Annual Hydrology Report Standard

Montana Department of Environmental Quality
Coal and Uranium Program

Last Updated: September 18, 2012

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The Annual Hydrology Report (AHR) serves two purposes: 1) as a mechanism to report hydrologic data collected by mine operators to MT DEQ; 2) as a yearly assessment of hydrologic conditions at the mine. The AHR is required by ARM 17.24.645(8) and ARM 17.24.646(2), and the report is used to address rules pertaining to hydrologic monitoring and protection of the hydrologic balance. The most pertinent rules are summarized in **Table 1**.

Table 1. Administrative Rules of Montana relevant to hydrologic monitoring.

Rule/Statute	Requirement
17.24.645(1)	Monitoring must be conducted in accordance with monitoring plan. Monitor levels, subsurface flow, storage characteristics, and quality of ground water, recharge capacity of reclaimed land in permit and adjacent areas
17.24.645(2)(a)	Monitor all disturbed or potentially affected strata; be of sufficient frequency and extent to identify changes
17.24.645(5)	Monitoring must proceed through mining and continue until phase IV bond release.
17.24.645(6)	GW Sample and analytical methods and Quality Assurance Plan
17.24.645(8)	Monitoring results reported semi-annually
17.24.646(1)	Surface water monitoring must be conducted in accordance with monitoring program
17.24.646(1)(a)	Adequate to accurately measure quantity and quality of all discharges
17.24.646(2)	Operator shall submit semi-annual reports
17.24.646(3)	Monitoring must be conducted at appropriate frequencies
17.24.646(4)	Reclamation monitoring
17.24.646(6)	SW Sample and analytical methods and Quality Assurance Plan
17.24.646(7)	Monitoring must proceed through mining and continue until phase IV bond release.
17.24.314(2)(d)	Plans for monitoring and semi-annual reporting
17.314.(1)&(3)	Plan for protection of the hydrologic balance & PHC determination
17.24.631(1)	General hydrology Requirements - minimize disturbance to the hydrologic balance and prevent material damage
17.24.631(2)	Changes in water quantity and quality, depth to groundwater, location of surface water drainage channels must be minimized to preserve post-mine land uses and federal and states statutes/regulations are not violated.
17.24.633(4)&(5)	All discharges must be in compliance with federal and state laws and regulations and applicable effluent limitations
	Restoration of premine recharge capacity and capability of reclaimed areas to transmit water to ground water system. Collect data to determine recharge capacity approximates premine.

The AHR is linked to two new documents: the Monitoring and Quality Assurance Plan (MQAP) and the Quality Assurance Summary Report (QASR). See the guidelines developed for the MQAP and QASR for information on these two documents.

In this guideline, template statements are shown italicized and bracketed with <>. These statements are given as examples and may be directly copied by mine operators when writing the AHR. Portions of example tables are included in this document to illustrate how to fill in data tables. A more complete example can be found in the accompanying example Excel files.

Deadlines

The reporting period for the Annual Hydrology Report is the water year (October through September). The Semi-Annual Hydrology Report (SAHR) is due to the Department by May 31st. The SAHR consists of the data collected October through March of the water year, and only the data-populated Excel templates are required. The AHR is due to the Department by December 31st of the reporting year.

Main Document

Cover Page

Include the following information on the Annual Hydrology Report cover page:

- Mine name
- Permit number
- Reporting water year with range of months
- Mine contact information
- Names and contact information of personnel and companies involved in data collection, processing, and analysis

The following page shows an example Annual Hydrology Report cover page and can be used as a template.

Mine Name

Permit Number(s)

2011 Annual Hydrology Report

(Oct. 2010 – Sept. 2011)

Contact Name

Mine Address

Mine Address

Contact Phone Number

Prepared by:

Preparer Name

Preparer Company

Preparer Phone Number

Preparer Email

Data Collected by:

Collector Name & Company; Collector Name & Company; Collector Name & Company

Table of Contents

The Annual Hydrology Report contains the following sections. Use the numbering scheme provided below. The Table of Contents should be placed after the Cover Page and should outline the sections described below.

Text

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- Stream crest gauge readings
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Attachments

Attachment A: Monitoring and Quality Assurance Plan (MQAP)

Acronyms

AHR	Annual Hydrology Report
DEQ	Montana Department of Environmental Quality
DEQ-7	Department Circular DEQ-7, Montana Numeric Water Quality Standards
GW	groundwater
MPDES	Montana Pollutant Discharge Elimination System
MQAP	Monitoring and Quality Assurance Plan
MR	minor revision
PE	Professional Engineer
QASR	Quality Assurance Summary Report
SMP	Surface Mine Permit
SW	surface water
WY	water year

1. Introduction

The introduction states the purpose of the Annual Hydrology Report and presents the sections of the report. Reference the attached QASR and MQAP. The following paragraph can be used as a template for the introduction:

<This Annual Hydrology Report presents the results of annual groundwater and surface water quality and quantity monitoring, and a summary of quality assurance elements in accordance with ARM 17.24.314, and as described in the Monitoring and Quality Assurance Plan (MQAP) (Attachment A). Included herein are results of water monitoring activities. Appendix J, the Quality Assurance Summary Report, presents an evaluation of quality assurance elements and includes a performance review of data quality indicators as directed in the MQAP. The Monitoring and Quality Assurance Plan represents the active hydrology monitoring plan for water year **XXXX** *for Surface Mine Permit* **XXXXXX***. The MQAP was approved by DEQ on* **XX/XX/XX***. Modifications to the MQAP from the previous year's plan are listed in Section 2.1.>*

2. Modifications to the MQAP

2.1. Approved Revisions to the MQAP

List and discuss any minor revisions (MR) to the MQAP that were approved during the water year.

For example, this table reports on changes to the monitoring plan from two MRs:

MR	Summary of MR	Sites Affected	Comments
MR45	Removed C2 from monitoring; changed A1 to monthly monitoring	C2, A1	
MR48	Changed groundwater monitoring suite parameters	All groundwater monitoring sites	

2.2. Anticipated Revisions to the MQAP

List and discuss anticipated revisions to the MQAP that may be requested during the subsequent water year. Changes to the MQAP must be submitted as a Minor Revision and approved before they are implemented. Changes that require approval include the removal or addition of monitoring sites, changes to the sampling frequency, methodology, measured parameters, instrumentation or configuration of a monitoring site.

2.3. Deviations from the Approved MQAP

Document all instances where the sampling plan was not followed as approved. Deviations from the sampling plan may include changes in field or analytical parameters, omission of a scheduled site visit, analytical or field procedures, sampling frequency, site location, etc. Also note when the Department was informed of the omission or problem. The Department must be notified as soon as a monitoring problem is identified by the mine. A problem is an event that precludes adherence to the monitoring plan or meeting monitoring requirements outlined in the MQAP.

This section serves to briefly list deviations. Detailed documentation of deviations from the monitoring plan can be given in the applicable narrative section in Section 3.

3. Hydrologic Observations and Analysis

The narrative is comprised of a discussion and an analysis of the hydrologic data. An assessment of data quality is included in the Quality Assurance Summary Report.

3.1. Climate

Data Description

Include a general description of weather monitoring sites (number and distribution) and the monitoring plan (refer to maps and data in appropriate Appendices).

Deviations from monitoring plan (field or analytical) for water year

Discuss in detail deviations from the monitoring plan. Include photos as necessary.

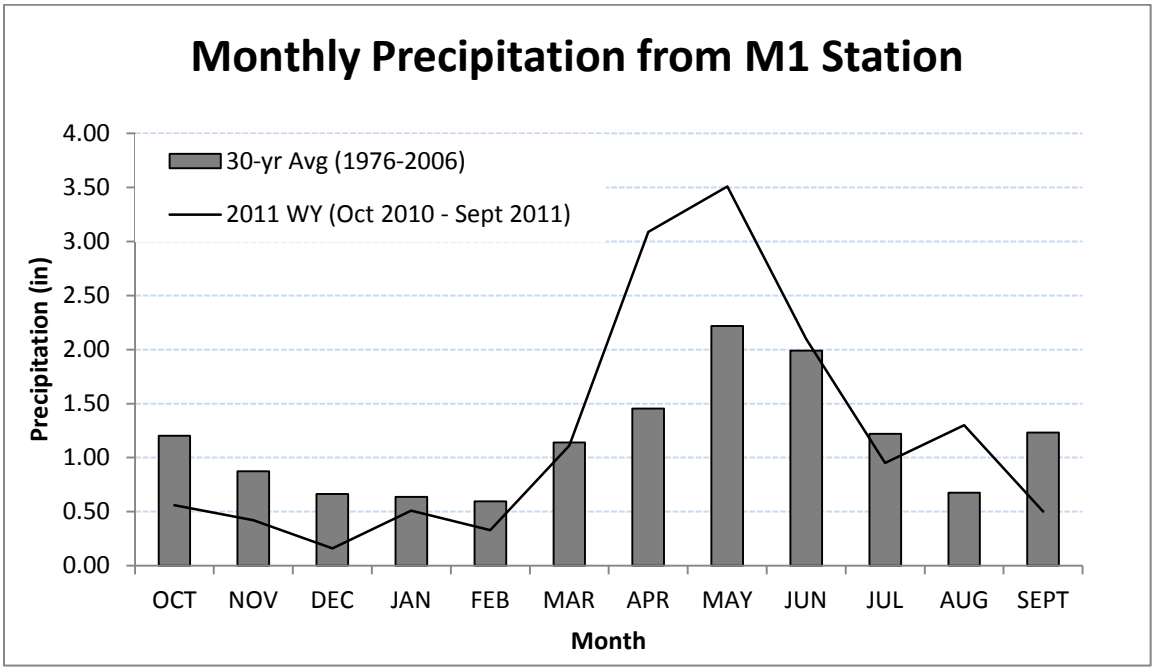
Discussion

Explain the general climatic conditions of the year and any exceptional weather conditions. Link weather events to any specific water quality conditions of note. Note and discuss conditions at the mine that resulted in storm-driven MPDES discharges.

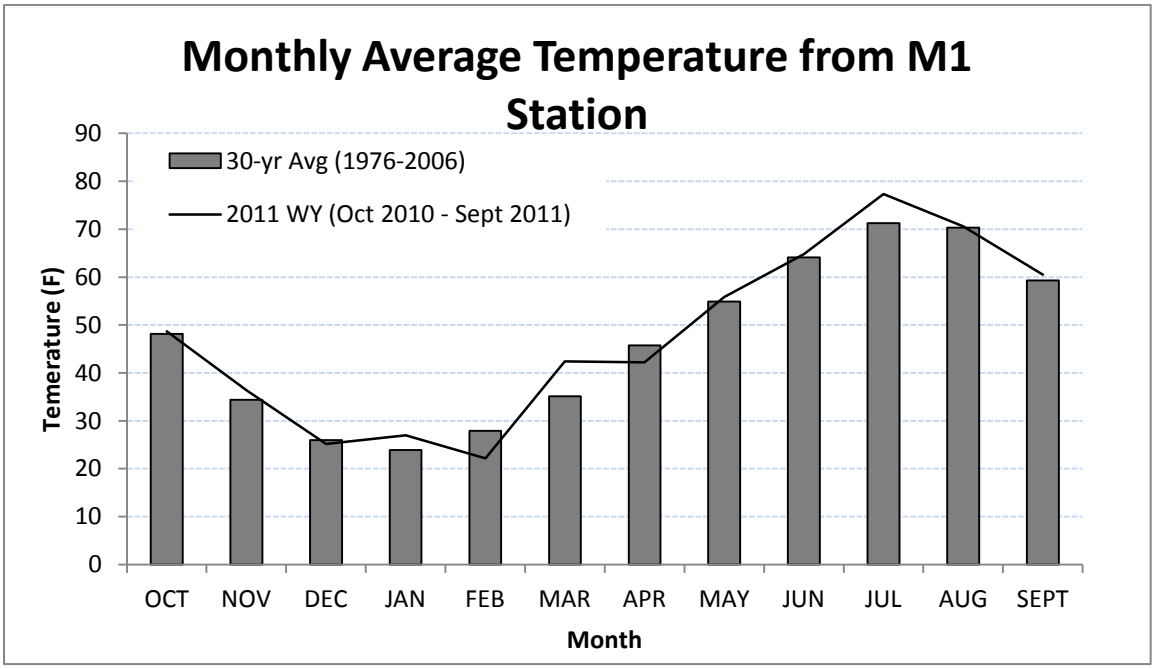
Include the following graphs in the discussion:

- Recorded monthly average temperature and 30 year average
- Recorded monthly average precipitation and 30 year average

Example: Average temperature graph



Example: Average precipitation graph



3.2. Springs

Data Description

Include a general description of sites (number and distribution) and the monitoring plan (refer to maps

and data in appropriate appendices).

Deviations from monitoring plan (field or analytical) for water year
Discuss in detail deviations from the monitoring plan. Include photos as necessary.

Discussion
Describe and discuss significant and predicted changes in water quantity and quality. Consider short-term changes, long-term changes, and developing trends in water quantity and quality. Discuss trends in the measured data that suggest potential impacts to or recovery of springs on or off of the permit. Include tables and graphs as needed. For water quality parameters with a DEQ-7 human health limit, compare the measured value to the limit and highlight or list samples which exceed the limit. For the purposes of AHR reporting, water quality criteria (standards) given in DEQ-7 are used solely for screening-level analysis of monitored analytical parameters. An exceedance of a DEQ-7 standard does not, in itself, necessarily constitute a standard or permit violation.

3.2. Streams

Data Description
Include a general description of sites (number and distribution) and the monitoring plan (refer to maps and data in appropriate appendices).

Deviations from monitoring plan (field or analytical) for water year
Discuss in detail deviations from the monitoring plan. Include photos as necessary.

Discussion
Describe and discuss significant and predicted changes in water quantity and quality. Consider short-term changes, long-term changes, and developing trends in water quantity and quality. Discuss trends in the measured data that suggest potential impacts to or recovery of streams on or off of the permit. Include tables and graphs as needed. For water quality parameters from perennial and intermittent stream reaches with a DEQ-7 aquatic life limit, compare the measured value to the limit and highlight or list samples which exceed the limit. For the purposes of AHR reporting, water quality criteria (standards) given in DEQ-7 are used solely for screening-level analysis of monitored analytical parameters. An exceedance of a DEQ-7 standard does not, in itself, necessarily constitute a standard or permit violation. All stream water quality sampling sites are identified as being on a perennial, intermittent, or ephemeral stream reach in the MQAP.

3.4. Ponds

Data Description
Include a general description of sites (number and distribution) and the monitoring plan (refer to maps and data in appropriate appendices).

Deviations from monitoring plan (field or analytical) for water year
Discuss in detail deviations from the monitoring plan. Include photos as necessary.

Discussion

Describe and discuss significant and predicted changes in water quantity and quality. Consider short-term changes, long-term changes, and developing trends in water quantity and quality. Discuss trends in the measured data that suggest potential impacts or recovery to ponds on or off of the permit. Include tables and graphs as needed. Note ponds that had changes to their as-built specifications or that required maintenance. Describe general usage of ponds through the year (water routing, pumping).

3.5. Groundwater

Data Description

Include a general description of sites (number and distribution) and the monitoring plan (refer to maps and data in appropriate appendices).

Deviations from monitoring plan (field or analytical) for water year

Discuss in detail deviations from the monitoring plan. Include photos as necessary.

Discussion

Describe and discuss significant observed and potential changes in water quantity and quality. Consider short-term changes, long-term changes, and developing trends in water quantity and quality. Discuss trends in the measured data that suggest potential impacts to or recovery of groundwater on or off of the permit. Include tables and graphs as needed. Hydrographs showing significant changes in water level are useful, but hydrographs for every monitored well are discouraged by the Department. For water quality parameters with a DEQ-7 human health limit, compare the measured value to the limit and highlight or list samples which exceed the limit. For the purposes of AHR reporting, water quality criteria (standards) given in DEQ-7 are used solely for screening-level analysis of monitored analytical parameters. An exceedance of a DEQ-7 standard does not, in itself, necessarily constitute a standard or permit violation.

Appendices

Submit tables as PDFs and electronic data deliverables (Excel files) unless otherwise specified.

Data deliverables should include only data collected over the previous water year (October through September), unless otherwise specified. A cumulative database or complete record of all hydrologic data should be kept by mine operators and be available upon request. Use the Excel templates developed by DEQ for all data tables. Template spreadsheets have an Information tab worksheet that explains how to fill out the spreadsheet. Careful attention to these instructions will facilitate template use. Data not in the required format will not be accepted.

General guidelines for all electronic data include:

- Do not use borders, colored text, highlighted cells, or other special formatting features.
- Maintain a consistent data type in each spreadsheet column. For instance, columns with numeric data should only contain numeric data. Do not mix numeric data with text in a column or an individual cell.
- Include summary rows or columns ONLY if required in the Excel template.
- Report data in the units specified for each column.
- When pick-lists are provided, choose from the designated options. If a description is needed that is not provided by the pick-list, contact the Department to request that a new description be added to the list.

Appendix A: Climate

Climate data summarizes measurements taken from mine operated meteorological stations or nearby National Weather Service stations. Report the highest resolution collected at the station. For instance, if a station only records daily temperature, hourly temperature data is not required.

Include the following tables as a PDF and an electronic data deliverable:

- Temperature summary
  Hourly and daily temperature is summarized in the "**climatedata.xlsx/Temperature Summary**" worksheet for each climate station that records continuous temperature readings. Rename the worksheet tab to include the station name (i.e. the worksheet for station M1 would be called "M1 Temperature Summary"). Add more worksheets as needed for additional climate stations.

- Precipitation summary
  Hourly and daily precipitation is summarized in the "**climatedata.xlsx/Precipitation Summary**" worksheet for each climate station that records continuous precipitation readings. Rename the worksheet to include the station name (i.e. the worksheet for station M1 would be called "M1 Precipitation Summary"). Add more worksheets as needed for additional climate stations.

- Rain gauge readings
  All rain gauge readings that are not continuously recorded are recorded in the "**climatedata.xlsx/Rain Gauges**" worksheet.

Include the following table only as an electronic data deliverable:

- Climate station raw data
  Include a "**climatedata.xlsx/Data Logger**" worksheet for each climate station that records continuously. Any climate station with a "Temperature Summary" or "Precipitation Summary" worksheet must also have a "Data Logger" worksheet and vice versa. Name the worksheet to include the station name (i.e. the worksheet for station M1 would be called "M1 Data Logger").

Example: Temperature Summary Table

Station:	M1																											
Temperature Units:	F																											
DATE	HOUR																								Avg	Low	High	Comments
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
10/1/2010	35	35	35	35	36	36	36	36	37			37	37	37	38	38	39	40	39	39	38	37	36	36	37	35	40	Battery died at 9:00; running at 11:00
10/2/2010	35	35	35	36	36	36	36	37	38	39	40	40	41	42	43	44	44	44	42	40	37	32	31	29	38	29	44	
10/3/2010	28	27	25	23	22	21	21	23	25	26	27	27	28	28	29	30	31	31	30	29	28	27	27	26	27	21	31	
10/4/2010	25	24	23	23	23	22	21	18	19	25	27	28	29	30	36	40	41	42	40	39	38	37	37	36	30	18	42	
10/5/2010	50	48	49	49	48	46	45	49	53	57	61	66	73	76	80	82	79	69	68	62	60	57	56	54	60	45	82	
10/6/2010	54	49	49	46	47	47	44	49	53	59	65	68	72	76	81	79	73	74	67	68	67	65	63	56	61	44	81	
10/7/2010	53	54	55	51	47	50	53	54	57	63	66	69	74	77	76	77	67	62	59	59	59	58	59	57	61	47	77	
10/8/2010	42	38	39	37	37	37	38	39	39	39	39	40	39	39	39	39	40	41	42	43	45	46	46	46	40	37	46	
10/9/2010	53	52	52	49	47	48	45	45	44	45	45	45	46	45	43	43	43	45	45	45	45	44	43	45	46	43	53	
10/10/2010	54	54	45	46	44	46	44	49	52	59	66	67	67	68	69	68	68	65	62	60	58	57	54	52	57	44	69	
10/11/2010	51	52	56	54	50	51	50	52	52	53	54	55	57	57	56	55	52	47	45	45	44	44	41	43	51	41	57	

climatedata.xlsx/Temperature Summary

Example: Precipitation Summary Table

Station:	M1																									
Precip units:	in																									
DATE	HOUR																							Total	Comments	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
10/1/2010	0	0	0	0	0	0	0	0			0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	Battery died at 9:00; running at 11:00
10/2/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.1	0.5	0.2	0.02	0.01	0	0	0	0	0	0.84	
10/3/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/4/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/5/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/6/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/7/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/8/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/9/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/10/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10/11/2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

climatedata.xlsx/Precipitation Summary

Example: Rain Gauge Readings Table

Site ID	Date	Precipitation (in)	Comments
RG-1	10/5/2010	1.2	
RG-2	10/5/2010	1.8	
RG-1	11/6/2010	0.2	
RG-2	11/6/2010	0.3	
RG-1	12/10/2010	0.1	
RG-2	12/10/2010	0.1	
RG-1	1/3/2011	1.4	
RG-2	1/3/2011	2.8	Localized downpour near RG-2 on 1/1/11
RG-1	2/6/2011	0.1	
RG-2	2/6/2011	0.1	

climatedata.xlsx/Rain Gauges

Appendix B: Field Measurements

Field measurement tables are used to track all visits to hydrologic monitoring sites with the exception of crest gauge readings, auto-sampler / sediment sampler water quality samples, and continuously monitored stations which are recorded in separate tables. The tables record groundwater levels, groundwater quality field parameters, surface water instantaneous depth and flow, and surface water quality field parameters.

Each time a site is visited, a corresponding entry in the appropriate field parameter table is made, whether or not field data was collected. For instance, an entry for site visit to a dry stream would record the date, site, and observed site conditions. A visit to an inaccessible site would record the date, site, and a comment describing while the site could not be accessed. All water quality samples must have an accompanying water quantity measurement.

Include the following tables as a PDF and an electronic data deliverable:

- Spring instantaneous flow measurements and water quality field parameters
  Spring instantaneous flow measurements, predominately from staff gauges, and field parameters are recorded in "**fieldparameters.xls/Spring**".

- Stream instantaneous flow measurements and water quality field parameters
  Stream instantaneous flow measurements, predominately from staff gauges, and field parameters are recorded in "**fieldparameters.xls/Stream**".

- Pond depth measurements and water quality field parameters
  Pond instantaneous depth measurements, predominately from staff gauges, and field parameters are recorded in "**fieldparameters.xls/Pond**".

- Groundwater levels and water quality field parameters
  Groundwater levels and field parameters are recorded in "**fieldparameters.xls/Groundwater**"

- MPDES discharge rates and water quality field parameters
  MPDES discharge rates and field parameters are recorded in "**fieldparameters.xls/MPDES**".

Example: Springs Field Parameters Table

Station	Date	Time	Sampler	Sample Type	Sample ID	Status	Water Quantity Measurement Instrumentation	Water Quality Sample Method	Inst. Water Depth (ft)	Inst. Flow Rate (gpm)	pH	Temp (C)	EC (us/cm)	Comments
S1	10/29/2010	10:00	EAH	Routine	S1-102910R	Ponded	Staff Gauge	Grab	1.7	0	7.9	5.4	135	
S1	11/30/2010		EAH			Ponded	Staff Gauge		1.2	0				
S1	12/29/2010		EAH			Ponded	Staff Gauge		0.6	0				
S1	1/18/2011		EAH			Wet			0	0				
S1	1/30/2011		EAH			Frozen			0	0				
S1	2/28/2011		EAH			Frozen			0	0				
S1	3/30/2011		EAH			Dry			0	0				
S1	4/30/2011		EAH			Wet			0	0				
S1	5/8/2011		EAH			Flowing, measurable	Staff Gauge		2.3	10.8				
S1	5/29/2011		EAH			Dry			0	0				
S1	6/27/2011	10:59	EAH	Routine	S1-062711R	Flowing, measurable	Other	Grab		6.4	7.2	6.9	328	Staff gauge damaged; no water height
S1	7/28/2011		EAH			Dry			0	0				
S1	8/30/2011		EAH			Dry			0	0				
S1	9/30/2011		EAH			Ponded	Staff Gauge		0.6	0				

fieldparameters.xls/Spring

Example: Streams Field Parameters Table

Station	Date	Time	Sampler	Sample Type	Sample ID	Status	Water Quantity Measurement Instrumentation	Water Quality Sample Method	Inst. Water Depth (ft)	Inst. Flow Rate (gpm)	pH	Temp (C)	EC (us/ cm)	Comments
St-1	10/30/2010	14:23	EAH			Wet			0	0				Siphon Sampler bottle collected
St-1	11/30/2010		EAH			Dry			0	0				
St-1	12/29/2010		EAH			Dry			0	0				
St-1	1/18/2011	11:21	EAH	Routine	St1-011811G	Flowing, measurable	Staff Gauge	Grab	0.42	2.1	7.5	4.2	214	Special sampling after 1 in rainfall on 1/17/11
St-1	1/30/2011		EAH			Dry				0				
St-1	2/28/2011		EAH			Flowing, measurable	Staff Gauge		0.3	1.8				
St-1	3/30/2011		EAH			Flowing, measurable	Staff Gauge		0.25	1.3				
St-1	4/30/2011	8:54	EAH			Flowing, measurable	Staff Gauge		0.68	3.8				Did not have sample bottle on hand. Will revisit site and collect single-stage sample
St-1	5/8/2011	8:54	EAH			Dry			0	0				Dry in April until 4/28/11 Siphon Sampler bottle collected
St-1	5/29/2011		EAH			Dry			0	0				
St-1	6/30/2011	10:00	EAH			Dry			0	0				
St-1	7/28/2011		EAH			Dry			0	0				
St-1	8/30/2011		EAH			Dry			0	0				
St-1	9/30/2011		EAH			Dry			0	0				

fieldparameters.xls/Stream

Example: Ponds Field Parameters Table

Station	Date	Time	Sampler	Sample Type	Sample ID	Status	Water Quantity Measurement Instrumentation	Water Quality Sample Method	Pond Water Level (ft)	pH	Temp (C)	EC (uS/cm)	Comments
PO1	10/5/2010	15:43	EAH			Ponded	Staff Gauge		1.5				
PO1	3/15/2011	14:38	EAH			Frozen	Staff Gauge		8.6				
PO1	5/14/2011	14:49	EAH			Ponded	Staff Gauge		8.7				
PO1	8/21/2011	18:27	EAH			Ponded	Staff Gauge		4.1				
PO2	10/5/2010	7:39	EAH			Dry	Staff Gauge		0				
PO2	3/15/2011	11:27	EAH			Dry	Staff Gauge		0				
PO2	5/14/2011	16:54	EAH			Dry	Staff Gauge		0				
PO2	8/21/2011	20:01	EAH			Dry	Staff Gauge		0				

fieldparameters.xls/Pond

Example: Groundwater Field Parameters Table

Station	Date	Time	Sampler	Sample Type	Sample ID	Water Quality Sample Method	Purged Volume (gal)	MP Elevation (ft)	Depth to Water (ft)	SWL Elevation (ft)	Dry Well	pH	Temp (C)	EC (uS/cm)	Comments
A1	10/5/2010	13:30	EAH												Site inaccessible. Will try again within the month.
A1	10/20/2010	10:00	EAH	Routine	A1-102010R	Bailed	20	3050	17.3	3032.7	No	7.1	5.1	1003	
A1	3/15/2011	16:14	EAH					3050	16.18	3033.8	No				
A1	5/14/2011	8:07	EAH	Field Duplicate	A1-051411D	Bailed									
A1	5/14/2011	8:07	EAH	Routine	A1-051411R	Bailed	25	3050	13.25	3036.8	No	6.9	10.7	1275	
A1	8/21/2011		EAH								No				Not measured because of gas in the well
A2	10/5/2010		EAH					3364.1	125.2	3238.9	No				
A2	10/20/2010	11:05	EAH	Routine	A2-102010R	Bailed	30	3364.1	153.7	3210.4	No	7.4	23.4	365	

fieldparameters.xls/Groundwater

Example: MPDES Field Parameters Table

Station	Date	Time	Sampler	Reason for Discharge	Water Quantity Measurement Instrumentation	Water Quality Sample Method	Sample Type	Sample ID	Flow Rate (mgd)	pH	Temp (C)	Dissolved Oxygen (mg/L)	EC (uS/cm)	Comments
Outfall 017	2/1/2011		EAH	Dry weather	Flow Meter	Single-stage sampler	Routine	Outfall017-1	2.24	8.3	38.0		1050	
Outfall 017	3/2/2011		EAH	Wet weather, <= 10yr/24hr	Flow Meter	Single-stage sampler			1.38	8.2	44.2		1266	
Outfall 017	4/1/2011		EAH	Dry weather	Flow Meter	Grab			2.07	7.9	49.1		1089	
Outfall 002	6/15/2011		EAH	Dry weather	Staff Gauge	Grab			0.88	8.0	64.4		1174	

fieldparameters.xls/MPDES

Appendix C: Auto-Samplers for Water Quality

Auto-samplers encompass a large range of devices used to automatically collect surface water quality samples during flow events. These devices include siphon samplers, single-stage samplers, and automated pump samplers. Since these devices are fixed at a certain height above the stream channel, the exact height of the flow that filled the bottle is known. The flow rate can be extrapolated from rating curves or from correlation with the height and flow measured at a coincidently located flume or weir.

Because the water samples sit for an unknown amount of time in the bottle, the holding times and temperatures required for most analytes cannot be met by these types of devices. Consequently, auto-samplers should only be used for Total Suspended Solids (TSS) measurements and are meant as a supplement to and not a substitution for grab samples.

Include the following tables as a PDF and an electronic data deliverable:

- Spring auto-sampler bottles
  Spring auto-sampler bottle retrievals are recorded in "**autosamplers.xls/Spring**".

- Stream auto-sampler bottles
  Stream auto-sampler bottle retrievals are recorded in "**autosamplers.xls/Stream**".

- Pond auto-sampler bottles
  Pond auto-sampler bottle retrievals are recorded in "**autosamplers.xls/Pond**".

- MPDES auto-sampler bottles
  MPDES auto-sampler bottle retrievals are recorded in "**autosamplers.xls/MPDES**".

Example: Stream Auto-Sampler Table

Station	Date	Time	Sampler	Sample ID	Water Quality Sample Method	Estimated Min. Date of Sample	Estimated Max. Date of Sample	Inst. Water Depth (ft)	Inst. Flow Rate (gpm)	Comments
St-1	10/30/2010	14:23	EAH	St1-103010SSR	Single-stage sampler	9/1/2010	10/30/2010	0.5	2.3	
St-1	5/8/2011	8:54	EAH	St1-050811SSR	Single-stage sampler	4/28/2011	4/30/2011	0.5	2.3	Dry in April until 4/28/11
St-11	10/30/2010	13:04	EAH	St11-103010SSR	Single-stage sampler	9/1/2010	10/30/2010	1.5	20.9	
St-11	6/30/2011	9:21	EAH	St11-063011SSR	Single-stage sampler	6/1/2011	6/29/2011	1.5	20.9	

autosamplers.xlsx/Streams

Example: MPDES Auto-Sampler Table

Station	Date	Time	Sampler	Sample ID	Inst. Water Depth (ft)	Inst. Flow Rate (gpm)	Comments
Outfall 017	2/1/2011		EAH	Outfall017-1	1	265	
Outfall 017	3/2/2011		EAH	Outfall017-2	1	265	

autosamplers.xlsx/MPDES

Appendix D: Continuously Monitored Stations

Continuously monitored stations record time-series data. Most sites record water depth which can be converted into water velocity for surface water sites. Both surface and groundwater sites with continuous recorders are included in the appendix. In the table templates provided, fill in only the pertinent columns for each site.

Continuously monitored stations have data delivery requirements similar to the meteorological data; both the full recorded data sets and summary tables are required.

Include the following tables as a PDF and an electronic data deliverable:

- Continuous recorder summary tables

  Use the "**continuous_recorder_flows.xlsx/Flow Summary**" worksheet for each continuously monitored station. Rename the worksheet to include the station name (i.e. the worksheet for station St-11 would be called "St-11 Flow Summary"). Group all continuous recorder worksheets into a single appendix.

Include the following table only as an electronic data deliverable:

- Data logger download and calculations
  Use the "**continuous_recorder_flows.xlsx/Data Logger**" worksheet for each continuously monitored digital station. Any station with a "Flow Summary" worksheet must also have a "Data Logger" worksheet and vice versa. Rename the worksheet to include the station name (i.e. the worksheet for station St-1 would be called "St-1 Data Logger").

  For continuously monitored stations that record analog data on paper, submit a scanned copy of the recorder's log along with the "Flow Summary" worksheet.

Appendix E: Crest Gauge Readings

Each time a crest gauge site is required to be sampled by the monitoring plan, there should be a corresponding entry in the crest gauge spreadsheet whether or not data was collected during that visit.

- Spring crest gauge readings
  Crest gauge readings from springs are recorded in the "**crestgauges.xlsx/Spring**" worksheet.

- Stream crest gauge readings
  Crest gauge readings from streams are recorded in the "**crestgauges.xlsx/Stream**" worksheet.

- Pond crest gauge readings
  Crest gauge readings from ponds are recorded in the "**crestgauges.xlsx/Pond**" worksheet.

Example: Stream Crest Gauge Table

Station	Date	Time	Sampler	Estimated Min. Date of Event	Estimated Max. Date of Event	Max. Depth (ft)	Max. Flow (gpm)	Comments
St-1	10/13/2010		EAH					No Mark
St-1	1/18/2011		EAH	1/16/2011	1/18/2011	1.4	10.5	Checked after large rain event
St-1	11/15/2010		EAH					No Mark
St-1	12/9/2010		EAH					No Mark
St-1	1/15/2011		EAH					1 in snow in channel; no mark
St-1	2/14/2011		EAH					4 in snow in channel; no mark
St-1	3/13/2011		EAH	3/13/2011	3/13/2011	0.5	11.6	
St-1	4/13/2011		EAH					No Mark
St-1	5/16/2011		EAH					No Mark
St-1	5/18/2011		EAH					No Mark
St-1	6/15/2011		EAH					No Mark

crestgauges.xlsx/Stream

Example: Spring Crest Gauge Table

Station	Date	Time	Sampler	Estimated Min. Date of Event	Estimated Max. Date of Event	Max. Depth (ft)	Max. Flow (gpm)	Comments
S2	10/28/2010	10:12	EAH	10/1/2010	10/28/2010	0.5	3.6	
S2	6/27/2011	13:45	EAH	6/1/2011	6/5/2011	1.2	10.5	No precip after 6/1/11; other streams dry after 6/5/11

crestgauges.xlsx/Spring

Example: Pond Crest Gauge Table

Station	Date	Time	Sampler	Estimated Min. Date of Water Height	Estimated Max Date of Water Height	Pond Water Level (ft)	Comments
PO1	10/5/2010	15:43	EAH	10/1/2010	10/5/2010	1.8	
PO1	3/15/2011	14:38	EAH	2/2/2011	3/14/2011	8.6	
PO1	5/14/2011	14:49	EAH	5/6/2011	5/14/2011	8.9	
PO1	8/21/2011	18:27	EAH	8/1/2011	8/10/2011	4.5	
PO2	10/5/2010	7:39	EAH	10/1/2010	10/5/2010	1.5	
PO2	3/15/2011	11:27	EAH	2/2/2011	3/14/2011	1.4	
PO2	5/14/2011	16:54	EAH	5/6/2011	5/14/2011	1.9	

crestgauges.xlsx/Pond

Appendix F: Equations and Rating Curves

Include a PDF showing all equations and site-specific constants used to calculate flow at the monitored surface water sites. Also include any relevant rating curves. Include date of last calibration for each site

and show the results of any calibration tests. For example, if a site uses a rating curve which is also occasionally checked with a flow meter, show both the rating curve and the comparison of the flow meter to the predicted flow.

Appendix G: Laboratory Water Quality Results

Laboratory water quality analysis results for all samples (scheduled samples, unscheduled or additional sampling, and MPDES samples) should be submitted to the Department in two forms: 1) PDFs of laboratory-generated analytical reports/lab sheets; 2) Excel spreadsheet of water quality analyses.

Include the following only as a PDF:

- Laboratory summary reports
  Laboratories produce a report for each sample analyzed by the laboratory. The report includes statistics on sample and batch quality. Attach the full reports for all water quality samples in this appendix.

Include the following table only as an electronic data deliverable:

- Laboratory water quality results
  Use the Excel template shown in "**labWQ.xls/WQ**". Submit this template to the laboratory as a download format. The laboratory will populate all fields except the DEQ Qualifier column. This column is left blank and populated by DEQ staff after review of the AHR and QASR for internal use.

Appendix H: Pond Inspection Report

As part of the new formats for both the Annual Mine Report and Annual Hydrology Report, pond inspection reports are now included in the Annual Hydrology Report. The Department has developed a standard pond report with defined terms to describe site conditions. Include all pond inspection tables as a PDF and as an electronic data deliverable.

The pond inspection report consists of:

- Coversheet with PE stamp
- Quarterly pond inspection report
  Use "**pondcertification.xlsx/pond_inspection**" for all ponds. Any observed site condition other than "not applicable" or no evidence of the condition" requires additional commentary. The inclusion of photos documenting site conditions and site maintenance or repair is encouraged.
- Pond storage calculations

Use "**pondcertification.xlsx/pond_storage**" for all ponds. The Information tab on in the **pondcertification** spreadsheet gives detailed information on how to fill out the storage calculations.

Example: Pond Inspection Table

Pond ID		1	1	1	1	2	2	2	2
Date of Inspection		12/14/2010	3/16/2011	6/14/2011	9/20/2011	12/14/2010	3/16/2011	6/14/2011	9/20/2011
Embankment Slope	Sloughing or sliding	No	No	Yes	IC	No	No	No	No
	Subsidence	No	No	No	No	No	No	No	No
	Erosion	No	No	No	No	No	No	No	No
	Seepage areas	Yes	Yes	No	No	No	No	No	No
	Rating of vegetative cover (Rate P, G, E)	P	P	P	G	E	E	E	E
Upstream Channel	Erosion	No	No	No	No	No	No	No	No
	Obstruction of flow	No	No	No	No	No	No	No	No
	Rating of riprap (Rate P, G, E)	NA	NA	NA	NA	NA	NA	NA	NA
	Rating of vegetative cover (Rate P, G, E)	E	E	E	E	E	E	E	E
Below Outlet	Erosion	No	No	No	No	No	No	No	No
	Seepage areas	No	No	No	No	No	No	No	No
	Changes in vegetation	No	No	No	No	No	No	No	No
	Obstruction of flow	No	No	No	No	No	No	No	No
Concrete Channel	Cracking or seepage	No	No	No	No	No	No	No	No
	Vertical - horizontal tilting	No	No	No	No	No	No	No	No
	Undermining	No	No	No	No	No	No	No	No
	Irregularities	No	No	No	No	No	No	No	No
Inlets & Pipes	Clogging	NA	NA	NA	NA	NA	NA	NA	NA
	Corrosion	NA	NA	NA	NA	NA	NA	NA	NA
	Cracking or crushing	NA	NA	NA	NA	NA	NA	NA	NA
	Erosion	NA	NA	NA	NA	NA	NA	NA	NA
Outlet or Principal Spillway	Corrosion	No	No	No	No	No	No	No	No
	Cracking or crushing	No	No	No	No	No	No	No	No
	Clogging	No	No	No	No	No	No	No	No
Emergency Spillway	Corrosion	No	No	No	No	No	No	No	No
	Cracking or crushing	No	No	No	No	No	No	No	No
	Clogging	No	No	No	No	No	No	No	No
Comments		Wet soil below embankment; no hazard yet	Wet soil below embankment; no hazard yet	Embankment face caved in; DEQ notified 6/16/11	Fixed embankment and reseeded. Good vegetation growth				

pondcertification.xlsx/pond_inspection

Example: Pond Storage Table

Pond ID	Date of Survey	Current Water Elevation (ft)	Est. Current Water Volume (ac-ft)	Est. Sediment Volume (ac-ft)	Pond Requires Pumping (yes/no)	Pond Requires Cleanout (yes/no)	Notes	Required Runoff Storage (ac-ft)	Required Sediment Storage (ac-ft)	Required Total Storage (ac-ft)	60% of Required Sediment Storage (ac-ft)	As-Built Total Storage (ac-ft)	Supplemental Storage (ac-ft)	Max. Sediment Volume Before Cleanout (ac-ft)	Elevation of Primary Spillway (ft)
1	3/11/2011	3496.0	16.70	2.99	no	no		42.00	63.35	105.35	38.01	105	-0.35	37.66	3500
2	3/12/2011	3809.0	4.50	3.50	no	yes		12.98	4.72	17.7	2.832	18.11	0.41	3.242	3510
7	3/15/2011		0.00	0.29	no	no		3.15	1.13	4.28	0.678	9.97	5.69	6.368	3490

pondcertification.xlsx/pond_storage

Appendix I: Site Visit Forms

Attach PDFs of all site visit forms used during field data collection. Copies of forms or field notes are both acceptable. Photos of anomalous site conditions or changes to the site or instrumentation that could be useful in documenting site conditions are encouraged and should be attached to the pertinent site visit documentation.

Appendix J: Quality Assurance Summary Report (QASR)

The quality assurance summary report serves to document an analysis by the mine of data quality indicators, performance criteria, and corrective actions.

Refer to the accompanying QASR guideline for writing the quality assurance summary report. Attach the report as a PDF to the Annual Hydrology Report. Unless otherwise noted, table and data used to create the report do not need to be delivered electronically in addition to being included in the PDF.

Appendix K: Maps

Maps are subject to Department standards (ARM 17.24.305). Refer to the Submittal Guidelines for a complete list of requirements. Maps are submitted as PDFs and as CAD or GIS layers.

CAD/GIS Data

The following spatial features must accompany the Annual Report submittal in CAD or GIS format:

- Potentiometric contours (Line)

Potentiometric Map

Include a potentiometric surface map for each monitored aquifer. The maps should be updated with new data every 2 years, at a minimum, unless water level response has changed significantly over the past year, in which case a new map should be submitted.

Layers: The following list contains examples of features to be included on the Potentiometric Map.

- Groundwater monitoring wells for the aquifer
- Potentiometric contours (10 ft interval)
- Permit boundary
- Mined out area
- Currently active pit locations

Hydrologic Monitoring Sites Map

The Hydrologic Monitoring Sites map should show all current hydrologic monitoring locations and is a copy of the map required by Section 2.2, Surface and Groundwater Monitoring Design, in the MQAP. Both surface water and groundwater sites should be included. Label all sites with the monitoring station name.

Background: As-built topo (minimum 10' Contours with labels) or most current aerial photograph

Layers:

- Groundwater monitoring site name and location
    - The map should identify the aquifer being sampled at each station. Some wells may have the aquifer identified in their name. If a well name does not identify the aquifer, use colors, symbols, or additional annotation to designate the monitored aquifer(s).
- Springs monitoring site locations
- Streams monitoring site locations
- Ponds monitoring site locations
- MPDES discharge locations
- Permit boundary
- Current streams and major tributaries
    - Label all streams
- Ponds and impoundments
    - Label all ponds

Attachments

Attachment A: Monitoring and Quality Assurance Plan (MQAP)

The MQAP, which includes the monitoring plan and schedule, will be placed into the permit for all mines. A PDF copy of the MQAP approved as of the start of the monitoring period (Oct. 1st of the water year) is attached to the Annual Hydrology Report to document the plan used for the reported monitoring period. Approved changes to the MQAP that occurred during the water year are listed in the Narrative section (under Approved changes to the MQAP) of the Annual Hydrology Report.

For further information on the Monitoring and Quality Assurance plan, refer to the MQAP format guidelines.