

## GROUNDWATER GUIDELINE

The Opencut Mining Act (Act) requires that a Plan of Operation provide appropriate protection of surface and groundwater quality and quantity, and prevent significant physical harm to the affected land, adjacent land, or life forms [82-4-434(3) (l & n), MCA]. This document outlines the requirements for characterizing water resources at a site through a *Water Resources Assessment* and provides guidance for operators who are required to install monitoring wells and conduct groundwater monitoring and reporting [ARM 17.24.212(6), 17.24.218(1)(g & h), and 17.24.222(1)].

Specific conditions and operations at a proposed Opencut mine site may require submittal of additional hydrogeologic information in order to demonstrate that groundwater and surface water have been adequately assessed and would be given appropriate protection as required under the Act and Rules. The following conditions may provide DEQ to require a *Water Resources Assessment* and/or a *Groundwater Monitoring Plan* as part of the Plan of Operation (these two documents may be required together or as individual components):

- The *Determining Depth to Groundwater* Worksheet indicates that Opencut operations would result in a surface water feature postmining land use.
- Shallow groundwater or potential for shallow groundwater given surrounding topography and surface water features.
- Public water supply well located within ½ mile of the proposed Opencut operation.
- Residential/private water supply wells located within 1,000 feet of the proposed Opencut operation.
- Proposed Asphalt Plant.
- Proposed Concrete Plant.
- Fuel storage, fueling or other onsite chemical storage.
- Groundwater interaction with nearby surface water (i.e. creek/stream, river, wetland, irrigation ditch, pond, etc.), located within 1,000 feet of the proposed permit boundary.
- Groundwater quantity and/or quality issues or concerns.

### **I. WATER RESOURCES ASSESSMENT AND GROUNDWATER MONITORING**

#### **A. Pre-Meeting:**

If a *Water Resources Assessment* is required, DEQ requests that the Operator meet with Opencut staff (scientist & hydrologist) in Helena to discuss the project. The purpose of this meeting is for the Operator and Opencut to discuss site-specific project information and identify site-specific *Water Resources Assessment* requirements (e.g. pump test, monitoring requirements, well installation, etc.). The meeting will help the Operator to ascertain the information DEQ would require within the *Water Resources Assessment* for both completeness and acceptability.

\*\* Based on site-specific conditions, it may be determined that a less complicated or abbreviated version of the specifics outlined below would be adequate to meet the requirements for assessment and protection of water resources. In some cases, additional information may be needed to fully evaluate site hydrogeology.

#### **B. Report Requirements:**

The information below outlines DEQ's basic report formatting and plan requirements for *Water Resources Assessment* and *Groundwater Monitoring Plan* development. The required data and information must be gathered, analyzed, and presented according to current professionally accepted standards and practices. All data must be accompanied by the names and addresses of the parties that collected and analyzed the data, and by a description of the methodologies used to gather and analyze the data [ARM 17.24.222(2)].

DEQ Opencut would evaluate the submitted report/plan as it compares to the detailed expectations

below; if the report/plan is found to adequately address all requirements, the document would be accepted. If DEQ determines that additional information, data, analysis, or corrections are required, then DEQ would notify the Operator of deficiencies.

DEQ expects sufficient detail in the required *Water Resources Assessment* and *Groundwater Monitoring Plan* to fulfill the requirements of the Act and its implementing rules. Plans and reports must present and interpret comprehensive data and information in a clear, concise manner that can be readily understood by DEQ, the public, and other interested parties. The *Water Resources Assessment* pre-meeting described in “A” above would help inform the Operator of any specific requirements related to their project.

### C. Minimum Requirements for a Pump Test

A pump test will be required any time there is a likelihood of groundwater interaction with a proposed Opencut operation. The requirements of the test will be highly dependent upon the proposed operation and site-specific conditions. Close cooperation with DEQ Opencut is recommended to ensure that the planned test will be acceptable to DEQ. At a minimum, the test must establish hydraulic conductivity, storativity, and specific yield of the aquifer. A test that does not adequately determine these factors would not be acceptable and may need to be repeated.

Likely minimum pump test parameters:

- **Pump Test Length:** Discuss with DEQ Opencut to determine pump test length requirements. Required pump test length is variable and highly dependent on the site’s location and conditions. Monitoring of pumping and observation wells must continue during recovery (after the pumping stops) for a period of time at least equal to the pumping time, or until at least 95% of drawdown is recovered.
- **Observation Well:** Minimum of one observation well within 100-150 feet from the pumping well is required. Discuss with DEQ Opencut to ensure that acceptable numbers and locations of observation wells are selected.
- **Discharge:** Pumping discharge must be at least 300 feet downgradient of the pumping and observation wells and directed so it will flow away from the test area.
- **Flow Meters:** If possible, an inline or ultrasonic flow meter should be installed on the discharge line.
- **Data Loggers:** Data loggers should be installed in the pumping well and observation well(s) and be in place at least one day prior to the start of the pump test to capture baseline water levels and spot any trends.

## II. REPORT FORMATTING AND REQUIREMENTS

### A. Water Resources Assessment:

The purpose of the *Water Resources Assessment* (Assessment) is to compile data and information available from existing sources to characterize water resources at and near the site, and to describe in detail how water resources would be protected. If existing sources do not provide all of the needed information, the installation of monitoring wells, groundwater sampling, and submittal of routine monitoring reports may also be required (as described below under B - *Groundwater Monitoring Plan*). The Assessment must respond to, address, and include the information below.

#### a. Title Page

Title of report/plan (e.g. *Water Resources Assessment*)

Operator name, Site name, Opencut number

Operator contact person’s name, email, mailing address, and phone number

Consultant’s name, email, mailing address, and phone number

Date of report

#### b. Table of Contents

Titles of plan/report sections with page numbers

List of tables

List of figures

List of appendices

**c. Introductory Information**

Summarize relevant background information as needed to orient the reader and put the information to be presented in proper context (e.g. site description and history, geology/hydrology, previous investigations and sampling, monitoring well network, etc.).

**d. Hydrogeologic Assessment - Provide thorough, complete, and well substantiated documentation (text, tables, maps, figures, cross-sections, and graphs) characterizing current hydrologic and hydrogeologic conditions at and near the site. Information required to characterize current site conditions must include, but is not limited to:**

- A summary of hydrologic and hydrogeologic information available for the site and vicinity from the scientific literature and other public sources, as well as pertinent data collected at the site. Include information regarding lithology, hydraulic conductivity, and transmissivity of the aquifer(s) underlying the site vicinity.
- Results of a field inventory conducted to physically locate public water supply well(s) located within ½ mile of the proposed permit boundary; and show the well(s) on a *Well Locations Map*.
- Results of a field inventory conducted to physically locate residential/private water well(s) located within 1,000 feet of the proposed permit boundary; show the well(s) on a *Well Locations Map*.
- Hydrogeologic cross-sections and interpretive text describing the ground water system(s) at and near the site, including discussion of groundwater flow and gradient beneath the site and across the downgradient area and its relationship with surface water within 1,000 feet of the proposed permit boundary. Initial cross-sections must be based on the lithologic and completion logs for any new required monitoring wells, as well as the existing wells in the vicinity. Cross-sections must include topography, well depths, screened intervals, lithology, and depth to groundwater, including any available seasonal high and low water level data.
- Currently available groundwater flow direction and gradient data in the form of tables, graphs, and representative maps, as well as written interpretations of historic trends and seasonal variations in groundwater elevations.
  - Include a description of any known or observed site specific features (lithology, surface water features, ditches, ponds, etc.) and include interpretations of potential effects related to Opencut operations.
- Information on operation and uses of irrigation ditches in and within 1,000 feet of the site, as well as interpretations regarding ditch effects on groundwater elevations over time and how ditch flows could be affected by proposed Opencut operations.
- Tables and laboratory reports for currently available ground water analytical data from the site and vicinity, as well as text, figures, graphs, and diagrams as necessary to characterize the existing water quality.
- Description of source, quantity, use, de-watering, and potential discharge of water at the proposed Opencut operation. Include any measures necessary to protect on- and off-site surface water and groundwater from deterioration of water quantity and quality; and any measures necessary to prevent, minimize or mitigate on- and off-site surface water and groundwater systems and structures.

**B. Groundwater Monitoring Plan:**

DEQ Opencut may require surface and groundwater monitoring to determine site-specific lithology, hydraulic conductivity, ground water levels, seasonal variations in flow direction, and groundwater quality. A required *Groundwater Monitoring Plan* (Plan) must be approved by DEQ Opencut prior to

implementation.

The format of the Plan must include items **a.**, **b.**, and **c.** as described above under A - *Water Resources Assessment*, as well as the additional information identified below.

**a.** Title Page

**b.** Table of Contents

**c.** Introductory Information

**d.** Monitoring Well Installation

- Describe the monitoring wells to be included in the monitoring program and the rationale and justification for the location selected for each well. Describe how all wells to be used in the monitoring program would be protected and maintained before, during, and after Opencut operations. Note that monitoring well locations and procedures must be approved by DEQ Opencut prior to installation.
- Locate at least one monitoring well upgradient of operations, with the remaining proposed monitoring wells located down-gradient of areas where fuel or other hazardous substances would be used, stored, transferred, or handled, and where runoff would be concentrated. The intended monitoring purpose and function of each well must be clearly described. The proposed wells must be shown on the site and area map, and be located where they would not be disturbed by Opencut operations so as to remain accessible until site reclamation is approved by Opencut.
- Describe drilling, soil sampling, and monitoring well installation procedures: screened interval, length of screen and slot size, length of casing, type of annular material (sand pack), type of annular sealant, surface completion, and total depth; construction techniques may be referenced in a standard operating plan (SOP) attached to the Plan. Note that each well must be constructed using factory-slotted screen such that the screen extends across the full range of water table fluctuations in order to monitor for petroleum or other hazardous substances that float on water, unless otherwise approved by the DEQ. If the aquifer appears to be confined, alternative screened intervals may be appropriate.
- Describe well development procedures including: date, type of development, volume of water removed, and water quality.
- Provide results of surveyed locations and elevations of wellheads; describe reference datum. Provide locations for any surface water measurements points.

**e.** Monitoring and Sampling Procedures

- Describe groundwater monitoring procedures including: date (sufficient days after well development to ensure well equilibration to aquifer), groundwater elevation measurements, sampling method, purging method, and stabilization parameters.
- Describe the frequency of groundwater level monitoring and estimated months that sample collection would take place. Generally, for the first two years, groundwater levels must be measured monthly and groundwater samples collected quarterly. Thereafter, monitoring may be reduced to semiannually during the approximate high and low seasonal water levels.
- The condition of any surface water within the proposed permit area or within 1,000 feet of the permit boundary (stream, ephemeral drainage, ditch, pond, etc.) must be noted during each monitoring event (i.e. the presence or absence of water, estimated flow, etc.).
- Describe field and laboratory parameters to be analyzed consistent with current professionally accepted standards and practices as necessary to characterize general ground water quality. The laboratory analyses proposed must also include parameters selected based on an inventory of petroleum and other hazardous substances to be used at the site (refer to Appendix A *Groundwater Sampling Procedures* for additional information).
- Describe groundwater sampling methods, type of pump used, sample containers, decontamination procedures, and sample preservation (sample collection SOPs may be

included as an appendix to the Plan).

- Describe Quality Assurance/Quality Control (QA/QC) procedures including collection of duplicate samples and other QA/QC samples as may be appropriate.
- The plan must also provide for additional monitoring as warranted based on findings of the water resources assessment, and in the event of a spill of petroleum or other hazardous substance at the site.

f. Groundwater Monitoring Reports

- Monitoring reports must present comprehensive data and information as needed to document that human health and the environment are being protected. Some information is repeated in successive reports to provide background the reader needs to understand monitoring results in proper context. The latest information is updated into each new report to present and interpret the current monitoring results.
- Indicate the frequency of monitoring reports to be submitted to DEQ Opencut (e.g. quarterly or semiannual)
- Monitoring reports must be submitted after each sampling event within 30 days after receipt of the laboratory analytical results.
- Describe the monitoring event that is the subject of this report.
- Identify the title and date of the approved monitoring plan.
- If new or replacement monitoring wells, piezometers, or other sampling points were constructed during the reporting period, and not otherwise reported to DEQ, include a description of those points and their construction event(s).
- Each report must include field notes and sampling logs; comprehensive data tables, graphs, and maps; interpretive text; conclusions and recommendations, and supporting lab documentation consistent with current professionally accepted standards and practices (refer to attached examples).
- Provide a vicinity map and monitoring well locations map (include any surface water monitoring locations)
- Present cumulative groundwater elevation data in a table and construct maps indicating potentiometric surface with groundwater flow direction(s). Provide graph(s) showing groundwater elevations over time.
- Present groundwater analytical results in cumulative table(s) including field data such as sample identification, screened interval, depth to groundwater, and collection date. Groundwater analytical results should be compared to applicable standards presented in the most recent version of DEQ Circular 7 – Montana Numeric Water Quality Standards, which is currently available at: <http://deq.mt.gov/water/resources/circulars>
- Present a discussion of the field and laboratory results, including detections of analytical parameters at concentrations of potential concern, any deviation in sample collection protocols, data anomalies, and laboratory QA/QC discrepancies.
- Present conclusions regarding the site status and the data presented, and provide recommendations for any further sampling, investigations, or repairs that may be needed to ensure human health and the environment are appropriately protected
- Appendices  
The following appendices to the reports would typically be required:
  - Boring logs – typically in initial report only
  - Well completion logs – typically in initial report only
  - Groundwater sampling logs and field notes
  - Laboratory analytical results reports
  - Chain of custody documentation
  - Sample receipt checklist(s)
  - Quality assurance/quality control reports for laboratory data

### **III. PREVENTATIVE MEASURES**

Equipment, product plants, and maintenance operations at a proposed Opencut site typically use petroleum fuel and other hazardous substances (e.g. lubricants, solvents, antifreeze, product additives, etc.). Spillage is the most common way for a release of petroleum or other hazardous substances from an Opencut operation to impact soil and water quality. Costs to investigate and remediate spills are often substantial; as a result, in addition to protecting human health and water quality, well-thought out preventative measures may also reduce an Operator's liability and potential for financial loss. The measures listed below may be required by DEQ, based on site-specific conditions. Alternatively, an Operator may elect to voluntarily include preventative measures which could reduce the need for additional study or monitoring of groundwater systems.

Preventative Measures may include:

- a. **Spill Response Plan:** Develop a site-specific *Spill Response Plan* that includes, in detail, how spills at the site would be prevented, contained, reported and addressed. The *Spill Response Plan* must be consistent with the Opencut permit and current codes adopted by the State Fire Marshal. An acceptable format for developing a site-specific *Spill Response Plan* can be found at <https://www.epa.gov/oil-spills-prevention-and-preparedness-regulations/spill-prevention-control-and-countermeasure-17>.
- b. **Fueling Area:** An on-site fueling area may be established that is liquid tight, would prevent spills from reaching groundwater or surface water, and complies with the State Fire Marshal's specific requirements for storage, dispensing and piping. Refer to Opencut's *Fuel Guideline for Spill Prevention & Management Worksheet* located at <http://deq.mt.gov/Mining/opencut>.
- c. **Facilities Siting:** Deliberate siting or locating of facilities such as an asphalt plant and/or fuel storage, such as selecting highest ground (away from residences) where no mining would occur.
- d. **Biodegradable Products:** Use of biodegradable products as part of operations and providing product details in the permit application.
- e. **Other:** The Operator may propose acceptable alternatives that protect water quality from fuel, oil and other contaminants, spills, etc. to be evaluated by DEQ Opencut.

### **IV. REQUESTING A REVISED MONITORING SCHEDULE**

Under certain circumstances, an Operator may request revision of an existing Groundwater Monitoring Plan. Situations where a revised Plan might be appropriate would include a significant change in surrounding property use or site acreage, a contaminant release, or submittal of an amendment or release request. The Operator must submit a revised Plan to DEQ Opencut, and continue monitoring as required under the approved Plan until revisions meet DEQ approval. Note that there is no statutory time requirement for DEQ Opencut's review of a revised Plan, and that a revised Plan would be reviewed as Opencut has allowable time.

### **V. PROPER ABANDONMENT OF MONITORING WELLS**

The Operator must obtain approval from DEQ Opencut prior to decommissioning observation wells or abandoning established monitoring wells. Final monitoring results or information may be required as part of a Phase I Release Request. The Montana Department of Natural Resources and Conservation (DNRC) has adopted rules governing the installation and abandonment of monitoring wells in Montana. Standards for abandoning monitoring wells are provided in ARM 36.21.810. A water well log report, fully describing all abandonment procedures, shall be submitted to the Ground Water Information Center (GWIC) within 60 days of abandoning a well [ARM 36.21.810(5)]. Groundwater observation wells less than 10 feet deep are excluded from the DNRC construction standard rules [ARM 36.21.802(2)].

#### **Sources:**

Circular DEQ 4, Montana Standards for Subsurface Wastewater Treatment Systems, 2013 Edition, Appendix C- *Ground Water Observation Well Installation and Measuring Procedures*. 2013 Edition.

Montana Department of Environmental Quality. *Montana Remedial Investigation Guidance for Petroleum*

DEQ OPENCUT MINING SECTION • PO BOX 200901 • HELENA MT 59620-0901 • PHONE: 406-444-4970 • FAX: 406-444-4988 • EMAIL: [DEQOpencut@mt.gov](mailto:DEQOpencut@mt.gov)  
*Releases. Draft. October 2017.*

Montana Department of Environmental Quality. *Montana Risk-Based Corrective Action Guidance for Petroleum Releases.* May 2018.

U.S. Environmental Protection Agency Tier 1 Qualified Facility SPCC Plan Template.

EXAMPLE FORM-1  
SAMPLING LOG

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name) \_\_\_\_\_ Date \_\_\_\_\_  
Well Number \_\_\_\_\_ Depth to \_\_\_\_\_ of screen  
Field Personnel \_\_\_\_\_ (below MP) top bottom  
Sampling Organization \_\_\_\_\_ Pump Intake at (ft. below MP) \_\_\_\_\_  
Identify MP \_\_\_\_\_ Purging Device; (pump type) \_\_\_\_\_  
Total Volume Purged \_\_\_\_\_

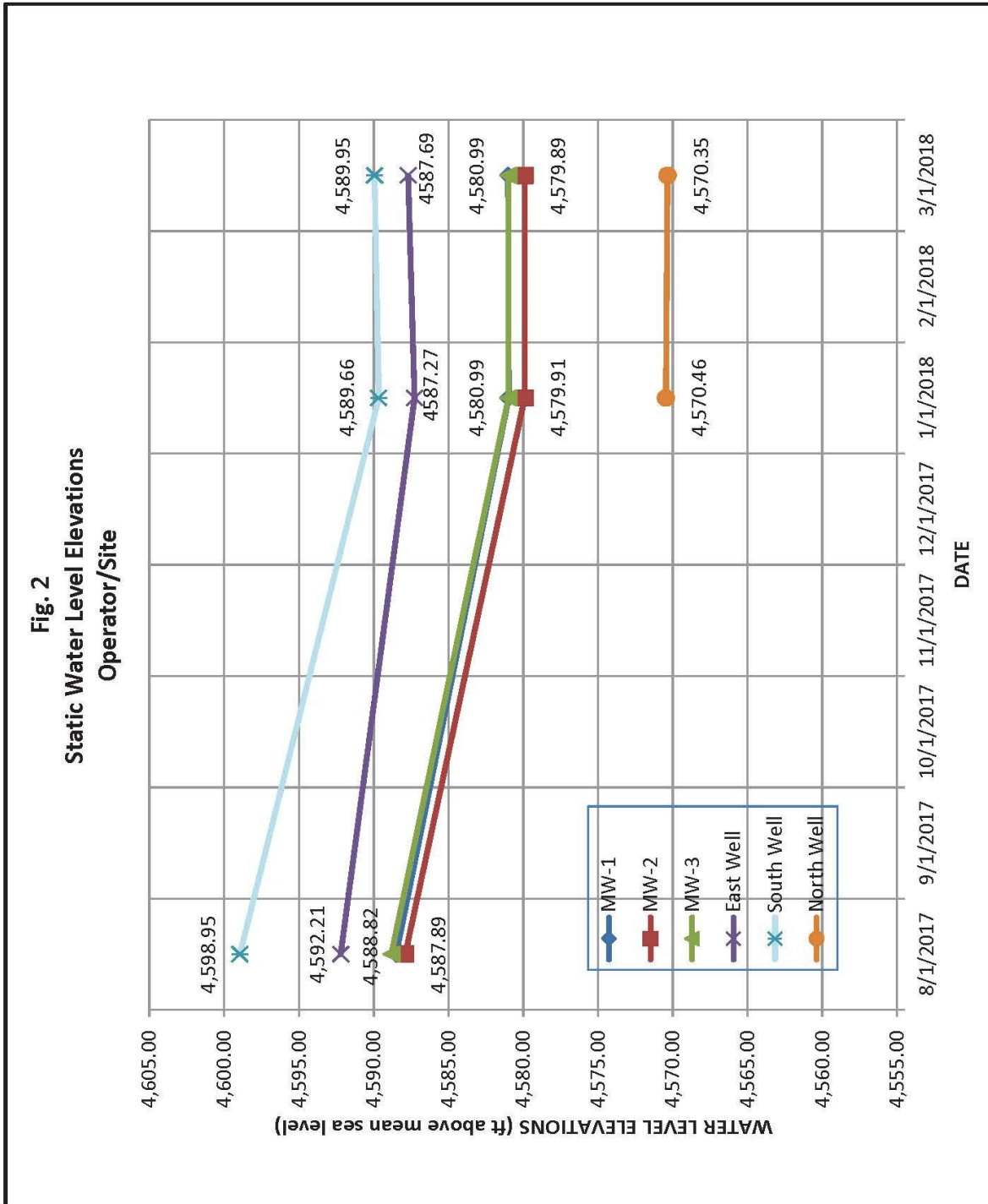
Clock Time	Water Depth below MP ft	Pump Dial	Purge Rate ml/min	Cum. Volume Purged liters	Temp. °C	Spec. Cond. <sup>2</sup> μS/cm	pH	ORP <sup>3</sup> mv	DO mg/L	Turbidity NTU	Comments
24 HR											

Stabilization Criteria      3%      3%      ±0.1 ± 10 mv      10%      10%      10%

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. μSiemens per cm(same as μmhos/cm) at 25 °C.
3. Oxidation reduction potential (ORP)

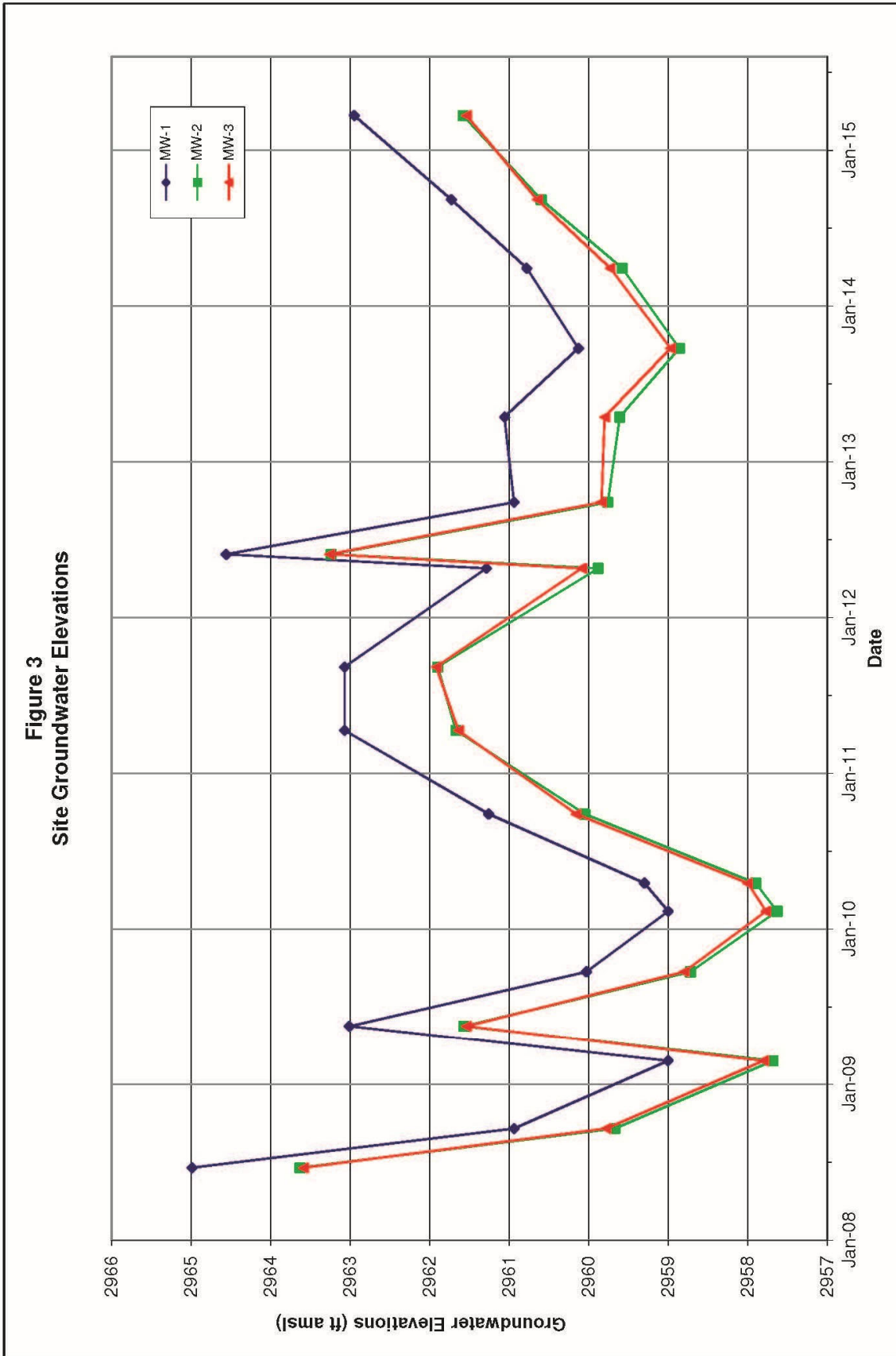


**EXAMPLE FORM-2**  
**STATIC WATER ELEVATIONS GRAPH**



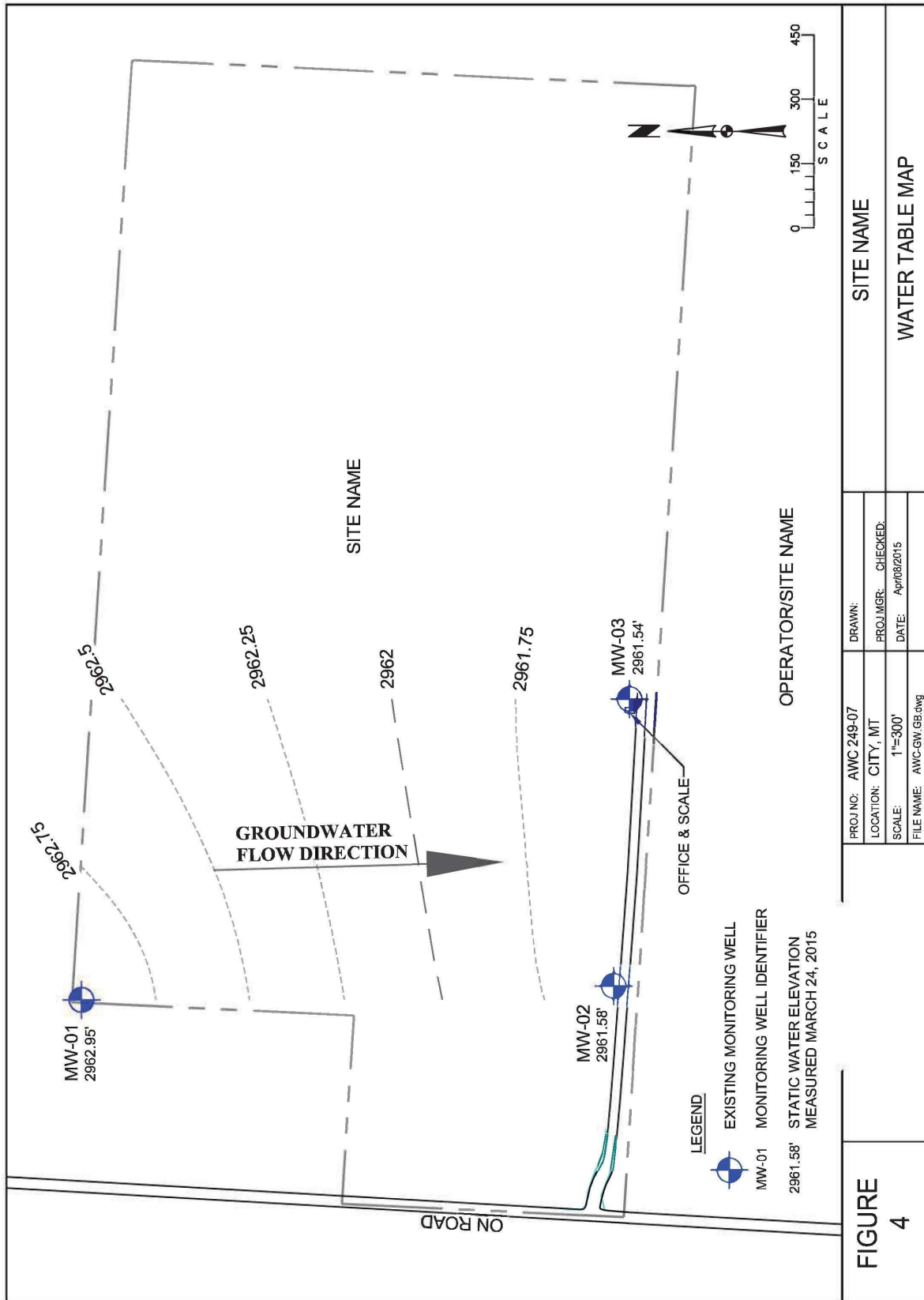
**EXAMPLE FORM-3**

GROUNDWATER ELEVATIONS GRAPH



**EXAMPLE FORM-4**

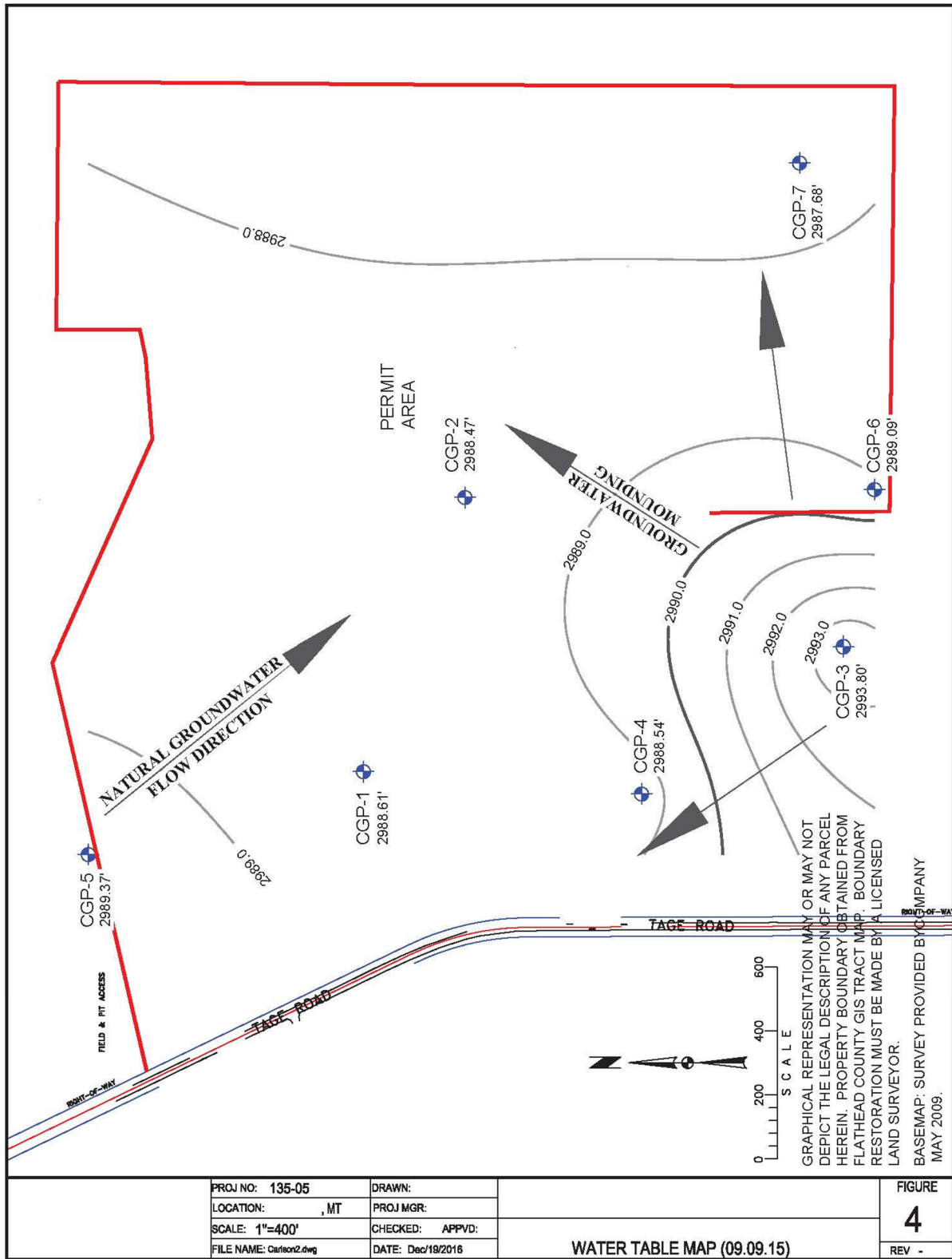
## GROUNDWATER ELEVATIONS MAP



**FIGURE 4**

### EXAMPLE FORM-5

### GROUNDWATER ELEVATION/FLOW MAP



### EXAMPLE FORM-6

### MONITORING WELL LOCATION MAP



## APPENDIX A - GROUNDWATER SAMPLING PROCEDURES

### Sampling Objectives:

The objective of groundwater monitoring, sampling and analysis at Opencut mine sites is to:

- Document baseline groundwater quality, elevation, gradient, and flow direction; and
- Evaluate and monitor any potential impacts to groundwater quality and quantity associated with a specific mining operation.

Upgradient monitoring wells are used to establish “background” conditions and/or to monitor for potential impacts from adjacent properties or sites. Down-gradient situated wells are intended to monitor for potential contamination resulting from onsite operations and determine potential for offsite migration. All installed wells should be located to monitor water table elevations and assist in determining groundwater flow direction.

### Scheduling:

Quarterly monitoring is typically required during the first year of mining in order to establish background data and information for the site. Thereafter, routine required sampling would be on a twice per year (semi-annual) basis, with monitoring occurring during seasonally high and low groundwater conditions. Groundwater monitoring is required before, during and after Opencut operations until the Operator submits a Phase II Release Request for the entire site and DEQ approves that request. Monitoring would typically include measuring static water levels and collecting samples from each monitoring well.

The Groundwater Monitoring Plan must specify the short- and long-term monitoring schedule. The plan should also identify when the required analytical suite would be reduced and/or modified. Any additional revisions to the plan must be requested as specified in Section IV of the Opencut *Groundwater Guideline*.

### Potential Sources (basis for selected lab analyses, etc.):

Potential impacts to groundwater quality from Opencut operations include: fuel storage, equipment refueling operations, hot mix asphalt plants, wet scrubber discharge water, salt stockpiling/storage, concrete batching and washout, other on-site chemical storage and use (lubricants, hydraulic fluid, coolants, etc.), storm water runoff, etc.

### Analytical Parameters:

The list of required analytes below are specifically selected to establish water quality baseline information and to evaluate whether impacts to groundwater or surface water from Opencut mine facility operations may have occurred. Initial sample collection would typically require analysis of all analytes listed on both tables below, with a simplified list established for ongoing semi-annual monitoring. Site-specific conditions, identified use or storage of certain chemicals or materials on site, or a documented release, may require additional sample collection and laboratory analysis.

Water quality parameters collected in the field as part of each sampling event include:

- Depth to groundwater
- Temperature (°C)
- pH
- Turbidity
- Specific conductivity
- Dissolved Oxygen

Laboratory sample results must be comparable to *Circular DEQ-7 Montana Numeric Water Quality Standards* and *Tier 1 Groundwater RBSLs and Standards* for contamination in groundwater.

**Routine Semi-annual Laboratory Analytical Suite**

Analyte	Unit	Reporting Limit	Method
EPH Screen <sup>1</sup>	µg/L	300	Montana Method EPH
VPH	µg/L	1	Montana Method VPH

<sup>1</sup>EPH fractionation may be necessary if the EPH screen concentration is >1,000 ug/L TEH.

**Baseline Laboratory Analytical Suite (\*Required during initial sample collection.)**

Water Quality/Indicator Parameters			
Total Dissolved Solids (TDS)	mg/L	10	A 2540 C
Alkalinity as CaCO <sub>3</sub> (bicarbonate as HCO <sub>3</sub> , carbonate as CO <sub>3</sub> , and hydroxide as OH)	mg/L	4	A 2320 B
Hardness (Total as CaCO <sub>3</sub> )	mg/L	1	E130.1
Chloride (Cl)	mg/L	1	E300.0
Chemical Oxygen Demand (COD)	mg/L	5	E410.4
Sulfate (SO <sub>4</sub> )	mg/L	1	E300.0
Nitrate + Nitrite as N	mg/L	0.01	E353.2
Aluminum (Al)	mg/L	0.03	E200.7/E200.8
Arsenic (As)	mg/L	0.001	E200.7/E200.8/A3114C
Copper (Cu)	mg/L	0.005	E200.7/E200.8
Lead (Pb)	mg/L	0.001	E200.7/E200.8
Selenium (Se)	mg/L	0.001	E200.7/E200.8/A3114C
Iron (Fe)	mg/L	0.02	E200.7/E200.8
Manganese (Mn)	mg/L	0.001	E200.7/E200.8
Sodium (Na)	mg/L	1	E200.7/E200.8
Calcium (Ca)	mg/L	1	E200.7/E200.8
Magnesium (Mg)	mg/L	1	E200.7/E200.8
Potassium (K)	mg/L	1	E200.7/E200.8
Phosphorus (P)	mg/L	0.005	E365.1

**\*This list is required during initial sample collection for establishing site background conditions. These parameters may be required as part of additional investigation if determined necessary.**

**Quality Control Samples:**

Collection of Quality Control samples during each sampling event will be required as follows:

- Temperature blank – a vial of water that accompanies the samples that will be opened and tested upon arrival at the laboratory to ensure that the temperature of the contents of the sampling shipping container was within the required 4°C± 2°C.  
\*Not required if the laboratory documents sample receipt temperature compliance as part of the lab report.
- Field blank – A full set of sample bottles filled with laboratory-supplied distilled deionized water on site, using the same methods employed in sample collection. Its purpose is to verify that sampling procedures are not introducing additional contamination.