WATER MONITORING AND RESPONSE ACTION PLAN

Jordan Aggregates Proposed Sand and Gravel Mine
Sand Creek Township, Minnesota

Prepared for:

Jordan Aggregates, LLC

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1.0 INTRODUCTION

This Water Monitoring and Response Action Plan (Plan) defines procedures to be used for collecting and analyzing water samples and reporting results for the Proposed Jordan Aggregates Sand and Gravel mine. The purpose of this document is to provide guidance and rationale on issues related to routine environmental monitoring. The term "monitoring" refers to all tasks included in the collection of data from groundwater wells and surface water sampling locations at the site including: water level data collection, water sampling for chemical analysis, and documentation of well and field conditions. This information is intended to fulfill requirements that will be established by the Scott County Interim Use Permit (IUP) for the mine.

This Plan is a preliminary plan, as specific monitoring requirements have not yet been promulgated in the IUP; the Plan will be finalized upon the execution of the IUP. This Plan will be reviewed annually, and updated as necessary. Revisions to this sampling and analysis plan, including statistical methods, will be submitted to Scott County for approval along with the rationale for the proposed change. Deviations from the procedures described in this plan may be required due to unforeseen circumstances. Such deviations will be clearly noted on field sheets and groundwater monitoring reports.

1.1 Plan Objectives

The primary objective of this Plan is to ensure proper groundwater sample collection, analysis, and reporting as required by the IUP. Monitoring data will be used to evaluate permit compliance and assess potential impacts of the mine on groundwater and surface water. Indicator parameters such as isotope ratios and dissolved oxygen will be used to evaluate the effect of an open water body and surface water/groundwater mixing in terms of trends and spatial distribution. Contaminant analysis (e.g. organic compounds) will be used to evaluate permit compliance and for ongoing risk assessments. Water level data will be used to evaluate impacts on the water table elevation.

The Plan also presents response actions that would be triggered by exceedences of applicable water quality limits defined in the IUP.

1.1.1 Data Quality Objectives

The procedures defined in this Plan are intended to provide representative groundwater data at the facility. Representative data are critical to assessing the potential for the Facility to influence groundwater. The objective is to ensure that the data are collected, transported, and analyzed in a consistent manner with appropriate levels of quality assurance and quality control (QA/QC) at each step of the process.

The QA/QC program is designed to continuously refine and implement processes to achieve maximum completeness and accuracy. At a minimum, data collection and reporting will be of

sufficient quality to identify statistical trends in groundwater quality and evaluate facility compliance.

1.2 Plan Organization

This Plan consists of three sections following this introductory section:

- Section 2 describes background information and the site conceptual model.
- Section 3 describes the monitoring network, sample parameters, and monitoring procedures.
- Section 4 provides information on data analysis, including statistical methods and contingencies, as well as groundwater analysis reporting.
- Section 5 describes response actions to be conducted in the event of a water quality impact.
- Section 6 provides references cited in the text.

2.0 BACKGROUND DATA AND SITE CONCEPTUAL MODEL

2.1 Site Description

The proposed mine site is located between Valley View Drive and U.S. Highway 169 approximately one mile northeast of Jordan Minnesota. A site location map is included as Figure 1. The mine property occupies 98 acres within portions of the southwest quarter of Section 8 and the northwest quarter of Section 17, Township 114 North, Range 23 West. Current land use at the site consists of agricultural and open land use.

The proposed mining operation would occupy approximately 84.7 acres of the mine property. As shown on Figure 2, the proposed mining plan includes excavating below the water table in the center of the site, creating a small lake of approximately 36 acres. In the areas surrounding the lake mining will occur down to the water table and reclamation fill will be imported to the to bring portions of the site back up to grade in order to allow for future development of the site.

2.2 Physical Setting and Hydrology

The site is situated on the southeastern edge of the Minnesota River Valley between the base of the bluffs to the southeast and the Minnesota River to the northwest. The site is bounded by Valley View Drive to the northwest, Sand Creek to the southeast, and adjacent properties on the remainder of the perimeter. Existing topography on the site is shown on Figure 2. 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 where it infiltrates. Regional drainage is toward the Minnesota River, which is approximately 0.7 miles northwest of the site.

2.3 Hydrogeologic Conceptual Model

The following paragraphs summarize the site hydrogeologic conceptual model. Much of the information presented below has been adapted from a more detailed discussion of the conceptual model presented in the Groundwater Model for the site (McCain 2010); with additional detail and

refinement based on data from the Groundwater-Flow and Solute-Transport Modeling report (Barr, 2012).

2.3.1 Geology

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. The unit typically ranges in thickness from 55 to 80 feet; however at the site it is about 0 to 20 feet thick. 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.

2.3.2 Hydrostratigraphic Units

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, permeable alluvial deposits of mostly sand and gravel with varying amounts of fines. 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.
3) **Franconia-Ironton-Galesville (FIG) bedrock aquifer –** This aquifer is comprised of the Franconia formation as well as the underlying Ironton-Galesville sandstone. The Franconia is composed 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.

2.3.3 Groundwater Occurrence and Movement

Groundwater beneath the site occurs within the unconsolidated alluvial deposits as well as the underlying bedrock aquifers. Water level measurements collected in late August 2009 indicate that groundwater elevation at the site is approximately 720 ft above msl. Groundwater contours from this measurement event are illustrated on Figure 3. 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.

The Minnesota River is the regional discharge location for each of the three hydrostratigraphic units listed above. Groundwater within the various aquifers flows both laterally northwest toward the river and upward from deeper aquifers to the surficial aquifer and the river itself. On site data indicates a moderate upward vertical gradient of 0.004 between the upper FIG aquifer and the water table (Barr, 2012).

2.3.4 Potential Contamination

Potential groundwater contamination from the mining operation would be the result of two primary mechanisms:

1. Spills, leaks, or other surface contamination that infiltrates downward from the ground surface and enters the surficial aquifer at the water table.
2. Floodwater from Sand Creek that enters the aquifer via the mine pond.

Surface spills and leaks would be directly attributable to the mining operation and would be the result of a correctable issue such as equipment failure, maintenance issues, or improper material storage. Conversely, floodwater inundation is an inevitable occurrence once the mine pond has been excavated so it is certain that floodwater will enter the groundwater to some extent. Unlike surface spills, the contaminants carried in the floodwater are not generated by the proposed mine and will already be reaching the surficial aquifer and the Minnesota River (which is the ultimate discharge point for the aquifer) regardless of whether the mine is developed. Due to the uncertainty regarding current and emerging contaminants of concern in the floodwater and the implications of these COCs on mitigation strategies, Jordan Aggregates is pre-emptively replacing existing downgradient receptors (wells completed in the surficial aquifer that are predicted to receive flood-impacted groundwater) with deeper wells completed in the Ironton-Galesville Sandstone, also known as the Lower FIG, which is not predicted to be impacted by floodwater. In this way, impacts from floodwater on receptors is mitigated. More information on the proposed mitigation is included in Section 5.

Despite modeling results predicting no impact to the Lower FIG due to floodwater, the unit will still be monitored for floodwater impacts. This will provide an extra degree of protection for the downgradient replacement wells and will provide site-specific data on groundwater movement in the deep surficial aquifer and groundwater-surface water interaction within the mine pond.

2.4 Summary of Monitorable Units

The uppermost saturated unit at the site is the surficial sand and gravel aquifer, and this unit occurs immediately beneath the proposed mine plant site. Therefore; the primary target of monitoring at the site is the surficial sand and gravel aquifer. Modeling results indicate that the lower portion of the FIG aquifer will not be impacted by flood water. Nevertheless, because the anticipated depth of the mine pond will result in the removal of much of the overburden above the FIG aquifer, this aquifer will also be monitored.

3.0 WATER MONITORING NETWORK

This section presents the proposed monitoring network, sampling methods, analytical methods, and parameters.

3.1 Monitoring Network

The monitoring well network at the site is summarized on Table 1 and is shown on Figure 4. Well logs are included in Appendix A. The network consists of 7 groundwater monitoring wells (4 existing wells, 3 proposed new wells), 2 water level piezometers, and one surface water monitoring point:

Groundwater Monitoring Wells
Upgradient Wells:
MW-5 (proposed new well – deep surficial aquifer)

Downgradient Wells:

Surficial aquifer wells — Water table wells:
MW-1
MW-2
MW-3
MW-4

Lower FIG wells
MW-7 (proposed new well)

MW-6 (proposed new well – deep surficial aquifer)

Water Level Piezometers
PZ-1 PZ-2

Surface Monitoring Point
Center of the mining pond, or location of deepest point.

Well construction information for existing and proposed wells is summarized in Table 1. Wells will comply will applicable portions of the Minnesota Well Code. The proposed upgradient well will be located within the Sand Creek floodplain, so it will be constructed to prevent invasion of flood water as required by the well code.

Wells will be equipped with dedicated bladder pumps for sampling.

3.2 Monitoring Parameters and Frequency

Each of the wells and surface water sampling locations in the monitoring network will be analyzed for the full list of parameters presented in Table 2. The parameter list includes surface water

indicator parameters such as isotope ratios, dissolved oxygen, and temperature; as well as groundwater contaminants such as nitrate, organic compounds and microorganisms. For parameters with promulgated regulatory limits, such as the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs) or Minnesota Department of Health (MDH) Health Risk Limits (HRLs) and/or Health Based Values (HBVs), the limits are listed in the tables. Table 2 also lists Action Levels which will trigger response actions described in Section 4.4 and Section 6 of this Plan. The list may be revised with additional parameters as new COCs are identified, and intervention limits (ILs) will be updated as MCL or HRL values change. Also, parameters may be removed from the list if analysis demonstrates that they are consistently absent in the water samples

Monitoring at the mine will consist of two primary phases: 1) background data collection, and 2) detection monitoring. Samples collected during the background phase will provide data used to establish existing or baseline water quality; as it may be that groundwater already exhibits elevated levels of contaminants. It is important that background samples be statistically independent, meaning that water collected during each sampling event must be unique to that event and not include water 'left over' from the previous event. Therefore, sufficient time needs to be allowed between sampling events to ensure that water sampled during the previous event has moved beyond the capture zone for the current event. For the monitoring zone at the site, bi-monthly sampling is an acceptable frequency to ensure sample independence. Based on measured values of hydraulic conductivity and horizontal gradients presented in the Groundwater Model (McCain 2010), groundwater velocities within the surficial aquifer are on the order of 1.0 to 1.5 feet per day. With this rate of groundwater movement, water will have moved far enough from the well in a three-month period so as to not be captured during the subsequent sampling event. Additionally, collecting samples quarterly over the course of eight months will account for seasonal variation in water levels and parameter concentrations

During the detection monitoring phase samples will be collected quarterly according to the following schedule:

Quarter	Sampling Date Range
1	January 1 – March 31
2	April 1 – June 30
3	July 1 – September 30
4	October 1 – December 31

Additional groundwater and surface water sampling will be conducted after flood events. During flood events occurring prior to excavating below the water table, a sample of the floodwater will be collected from the edge of the creek in the floodplain. Once the mine is excavated below the water table, the surface water sample(s) will be collected from the approximate center of the pond or the location where the pond is the deepest. The pond sampling will occur as soon as safely possible

after the flood event. Pond samples will be collected at multiple depths based on the depth of the pond at the time of sampling, as described in Section 3.4.7.

The downgradient well nest will also be sampled more frequently after flood events, however it is important to note that there is little potential for contaminant transport deep into the aquifer when the pond is shallow. Therefore the accelerated sampling will commence once the pond bottom reaches an elevation of 775 feet above msl, which is approximately 10 feet above the top of the screen of the proposed deep surficial aquifer well, and 50 to 55 feet above the top of bedrock. However, if prior sampling indicates significant downward movement of floodwater within the pond or significant downward vertical gradients during/after flooding it may be appropriate to initiate the accelerated sampling of the well nest earlier than pond elevation 775. The accelerated sampling will occur at two-week intervals for a period of eight weeks immediately following a flood event. If the wells show no IL exceedences, the accelerated sampling may be discontinued until the pond is excavated an additional 10 feet, at which time the accelerated sampling would recommence. This pattern of sampling would continue until the termination depth of the pond is reached.

The mine pond will remain after the conclusion of the project. Monitoring will therefore continue after site reclamation for the period of time required to observe five flood events. If no exceedences are observed sampling may be discontinued after five flood events.

As with any monitoring program, the collection of data over time may result modifications to the sampling parameters or schedule as the subsurface conditions at the project site become better understood.

3.3 Staff Qualifications

Sampling activities will be performed by MVTL of New Ulm, MN or another qualified contractor. Personnel engaged in sampling will have the necessary skills and training to complete the work described in this plan. The analytical laboratory will be MVTL of New Ulm, MN or another qualified laboratory. MVTL is certified by the Minnesota Department of Health and has a written quality assurance/quality control manual available on their website: http://www.mvtl.com.

3.4 Monitoring Procedures

The routine monitoring procedures include inspection of the well integrity, notation of any problems with the protective casing, surface seal, or lock, and tasks summarized in the following sections. In general, the wells should be sampled in the order deepest to shallowest and upgradient or sidegradient to downgradient. Relative position of each well is shown on Figure 4.

3.4.1 Initial Water Level

A water level measurement and a total depth measurement referenced to the north side of the top of the riser pipe will be collected prior to purging or sampling. The water level indicator, as well as other non-dedicated downhole equipment, should be decontaminated between each well by washing with a phosphate-free detergent.

3.4.2 Well Volume Calculations

The well volume will be calculated by subtracting the depth to water from the total depth and multiplying the result by 0.16 to obtain the well volume in gallons for 2 inch diameter wells. The result may be reported in metric units by multiplying gallons by 3.8 to obtain liters.

3.4.3 Purging and Stabilization

Purging is performed using either electric submersible pumps or dedicated bladder pumps. Purging rates vary depending on well depth, but stabilization parameters will be collected every one to two minutes to ensure that formation water is collected from the well. Stabilization parameters include pH, specific conductivity (corrected to 25°C) and temperature. Once three consecutive readings are obtained with less than 5 percent change in parameter readings, the well may be sampled. If the well is approaching stabilization after three well volumes, additional volumes may be removed to achieve stabilization. If the well is not approaching stabilization after three well volumes, the well is unlikely to stabilize and may be sampled after four well volumes.

Interruptions in pumping that may cause a surge of water to run back down into the well are to be avoided if possible. Turbidity and color are noted on the field data sheet by indicating whether the sample was opaque, cloudy, or clear. Color will be noted separately on the field data sheet (i.e. yellow, red, gray, none, etc.). Blanks and/or duplicates are also documented on the field sheet and whether they were collected before or after the identified well sample.

3.4.4 Sampling and Handling

In general, samples will be collected in accordance with the MPCA's *Sampling Procedures for Ground Water Monitoring Wells (MPCA, 2006).* Sampling personnel shall wear a new pair of disposable latex or nitrile gloves at each sampling location.

Wells are sampled for the parameters listed in Table 2 including (in order of sample collection) organic compounds, microorganisms, and general geochemical parameters and field parameters. General and field parameters (pH, specific conductivity, and temperature) are collected after all the other samples have been placed in their proper containers. If a well(s) is found to have insufficient volume for a full sample, then water shall be collected for field parameters. Samples will be placed directly in a cooler with ice maintained at about 4°C. Each sample container should be labeled

clearly prior to sampling with the well ID, date, analysis, preservative if any, and sampler's initials. The samples will be transported under chain of custody, on ice and in a sealed cooler.

Samples collected for bacterial/microbial analysis will follow EPA-prescribed procedures presented in EPA 817-R-08-003, *Sampling Guidance for Unknown Contaminants in Drinking Water;* EPA 542-S-02-001, *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers;* and the EPA Ground Water Rule, as appropriate. Samples should be collected using clean, sterile equipment. Sampler tubing should not be allowed to touch the ground and handling of the tubing should be limited to only the amount necessary to collect the sample. Care should be taken not to touch the lip or cap of the bottle with the tubing or fingers.

3.4.5 Final Water Level

After sampling, a final water level and total depth measurement will be obtained and the well will be capped, locked, and the bailer or tubing disposed of properly. All information from the well will be noted on the field sampling data sheets and the preceding steps repeated on the next well.

3.4.6 Purge Water and Decontamination

Purge water may be conveyed to the ground surface on the downgradient side of the well location.

All downhole equipment is rinsed with deionized water after each well. Non-dedicated purge pumps (if used) are flushed with Alconox solution and rinsed with deionized water.

3.4.7 Sample Procedures for Surface Water

The surface water sample shall be collected from near the center of the pond or at the location where the pond is the deepest if that location differs from the geographic center of the pond. Sampling will consist of collecting a number of individual samples at discrete depths in order to assess the degree to which the water column may exhibit stratification. The number of samples collected will depend on the depth of the pond at the time of sampling, as shown in the following schedule:

Depth of Pond (ft)	Number of Samples
0 – 10	1
10 – 20	2
20 – 40	3
40 – 60	4
60 – 80	5

The uppermost sample will be collected within five feet of the surface, however the sampler shall avoid collection of the surface layer of water that may contain dust particles. Deeper samples will

be spaced evenly throughout the water column depending on the actual depth of the pond at the time of sampling. The sample shall also avoid sediments from the pond bottom. The sample may be collected with a Kemmerer sampler or similar type sampler that can be lowered through the water column and closed from the surface. No water level measurements or purging are required, but field parameters shall be collected as described above.

3.4.8 Field Blanks and Duplicates

All quality assurance/quality control (QA/QC) samples will be collected in the same manner and type of container as the corresponding primary samples. A field method (equipment) blank will be collected to detect method or background contamination. Duplicate samples will be collected to evaluate variability in analytical methods. These QA/QC samples will be collected at sampling points which represent the entire range of contamination concentrations in order to provide meaningful information for blank or duplicate sample evaluation.

QA/QC samples will be assigned identification aliases on the sample bottle label and on the chain of custody sheet to avoid alerting laboratories that the sample is a blank or duplicate sample. The true identity of the QA/QC samples will be recorded in the sampling field sheet and in the Sampling and Analysis Report.

Field Methods (Equipment) Blanks

One field method (equipment) blank for each event will be collected and analyzed for the following parameters: Alkalinity, Ammonia nitrogen, Chloride, Nitrate, Sulfate, Total Dissolved Solids, VOCs, and Total Coliforms. Sample containers and preservatives used for each blank will be the same as those used for each primary sample. All containers shall be pre-cleaned according to the laboratory's QA/QC program, in the same manner as primary sample bottles. The sample blank container will be filled in the field in a manner that simulates actual field sampling methods. The field blank water will be run through all of the same tubes, sample collection devices, filters, etc. that the actual sample water will encounter. Trace metals blanks will be filled with laboratory-prepared, triple deionized water.

Duplicate Samples

One duplicate set will be collected and analyzed for each event sample collected. Duplicates will be collected and analyzed for the following parameters: Alkalinity, Ammonia nitrogen, Chloride, Nitrate, Sulfate, Total Dissolved Solids, and Total Coliforms.

Duplicate samples for each parameter group will be collected immediately after the corresponding primary sample, with a sampling stream that is steady and continuous. (Note: All duplicates are not sampled together, but are sampled immediately after the primary sample from each parameter group.) The time of duplicate sample collection will be recorded on the field sheet.

3.4.9 Sample Shipping

The coolers containing the samples will be shipped overnight or hand-delivered under chain of custody to the contract laboratory. The coolers will be sealed and packed on ice with appropriate inert padding materials to prevent breakage. A chain of custody will be included in the shipment clearly identifying each sample by both the laboratory number and the Well ID number. All copies of the chain of custody will be signed and dated by the sampler.

3.4.10 Field Documentation

All field data will be recorded on the appropriate field data sheets. Example field data sheets are included in Appendix B.

3.4.11 Analytical Procedures

Analysis of groundwater samples will be performed by a qualified contractor according to the methods indicated on Table 2. Sample requests will be initiated by the laboratory contractor. Any detection below the practical quantitation limits (PQLs) will be reported as non-detected quantities ("ND" values). Alternatively, non-detected values can be reported with a "<" symbol as long as the PQL is clearly defined.

Data will also be reported with method detection limits and satisfactory laboratory performance will be judged partly on the laboratory's ability to maintain constant PQLs. Any deviation from PQLs or dilutions will require appropriate qualifiers and should be supported by laboratory quality control data, matrix spike, and/or duplicate data that provide a basis for batch acceptance. Samples that do not meet laboratory defined QA/QC criteria will be flagged accordingly in the electronic data submittals Laboratory data will be reported within thirty days of each event electronically. Quality control data, field data sheets, and laboratory results with narrative should be submitted to Jordan Aggregates within 45 days of each event.

3.4.12 Data Validation

Basic data validation will be performed on each round of routine data by Jordan Aggregates or its designee. For each event, the laboratory will be checked for completeness and accuracy against Table 2. The completeness criteria will ensure that all the parameters were analyzed from all the sampling points required, using the specified methods. Assessment of accuracy will verify that the limits and units are reported as required and the sample/parameter names are consistent with those required and as shown on the chain of custody. Qualifiers and laboratory control data will be reviewed for evidence of matrix effects or cross-media effects that could influence sample results. Any inconsistency will be reported to the laboratory for correction or explanation as

appropriate. Corrective action may include recalculation, reanalysis, or resampling depending on the problem identified.

Prior to statistical analysis, the following results will be removed from the statistical data set if they carry any of the following qualifiers:

- Values recorded in sample or laboratory blanks ("b flag")
- Values recorded for samples that exceed holding times ("h flag"; e.g. laboratory pH)
- QA/QC problems that may require resampling (e.g., unpreserved samples received above 4 degrees Celsius)
- Other conditions that indicate samples are not representative (determined on a case by case basis).

3.4.13 Laboratory Data Deliverable

Consistent and efficient incorporation of the data into the database is integral to reporting representative data. A data deliverable specification has been developed to ensure that the data can be smoothly merged into the data management system and is described below:

All water quality data will be submitted to Jordan Aggregates electronically as both a .PDF and hardcopy of the laboratory report, and as a .CSV or .TXT file in spreadsheet format. The laboratory report shall include full narrative, methods, and quality assurance data, and chain of custody. If sampling services are provided a copy of the original field data sheets shall also be provided in PDF format or hardcopy.

The CSV or TXT file shall include the following column fields from left to right:

- Monitoring Point
- Constituent or parameter name as shown on Table 2
- Appropriate units (N/A is not an acceptable unit)
- Date (mm/dd/yyyy)
- Flag or qualifier, including "<" or ND for non-detect values
- Result
- Laboratory reporting limit
- Method detection limit

Date should be in numeric (serial) format with slashes as shown above. Monitoring points shall be the well names as listed in Table 1. Sample constituents shall be listed in the appropriate name exactly as shown on Table 2. The CAS number is not required. Results shall be reported in consistent units as noted on Table 2. All values must have appropriate units and defined detection limit as shown on Table 2.

Changes to reporting limits by more than 25% are not allowed without notification and authorization from Jordan Aggregates unless matrix interference is documented and fully described by the analyst. The last column will be a flag or quality control qualifier. Acceptable qualifiers include a blank for detected compounds, "<" or ND for No Detect, or one of the quality control flags described above.

4.0 DATA ANALYSIS AND REPORTING

4.1 Introduction

Sampling data, including analytical results, will be compiled and analyzed by a qualified environmental professional.

Groundwater elevation data will be analyzed by the following methods:

- Compare data to historical results
- Generate surface model and contour map of water table elevation

Analytical data will be analyzed by the following methods:

- Compare results to applicable limits
- Scan data for detections of organic compounds
- Perform statistical analysis of data

4.2 Statistical Approach

The following paragraphs briefly describe the statistical approach to identifying increasing parameter concentrations at the site. The rationale for selecting a specific method is based on discussion presented in various texts regarding statistical analysis of groundwater monitoring data (Gibbons, 1994; U.S. EPA, 2009), and the tests will be performed in general accordance with the considerations and assumption described in the texts. Statistical analysis will be performed using a statistical analysis software application such as *DUMPStat* developed by Robert Gibbons and Discerning Systems, Inc.; or *Sanitas* developed by Sanitas Technologies.

There are two main types of statistical tests used in groundwater monitoring: inter-well tests and intra-well tests. Inter-well tests compare data from upgradient wells to data from downgradient wells, while intra-well tests compare current data to historical data within a single well. An important factor in determining which type of test to use is data variability, particularly spatial variability. At sites where a high degree of spatial variability exists it becomes less certain that samples collected at downgradient wells will originate from the same statistical population as the upgradient wells. These sites are therefore better suited for intra-well tests because the impact of spatial variability is eliminated. Conversely, at sites where the aquifer is relatively homogeneous and gradients and flow directions are well-established (thereby minimizing spatial variability) inter-well tests are often preferred because of the statistical power associated with direct comparison of upgradient and downgradient data.

Because of the high groundwater velocity in the surficial aquifer and the lack of significant inhomogeneities identified in the aquifer, there appears to be a relatively low potential for spatial and temporal variability in parameter concentrations. Therefore inter-well statistical tests, specifically parametric prediction limits, will be the primary statistical methods used for

groundwater data evaluation. However; intra-well tests in the form of trend tests will also be performed through the use of Sen's estimate of slope. In particular, intra-well tests will be used for the lower FIG monitoring well due to the lack of an upgradient well in this monitoring unit. Trend tests are generally very useful for quickly assessing the data in terms of increasing or decreasing trends, and can be used in conjunction with inter-well tests to help identify potential spatial variability.

Prediction Limits

Prediction limits are tests that compare future results at downgradient wells to a predicted upper limit of expected values based on the upgradient concentrations. A key assumption in using these types of tests is that the samples are independent, that there are no increasing trends due to the monitored site and that there a minimum of eight sample events to generate a normal or transformed distribution.

In order to obtain the requisite number of background samples for a site, the monitoring schedule is often accelerated in the early stages of monitoring. This approach is reasonable for the site because statistical sample independence should be preserved due to the relatively high groundwater velocity in the monitoring zone.

The parametric prediction interval is calculated with the mean and standard deviation of the data as follows:

$$PL = \bar{x} + S\sqrt{1+\frac{1}{n}}\, t\,(n-1,\ k,\ 1-\frac{\alpha^*}{k})$$

Where:

PL =	prediction limit	
$\bar{x}$	=	mean
S	=	standard deviation
n	=	number of background samples
t	=	t-statistic from Table 1.2 (Gibbons, 1994)
k	=	number of future comparisons =5
α^*	=	site wide error rate = 0.05

The prediction limits will be updated annually incorporating the most recent upgradient background data.

Trend Tests

Trend tests involve analyzing time series data and identifying increasing or decreasing patterns, or *trends*, in the data. The method of trend analysis that will be used for the site is Sen's Estimate of Slope (SES). SES generally involves computing a simple slope estimate for each pair of measurements in the data set and computing the median of those pairwise slope values. This value

should then approximate the true slope of the data set. More information on SES, including governing equations, is presented in U.S. EPA 2009.

4.3 Determination of Statistically Significant Increases (SSI)

This section describes the procedures for determination of an SSI. Verification resampling is an integral part of all of the statistical testing. The resamples for this site will be collected during the next routine event.

An SSI may be caused by several factors including, but not limited to, a release of contamination to groundwater. The approach described in this plan is intended to minimize false positives (false indication of an SSI) while providing a means of determining whether the mine is influencing groundwater quality at the site.

The occurrence of an SSI does not necessarily indicate and exceedence of an applicable permit limit. Rather, it signals that a particular parameter concentration is elevated relative to background/upgradient data.

4.3.1 Parametric or Nonparametric Prediction Limit SSIs

The actions to be taken in response to an exceedence of the prediction limits are as follows:

- If a constituent exceeds the prediction limit in a downgradient well, the well will be resampled during the next routine monitoring event
- If the result from resampling is also above the prediction limit, an SSI will have been confirmed
- If the background sample size (n) is <= 12, the constituent would have to exceed the limit in two resamples to confirm the SSI (pass one of two resamples).

If a prediction limit is exceeded in the upgradient well, this information will be carried in the database and reported to Scott County during the annual report. If the resample is below the prediction limit, the original value will be retained in the database as an unverified exceedence.

4.4 Response to SSIs/Detections/Exceedences

In the event that a sample constituent exceeds an applicable limit or exhibits detections of organic compounds, the following steps should be followed:

Within 7 days of learning of exceedence: double check all sampling procedures, sample handling and analytical procedures used during the monitoring period to determine of the proper procedures were used when the samples were collected/analyzed.

Within 14 days of learning of exceedence: unless QA/QC issues are apparent from step 1, notify Scott County and resample for the applicable parameter(s). A rapid turn-around time would be requested for the analysis of the resample.

If subsequent resampling confirms the exceedence/detection there are two actions which can occur:

- a demonstration will be made that a non-mine source was the cause of the exceedence/SSI, or that the exceedence/SSI is not a threat to human health or the environment; or
- Response actions will be undertaken as described in Section 6.

4.4.1 Demonstrations

If an exceedence/detection is confirmed additional information may be collected and presented to Scott County to show that the exceedence does not represent contamination resulting from the mine, or that it is not a threat to human health or the environment. This information may include factual evidence or calculations that demonstrate (for example) natural geochemical factors, off-site sources, presence of suspended sediments, or other data depending on the specific parameter and well that resulted in the exceedence. The demonstration may also use associations of parameters or lack of parameters to show that the exceedences observed are inconsistent with contamination resulting from the mine.

4.5 Reporting

This section describes the two types of routine reports that are generated for this project:

1) Semi-annual Monitoring Report
2) Annual Monitoring Report

4.5.1 Semi-Annual Report

The Semi-Annual Monitoring Report will be submitted by June 30th following that year's spring sampling event. The report will summarize the results of the spring groundwater monitoring event; describe any changes or modifications at the site that may affect the monitoring network; and propose changes to the monitoring network, parameters or frequency based on evaluation of the annual data. Additionally, the report will include a comparison of measured contaminant concentrations to applicable permit limits. Any exceedences of permit limits will be documented in the report and will be analyzed in conjunction with statistical data to assess whether the exceedence is attributable to the site.

The following is a summary of the contents of a typical semi-annual report:

Introduction Section

- Name of field sampling organization and analytical laboratory
- Date samples collected
- Reference to field sampling protocol and laboratory protocol and plan
- Brief history of sampling activities at the site
- Brief review of monitoring system

Results Section

- Summary table and contour map for water elevations
- Highlight new monitoring points or analytical parameters
- Analytical results in tabular form
- Identify organic compound detections and permit limit exceedences

Quality Assurance/Quality Control (QA/QC) Section

- Weather conditions during sampling
- Unusual field conditions
- Observations regarding well security or damage
- Evaluation of field blank and duplicate QA/QC results
- Exceptions to field sampling protocol (include reason for the change and potential impact on data integrity.)
- Evaluation of laboratory QA/QC results and data validation (summarize detections in blanks, poor recoveries, etc. and discuss corrective measures taken by the laboratory.)
- Exceptions to laboratory QA protocol (list of holding times missed, lost samples, changed detection limits, etc.)

Discussion Section

- Discussion of groundwater elevations or flow direction
- Discussion of change in surface water conditions
- Evaluation of data completeness and consistency
- General discussion of water quality including organic compound detections and permit limit exceedences.
- Follow-up on previous recommendations or contingency actions

Conclusions and Recommendations Section

- Identification of gaps in data
- Recommendations for re-sampling or re-analysis
- Identify the need for contingency actions

Appendix

- Field and lab results in tabular form
- Groundwater sampling field sheets
- Chain of custody records

4.5.2 Annual Report

The annual monitoring report will be submitted to Scott County by February 1 of the year following the monitoring year. It is similar to the Semi-Annual Report in content and format, but includes additional background data on site hydrogeology and existing monitoring network, and additional discussion and analysis related to statistical evaluation of the data. The report will note the occurrence of any SSI's and proposed actions to resolve the SSI. Demonstration data will be submitted within 90 days of an SSI confirmed by resample.

The following presents an outline of a typical annual report – **bold** items indicates annual report exclusive:

Introduction Section

- Name of field sampling organization and analytical laboratory
- Date samples collected
- Reference to field sampling protocol and laboratory protocol and plan
- Brief history of sampling activities at the site
- **Brief review of site hydrogeology**
- Brief review of water monitoring system

Results Section

- Summary table and contour map for water elevations
- Highlight new monitoring points or analytical parameters
- Analytical results in tabular form
- Identify **SSIs**, **data trends**, organic compound detections, and exceedences of applicable limits

Quality Assurance/Quality Control (QA/QC) Section

- Weather conditions during sampling
- Unusual field conditions
- Observations regarding well security or damage
- Evaluation of field blank and duplicate QA/QC results
- Exceptions to field sampling protocol (include reason for the change and potential impact on data integrity.)
- Evaluation of laboratory QA/QC results and data validation (Summarize detections in blanks, poor recoveries, etc. and discuss corrective measures taken by the laboratory.)
- Exceptions to laboratory QA protocol (List of holding times missed, lost samples, changed detection limits, etc.)

Discussion Section

- Discussion of groundwater elevations, flow direction
- Discussion of surface water conditions
- Evaluation of data completeness and consistency
- General discussion of water quality including organic compound detections and permit limit exceedences.
- **Assessment of site impacts**
- Follow-up on previous recommendations or contingency actions

Conclusions and Recommendations Section

- Identification of gaps in data
- Recommendations for re-sampling or re-analysis
- Identification of contingency/response actions (if necessary)
- **Recommendations for water monitoring plan modifications**

Appendix

- **Statistical analysis charts & tables**
- Field and laboratory results, including QA/QC data
- Groundwater sampling field sheets
- Chain of custody records

5.0 PRE-EMPTIVE MITIGATION

5.1 Replacement Well Installation

In order to mitigate potential impacts from floodwater contamination to existing receptors in the surficial aquifer, Jordan Aggregates will provide new wells to be installed in the Ironton-Galesville Sandstone, which is the lower portion of the Franconia-Ironton-Galesville aquifer. A total of three new wells will be installed: one at the Robling property (assuming the existing well is completed in the surficial aquifer), one at the Scott County Association for Leadership and Efficiency (SCALE) training facility, and one at the Scott County Juvenile Alternative Facility (JAF). The wells will be installed prior to excavating the mine pit below the water table.

Wells completed in the Ironton-Galesville will provide an adequate supply of potable water to the proposed users. However, the new wells may require point-of-use treatment to address water aesthetics, specifically hardness and iron content. For the purposes of this mitigation plan, it is assumed that water from the bedrock aquifer is of inferior quality with respect to hardness and iron relative to the surficial aquifer. As such, each water supply is expected to be equipped with the a water softener and iron filter. Water testing upon completion of the replacement wells will ultimately determine the extent of treatment necessary.

5.2 Cost Estimates & Financial Assurance

5.2.1 Well Installation and Point-of Use Treatment

Based on cost estimates obtained from an area well driller, costs to install, develop, test, and complete the three wells will likely range from $50,000 to $60,000. Additionally, estimated costs to purchase and install point-of-use water treatment equipment, including a water softener and iron filter, for each replacement well will total approximately $12,000. Because these costs will be incurred prior to (and as a condition of) development of the mine into the water table, they are not included in financial assurance calculations.

5.2.2 Ongoing Operation and Maintenance Costs

As a condition of the IUP it is expected that Jordan Aggregates will be required to provide financial assurance for the ongoing operational and maintenance (O&M) costs for the water treatment systems at the subject properties. O&M costs for these systems will be covered by Jordan Aggregates until municipal water is brought to the properties, or until the properties change ownership. One or both of these conditions is likely to be met within 30 years, so 30 years

from the date the systems are installed is the time period used for the financial assurance calculation. The O&M items will include:

- salt for the water softeners;
- annual inspection of the iron filters;
- replacement of filtration media in iron filters – expected once every 5 years; and
- replacement of system – expected once in the 30-year period.

Total estimated costs for the required water treatment system O&M tasks for the 30 year period is $47,000. The tasks are broken out into line items and associated unit costs in Appendix C. Cost estimates will be revised upon installation of replacement wells and subsequent water testing. This cost is expected to be the basis for the financial assurance requirement developed during the IUP process. The financial assurance will be in the form of either a guarantee from a financial intermediary or collateral that is held by a regulatory entity.

If the properties already utilize softening and/or iron filtration, the cost estimates will be revised based on the degree to which the system would need to be upgraded to properly treat the water from the new wells.

6.0 RESPONSE ACTIONS

This Section outlines the procedures for responding to water quality impacts found to be caused by the mine. It is important to understand that water quality impacts could require a number of possible response actions and that no plan of action can directly address all circumstances encountered. Therefore, the following plan should be considered conceptual and flexible.

This section is divided into two categories or response actions based on the two types of potential contamination listed in Section 2.3.4, which include: 1) surface contamination (leaks, spills) from the active mining/processing operation, and 2) floodwater contamination via the mine pond.

6.1 Surface Contamination Response

Below are protocols relating to identification of surface contamination, which is likely to be identified in the downgradient water table wells.

6.1.1 Additional Investigation

In the event of a verified water quality limit exceedence that is found to be attributable to the mine, the next step is additional investigation is to determine the extent and magnitude of the problem. This would be done by either:

- monitoring existing groundwater monitoring wells and surface water sampling points in the affected area;
- installing new wells and/or soil borings on- and/or off-site; or
- a combination of the two methods.

Prior to performing additional investigation, a work plan would be submitted to Scott County detailing the proposed investigation tasks. The information gathered during the ensuing investigation would be submitted to Scott County in a report.

6.1.2 Response Actions

The results of the investigation report would be used to complete a feasibility study that would determine the response action needed to correct the occurrence. Response actions could consist of one or more of the following:

1. Additional groundwater monitoring of individual or all aquifer systems located downgradient from the problem area.

2. Repairing the on-site processing or surface drainage features if these have been identified as the cause of the problem.

3. Installation of a groundwater extraction system and/or groundwater flow barrier.

4. Source removal and monitored natural attenuation of contaminants.

6.1.3 Cost Estimates and Financial Assurance

Estimating costs associated with the investigation and response actions listed above requires selecting a particular response action. The response action should reflect the expected extent and magnitude of the contamination and the risk to receptors. In general, potential sources of contamination resulting from surface activities include spills and leaks from equipment and storage tanks. Primary contaminants of concern are petroleum hydrocarbons associated with diesel fuel, hydraulic fluids, lubricants, and asphalt cement. Because of the portable, temporary nature of site operations, the mine operation is not expected to utilize underground storage tanks, and large quantities of petroleum products and industrial chemicals will not be stored on the mine site. As a result, it is unlikely that significant quantities of contaminants would be leaked or that there would be a continuous source of contamination. Also, risk to receptors is low due the depths of the vicinity wells and the upward gradients within the aquifer.

Because the extent and magnitude of the potential contamination is expected to be limited, source removal and monitored natural attenuation (MNA) is the most likely response action to address potential contamination from the mine. Tasks associated with this remediation method include:

- conduct a remedial investigation including installation of soil borings and monitoring wells to delineate the source area and extent and magnitude of contamination;
- excavate and dispose of contaminated soil within the source area;
- prepare a feasibility study/work plan for MNA to assess adequacy of site and present proposed system design;
- install additional monitoring wells as needed; and
- conduct monitoring and prepare semi-annual reports on system performance and results – assume demonstration of adequate degradation in 3 years.

The expected cost for the above scope of work is $140,000. The tasks are broken out into line items and associated unit costs in Appendix C. This cost is expected to be the basis for the financial assurance requirement developed during the IUP process. This amount, or some derivation thereof based on "expected value" of the cost, would be funded throughout the life of the project. If the remedial action is ever necessary and the costs are actually incurred, the financial assurance requirement would then re-set based on the full amount rather than the expected value. The financial assurance will be in the form of either a guarantee from a financial intermediary or collateral that is held by a regulatory entity.

6.2 Floodwater Response

Below are protocols relating to identification of floodwater contamination of the bedrock aquifer, which is likely to be identified in the downgradient FIG well.

6.2.1 Response Actions

In the event of a verified IL exceedence in the FIG monitoring well, mitigation measures would immediately be implemented for downgradient receptors. Mitigation measures would include installation of a reverse osmosis (RO) system at the three receptors.

6.2.2 Cost Estimates and Financial Assurance

As a condition of the IUP it is expected that Jordan Aggregates will be required to provide financial assurance for the installation and ongoing operational and maintenance (O&M) costs for the RO systems at the subject properties. O&M costs for these systems will be covered by Jordan Aggregates until municipal water is brought to the properties, or until the properties change ownership. One or both of these conditions is likely to be met within 30 years, so 30 years from the date the systems are installed is the time period used for the financial assurance calculation. The O&M items will include:

- System inspection and membrane replacement – expected once every 5 years; and
- replacement of system – expected once in the 30-year period.

The tasks are broken out into line items and associated unit costs in Appendix C. Based on cost estimates obtained from Culligan of Minnetonka, the expected cost for the installation and O&M costs for the RO systems for the 30-year period is $36,000. This cost is expected to be the basis for the financial assurance requirement developed during the IUP process. The financial assurance will be in the form of either a guarantee from a financial intermediary or collateral that is held by a regulatory entity.

7.0 REFERENCES

Barr, 2012. Groundwater-Flow and Solute-Transport Modeling. Jordan Aggregates EIS. Prepared for Scott County, May 2012.

Gibbons, Robert, 1994. Statistical Methods for Groundwater Monitoring. John Wiley and Sons, Inc.

McCain, 2010. Groundwater Model, Jordan Aggregates Proposed Sand and Gravel Mine, prepared for Jordan Aggregates, LLC, Revised July 2010. Prepared by McCain and Associates, Inc.

MPCA, 2006. Sampling Procedures for Ground Water Monitoring Wells. Minnesota Pollution Control Agency, Water Quality Division; July 1997, Reviewed and re-approved September 2006.

U.S. EPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance. Office of Solid Waste U.S. EPA.

Tables

TABLE 1
WATER MONITORING NETWORK

Water Monitoring and Response Action Plan - Jordan Aggregates Sand and Gravel Mine
Sand Creek Township, Minnesota
October 2013

Monitoring Location	MN Unique Well Number	Location (Scott Co. Coords.)		Target Monitoring Unit	Measured Well Depth (ft bTOR)	Top of Riser Elevation (feet MSL)	Ground Elevation (feet MSL)	Riser Diameter / Material	Well Screen Information					
		Northing	Easting						Length (ft)	Top Depth (ft bgs)	Top Elevation (ft MSL)	Bottom Depth (ft)	Bottom Elevation (ft MSL)	Slot Size / Material
Groundwater Monitoring Wells / Piezometers - Monitored for Full List of Parameters (see Table 2)														
Upgradient Wells														
MW-5 (Proposed)	TBD	178610	422650	Surficial Aquifer	TBD	TBD	≈727	2" / PVC	10	≈62	665	≈72	655	No. 10 / PVC
Downgradient Wells														
MW-1	767636	178936.6	420390.8	Surficial Aquifer	33.37	741.45	739.10	2" / PVC	10	20.3	718.8	30.3	708.8	No. 10 / PVC
MW-2	767637	179409.9	420894.2	Surficial Aquifer	22.99	732.12	730.51	2" / PVC	10	11.7	718.8	21.7	708.8	No. 10 / PVC
MW-3	767638	179934.0	421448.8	Surficial Aquifer	23.56	731.99	730.59	2" / PVC	10	12.6	718.0	22.6	708.0	No. 10 / PVC
MW-4	767639	180262.9	422290.9	Surficial Aquifer	29.9	740.19	738.53	2" / PVC	10	18.1	720.4	28.1	710.4	No. 10 / PVC
MW-6 (Proposed)	TBD	179362	421910	Surficial Aquifer	TBD	TBD	≈734	2" / PVC	5	≈69	665	≈79	655	No. 10 / PVC
MW-7 (Proposed)	TBD	179367	421905	FIG Aquifer	TBD	TBD	≈734	2" / steel	5	≈139	≈595	≈144	≈590	No. 10 / SS
Water Level Piezometers - Monitored for Water Level Only														
PZ-1	none	178314.8	421989.6	Surficial Aquifer	NM	729.66	727.11	3/4" / PVC	3	6.0	721.1	9.0	718.1	60 um / HDPE
PZ-2	none	179214.5	423045.1	Surficial Aquifer	NM	728.63	726.30	3/4" / PVC	3	6.0	720.3	9.0	717.3	60 um / HDPE
One surface water sample collected from center of Mine Pond. Monitored for Full List of Parameters (see Table 2)														

NM Not Measured

TABLE 2
ROUTINE MONITORING PARAMETERS

Water Monitoring and Response Action Plan - Jordan Aggregates Sand and Gravel Mine

Sand Creek Township, Minnesota

October 2013

Parameter	Method	Required Units	Chemical Preservation	Hold Time	Reporting Target Limit	Intervention Limit
Inorganics / General Chemistry						
Alkalinity - Total as $CaCO_3$	SM2320-B	mg/L	None	14 days	4	NA - evaluate SSIs
Ammonia - Nitrogen as N	EPA 350.1	mg/L	H2SO4 to pH<2	28 days	0.1	
BOD5	EPA 405.1	mg/L	None	48 hours	2	
Chloride	EPA 300.0	mg/L	None	28 days	1	
Field Dissolved Oxygen	EPA 360.1	mg/L	NA	NA	NA	
Field Conductivity	EPA 120.1	umhos/cm	NA	NA	0.1	
Field pH	EPA 150.1	s.u.	NA	NA	0.1	
Field Temperature	EPA 170.1	degrees, C	NA	NA	0.1	
Isotope Ratio: H_2/H_1	stable isotope mass spectrometry	ppt	None	1 year	NA	
Isotope Ratio: O_{18}/O_{16}		ppt	None	1 year	NA	
Lab conductivity	EPA 120.1	umhos/cm	None	28 days	0.1	
Metals (Sb, As, Be, Cd, Cr, Cu, Mn, Pb, Hg, Ni, Se, Ag, Tl, Zn)	EPA 6020A	mg/L	HNO3 to pH <2	6 months	0.005	Lower of: HRL/HBV - Chronic (Table 3) or MCL (Table 4)
Nitrate+Nitrite as N	353.2	mg/L	H2SO4 to pH<2	28 days	0.1	10
Phosphorus, Total	EPA 365.1	mg/L	H2SO4 to pH<2	28 days	1	NA - evaluate SSIs
Total Dissolved Solids	SM2540-C	mg/L	None	7 days	1	
Total Suspended Solids	SM2540-D	mg/L	None	7 days	1	
Water Level Elevation		FT., MSL	NA	NA	0.01	
Organics						
SVOCs	8270D	ug/L	None	14 days	1	Lower of: HRL/HBV - Chronic, if promulated (Table 3) or MCL (Table 4); else evaluate SSIs
VOCs	8260B	ug/L	HCL to pH <2	14 days	1	
Pesticides	8081B	ug/L	None	7 days	1	
Chlorinated Herbicides	8151A	ug/L	None	14 days	1	
PAH	8270	ug/L	None	7 days	0.2	0.2 (BaP equiv.)
DRO	8015	mg/L	HCL to pH <2	7 days	0.2	Detection
Microorganisms						
Total Coliforms	SM9222B	organisms / 100 mL	Sodium Thiosulfate	30 hrs	<1 org / 100mL	Detection

TABLE 3
MDH HUMAN HEALTH-BASED WATER GUIDANCE TABLE

Water Monitoring and Response Action Plan - Jordan Aggregates Sand and Gravel Mine
Sand Creek Township, Minnesota
October 2013

Table reproduced from Mn Depth of Health website - available at www.health.state.mn.us

Value Type Key: HRL = Health Risk Limits
HBV = Health-Based Values
RAA = Risk Assessment Advice

Numerical subscripts indicate the year the value was developed. MCL denotes a HRL based on a US EPA Maximum Contaminant Level.

Duration Key: Acute = one day exposure
Short-term = greater than one day up to 30 days
Subchronic = greater than 30 days up to 10% of a lifetime
Chronic = greater than 10% of a lifetime

The review history, i.e., date posted for review and date guidance was issued, for chemicals completing review in 2009 (HBV09 and RAA09) is available at Health-Based Guidance Review History

See also degradates: Metribuzin DA, DK, and DADK (PDF: 32KB/4 pages)

CAS Number	Chemical	Value Type	Exposure Duration	Value (µg/L)	Health Endpoint(s)
Find chemicals beginning with: A - C D - E F - M N - S T - Z					
83-32-9	Acenaphthene	HRL_{93}	Chronic	400	Liver system
	Acetaminophen				
	Toxicological Summary (PDF: 87KB/13 pages)		Acute	200	Liver system
			Short-term	200	Liver system
			Subchronic	200*	Liver system
	Information Sheet (PDF: 154KB/2 pages)		Chronic	200*	Liver system
103-90-2		HBV_{11}	Cancer	N/A	--
	Acetochlor (PDF: 32KB/5 pages)		Acute	40	Developmental
			Short-term	40	Developmental
	See also degradates: Acetochlor ESA		Subchronic	40*	Developmental
	Acetochlor OXA		Chronic	9	Liver system; Male reproductive system; Nervous system; Kidney system; Respiratory system
34256-82-1		HRL_{08}	Cancer	NA	--
	Acetochlor ESA (PDF: 143KB/6 pages) (degradate of Acetochlor)		Acute	ND	--
			Short-term	600	Thyroid (E)
			Subchronic	600	Thyroid (E)
			Chronic	300	Thyroid (E)
187022-11-3		HRL_{11}	Cancer	NA	--
	Acetochlor OXA (PDF:142KB/5 pages) (degradate of Acetochlor)		Acute	ND	--
			Short-term	200	Thyroid (E)
			Subchronic	200	Thyroid (E)
			Chronic	100	Thyroid (E)
184992-44-4		HRL_{11}	Cancer	NA	--
	Acetone (PDF: 152KB/6 pages)		Acute	ND	--
			Short-term	9,000	Kidney system
			Subchronic	8,000	Kidney system; Blood system
			Chronic	4,000	Kidney system; Blood system
67-64-1		HRL_{11}	Cancer	NA	--
	6-Acetyl-1,1,2,4,4,7-hexamethyltetraline (AHTN or Tonalide				
	Toxicological Summary (PDF:60KB/6 pages)		Acute	ND	--
			Short-term	100	Liver system

			Subchronic	30	Liver system
21145-77-7 or 1506-02-1	Information Sheet (PDF: 160KB/2 pages)	HBV_{12}	Chronic	20	Liver system
			Cancer	NA	--
	Alachlor (PDF: 32KB/6 pages) See also degradates Alachlor ESA Alachlor OXA		Acute	ND	--
			Short-term	200	Kidney system
			Subchronic	30	Blood system; Liver system
			Chronic	5	Blood system; Liver system
15972-60-8		HRL_{08}	Cancer	NA	--
	Alachlor ESA (PDF: 29KB/5 pages (degradate of Alachlor)		Acute	ND	--
			Short-term	ND	--
			Subchronic	100	Blood system
			Chronic	70	Blood system
142363-53-9		RAA_{09}	Cancer	NA	--
	Alachlor OXA (PDF: 29KB/5 pages) (degradate of Alachlor)		Acute	ND	--
			Short-term	ND	--
			Subchronic	100	Blood system
			Chronic	70	Blood system
171262-17-2		RAA_{09}	Cancer	NA	--
116-06-3	Aldicarb	HRL_{93}	Chronic	1	Nervous system
107-05-1	Allyl chloride (3 chloropropene)	HRL_{94}	Chronic	30	Nervous system
120-12-7	Anthracene	HRL_{93}	Chronic	2,000	None
7440-36-0	Antimony	HRL_{93}	Chronic	6	--
1912-24-9	Atrazine	HRL_{MCL}	Chronic	3	see USEPA Organic Chemicals table
7440-39-3	Barium	HRL_{93}	Chronic	2,000	Cardiovascular system
	Benzene (PDF: 144KB/23 pages)		Acute	10	Developmental
			Short-term	10	Blood system; Immune system
			Subchronic	3	Blood system; Immune system
			Chronic	3**	Blood system; Immune system
71-43-2		HRL_{08}	Cancer	2	Cancer
	Benzo[a]pyrene Toxicological Summary (PDF: 86KB/ 10pages) Information Sheet (PDF: 131KB/2 pages)		Acute	2	Developmental
			Short-term	0.3	Developmental
			Subchronic	0.3*	Developmental
			Chronic	0.3*	Developmental
50-32-8		HBV_{12}	Cancer	0.06	Cancer
			Go to > top.		
65-85-0	Benzoic acid	HRL_{93}	Chronic	30,000	None
7440-41-7	Beryllium	HRL_{93}	Cancer	0.08	Cancer
92-52-4	1,1-Biphenyl (Diphenyl)	HRL_{93}	Chronic	300	Kidney system
111-44-4	Bis(chloroethyl) ether (BCEE)	HRL_{93}	Cancer	0.3	Cancer
542-88-1	Bis(chloromethyl) ether (BCME)	HRL_{93}	Cancer	0.002	Cancer
	Bisphenol A (BPA) Toxicological Summary		Acute	300	Developmental; Female reproductive system
	(PDF: 119KB/22 pages)		Short-term	300	Developmental; Female reproductive system (E); Liver system; Male reproductive system (E); Kidney system; Thyroid
			Subchronic	100	Liver system; Kidney system
	Information Sheet		Chronic	100**	Liver system; Kidney system
80-05-7	(PDF: 144KB/2 pages)	HBV_{12}	Cancer	NA	--
7440-42-8	Boron	RAA_{08}	Chronic	1,000	Developmental
75-27-4	Bromodichloromethane	HRL_{93}	Cancer	6	Cancer
75-25-2	Bromoform	HRL_{93}	Cancer	40	Cancer
74-83-9	Bromomethane (Methyl bromide)	HRL_{93}	Chronic	10	Gastrointestinal system
71-36-3	n-Butanol	HRL_{93}	Chronic	700	Nervous system
	Butyl benzyl phthalate (BBP)	HRL_{93}	Chronic	100	None
	Toxicological Summary		Acute	100	Developmental (E)

	(PDF: 116KB/11 pages)		Short-term	100	Developmental (E)
			Subchronic	100*	Developmental (E)
	Information Sheet		Chronic	100*	Developmental (E)
85-68-7	(PDF: 142KB/2 pages)	HBV_{12}	Cancer	NA	--
85-70-1	Butylphthalyl butylglycolate (BPBG)	HRL_{93}	Chronic	7,000	None
7440-43-9	Cadmium	HRL_{93}	Chronic	4	Kidney system
	Carbamazepine				
	Toxicological Summary		Acute	40	Developmental; Nervous system
	(PDF: 104KB/17 pages)				Developmental; Blood system; Liver system; Immune system; Nervous system; Male reproductive system (E); Female reproductive system (E); Thyroid (E)
	Information Sheet		Short-term	40	
	(PDF: 179KB/2 pages)		Subchronic	40*	Developmental; Blood system; Liver system; Immune system; Nervous system; Male reproductive system (E); Female reproductive system (E);Thyroid (E)
			Chronic	40*	Developmental; Blood system; Liver system; Immune system; Nervous system; Male reproductive system (E); Female reproductive system (E); Thyroid (E)
298-46-4		HBV_{11}	Cancer	NA	--
75-15-0	Carbon disulfide	HRL_{93}	Chronic	700	Developmental
	Carbon tetrachloride	HRL93	Cancer	3	Cancer
			Acute	100	Developmental; Liver system
	Toxicological Summary		Short-term	3	Liver system
	(PDF: 66KB/8 pages)		Subchronic	3*	Liver system
			Chronic	3*	Liver system
56-23-5		HBV_{12}	Cancer	1	Cancer
133-90-4	Chloramben	HRL_{94}	Chronic	100	Liver system
108-90-7	Chlorobenzene	HRL_{93}	Chronic	100	Liver system
	Chloroethane		Acute	ND	--
	(PDF: 44KB/4 pages)		Short-term	ND	--
			Subchronic	ND	--
			Chronic	ND	--
75-00-3		RAA_{09}	Cancer	NA	--
	Chloroform		Acute	ND	--
	(PDF: 36KB/7 pages)		Short-term	30	Developmental; Liver system; Immune system
			Subchronic	30*	Developmental; Liver system; Immune system; Male reproductive system
			Chronic	30*	Developmental; Liver system; Immune system; Male reproductive system
67-66-3		HRL_{08}	Cancer	NA	--
95-57-8	2-Chlorophenol	HRL_{93}	Chronic	30	Developmental
1897-45-6	Chlorothalonil	HRL_{94}	Cancer	30	Cancer
16065-83-1	Chromium III	HRL_{94}	Chronic	20,000	None
18540-29-9	Chromium VI	HRL_{93}	Chronic	100	None
98-82-8	Cumene (Isopropyl benzene) 1	HRL_{93}	Chronic	300	None
	Cyanazine		Acute	2	Developmental, Female reproductive system
	(PDF: 56KB/6 pages)		Short-term	2	Developmental, Female reproductive system
			Subchronic	2	Liver system; Kidney system
			Chronic	1	None
21725-46-2		HRL_{08}	Cancer	NA	--
57-12-5	Cyanide, free	HRL_{93}	Chronic	100	Nervous system; Thyroid (E)
			Go to > top.		
124-48-1	Dibromochloromethane	HRL_{93}	Chronic	10	Liver system
106-93-4	1,2-Dibromoethane (ethylene dibromide, EDB)	HRL_{93}	Cancer	0.004	Cancer
	Dibutyl phthalate (DBP)	HRL_{93}	Chronic	700	None
	Toxicological Summary		Acute	20	Developmental (E)
	(PDF: 109KB/12 pages)		Short-term	20	Developmental (E)
			Subchronic	20*	Developmental (E)
	Information Sheet		Chronic	20*	Developmental (E)

84-74-2	(PDF: 97KB/2 pages)	HBV_{12}	Cancer	NA	--
1918-00-9	Dicamba	HRL_{93}	Chronic	200	Developmental
95-50-1	1,2-Dichlorobenzene	HRL_{93}	Chronic	600	Liver system
106-46-7	1,4-Dichlorobenzene (para)	HRL_{94}	Cancer	10	Cancer
91-94-1	3,3'-Dichlorobenzidine	HRL_{93}	Cancer	0.8	Cancer
	Dichlorodifluoromethane				
	(PDF: 129KB/4 pages)		Acute	ND	--
			Short-term	ND	--
			Subchronic	ND	--
			Chronic	700	None
75-71-8		HRL_{11}	Cancer	NA	--
72-54-8	p,p'-Dichlorodiphenyldichloroethane (DDD)	HRL_{93}	Cancer	1	Cancer
72-55-9	p,p'-Dichlorodiphenyldichloroethylene (DDE)	HRL_{93}	Cancer	1	Cancer
50-29-3	p,p'-Dichlorodiphenyltrichloroethane (DDT)	HRL_{93}	Cancer	1	Cancer
	1,1-Dichloroethane				
	(PDF: 36KB/6 pages)		Acute	ND	--
			Short-term	500	Nervous system
			Subchronic	500*	Nervous system
			Chronic	100	Nervous system
75-34-3		RAA_{09}	Cancer	NA	--
	1,2-Dichloroethane	HRL93	Cancer	4	Cancer
			Acute	ND	--
	Toxicological Summary (PDF: 65KB/7 pages)		Short-term	200	Liver system
			Subchronic	200*	Liver system
			Chronic	60	Kidney system; Liver system
107-06-2		HBV_{12}	Cancer	1	Cancer
	cis-1,2-Dichloroethene		Acute	ND	--
	(PDF: 28KB/4 pages)		Short-term	70	Blood system
			Subchronic	70*	Blood system
			Chronic	50	Blood system
156-59-2		HRL_{08}	Cancer	NA	--
	trans-1,2-Dichloroethene	HRL93	Chronic	100	None
			Acute	ND	--
	Toxicological Summary (PDF: 45KB/4 pages)		Short-term	ND	--
			Subchronic	200	Immune system
			Chronic	40	Immune system
156-60-5		HBV_{12}	Cancer	NA	--
			Acute	ND	--
			Short-term	ND	--
			Subchronic	200	Liver system
	1,1-Dichloroethylene (Vinylidene chloride) (PDF: 127KB/4 pages)		Chronic	200	Liver system
75-35-4		HRL_{11}	Cancer	NA	--
	Dichlorofluoromethane (PDF: 43KB/3 pages)		Acute	NA	--
			Short-term	ND	--
			Subchronic	ND	--
75-43-4		RAA_{09}	Chronic	ND	--
75-09-2	Dichloromethane (Methylene chloride)	HRL_{MCL}	Chronic	5	see USEPA Organic Chemicals table
120-83-2	2,4-Dichlorophenol	HRL_{93}	Chronic	20	Immune system
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	HRL_{93}	Chronic	70	Blood system; Liver system; Kidney system
78-87-5	1,2-Dichloropropane	HRL_{94}	Cancer	5	Cancer
542-75-6	1,3-Dichloropropene	HRL_{94}	Cancer	2	Cancer
	Dieldrin		Acute	0.2	Developmental
			Short-term	0.2	Developmental; Immune system; Nervous system
	(PDF: 82KB/6 pages)		Subchronic	0.2*	Developmental; Immune system; Nervous system
			Chronic	0.2	Liver system; Nervous system
60-57-1		HRL_{08}	Cancer	0.006	Cancer

134-62-3	N,N-Diethyl-meta-toluamide (DEET) Toxicological Summary (PDF:66KB/8 pages) Information Sheet (PDF: 140KB/2 pages)	HBV_{12}	Acute	ND	--
			Short-term	200	Developmental; Nervous system
			Subchronic	200*	Developmental; Nervous system
			Chronic	200*	Developmental; Nervous system
			Cancer	NA	--
117-81-7	Di(2-ethylhexyl)phthalate (DEHP) Toxicological Summary (PDF: 140KB/14 pages) Information Sheet (PDF: 96KB/2 pages)	HBV_{13}	Acute	20	Developmental (E); Male reproductive system
			Short-term	20	Developmental (E); Male reproductive system
			Subchronic	20	Developmental (E); Male reproductive system
			Chronic	20	Developmental (E); Male reproductive system
			Cancer	7	Cancer
84-66-2	Diethyl phthalate	HRL_{93}	Chronic	6,000	None
87674-68-8 163515-14-8	Dimethenamid & Dimethenamid-P Toxicological Summary (PDF: 53KB/5 pages) Information Sheet (PDF: 46KB/2 pages) See also degradates: Dimethenamid ESA & Dimethenamid OXA (PDF: 34KB/3 pages)	HBV_{13}	Acute	--	ND
			Short-term	600	Developmental; Liver system; Nervous system; Female reproductive system
			Subchronic	600	Developmental; Liver system
			Chronic	300	Liver system
			Cancer	--	NA
205939-58-8 not found	Dimethenamid ESA Dimethenamid OXA Toxicological Summary (PDF: 34KB/3 pages) Information Sheet (PDF: 46KB/2 pages)	RAA_{13}	Acute	--	ND
			Short-term	600	Developmental; Liver system; Nervous system; Female reproductive system
			Subchronic	600	Developmental; Liver system
			Chronic	300	Liver system
			Cancer	--	NA
105-67-9	2,4-Dimethylphenol	HRL_{93}	Chronic	100	Blood system; Nervous system
131-11-3	Dimethylphthalate	HRL_{94}	Chronic	70,000	Kidney system
51-28-5	2,4-Dinitrophenol	HRL_{94}	Chronic	10	Eyes
123-91-1	1,4-Dioxane Toxicological Summary (PDF: 72KB/7 pages) Information Sheet (PDF: 157KB/2 pages)	HBV_{11}	Acute	ND	--
			Short-term	ND	--
			Subchronic	300	Liver system; Kidney system; Respiratory system
			Chronic	100	Liver system; Kidney system; Respiratory system
			Cancer	1	Cancer
298-04-4	Disulfoton	HRL_{94}	Chronic	0.3	Nervous system
100-41-4	Ethylbenzene (PDF: 154KB/7 pages)	HRL_{11}	Acute	ND	--
			Short-term	50	Liver system; Kidney system
			Subchronic	50*	Liver system; Kidney system
			Chronic	50*	Liver system; Kidney system
			Cancer	NA	--
759-94-4	S-Ethyl dipropylthiocarbamate (EPTC)	HRL_{93}	Chronic	200	Cardiovascular system; Nervous system
60-29-7	Ethyl ether (PDF: 55KB/5 pages)	RAA_{10}	Acute	ND	--
			Short-term	ND	--
			Subchronic	1000	Liver system; Kidney system
			Chronic	200	Liver system; Kidney system
			Cancer	NA	--

107-21-1	Ethylene glycol (PDF: 157KB/7 pages)	HRL_{11}	Acute	4,000	Developmental
			Short-term	4,000	Developmental
			Subchronic	2,000	Developmental; Kidney system
			Chronic	2,000	Developmental; Kidney system
			Cancer	NA	--
206-44-0	Fluoranthene	HRL_{93}	Chronic	300	Liver system; Kidney system
86-73-7	Fluorene (9H-Fluorene)	HRL_{93}	Chronic	300	Blood system
50-00-0	Formaldehyde	HRL_{94}	Chronic	1,000	Gastrointestinal system
76-44-8	Heptachlor	HRL_{93}	Cancer	0.08	Cancer
1024-57-3	Heptachlor epoxide	HRL_{93}	Cancer	0.04	Cancer
118-74-1	Hexachlorobenzene	HRL_{93}	Cancer	0.2	Cancer
87-68-3	Hexachlorobutadiene	HRL_{93}	Chronic	1	Kidney system
110-54-3	Hexane (n-hexane)	HRL_{94}	Chronic	400	Nervous system
78-59-1	Isophorone	HRL_{93}	Chronic	100	Kidney system
330-55-2	Linuron	HRL_{93}	Chronic	1	Blood system
7439-96-5	Manganese Toxicological Summary (PDF: 68KB/7 pages) Tiered Health Based Guidance for Water Information sheet (PDF: 62KB/ 2 pages)	HRL93***	Chronic	100	Nervous system
		RAA_{12}	Infant	100	Nervous system
		RAA_{12}	Child/Adult	300	Nervous system
67-56-1	Methanol	HRL_{94}	Chronic	3,000	Liver system; Nervous system
94-74-6	2-Methyl-4-chlorophenoxyacetic acid (MCPA)	HRL_{93}	Chronic	3	Liver system; Kidney system
78-93-3	Methyl ethyl ketone (MEK, 2-butanone)	HRL_{94}	Chronic	4,000	Developmental
108-10-1	Methyl isobutyl ketone (MIBK)	HRL_{94}	Chronic	300	Liver system; Kidney system
95-48-7	2-Methylphenol (o-cresol)	HRL_{93}	Chronic	30	Nervous system
108-39-4	3-Methylphenol (m-cresol)	HRL_{93}	Chronic	30	Nervous system
106-44-5	4-Methylphenol (p-cresol)	HRL_{94}	Chronic	3	None
51218-45-2; 87392-12-9	Metolachlor and s-Metolachlor (PDF: 144KB/6 pages) See also degradates Metolachlor ESA Metolachlor OXA	HRL_{11}	Acute	400	Developmental
			Short-term	400	Developmental
			Subchronic	300	None
			Chronic	300**	None
			Cancer	NA	--
171118-09-5	Metolachlor ESA (PDF:131KB/5 pages) (degradate of Metolachlor)	HRL_{11}	Acute	ND	--
			Short-term	ND	--
			Subchronic	4,000	Liver system
			Chronic	800	Liver system
			Cancer	NA	--
152019-73-3	Metolachlor OXA (PDF: 138KB/5 pages) (degradate of Metolachlor)	HRL_{11}	Acute	ND	--
			Short-term	3,000	None
			Subchronic	3,000*	None
			Chronic	800	None
			Cancer	NA	--
21087-64-9	Metribuzin Toxicological Summary (PDF: 58KB/7 pages) See also degradates: Metribuzin DA, DK, and DADK (PDF: 32KB/4 pages)	HRL93	Chronic	200	Liver system; Kidney system
		HBV_{12}	Acute	30	Developmental; Nervous system
			Short-term	10	Thyroid (E)
			Subchronic	10*	Thyroid (E)
			Chronic	10*	Thyroid (E)
			Cancer	NA	--
35045-02-4; 56507-37-0; 52236-30-3	Metribuzin DA, DK, and DADK Toxicological Summary (PDF: 36KB/4 pages)		Acute	30	Developmental; Nervous system
			Short-term	10	Thyroid (E)

	Information Sheet (PDF: 251KB/2 pages)	RAA_{12}	Subchronic	10*	Thyroid (E)
			Chronic	10*	Thyroid (E)
			Cancer	NA	--
77238-39-2; 101043-37-2	Microcystin Toxicological Summary (PDF: 79KB/12 pages) Information Sheet (PDF: 130KB/2 pages)	HBV_{12}	Acute	NA	--
			Short-term	0.04	Liver System
			Subchronic	0.04*	Liver System
			Chronic	0.04*	Liver System
			Cancer	NA	--
91-20-3	Naphthalene Toxicological Summary (PDF: 72KB/7 pages)	HRL_{94}	Chronic	300	None
		HBV_{11}	Acute	70	Nervous system
			Short-term	70	Nervous system
			Subchronoic	70*	Nervous system
			Chronic	70	Nervous system, Spleen
			Cancer	NA	--
7440-02-0	Nickel, soluble salts	HRL_{93}	Chronic	100	None
14797-55-8	Nitrate (as nitrogen)	HRL_{MCL}	Acute	10,000	see USEPA Inorganic Chemicals table
86-30-6	N-Nitrosodiphenylamine	HRL_{93}	Cancer	70	Cancer
87-86-5	Pentachlorophenol (PCP) Toxicological Summary (PDF: 96KB/8 pages) Information Sheet (PDF: 75KB/2 pages)	HRL_{MCL***}	Chronic	1	see USEPA Organic Chemicals table
		HBV_{13}	Acute	7	Developmental; Thyroid (E)
			Short-term	7	Developmental (E); Thyroid (E)
			Subchronic	7*	Developmental (D); Liver system; Immune system; Male Reproductive system; Thyroid (E)
			Chronic	7*	Developmental (E); Liver system; Immune system; Male Reproductive system; Thyroid (E)
			Cancer	0.3	Cancer
375-73-5	Perfluorobutane sulfonate (PFBS) (PDF: 141KB/6 pages)	HRL_{11}	Acute	ND	--
			Short-term	ND	--
			Subchronic	9	Blood system; Liver system;Kidney system
			Chronic	7	Blood system; Liver system;Kidney system
			Cancer	NA	--
375-22-4	Perfluorobutyrate (PFBA) (PDF: 143KB/7 pages)	HRL_{11}	Acute	ND	--
			Short-term	7	Liver system; Thyroid (E)
			Subchronic	7*	Liver system; Thyroid (E)
			Chronic	7*	Liver system; Thyroid (E)
			Cancer	NA	--
355-46-4	Perfluorohexane sulfonate (PFHxS) (PDF: 43KB/6 pages)	RAA_{09}	Acute	ND	--
			Short-term	ND	--
			Subchronic	ND	--
			Chronic	ND	--
			Cancer	NA	--
335-67-1; 335-66-0; 3825-26-1; 2395-00-8; 335-93-3; 335-95-5	Perfluorooctanoic Acid (PFOA) and Salts (PDF: 109KB/11 pages)	HRL_{08}	Acute	ND	--
			Short-term	ND	--
			Subchronic	ND	--
			Chronic	0.3	Development effects; Liver system; Immune system
			Cancer	NA	
1763-23-1; 29081-56-9; 70225-14-8; 2795-39-3; 29457-72-5	Perfluorooctane Sulfonate (PFOS) and Salts (PDF: 96KB/9 pages)	HRL_{08}	Acute	ND	--
			Short-term	ND	--
			Subchronic	ND	--
			Chronic	0.3	Developmental effects; Liver system; Thyroid (E)
			Cancer	NA	--
108-95-2	Phenol	HRL_{93}	Chronic	4,000	Developmental
2/1/1918	Picloram	HRL_{93}	Chronic	500	Liver system
1336-36-3	Polychlorinated biphenyls (PCBs)	HRL_{94}	Cancer	0.04	Cancer
1610-18-0	Prometon	HRL_{93}	Chronic	100	None
1918-16-7	Propachlor	HRL_{93}	Chronic	90	None

94-13-3	Propyl Paraben Information Sheet (PDF: 98KB/1 page)	NA	NA	NA	NA
175013-18-0	Pyraclostrobin Toxicological Summary (PDF: 96KB/9 pages) Information Sheet (PDF: 163KB/1 page)	HBV_{11}	Acute	300	Developmental; Female Reproductive system
			Short-term	100	Developmental; Female Reproductive system; Gastrointestinal system; Spleen
			Subchronic	100	Developmental; Female Reproductive system; Gastrointestinal system; Blood system; Immune system
			Chronic	100**	Developmental; Female Reproductive system; Gastrointestinal system; Blood system; Immune system
			Cancer	NA	--
129-00-0	Pyrene	HRL_{93}	Chronic	200	Kidney system
7782-49-2	Selenium	HRL_{93}	Chronic	30	None
7440-22-4	Silver	HRL_{93}	Chronic	30	None
122-34-9	Simazine	HRL_{MCL}	Chronic	4	see USEPA Organic Chemicals table
83-34-1	Skatol (3-Methyl-1H-Indole) Information Sheet (PDF: 173KB/2 pages)	NA	NA	NA	NA
57-68-1	Sulfamethazine Toxicological Summary (PDF: 78KB/7 pages) Information Sheet (PDF: 164KB/2 pages)	HBV_{13}	Acute	--	ND
			Short-term	100	Thyroid
			Subchronic	100	Developmental; Thyroid
			Chronic	100	Developmental; Blood system; Thyroid
			Cancer	--	NA
723-46-6	Sulfamethoxazole Toxicological Summary (PDF: 71KB/6 pages) Information Sheet (PDF: 164KB/2 pages)	RAA_{13}	Acute	--	ND
			Short-term	100	Thyroid
			Subchronic	100	Thyroid
			Chronic	100	Thyroid
			Cancer	--	NA
630-20-6	1,1,1,2-Tetrachloroethane	HRL_{93}	Chronic	70	Kidney system; Liver system
79-34-5	1,1,2,2-Tetrachloroethane	HRL_{94}	Cancer	2	Cancer
127-18-4	1,1,2,2-Tetrachloroethylene (PERC)	HRL_{MCL}	Chronic	5	see USEPA Organic Chemicals table
7440-28-0	Thallium salts	HRL_{94}	Chronic	0.6	Liver system
7440-31-5	Tin	HRL_{94}	Chronic	4,000	Liver system; Kidney system
108-88-3	Toluene (PDF: 143KB/6 pages)	HRL_{11}	Acute	ND	--
			Short-term	200	Immune system; Nervous system
			Subchronic	200*	Immune system; Nervous system
			Chronic	200*	Immune system; Nervous system
			Cancer	NA	
8001-35-2	Toxaphene	HRL_{93}	Cancer	0.3	Cancer
120-82-1	1,2,4-Trichlorobenzene Toxicological Summary (PDF: 88KB/7 pages)	HBV_{12}	Acute	ND	--
			Short-term	100	Liver system; Adrenal (E); Blood system
			Subchronic	100*	Liver system; Adrenal (E); Blood system
			Chronic	100	Liver system; Adrenal (E); Kidney system
			Cancer	4	Cancer
108-70-3	1,3,5-Trichlorobenzene (PDF: 42KB/4 pages)	RAA_{12}	Acute	ND	--
			Short-term	100	Liver system; Adrenal (E); Blood System
			Subchronic	100*	Liver system; Adrenal (E); Blood system
			Chronic	100	Liver system; Adrenal (E); Kidney system
			Cancer	4	Cancer
71-55-6	1,1,1-Trichloroethane (PDF: 30KB/4 pages)	HRL_{08}	Acute	ND	--
			Short-term	ND	--
			Subchronic	20,000	Liver system; Male reproductive system
			Chronic	9,000	Liver system; Male reproductive system
			Cancer	NA	
79-00-5	1,1,2-Trichloroethane	HRL_{93}	Chronic	3	Immune system

	1,1,2-Trichloroethylene (TCE) Toxicological Summary (PDF: 75KB/7 pages) Technical and Application Information Information Sheet (PDF: 62KB/2 pages)	HRLMCL***	Chronic	5	see USEPA Organic Chemicals table
			Acute	ND	Developmental, Immune
			Short-term	0.4	Developmental, Immune
			Subchronic	0.4	Developmental, Immune
			Chronic	0.4**	Developmental, Immune
79-01-6		HBV_{13}	Cancer	2	Cancer
75-69-4	Trichlorofluoromethane	HRL_{93}	Chronic	2,000	None
88-06-2	2,4,6-Trichlorophenol	HRL_{93}	Cancer	30	Cancer
93-76-5	2,4,5-Trichlorophenoxyacetic acid	HRL_{93}	Chronic	70	Developmental; Blood system
93-72-1	2-(2,4,5-Trichlorophenoxy) propionic acid	HRL_{MCL}	Chronic	50	see USEPA Organic Chemicals table
	1,2,3-Trichloropropane Toxicological Summary (PDF: 71KB/7 pages) Information Sheet (PDF: 148KB/2 pages)	HRL93	Chronic	40	Kidney system, Liver system
			Acute	7	Developmental
			Short-term	7	Developmental
			Subchronic	7*	Developmental
			Chronic	7*	Developmental
96-18-4		HBV_{12}	Cancer	0.003	Cancer
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	HRL_{93}	Chronic	200,000	None
	Triclocarban Toxicological Summary (PDF: 84KB/6 pages) Information Sheet (PDF: 141KB/2 pages)		Acute	ND	--
			Short-term	ND	--
			Subchronic	ND	--
			Chronic	100	Blood system; Liver system; Male reproductive system; Kidney system
101-20-2		RAA_{13}	Cancer	NA	--
	Triclosan Toxicological Summary (PDF: 55KB/9 pages) Information Sheet (PDF: 85KB/2 pages)		Acute	200	Developmental
			Short-term	50	Thyroid (E); Female Reproductive system (E)
			Subchronic	50*	Thyroid (E); Female Reproductive system (E)
			Chronic	50*	Thyroid (E); Female Reproductive system (E)
3380-34-5		HBV_{10}	Cancer	NA	--
	1,2,4-Trimethylbenzene (PDF: 46KB/4 pages)		Acute	ND	--
			Short-term	100	Liver system
			Subchronic	100*	Liver system
			Chronic	100*	Liver system
95-63-6		RAA_{10}	Cancer	NA	--
	1,3,5-Trimethylbenzene (PDF: 34KB/5 pages)		Acute	ND	--
			Short-term	100	Liver system
			Subchronic	100*	Liver system
			Chronic	100*	Liver system
108-67-8		HRL_{08}	Cancer	NA	--
99-35-4	1,3,5-Trinitrobenzene	HRL_{93}	Chronic	0.3	None
	Tris(2-chloroethyl)phosphate (TCEP) Toxicological Summary (PDF: 62KB/7 pages) Information Sheet (PDF: 171KB/2 pages)		Acute	ND	--
			Short-term	300	Developmental, Nervous system, Kidney system
			Subchronic	200	Kidney system
			Chronic	200**	Kidney system
115-96-8		HBV_{11}	Cancer	5	Cancer
	Tris(1,3-dichloroisopropyl)phosphate (TDCPP) Toxicological Summery (PDF: 46KB/6 pages) Information Sheet (PDF: 197KB/2 pages)		Acute	ND	--
			Short-term	ND	--
			Subchronic	20	Liver system; kidney system
			Chronic	9	Kidney system; Male reproductive system
13674-87-8		HBV_{13}	Cancer	0.8	Cancer

7440-62-2	Vanadium	HRL_{94}	Chronic	50	None
	Vinyl Chloride (PDF: 32KB/5 pages)		Acute	ND	--
			Short-term	ND	--
			Subchronic	80	Liver system
			Chronic	10	Liver system
75-01-4		HRL_{08}	Cancer	0.2	Cancer
	Xylenes (mixture of isomers, o, m, p) (PDF: 160KB/7 pages)				
			Acute	800	Nervous system
			Short-term	300	Nervous system
			Subchronic	300*	Kidney system; Nervous system
			Chronic	300*	Kidney system; Nervous system
1330-20-7		HRL_{11}	Cancer	NA	--
7440-66-6	Zinc	HRL_{94}	Chronic	2,000	None

Go to > top.

NA - Not Applicable
ND - Not derived due to insufficient information
None - Nonspecific effects that could not be attributed to an organ system
(E) = Endocrine mediated effect on the specified target organ

*Set at short-term value
**Set at subchronic value
***Dual guidance applies: See Dual Guidance for Drinking Water

[1] Chemical to be reviewed and is likely to change.

TABLE 4

National Primary Drinking Water Regulations

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC Acrylamide	TT[4]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]
OC Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	0.8
OC Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC Copper	TT[5]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M *Cryptosporidium*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero

LEGEND

D Disinfectant | IOC Inorganic Chemical | OC Organic Chemical

DBP Disinfection Byproduct | M Microorganism | R Radionuclides

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
IOC Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC 2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC 1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC 1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC 1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC 1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC Epichlorohydrin	TT[4]	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
M Fecal coliform and *E. coli*	MCL[6]	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	zero[6]
IOC Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M *Giardia lamblia*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M Heterotrophic plate count (HPC)	TT[7]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a

LEGEND

D Disinfectant
IOC Inorganic Chemical
OC Organic Chemical
DBP Disinfection Byproduct
M Microorganism
R Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT5; Action Level=0.015	Infants and children: Delays in physical or or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT7	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms	5.0 percent[8]	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and *E. coli*	Naturally present in the environment	zero
DBP	Total Trihalomethanes (TTHMs)	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.2
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero

LEGEND

D Disinfectant
DBP Disinfection Byproduct
IOC Inorganic Chemical
M Microorganism
OC Organic Chemical
R Radionuclides

Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
M Turbidity	TT[7]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R Uranium	30µg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M Viruses (enteric)	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D Disinfectant
DBP Disinfection Byproduct
IOC Inorganic Chemical
M Microorganism
OC Organic Chemical
R Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 Health effects are from long-term exposure unless specified as short-term exposure.

4 Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

5 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

6 A routine sample that is fecal coliform-positive or *E. coli*-positive triggers repeat samples--if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or *E. coli*-negative triggers repeat samples--if any repeat sample is fecal coliform-positive or *E. coli*-positive, the system has an acute MCL violation. See also Total Coliforms.

7 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*: 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- Giardia lamblia: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- Turbidity: For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelolometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment; Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Long Term 2 Enhanced Surface Water Treatment; This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

8 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* or fecal coliforms, system has an acute MCL violation.

9 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

National Secondary Drinking Water Regulation

National Secondary Drinking Water Regulations are non-enforceable guidelines regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, some states may choose to adopt them as enforceable standards.

Contaminant	Secondary Maximum Contaminant Level
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

For More Information

EPA's Safe Drinking Water Web site:
http://www.epa.gov/safewater/

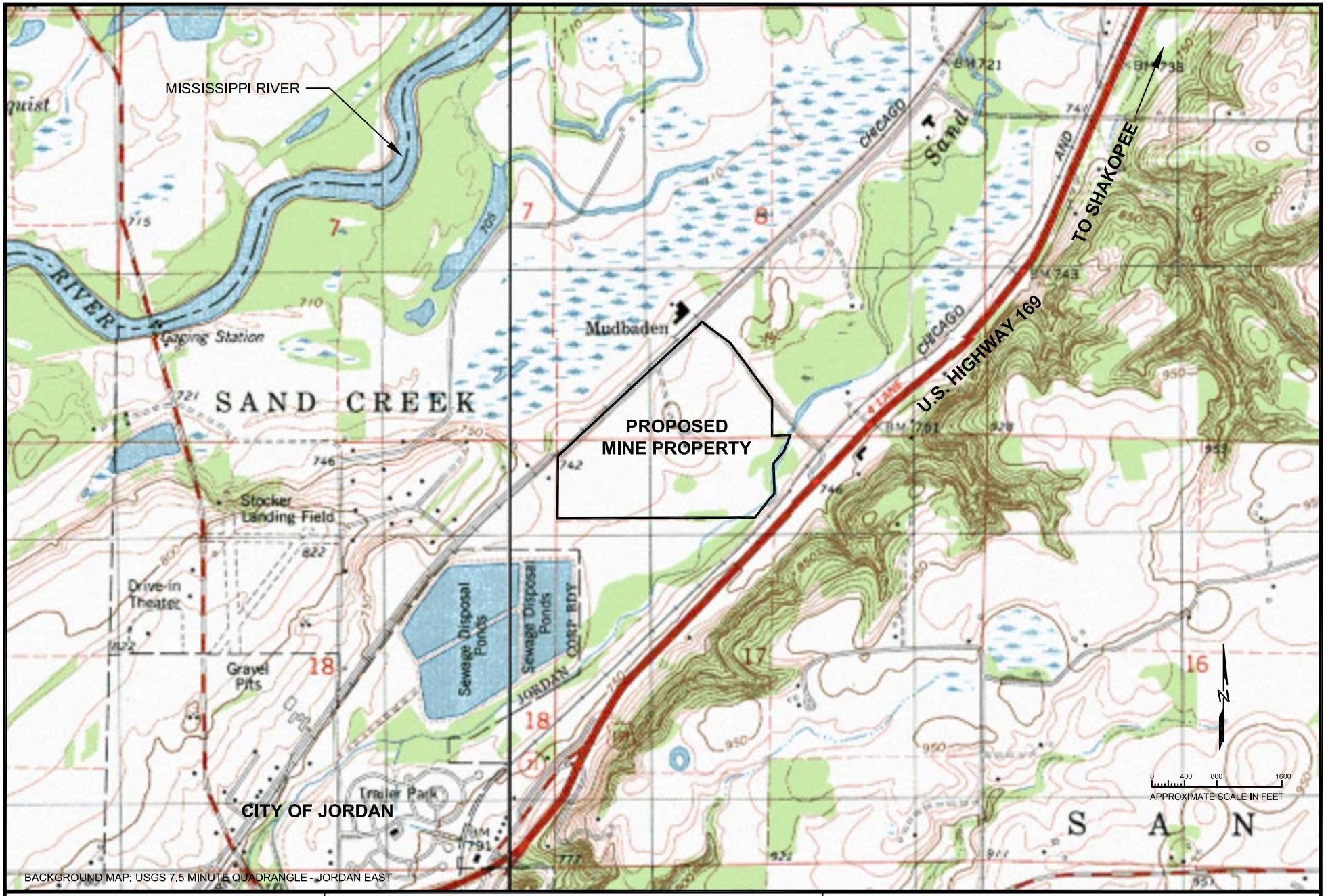
EPA's Safe Drinking Water Hotline:
(800) 426-4791

To order additional posters or other ground water and drinking water publications, please contact the National Service Center for Environmental Publications at :
(800) 490-9198, or
email: nscep@bps-lmit.com.

United States Environmental Protection Agency

EPA 816-F-09-004
May 2009

Figures



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JORDAN AGGREGATES
Sand Creek Township
Scott County, MN

FIGURE 1
SITE LOCATION
WATER MONITORING AND RESPONSE ACTION PLAN

PHASE 4

PHASE 1

SEE MINING PLANS FOR PROCESSING PLANT LAYOUT AND GRADING

PHASE 2A

PHASE 3

POND PHASE (ONGOING)

PHASE 2B

PHASE 2C

PHASE 3B

SAND CREEK

SAND CREEK

LEGEND

- 735 — EXISTING INDEX CONTOUR (5-FT CI)
- EXISTING INTERMEDIATE CONTOUR
- 735 — PROPOSED MINING INDEX CONTOUR (5-FT CI)
- PROPOSED MINING INTERMEDIATE CONTOUR
- 719 — WATER TABLE CONTOUR (08/24/09)
- FP FP FP — EXISTING 100-YEAR FLOODPLAIN LINE
- SHORELAND BOUNDARY
- PROPOSED MINING LIMITS
- PROPERTY LINE
- EASEMENT LINE
- RIGHT-OF-WAY LINE
- MINING/RECLAMATION PHASE BOUNDARIES

N

0 50 100 200
SCALE IN FEET

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JORDAN AGGREGATES
SAND CREEK TOWNSHIP
SCOTT COUNTY, MN

FIGURE 2
EXISTING CONDITIONS AND PROPOSED FACILITY LAYOUT
WATER MONITORING AND RESPONSE ACTION PLAN

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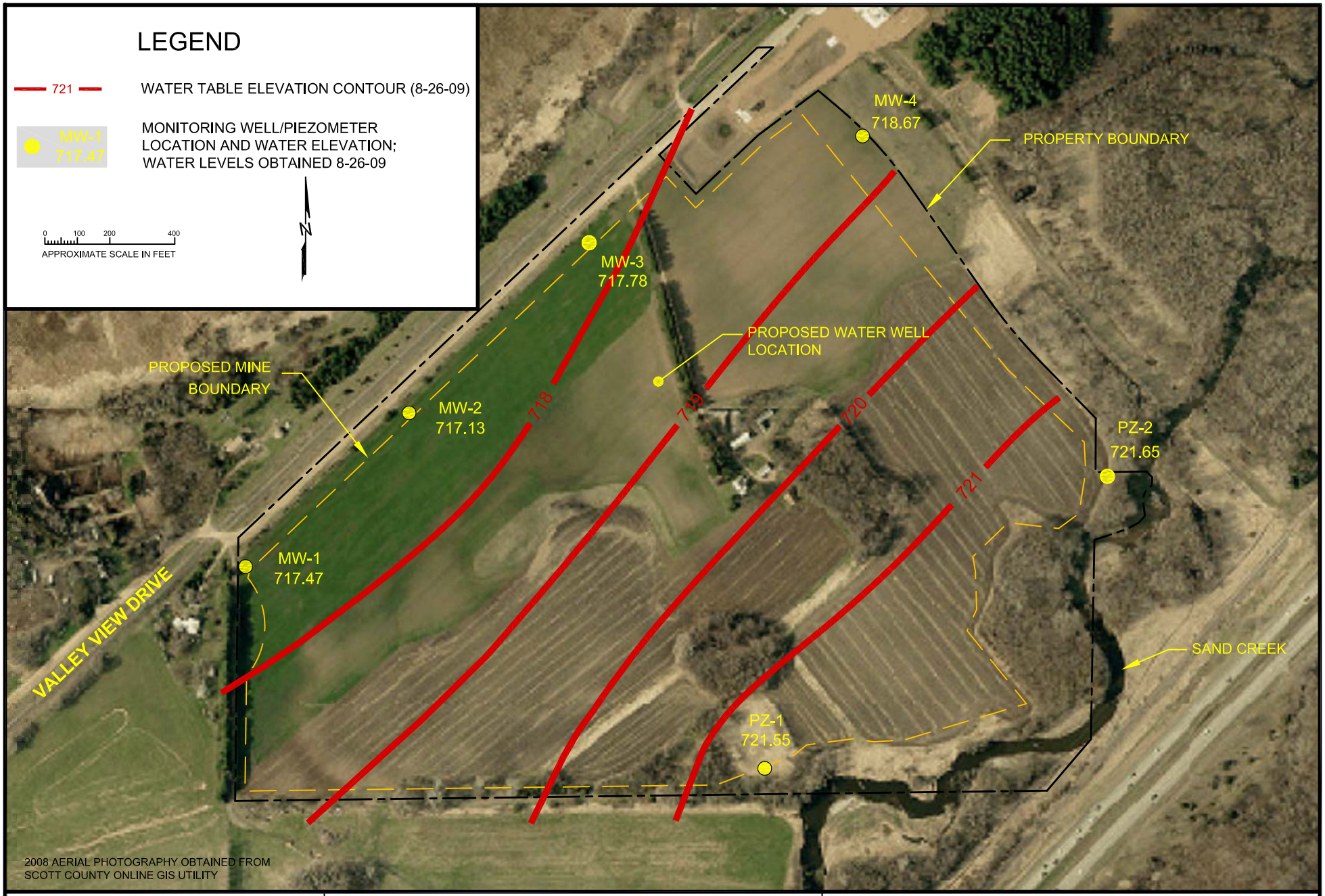

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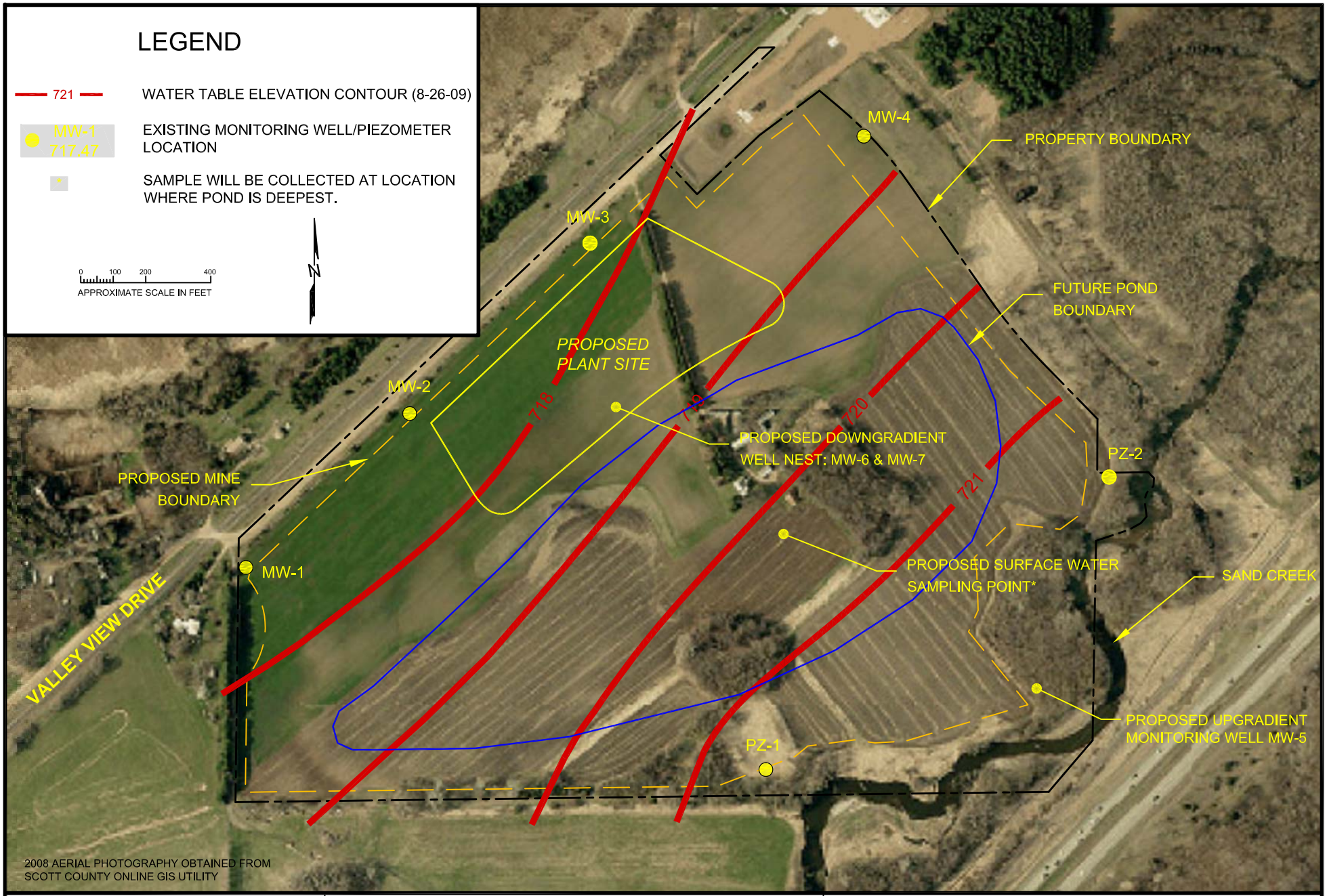
JORDAN AGGREGATES
Sand Creek Township
Scott County, MN

FIGURE 3
WATER TABLE ELEVATION
(8-26-09)
WATER MONITORING AND RESPONSE ACTION PLAN



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JORDAN AGGREGATES
Sand Creek Township
Scott County, MN

FIGURE 4
PROPOSED MONITORING NETWORK
WATER MONITORING AND RESPONSE ACTION PLAN

P:\Projects\HEN\HEN0901 Keefe\dwg\2013 EIS dwg\GW Monitoring Figures 3-4.dwg, Proposed Network, 10/14/2013 7:26:47 AM

Appendix A

Well Logs

MINNESOTA DEPARTMENT OF HEALTH

WELL AND BORING RECORD

Minnesota Statutes, Chapter 103I

MINNESOTA UNIQUE WELL AND BORING NO.: 767639

WELL OR BORING LOCATION

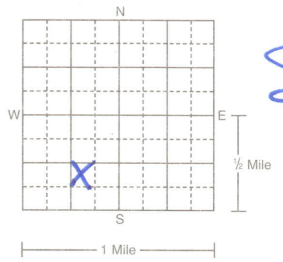
County Name: Scott

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 HEALTH COPY 767639

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

DRILLING METHOD: [X] Auger [ ] Cable Tool [ ] Driven [ ] Dug [ ] Rotary [ ] Jetted

DRILLING FLUID: NONE | WELL HYDROFRACTURED? [ ] Yes [X] No From ____ ft. To ____ ft.

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

CASING MATERIAL: [X] Plastic [ ] Steel | Drive Shoe? [ ] Yes [X] No | [X] Threaded [ ] Welded

CASING Diameter / Weight / Specifications:
2 in. to 29 ft. — lbs./ft. Sch 40 PVC
____ in. to ____ ft. ____ lbs./ft. ____
____ in. to ____ ft. ____ lbs./ft. ____

HOLE DIAM.: 8 in. to 39 ft.

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

OPEN HOLE: From ____ ft. To ____ ft.

STATIC WATER LEVEL: 20' ft. [X] 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 ____
[X] Casing Protection 6" locking steel [X] 12 in. above grade
[ ] At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION: Well grouted [X] Yes [ ] No
Grout materials: [ ] Neat cement [X] Bentonite [O] Concrete [ ] Other
[O] From 0 To 4 ft. 3 [ ] Yds. [X] Bags
[X] From 4 To 25 ft. 1 [ ] Yds. [ ] Bags
From ____ To ____ ft. ____ [ ] Yds. [ ] Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type
Well disinfected upon completion? [ ] Yes [X] No

PUMP: [X] 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 [X] No

VARIANCE: Was a variance granted from the MDH for this well? [ ] Yes [X] 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.

Craig Sellon — 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. 767638

WELL OR BORING LOCATION

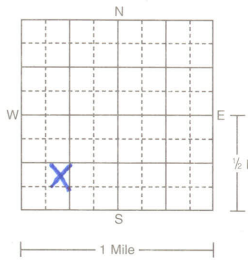
County Name: Scott

Township Name	Township No.	Range No.	Section No.	Fraction
Jordan	114	23	8	NE SW SW

GPS LOCATION: Sand Creek — 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	Dark BRN	moist	0	2'
Poorly Graded Sand	BRN	med	2'	24'

Use a second sheet, if needed.

REMARKS, ELEVATION, SOURCE OF DATA, etc.

MW-3 BL-09-03429 Jim Craig

MINN. DEPT. OF HEALTH COPY 767638

WELL/BORING DEPTH (completed): 24' ft. — DATE WORK COMPLETED: 8/26/09

DRILLING METHOD: [X] Auger [ ] Cable Tool [ ] Driven [ ] Dug [ ] Rotary [ ] Jetted

DRILLING FLUID: NONE — WELL HYDROFRACTURED? [ ] Yes [X] No From ____ ft. To ____ ft.

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

CASING MATERIAL: [X] Plastic [ ] Steel — Drive Shoe? [ ] Yes [ ] No — [X] Threaded [ ] Welded

HOLE DIAM.

CASING

Diameter	Weight	Specifications	HOLE DIAM.
2 in. to 14 ft.	14 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 — OPEN HOLE From ____ ft. To ____ ft.

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

STATIC WATER LEVEL: 12 ft. [X] Below [X] 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 ____
[X] Casing Protection 6" locking steel — [X] 12 in. above grade
[ ] At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION
Well grouted [X] Yes [ ] No
Grout materials [ ] Neat cement [X] Bentonite [ ] Concrete [ ] Other ____

From 0 To 4 ft.	3	[ ] Yds.	[X] Bags
From 4 To 10 ft.	.5	[ ] Yds.	[X] Bags
From ____ To ____ ft.	____	[ ] Yds.	[ ] Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type
Well disinfected upon completion? [ ] Yes [X] No

PUMP
[X] 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 [X] No

VARIANCE
Was a variance granted from the MDH for this well? [ ] Yes [X] 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 — 1323
Licensee Business Name — Lic. or Reg. No.

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

Matt Takada
Name of Driller

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

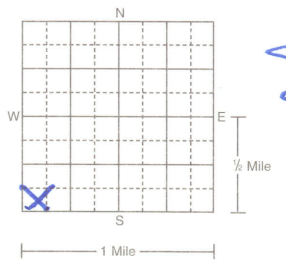
Township Name	Township No.	Range No.	Section No.	Fraction
Sand Creek	114	23	8	SW SW SW

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

Same. 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 HEALTH COPY 767637

WELL/BORING DEPTH (completed): 24 ft. DATE WORK COMPLETED: 8/26/09

DRILLING METHOD: [X] Auger [ ] Cable Tool [ ] Driven [ ] Dug [ ] Rotary [ ] Jetted

DRILLING FLUID: NONE

WELL HYDROFRACTURED? [ ] Yes [X] No From ____ ft. To ____ ft.

USE: [X] Monitoring [ ] Domestic [ ] Noncommunity PWS [ ] Environ. Bore Hole [ ] Industry/Commercial [ ] Community PWS [ ] Irrigation [ ] Remedial [ ] Elevator [ ] Dewatering [ ] ____

CASING MATERIAL: [X] Plastic [ ] Steel Drive Shoe? [ ] Yes [ ] No [X] Threaded [ ] Welded [ ] ____

HOLE DIAM.

CASING: Diameter 2 in. to 14 ft. Weight — lbs./ft. Specifications Sch 40 PVC

HOLE DIAM.: 8 in. to 24 ft.

SCREEN: Make Johnson PVC Type ____ Slot/Gauze .010 Set between 14 ft. and 24 ft.

OPEN HOLE From ____ ft. To ____ ft. Diam. 2" Length 10' FITTINGS Flush Thread

STATIC WATER LEVEL: 12 ft. [X] 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 ____ [X] Casing Protection 6" locking steel [X] 12 in. above grade [ ] At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION: Well grouted [X] Yes [ ] No

Grout materials: [ ] Neat cement [X] Bentonite [X] Concrete [ ] Other ____

[X] From 0 To 4 ft. 3 [ ] Yds. [X] Bags

[X] From 4 To 18 ft. .5 [ ] Yds. [X] Bags

From ____ To ____ ft. ____ [ ] Yds. [ ] Bags

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

Well disinfected upon completion? [ ] Yes [X] No

PUMP: [X] 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 [X] No

VARIANCE: Was a variance granted from the MDH for this well? [ ] Yes [X] 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 — STD — 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. 767636

WELL OR BORING LOCATION

County Name: Scott

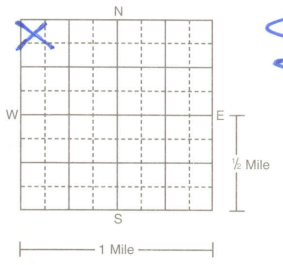
Township Name	Township No.	Range No.	Section No.	Fraction
Sand Creek	114	23	17	NW NW NW

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 HEALTH COPY 767636

WELL/BORING DEPTH (completed): 33 ft. DATE WORK COMPLETED: 8/26/09

DRILLING METHOD: [X] Auger [ ] Cable Tool [ ] Driven [ ] Dug [ ] Rotary [ ] Jetted

DRILLING FLUID: NONE

WELL HYDROFRACTURED? [ ] Yes [X] No From ____ ft. To ____ ft.

USE: [X] Monitoring [ ] Domestic [ ] Noncommunity PWS [ ] Environ. Bore Hole [ ] Industry/Commercial [ ] Community PWS [ ] Irrigation [ ] Remedial [ ] Elevator [ ] Dewatering [ ]

CASING MATERIAL: [X] Plastic [ ] Steel
Drive Shoe? [ ] Yes [X] No
[X] Threaded [ ] Welded

HOLE DIAM.

CASING: Diameter 2 in. to 23 ft. Weight — lbs./ft. Specifications Sch 40 PVC
HOLE DIAM.: 8 in. to 33 ft.

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

OPEN HOLE From ____ ft. To ____ ft.

STATIC WATER LEVEL: 23 ft. [X] 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
[X] Casing Protection 6" locking steel [X] 12 in. above grade
[ ] At-grade (Environmental Well and Boring ONLY)

GROUTING INFORMATION
Well grouted [X] Yes [ ] No
Grout materials [ ] Neat cement [X] Bentonite [O] Concrete [ ] Other
O From 0 To 4 ft. 3 Yds. [X] Bags
X From 4 To 19 ft. 1 Yds. [X] Bags
From ____ To ____ ft. ____ Yds. [ ] Bags

NEAREST KNOWN SOURCE OF CONTAMINATION: Unknown feet ____ direction ____ type
Well disinfected upon completion? [ ] Yes [X] No

PUMP
[X] 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 [X] No

VARIANCE
Was a variance granted from the MDH for this well? [ ] Yes [X] 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 — 1333 Lic. or Reg. No.

Greg Scallon — 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)

Appendix B

Example Field Data Sheet

MVTL Field Datasheet

1411 South 12th Street
Bismarck, ND 58504
Phone: (701) 258-9720
Toll Free: (800) 279-6885

Groundwater Assessment

Site:

Sampling Personnel: Jeremy Mayer

Facility ID:

Date: 23 Jun 09 - 24 Jun 09

Unique Station ID:

Sample ID: MW-18

Well Condition

Well Locked? Yes (No)
Well Labeled? (Yes) No

Casing Straight? (Yes) No
Grout Seal Intact? (Yes) No

Repairs Necessary:

Well Information

Well Depth: 18.01
Constructed Depth: 17.90
Casing Diameter: 2"
Water Level Before Purge: 12.11
Well Volume: 3.6 Liters

Well Casing Elevation: 2135.30
Static Water Elevation: 2123.19
Previous Static: 2122.08
Water Level After Sample: 15.74
Measurement Method: (Elec. WL) Steel Tape

Sampling Information

Weather Conditions: Temp: 70°F Wind: W @ 10-15 Precip: 10% Overcast

Sampling Method: Keck Bladder Pump (Bailer) Whale Peristaltic Grab Other:

Dedicated Equipment? Yes (No)
Well Purged Dry? (Yes) No
Time Purged Dry? 1521
Duplicate Sample? Yes (No) ID: —

Pumping Rate: — ml/min
Time Purging Began: 1518 am / (pm)
Time of Sampling: 1200 am / (pm)
24 Jun 09

Sample Appearance: General: Clear Phase: —
Color: Yellow Tint Odor: —

SEQ #	Time	Temp °C	Specific Cond.	pH		Liters Removed	Appearance
1	1521	9.59	12032	7.11		4.1	Clear
2							
3							
4							
5	1200	10.47	12053	7.13		~	recharge

Stablitized? Yes (No)
Amount of Water Removed: 4.1 Liters

Comments:
Overnight recharge

Exceptions to Protocol:

Appendix C

Remedial Action Cost Estimate

Table C-1
30-Year Estimated Operation/Maintenance Costs for Water Treatment
Jordan Aggregates Proposed Sand & Gravel Mine
Water Monitoring & Remedial Action Plan

	Item	Unit	Quantity	Unit Price ($)	Extension ($)
1	**ROBLING PROPERTY**				
	a. Water softener: purchase/install replacment system (assume one replacement in 30 years)	Each	1	$1,200	$1,200
	b. Water softener: Annual O&M (salt)	Year	30	$120	$3,600
	c. Iron filter: purchase/install replacement system (assume one replacement in 30 years)	Each	1	$1,400	$1,400
	d. Iron filter: annual O&M (annual tune-up, 5-year media replacment)	Year	30	$200	$6,000
	Subtotal - Robling Property				**$12,200**
2	**S.C.A.L.E. FACILITY**				
	a. Water softener: purchase/install replacment system (assume one replacement in 30 years)	Each	1	$2,500	$2,500
	b. Water softener: Annual O&M (salt)	Year	30	$220	$6,600
	c. Iron filter: purchase/install (assume two systems in 30 years)	Each	1	$3,000	$3,000
	d. Iron filter: annual O&M (annual tune-up, 5-year media replacment)	Year	30	$250	$7,500
	Subtotal - SCALE Facility				**$19,600**
3	**JUVENILE ALTERNATIVE FACILITY**				
	a. Water softener: purchase/install replacment system (assume one replacement in 30 years)	Each	1	$1,600	$1,600
	b. Water softener: Annual O&M (salt)	Year	30	$160	$4,800
	c. Iron filter: purchase/install (assume two systems in 30 years)	Each	1	$2,200	$2,200
	d. Iron filter: annual O&M (annual tune-up, 5-year media replacment)	Year	30	$220	$6,600
	Subtotal - Juvenile Alternative Facility				**$15,200**
	TOTAL OF ALL O & M COSTS				**$47,000**

- Costs reflect 2013 pricing
- Pricing information provided by Water Doctors Treatment Company of Spring Lake Park, MN; based on typical area water quality of 2-8 ppm iron and 20-25 grains per gallon hardness. Costs will be revised upon installation of replacement wells and subsequent water testing.

Table C-2
Remedial Action Costs for Exceedence of Groundwater Standards
Jordan Aggregates Proposed Sand & Gravel Mine
Water Monitoring & Remedial Action Plan

	Item	Units	Quantity	Unit Price ($)	Extension ($)
1	**CONTAMINATION DETECTED (Remedial Investigation, Source Control)**				
	a. Engineering (investigation design/work plan, coordination)	Lump Sum	1	5,000	$5,000
	b. Field Services (Phase II-type investigation: 2 days drilling; install 3 monitoring wells)	Lump Sum	1	15,000	$15,000
	c. Lab analysis of soil/groundwater samples	Lump Sum	1	2,500	$2,500
	d. Excavate/dispose contaminated soil	Cubic Yard	50	80	$4,000
	e. Reporting	Lump Sum	1	6000	$6,000
	Subtotal - CONTAMINATION DETECTED				**$32,500**
2	**REMEDIATION: MONITORED NATURAL ATTENUATION**				
	a. Engineering (MNA feasibility study/work plan; project management)	Lump Sum	1	12,000	$12,000
	b. Install 5 additional wells (performance monitoring and sentinel wells)	Lump Sum	1	11,000	$11,000
	c. Monitoring phase - assume 15 events over a three-year period (field and lab costs)	Each	15	2,800	$42,000
	d. Semi-annual evaluation/reporting	Each	6	6,500	$39,000
	e. Seal monitoring wells after completion of MNA	Lump Sum	1	3,000	$3,000
	Subtotal - REMEDIATION				**$107,000**
TOTAL OF ALL REMEDIAL ACTIONS					**$140,000**

Costs reflect 2013 pricing

Table C-3

30-Year Estimated Operation/Maintenance Costs for Water Treatment - Purification

Jordan Aggregates Proposed Sand & Gravel Mine

Water Monitoring & Remedial Action Plan

	Item	Unit	Quantity	Unit Price ($)	Extension ($)
1	**ROBLING PROPERTY**				
	a. Purchase/install Reverse Osmosis system including tank, electrical, plumbing, etc. (assume one replacement in 30 years)	Each	2	$3,000	$6,000
	b. O & M - system tune up & replace membrane once every five years	Year	6	$300	$1,800
	Subtotal - Robling Property				**$7,800**
2	**S.C.A.L.E. FACILITY**				
	a. Purchase/install Reverse Osmosis system including tank, electrical, plumbing, etc. (assume one replacement in 30 years)	Each	2	$6,000	$12,000
	b. O & M - system tune up & replace membrane once every five years	Year	6	$500	$3,000
	Subtotal - SCALE Facility				**$15,000**
3	**JUVENILE ALTERNATIVE FACILITY**				
	a. Purchase/install Reverse Osmosis system including tank, electrical, plumbing, etc. (assume one replacement in 30 years)	Each	2	$5,000	$10,000
	b. O & M - system tune up & replace membrane once every five years	Year	6	$500	$3,000
	Subtotal - Juvenile Alternative Facility				**$13,000**
TOTAL OF ALL O & M COSTS					**$36,000**

- Costs reflect 2013 pricing. Costs will be updated annually using inflaction factor provided by MPCA.
- Pricing information provided by Culligan of Minnetonka, MN; based on use with softened water.