Groundwater Model

Jordan Aggregates Proposed Sand and Gravel Mine

17825 Valley View Drive

Sand Creek Township, Scott County, Minnesota

Prepared for:

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1.0 Introduction

A groundwater flow model for the proposed Jordan Aggregates sand and gravel mine (Site) was prepared using the Wellhead Analytic Element Model (WhAEM), an analytic element modeling program available developed by the U.S. Environmental Protection Agency (EPA). The software and documentation is available free of charge from the EPA's website (http://www.epa.gov/athens/software/whaem/).

2.0 Model Purpose and Setup

The general purpose of the model is to predict the effects of the proposed on-site wash water pumping well and the creation of the mining pond on groundwater flow and elevation in the vicinity of the Site. Specific goals of the model include:

- Predict drawdown at the locations of private wells surrounding the Site resulting from operation of the wash water well (Mine Well) as well as the creation of the mine pit pond (Mine Pit).
- Predict groundwater flow paths from the Mine Pit and identify well locations near the Site that may have the potential for water-quality impacts originating from the Mine Pit.
- Perform a general assessment of the on the base flow of Sand Creek resulting from the Mine Well and Mine Pit.

Input parameters in the model include aquifer properties (e.g. thickness, hydraulic conductivity) groundwater recharge rate, line sinks representing the heads in nearby streams and rivers, and well properties (e.g. well diameter, pumping rate). The line sinks and aquifer properties are used to establish baseline water table elevations and groundwater flow directions, essentially representing a snapshot of aquifer conditions. The addition of a well at various pumping rates modifies the water table contours to reflect the groundwater withdrawal and resulting cone of depression. This allows the user to determine the approximate amount of drawdown in nearby wells, as well as investigate capture zones for wells with a specified discharge.

3.0 Site Background Data and Hydrogeologic Conceptual Model

In order to utilize a numerical computer model, the user must understand the geologic setting of the site and develop a conceptual hydrogeologic model to define the input parameters discussed previously. The conceptual model provides a framework for the numerical model by simplifying the Site geology into a series of hydrostratigraphic units for which hydraulic properties can be assigned.

3.1 Site Setting and Topography

The Site is located between Valley View Drive and U.S. Highway 169 approximately one mile northeast of Jordan Minnesota. The Site is generally situated on the southeastern edge of the Minnesota River Valley between the base of the bluffs/upland area to the southeast and the Minnesota River to the northwest. The average site elevation is approximately 730 ft above mean sea level (msl). Comparatively, the elevation of the Minnesota River is approximately 695 and the elevation at the top of the bluffs is approximately 970. Site topography is characterized by two primary regions:

1. Upland Area located in the northwestern portion of the site – The upland area is characterized by gently rolling terrain with surface elevations ranging from approximately 727 feet to 749 feet above msl.

2. Lowland Area located in the southeastern portion of the site – The lowland area is located within the Sand Creek floodplain and is characterized by generally flat terrain. Surface elevations range from 724 feet to 727 feet above msl.

Site drainage flows either southeast toward Sand Creek or northwest to the ditch along Valley View Drive. Regional drainage is toward the Minnesota River, which is approximately 0.7 miles northwest of the Project Site.

3.2 Site Geology

Information on Site geology was obtained from the following sources:

1. Soil borings completed at the Site during June through August, 2009. Boring logs are included in Appendix A.
2. Water well construction logs available through the Minnesota County Well Index. Twenty-four water supply wells were identified in the vicinity of the Project Site. Available well logs are included in Appendix A; well construction information is summarized in Table C1; and approximate well locations are shown on Figure C1.
3. The Scott County Geologic Atlas, which is available online through the Scott County website.

Figure C2 presents a generalized cross section showing geology between the bluffs to the southeast of the site and the Minnesota River to the northwest. Figures C3 and C4 present scaled cross-sections through the site based on site-specific soil boring data. Surficial geology at the Site consists of unconsolidated river terrace deposits of sand and gravely sand with localized deposits of gravel and cobbly gravel. Areas of clay and silt loam floodplain deposits up to 20 feet thick occur in the lowland area near Sand Creek, and in the area to the northwest of the Site between Valley View Drive and the Minnesota River. The unconsolidated deposits span the Minnesota River Valley to the northwest and range from 70 to 150 feet thick and average approximately 100 feet thick across the Site. To the southeast of the Site the alluvial deposits pinch out and are replaced by unsorted glacial sediment or till.

The first bedrock encountered over the southwestern 1/3 of site is St. Lawrence Formation. This unit is characterized by dolomite-cemented very fine-grained sandstone and siltstone, occasionally interbedded with shale and dolostone; and ranges in thickness from 55 to 80 feet. Under the northern two-thirds of the Site the St. Lawrence Formation has been eroded away and as a result the first bedrock encountered is the Franconia Formation. This unit is characterized by glauconitic sandstone, siltstone and shale; with grain size generally decreasing with depth. Based on the logs of water wells penetrating the formation, shale appears to be prominent within the Franconia in the vicinity of the Site. The Franconia formation is approximately 120 to 140 feet thick. Bedrock slopes to the north at a grade of approximately 4% toward a bedrock valley.

Elevation of the bedrock surface varies from approximately 670 in the southwest corner of the Site to 570 at the north end of the Site.

3.3 Groundwater Occurrence and Flow

Information on groundwater was obtained from the following sources:

1. Soil borings and monitoring wells/piezometers installed on site. Boring logs and well completion reports are included in Appendix A.
2. Water well construction logs available through the Minnesota County Well Index (Appendix A, Table C1, Figure C1)
3. The Metropolitan Area Groundwater Model (Metro Model), a regional-scale multi-aquifer groundwater flow model of the Twin Cities (Minneapolis and St. Paul, Minnesota) metropolitan area available via the Minnesota Pollution Control Agency (MPCA) website.

Groundwater beneath the Site occurs within the unconsolidated alluvial deposits as well as the underlying bedrock units. Wells in the area are screened in each of these units, as shown schematically on Figure C2. Based on measurements collected in late August 2009, groundwater elevation at the Site is approximately 720 ft above mean sea level (MSL). Groundwater contours from this measurement event are illustrated on Figure C1. Based on the contours, groundwater flow is generally to the northwest towards the Minnesota River with a horizontal gradient of approximately 0.0025 vertical feet / horizontal foot. Figure C5 includes a potentiometric surface map created using WhAEM that shows water table contours in the vicinity of the Site. The modeled contours indicate groundwater flow direction is to the northwest and hydraulic gradient is approximately 0.003, both of which are comparable to the field-measured data. Figure C5 also includes comparisons between observed and modeled data, or *residuals*, at a series of locations in the vicinity of the Site. These residuals are a measure of model's representation of actual conditions and are discussed further in Section 4.1.1.

3.4 Hydrogeologic Conceptual Model

Three primary hydrostratigraphic units have been identified in the vicinity of the site:

1) **Surficial sand and gravel aquifer** – This unconfined aquifer is comprised of unconsolidated alluvial deposits of mostly sand and gravel with varying amounts of fines. Horizontal hydraulic conductivity of the unit was determined by performing slug tests at each of the four monitoring wells on Site. An average hydraulic conductivity (k)of 67 feet per day was determined for the unit based on the results of slug tests that were performed on each of the four monitoring wells on Site. Slug test results are included in Appendix B. Based on the observed water table elevation the unit has a saturated thickness of 60 to 130 feet, resulting in transmissivity (T) values ranging from 4000 to 8700 ft^2/day. As stated above, horizontal groundwater flow is toward the northwest toward the Minnesota River, which is the primary discharge for the aquifer. Site-specific vertical gradients have not been determined, however it is likely that the vertical component of flow within the upper portion of the surficial aquifer is downward; as the water table at the site is higher than the Minnesota River. Water wells completed at different depths within the unit show similar water levels, indicating that there are not significant vertical gradients; however the potential error associated with these measurements precludes them from being used for gradient calculations. Recharge to the unit is predominantly via surface infiltration of precipitation in river valley alluvial sediments and stream-bed infiltration of runoff transported from the till-mantled upland/bluff area.

2) **St. Lawrence Formation bedrock aquifer** – This aquifer is comprised of fine-grained sandstone. It occurs immediately beneath the surficial aquifer under the southern one-third of the Site and has been eroded away in the northern part of the Site. The unit is approximately 30 feet thick at the location of the southeastern-most water well and thins out under the Site until it terminates. Groundwater movement within the unit is likely to the northwest, as the aquifer transitions from a confined state beneath the clay till of the bluffs to an unconfined state beneath the surficial aquifer. Hydraulic conductivity data for the unit is limited and there has been no Site-specific hydraulic testing to determine aquifer properties; however the Metro Model provides a horizontal hydraulic conductivity value of 0.1 ft/day and a transmissivity

value of 1-10 m^2/day. It is reasonable that the conductivity and transmissivity values are significantly lower than the surficial aquifer due to the fine-grained, lithified nature of the St. Lawrence formation. Much of the recharge for this unit likely originates in the Jordan Sandstone, which overlies the St. Lawrence Formation to the southeast of the Site, as well as from upgradient surficial sources that penetrate the unit.

3) **Franconia Formation bedrock aquifer** – This aquifer is comprised mainly of shale in the vicinity of the Site. It occurs immediately beneath the surficial aquifer under the northern two-thirds of the Site and is overlain by the St. Lawrence Formation in the southern portion of the Site. The Scott County Atlas indicates that the Franconia is 120 to 140 feet thick, and the log for the only well that fully penetrates the unit, Well 16, reports a thickness of 103 feet. Water levels from wells completed within the unit indicate that groundwater movement is to the northwest, which is consistent with the overlying units and the regional flow direction toward the Minnesota River. Hydraulic conductivity data for the unit is limited; however the Metro Model provides a horizontal hydraulic conductivity value of 2 ft/day and a transmissivity of 340 ft^2/day. Static water elevation is lower in the Franconia than in the underlying Ironton-Galesville sandstone based on a comparison of Wells 15 and 16. This indicates that pressure head within the Ironton-Galesville is higher than the Franconia and there is potentially some upward seepage recharging the Franconia from below. Where St. Lawrence is absent, head appears to be similar in Franconia and surficial aquifer

4) **Glacial sediment aquitard** – This unit is comprised of glacial clay till that is present to the southeast of the Site in the upland/bluff area. It acts as an aquitard because the low-permeability clay greatly retards infiltration. Much of the runoff from the upland area is collected by streams such as Sand Creek and transferred to the lowland where it can directly infiltrate through the alluvial deposits into the surficial aquifer.

The proposed mining well would be completed within the unconsolidated deposits overlying bedrock , therefore the surficial aquifer is of primary importance for the model. The average saturated thickness of this aquifer is approximately 85 feet and the underlying bedrock units have

a significantly higher fine-grained fraction and lower hydraulic conductivity, creating a unique and separate flow regime within the surficial aquifer. For these reasons, the bedrock aquifers are not included in the numerical model.

4.0 Numerical Model

As stated previously, a numerical groundwater model was prepared using WhAEM, an analytic element modeling computer program. The analytic element method is based on the superposition of functions, or *analytic elements*, that represent different features of the aquifer. Background information on the development and use of the model can be found in Strack, 1989 and Haitjema, 1995. Of primary importance in the model are the assignment of 1) linesinks (analytic elements representing rivers, lakes, and streams) and their associated head or discharge values, and 2) aquifer properties (hydraulic conductivity, aquifer thickness, recharge rate). Using these primary inputs the user can obtain a useful representation of the groundwater flow regime.

Like any modeling tool, WhAEM presents a simplification of a complex system and has inherent assumptions and limitations. Examples of these limitations area listed below along with an explanation of why they are not limiting for the problem and setting at hand:

- The model is not capable of transient solutions – Groundwater flow is nearly always transient (magnitude and direction change with time) due to factors such as seasonal differences in aquifer recharge and variable pumping of nearby water wells. This model is treated as a steady-state setting where flow into the model domain equals flow out, i.e. there is no aquifer 'storage'. Steady-state models are simpler, required fewer input parameters, and are often preferred at sites with limited time-series water level data. A steady-state model is appropriate for this site because the model is set up to analyze the worst-case scenario in which all the surrounding wells are pumping simultaneously at a specific time of year. It does not aim to provide time-series output data; rather it provides a snapshot of the results for average flow conditions.

- Only one layer can be simulated – A single layer model is appropriate because both the mine well and mine pit will be located within the surficial aquifer. As stated in the hydrogeologic conceptual model, the surficial aquifer has significantly higher hydraulic conductivity and transmissivity than the bedrock aquifers and is therefore treated separately.

- It is difficult to model sloping aquifers – The surficial aquifer base slopes northward at approximately 4%, resulting in increased transmissivity moving from south to north, all other parameters remaining constant. The wells nearest the Site that would be most affected by water withdrawals at the Site have a similar or lower base elevation for the surficial aquifer than the average aquifer thickness of 85 feet – the thickness used in the model. This means that transmissivity at these well locations will be similar to or greater than the transmissivity used in the model, making the model conservative in that it is more likely to overestimate the drawdown at these locations.

Overall, WhAEM is an acceptable modeling tool for this project given the goals of the model and the limitations of the modeling program.

Several assumptions were made in the development of the model:

1. Water use requirements for the mining operation will range from 0 to 200 gallons per minute – Based on the anticipated aggregate washing operations and dust suppression activities, maximum water use is expected to be approximately 100 gallons per minute. For this exercise, a conservative upper bound of 200 gallons per minute was used.

2. Water use requirements for other properties range from 12 to 300 gallons per minute – Of the 24 water supply wells in the vicinity of the site, 19 are located a residences and have been assumed to have a water supply demand of 12 gpm. Assumed water use values for the remaining 5 wells are as follows:
    a. Metropolitan Mosquito Control District (Well 2): 20 gpm

b. Juvenile Alternative Facility (Well 3): 40 gpm
c. S.C.A.L.E. building water supply (Wells 4 & 5): 50 gpm
d. S.C.A.L.E. training exercise wells (Well 6): 300 gpm

3. The aquifer is unconfined – Surficial geology consists of alluvial deposits of sand and gravel with varying amounts of fine-grained material. None of the soil borings completed at the site show evidence of a buried confining layer within the aquifer.

4. Regional recharge rate = 0.001 ft/day – Typical rainfall amounts for the Twin Cities metro area are around 28.0 to 30.0 inches per year, which results in an average of 0.006 to 0.007 feet per day. A recharge rate of 0.001 feet per day was chosen to account for water lost to evaporation and plant uptake and transpiration.

5. Effective porosity of the aquifer was estimated at 0.3 – This value is reasonable based on the relatively coarse-grained nature of the aquifer.

6. All linesinks are fully penetrating – This is valid because the only linesinks used are located in the alluvial sediments and are either in direct contact with the water table (e.g. the ponds and streams between Valley View Drive and the Minnesota River) or occur above the water table but have little resistance to infiltration (e.g. Sand Creek).

7. The Mine Pit pond is a source of groundwater discharge – Mining will occur below the water table; therefore the mine pit pond will be a direct expression of the water table. There are two primary factors in classifying the Mine Pit as a groundwater sink:
   - Physical removal of aquifer substrate – The volume of sand and gravel removed will be replaced by groundwater as mining progresses. For the model the rate of excavation was set at 2700 tons per day.
   - Net evaporation from the surface of the Mine Pit pond – Net evaporation is calculated as total evaporation minus direct precipitation on the pond surface minus surface runoff into the pond. For the model it was assumed that the pond is at its final areal extent of 36 acres and that evaporation is occurring during July.

These two discharge mechanisms result in a water removal rate of 370 gallons per minute. Calculations are included in Appendix C. It is important to note that this removal rate represents a conservative scenario. The model uses evaporation data for July; and net evaporation is 33% greater in July than in June, the month with the next highest net evaporation, and 177% greater than the average yearly net evaporation.

8. Sand Creek is a losing stream in the vicinity of the Site and should not be considered a groundwater sink for purposes of the model – Base flow measurements in Sand Creek obtained from the USGS Water Data Report for the year 2003 (Mitton et al, 2003) demonstrate that discharge in Sand Creek decreases between downtown Jordan and Lynnville Drive, which is the old road bed adjacent to the northeast of the Site that previously connected Valley View Drive to U.S. 169. Discharge measurements from downtown Jordan show a discharge of approximately 1.8 cubic feet per second (cfs), while at Lynnville Drive the discharge had decreased to less than 1.1 cfs; resulting in a loss of over 60,000 cubic feet of water per day between the two locations. This indicates that Sand Creek is not only not being appreciably recharge by groundwater through this reach, but is actually losing water to infiltration and evaporation. Additionally, hydrograph data from stream monitoring reports prepared by Metropolitan Council Environmental Services (MCES) for the years 2003 and 2004 show flows at or near zero during base flow conditions (MCES 2003, 2004). It is likely that Sand Creek is recharged mostly from surface water runoff from the upland/bluff areas where low-permeability glacial sediments are predominant. Once Sand Creek enters the alluvial setting of the river valley, water begins to infiltrate and the Creek becomes a losing stream in the vicinity of the site. During high water table conditions groundwater may recharge Sand Creek; however for the purposes of the groundwater model the stream is not a significant sink for groundwater and is therefore not modeled as a linesink element. Although this reach of Sand Creek has negligible base flow, it is still useful to model the change in water table elevation at the location of the Creek. This is done by placing test points at various locations along Sand Creek within the model. The model then provides head measurements at these test point locations, allowing drawdown calculations to be performed.

4.1 Model Results

4.1.1 Static Conditions

The modeled static water table in the vicinity of the Site is shown in Figure C5. In order to assess the model's representation of reality, both simulated and measured/calculated water levels have been plotted for wells and piezometers completed in the surficial aquifer for which water level measurements are available. Additionally, the residuals for each pair of observations have also been plotted. Specific water levels from wells are not included as model inputs in analytic element models so it is not unexpected that modeled water elevations do not match up exactly with measured values, but the numbers should be similar. Comparing the modeled and observed values at each location indicates that the model is an acceptable representation of actual water table conditions, particularly on the Site itself. Residuals for the monitoring wells/piezometers are all less than 0.8 feet, with a mean residual of 0.4 feet. Residuals have also been plotted graphically on Figure C6. The diagonal line shown on the plot represents the zero-residual line, i.e. the line upon which the observed value equals the modeled value. Ideally points would be as close to this line as possible. The maximum residual is 7.52 feet and occurs at Well 1, which is the Stich Property well to the east of the Site. This is more than twice the magnitude of the next highest residual of 3.11 feet at Well 3. Residuals are significantly greater for water levels obtained from CWI records, and the mean residual for these wells is 2.91. This is not unexpected because of the accuracy associated with the elevation data listed on well logs. Many times the most accurate maps available upon which to identify the well location have 5-foot contour intervals, leading to estimated elevations that are less useful for model calibration. Despite the uncertainty associated with the well log groundwater elevations, with the exception of Well 1 the remainder of the well log elevations generally conform to the modeled water table. For example, Well 6 and Well 7, which are approximately 2900 feet apart, have a modeled head difference of 7.44 feet and a calculated head difference of 7 feet.

4.1.2 Drawdown

Drawdown was obtained by calculating the difference in modeled groundwater elevations between static conditions and pumping conditions under four different scenarios, as shown in Figures C7 through C10. In the figures, each of the wells in the vicinity of the Site is labeled as 'Well x', and the test points representing the locations of Sand Creek are denoted by circles labeled 'SC-x'. Results from each of the scenarios are presented below:

<u>Scenario 1 – Static Conditions (See Figure C7)</u>
No drawdown occurs under static conditions because none of the water wells are pumping; hence the discharge column shows all zeros.

<u>Scenario 2 – Surrounding Wells Pumping (See Figure C8)</u>
In this scenario, all of the vicinity wells (NOT including the Mine Well) screened in the surficial aquifer have been set to a specified discharge value. Drawdown is then calculated using the water levels from static and pumping conditions. It is important to note that wells completed in the bedrock aquifers have not been included in the model, however a drawdown value has still been computed for the location of each well. For those wells showing zero discharge, the drawdown is for the well *location* (within the surficial aquifer), not for the well itself. This scenario was performed to establish baseline drawdown conditions so that when the Mine Well is added to the model it is possible to differentiate drawdown attributable to the Mine Well from drawdown attributable to the surrounding wells.

<u>Scenario 3 – Surrounding Wells and Mine Well Pumping (See Figure C9)</u>
In this scenario all the surficial aquifer wells, including the Mine Well, are pumping. Subtracting the total drawdown in this scenario from the drawdown values generated in scenario 2 results in values for drawdown attributable to the Mine Well. The largest magnitude total drawdown is 11.22 feet at Well 6, which is screened at a depth of 163 feet below ground surface. The remaining well locations experience total drawdown of 0.2 to 4.1 feet. The largest magnitude drawdown attributable to the Mine Well, other than at the location of the Mine Well itself, is 1.00 feet observed at Well 6. Based on the Sand Creek test points, pumping at the Mine Well

results in an average drop in the water table elevation through this reach of approximately 0.6 feet. As stated previously, Sand Creek is a losing stream through this reach so the drop in groundwater elevation is not likely to have a large impact on discharge volume in the creek.

Scenario 4 – Water Withdrawal via the Mine Pit (See Figure C10)

In this scenario all the surficial aquifer wells surrounding the Site are pumping and the Mine Pit pond is discharging groundwater at a rate of 370 gallons per minute. In the previous three scenarios the Mine Pit has not been a factor in the model output so it was not necessary to assign specific hydraulic properties to it. In this scenario the Mine Pit is a factor in the model solution, so it has been modeled as an inhomogeneity with a *k* value of 500 feet/day. This allows the model to reflect the change in gradient resulting from the presence of the open water in the Mine Pit. The gradients are steeper at the edges of the pond and flat across the pond.

The largest total drawdown in this scenario is 10.89 feet at Well 6. The remaining well locations experience total drawdown of 0.26 to 4.2 feet. The largest magnitude drawdown attributable to the Mine Pit is 1.0 feet at the Mine Well; while the remaining well locations experience less than one foot of Mine Pit-attributable drawdown. Based on the Sand Creek test points, the Mine Well results in an average drop in the water table elevation through this reach is approximately 1.8 feet.

Based on the drawdown results in the scenarios above, the effect of the Mine Well and the Mine Pit on the water table will be small. Water supply wells in the vicinity will not be adversely affected, as none of the wells experience a drawdown of greater than 7% of their total depth under the most conservative scenario in which all the wells are pumping and the maximum amount of evaporation is occurring.

4.1.3 Particle Tracking and Well Capture Zones

The following scenarios analyze particle flow paths and well capture zones under variable pumping conditions, as shown in Figures C11 through C15. Particle flow paths originating from the Mine Pit are shown beginning at the dots along the northwestern edge of the pit. The flow

paths represent a five-year travel time from the origin to the point where the line stops. In the scenarios in which wells are pumping, five-year capture zones are illustrated by orange lines extending in the upgradient direction (southeast) from the wells. For particle tracking and capture zone analysis, the Mine Pit has again been modeled as an inhomogeneity with k = 500 ft/day.

Scenario 1 – Static Conditions (See Figure C11)

This scenario depicts groundwater movement under static conditions when none of the vicinity wells are pumping. Particle flow paths proceed uniformly to the northwest. Of the surrounding water supply wells, Well 6 and Well 12 occur within the envelope of particle flow paths moving to the northwest in the direction of groundwater flow.

Scenario 2 – Surrounding Wells Pumping (See Figure C12)

In this scenario all the surrounding wells with the exception of Well 6 and the Mine Well are pumping. Capture zones are depicted for each of the pumped wells and indicate that Wells, 4, 5 and 12 receive water originating from the Mine Pit, and Well 13 receives water originating from within the mine boundary.

Scenario 3 – Surrounding Wells and Mine Well Pumping (See Figure C13)

In this scenario, all of the surrounding wells (including the Mine Well) with the exception of Well 6 are pumping. Capture zones indicate that the Mine Well receives all of its water from the Mine Pit. Wells 4, 5 and 12 also receive water from the Mine Pit. The capture zone for Well 13 is within 10 feet of the mine boundary

Scenario 4 – Surrounding Wells and S.C.A.L.E. Well Pumping (See Figure C14)

In this scenario, all of the surrounding wells (including Well 6) with the exception of the Mine Well are pumping. Capture zones indicated that Wells 4, 5, 6 and 12 receive water from the Mine Pit. The capture zone for Well 13 remains within 10 feet of the edge of the mine boundary – similar to its position in previous scenarios.

Scenario 5 – All Wells Pumping (See Figure C15)

In this scenario all of the surrounding wells, including both Well 6 and the Mine Well, are pumping. Capture zones indicate that the Mine Well and Well 6 receive water from the Mine Pit. The capture zone for Well 12 has moved away from the Mine Pit due to pumping at the Mine Well but still occurs within the mine boundary. The capture zone for Well 13 is within 100 feet of the mine boundary.

Overall, in the case of potential contamination of the Mine Pit water the Mine Well would be most susceptible to groundwater impacts, as it receives the entirety of its water supply from the Mine Pit area and the groundwater travel time from the pit to the well is the shortest of any of the surrounding wells. Well 6 also captures water from the Mine Pit and would be susceptible to groundwater impacts. However; because Well 6 also captures water from outside the mine boundary and the groundwater travel time is greater than for the Mine Well the magnitude of the impacts would likely be less at Well 6 than at the Mine Well. Groundwater impacts could potentially be observed at the locations of Wells 4, 5, and 12, given the proximity of their capture zones to the Mine Pit. Impacts at the location of Well 13 related to the Mine Pit are unlikely, as this well is more sidegradient than downgradient of the pit; however groundwater contamination resulting from a surface spill in the far southwest corner of the mine could result in impacts at Well 13.

5.0 Conclusion

Using the groundwater flow model created by WhAEM, it was possible to present a quantitative assessment of the impacts of the Mine Well and Mine Pit on the water table and groundwater flow direction in the vicinity of the Site.

Based on the modeled drawdown values, the surficial aquifer is able to sustain the additional withdrawals associated with the mining project without adverse affects on surrounding wells or base flow conditions in Sand Creek. In conservative scenarios in which all wells are pumping and evaporation losses are at their yearly maximum, drawdown associated with the Mine Well range from 0.2 to 1 foot at the locations of off-site wells and drawdown associated with evaporation and excavation from the Mine pit range from 0.1 feet to 1.5 feet in the vicinity of the

Site. Sand Creek is a losing stream in the vicinity of the Site in low-flow conditions, so the lowering of the water table will not have a significant impact on discharge volume in creek.

Based on the modeled capture zones, the Mine Well as well as Wells, 4, 5, 6 and 12 receive water from the Mine Pit during pumping. Well 13 receives water from near the mine boundary. If groundwater contamination were to occur at the Site these wells would have the greatest potential for groundwater impacts at the well location. Monitoring wells have been installed along the northwest boundary of the mine, directly downgradient of the Mine Pit, so that periodic groundwater sampling and analysis may be performed.

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Tables

TABLE C1
NEARBY WATER WELLS
Jordan Aggregates Proposed Sand & Gravel Mine

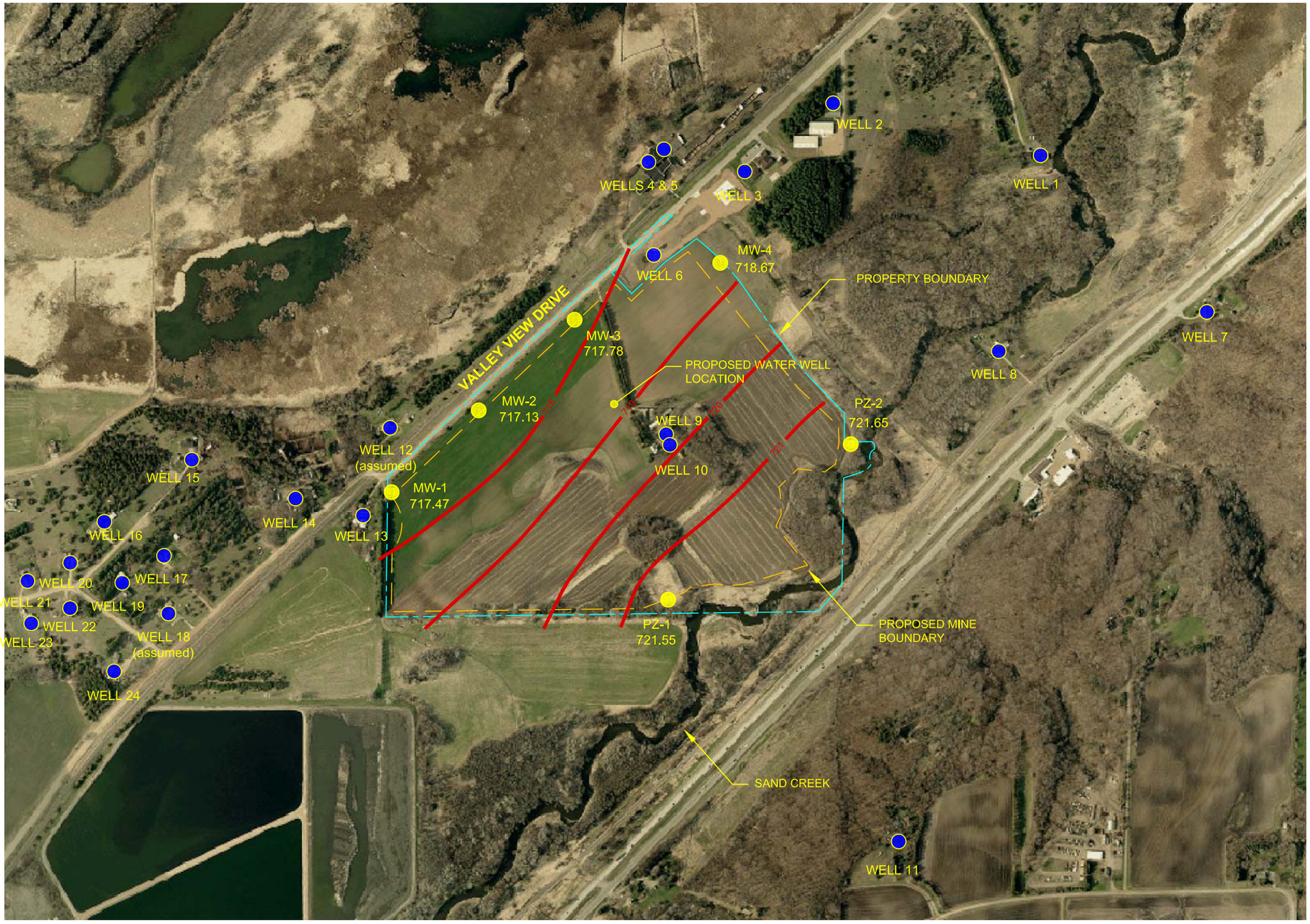
Well Common	Unique Well ID	Owner name	Surface Elevation	Well Depth	Depth to Bedrock	Unit Completed In	Static Water	Notes
1	404675	Stich, Edwin	737	60	NE	Surficial sand & gravel aquifer	728[C]	Well located approximately 1900' NE of Project Site
2	474684	Metropolitan Mosquito Control District	740	117	NE	Surficial sand & gravel aquifer	720[C]	Well located approximately 1200' NE of Project Site
3	595225	Scott County	746	131	NE	Surficial sand & gravel aquifer	720[C]	Well located approximately 560' NE of Project Site
4	NA	Abbott Northwestern Hospital	739	179	176	Surficial sand & gravel aquifer	NA	Located near main building - approximately 530' N of Project Site
5	NA	Linville Family CTR	734	179	179	Surficial sand & gravel aquifer	NA	Located near main building - approximately 530' N of Project Site
6	753654	Scott County	740	163	NE	Surficial sand & gravel aquifer	719[C]	S.C.A.L.E. training well - located approximately 100' NW of Project Site
7	443648	Alexon, Patrick	738	93	NE	Surficial sand & gravel aquifer	726[C]	Well located approximately 2400' E of Project Site
8	760017	Chermak, Otto	NA	NA	NA	NA - assumed surficial sand & gravel aquifer based on nearby wells	NA	Well located approximately 1300' E of Project Site
9	207419	Hentges, Steve	742	174	138	Shale - Franconia Fmn.	716[C]	Well located near center of Project Site
10	207418	Hentges, Steve	742	158	116	Shale - Franconia Fmn.	NA	Well located near center of Project Site
11	150106	Sperbeck, Craig	935	260	190	Sandstone - St. Lawrence Fmn.	730[C]	Well located approximately 1700' SE of Project Site
12	NA	Robling, Kenneth & Amy	NA	NA	NA	NA - assumed surficial and & gravel aquifer based on nearby wells	NA	300' NW of the Project Site. No Unique Well ID number is available for this well and a phone message left at the number listed for the property was not returned. Based on depths of nearby wells, it is anticipated that the well is over 100 feet deep
13	NA	Wayne, Phyllis	736	<=105[B]	NA	Surficial sand & gravel - assumed based on well depth	NA	One well is located near the homestead approximately 200' from the Project Site. No Unique Well ID number is available for this well; however the property owner stated that the well is 105' deep
14	70W0005585[A]	Schenck, Lawrence & Mary	NA	NA	NA	NA - assumed surficial sand & gravel aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 500' NW of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
15	498564	Larca, Lucy	765	200	152	Shale - Franconia Fmn.	705[C]	Well located approximately 1200' W of Project Site
16	211711	Pauly, Myron	785	265	160	Shale - Franconia Fmn & Sandstone - Ironton-Galesville Fmn.	727	One well presumably located near the homestead approximately 1700' W of the Project Site
17	70W0005202[A]	Lennox, Jake & Janice	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 1700' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
18	NA	Cherro, Travis	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	Presumed to be one well located near the homestead approximately 1300' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that the well is over 100' deep
19	70W0005581[A]	Gallentine, Steven & Carolyn	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 1550' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
20	70W0005200[A]	Anderson, Kelly & Jodi	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 1800' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
21	70W0005201[A]	Plonski, William & Irene	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 2100' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
22	70W0005583[A]	Frey, Michael & Wanda	NA	NA	NA	NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 1800' W of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
23	510414	Gower, Martha	785	147	104	Sandstone - St. Lawrence Fmn. & Shale-Franconia Fmn.	710[C]	One well presumably located near the homestead approximately 2100' NW of the Project Site
24	70W0005587[A]	Elke, Michael & Lori	NA	NA		NA - assumed bedrock aquifer based on nearby wells	NA	One well presumably located near the homestead approximately 1640' SW of the Project Site. No Unique Well ID number is available for the well. Based on depths of nearby wells, it is anticipated that this well is over 100' deep
MW-1	767636	Hentges, Steve	739.10	30	NE	Surficial sand & gravel aquifer	717.47	Well located along northwest property boundary adjacent to Project Site
MW-2	767637	Hentges, Steve	730.51	21.5	NE	Surficial sand & gravel aquifer	717.13	Well located along northwest property boundary adjacent to Project Site
MW-3	767638	Hentges, Steve	730.59	21	NE	Surficial sand & gravel aquifer	717.78	Well located along northwest property boundary adjacent to Project Site
MW-4	767639	Hentges, Steve	738.53	28	NE	Surficial sand & gravel aquifer	718.67	Well located along northeast property boundary adjacent to Project Site
PZ-1	NA	Hentges, Steve	726.30	9	NE	Surficial sand & gravel aquifer	721.55	Well located along southeast boundary of Project Site
PZ-2	NA	Hentges, Steve	727.11	9	NE	Surficial sand & gravel aquifer	721.65	Well located along southeast boundary of Project Site

SEE FIGURE C1 FOR WELL LOCATIONS

[A] Well Identification number listed in County Well Index Database. A well is known to exist on site but no log is available.
[B] Well owner stated that well is 105' deep. Well maintenance contractor stated that depth is likely shallower due to the use of a 1/2 HP well pump.
[C] From County Well Index well log.

NE = not encountered
NA = no data available

Figures



SEE TABLE C1 FOR DETAILED WELL DATA SUMMARY

WELL NUMBER	MN UNIQUE WELL #	WELL DEPTH
1	404675	60
2	474684	117
3	595225	131
4	NA	179
5	NA	179
6	753654	163
7	443648	93
8	760017	NA
9	207419	174
10	207418	158
11	150106	260
12	NA	NA
13	NA	≤105
14	70W0005585	NA
15	498564	200
16	211711	265
17	70W0005202	NA
18	NA	NA
19	70W0005581	NA
20	70W0005200	NA
21	70W0005201	NA
22	70W0005583	NA
23	510414	147
24	70W0005587	NA
MW-1	767636	30
MW-2	767637	21.5
MW-3	767638	21
MW-4	767639	28
PZ-1	NA	9
PZ-2	NA	9

2008 AERIAL PHOTOGRAPHY OBTAINED FROM
SCOTT COUNTY ONLINE GIS UTILITY

721 — WATER TABLE ELEVATION CONTOUR (8-26-09)

WELL 6 — EXISTING WATER SUPPLY WELL

MW-1 717.47 — MONITORING WELL/PIEZOMETER
WATER LEVELS OBTAINED 8-26-09

N

0 150 300 600
APPROXIMATE SCALE IN FEET

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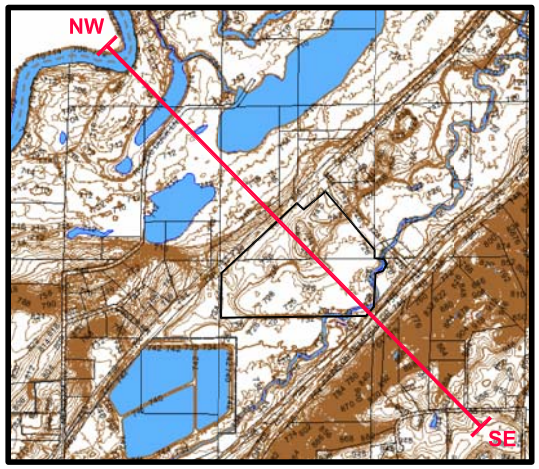
Maple Plain, MN 55359
ph 952-346-3900
fx 952-346-3901

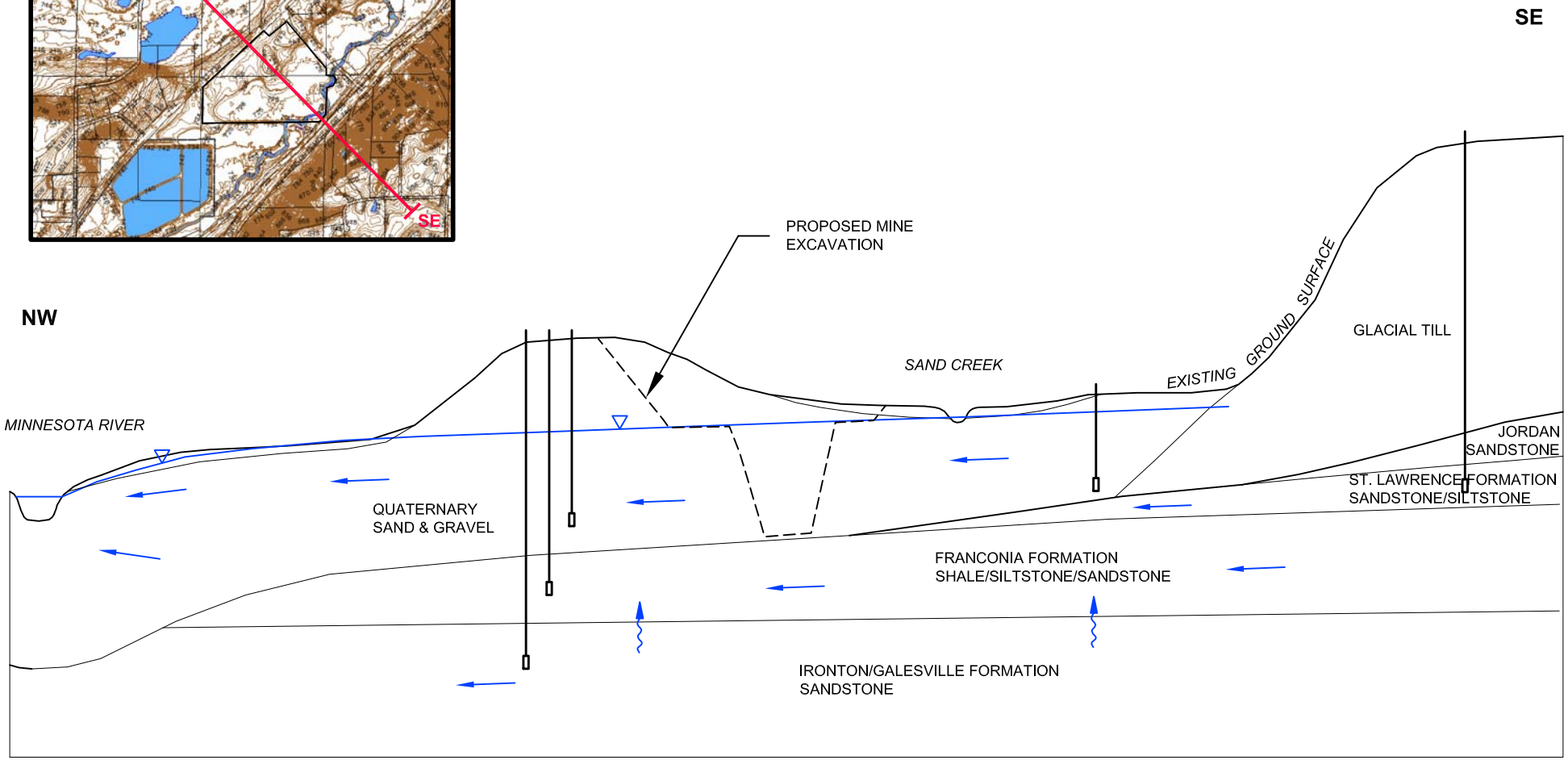
FIGURE C1

VICINITY WELLS

JORDAN AGGREGATES PROPOSED SAND AND GRAVEL MINE
SAND CREEK TOWNSHIP, MN

CROSS-SECTION ORIENTATION





GROUNDWATER TABLE

GROUNDWATER FLOW DIRECTION

WATER SUPPLY WELL (POSSIBLE LOCATION/DEPTH)

NOT TO SCALE

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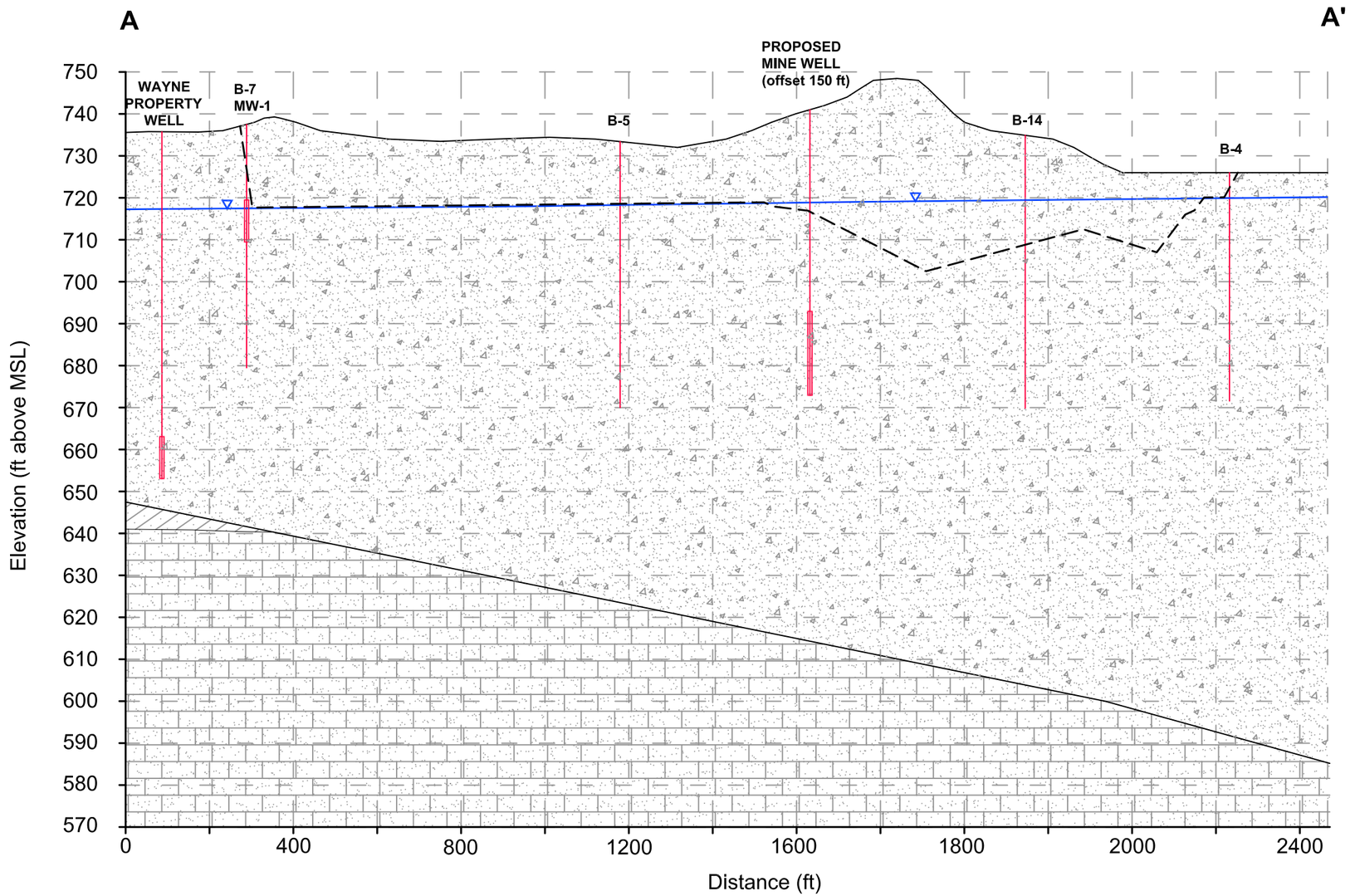
fx 952-346-3901

FIGURE C2

CONCEPTUAL GEOLOGIC CROSS-SECTION

JORDAN AGGREGATES PROPOSED SAND AND GRAVEL MINE
SAND CREEK TOWNSHIP, SCOTT COUNTY, MN



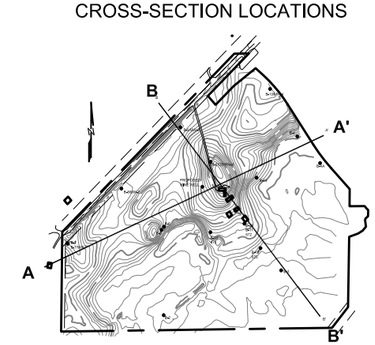
LEGEND

- SCREENED INTERVAL
- STATIC WATER ELEVATION (8-26-09)
- PROPOSED MINE EXCAVATION DEPTH
- UNCONSOLIDATED SAND & GRAVEL
- ST. LAWRENCE FORMATION; FINE SANDSTONE/SILTSTONE
- FRANCONIA FORMATION; SANDSTONE/SILTSTONE/SHALE

NOTES:

1) VERTICAL EXAGGERATION = 10X
2) BORING LOCATIONS OFFSET 20 TO 130 FEET FROM SECTION LINE
3) BEDROCK SURFACE ELEVATION OBTAINED FROM SCOTT COUNTY GEOLOGIC ATLAS

CROSS-SECTION LOCATIONS



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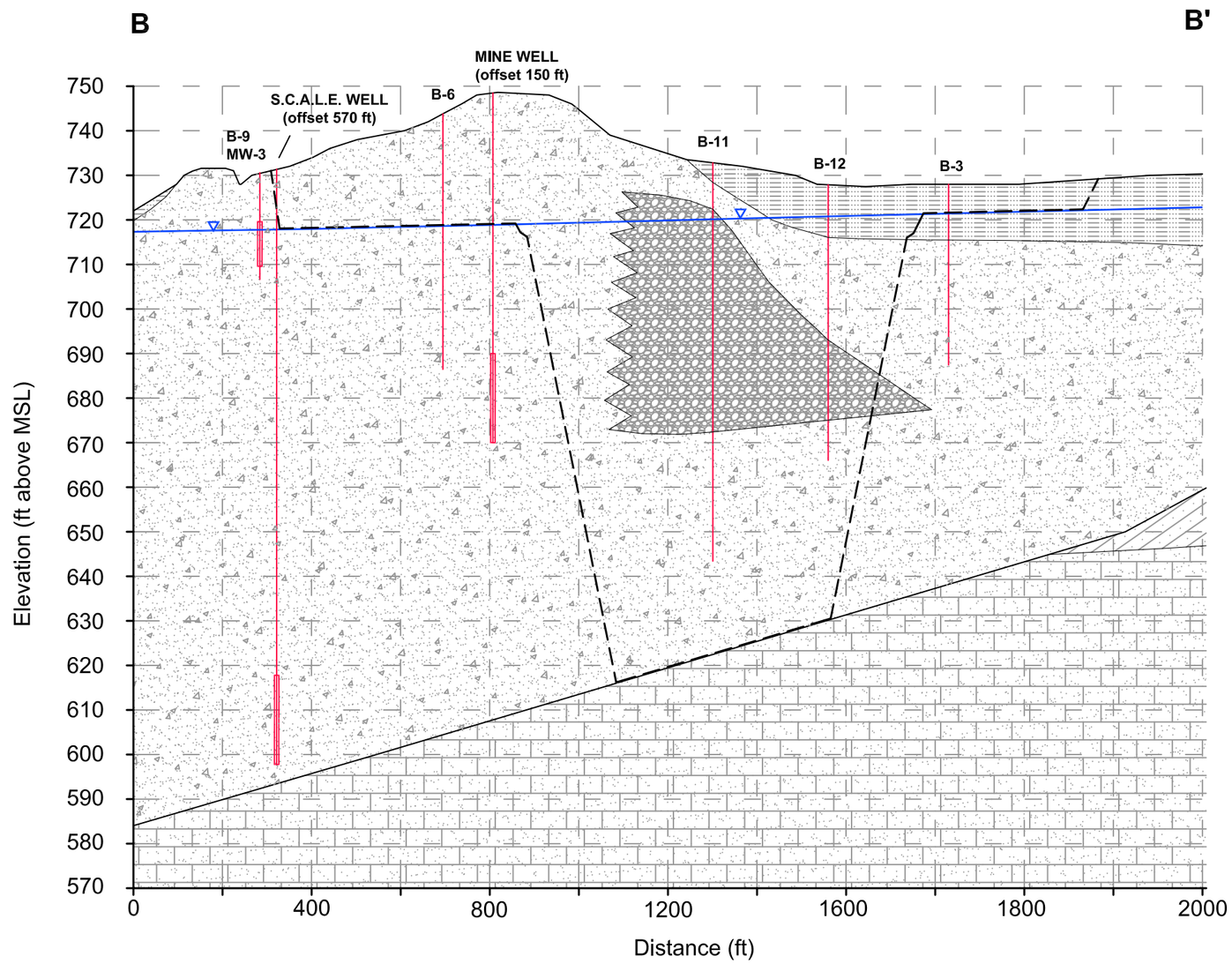
fx 952-346-3900

FIGURE C3

GEOLOGIC CROSS-SECTION A-A'

JORDAN AGGREGATES PROPOSED SAND AND GRAVEL MINE
SAND CREEK TOWNSHIP, SCOTT COUNTY, MN



LEGEND

- SCREENED INTERVAL
- STATIC WATER ELEVATION (8-26-09)
- PROPOSED MINE EXCAVATION DEPTH
- UNCONSOLIDATED SILT AND CLAY; FLOODPLAIN ALLUVIUM
- UNCONSOLIDATED SAND & GRAVEL
- FINE TO COARSE GRAVEL
- ST. LAWRENCE FORMATION; FINE SANDSTONE/SILTSTONE
- FRANCONIA FORMATION; SANDSTONE/SILTSTONE/SHALE

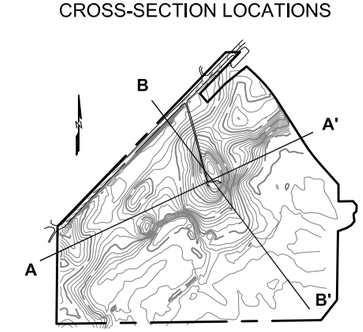
NOTES:

1) VERTICAL EXAGGERATION = 10X

2) BORING LOCATIONS OFFSET 20 TO 130 FEET FROM SECTION LINE

3) BEDROCK SURFACE ELEVATION OBTAINED FROM SCOTT COUNTY GEOLOGIC ATLAS

CROSS-SECTION LOCATIONS



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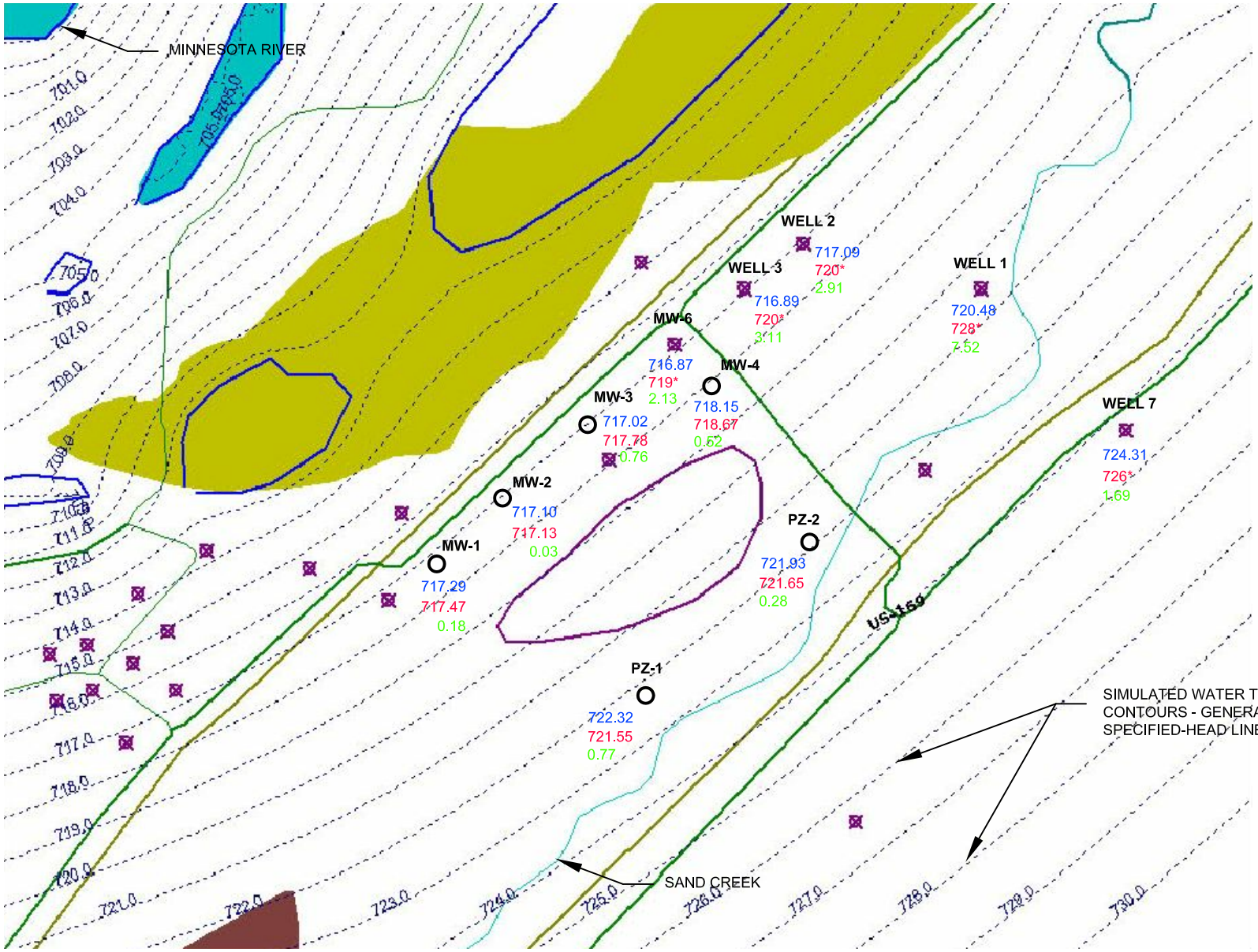
fx 701-255-1477

FIGURE C4

GEOLOGIC CROSS-SECTION B-B'

JORDAN AGGREGATES PROPOSED SAND AND GRAVEL MINE
SAND CREEK TOWNSHIP, SCOTT COUNTY, MN



717.29	MODELED GROUNDWATER ELEVATION
717.47	MEASURED GROUNDWATER ELEVATION - DIRECT FIELD MEASUREMENT (MONITORING WELL / PIEZOMETER)
720*	CALCULATED GROUNDWATER ELEVATION USING CWI WELL LOG (WATER WELL)
0.28	RESIDUAL (ABSOLUTE VALUE)

ALL DATA POINTS
MEDIAN RESIDUAL = 0.77
MEAN RESIDUAL = 1.81

MONITORING WELLS / PIEZOMETERS
MEDIAN RESIDUAL = 0.40
MEAN RESIDUAL = 0.42

WATER WELLS
MEDIAN RESIDUAL = 2.91
MEAN RESIDUAL = 3.47

N

APPROXIMATE SCALE:
1INCH = 956 FT

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Maple Plain, MN 55359
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fx 952-346-3901

FIGURE C5

MODELED WATER TABLE ELEVATION

JORDAN AGGREGATES PROPOSED SAND AND GRAVEL MINE
SAND CREEK TOWNSHIP, SCOTT COUNTY, MN

FIGURE C6
Observed vs. Modeled Groundwater Elevation
Jordan Aggregates Proposed Sand and Gravel Mine

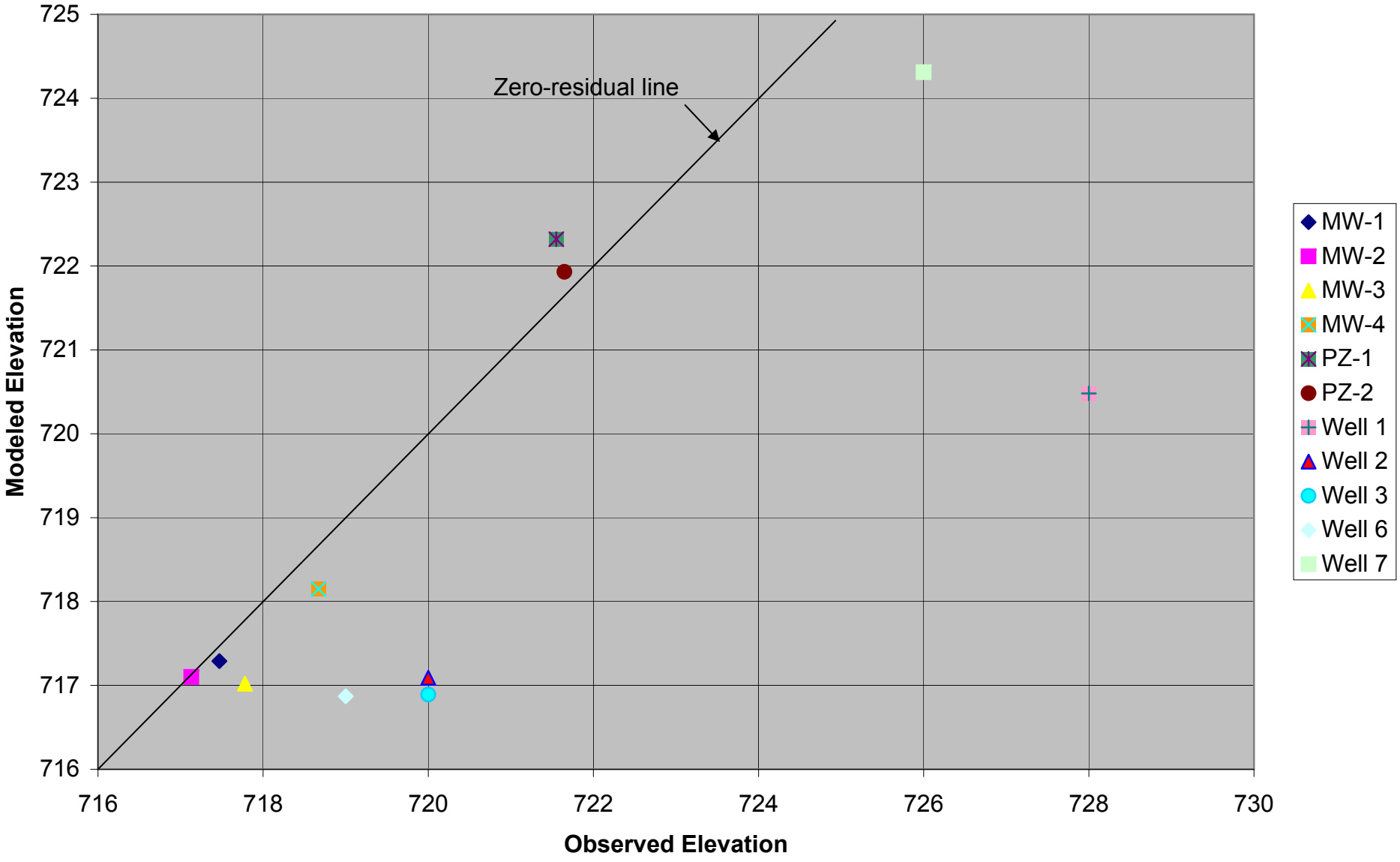
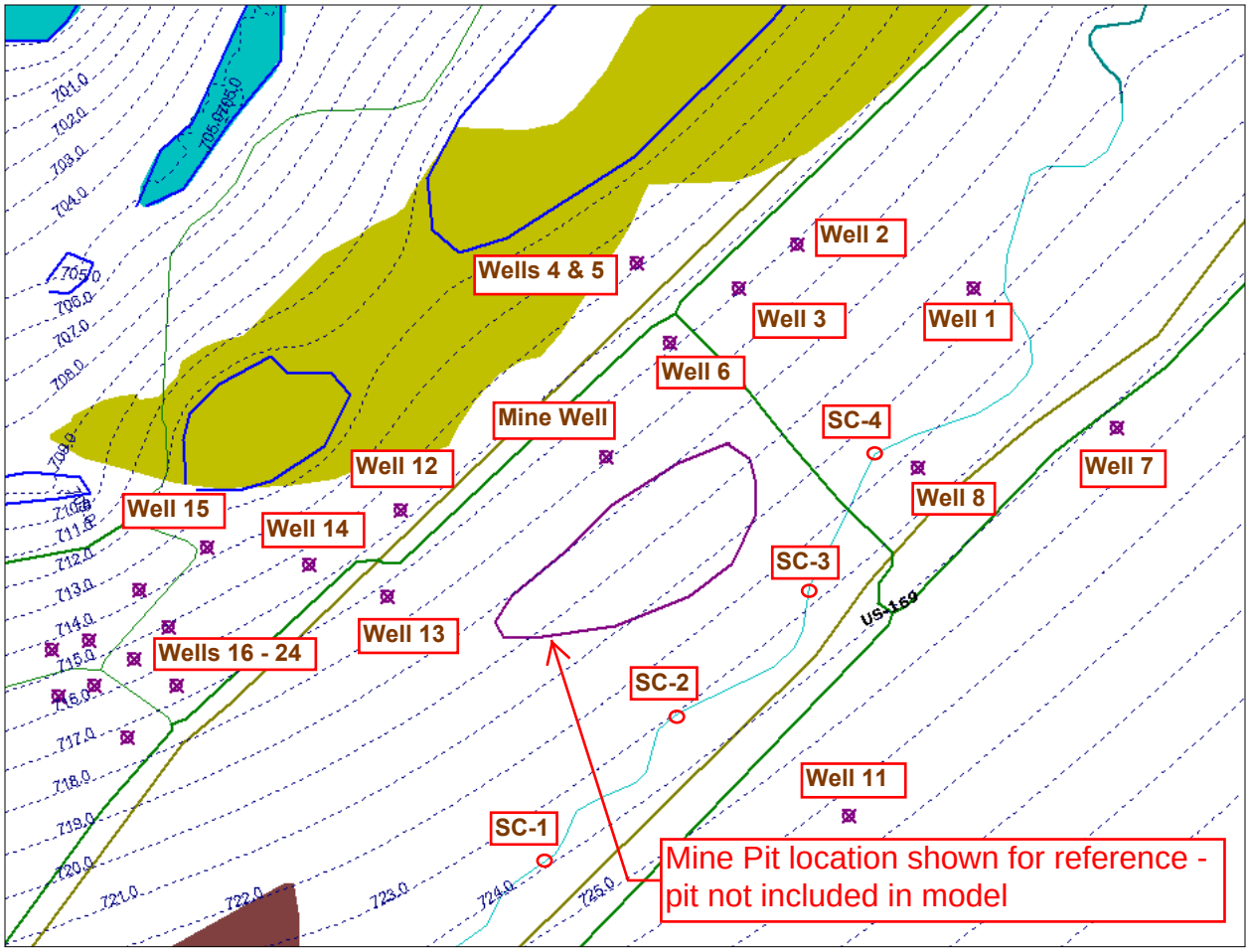
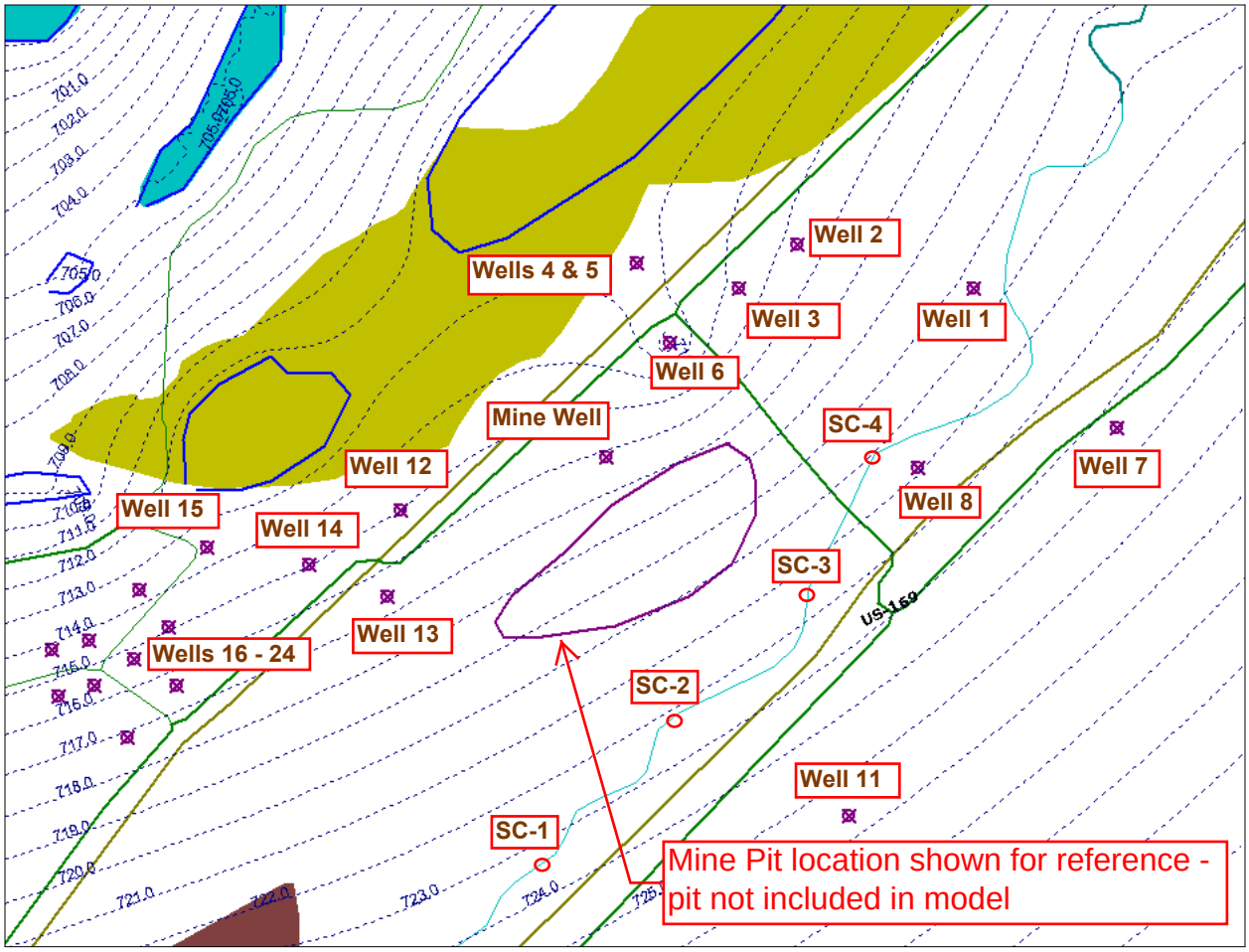


Figure C7 - Surficial Aquifer Water Table Drawdown: Scenario 1



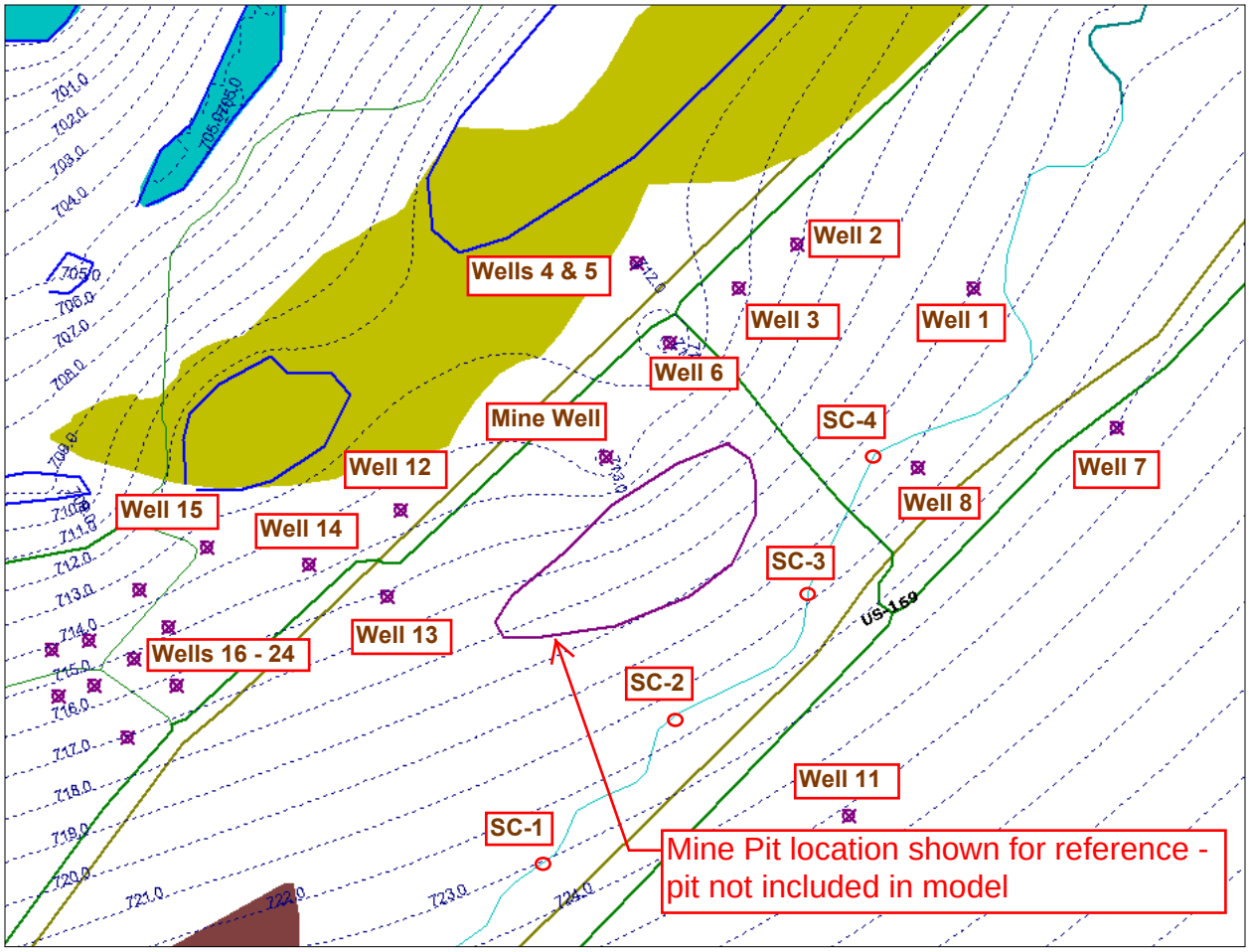
Location ID	Discharge (ft^3/day)	Water Level (ft msl)
Mining Well	0	717.93
Well 1	0	720.51
Well 11	0	726.38
Well 12	0	715.73
Well 13	0	717.32
Well 14	0	715.45
Well 15	0	713.69
Well 16	0	713.76
Well 17	0	715.09
Well 18	0	716.61
Well 19	0	715.49
Well 2	0	717.11
Well 20	0	714.46
Well 21	0	714.28
Well 22	0	715.71
Well 23	0	715.60
Well 24	0	717.33
Well 3	0	716.94
Well 6	0	716.87
Well 7	0	724.34
Well 8	0	722.34
Wells 4 & 5	0	714.88
SC-1	NA	723.90
SC-2	NA	723.09
SC-3	NA	722.70
SC-4	NA	721.54

Figure C8 - Surficial Aquifer Water Table Drawdown: Scenario 2



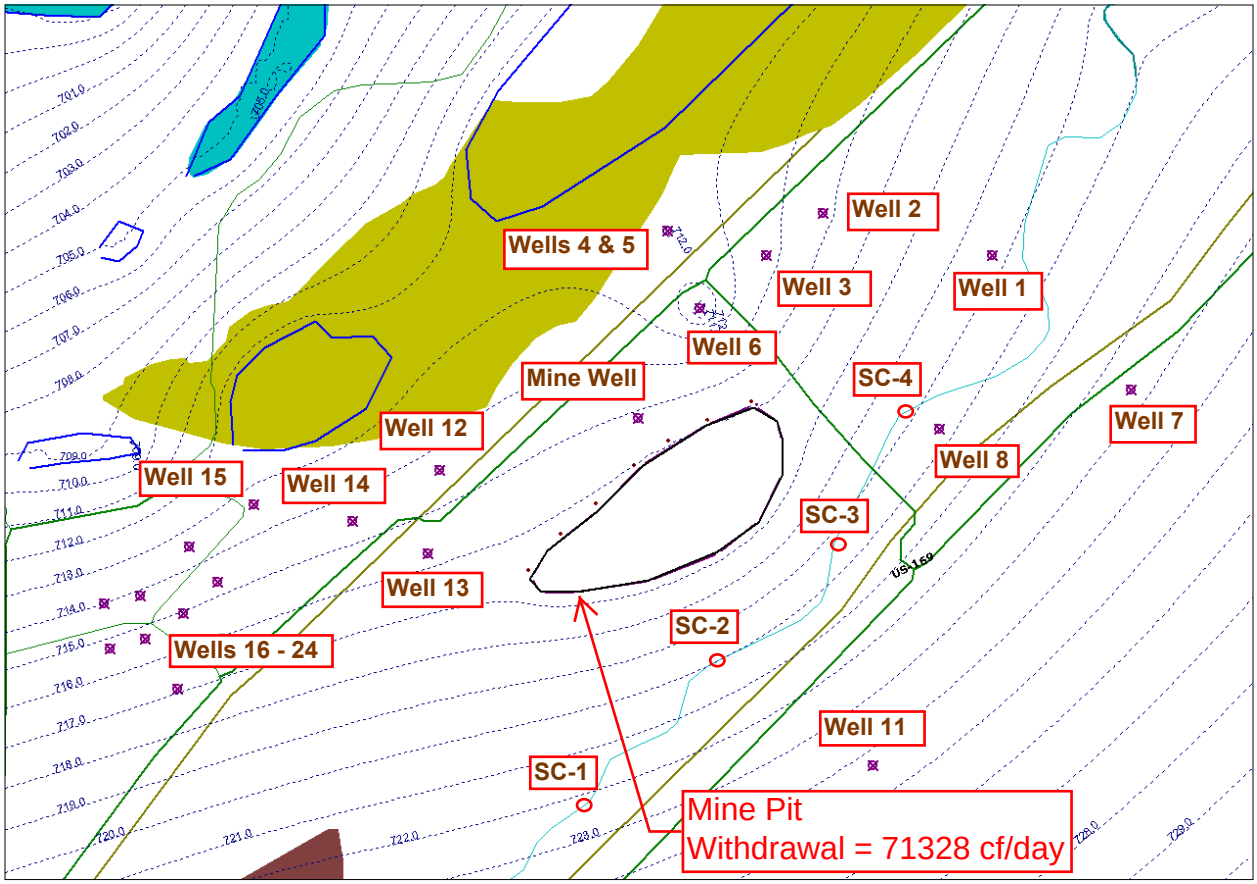
Location ID	Discharge (ft^3/day)	Water Level: Static (ft msl)	Water Levels: Pumping (ft msl)	Drawdown: Pumping (ft)
Mining Well	0	717.93	716.2	1.77
Well 1	2310	720.51	719.1	1.42
Well 11	0	726.38	725.6	0.75
Well 12	2310	715.73	714.8	0.97
Well 13	2310	717.32	716.3	0.98
Well 14	2310	715.45	714.7	0.74
Well 15	0	713.69	713.5	0.14
Well 16	0	713.76	713.6	0.13
Well 17	0	715.09	714.9	0.18
Well 18	0	716.61	716.4	0.21
Well 19	0	715.49	715.3	0.16
Well 2	3850	717.11	714.9	2.21
Well 20	0	714.46	714.3	0.12
Well 21	0	714.28	714.2	0.10
Well 22	0	715.71	715.6	0.14
Well 23	0	715.60	715.5	0.12
Well 24	0	717.33	717.2	0.17
Well 3	7700	716.94	713.4	3.51
Well 6	57754	716.87	706.6	10.23
Well 7	2310	724.34	723.1	1.20
Well 8	2310	722.34	720.7	1.67
Wells 4 & 5	9625	714.88	711.6	3.31
SC-1	0	723.90	723.4	0.51
SC-2	0	723.09	722.2	0.90
SC-3	0	722.70	721.4	1.25
SC-4	0	721.54	720.0	1.52

Figure C9 - Surficial Aquifer Water Table Drawdown: Scenario 3



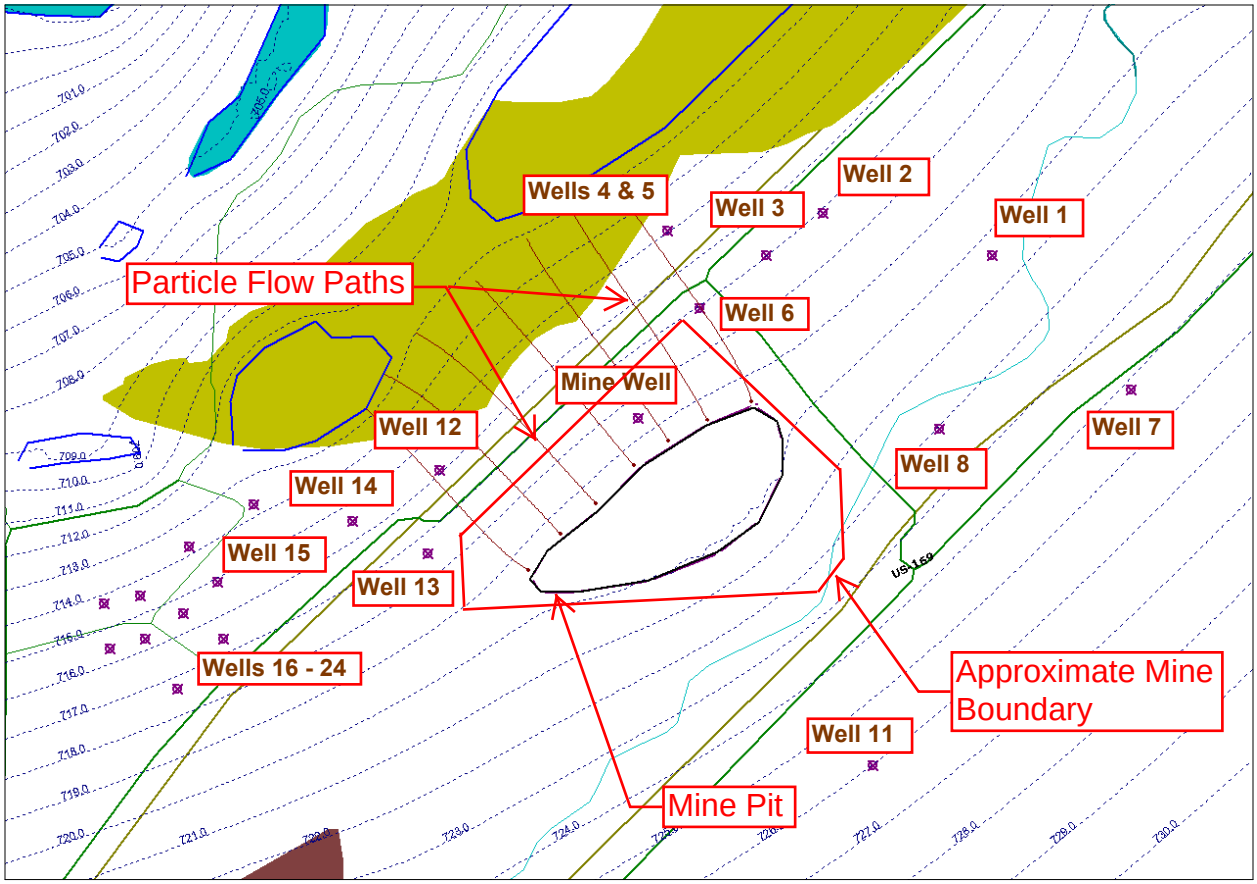
Location ID	Discharge (ft^3/day)	Water Level: Static (ft msl)	Water Levels: Surrounding Wells Pumping (ft msl)	Water Levels: All Wells Pumping (ft msl)	Drawdown: Total (ft)	Drawdown Contributed by Mine Well (ft)
Mining Well	38503	717.93	716.2	709.6	8.34	6.58
Well 1	2310	720.51	719.1	718.8	1.75	0.34
Well 11	0	726.38	725.6	725.2	1.18	0.44
Well 12	2310	715.73	714.8	714.3	1.46	0.48
Well 13	2310	717.32	716.3	715.9	1.42	0.45
Well 14	2310	715.45	714.7	714.5	0.98	0.24
Well 15	0	713.69	713.5	713.5	0.23	0.08
Well 16	0	713.76	713.6	713.6	0.21	0.08
Well 17	0	715.09	714.9	714.8	0.30	0.11
Well 18	0	716.61	716.4	716.3	0.34	0.13
Well 19	0	715.49	715.3	715.2	0.27	0.10
Well 2	3850	717.11	714.9	714.5	2.62	0.41
Well 20	0	714.46	714.3	714.3	0.20	0.08
Well 21	0	714.28	714.2	714.1	0.17	0.06
Well 22	0	715.71	715.6	715.5	0.23	0.09
Well 23	0	715.60	715.5	715.4	0.19	0.08
Well 24	0	717.33	717.2	717.1	0.27	0.11
Well 3	7700	716.94	713.4	712.8	4.10	0.59
Well 6	57754	716.87	706.6	705.6	11.22	1.00
Well 7	2310	724.34	723.1	722.8	1.52	0.32
Well 8	2310	722.34	720.7	720.1	2.23	0.56
Wells 4 & 5	9625	714.88	711.6	711.1	3.79	0.48
SC-1	NA	723.90	723.4	723.0	0.87	0.36
SC-2	NA	723.09	722.2	721.5	1.55	0.65
SC-3	NA	722.70	721.4	720.7	1.99	0.73
SC-4	NA	721.54	720.0	719.4	2.15	0.63

Figure C10 - Surficial Aquifer Water Table Drawdown: Scenario 4



Location ID	Discharge (ft^3/day)	Water Level: Static (ft msl)	Water Levels: Surrounding Wells Pumping (ft msl)	Water Levels: Wells+Mine Pit withdrawal (ft msl)	Drawdown: Total (ft)	Drawdown Contributed by Mine Pit (ft)
Mining Well	0	717.93	716.2	715.2	2.76	1.00
Well 1	2310	720.51	719.1	718.4	2.07	0.65
Well 11	0	726.38	725.6	724.3	2.07	1.32
Well 12	2310	715.73	714.8	714.1	1.64	0.67
Well 13	2310	717.32	716.3	715.4	1.88	0.90
Well 14	2310	715.45	714.7	714.2	1.20	0.47
Well 15	0	713.69	713.5	713.4	0.32	0.18
Well 16	0	713.76	713.6	713.5	0.31	0.18
Well 17	0	715.09	714.9	714.6	0.45	0.26
Well 18	0	716.61	716.4	716.1	0.53	0.32
Well 19	0	715.49	715.3	715.1	0.41	0.24
Well 2	3850	717.11	714.9	714.4	2.76	0.55
Well 20	0	714.46	714.3	714.2	0.30	0.18
Well 21	0	714.28	714.2	714.0	0.26	0.16
Well 22	0	715.71	715.6	715.4	0.35	0.21
Well 23	0	715.60	715.5	715.3	0.31	0.19
Well 24	0	717.33	717.2	716.9	0.43	0.27
Well 3	7700	716.94	713.4	712.8	4.16	0.66
Well 6	57754	716.87	706.6	706.0	10.89	0.66
Well 7	2310	724.34	723.1	722.4	1.96	0.76
Well 8	2310	722.34	720.7	719.4	2.94	1.27
Wells 4 & 5	9625	714.88	711.6	711.2	3.69	0.38
SC-1	NA	723.90	723.4	721.8	2.10	1.59
SC-2	NA	723.09	722.2	720.0	3.05	2.14
SC-3	NA	722.70	721.4	719.3	3.40	2.14
SC-4	NA	721.54	720.0	718.7	2.84	1.32

Figure C11 - Particle Travel Time / Well Capture Zones: Scenario 1



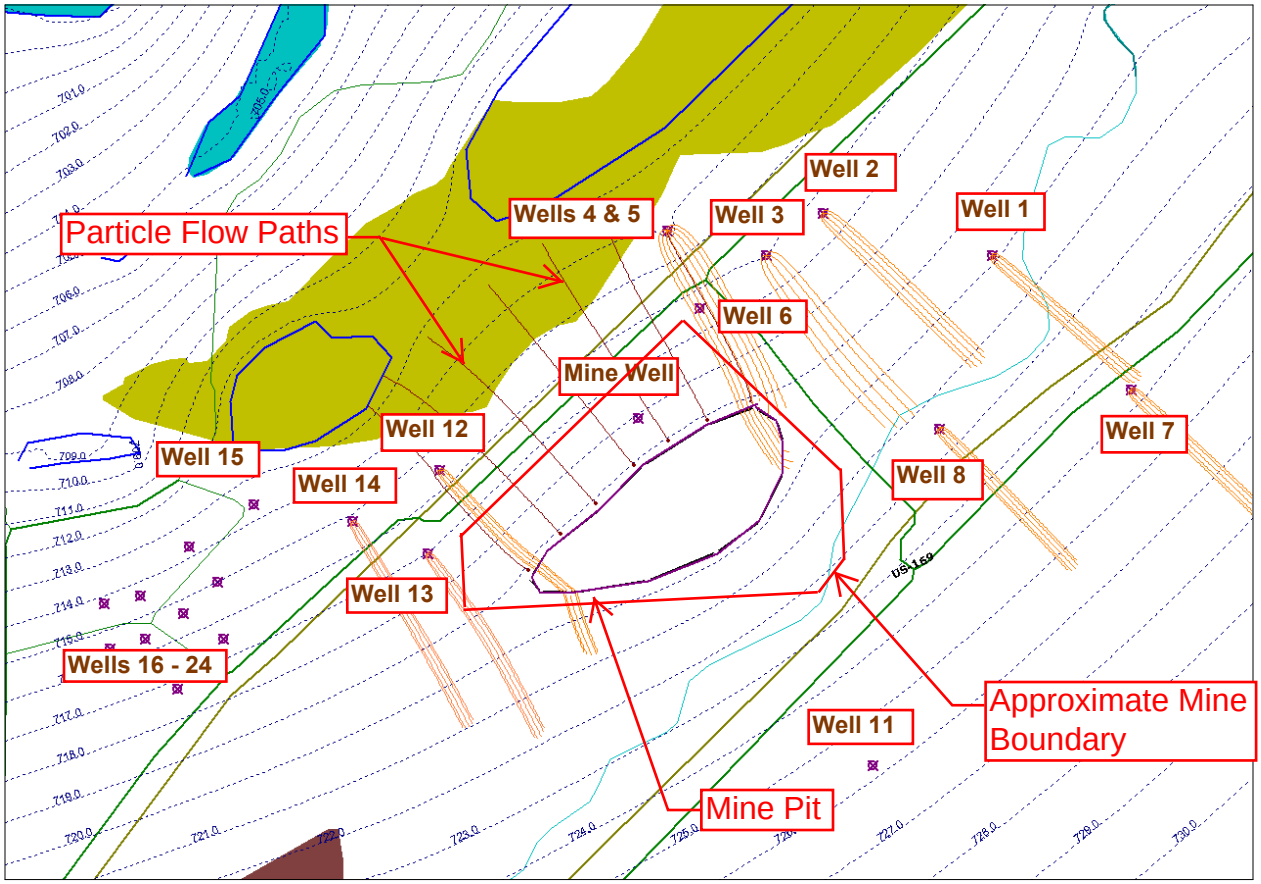
Location ID	Discharge (ft^3/day)
Mining Well	0
Well 1	0
Well 11	0
Well 12	0
Well 13	0
Well 14	0
Well 15	0
Well 16	0
Well 17	0
Well 18	0
Well 19	0
Well 2	0
Well 20	0
Well 21	0
Well 22	0
Well 23	0
Well 24	0
Well 3	0
Well 6	0
Well 7	0
Well 8	0
Wells 4 & 5	0

Notes:

1. Particle flow paths represent 5-year travel time.

Approximate Scale: 1inch = 1100 ft

Figure C12 - Particle Travel Time / Well Capture Zones: Scenario 2



Location ID	Discharge (ft^3/day)
Mining Well	0
Well 1	2310
Well 11	0
Well 12	2310
Well 13	2310
Well 14	2310
Well 15	0
Well 16	0
Well 17	0
Well 18	0
Well 19	0
Well 2	3850
Well 20	0
Well 21	0
Well 22	0
Well 23	0
Well 24	0
Well 3	7700
Well 6	0
Well 7	2310
Well 8	2310
Wells 4 & 5	9625

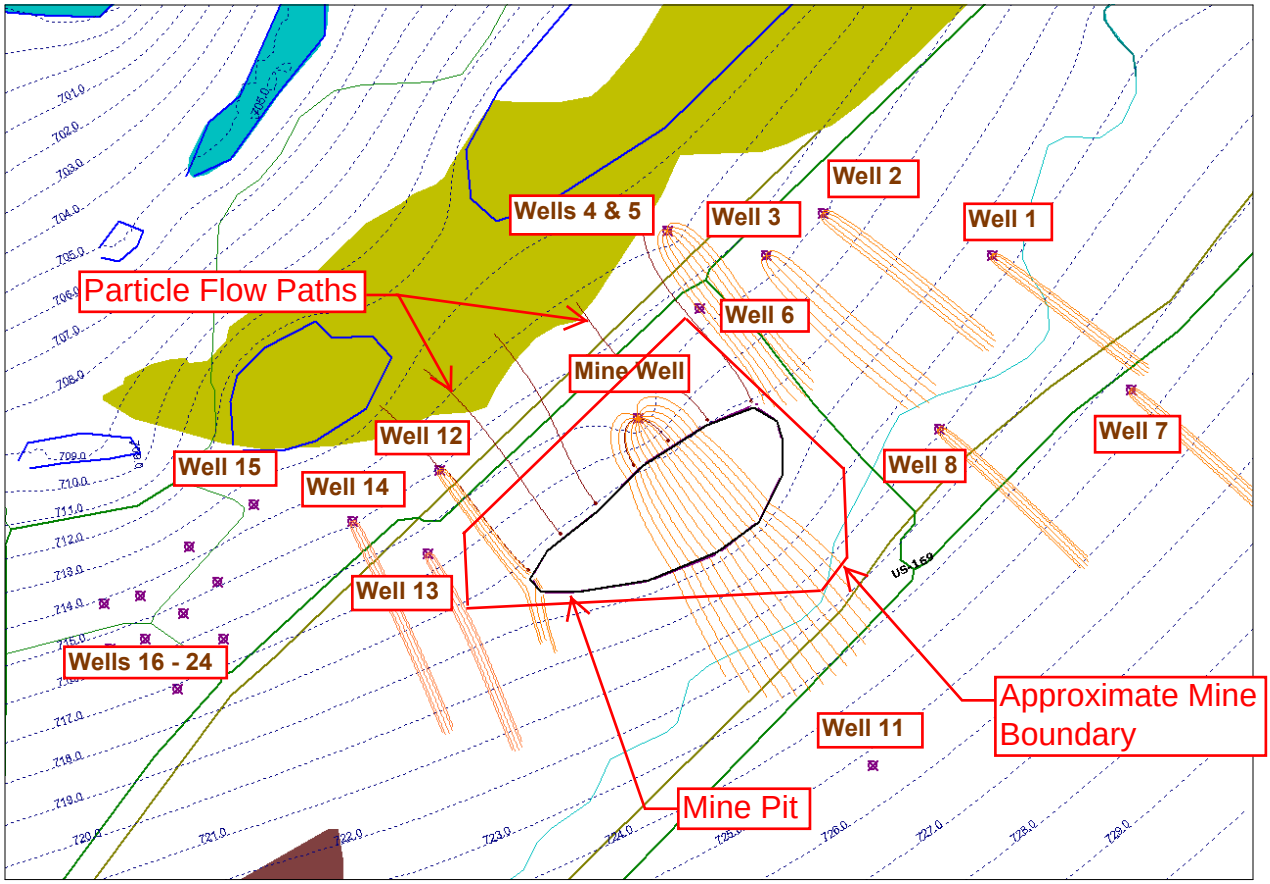
Notes:

1. Orange lines represent 5-year capture zone for well.

2. Particle flow paths represent 5-year travel time.

Approximate Scale: 1inch = 1085 ft

Figure C13 - Particle Travel Time / Well Capture Zones: Scenario 3



Location ID	Discharge (ft^3/day)
Mining Well	38503
Well 1	2310
Well 11	0
Well 12	2310
Well 13	2310
Well 14	2310
Well 15	0
Well 16	0
Well 17	0
Well 18	0
Well 19	0
Well 2	3850
Well 20	0
Well 21	0
Well 22	0
Well 23	0
Well 24	0
Well 3	7700
Well 6	0
Well 7	2310
Well 8	2310
Wells 4 & 5	9625

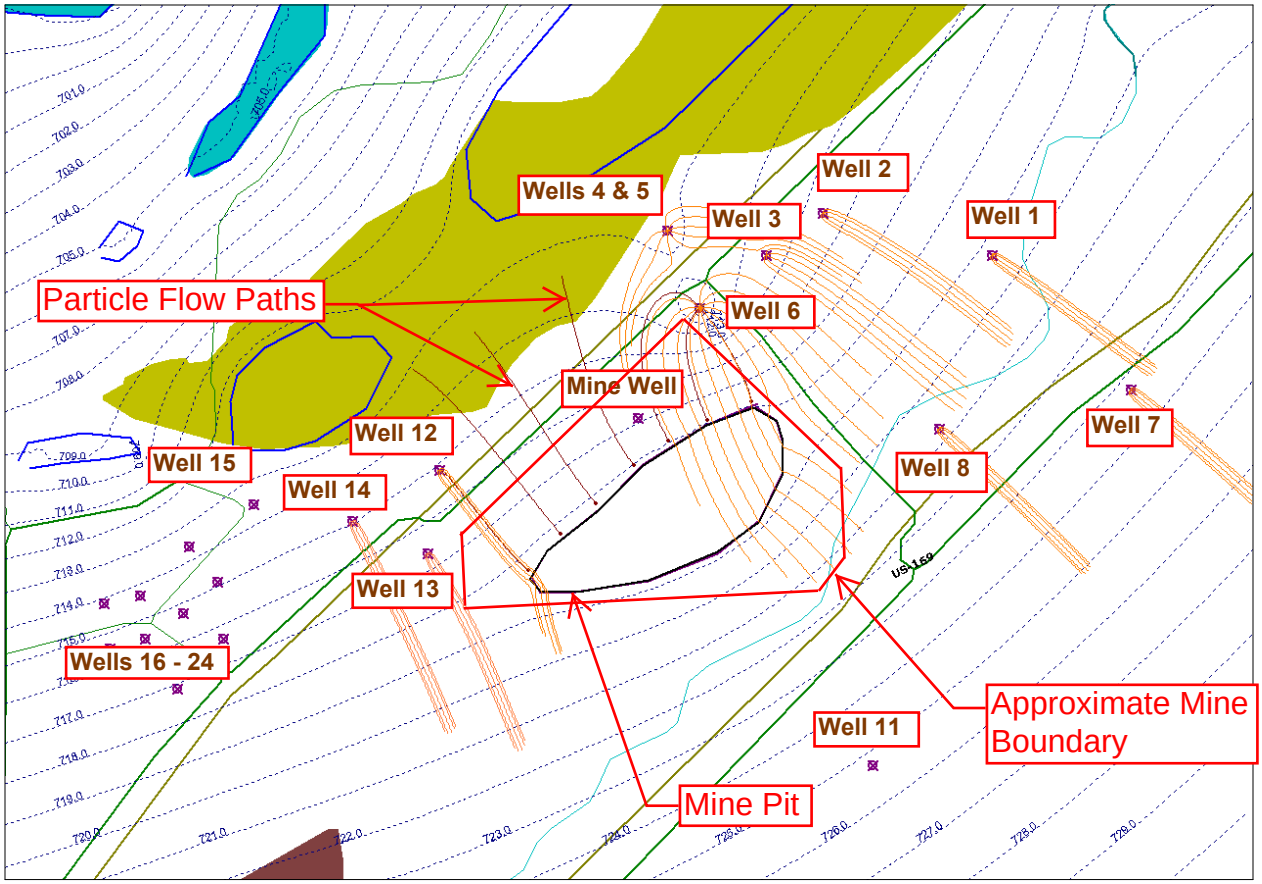
Notes:

1. Orange lines represent 5-year capture zone for well.

2. Particle flow paths represent 5-year travel time.

Approximate Scale: 1inch = 1085 ft

Figure C14 - Particle Travel Time / Well Capture Zones: Scenario 4



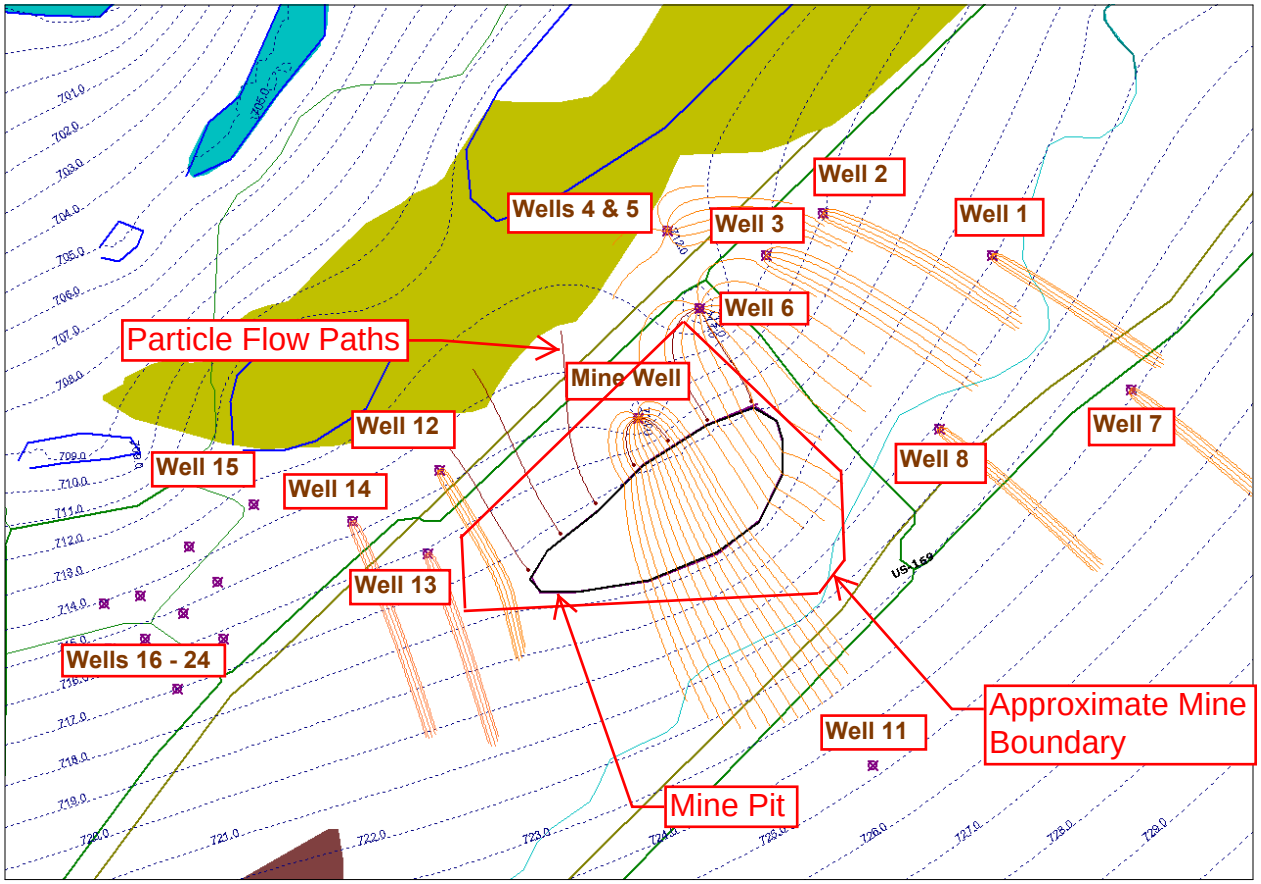
Location ID	Discharge (ft^3/day)
Mining Well	0
Well 1	2310
Well 11	0
Well 12	2310
Well 13	2310
Well 14	2310
Well 15	0
Well 16	0
Well 17	0
Well 18	0
Well 19	0
Well 2	3850
Well 20	0
Well 21	0
Well 22	0
Well 23	0
Well 24	0
Well 3	7700
Well 6	57754
Well 7	2310
Well 8	2310
Wells 4 & 5	9625

Notes:

1. Orange lines represent 5-year capture zone for well.
2. Particle flow paths represent 5-year travel time.

Approximate Scale: 1inch = 1085 ft

Figure C15 - Particle Travel Time / Well Capture Zones: Scenario 5



Location ID	Discharge (ft^3/day)
Mining Well	38503
Well 1	2310
Well 11	0
Well 12	2310
Well 13	2310
Well 14	2310
Well 15	0
Well 16	0
Well 17	0
Well 18	0
Well 19	0
Well 2	3850
Well 20	0
Well 21	0
Well 22	0
Well 23	0
Well 24	0
Well 3	7700
Well 6	57754
Well 7	2310
Well 8	2310
Wells 4 & 5	9625

Notes:

1. Orange lines represent 5-year capture zone for well.

2. Particle flow paths represent 5-year travel time.

Approximate Scale: 1inch = 1085 ft

Appendix A

Soil Boring & Well Logs

S.M.Hentges & Sons Inc.
SITE DEVELOPMENT · UTILITIES · TRUCKING · Est. 1981
650 Quaker Avenue • P.O. Box 69 • Jordan, MN 55352
Phone: 952.492.5700 • Fax: 952.492.5705 • www.smhentges.com • e-mail: mailbox@smhentges.com

July 1, 2009

John McCain

The following are for Boring Logs for Keefe's Property. Boring date June 9, 2009

B1 TOP OF FILL SOUTH END OF PROPERTY BY DRIVEWAY

- 1'-2' Sandy Top Soil Brown
- 2'-10' Fine sand 2%-3% on 200
- 10'-12' Fine sand trace of grave
- 12'-22' Med Grand sand with more trace rock
- 22'-35' Trace gravel – coarse sand clean
- 35'-39' Coarse sand - trace rock
- 39'-45' Coarse sand
- 45'-49' Coarse sand – more rock
- 49'-54' Same
- 54'-60' Same
- **WATER LEVEL 22' AUGER**

B2 LOW LAND STRAIGHT DOWN DRIVEWAY THEN NE 500 LF

- 0'-1' Topsoil
- 1'-2' Sand
- 2'-19' Silt – Soft (12'-14') Gravel-Gray
- 19'-24' Silt w/gravel - Seems rocky
- 24'-35' Silt – Fine w/rocky Layers
- 35'-40' Silt w/trace of rock
- **WATER LEVEL – 3'**

B-2A SPUN AUGERS TO 40 & BROUGHT TO TOP – 15' FROM B-2

- 0'-1' Top Soil
- 1'-15' Silt – Heavy Water
- 15'-40' Silt with trace of rock

****Could be sand with heavy water auger wash clean – only thing coming up is 1/3 auger silt**

B-3 STRAIGHT EAST OF HOUSE 1000 LF

- 0'- 1 ½ ' Top Soil
- 2'-5' Sand
- 5'-12' Silt
- 12'-16' Clay – silt – gravel
- 16'-24' Trace gravel & silt sand
- 24'-32' Silty sand – trace of rock
- 32'-40' water Bearing Sandy
- **WATER LEVEL - _____**

B4 1000' NORTH OF HOUSE – END OF CORN & WHEAT FIELD

- 0'-1' Top soil san
- 1'-9' Fine Sand
- 9'-'12' Clean Gravel
- 12'-19' Dirty gravel – coarse sand
- 19'-21' Gravel Clean
- 21'-26' Small size gravel – clean
- 26'-30' Silty med coarse sand
- 30'-'35' Fine sand – Trace of Gravel 30%
- 35'-39' Coarse sand 50% Gravel
- 39'-45' Coarse Sand 80% Gravel
- 45'-54' Coarse Sand Small Gravel size
- **WATER LEVEL DOWN 13'**

B4A 300 lf EAST OF B4

- 0'-1' Top Soil
- 1'-12' Silt
- 12'-16' Gravel – Small Size
- 16'-19' Gray coarse sand
- **WATER LEVEL 6'-'7**

B4B EAST OF HOUSE 100 lf

- 0'-5' Top Soil
- 5'-45' 95% Gravel
- 45'-60' 80% Trace sand
- **GREAT HOLE**

B5 SOUTH OF HOUSE ½ BETWEEN THERE & SO OF TREE LINE – BETWEEN CORN & WHEAT

- 0'-5' Black Sands (Fine)
- 5'-15' Sands w/gravel 50% +/-
- 15'-25' Fine sands to med clean
- 25'-32' Med coarse sand clean
- 32'-40' Fine sands to med little dirty
- 40'-'48' Coarse sand
- 48'-60' Coarse sand – little gravel
- **WATER LEVEL 10'**

B6 ½ WAY BETWEEN HOUSE & VALLEY VIEW ON DRIVEWAY

- 0'-6' Top Soil
- 6'-13' Fine Sand <5%
- 13'-15' Fine sand – trace gravel
- 15'-33' Fine to med sand – different color – trace gravel
- 33'-50' Coarse sand clean < 2% - Trace Rock
- 50'-54' Fine sand
- 54'-60' Coarse sand – trace Gravel
- **WATER LEVEL 28'**
- **GOOD CLEAN SAND FINE TO COARSE**

BRAUN[SM]
INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-7 (MW-1)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/25/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
734.5	0.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with some Gravel, brown. (Alluvium)			
729.5	5.0	GP-GM	POORLY GRADED GRAVEL with SILT and SAND, brown, moist. (Alluvium) Auger encountered Cobbles and Boulders.			Gradation
724.5	10.0		END OF BORING. Auger refusal on Boulders. Boring attempted 4 times in close proximity and each time met refusal.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN[SM]
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LOG OF BORING

Braun Project BL-09-03429 **Gravel Investigation** **Hentges Jordan Gravel Pit** **17825 Valley View Drive** **Jordan, Minnesota**	BORING: **B-7A (MW-1)** LOCATION: Northing 178936.6, Easting 420390.8 See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/26/09**	SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
739.1	0.0					
		SM	SILTY SAND, fine-grained, dark brown. (Topsoil)			Top of Riser Elevation 741.4
737.6	1.5	SP	POORLY GRADED SAND, fine-grained, light brown, moist, waterbearing below about 23 feet. (Alluvium)			
						Gradation
					▼	Water level 717.5 on 8/26/09
			Some Gravel encountered by auger between 22 and 26 feet.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 16:25

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LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-7A (MW-1) (cont.)**

LOCATION: Northing 178936.6, Easting 420390.8
See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/26/09**	SCALE: **1" = 4'**

Elev. feet 707.1	Depth feet 32.0	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
706.1	33.0					
			END OF BORING. 2" PVC monitoring well installed.			

(See Descriptive Terminology sheet for explanation of abbreviations)

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LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-8 (MW-2)**

LOCATION: Northing 179409.9, Easting 420894.2
See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/26/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
730.5	0.0	SM	SILTY SAND, fine-grained, dark brown, moist. (Topsoil)			Top of Riser Elevation 732.1
728.5	2.0	SP-SM	POORLY GRADED SAND with SILT, fine-grained, with a trace of Gravel, brown, moist to waterbearing. (Alluvium)			
					▼	Water level 717.1 on 8/26/09
			Auger encountered some Gravel between 16 and 21 feet.			
706.5	24.0		END OF BORING. 2" PVC monitoring well installed.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 16:25

BRAUN[SM]
INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-9 (MW-3)**

LOCATION: Northing 179934, Easting 421448.8
See attached sketch.

DRILLER: M. Takada | METHOD: Power Auger | DATE: **8/26/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
730.6	0.0					
		SM	SILTY SAND, fine-grained, dark brown, moist. (Topsoil)			Top of Riser Elevation 732.0
728.6	2.0					
		SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, with occasional Cobbles, brown, moist. (Alluvium)			
718.6	12.0					
		SP	POORLY GRADED SAND, fine- to coarse-grained, with Gravel, with occasional Cobbles, brown, moist to waterbearing. (Alluvium)		▼	Water level 717.8 on 8/26/09
				X		Gradation
706.6	24.0					
			END OF BORING. 2" PVC monitoring well installed.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 16:25

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-10 (MW-4)**

LOCATION: Northing 180262.9, Easting 422290.9
See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/24/09** | SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0					
	SM	SILTY SAND, fine-grained, dark brown. (Topsoil)			Top of Riser Elevation 740.2
1.0	SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, with a trace of Gravel, brown, moist. (Alluvium)			
8.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with some Gravel, brown, moist to waterbearing. (Alluvium)			
			X		Gradation
		With a trace of Gravel from 14 to 19 feet.			
		With Gravel from 19 to 24 feet.		▼	Water level 718.7 on 8/26/09
			X		
29.0	SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium)			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 16:30

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LOG OF BORING

Braun Project BL-09-03429 **Gravel Investigation** **Hentges Jordan Gravel Pit** **17825 Valley View Drive** **Jordan, Minnesota**	BORING: **B-10 (MW-4) (cont.)** LOCATION: Northing 180262.9, Easting 422290.9 See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/24/09**	SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
32.0		POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium) *(continued)*			
39.0		END OF BORING. 2" PVC monitoring well installed.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 16:30

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LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-11**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/19/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
732.0	0.0					
730.0	2.0	SM	SILTY SAND, fine-grained, dark brown, moist. (Topsoil)			
728.0	4.0	SC	CLAYEY SAND, fine- to medium-grained, with a trace of Gravel, dark brown, moist. (Alluvium)			
722.0	10.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with Gravel, with Silty Sand, brown, moist. (Alluvium)	X		Grdations LA rattler Soundness
708.0	24.0	GP	POORLY GRADED GRAVEL, with Silty Sand and Poorly Graded Sand, brown, moist to waterbearing at 15 feet. (Alluvium)	X		
		SP	POORLY GRADED SAND, fine- to medium-grained, with Gravel, brown, waterbearing. (Alluvium)	X		
				X		No sample recovery.

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-11 (cont.)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/19/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
700.0	32.0		POORLY GRADED SAND, fine- to medium-grained, with Gravel, brown, waterbearing. (Alluvium) *(continued)*			
				X		No sample recovery.
			Auger likely encountered Cobbles at 45 feet.			
683.0	49.0					
		SW-SM	WELL-GRADED SAND with SILT, fine- to coarse-grained, with Gravel, brown, waterbearing. (Alluvium)	X		
				X		Gradation

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-11 (cont.)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/19/09** | SCALE: **1" = 4'**

Elev. feet 668.0	Depth feet 64.0	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
663.0	69.0		WELL-GRADED SAND with SILT, fine- to coarse-grained, with Gravel, brown, waterbearing. (Alluvium) *(continued)*			
653.0	79.0	SP	POORLY GRADED SAND, fine- to medium-grained, brown, waterbearing. (Alluvium)			
642.0	90.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with a trace of Gravel, brown, waterbearing. (Alluvium)			
			END OF BORING. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-12**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/21/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
725.0	0.0					
		CL	LEAN CLAY, dark brown, wet. (Topsoil)			
722.0	3.0					
		CL	SANDY LEAN CLAY, dark gray, wet. (Alluvium)			
717.0	8.0					
		SP	POORLY GRADED SAND, fine- to medium-grained, brown, moist to waterbearing. (Alluvium)			
			Possible Cobbles at 12 feet.			
711.0	14.0					
		SP	POORLY GRADED SAND, fine- to coarse-grained, with some Gravel, brown, waterbearing. (Alluvium)			
						Gradation
			Possible Cobbles at 32 feet.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-12 (cont.)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/21/09** | SCALE: **1" = 4'**

Elev. feet	Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
693.0	32.0					
691.0	34.0		POORLY GRADED SAND, fine- to coarse-grained, with some Gravel, brown, waterbearing. (Alluvium) *(continued)*			
688.0	37.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with a trace of Gravel and Silty Sand, grayish brown, waterbearing. (Alluvium)	X		
675.0	50.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with some Gravel, brown, waterbearing. (Alluvium)	X		Gradation No sample recovery.
665.0	60.0	SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium)			
			END OF BORING. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project BL-09-03429 **Gravel Investigation** **Hentges Jordan Gravel Pit** **17825 Valley View Drive** **Jordan, Minnesota**	BORING: **B-13** LOCATION: See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/21/09**	SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0	SC	CLAYEY SAND, fine-grained, black, moist. (Topsoil)			
2.0	CL	LEAN CLAY, with a trace of Gravel, brown, moist. (Alluvium)			
4.0	SP-SM	POORLY GRADED SAND with SILT, fine- to medium-grained, with a trace of Gravel, brown, moist. (Alluvium)			
7.0	GP	POORLY GRADED GRAVEL with SAND, brown, moist. (Alluvium)			Gradation
12.0	SP	POORLY GRADED SAND, fine- to medium-grained, with some Gravel, brown, moist to waterbearing. (Alluvium)			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-13 (cont.)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/21/09** | SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
32.0		POORLY GRADED SAND, fine- to medium-grained, with some Gravel, brown, moist to waterbearing. (Alluvium) *(continued)*			
38.0	SP	POORLY GRADED SAND, fine- to coarse-grained, with some Gravel, brown, waterbearing. (Alluvium) Possible Cobbles at 40 feet.			Gradation
48.0	SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium)			
58.0	SP	POORLY GRADED SAND, fine- to medium-grained, with some Gravel, brown, waterbearing. (Alluvium)			
62.0	SP	POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium)			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN™ INTERTEC

LOG OF BORING

Braun Project BL-09-03429
Gravel Investigation
Hentges Jordan Gravel Pit
17825 Valley View Drive
Jordan, Minnesota

BORING: **B-13 (cont.)**

LOCATION: See attached sketch.

DRILLER: M. Takada | METHOD: 3 1/4" HSA, Autohammer | DATE: **8/21/09** | SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
64.0		POORLY GRADED SAND, fine- to medium-grained, with a trace of Gravel, brown, waterbearing. (Alluvium) *(continued)*			
69.0		END OF BORING. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:17

BRAUN[SM]
INTERTEC

LOG OF BORING

Braun Project BL-09-03429 **Gravel Investigation** **Hentges Jordan Gravel Pit** **17825 Valley View Drive** **Jordan, Minnesota**	BORING: **B-14** LOCATION: See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/24/09**	SCALE: **1" = 4'**

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0	SM	SILTY SAND, fine-grained, dark brown, moist. (Topsoil)			
1.0	SP-SM	POORLY GRADED SAND with SILT, fine-grained, with a trace of Gravel, brown, moist, waterbering below about 10 feet (Alluvium)			
		With some Gravel from 23 to 26 feet.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:43

BRAUN℠ INTERTEC

LOG OF BORING

Braun Project BL-09-03429 **Gravel Investigation** **Hentges Jordan Gravel Pit** **17825 Valley View Drive** **Jordan, Minnesota**	BORING: **B-14 (cont.)** LOCATION: See attached sketch.

DRILLER: M. Takada	METHOD: 3 1/4" HSA, Autohammer	DATE: **8/24/09**	SCALE: **1" = 4'**

Depth feet 32.0	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
		POORLY GRADED SAND with SILT, fine-grained, with a trace of Gravel, brown, moist, waterbering below about 10 feet (Alluvium) *(continued)*			
59.0		END OF BORING. Boring immediately backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING 03429.GPJ BRAUN_08.GDT 9/21/09 15:43

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL AND BORING NO. 767639

WELL OR BORING LOCATION

County Name: Scott

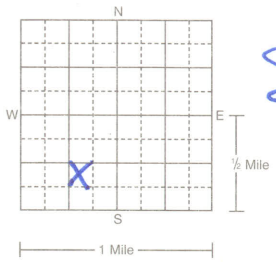
Township Name	Township No.	Range No.	Section No.	Fraction
Sand Creek	114	23	8	NW SE SW

GPS LOCATION: Latitude ____ degrees ____ minutes ____ seconds ____ Longitude ____ degrees ____ minutes ____ seconds ____

House Number, Street Name, City, and Zip Code of Well Location: 17825 Valley View Dr.

or Fire Number:

Show exact location of well/boring in section grid with "X." Sketch map of well/boring location. Showing property lines, roads, buildings, and direction.



See Site Map

PROPERTY OWNER'S NAME/COMPANY NAME: S. M. Hentges + Sons Inc

Property owner's mailing address if different than well location address indicated above.
650 Quaker Ave
Jordan, MN. 55352

WELL OWNER'S NAME/COMPANY NAME: S.M. Hentges + Sons Inc.

Well/boring owner's mailing address if different than property owner's address indicated above.
650 Quaker Ave
Jordan, MN. 55352

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Silty Sand	Drk Brn		0	1'
Poorly Graded Sand w/silt	Brn	Med	1'	8'
Poorly Graded Sand	Brn	Med	8'	39'

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.

MW-4 BL-09-03429 Jim Craig

MINN. DEPT. OF HEATLH COPY 767639

WELL/BORING DEPTH (completed): 39' ft. DATE WORK COMPLETED: 8/24/09

DRILLING METHOD: ☐ Cable Tool ☒ Auger ☐ Driven ☐ Rotary ☐ Dug ☐ Jetted

DRILLING FLUID: NONE

WELL HYDROFRACTURED? ☐ Yes ☒ No From ____ ft. To ____ ft.

USE: ☐ Domestic ☒ Monitoring ☐ Heating/Cooling ☐ Noncommunity PWS ☐ Environ. Bore Hole ☐ Industry/Commercial ☐ Community PWS ☐ Irrigation ☐ Remedial ☐ Elevator ☐ Dewatering

CASING MATERIAL: ☐ Steel ☒ Plastic

Drive Shoe? ☐ Yes ☒ No ☒ Threaded ☐ Welded

HOLE DIAM.

CASING

Diameter	Weight	Specifications	HOLE DIAM.
2 in. to 29 ft.	— lbs./ft.	Sch 40 PVC	8 in. to 39 ft.
in. to ft.	lbs./ft.		in. to ft.
in. to ft.	lbs./ft.		in. to ft.

SCREEN: Make Johnson; Type PVC; Diam. 2"; Slot/Gauze .010; Length 10'; Set between 29 ft. and 39 ft.; FITTINGS Flush threed

OPEN HOLE: From ____ ft. To ____ ft.

STATIC WATER LEVEL: 20' ft. ☒ Below ☐ Above land surface; Measured from Ground surface; Date measured 8/24/09

PUMPING LEVEL (below land surface): NA ft. after ____ hrs. pumping ____ g.p.m.

WELLHEAD COMPLETION: ☐ Pitless/adapter manufacturer ____ Model ____; ☒ Casing Protection 6" Locking Steel ☒ 12 in. above grade; ☐ At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION: Well grouted ☒ Yes ☐ No; Grout materials ☐ Neat cement ☒ Bentonite ☒ Concrete ☐ Other ____

	From	To		
⊙	0	4	3	☐ Yds. ☒ Bags
✕	4	25	1	☐ Yds. ☐ Bags
				☐ Yds. ☐ Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type

Well disinfected upon completion? ☐ Yes ☒ No

PUMP: ☒ Not installed Date installed ____

Manufacturer's name ____

Model Number ____ HP ____ Volts ____

Length of drop pipe ____ ft. Capacity ____ g.p.m.

Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐ ____

ABANDONED WELLS: Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE: Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ____

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Braun Intertec — Licensee Business Name; 1323 — Lic. or Reg. No.

Greg Sedlon — Certified Representative Signature; 870 — Certified Rep. No.; 12-15-09 — Date

Matt Takada — Name of Driller

IC 140-0020 HE-01205-11 (Rev. 3/07)

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL AND BORING NO. 767637

WELL OR BORING LOCATION

County Name: Scott

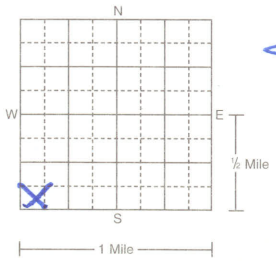
Township Name	Township No.	Range No.	Section No.	Fraction
Sand Creek	114	23	8	SW SW SW

GPS LOCATION: Latitude ____ degrees ____ minutes ____ seconds ____ Longitude ____ degrees ____ minutes ____ seconds ____

House Number, Street Name, City, and Zip Code of Well Location: 17825 Valley View Dr

or Fire Number:

Show exact location of well/boring in section grid with "X." Sketch map of well/boring location. Showing property lines, roads, buildings, and direction.



See Site Map

PROPERTY OWNER'S NAME/COMPANY NAME: S.M. Hentges + Sons Inc

Property owner's mailing address if different than well location address indicated above.
650 Quaker Ave
Jordan, MN. 55352

WELL OWNER'S NAME/COMPANY NAME: S.M. Hentges + Sons Inc

Well/boring owner's mailing address if different than property owner's address indicated above.
650 Quaker Ave
Jordan, MN. 55352

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Silty Sand	Drk Brn		0	2'
Poorly Graded Sand w/Silt	Brn		2'	24'

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.
B-8

Mw-2 BL-09-03429 Jim Craig

MINN. DEPT. OF HEATLH COPY 767637

WELL/BORING DEPTH (completed): 24 ft.

DATE WORK COMPLETED: 8/26/09

DRILLING METHOD: ☐ Cable Tool ☒ Auger ☐ Driven ☐ Rotary ☐ Dug ☐ Jetted

DRILLING FLUID: NONE

WELL HYDROFRACTURED? ☐ Yes ☒ No From ____ ft. To ____ ft.

USE: ☐ Domestic ☒ Monitoring ☐ Heating/Cooling ☐ Noncommunity PWS ☐ Environ. Bore Hole ☐ Industry/Commercial ☐ Community PWS ☐ Irrigation ☐ Remedial ☐ Elevator ☐ Dewatering

CASING MATERIAL: ☐ Steel ☒ Plastic Drive Shoe? ☐ Yes ☐ No ☒ Threaded ☐ Welded

CASING Diameter / Weight / Specifications

Diameter	Weight	Specifications	HOLE DIAM.
2 in. to 14 ft.	— lbs./ft.	Sch 40 PVC	8 in. to 24 ft.
in. to ft.	lbs./ft.		in. to ft.
in. to ft.	lbs./ft.		in. to ft.

SCREEN Make: Johnson Type: PVC Diam. 2" Slot/Gauze .010 Length 10' Set between 14 ft. and 24 ft. FITTINGS: Flush thread

OPEN HOLE From ____ ft. To ____ ft.

STATIC WATER LEVEL 12 ft. ☒ Below ☐ Above land surface Measured from ____ Date measured 8/26/09

PUMPING LEVEL (below land surface) NA ft. after ____ hrs. pumping ____ g.p.m.

WELLHEAD COMPLETION: ☐ Pitless/adapter manufacturer ____ Model ____ ☒ Casing Protection 6" locking steel ☒ 12 in. above grade ☐ At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION: Well grouted ☒ Yes ☐ No. Grout materials: ☐ Neat cement ☒ Bentonite ☒ Concrete ☐ Other ____

	From	To	ft.		
☒	0	4	3	Yds.	☒ Bags
☒	4	18	.5	Yds.	☒ Bags
				Yds.	☐ Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type

Well disinfected upon completion? ☐ Yes ☒ No

PUMP: ☒ Not installed Date installed ____

Manufacturer's name ____

Model Number ____ HP ____ Volts ____

Length of drop pipe ____ ft. Capacity ____ g.p.m.

Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet

ABANDONED WELLS: Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE: Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ____

WELL CONTRACTOR CERTIFICATION

This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Braun Intertec — Licensee Business Name — Lic. or Reg. No.

Greg Scallon — Certified Representative Signature — 370 — Certified Rep. No. — 12-15-09 Date

Matt Takada — Name of Driller

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL AND BORING NO. 767636

WELL OR BORING LOCATION

County Name: Scott

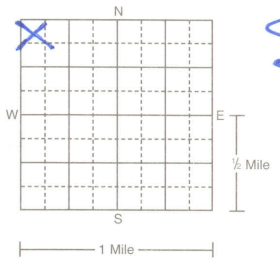
Township Name	Township No.	Range No.	Section No.	Fraction
Sand Creek	114	23	17	NW NW NW

GPS LOCATION: Latitude ____ degrees ____ minutes ____ seconds ____ Longitude ____ degrees ____ minutes ____ seconds ____

House Number, Street Name, City, and Zip Code of Well Location: 17825 Valley View Dr

or Fire Number:

Show exact location of well/boring in section grid with "X." Sketch map of well/boring location. Showing property lines, roads, buildings, and direction.



See Site Map

PROPERTY OWNER'S NAME/COMPANY NAME: S.M. Hentges

Property owner's mailing address if different than well location address indicated above.
650 Quaker Ave
Jordan, MN. 55352

WELL OWNER'S NAME/COMPANY NAME: S.M. Hentges

Well/boring owner's mailing address if different than property owner's address indicated above.
650 Quaker Ave
Jordan, MN. 55352

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
Silty Sand	Drk Brn	medium	0	1.5'
Poorly Graded Sand	Light Brn	medium dense	1.5'	33'

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.
B-7A

MW-1 BL-09-03429 Jim Craig

MINN. DEPT. OF HEATLH COPY 767636

WELL/BORING DEPTH (completed): 33 ft.

DATE WORK COMPLETED: 8/26/09

DRILLING METHOD: ☐ Cable Tool ☐ Driven ☐ Dug ☒ Auger ☐ Rotary ☐ Jetted

DRILLING FLUID: NONE

WELL HYDROFRACTURED? ☐ Yes ☒ No From ____ ft. To ____ ft.

USE: ☐ Domestic ☒ Monitoring ☐ Heating/Cooling ☐ Noncommunity PWS ☐ Environ. Bore Hole ☐ Industry/Commercial ☐ Community PWS ☐ Irrigation ☐ Remedial ☐ Elevator ☐ Dewatering

CASING MATERIAL: ☐ Steel ☒ Plastic Drive Shoe? ☐ Yes ☒ No ☒ Threaded ☐ Welded

HOLE DIAM.: 8 in. to 33 ft.

CASING Diameter: 2 in. to 23 ft. Weight: – lbs./ft. Specifications: Sch 40 PVC

SCREEN Make: Johnson Type: PVC Diam.: 2" Slot/Gauze: .010 Length: 10' Set between: 23 ft. and 33 ft. FITTINGS: Flush thread

OPEN HOLE From ____ ft. To ____ ft.

STATIC WATER LEVEL: 23 ft. ☒ Below ☐ Above land surface Measured from: Ground Surface Date measured: 8-26-09

PUMPING LEVEL (below land surface): NA ft. after ____ hrs. pumping ____ g.p.m.

WELLHEAD COMPLETION: ☐ Pitless/adapter manufacturer ____ Model ____ ☒ Casing Protection: 6" locking steel ☒ 12 in. above grade ☐ At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION: Well grouted ☒ Yes ☐ No
Grout materials: ☐ Neat cement ☒ Bentonite ⊙ Concrete ☐ Other ____
⊙ From 0 To 4 ft. 3 ☐ Yds. ☒ Bags
X From 4 To 19 ft. 1 ☐ Yds. ☒ Bags
From ____ To ____ ft. ____ ☐ Yds. ☐ Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type

Well disinfected upon completion? ☐ Yes ☒ No

PUMP: ☒ Not installed Date installed ____
Manufacturer's name ____
Model Number ____ HP ____ Volts ____
Length of drop pipe ____ ft. Capacity ____ g.p.m.
Type: ☐ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐ ____

ABANDONED WELLS: Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE: Was a variance granted from the MDH for this well? ☐ Yes ☒ No TN# ____

WELL CONTRACTOR CERTIFICATION
This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Braun Intertec — Licensee Business Name — Lic. or Reg. No. 1323

Greg Scallon — Certified Representative Signature — Certified Rep. No. 870 — Date 12-15-09

Matt Takada — Name of Driller

IC 140-0020 HE-01205-11 (Rev. 3/07)

Minnesota Unique Well No.

404675

County: Scott
Quad: Jordan East
Quad ID: 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date: 02/11/1988
Update Date: 05/02/2005
Received Date:

Well Name STICH, EDWIN

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	8	DBDACC	737 ft.	CALC FROM 2-FOOT COUNTY DEM

Well Depth	Depth Completed	Date Well Completed
60 ft.	60 ft.	07/10/1984

Drilling Method Non-specified Rotary

Well Address
17521 VALLEY VIEW DR
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
CLAY	BROWN	SOFT	0	5
SAND & GRAVEL	BROWN	MEDIUM	5	50
SAND (COARSE)	BROWN	MEDIUM	50	60

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Steel (black or low carbon) Joint Threaded Drive Shoe? ☑ Yes ☐ No Above/Below 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 55 ft.	11 lbs./ft.	6 in. to 50 ft.
		4 in. to 60 ft.

Open Hole from ft. to ft.

Screen YES Make JOHNSON Type stainless steel

Diameter	Slot/Gauze	Length	Set Between
3.75	18	8.5	55 ft. and 60 ft.

Static Water Level
9 ft. from Land surface Date Measured 07/10/1984

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer MONITOR Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Cuttings from 0 to 50 ft.

Located by: Minnesota Geological Survey
Method: Digitization (Screen) - Map (1:24,000)
Unique Number Verification: Address verification
Input Date: 12/13/2004
System: *UTM - Nad83, Zone15, Meters*
X: 451760 Y: 4949085

Nearest Known Source of Contamination
90 feet S direction Septic tank/drain field type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed 07/11/1984
Manufacturer's name PIONEER Model number HP 0.75 Volts 220
Length of drop Pipe 36 ft. Capacity 12 g.p.m
Type Submersible Material Galvanized

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock
Last Strat Sand-brown
Aquifer Quat. Water Table Aquifer
Depth to Bedrock ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Hartmann Well Co.	40174	JAECKELS, R.

County Well Index Online Report 404675 Printed 9/28/2009
HE-01205-07

1. LOCATION OF WELL

County Name: Scott

WATER WELL RECORD

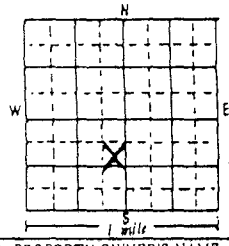
Minnesota Statutes 156A.01-.08

MINNESOTA UNIQUE WELL NO. *for Water Sample*: 414004

Township Name	Township Number	Range Number	Section No.	Fraction
Sand Creek	114 N	23 W	8	SE ¼ NE ¼ SW¼

Numerical Street Address and City of Well Location or Distance from Road Intersection.
17575 Valley View Rd., Jordan, Mn.

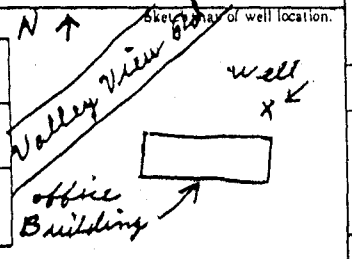
Show exact location of well in section grid with "X." Sketch map of well location.



Addition Name

Block Number

Lot Number



2. PROPERTY OWNER'S NAME: Metropolitan Mosquito Control - Scott-Carver Division

Mailing Address if different than property address indicated above.
2380 Wycliff
St. Paul, Mn.

3. FORMATION LOG	COLOR	HARDNESS OF FORMATION	FROM	TO
Sugar sand	brown	soft	0	14
Large gravel with rocks	brown	hard	14	47
Clay	brown	soft	47	55
Sand & gravel	brown	med.	55	117

Use a second sheet, if needed

17. REMARKS, ELEVATION, SOURCE OF DATA, etc.

IMPORTANT:
FILE WITH DEED – WELL OWNER COPY

474684

4. WELL DEPTH (completed): 117 ft.

Date of Completion: 1-8-91

5. DRILLING METHOD
☐ Cable Tool ☐ Reverse ☐ Driven ☐ Dug
☐ Hollow Rod ☐ Air ☐ Bored ☐ _____
■ Rotary ☐ Jetted ☐ Power Auger

6. DRILLING FLUID: Baroid Quik Gel

7. USE
☐ Domestic ☐ Monitoring ☐ Heat Pump
☐ Irrigation ☐ Public ☐ Industry
☐ Test Well ☐ Municipal ■ Commercial
☐ Air Conditioning ☐ _____

8. CASING
■ Black ■ Threaded
☐ Galv. ☐ Welded
☐ Plastic ☐

HEIGHT: Above/~~Below~~ Surface 1 ft.
Drive Shoe? Yes X No ___

				HOLE DIAM.
___ in. to ___ ft.	Weight ___ lbs./ft.	6 in. to 106 ft.
4 in. to 107 ft.	Weight 11 lbs./ft.	___ in. to ___ ft.
___ in. to ___ ft.	Weight ___ lbs./ft.	___ in. to ___ ft.

9. SCREEN
Make Howard Smith
Type Stainless steel Diam. 3½
Slot/~~Gauge~~ #10 on top, #15 on bottom Length 12 feet
Set between 107 ft. and 117 ft.
FITTINGS: 3x4 K packer seal on top

Or open hole from ___ ft. to ___ ft.

10. STATIC WATER LEVEL
22 ft. ■ below ☐ above land surface Date Measured 1-8-91

11. PUMPING LEVEL (below land surface)
___ ft. after ___ hrs. pumping ___ g.p.m.
___ ft. after ___ hrs. pumping ___ g.p.m.

12. HEAD WELL COMPLETION
■ Pitless adapter manufacturer Monitor Model ___
☐ Basement, offset ☐ At least 12" above ground
☐ Plastic casing protection ___

13. WELL GROUTED? ■ Yes ☐ No
☐ Neat Cement ■ Bentonite ☐ ___
Grout material also sand & clay cuttings from 0 to 106 ft. cu. yds. ___

14. NEAREST SOURCES OF POSSIBLE CONTAMINATION
60 feet SW direction Sewer drain type
Well disinfected upon completion? ■ Yes ☐ No

15. PUMP
Date installed 3-10-91 ☐ Not installed
Manufacturer's name Flint & Walling
Model number 4F27B20 (27 c pump) HP 2 Volts 220
Length of drop pipe 73 ft. Capacity 31 g.p.m.
Material of drop pipe 1½ inch galvanized
Type: ■ Submersible ☐ L.S. Turbine ☐ Reciprocating
☐ Jet ☐ Centrifugal ☐ ___

16. ABANDONED WELLS
Unused well on property? ☐ Yes ■ No
Sealed ☐ Permanent ☐ Temporary ☐ Not sealed

18. WATER WELL CONTRACTOR CERTIFICATION
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Hartmann Well Co. 40174
Licensee Business Name *License No.*
Address 308 E. Main, New Prague, Mn. 56071
Signed Roger Hartmann Date 2-2-91
Authorized Representative
Duane Peterson Date ___
Name of Driller

HE-01205-03(Rev. 9/88)

5/74 30M
7/76 30M
7/78 30M
2/82 10M

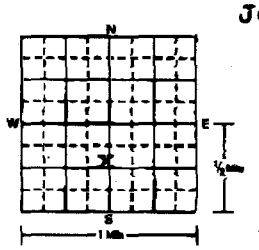
MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

MINNESOTA UNIQUE WELL NO. 595225

WELL LOCATION
County Name: Scott
Township Name: SandCreek | Township No.: 114 | Range No.: 23 | Section No.: 8 | Fraction: SE NE SW
House Number, Street Name, City, and Zip Code of Well Location: 17681 ValleyView Dr.
or Fire Number:

Show exact location of well in section grid with "X". Sketch map of well location. Showing property lines, roads and buildings.

Jordan



drawing building well

PROPERTY OWNER'S NAME
Scott County Co-Op

Property owner's mailing address if different than well location address indicated above.

WELL OWNER'S NAME

Well owner's mailing address if different than property owner's address indicated above.

GEOLOGICAL MATERIALS	COLOR	HARDNESS OF MATERIAL	FROM	TO
sabd	brown	soft	0	17
gravel	brown	soft	17	48
sand & clay	brown	soft	48	107
sand & gravel	brown	soft	107	131

Use a second sheet if needed

REMARKS, ELEVATION, SOURCE OF DATA, etc.

DEC 1998 RECEIVED MGT.

WELL DEPTH (completed) 131 ft. | **Date Work Completed** 8/14/98

DRILLING METHOD
☐ Cable Tool ☐ Driven ☐ Dug
☐ Auger ☒ Rotary ☐ Jetted
☐

DRILLING FLUID
Baroid quik gel

USE
☒ Domestic ☐ Monitoring ☐ Heating/Cooling
☐ Irrigation ☐ Community PWS ☐ Industry/Commercial
☐ Test Well ☐ Noncommunity PWS ☐ Remedial
☐ Dewatering ☐

CASING Drive Shoe? ☐ Yes ☒ No
☐ Steel ☐ Threaded ☐ Welded
☒ Plastic ☐

CASING DIAMETER / WEIGHT
4 in. to 111 ft. 1.9 lbs./ft.
in. to ft. lbs./ft.
in. to ft. lbs./ft.

HOLE DIAM.
8½ in. to 30 ft.
6¼ in. to 131 ft.
in. to ft.

SCREEN
Make crosline
Type plastic Diam. 4"
Slot/Gauze Length 20 ft.
Set between 111 ft. and 131 ft. FITTINGS:

OPEN HOLE from ft. to ft.

STATIC WATER LEVEL 24 ft. ☒ below ☐ above land surface Date measured 8/14

PUMPING LEVEL (below land surface) 5 ft. after 1 hrs. pumping 30 g.p.m.

WELL HEAD COMPLETION
☒ Pitless adapter manufacturer whitewater Model SU 45½
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

GROUTING INFORMATION
Well grouted? ☒ Yes ☐ No
Grout Material ☐ Neat cement ☐ Bentonite ☐ Concrete ☒ High Solids Bentonite
from 30 to 0 ft. 3 ☐ yds. ☒ bags
from to ft. ☐ yds. ☐ bags
from to ft. ☐ yds. ☐ bags

NEAREST KNOWN SOURCE OF CONTAMINATION
75 feet east direction ~~septic~~ tank type
Well disinfected upon completion? ☐ Yes ☒ No

PUMP
☐ Not installed Date installed
Manufacturer's name Aermotor
Model number HP 1½ Volts 220
Length of drop pipe 63 ft. Capacity 15 g.p.m.
Pressure Tank Capacity
Type: ☒ Submersible ☐ L.S. Turbine ☐ Reciprocating ☐ Jet ☐

ABANDONED WELLS
Does property have any not in use and not sealed well(s)? ☐ Yes ☒ No

VARIANCE
Was a variance granted from the MDH for this well? ☐ Yes ☒ No

WELL CONTRACTOR CERTIFICATION
This well was drilled under my supervision and in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Leuthner Well Inc. 10125
Licensee Business Name Lic. or Reg. No.
Maurice Leuthner 11/30/98
Authorized Representative Signature Date
Maurice L. Leuthner 10/26/98
Name of Driller Date

12-23-98

MINN. DEPT. OF HEALTH COPY 595225

HE-01205-05 (Rev. 1/99)

Minnesota Unique Well No.

753654

County Scott
Quad Jordan East
Quad ID 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 12/19/2007
Update Date 07/08/2008
Received Date

Well Name WELL NO 1

Township	Range	Dir	Section	Subsections	Elevation	
114	23	W	8	CDBBDA	Elevation Method	740 ft. 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
163 ft.	163 ft.	06/06/2008

Drilling Method Cable Tool

Well Address
17706 VALLEY VIEW DR
JORDAN MN

Geological Material	Color	Hardness	From	To
CLAY/GRAVEL	BROWN	SOFT	0	90
SAND	BROWN	SOFT	90	98
SAND & GRAVEL	BROWN	SOFT	98	100
GRAVEL	BROWN	SOFT	100	123
SAND & GRAVEL	BROWN	SOFT	123	135
GRAVEL	BROWN	SOFT	135	163

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☑ No
From Ft. to Ft.

Use Other (specify in remarks)

Casing Type Steel (black or low carbon) Joint Welded Drive Shoe? ☑
Yes ☐ No Above/Below ft.

Casing Diameter	Weight	Hole Diameter
12 in. to 142 ft.	49.56 lbs./ft.	12 in. to 163 ft.

Open Hole from ft. to ft.

Screen YES Make JOHNSON Type

Diameter	Slot/Gauze	Length	Set Between
10	60	20	143 ft. and 163 ft.

Static Water Level
21 ft. from Land surface Date Measured 08/31/2007

PUMPING LEVEL (below land surface)
23 ft. after 6 hrs. pumping 300 g.p.m.

Well Head Completion
Pitless adapter manufacturer BAKER Model 9PS1214
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
NON-POTABLE WATER SUPPLY.

Located by: Minnesota Department of Health Method: GPS SA Off (averaged)
Unique Number Verification: N/A Input Date: 12/19/2007
System: *UTM - Nad83, Zone15, Meters* X: 451139 Y: 4948907

Grouting Information Well Grouted? ☐ Yes ☑ No

Nearest Known Source of Contamination
62 feet S direction Body of water type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed 02/08/2008
Manufacturer's name GRUNDFOS Model number 235S75-3
HP 7.5 Volts 460
Length of drop Pipe 105 ft. Capacity g.p.m Type Submersible Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐
Yes ☑ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☑ No

First Bedrock
Last Strat Gravel (+larger)-brown
Aquifer Quat. Buried Artes. Aquifer
Depth to Bedrock ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
EH Renner and Sons, Inc.	1431	MOSS, P

County Well Index Online Report 753654 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

443648

County: Scott
Quad: Jordan East
Quad ID: 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date: 03/27/1991
Update Date: 05/02/2005
Received Date:

Well Name ALEXON, PATRICK

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	8	DDACCA	738 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
93 ft.	93 ft.	08/19/1988

Drilling Method: Non-specified Rotary

Well Address
17655 JOHNSON MEMORIAL DR
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
CLAY	YELLOW	SOFT	0	10
COARSE SAND	YELLOW	SOFT	10	93

Drilling Fluid: Qwik gel

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use: Domestic

Casing Type: Steel (black or low carbon) Joint: Threaded Drive Shoe? ☑ Yes ☐ No Above/Below: 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 87 ft.	11 lbs./ft.	8 in. to 80 ft.
		4 in. to 93 ft.

Open Hole: from ft. to ft.

Screen: YES Make: JOHNSON Type: stainless steel

Diameter	Slot/Gauze	Length	Set Between
3.5	20	7	87 ft. and 93 ft.

Static Water Level
12 ft. from Land surface Date Measured 08/19/1988

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer: MONITOR Model:
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
FORMER OWNER SCOTT NUTT.

Located by: Minnesota Geological Survey
Method: Digitization (Screen) - Map (1:24,000)
Unique Number Verification: Address verification
Input Date: 12/13/2004
System: *UTM - Nad83, Zone15, Meters*
X: 452098 Y: 4948809

Grouting Information: Well Grouted? ☑ Yes ☐ No
Grout Material: Cuttings from 0 to 80 ft.

Nearest Known Source of Contamination
55 feet N direction Volatile organic compounds type
Well disinfected upon completion? ☑ Yes ☐ No

Pump ☐ Not Installed Date Installed 08/24/1988
Manufacturer's name FLINT & WALLING Model number BA
HP 0.75 Volts 220
Length of drop Pipe 39 ft. Capacity 10 g.p.m
Type Submersible Material Galvanized

Abandoned Wells: Does property have any not in use and not sealed well(s)? ☐ Yes ☑ No

Variance: Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock
Last Strat: Sand-yellow
Aquifer: Quat. Buried Unconf. Aquife
Depth to Bedrock: ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Hartmann Well Co.	40174	PETERSON, D.

County Well Index Online Report 443648 Printed 9/14/2009
HE-01205-07

Minnesota Unique Well No.

760017

County Scott
Quad Jordan East
Quad ID 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 09/03/2009
Update Date 0
Received Date

Well Name

Township Range Dir Section Subsections Elevation

114 23 W 8 DCDBAD

Elevation Method: 741 ft. Calc from DEM (USGS 7.5 min or equiv.)

Well Depth 0 ft. | Depth Completed 0 ft. | Date Well Completed 0

Drilling Method

Drilling Fluid

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Unknown

Casing Type Joint Drive Shoe? ☐ Yes ☐ No Above/Below ft.

Geological Material	Color	Hardness	From	To

Casing Diameter	Weight	Hole Diameter

Open Hole from ft. to ft.

Screen

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Located by: Minnesota Department of Health
Method: GPS SA Off (averaged)
Unique Number Verification: N/A
Input Date: 09/03/2009
System: *UTM - Nad83, Zone15, Meters*
X: 451740 Y: 4948728

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
0 feet direction type

Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number HP Volts
Length of drop Pipe ft. Capacity g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐
Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification

License Business Name | Lic. Or Reg. No. | Name of Driller

First Bedrock
Last Strat
Aquifer
Depth to Bedrock ft.

County Well Index Online Report 760017 Printed 9/10/2009
HE-01205-07

Minnesota Unique Well No.

207419

County Scott
Quad Jordan East
Quad ID 90A

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING RECORD
Minnesota Statutes Chapter 103I

Entry Date 02/23/1989
Update Date 02/08/1996
Received Date

Well Name KEEFE, B.W.

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	8	CDCCDC	742 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
174 ft.	174 ft.	02/13/1970

Drilling Method --

Well Address
17825 JOHNSON MEMORIAL DR
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
SAND + GRAVEL	BROWN		0	18
STONES + GRAVEL	BROWN		18	40
STONES + ROCKS	BROWN	HARD	40	55
SAND + GRAVEL	BROWN		55	138
SHALE	GRN/WHT		138	174

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Joint No Information Drive Shoe? ☐ Yes ☐ No Above/Below 0 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 154 ft.	lbs./ft.	

Open Hole from 154 ft. to 174 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
26 ft. from Land surface Date Measured 02/13/1970

PUMPING LEVEL (below land surface)
0 ft. after hrs. pumping 50 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☐ Yes ☐ No

Located by: Minnesota Geological Survey
Method: Digitization (Screen) - Map (1:24,000)
Unique Number Verification: N/A
Input Date: 08/23/2004
System: *UTM - Nad83, Zone15, Meters* X: 451128 Y: 4948584

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock Franconia
Last Strat Franconia
Aquifer Franconia
Depth to Bedrock 138 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Leuthner Well Co.	10125	

County Well Index Online Report 207419 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

207418

County Scott
Quad Jordan East
Quad ID 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 02/23/1989
Update Date 02/08/1996
Received Date

Well Name KEEFE, B.W.

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	8	CDCCDC	742 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
158 ft.	158 ft.	06/22/1972

Drilling Method --

Well Address
17825 JOHNSON MEMORIAL DR
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
SAND	BROWN		0	8
STONES + GRAVEL	BROWN		8	38
SAND + GRAVEL	BROWN		38	110
STONES + GRAVEL	BROWN		110	116
SHALE	GREEN		116	158

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Joint No Information Drive Shoe? ☐ Yes ☐ No Above/Below 0 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 124 ft.	lbs./ft.	

Open Hole from 124 ft. to 158 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
ft. from Date Measured

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Grouting Information Well Grouted? ☐ Yes ☐ No

Located by: Minnesota Geological Survey
Method: Digitization (Screen) - Map (1:24,000)
Unique Number Verification: N/A
Input Date: 02/20/2003
System: *UTM - Nad83, Zone15, Meters* X: 451134 Y: 4948573

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed
Manufacturer's name Model number __ HP 0 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock Franconia
Last Strat Franconia
Aquifer Franconia
Depth to Bedrock 116 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Leuthner Well Co.	10125	

County Well Index Online Report 207418 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

150106

County: Scott
Quad: Jordan East
Quad ID: 90A

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date: 03/27/1991
Update Date: 05/03/2005
Received Date:

Well Name SPERBECK, CRAIG

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	17	ACCBDA	935 ft.	CALC FROM 2-FOOT COUNTY DEM

Well Depth	Depth Completed	Date Well Completed
260 ft.	260 ft.	11/28/1978

Drilling Method Non-specified Rotary

Well Address
4410 185TH ST W
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
CLAY	YELLOW		0	18
CLAY	GRAY		18	190
SANDSTONE	WHT/YEL		190	227
SANDSTONE	PINK		227	231
SANDSTONE	GRAY		231	242
SANDSTONE	GRY/BRN		242	260

Drilling Fluid: --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Steel (black or low carbon) Joint Threaded Drive Shoe? ☑ Yes ☐ No Above/Below 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 228 ft.	11 lbs./ft.	6 in. to 228 ft.
		4 in. to 260 ft.

Open Hole from 228 ft. to 260 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
205 ft. from Land surface Date Measured 11/28/1978

PUMPING LEVEL (below land surface)
205 ft. after 2 hrs. pumping 20 g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
FORMER OWNER JIM JACKSON.

Located by: Minnesota Geological Survey
Method: Digitization (Screen) - Map (1:24,000)
Unique Number Verification: Address verification
Input Date: 12/14/2004
System: *UTM - Nad83, Zone15, Meters*
X: 451536 Y: 4947919

Grouting Information Well Grouted? ☑ Yes ☐ No
Grout Material: Bentonite from 0 to 228 ft.

Nearest Known Source of Contamination
50 feet S direction Sewer type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☐ Not Installed Date Installed 11/28/1978
Manufacturer's name A. Y. MCDONALD Model number 160100
HP 1 Volts 220
Length of drop Pipe 220 ft. Capacity 10 g.p.m
Type Submersible Material Galvanized

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock Jordan
Last Strat St.Lawrence
Aquifer St.Lawrence
Depth to Bedrock 190 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Bohn Well Co.	70350	BOHN, G.

County Well Index Online Report 150106 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

498564

County Scott
Quad Jordan West
Quad ID 90B

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 09/16/1992
Update Date 08/31/2006
Received Date

Well Name LARCA, LUCY

Township	Range	Dir	Section	Subsections	Elevation	Elevation Method
114	23	W	18	AABBAA	765 ft.	7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
200 ft.	200 ft.	03/06/1992

Drilling Method Non-specified Rotary

Well Address
5278 HIGHVIEW DR
JORDAN MN

Geological Material	Color	Hardness	From	To
SANDY DIRT	BLACK	SOFT	0	2
SAND	BROWN	MEDIUM	2	152
BROKEN SHALE & SOAPSTONE	GRN/WHT	MEDIUM	152	165
SHALE	GREEN	HARD	165	200

Drilling Fluid
Other

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Steel (black or low carbon) Joint Threaded Drive Shoe? ☑ Yes ☐ No Above/Below 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 167 ft.	lbs./ft.	6 in. to 167 ft.
		4 in. to 200 ft.

Open Hole from 167 ft. to 200 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
60 ft. from Land surface Date Measured 03/06/1992

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer MONITOR Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Located by: Minnesota Geological Survey
Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number Verification: Information from owner
Input Date: 03/10/1995
System: *UTM - Nad83, Zone15, Meters* X: 450305 Y: 4948548

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Cuttings from 0 to 167 ft. 0
Grout Material: Bentonite from 0 to ft. 0

Nearest Known Source of Contamination
54 feet N direction Tanks type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed 03/09/1992
Manufacturer's name FLINT & WALLING Model number 4F10B07
HP 0.75 Volts 220
Length of drop Pipe 118 ft. Capacity 10 g.p.m
Type Submersible Material Galvanized

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock Franconia
Last Strat Franconia
Aquifer Franconia
Depth to Bedrock 152 ft.

Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Hartmann Well Co.	40174	ECKLUND, B.

County Well Index Online Report 498564 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

211711

County Scott
Quad Jordan West
Quad ID 90B

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 02/23/1989
Update Date 02/14/1996
Received Date

Well Name PAULY, MYRON

Township	Range	Dir	Section	Subsections	Elevation	
114	23	W	18	AABCBB	Elevation Method	785 ft. 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
265 ft.	265 ft.	10/30/1973

Drilling Method --

Well Address
5276 HIGHVIEW DR
JORDAN MN 55352

Geological Material	Color	Hardness	From	To
FINE SAND			0	140
CLAY	BLUE		140	150
SOAPSTONE			150	160
SHALE			160	162
SHALE + SOAPSTONE			162	253
SANDROCK	WHITE		253	265

Drilling Fluid --

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Joint No Information Drive Shoe? ☐ Yes ☐ No Above/Below 0 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 184 ft.	lbs./ft.	

Open Hole from 184 ft. to 265 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
58 ft. from Land surface Date Measured 10/30/1973

PUMPING LEVEL (below land surface)
ft. after hrs. pumping g.p.m.

Well Head Completion
Pitless adapter manufacturer Model
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

REMARKS
304-B-11.

Located by: Minnesota Geological Survey
Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number Verification: N/A
Input Date: 01/01/1990
System: *UTM - Nad83, Zone15, Meters*
X: 450209 Y: 4948465

Grouting Information Well Grouted? ☐ Yes ☐ No

Nearest Known Source of Contamination
_feet _direction _type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed
Manufacturer's name Model number __ HP 0.75 Volts
Length of drop Pipe _ft. Capacity _g.p.m Type Submersible Material

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

Well Contractor Certification
Hartmann Well Co. 40174
License Business Name Lic. Or Reg. No. Name of Driller

First Bedrock Franconia
Last Strat Ironton
Aquifer Multiple
Depth to Bedrock 160 ft.

County Well Index Online Report 211711 Printed 7/6/2009
HE-01205-07

Minnesota Unique Well No.

510414

County Scott
Quad Jordan West
Quad ID 90B

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes Chapter 103I

Entry Date 03/28/1991
Update Date 08/31/2006
Received Date

Well Name GOWER, MARTHA

Township	Range	Dir	Section	Subsections	Elevation	
114	23	W	18	ABDBDA	Elevation Method	785 ft. 7.5 minute topographic map (+/- 5 feet)

Well Depth	Depth Completed	Date Well Completed
147 ft.	147 ft.	11/29/1989

Drilling Method Non-specified Rotary

Well Address
5401 CIRCLE DR
JORDAN MN

Geological Material	Color	Hardness	From	To
DIRT	BLACK		0	1
SAND & GRAVEL	BROWN		1	104
SAND, SHALE, ROCK	BRN/GRN		104	118
ROCK BROWN, GREEN, PINK	VARIED		118	128
ROCK, SHALE, FRANCO	GRN/BLK		128	147

Drilling Fluid Bentonite

Well Hydrofractured? ☐ Yes ☐ No
From Ft. to Ft.

Use Domestic

Casing Type Steel (black or low carbon) Joint Threaded Drive Shoe? ☑ Yes ☐ No Above/Below 1 ft.

Casing Diameter	Weight	Hole Diameter
4 in. to 119 ft.	lbs./ft.	6 in. to 119 ft.
		4 in. to 147 ft.

Open Hole from 119 ft. to 147 ft.

Screen NO Make Type

Diameter	Slot/Gauze	Length	Set Between

Static Water Level
75 ft. from Land surface Date Measured 11/29/1989

PUMPING LEVEL (below land surface)
75 ft. after hrs. pumping 20 g.p.m.

Well Head Completion
Pitless adapter manufacturer MONITOR Model 4
☐ Casing Protection ☐ 12 in. above grade
☐ At-grade (Environmental Wells and Borings ONLY)

NO REMARKS

Located by: Minnesota Geological Survey
Method: Digitized - scale 1:24,000 or larger (Digitizing Table)
Unique Number Verification: Address verification
Input Date: 10/09/1995
System: *UTM - Nad83, Zone15, Meters*
X: 450030 Y: 4948262

Grouting Information Well Grouted? ☑ Yes ☐ No

Grout Material: Bentonite from 0 to 119 ft. 0

Nearest Known Source of Contamination
70 feet W direction Septic tank/drain field type
Well disinfected upon completion? ☐ Yes ☐ No

Pump ☑ Not Installed Date Installed 11/30/1989
Manufacturer's name Model number HP 0.5 Volts 220
Length of drop Pipe 105 ft. Capacity 10 g.p.m
Type Submersible Material Galvanized

Abandoned Wells Does property have any not in use and not sealed well(s)? ☐ Yes ☐ No

Variance Was a variance granted from the MDH for this well? ☐ Yes ☐ No

First Bedrock St.Lawrence
Last Strat Franconia
Aquifer St.Lawrence-Franconia
Depth to Bedrock 104 ft.

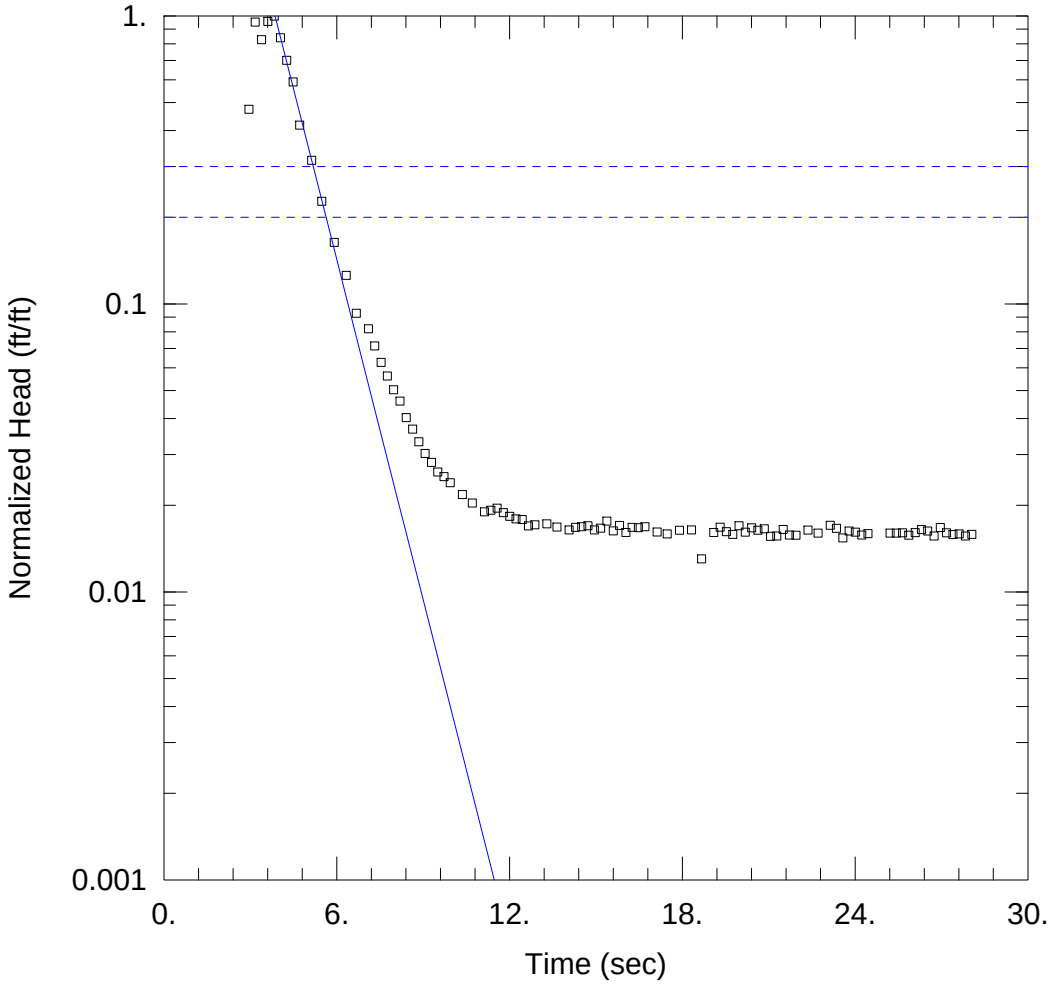
Well Contractor Certification

License Business Name	Lic. Or Reg. No.	Name of Driller
Bohn Well Co.	70350	VON BANK, B.

County Well Index Online Report 510414 Printed 7/6/2009
HE-01205-07

Appendix B

Slug Test Data



MW-1 OUT 1

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-1 Out 1.aqt
Date: 09/10/09 Time: 18:37:11

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-1
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

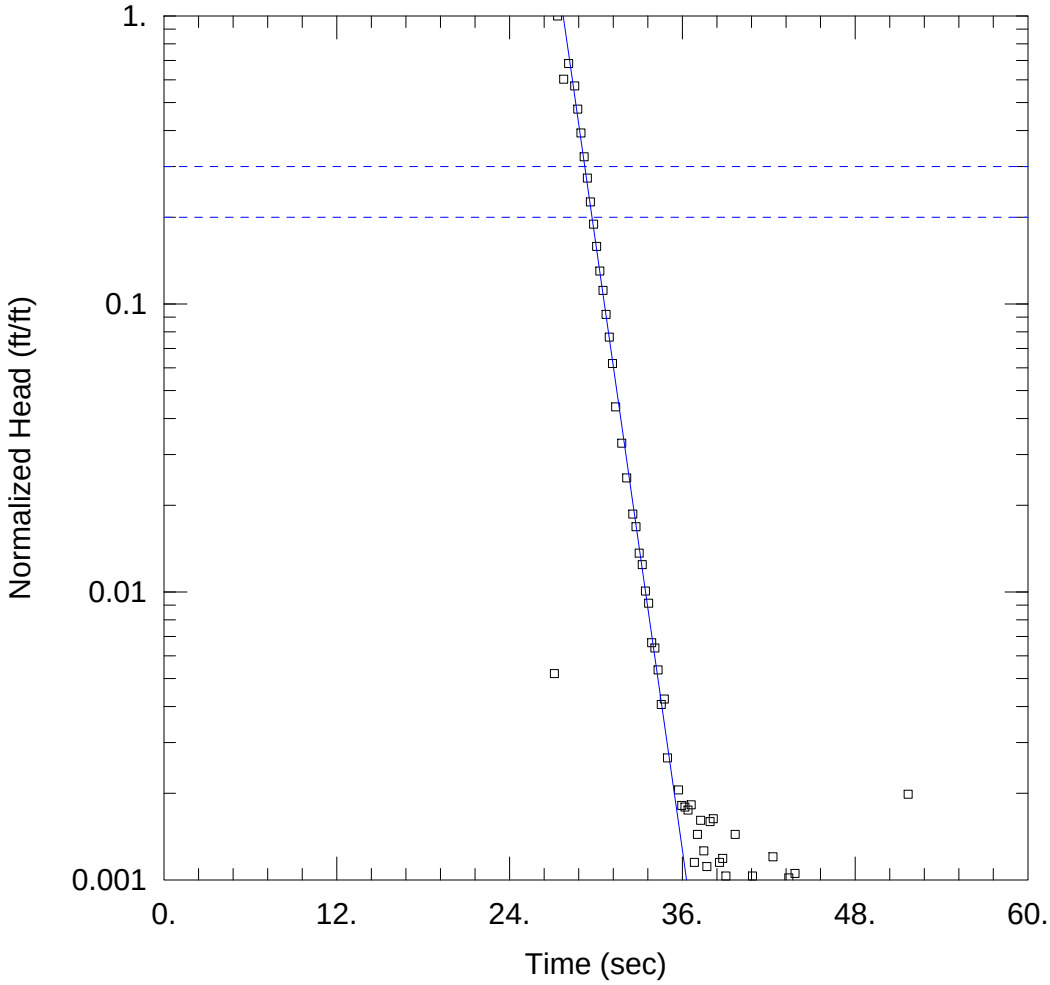
WELL DATA (MW-1)

Initial Displacement: -1.41 ft Static Water Column Height: 8.67 ft
Total Well Penetration Depth: 8.67 ft Screen Length: 8.67 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.03383 cm/sec y0 = -46.58 ft



MW-1 OUT 2

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-1 Out 2.aqt
Date: 09/23/09 Time: 12:46:22

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-1
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

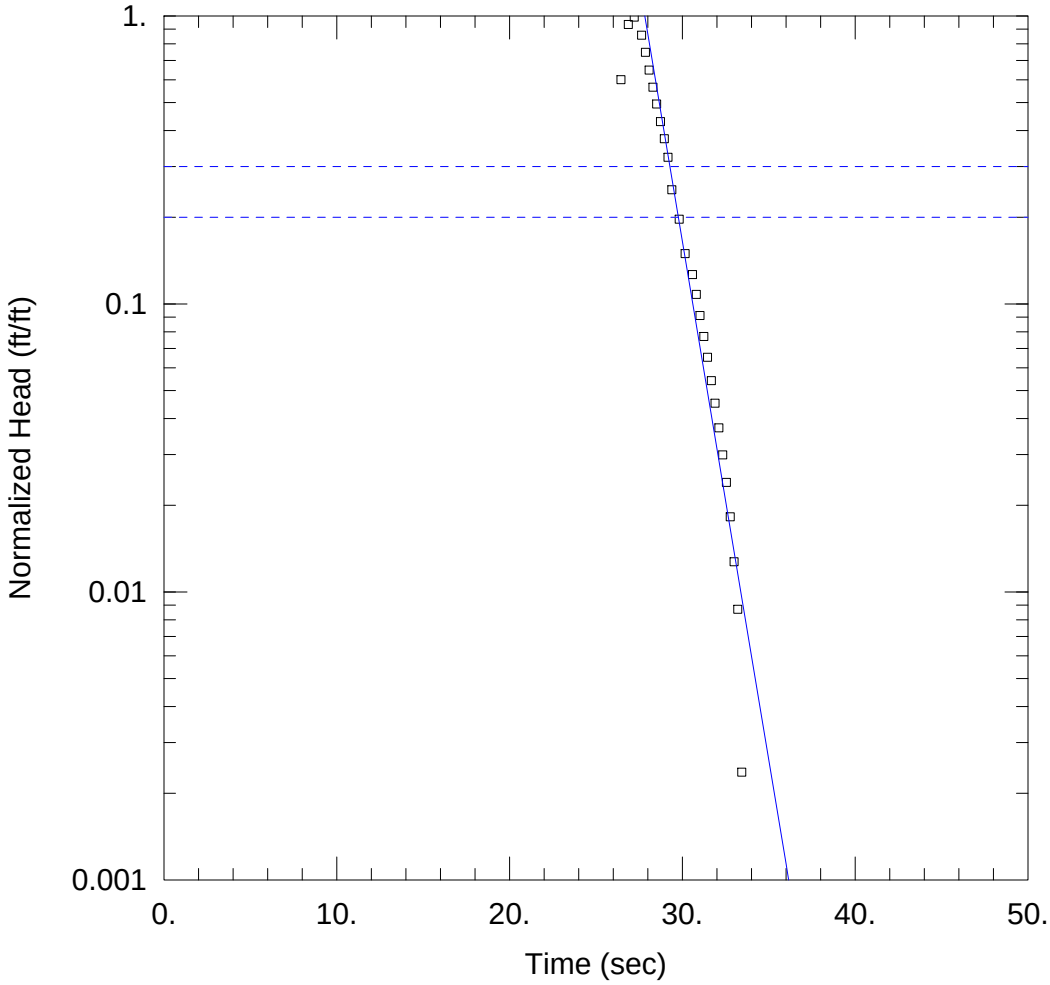
WELL DATA (MW-1)

Initial Displacement: -1.87 ft Static Water Column Height: 8.65 ft
Total Well Penetration Depth: 8.65 ft Screen Length: 8.65 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0301 cm/sec y0 = -9.508E+9 ft



MW-2 OUT 1

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-2 Out 1.aqt
Date: 09/10/09 Time: 18:40:13

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-2
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

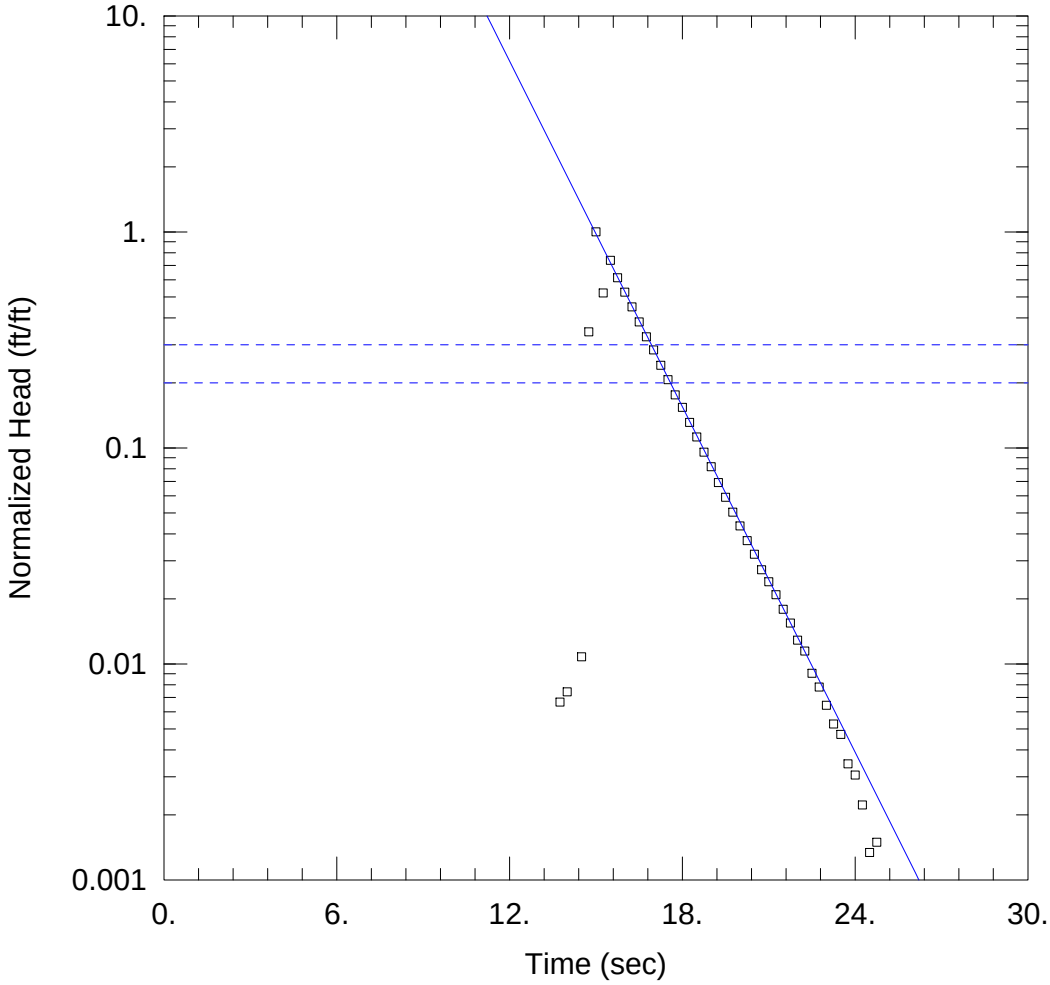
WELL DATA (MW-2)

Initial Displacement: -1.64 ft Static Water Column Height: 8.03 ft
Total Well Penetration Depth: 8.03 ft Screen Length: 8.03 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.03268 cm/sec y0 = -1.712E+10 ft



MW-2 OUT 2

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-2 Out 2.aqt
Date: 09/23/09 Time: 12:55:05

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-2
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

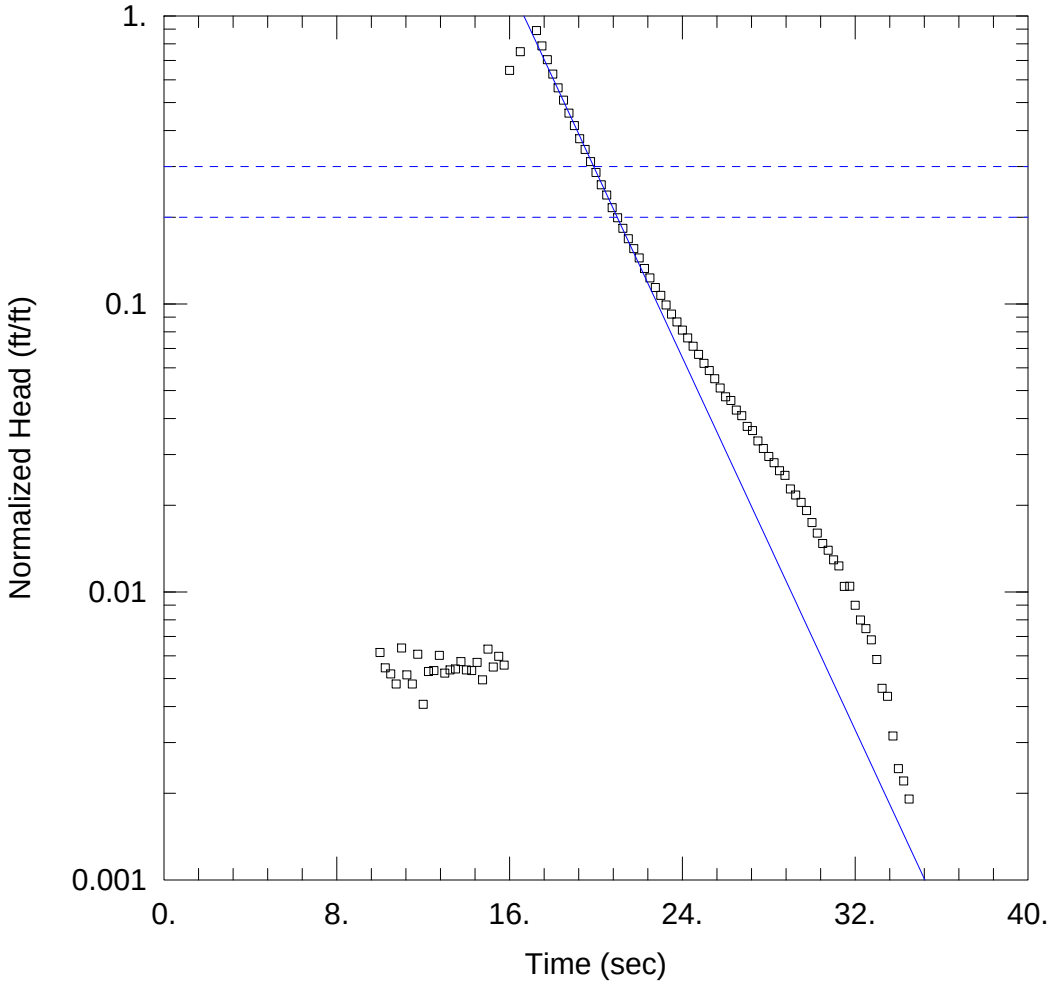
WELL DATA (MW-2)

Initial Displacement: -2.33 ft Static Water Column Height: 8.06 ft
Total Well Penetration Depth: 8.06 ft Screen Length: 8.06 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02414 cm/sec y0 = -2.286E+4 ft



MW-3 OUT 1

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-3 Out 1.aqt
Date: 09/10/09 Time: 18:41:29

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-3
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

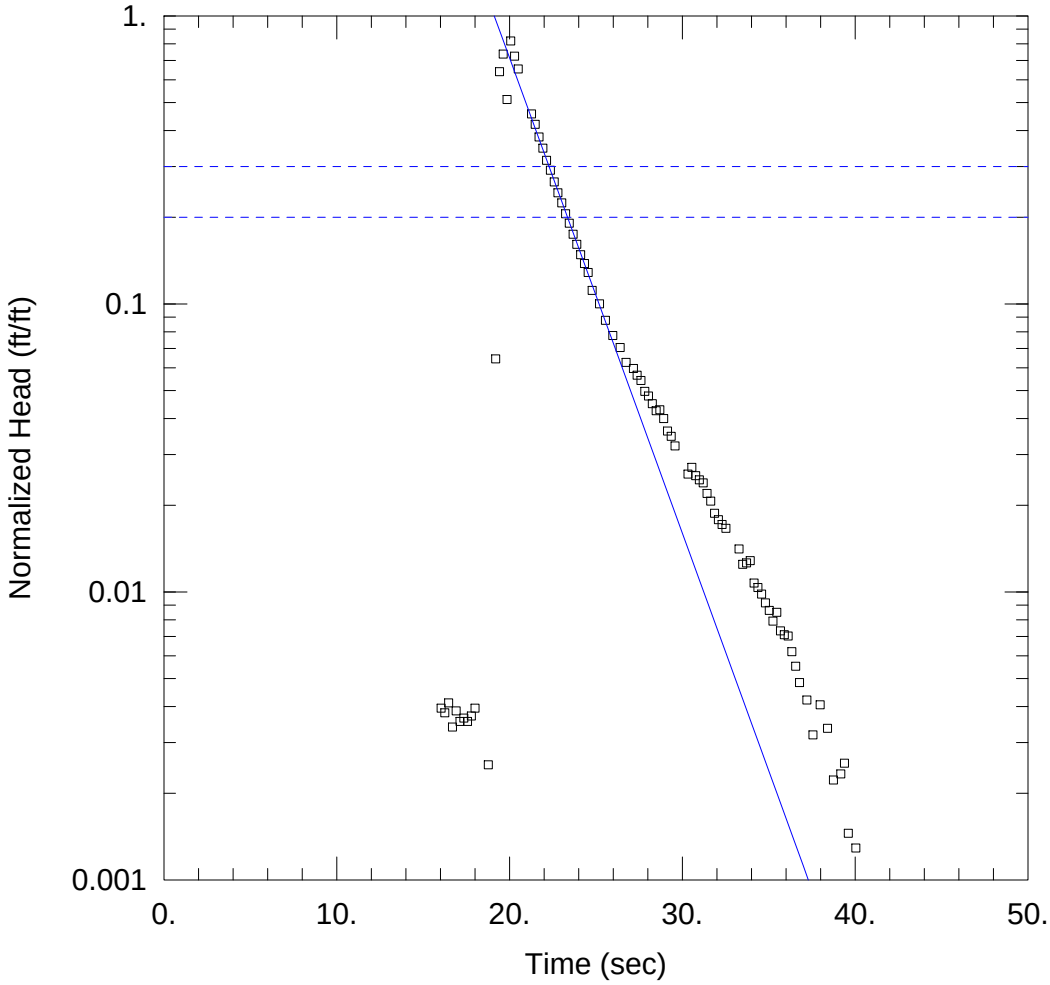
WELL DATA (MW-3)

Initial Displacement: -1.64 ft Static Water Column Height: 9.79 ft
Total Well Penetration Depth: 9.79 ft Screen Length: 9.79 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01269 cm/sec y0 = -807.5 ft



MW-3 OUT 2

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-3 Out 2.aqt
Date: 09/23/09 Time: 13:09:59

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-3
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

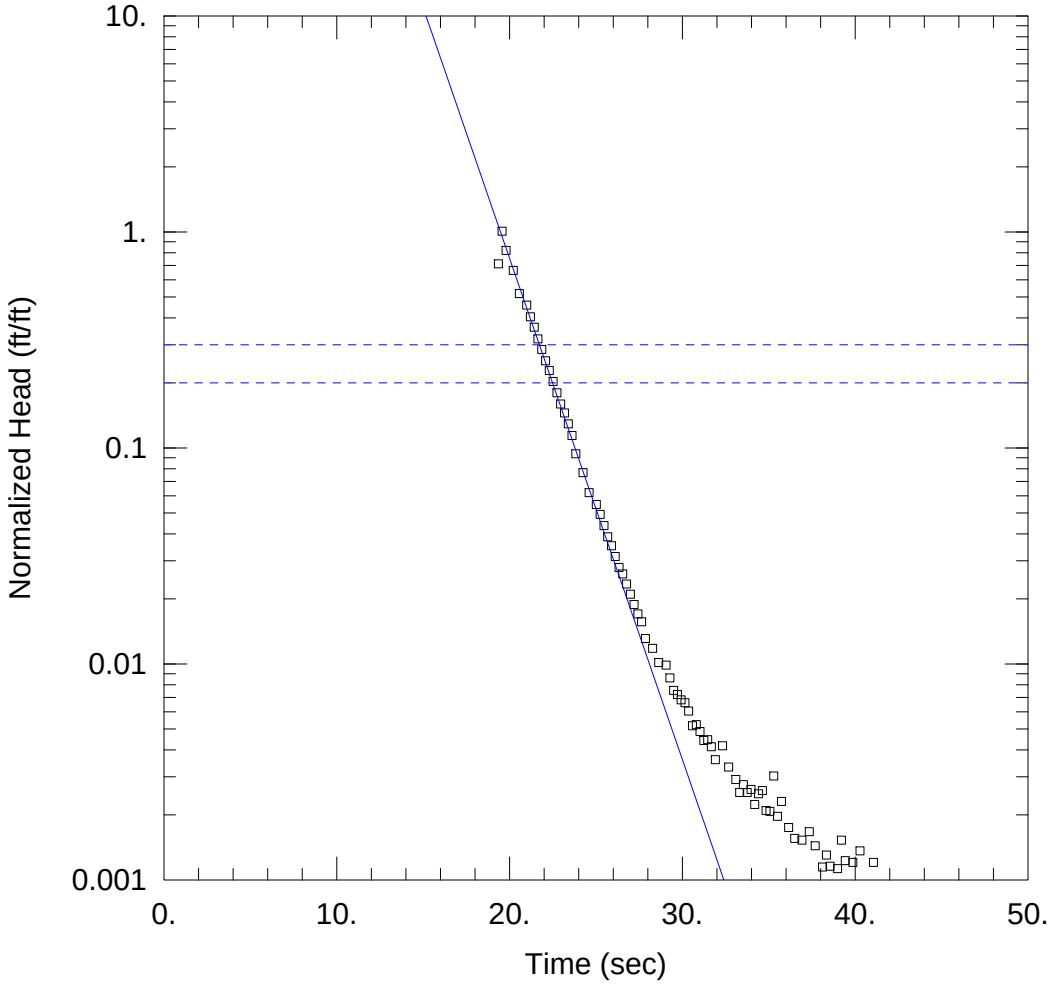
WELL DATA (MW-3)

Initial Displacement: -2.3 ft Static Water Column Height: 9.83 ft
Total Well Penetration Depth: 9.83 ft Screen Length: 9.83 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01292 cm/sec y0 = -3284.1 ft



MW-4 OUT 1

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-4 Out 1.aqt
Date: 09/10/09 Time: 18:41:58

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-4
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

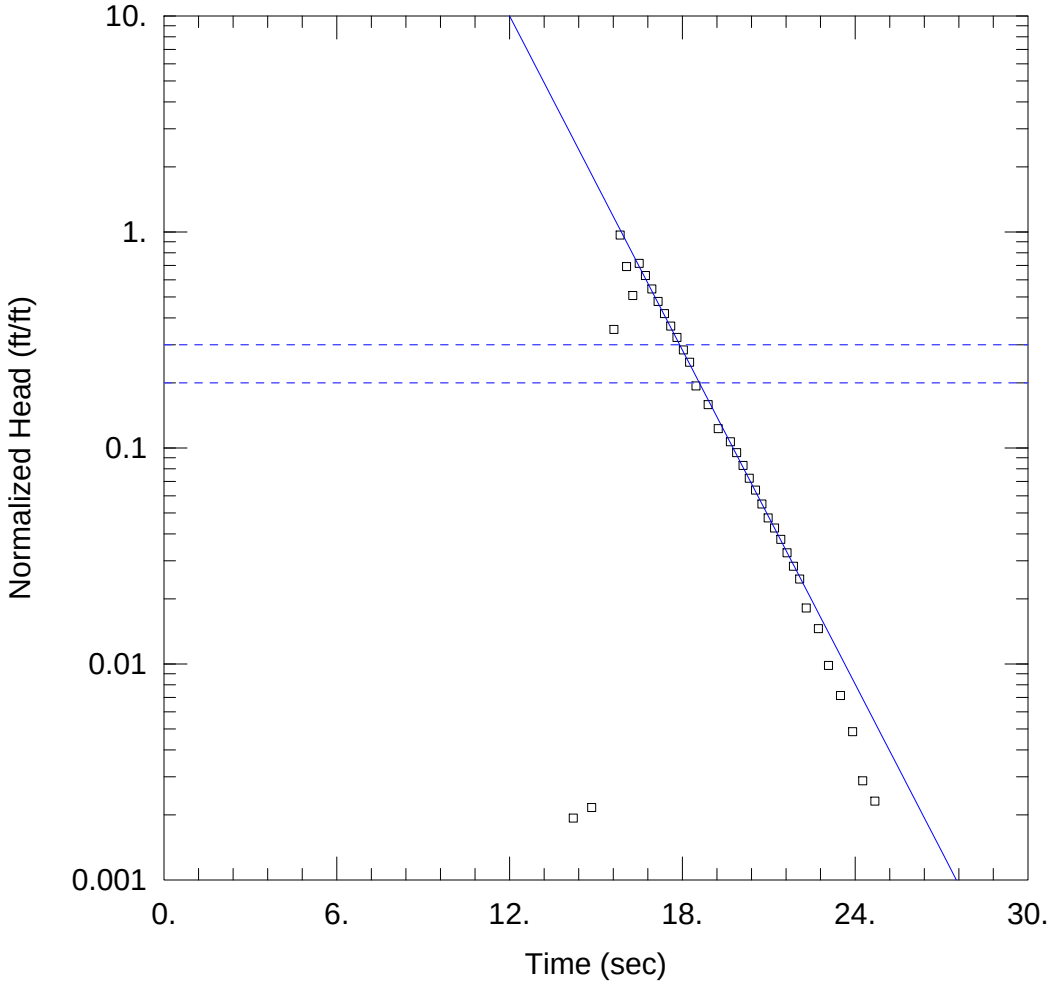
WELL DATA (MW-4)

Initial Displacement: -2.1 ft Static Water Column Height: 8.28 ft
Total Well Penetration Depth: 8.28 ft Screen Length: 8.28 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0206 cm/sec y0 = -6.927E+4 ft



MW-4 OUT 2

Data Set: C:\Documents and Settings\NRB\My Documents\WinSitu Data\K reports\MW-4 Out 2.aqt
Date: 09/23/09 Time: 13:20:25

PROJECT INFORMATION

Company: McCain and Associates, Inc.
Client: Jordan Aggregates, LLC
Project: HEN 0901
Location: Jordan, MN
Test Well: MW-4
Test Date: Sept. 5, 2009

AQUIFER DATA

Saturated Thickness: 100. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-4)

Initial Displacement: -2.2 ft Static Water Column Height: 8.29 ft
Total Well Penetration Depth: 8.29 ft Screen Length: 8.29 ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.02287

Appendix C

Evaporation and Excavation Volume Calculations

Appendix C - Table 1
Evaporation Calculations
Jordan Aggregates Proposed Sand and Gravel Mine

	Solar Radiation Flux (KWh / m^2) by Month and Year							Weather Station 214176; Jordan								
	2005 kWh/m^2	2005 MJ/m^2*	2004 kWh/m^2	2004 MJ/m^2*	2003 kWh/m^2	2003 MJ/m^2*	**Average MJ/m^2**	Rainfall Average (in)	Temperature Average (°C)	Latent Heat of Vaporization (MJ/Kg)	Er (mm)	e_{as} [Pa(N/M^2)]	Δ	E (mm/mo.)	E (in/mo)	Net loss Evap-Precip (in)
Jan	52.45	188.83	55.36	199.30	54.22	195.2	194.4	0.76	-12.7	2.531	77.11	230.74	18.74	21.96	0.86	0.10
Feb	67.22	241.98	73.42	264.32	76.95	277.0	261.1	0.52	-9.0	2.522	103.90	309.29	24.32	36.05	1.42	0.90
Mar	126.60	455.75	114.81	413.33	108.75	391.5	420.2	1.62	-1.9	2.505	168.33	531.94	39.33	81.10	3.19	1.57
Apr	114.84	413.43	160.25	576.88	139.33	501.6	497.3	2.34	6.1	2.487	200.73	939.02	64.98	128.67	5.07	2.73
May	139.48	502.14	157.73	567.82	167.98	604.7	558.2	3.4	13.5	2.469	226.93	1547.97	100.85	177.47	6.99	3.59
Jun	174.39	627.79	186.62	671.83	174.91	629.7	643.1	4.42	18.8	2.456	262.77	2167.82	135.47	228.79	9.01	4.59
Jul	200.26	720.92	182.78	658.02	189.15	680.9	686.6	3.86	20.8	2.452	281.10	2457.42	151.17	253.44	9.98	6.12
Aug	168.77	607.58	145.54	523.94	182.40	656.6	596.0	4.68	19.3	2.455	243.66	2236.50	139.22	214.05	8.43	3.75
Sep	119.87	431.54	126.46	455.24	119.04	428.5	438.4	2.97	14.2	2.467	178.36	1622.34	105.09	141.76	5.58	2.61
Oct	83.47	300.49	66.21	238.37	85.95	309.4	282.8	2.14	7.9	2.482	114.34	1069.07	72.84	77.54	3.05	0.91
Nov	49.00	176.41	48.63	175.05	47.98	172.7	174.7	1.71	-1.5	2.505	70.02	547.43	40.35	34.28	1.35	-0.36
Dec	26.86	96.70	47.46	170.87	41.22	148.4	138.7	0.77	-9.6	2.524	55.15	296.04	23.39	18.59	0.73	-0.04

Solar radiation data obtained from the National Solar Radiation Data Base: http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/

Indicates 6-month period where significant evaporation losses occur

Climate data obtained from the Midwestern Regional Climate Center: http://mrcc.sws.uiuc.edu/climate_midwest/historical/precip/mn/214176_psum.html

* 1kWh = 3.6 MJ

Priestley-Taylor Method for Calculating Evaporation

$$E = 1.3\left(\frac{\Delta}{\Delta+\gamma}\right)E_r$$

Where:
E = Evaporation Rate (total) (mm/month)
Δ = gradient of the saturated vapor pressure curve (Pa/°C)
γ = psychrometric constant = 66.8 Pa/°C
E_r = Evaporation Rate (vapor transport) (mm/month)

$$E_r = \frac{R_n}{l_v \rho_w}$$

Where:
R_n = Net radiation flux (from published source) (MJ/m^2)
l_v = Latent heat of vaporization
ρ_w = density of water = 996.3 kg/m3

$$l_v = 2.501\times10^6 - 2370T$$

Where:
T = average air temperature (°C)

$$\Delta = \frac{4098\, e_{as}}{(237.3 + T_\alpha)^2}$$

Where:
e_{as} = saturated vapor pressure (Pa (N/m^2)
T_α = average air temperature (°C)

$$e_{as} = 611\exp\left(\frac{17.27T}{237.3+T}\right)$$

Where:
$T = T_\alpha$ = average air temperature (°C)

Sample Calculation (June)

$T = 18.8°C$ $\qquad l_v = 2.501\times10^6 - 2370(18.8) = 2456444 \frac{J}{kg} = 2.456 \frac{MJ}{kg}$

$$E_r = \frac{643 \frac{MJ}{m^2}/month}{\left(2.456\frac{MJ}{kg}\right)\left(996.3\frac{kg}{m^3}\right)} \approx 0.263 \frac{m}{month} = 263 \frac{mm}{month}$$

$$e_{as} = 611 \exp\left[\frac{17.27(18.8)}{237.3+18.8}\right] \approx 2170 \frac{Pa\ N}{m^2}$$

$$\Delta = \frac{4098(2170)}{237.3+18.8} \approx 135.6 \frac{Pa}{°C}$$

$$E = 1.3\left(\frac{135.6\frac{Pa}{°C}}{135.6\frac{Pa}{°C} + 66.8\frac{Pa}{°C}}\right) 263 \frac{mm}{month} = 229 \frac{mm}{month}$$

Net evaporation for July

Volume of water evaporated from pond: Pond area = 36.0 acres

36.0 ac * 43560 sf/ac * 6.12 in/July * 1 ft/12 in * July/31 days = 25800 cf/day = 134 gallons per minute

McCain and Associates, Inc.

Name: Nick Borrow Date: Dec 11, 2009
Project: HEN 0901 No.
Desc. Pond loss calcs
Checked By: Sheet 1 of 2

Mine Pit Pond Net Evaporation Calculations for July

Net Evaporation = Total evap. − Precipitation − Surface runoff into pond

From Appendix C – Table 1 → Evaporation − Precipitation = 25 800 ft^3/day

Runoff (See attached Figures)

Total runoff = $Runoff_{watershed\ 1}$ + $Runoff_{watershed\ 2}$

- Use runoff data for 2-year, 24-hour storm

From HydroCAD: Watershed 2 → Area = 504,860 ft^2 Rainfall = 2.80" Runoff = 0.347 af

Total Precip: $504{,}860\ ft^2 \times 2.80\ in \times \frac{1\ ft}{12\ in} \times \frac{1\ ac}{43560\ ft^2} = 2.70\ af$

Ratio of Runoff to Total Precip $= \frac{0.347\ af}{2.70\ af} = 0.13$

July → Precip = 3.86 in = 0.322 ft (From Table 1)

$\frac{Precip\ Vol.}{day} = 504{,}860\ ft^2 \times 0.322\ ft = 162{,}565\ ft^3 \times \frac{July}{31\ days} = 5{,}244\ \frac{ft^3}{day}$

$\frac{Runoff\ Vol.}{day} = \frac{5{,}244\ ft^3}{day} \times 0.13 = \boxed{682\ \frac{ft^3}{day}}$ $Runoff_{watershed\ 2}$

From HydroCAD: Watershed 1 → Area = 2,055,596 ft^2 Rainfall = 2.80" Runoff Vol. = 0.443 af

Total Precip: $2{,}055{,}596\ ft^2 \times 2.80\ in \times \frac{1\ ft}{12\ in} \times \frac{1\ ac}{43560\ ft^2} = 11.01\ af$

Runoff to Total Precip $= \frac{0.443}{11.01} = 0.04$

July → Precip = 0.322 ft

Precip Vol./day $= 2{,}055{,}596\ ft^2 \times 0.322\ ft \times \frac{July}{31\ days} = 21{,}352\ \frac{ft^3}{day}$

Runoff Vol./day $= 21{,}352\ \frac{ft^3}{day} \times 0.04 = \boxed{854\ \frac{ft^3}{day}}$ $Runoff_{watershed\ 1}$

Net Evaporation $= 25{,}800\ \frac{ft^3}{day} - 854\ \frac{ft^3}{day} - 682\ \frac{ft^3}{day} = \boxed{24{,}264\ \frac{ft^3}{day}}$

Total Evap. + Precip Runoff

McCain and Associates, Inc.

Name: Nick Brown Date: Dec 11, 2009
Project: HEN 0901 No.
Desc. Pond loss rates
Checked By: Sheet 2 of 2

Mine Pit Pond Excavation Volume Calculations

Excavation rate below water table = 2,700 $\frac{ton}{day}$

Assume excavation rate represents moist sand which has drained to 15% of saturated water content.

Assume material density of 115 $\frac{lb}{ft^3}$ (moist)

$$2{,}700 \frac{ton}{day} \times \frac{1\ ft^3}{115\ lb} \times \frac{2000\ lb}{1\ ton} = 46{,}957 \frac{ft^3}{day}$$

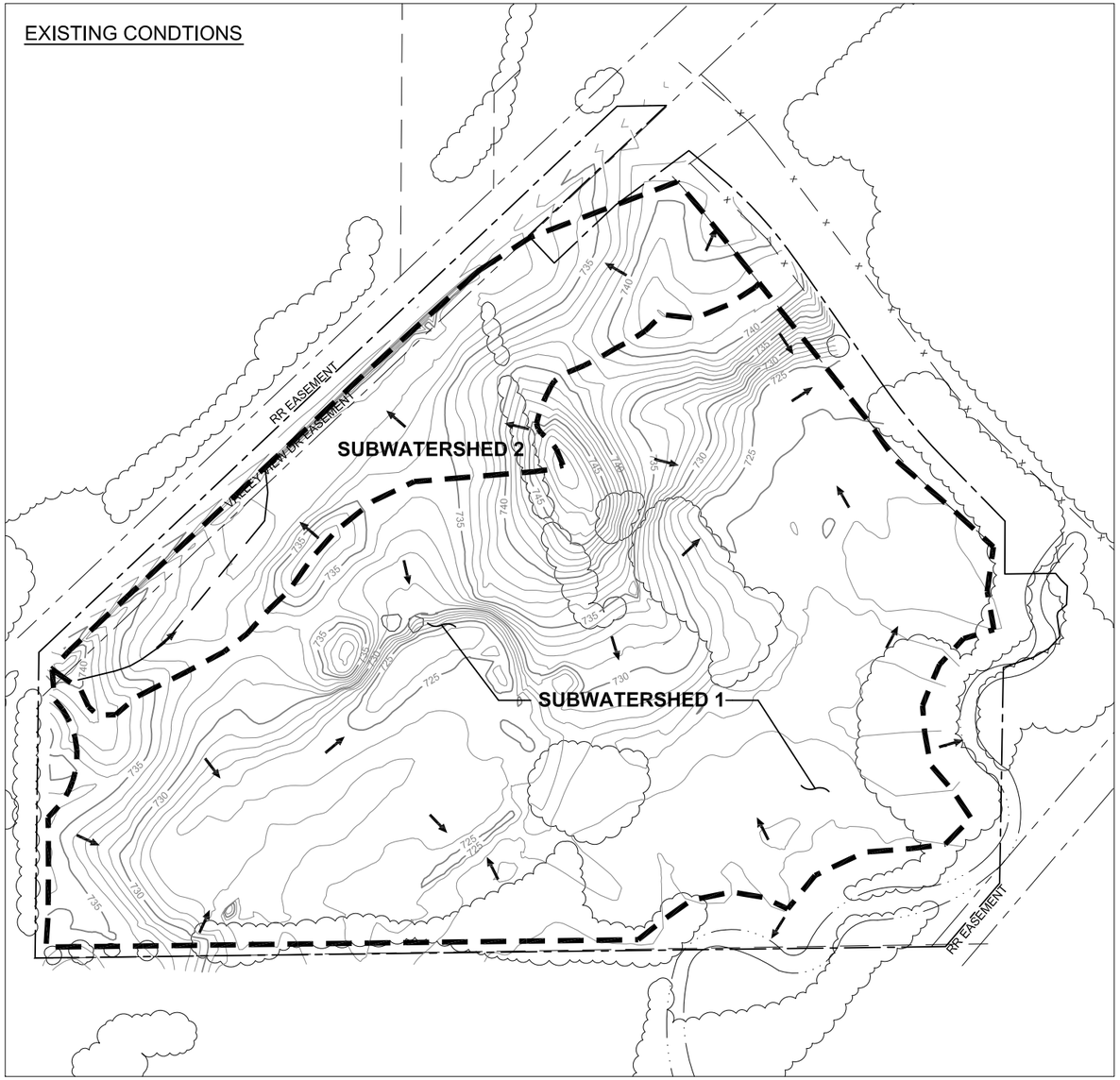
Total Water Replacement Needed to Account for Evaporation and Excavation Volume Losses – July

$$\underset{\text{Evap}}{24{,}264 \frac{ft^3}{day}} + \underset{\text{Excavation}}{46{,}957 \frac{ft^3}{day}} = 71{,}221 \frac{ft^3}{day} \times \frac{7.48\ gal}{ft^3} \times \frac{1\ day}{1440\ min}$$

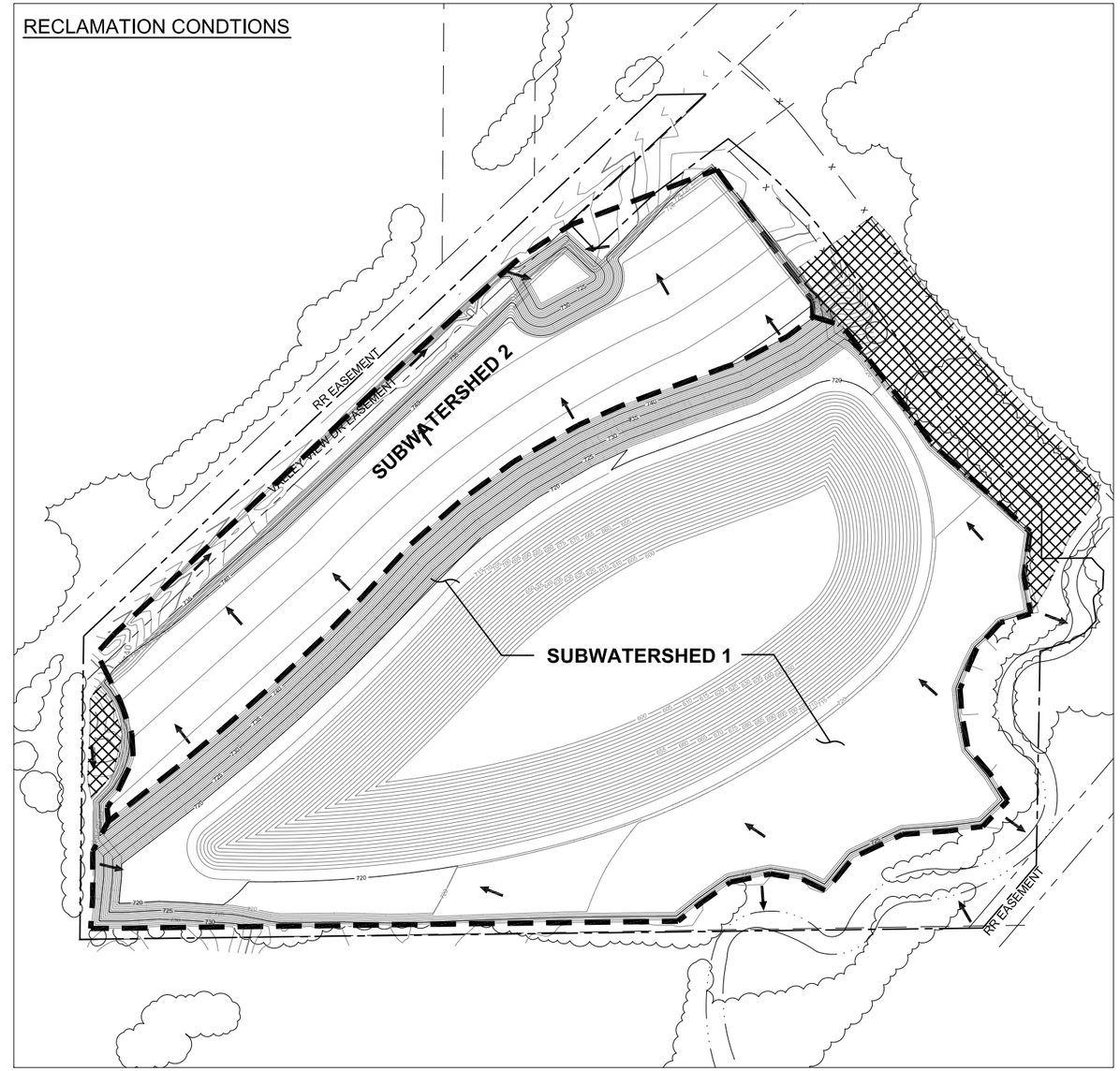
$$= 370\ gal/min$$

REV	DATE	BY	DESCRIPTION

EXISTING CONDTIONS



RECLAMATION CONDTIONS



WATERSHED BOUNDARY - WITHIN PROJECT BOUNDARY

SURFACE DRAINAGE DIRECTION

ADDITIONAL WATERSHED AREA BEYOND PROJECT BOUNDARY - INCLUDED IN WATERSHED 1

SUBWATERSHED 1

Storm Event	Peak Discharge (cfs)		Volume (af)	
	Existing	Reclamation	Existing	Reclamation*
2-yr (2.8")	10.10	NA - Entirety of subwatershed drains to on-site pond	2.72	0.44
10-yr (4.2")	29.32		7.01	2.06
100-yr (6.0")	60.37		13.91	5.23

* INCLUDES ADDITIONAL WATERSHED AREA

SUBWATERSHED 2

Storm Event	Peak Discharge (cfs)		Volume (af)	
	Existing	Reclamation	Existing	Reclamation
2-yr (2.8")	1.33	4.83	0.25	0.35
10-yr (4.2")	7.27	17.03	0.87	0.99
100-yr (6.0")	19.00	36.90	1.99	2.06

N

0 100 200 400
SCALE IN FEET

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

JOHN R. MCCAIN

SIGNATURE _____

DATE _____ REG. NO. 21635

McCain and Associates, Inc.
5300 Highway 12
Maple Plain, MN 55359
ph 952-346-3900
fx 952-346-3901

DWN	NRB	DATE	11/6/09
DGN'R	NRB	CHK'D	NRB
PROJECT NO.	HEN0901		
DRAWING NO.	MINING_PLAN.DWG		

WATERSHED DIAGRAM
PROPOSED MINE SITE

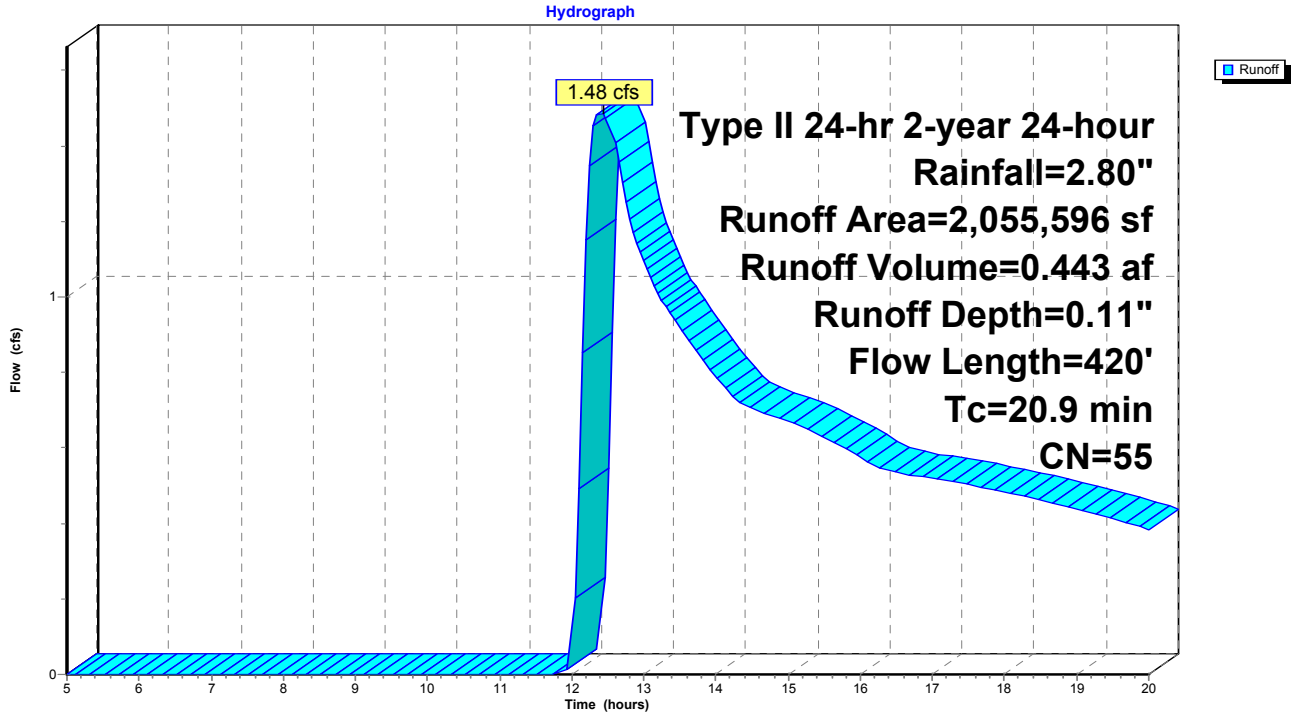
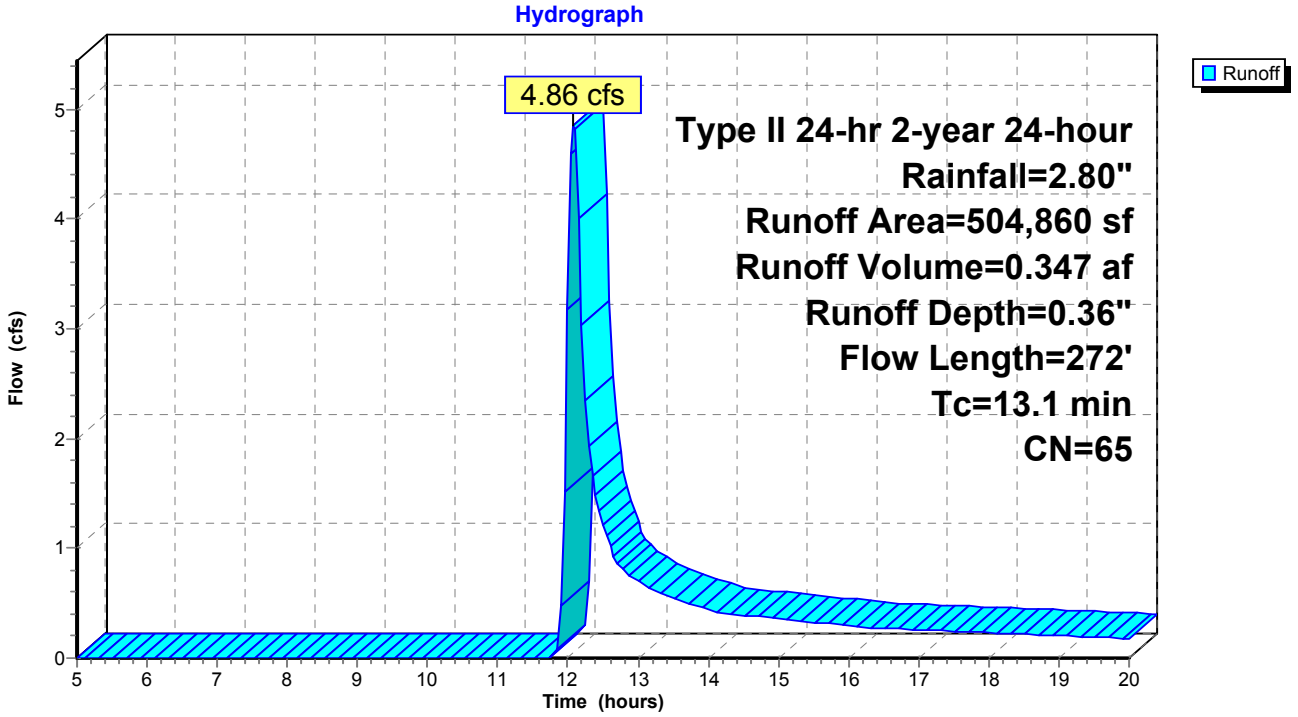
SAND CREEK TOWNSHIP, SCOTT COUNTY, MINNESOTA

JORDAN AGGREGATES, LLC

SHT 1 of 1 SHTS

P:\Projects\HEN\HEN0901 Keefe\dwg\VALLEY VIEW 6-24-09 ACD.dwg, Addnl. Watersheds

Subcatchment 1S: Lowland-Final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