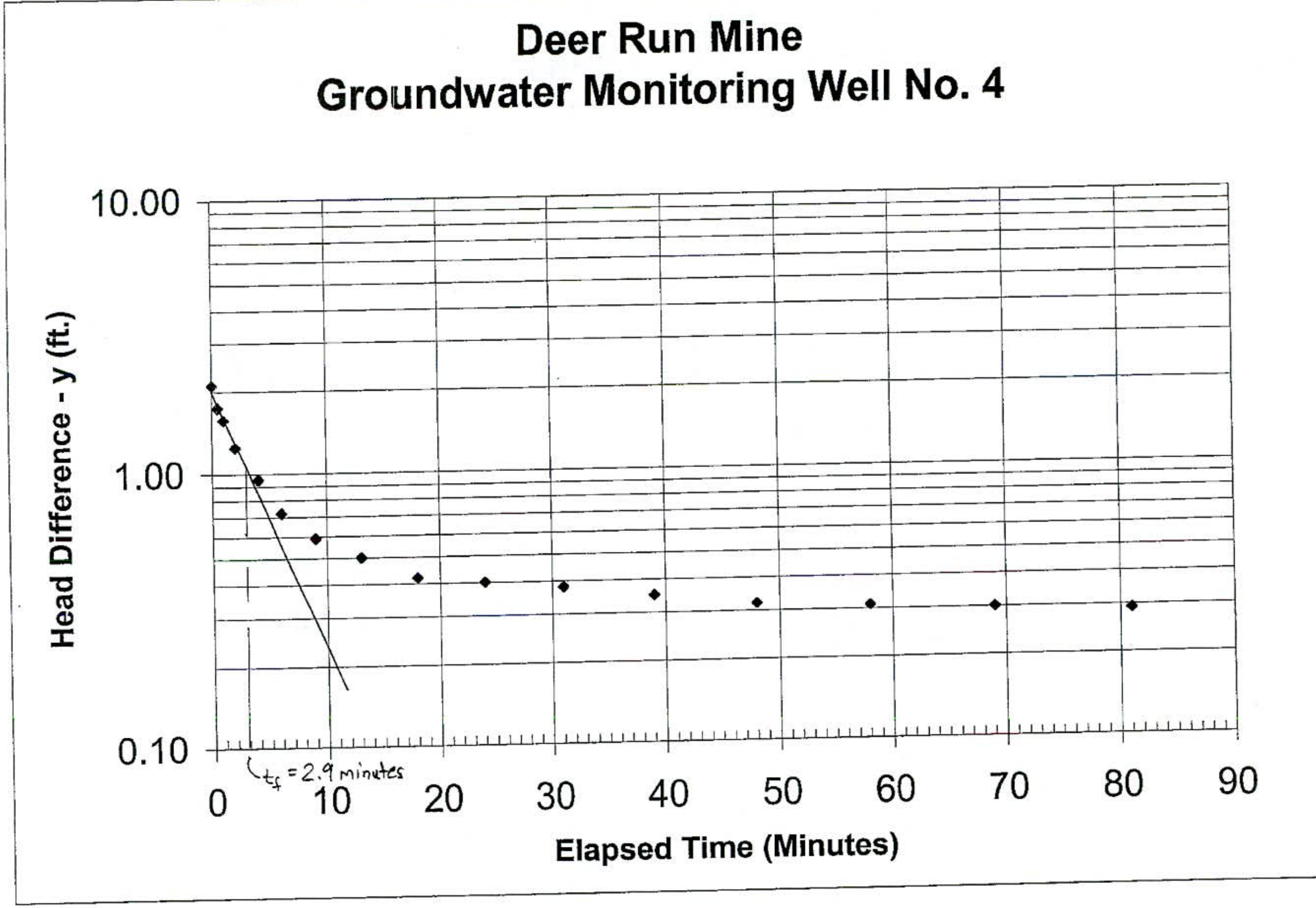
WELL NO.: 4 DATE: 1/16/2009

H_i = Initial depth to water before water was removed (ft.)* = 7.80

$y = H_t - H_i$ = Difference between original static water level (time = t_o) and water level during test at time t.

Date and Clock Time	Elapsed Time (Minutes)	Depth to Water (Feet)*	y (Feet)
1/16/09 12:38 PM	0.0	9.90	2.10
	0.5	9.55	1.75
	1	9.38	1.58
	2	9.05	1.25
	4	8.75	0.95
	6	8.52	0.72
	9	8.39	0.59
	13	8.30	0.50
	18	8.22	0.42
	24	8.20	0.40
	31	8.18	0.38
	39	8.15	0.35
	48	8.12	0.32
	58	8.11	0.31
	69	8.10	0.30
	81	8.09	0.29

* Water level measured from top of riser.



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To determine the in-situr hyrdualic conductivity of the soil at the project site, a slug test or bail test was completed and the test data used in the following calculations.

Reference to documentation presented by Bouwer and Rice, Water Resources Research, 1976, and ASTM D5912 provides the following equations and procedures.

Monitoring Well No. 4

R_e = effecitve radius, detrmined empirically based on well geometry over which y is dissipated.

r_w = radial distance from well center to original undisturbed aquifer (borehole radius): $r_w := 0.58$ ft.

H = distance between static water level and base of well open interval (screen): $H := 12.20$ ft.

A = coefficient determined graphically as function of L/r_w.

B = coefficient determined graphically as function of L/r_w.

D = aquifer thickness (distance between static water level and impermeable surface): $D := 13.6$ ft.

L= length of well open to aquifer (screen length exposed to groundwater): $L := 10.0$ ft.

$$\frac{L}{r_w} = 17.24$$

From Fig. No. 2 in ASTM D5912:

$A := 2.1$

$B := 0.3$

$C := 1.5$

Let x be equivalent to ln (R_e/r_w) for equation 2 in ASTM D5912 and below.

$$x := \begin{cases} \left(\dfrac{1.1}{\ln\left(\dfrac{H}{r_w}\right)} + \dfrac{A + B \cdot \ln\left(\dfrac{D-H}{r_w}\right)}{\dfrac{L}{r_w}} \right)^{-1} & \text{if } D > H \\ \left(\dfrac{1.1}{\ln\left(\dfrac{H}{r_w}\right)} + \dfrac{C}{\dfrac{L}{r_w}} \right)^{-1} & \text{otherwise} \end{cases}$$

$x = 2.01$

r_c = inside radius of well casing in which water level changes: $r_c := 0.083$ ft.

If some of filter pack around well is dewatered during test than a corrected r_c value should be used.

t_f = time at end point of straight line portion of graph: $t_f := 2.9$ minutes

t_o = time at beginning point of straight line portion of graph: $t_o := 0.0$ minutes

y_o = head difference at beginning of straight line portion of graph: $y_o := 2.0$ ft.

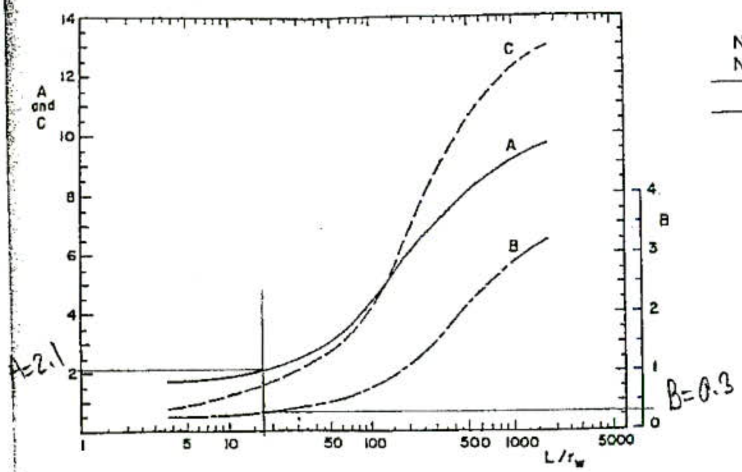
y_f = head difference at end point of straight line portion of graph: $y_f := 1.1$ ft.

$$K := \frac{r_c^{\,2} \cdot x}{2 \cdot L} \cdot \frac{1}{t_f - t_o} \cdot \ln\left(\frac{y_o}{y_f}\right)$$

$K = 1.43 \times 10^{-4}$ ft./min

$K := K \cdot 12 \cdot 2.54 \cdot \frac{1}{60}$ (conversion of units to cm/sec)

$K = 7.2 \times 10^{-5}$ cm/sec



NOTE—See Fig. 3 of Footnote 2.

FIG. 2 Curves Relating Coefficients *A*, *B*, and *C* to *L*/r_w

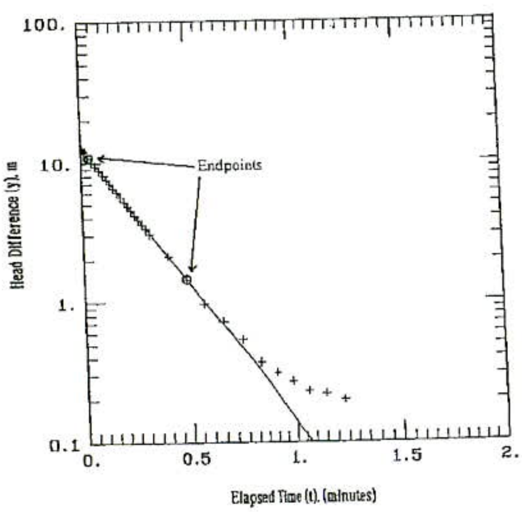


FIG. 3 Sample Plot of Slug Test Data

NOTE 7—An example of the plot of this test method is given in Fig. 3. The data used to prepare the plot is presented in Table 1. Table 1 also presents the well configuration data and the corresponding values of *A*, *B*, and *C*.

8. Report

8.1 Prepare a report including the information described in this section. The final report of the analytical procedure will include information from the report on the test method selection (see Guide D 4043) and the field testing procedure (see Test Method D 4044).

8.1.1 *Introduction*—The introductory section is intended to present the scope and purpose of the slug test method for determining hydraulic conductivity. Summarize the field hydrogeologic conditions and field equipment and instrumentation including the construction of the control well, and the method of measurement and of effecting a change in head. Discuss the rationale for selecting the method used (see Guide D 4043).

8.1.2 *Hydrogeologic Setting*—Review information available on the hydrogeology of the site; interpret and describe the hydrogeology of the site as it pertains to the method selected for selected for conducting and analyzing an aquifer test. Compare hydrogeologic characteristics of the site as it conforms and differs from the assumptions made in the solution to the aquifer test method.

TABLE 1 Sample Slug Test Data[A,B]

NOTE 1—*A* and *B* are not used since *D* = *H*.
NOTE 2—Endpoint values are highlighted.

Elapsed Time, min	Head Difference, m
0.0034	12.86
0.0067	12.71
0.0100	12.40
0.0134	12.13
0.0167	11.96
0.0334	10.94
0.0500	10.15
0.0667	9.45
0.0834	8.80
0.1000	8.16
0.1167	7.05
0.1334	6.54
0.1500	6.10
0.1667	5.64
0.1834	5.21
0.2000	4.85
0.2167	4.51
0.2334	4.14
0.2500	3.88
0.2667	3.59
0.2834	3.35
0.3000	3.06
0.3167	2.12
0.4001	1.45
0.4834	0.97
0.5667	0.72
0.6501	0.54
0.7334	0.37
0.8167	0.31
0.9001	0.27
1.0667	0.23
1.1501	0.22
1.2334	0.20

[A] Well configuration data, m: *Rc* = 0.0833, *Rw* = 0.1615, *D* = 41.5, *L* = 8, and *H* = 41.5.
[B] Coefficients (dimensionless): *A* = n/a, *B* = n/a, and *C* = 2.624.

8.1.3 *Equipment*—Report the field installation and equipment for the aquifer test. Include in the report, well construction information, diameter, depth, and open interval to the aquifer, and location of control well. Include a list of measuring devices used during the test; the manufacturer's name, model number, and basic specifications for each major item; and the name and date of the last calibration, if applicable.

8.1.4 *Test Procedures*—Report the steps taken in conducting the pretest and test phases. Include the frequency of head measurements made in the control well and other environmental data recorded before and during the test procedure.

8.1.5 *Presentation and Interpretation of Test Results:*

8.1.5.1 *Data*—Present tables of data collected during the test.

8.1.5.2 *Data Plots*—Present data plots used in analysis of the data.

8.1.5.3 Show calculation of hydraulic conductivity.

8.1.5.4 Evaluate the overall quality of the test on the basis of the adequacy of instrumentation and observations of

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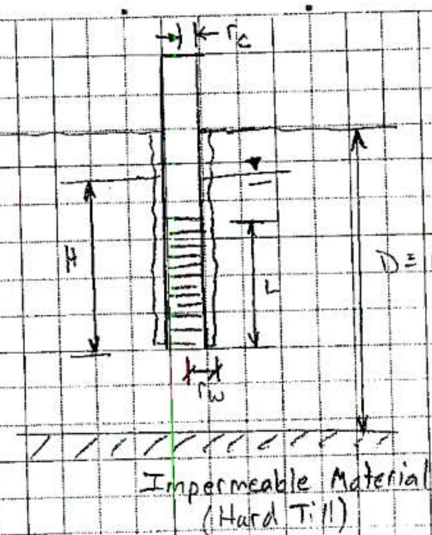
PROJECT: Deer Run Mine SHEET NO.: 1 OF: 1

COMPUTATIONS FOR: In-situ Hydraulic Cond.-MW4 DESIGNED: MEE DATE: 1/19/09

JOB CODE: 180-4298 CHECKED: DATE:

MW No. 4

$$K = \frac{r_c^2 \ln\left(\frac{R_e}{r_w}\right)}{2L} \cdot \frac{1}{t_f - t_o} \cdot \ln \frac{y_o}{y_f}$$



$$\ln\left(\frac{R_e}{r_w}\right) = \left[\frac{1.1}{\ln\left(\frac{H}{r_w}\right)} + \frac{A + B\ln\left[\frac{D-H}{r_w}\right]}{\frac{L}{r_w}}\right]^{-1}$$

r_c = well casing radius = 1 inch = 0.083 ft.

r_w = borehole diameter = 7" = 0.58 ft

H = distance from static water to well bottom = 12.20 ft

D = aquifer thickness = 19 − 5.4 = 13.6 ft

L = length of well open to aquifer

$$\ln\left(\frac{R_e}{r_w}\right) = \left[\frac{1.1}{\ln\left(\frac{12.20}{0.58}\right)} + \frac{2.1 + 0.3\ln\left(\frac{13.6-12.2}{0.58}\right)}{\frac{10\,ft.}{0.58}}\right]^{-1}$$

$$\frac{L}{r_w} = \frac{10.0\,ft}{0.58} = 17.24$$

$$= \left[\frac{1.1}{3.05} + \frac{2.1 + 0.26}{17.24}\right]^{-1} = (0.36 + 0.137)^{-1}$$

$$\ln \frac{R_e}{r_w} = (0.497)^{-1} = 2.01$$

$$K = \frac{0.083^2\,(2.01)}{2(10.0\,ft)} \cdot \frac{1}{2.9 - 0} \cdot \ln \frac{2.0}{1.1} = 6.92 \times 10^{-4}\,(0.345)(0.598)$$

$$= 1.43 \times 10^{-4}\ ft/min \cdot \frac{12\,inch}{ft} \cdot \frac{2.54\,cm}{inch} \cdot \frac{1\,min}{60\,sec} = 7.3 \times 10^{-5}\ cm/sec$$

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HYDROGEOLOGIC INVESTIGATION
HILLSBORO, ILLINOIS

WELL NO.: 35 DATE: 1/16/2009

H_i = Initial depth to water before water was removed (ft.)* = 9.80

$y = H_t - H_i$ = Difference between original static water level (time = t_o) and water level during test at time t.

Date and Clock Time	Elapsed Time (Minutes)	Depth to Water (Feet)*	y (Feet)
1/16/09 10:34 AM	0.0	11.04	1.24
	0.5	11.19	1.39
	1	10.96	1.16
	2	10.96	1.16
	4	10.65	0.85
	6	10.52	0.72
	9	10.30	0.50
	13	9.98	0.18
	18	9.86	0.06
	24	9.85	0.05
	31	9.81	0.01
	39	9.81	0.01
	48	9.80	0.00
	58	9.80	0.00

* Water level measured from top of riser.

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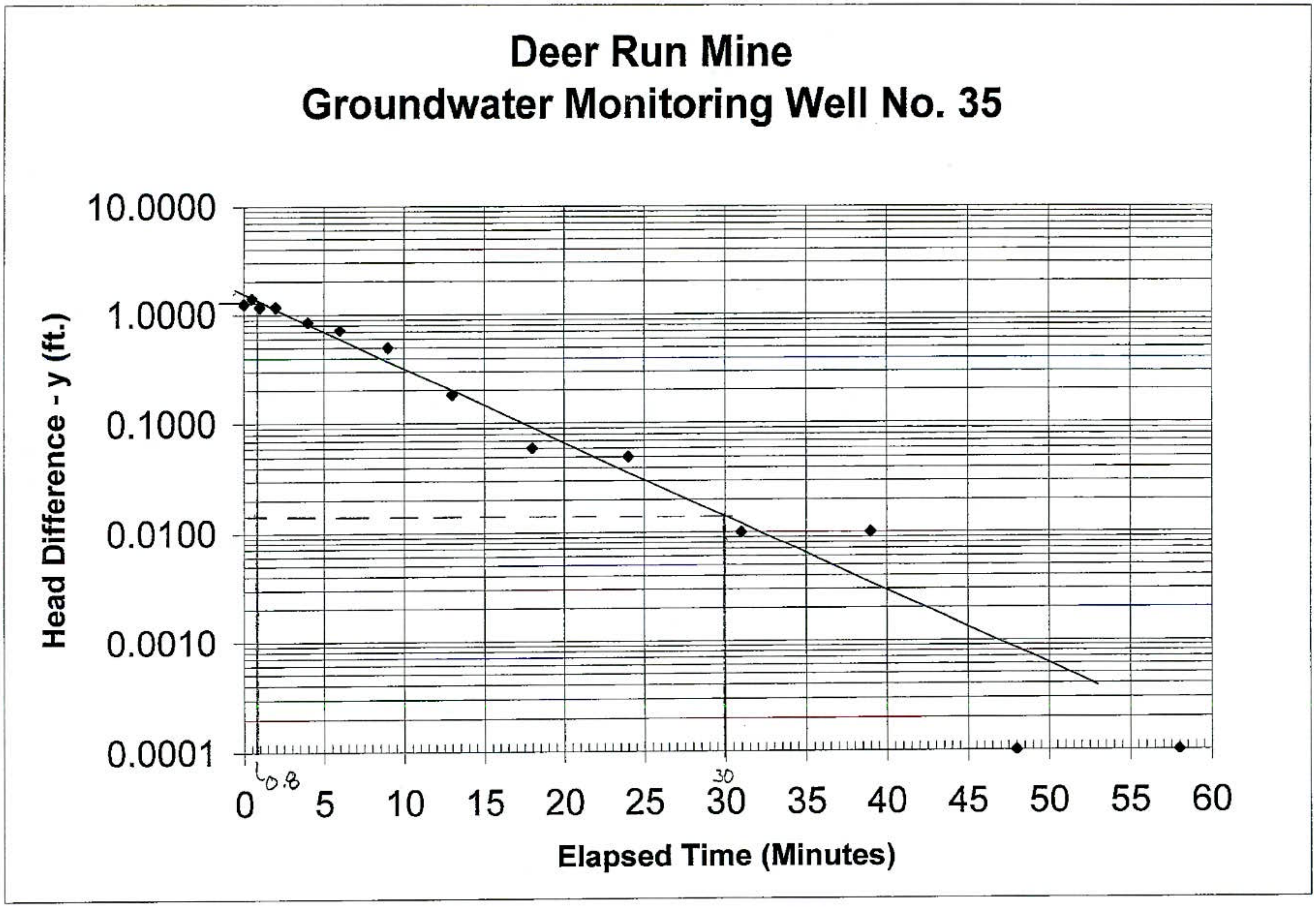

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Deer Run Mine
Hillsboro, Illinois

To determine the in-situr hyrdualic conductivity of the soil at the project site, a slug test or bail test was completed and the test data used in the following calculations.

Reference to documentation presented by Bouwer and Rice, Water Resources Research, 1976, and ASTM D5912 provides the following equations and procedures.

Monitoring Well No. 35

R_e = effecitve radius, detrmined empirically based on well geometry over which y is dissipated.

r_w = radial distance from well center to original undisturbed aquifer (borehole radius): $r_w := 0.58$ ft.

H = distance between static water level and base of well open interval (screen): $H := 10.2$ ft.

A = coefficient determined graphically as function of L/r_w.

B = coefficient determined graphically as function of L/r_w.

D = aquifer thickness (distance between static water level and impermeable surface): $D := 12.9$ ft.

L= length of well open to aquifer (screen length exposed to groundwater): $L := 10.0$ ft.

$$\frac{L}{r_w} = 17.24$$

From Fig. No. 2 in ASTM D5912:

$A := 2.1$

$B := 0.3$

$C := 1.6$

Let x be equivalent to ln (R_e/r_w) for equation 2 in ASTM D5912 and below.

$$x := \begin{cases} \left(\dfrac{1.1}{\ln\left(\dfrac{H}{r_w}\right)} + \dfrac{A + B\cdot\ln\left(\dfrac{D-H}{r_w}\right)}{\dfrac{L}{r_w}} \right)^{-1} & \text{if } D > H \\ \left(\dfrac{1.1}{\ln\left(\dfrac{H}{r_w}\right)} + \dfrac{C}{\dfrac{L}{r_w}} \right)^{-1} & \text{otherwise} \end{cases}$$

$x = 1.88$

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If some of filter pack around well is dewatered during test than a corrected r_c value should be used.

r_c = inside radius of well casing in which water level changes: $r_c := .276$ ft. (corrected)

t_f = time at end point of straight line portion of graph: $t_f := 30$ minutes

t_o = time at beginning point of straight line portion of graph: $t_o := 0.8$ minutes

y_o = head difference at beginning of straight line portion of graph: $y_o := 1.3$ ft.

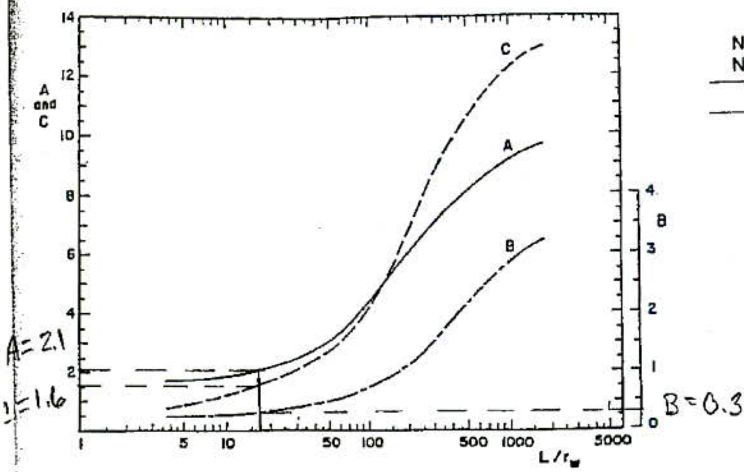
y_f = head difference at end point of straight line portion of graph: $y_f := 0.014$ ft.

$$K := \frac{r_c^{\,2} \cdot x}{2 \cdot L} \cdot \frac{1}{t_f - t_o} \cdot \ln\left(\frac{y_o}{y_f}\right)$$

$K = 1.11 \times 10^{-3}$ ft./min

$K := K \cdot 12 \cdot 2.54 \cdot \frac{1}{60}$ (conversion of units to cm/sec)

$K = 5.6 \times 10^{-4}$ cm/sec



NOTE—See Fig. 3 of Footnote 2.

FIG. 2 Curves Relating Coefficients *A*, *B*, and *C* to L/r_w

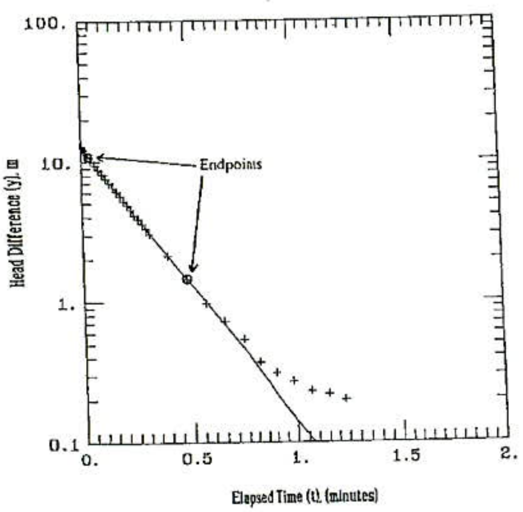


FIG. 3 Sample Plot of Slug Test Data

NOTE 7—An example of the plot of this test method is given in Fig. 3. The data used to prepare the plot is presented in Table 1. Table 1 also presents the well configuration data and the corresponding values of *A*, *B*, and *C*.

TABLE 1 Sample Slug Test Data[A,B]

NOTE 1—*A* and *B* are not used since $D = H$.
NOTE 2—Endpoint values are highlighted.

Elapsed Time, min	Head Difference, m
0.0034	12.86
0.0067	12.71
0.0100	12.40
0.0134	12.13
0.0167	11.96
0.0334	10.94
0.0500	10.15
0.0667	9.45
0.0834	8.80
0.1000	8.16
0.1167	7.05
0.1334	6.54
0.1500	6.10
0.1667	5.64
0.1834	5.21
0.2000	4.85
0.2167	4.51
0.2334	4.14
0.2500	3.88
0.2667	3.59
0.2834	3.35
0.3000	3.06
0.3167	2.12
0.4001	1.45
0.4834	0.97
0.5667	0.72
0.6501	0.54
0.7334	0.37
0.8167	0.31
0.9001	0.27
1.0667	0.23
1.1501	0.22
1.2334	0.20

[A] Well configuration data, m: $Rc = 0.0833$, $Rw = 0.1615$, $D = 41.5$, $L = 8$, and $H = 41.5$.
[B] Coefficients (dimensionless): A = n/a, B = n/a, and $C = 2.624$.

8. Report

8.1 Prepare a report including the information described in this section. The final report of the analytical procedure will include information from the report on the test method selection (see Guide D 4043) and the field testing procedure (see Test Method D 4044).

8.1.1 *Introduction*—The introductory section is intended to present the scope and purpose of the slug test method for determining hydraulic conductivity. Summarize the field hydrogeologic conditions and field equipment and instrumentation including the construction of the control well, and the method of measurement and of effecting a change in head. Discuss the rationale for selecting the method used (see Guide D 4043).

8.1.2 *Hydrogeologic Setting*—Review information available on the hydrogeology of the site; interpret and describe the hydrogeology of the site as it pertains to the method selected for selected for conducting and analyzing an aquifer test. Compare hydrogeologic characteristics of the site as it conforms and differs from the assumptions made in the solution to the aquifer test method.

8.1.3 *Equipment*—Report the field installation and equipment for the aquifer test. Include in the report, well construction information, diameter, depth, and open interval to the aquifer, and location of control well. Include a list of measuring devices used during the test; the manufacturer's name, model number, and basic specifications for each major item; and the name and date of the last calibration, if applicable.

8.1.4 *Test Procedures*—Report the steps taken in conducting the pretest and test phases. Include the frequency of head measurements made in the control well and other environmental data recorded before and during the test procedure.

8.1.5 *Presentation and Interpretation of Test Results:*

8.1.5.1 *Data*—Present tables of data collected during the test.

8.1.5.2 *Data Plots*—Present data plots used in analysis of the data.

8.1.5.3 Show calculation of hydraulic conductivity.

8.1.5.4 Evaluate the overall quality of the test on the basis of the adequacy of instrumentation and observations of

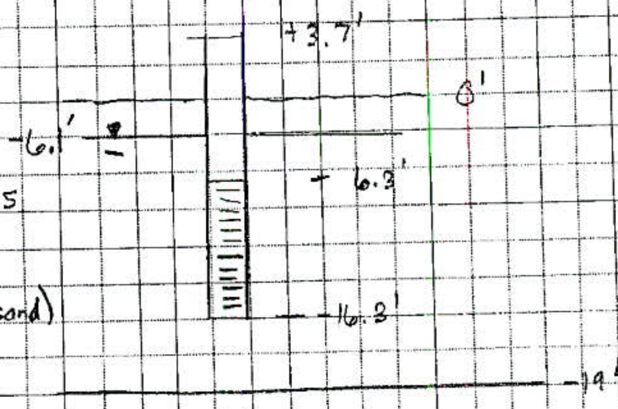
HURST-ROSCHE ENGINEERS, INC.

PROJECT: Deer Run Mine SHEET NO.: 1 OF: 1

COMPUTATIONS FOR: In-situ Hyd. Cond. DESIGNED: MEF DATE: 1/28/09

JOB CODE: 180 - 4298 CHECKED: DATE:

MW 35



$.8 \times 10^{-5}$ ft^2
2.7×10^{-3} ft/...
7.5×10^{-4} ft/...

$$r_c(\text{corrected}) = \left[(1-n)r_a^2 + n\,r_w^2\right]^{0.5}$$

$n = 0.21$ (from typical value fine sand)
$r_a = 0.083$ ft
$r_w = 0.58$ ft

$$r_c(\text{corrected}) = \left[(1-0.21)0.083^2 + 0.21(0.58)^2\right]^{0.5}$$

$$= (0.0054 + 0.0706)^{0.5} = 0.276 \text{ ft}$$

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ATTACHMENT IV.3.B.7.c

Hillsboro Energy, LLC currently has working agreements with several utilities companies and shall continue to do so in the future for the proposed shadow boundary revision

The following is a list of utility & road authority with status agreements for the shadow area.

Utility or Road Authority	Phone Number	Status
City of Coffeen	217-534-2216	Approved - General Agreement Water Line Along Hwy 185
Frontier Communications	217-854-2222	Approved - General Blanket Agreement
City of Hillsboro	217-532-3959	N/A - No Impact Under Rev #2 Area
Illinois Consolidated Telephone	217-235-3326	Continuing Negotiation - approves only 1 panel at a time
Ameren IP	618-236-6207	Approved - General Blanket Agreement
Montgomery County Water	618-252-8111	Future Negotiation
M.J.M. Electric Cooperative	217-854-3137	Approved - General Blanket Agreement
East Fork Twp. Road Commissioner	217-534-6315	Agreement in Place with exception of Section 16, 17 & 18 in T7N, R3W
Hillsboro Twp. Road Commissioner	217-532-6832	Approved - General Blanket Agreement
Montgomery Co. Highway Dept.	217-532-6109	N/A - No Impact Under Rev #2 Area
Illinois Dept. of Transportation	217-782-7331	Continuing Negotiation - IDOT approves only 1 panel at a time

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ATTACHMENT IV.3.C.1
GEOTECHNICAL INFORMATION

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- Mine Floor Safety Factor
- Summary of Geotechnical Data of Floor Core
- Detailed Lithology Log of Floor Core

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Deer Run Mine Floor Safety Factor

ESTIMATION OF FLOOR SAFETY FACTOR developed by Chugh and Hao (1990)

Log Hole Number	MC (pct)	LL	UBCm (psi)	B (in)	L	UBCplt (psi)	S1 (psi) (Speck)	(CHC)	S2 (psi)	K (Speck)	K (CHC)	Wp (ft)	Lp (ft)	We (ft)
08-03-18-15	6.71	38.95	0	8	8	753	142	122	700	5	6	60	60	20

Log Hole Number	H (ft)	D (ft)	BETA	NUME1 (Speck)	NUME2 (Speck)	DINO1 (Speck)	DINO2 (Speck)	Nm (Speck)	Er (pct)	RF	UBC (psi) (Speck)	q (psi)	SF (Speck)
08-03-18-15	2.16	500	6.944	367.21	447.69	16512.9	259.92	10.11	43.8	0.712	1441	978	1.5

* See Summary Geotechnical Data for Floor Cores Sheet for Test Results

Note:

MC	Moisture content (pct)
LL	Liquid limit (pct)
UBCm	Measured ultimate bearing capacity from plate load tests (psi)
S1	Cohesive strenth of the weak layer (psi)
S2	Cohesive strenth of competent stratum beneath the weak layer (psi)
K	S2/S1
Lp	Length of pillar (ft)
Wp	Width of pillar (ft)
We	Entry width (ft)
H	Thickness of the weak layer (ft)
D	Thickness of overburden
BETA	BL/[2(B+L)H]
NUME1	6.17K(6.17+BETA-1)
NUME2	6.17^2(K+1)+6.17(1+K*BETA)+BETA-1
DINO1	[6.17K(K+1)+K+BETA-1][6.17(6.17+BETA)+BETA-1]
DINO2	(6.17K+BETA-1)(6.17+1)
Nm	NUME1*NUME2/(DINO1-DINO2)
B	Plate width (in)
L	Plate length (in)
RF	Reduction factor
UBC	S1*Nm (psi)
p	Vertical pressure on a pillar (psi)
SF	Safety facotr of weak floor

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Summary Geotechnical Data for Floor Cores

Hole number: 08-03-18-15 | **Date logged: 10/23/2007**

Total core depth: 480.4.0 to 484.4

Sample depth below coal seam (inches)	Moisture content %	Point Load Index: Axial Is50	Point Load Index: Diametral Is50	Indirect Tensile Strength (psi)	Atterberg Limits (%): Plastic Limit	Atterberg Limits (%): Liquid Limit	Atterberg Limits (%): Plasticity Index	Water sensitivity index	Geotechnical description and length of pieces (inches) recovered from core sample
0	6.75	15.16	3.63		18.5	33.7	15.2		2.375, 3.5, 1.125, 1.75 (large gap on one side), 1.375, 3.125, 3.25, 1.375 (angled gap between segments), 3.0,
4.625	8.35								
10.125	6.7	16.25	5.08		18.3	40.9	22.6	-15	
13.25				51.17					
16.5				107.66					
17.875	6.6	15.96	10.16		18.1	41.9	23.8		
20.875	6.5								2.0, 3.0, 2.125, 2.125, 1.5 (broken , slickensides), 1.375 (broken, slickensides). 1.5, 1.75, 2.375, 1.25, 1.0, 1.5, 0.75, 1.25, 0.625 The last 5 segments were broken into several pieces.
22.875	5.9	8.345	1.16		16.9	39.3	22.4		
25.875	6.2							-15	
31.625	5.85	9	6.53						
36.25	6.4								
40.875	6.4	6.96	2.9						

Note: Water sensitivity index value of -15 implies the material is extremely sensitive to moisture.

Hillsboro Energy

Detail Lithology Log

Log ID: 08-03-18-15

Project/Area:

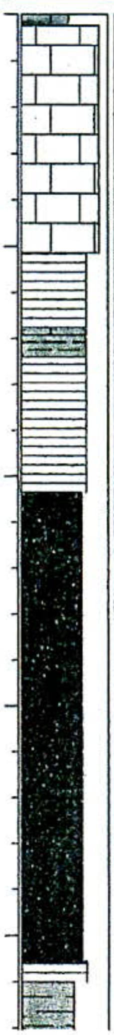
Easting:	2,497,941.90'	Total Depth (Driller):		Casing Depth:	145'
Northing:	897,914.27'	Total Depth (Logger):	500.34'	Core Interval:	439' - 500' adj.
Location:		Elevation (GS):	635.92'	Drilling Date:	8/23/2007
Township:	8N	Drilled By:	Goff & Pruitt		
Range:	3W	Core Logged By:	J. T. Padgett		
Section:	18	Cuttings Logged By:	Driller, J. T. Padgett		
County:	Montgomery	Geophysical Log Operator:	GLS		

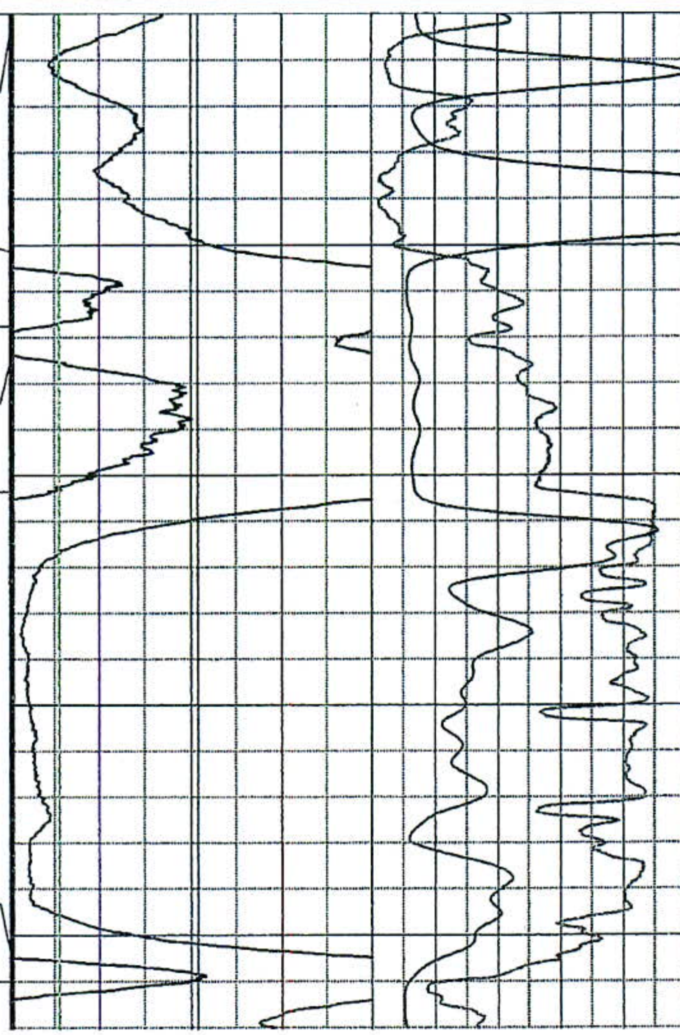
Notes: Drill depths adjusted 0.65' at coal seam to match E-log

Elevation	Depth (Feet)	Lithology			Natural Gamma 0 – 500 / Caliper 4 – 8	Density 3.0 – 1.0 / Resistivity 0 – 100
		Depth	**Thickness**	**Description**		
		460.25	4.90	Claystone: medium gray, calcareous, fossiliferous, firm		
				Limestone: medium gray to tan, argillaceous, mudstone, slightly fossiliferous, hard		
		465.15	1.60	Carbonaceous Shale: black, firm, slightly moisture sensitive		
		466.75	0.6	Shale and Limestone Interbeds: dark gray, very argillaceous, fossiliferous		
		467.40	2.95	Carbonaceous Shale: black, firm, slightly moisture sensitive		
		470.35	10.20	Coal: bright banded, calcite on cleat, <0.05' and .05' pyrite lenses at 472.1' and 476.15', <0.05' claystone partings at 475, 477.2' and 477.5', .05' claystone parting at 476.2'		
				Carbonaceous Shale: black, coaly, fissile		
		480.55	0.			
		481.00		Shale: green gray top becoming medium dark gray, top 0.3' fossiliferous		

Elevation scale: 175, 170, 165, 160

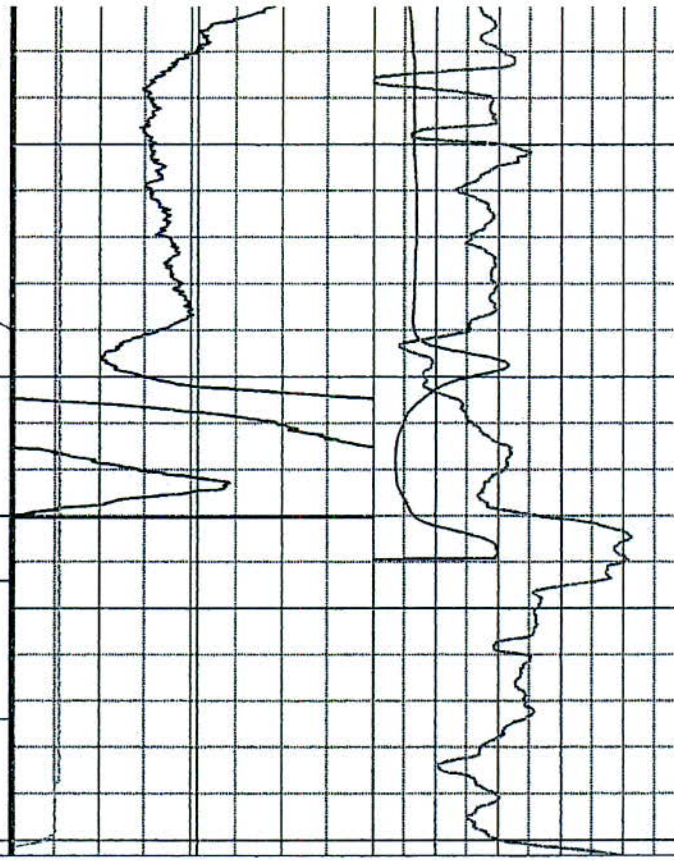
Depth scale: 460, 465, 470, 475, 480





Log ID: **08-03-18-15**

Elevation	Depth (Feet)	Lithology			Natural Gamma 0 – 500 / Caliper 4 – 8	Density 3.0 – 1.0 / Resistivity 0 – 100
150	485		8.00	top, plant fragments top 2.0',slightly calcareous, silty, sandy and micaceous top 3.0',becomes softer with slip fractures in lower half, firm to moderately hard		
		489.00	1.00	Limestone		
145	490	490.00	3.00	Carbonaceous Shale		
		493.00	1.40	Coal		
140	495	494.40	3.00	Claystone		
	500	497.40	2.60	Shale		



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Coal Pillar Strength Calculation

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Comparison of Area Seam Coal Values to ARMPS Recommended In Situ Coal Pillar Strength

Based on (Hustrulid, 1976), the scaling of coal properties from laboratory-measured data to field values may be estimated by the following equation:

$\sigma_{cube}=k/36^{1/2}$

$k=\sigma_c\,(D)^{1/2}$

Where: σ_c=uniaxial compressive strength of coal specimens tested in the lab (psi)

D=diameter or cube side dimension, in.

k=constant characteristic of coal seam (Gaddy 1956)

Where: σ_c=3,372 psi (average of 32 samples)

D=2.5 in. (sample size)

Therefore: $\sigma_{cube}=((3{,}372)(2.5)^{1/2})/36^{1/5}$

888.5 psi

The strength value of 888.5 psi is very close to the recommended value of 900 psi used in the ARMPS program.

NIOSH, ARMPS Simulation

[PROJECT TITLE]
Hillsboro Energy LLC, Deer Run Mine

[PROJECT DESCRIPTION]
Pillar Stability Factors for the Main Entries on 80ft. by 80ft. Centers

[DEVELOPMENT GEOMETRY PARAMETERS]
Entry Height.....................................10 (ft)
Depth of Cover...................................500 (ft)
Crosscut Angle...................................90 (deg)
Entry Width......................................20 (ft)
Number of Entries................................6
Crosscut Spacing.................................80 (ft)
Center to Center Distance #1.....................80 (ft)
Center to Center Distance #2.....................80 (ft)
Center to Center Distance #3.....................80 (ft)
Center to Center Distance #4.....................80 (ft)
Center to Center Distance #5.....................80 (ft)

[DEFAULT PARAMETERS]
In Situ Coal Strength............................900 (psi)
Unit Weight of Overburden........................162 (pcf)
Breadth of AMZ...................................111 (ft)
AMZ set automatically

[RETREAT MINING PARAMETERS]
Loading Condition................................DEVELOPMENT

[ARMPS STABILITY FACTORS]

DEVELOPMENT........................2.52

[DATA ABOUT THE ACTIVE MINING ZONE (AMZ)]

AMZ Width..............................400.0 (ft)
AMZ Breadth............................111.0 (ft)
AMZ Area...............................44400.0 (ft)*(ft)
Extraction Ratio Within AMZ............0.44
Development Load on AMZ................1.80E+06 (tons)

TOTAL LOADINGS ON AMZ, INCLUDING TRANSFER FROM BARRIERS

LOAD CONDITION	ABUTMENT LOAD (tons)	LTRANSBAR (tons)	LTRANSREM (tons)	TOTAL (tons)
DEVELOPMENT	0.00E+00	0.00E+00	0.00E+00	1.80E+06

R-Factor for front abutment is the percent of the total front abutment load that is applied to the AMZ.

R-Factor for side abutment is the percent of the total side abutment load that is applied to the barrier pillar (the remainder is applied to the AMZ).

LTRANSBAR is the load transferred to the AMZ from the barrier pillar between the side and active gob if the barrier's SF is less than 1.5.

LTRANSREM is the load transferred to the AMZ from the remnant barrier between the side and active gob if the remnant's SF is less than 1.5.

[PILLAR PARAMETERS]

PILLAR ENTRY MINIMUM MAXIMUM

	CENTER (ft)	DIMENSION (ft)	DIMENSION (ft)
1	80.00	60.00	60.00
2	80.00	60.00	60.00
3	80.00	60.00	60.00
4	80.00	60.00	60.00
5	80.00	60.00	60.00

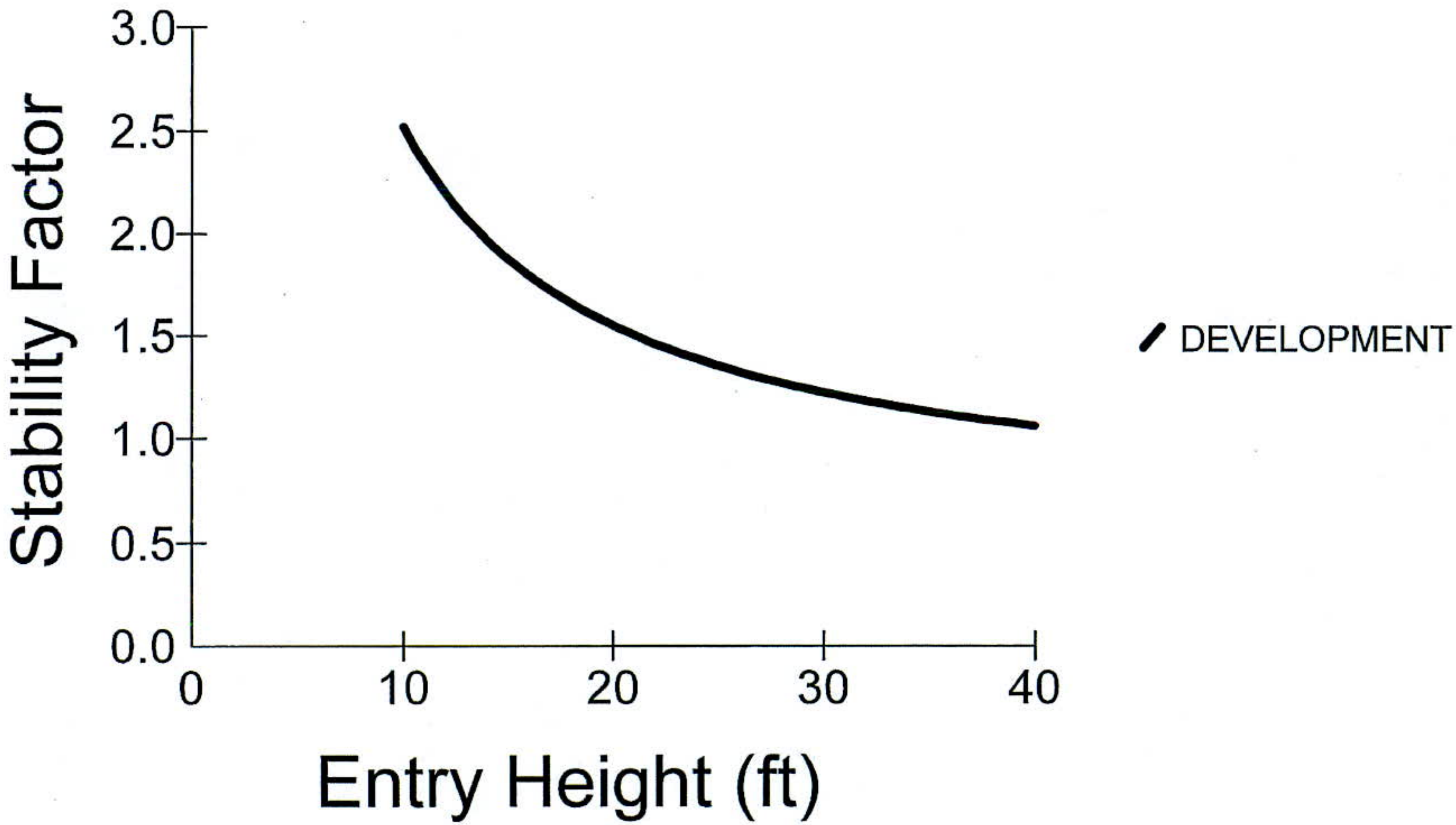
PILLAR	AREA (ft)*(ft)	STRENGTH (psi)	LOAD-BEARING CAPACITY (tons)
1	3.60E+03	2.52E+03	6.53E+05
2	3.60E+03	2.52E+03	6.53E+05
3	3.60E+03	2.52E+03	6.53E+05
4	3.60E+03	2.52E+03	6.53E+05
5	3.60E+03	2.52E+03	6.53E+05

TOTAL LOAD-BEARING CAPACITY OF PILLARS WITHIN AMZ: 4.53E+06 (tons)

To view the distribution of Pillar Load Bearing Capacity
select 'View Plots->Settings->Pillar Load Bearing Capacity'

[BARRIER PILLAR PARAMETERS]
none

Analysis of Retreat Mining Pillar Stability



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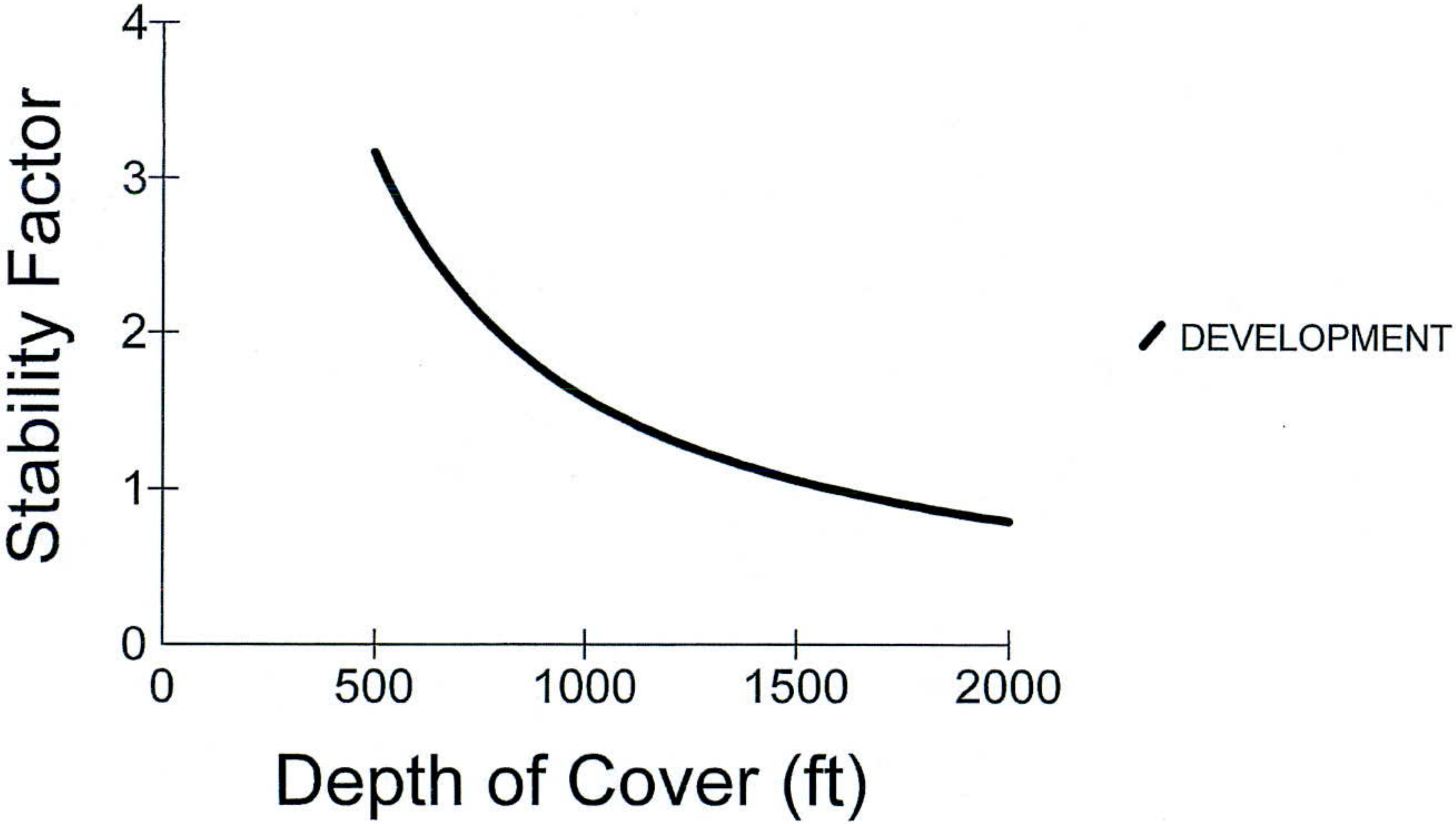

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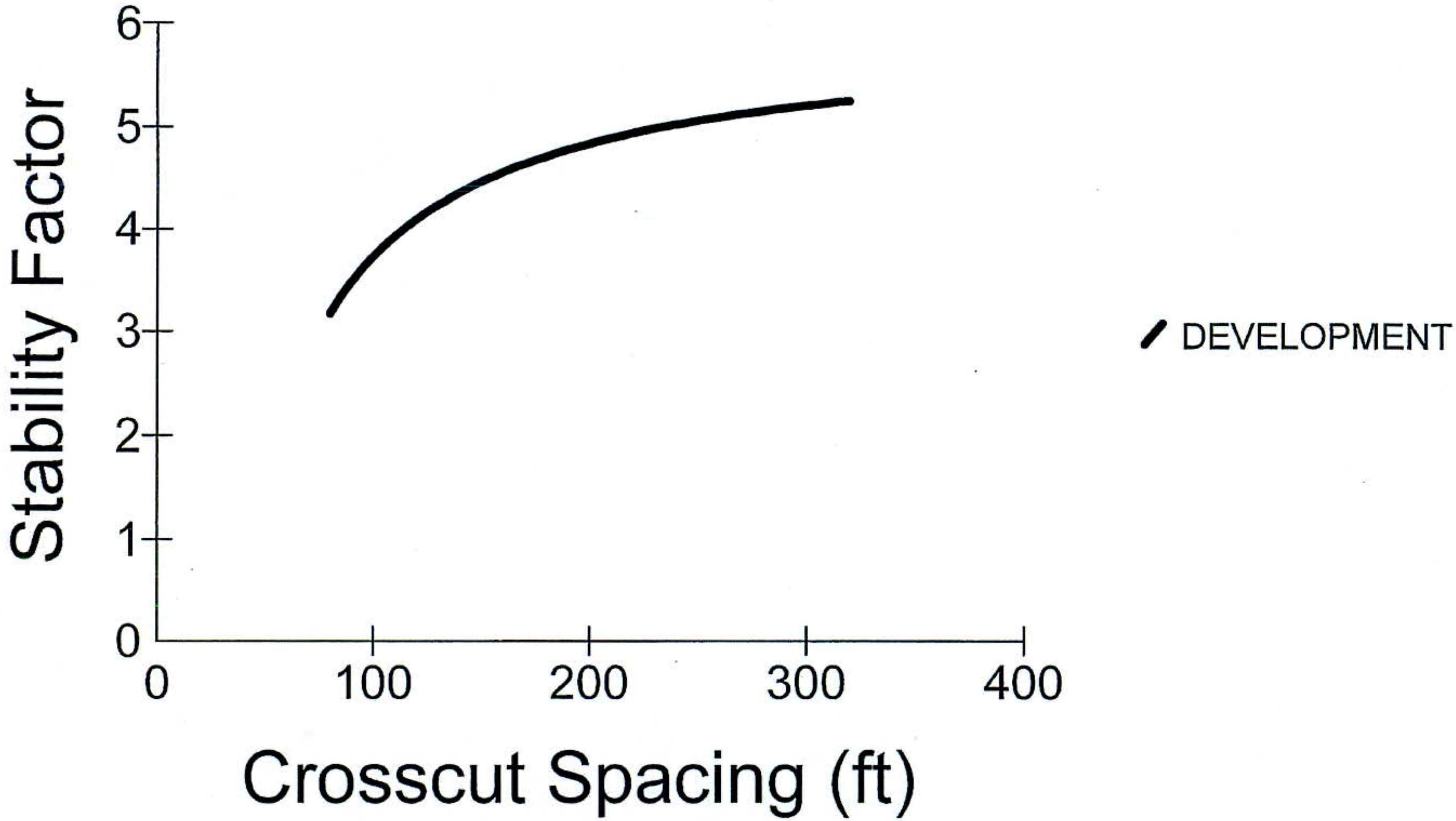

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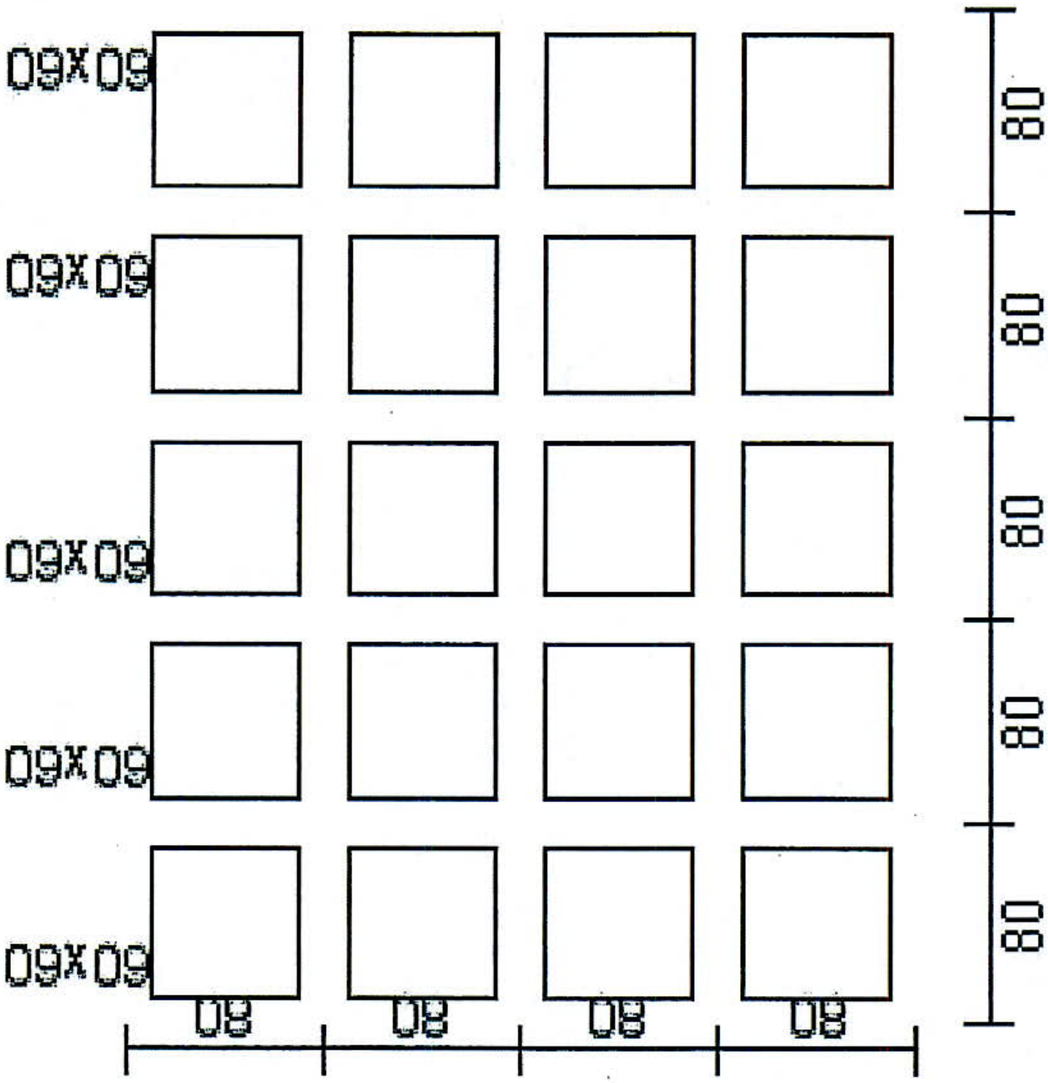

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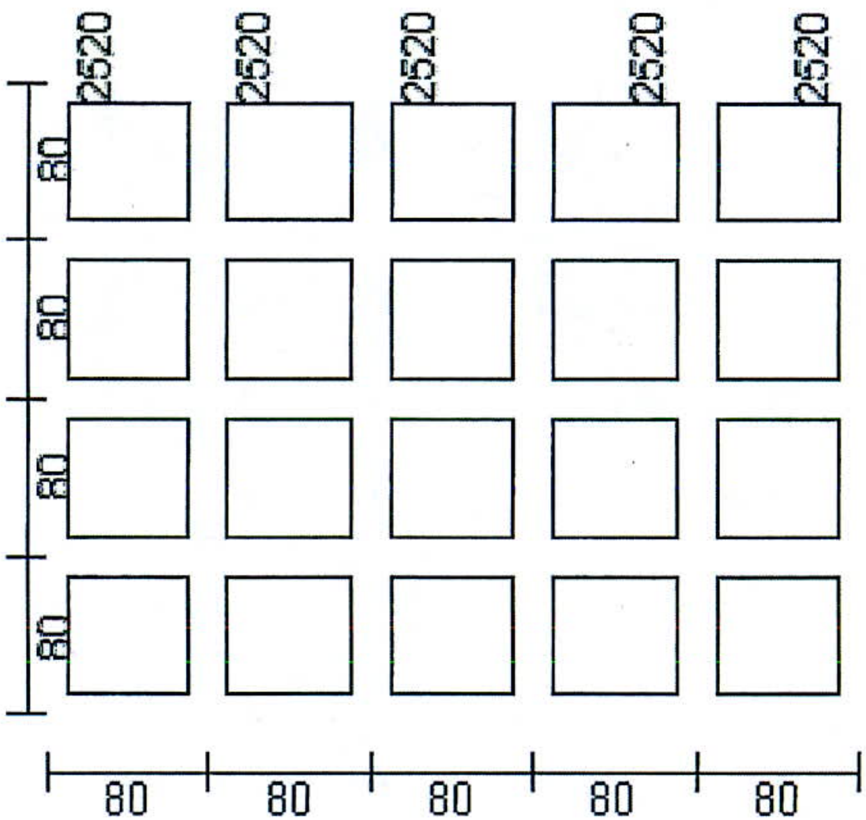
ARMPS: Unit Pillar Strength (ps Entries shown from left to right.



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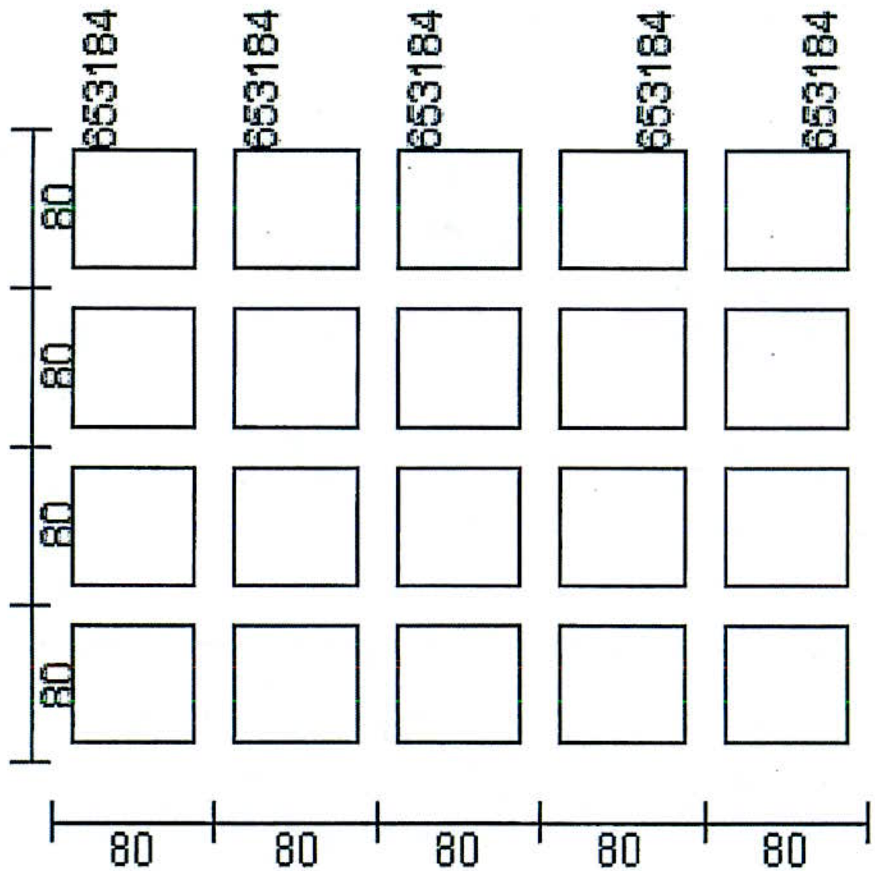
\RMPS: Pillar Load Bearing Capacity ns)/ (ft). Entries shown from left to rig



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Angle of Draw Example

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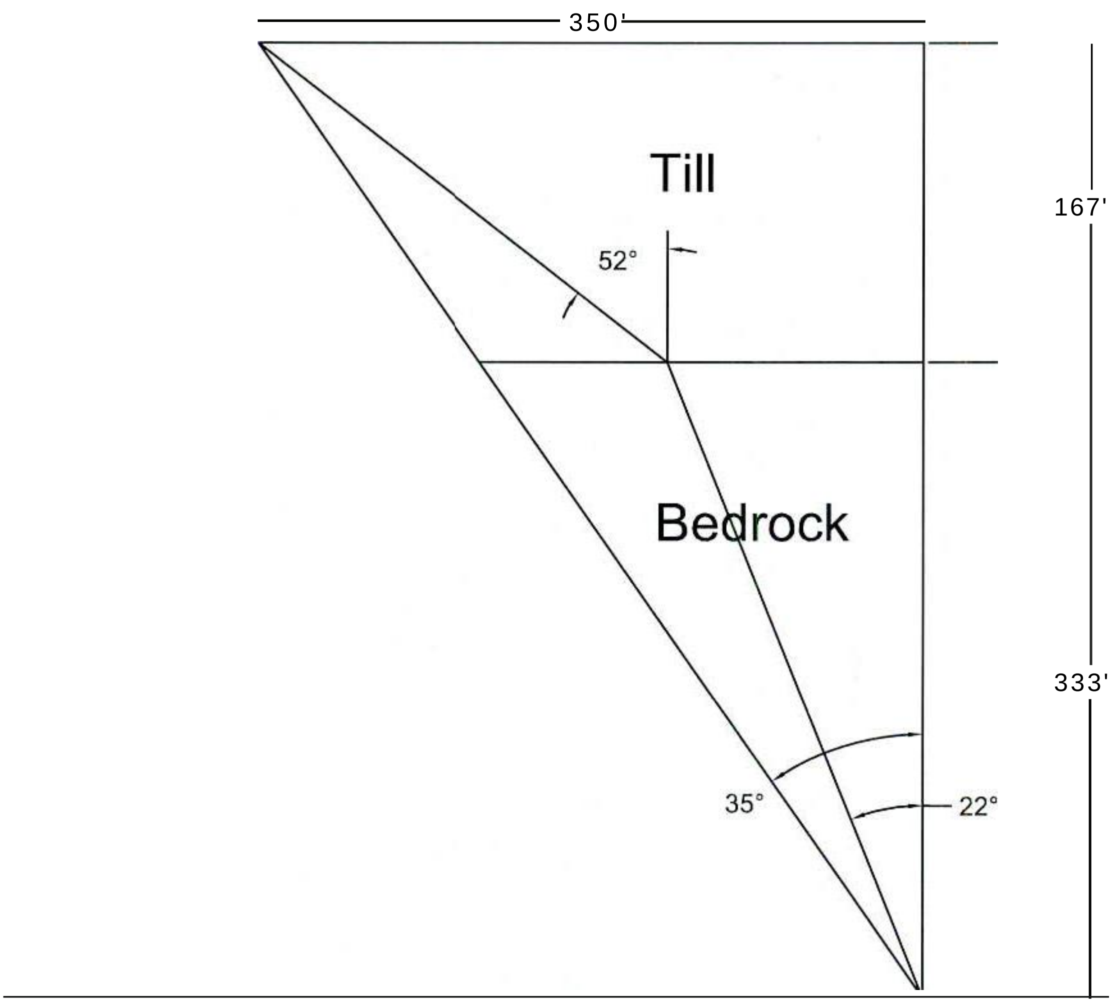
Deer Run Mine Typical

Example Angle of Draw Calculation



The average angle of draw is 35 degrees.
The bedrock is 22 degrees and the till is 53 degrees.