STATEMENT OF BASIS
For Proposed Permit Limits (New Permit)

PERMITTEE:	Powder River Gas, LLC
PERMIT NO.:	MT-0030660
RECEIVING WATERS:	Tongue River
FACILITY INFORMATION:	Coal Creek Federal CBNG Development Unit
MAILING ADDRESS:	850 Val Vista Sheridan, WY 82801
CONTACT:	Casey Osborn, Operations Manager
PHONE:	(307) 673-1500

FEE INFORMATION

Type:	Privately Owned Treatment Works, Minor
Number of Outfalls:	2, Flow Based (For fee determination only)
Outfall Type:	001 (process wastewater)
Application Fee:	$5,000
Annual Fee (Max):	$2,000

I. PERMIT STATUS

Powder River Gas, LLC (PRG) of Sheridan Wyoming submitted an application to discharge under the Montana Pollutant Discharge Elimination System (MPDES) on August 18, 2003. Additional material was received on September 5, 2003 and the application was determined to be complete on September 15, 2003. In response to a preliminary draft statement of basis prepared by the Department in December 2003, PRG revised the application February 5, 2004 and submitted supplemental information of February 5, February 16 (2 documents), and February 25, 2004. The Department sought clarification of this material on March 4, 2004 and PRG submitted a response to this notice on March 4. The amended application was complete on April 4, 2004.

The application lists PRG as the owner and operator of the Coal Creek Federal Coalbed Natural Gas Development Unit and associated treatment facility. The source is considered a new discharger under Administrative Rules of Montana (ARM) 17.30.1304(36) and a new source under the Montana Nondegradation rules. It is not a new source pursuant to ARM 17.30.1340.

II. FACILITY INFORMATION

a. Facility Description

The proposed Coal Creek Federal project is located approximately 10 miles north of Decker, Montana in Bighorn County. The project area lies on the west side of the Tongue River approximately two miles north of the Tongue River Reservoir dam in Township 8 South, Range 41 East, Sections 6 and 7.

A total of nine (9) well locations are proposed in this project. At each of the well locations, two (2) wells will be drilled, one to the Flowers-Goodale and one to the Wall coal formation, for a total of 18 wells for the project. Well locations will be on 80-acre spacing units. Initial maximum discharge rates for the proposed 18 wells are expected to be 25 gallons per minute (gpm) per well. Total initial production for the 18 wells will be 450 gpm or 648,000 gallons per day (gpd). An additional 28 wells are proposed for full development of the project for a total of 46 wells. The total discharge rate for all 46 wells would be 2.56 cubic feet per second (cfs).

PRG proposes to treat produced water utilizing the EMIT Water Discharge Technology based on the Higgins Loop ^{tm} ion-exchange method prior to discharge to the Tongue River. A strong acid cation exchange resin (R) is used to scavenge the cations from the water as it is passed through the Higgins Loop ^{tm}. The cations are replaced by hydronium ions (H_3O^+) from the resin beads. The hydronium ions are released into the treated water, which lowers the pH of the water. This will allow the bicarbonate ions in the water to react with the hydronium ions to form carbon dioxide gas. The treated water is then discharged to a neutralizing bed where excess hydronium ions and residual bicarbonate ions can react with selected limestone to achieve the desired pH.

Concurrent with the sodium and other cation loading that is taking place in the absorber section of the Loop, cations are stripped from the resin in the regeneration section. Dilute hydrochloric acid is injected into the Loop and moves counter-current to the resin to the spent brine discharge, leaving the resin restored to the hydronium form. Concentrated brine volumes average approximately 1.0% of the total Loop feed volume, depending on the degree of cation loading that is removed from the treated water. Brine may be beneficially reused or discharged at a permitted underground injection site.

The proposed treatment system will occupy a 200’ x 200’ area. In addition to the treatment facility, a small (1.28 acre-foot) lined total containment pond will be constructed to allow suspended solids to settle out of the treated effluent prior to discharge into the Tongue River. All chemical containment facilities will be surrounded by a shallow spill containment berm.

PRG proposes to discharge the effluent to the Tongue River from a 10” diameter high density poly-ethylene (HDPE) pipe, which will have an energy dissipation device installed on the end of the pipe in order to decrease the hydraulic energy associated with discharge activity.

b. Effluent Characteristics

The applicant provided an estimate of the pollutant concentrations expected to be present in treated wastewater as required by ARM 17.30.1322(8). The effluent is a by-product of the gas extract process and is therefore considered process wastewater (industrial wastes) (40 CFR 401.11(m); ARM 17.30.1344). The primary parameters of concern (POC) are elevated sodium and incidental metals such as arsenic, selenium, and zinc, ammonia, nutrients (nitrogen and phosphorous) and organic constituents present in the coal formation. These POC and several other constituents are summarized in Appendix II. Without treatment the sodium adsorption ratio (SAR) ranges between 50 and 60. The primary objective in treating the wastewater is the removal of sodium in order to reduce the SAR levels. Electrical conductivity (EC) is also slightly elevated but does not exceed the standard for this parameter.

PRG provided an estimate of effluent quality in the original application and in supplemental material submitted February 5, February 16 and March 4, 2004. The effluent data is based on a composite of samples of untreated ground water from the target formations and treated effluent from a similar (EMIT Water Discharge Technology) treatment unit operating in Wyoming. No data is available to estimate operational characteristics, such as long-term average, daily maxima, and coefficients of variation, for effluent limits development. The permittee will be required to monitor for parameters of concern, in addition to the compliance monitoring requirements in order to further characterize the effluent in the first two years of the permit cycle [ARM 17.30.1322(10)(e)(i), (ii) and (iii), see Section VII – Monitoring Requirements].

The treatment technology is capable of removing sodium to less than 0.5 mg/L resulting in an SAR of 0.1 or less. However, PRG proposes to treat a portion of the effluent and blend it with untreated CBM water to meet Montana water quality standards for EC and SAR prior to discharge into the Tongue River. These standards vary by season and are discussed in the next section. PRG (3/4/04) has proposed the following level of treatment for EC and SAR:

	SAR	Sodium	Calcium	Magnesium	EC
Nov 1 – March 2	5	131	51	<1	<1000
March 2 – Oct 31	3	87	60	<1	<850

III. TECHNOLOGY-BASED EFFLUENT LIMITS

The Montana Board of Environmental Review has adopted performance standards for point source discharges to state waters, Title 17, Chapter 30, Subchapter 12. The Board has adopted by reference 40 CFR Subpart N which is a series of federal agency rules which adopt technology based effluent limitations for existing sources and performance standards for new sources (ARM 17.30.1207(1)). National Effluent Limit Guidelines (ELG) have not been promulgated under Subchapter N for produced water discharges from coalbed methane wells.

In addition to Subchapter 12, the Board has adopted General Treatment Requirements that establish the degree of wastewater treatment required to maintain and restore the quality of state surface

waters (ARM 17.30.635(1)). This rule states that in addition to federal ELG, the degree of wastewater treatment is based on the surface water quality standards; the state's nondegradation policy; the quality and flow of the receiving water; the quantity and quality of sewage, industrial wastes and other wastes to be treated; and the presence or absence of other sources of pollution on the watershed. ARM 17.30.635(4) requires that wastewater disposal systems be designed to protect water quality standards at stream flows equivalent to the minimum 7-day average flow which may be expected to occur on the average of once in ten years. Design conditions are discussed in the next section.

IV. WATER-QUALITY BASED EFFLUENT LIMITS (WQBEL)

a. Receiving Water

The proposed discharge is to the Tongue River at a point located approximately 1 mile below the Tongue River Reservoir as described in the application. The Tongue River in the area of the proposed discharge is classified as "B-2" water according to the Montana Surface Water Use Classification [ARM 17.30.611(1)(c)(vii)]. Waters classified B-2 are to be maintained suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. Discharges to B-2 waters must comply with the specific water quality standards in ARM 17.30.624, as well as numeric water quality standards in Department Circular WQB-7 (DEQ). The Tongue River is considered high quality water pursuant to Montana's Nondegradation Policy and degradation of high quality water is not allowed unless authorized by the Department under 75-5-303(3), MCA.

The Tongue River is in the Upper Tongue watershed and the Hydrologic Unit Code is 10090101 and the water body number is MT42B001-2. The Tongue River in the location of the proposed discharge is listed as impaired for aquatic life support, and cold-water fishery for trout on the 1996 303(d) list. The probable cause is flow alteration. The probable sources are agriculture, flow regulation and/or modification and irrigated crop production. The Tongue River in the location of the proposed discharge has been removed from the 2000 and 2002 303(d) lists based on reassessment of the water quality.

Flow in the receiving water at the point of discharge is regulated by the Tongue River dam, which is owned by the Montana Department of Natural Resources and Conservation (DNRC). The dam is operated and maintained by the Tongue River Water Users Association (TRWUA) for the purpose of fulfilling water use contracts to all downstream users. In 1978, a flood damaged the spillway resulting in conservative operation of the reservoir until 1999 when the spillway and other improvements were made to the dam. The improvements at the dam included raising the height of the embankment by 4 feet to increase the storage capacity. Water is released from the reservoir to satisfy irrigation demand with a minimum of 175 cfs or inflow maintained for fish and wildlife through the winter (DNRC, 1996). According to the Operating Plan for the Tongue River Reservoir, flow may drop below this level for essential maintenance, dam inspections, drought conditions or other emergency purposes. According to recent flow measurements, releases from the reservoir are

routinely below 175 cfs. The minimum observed flow for the last five years at the USGS station has been has been 70 cfs.

Montana water quality standards [ARM 17.30.635(4)], nondegradation [ARM 17.30.715(1)] and mixing zone [ARM 17.30.516(3)(d)] regulations require that effluent limits for discharge permits be based on the 7-day, 10-year low flow (7Q10).

Flow statistics from USGS station 06307500 (Tongue River at Tongue River Dam near Decker, MT) for the period of record (POR) 1939 to 2002 were compiled by USGS to calculate annual and seasonal 7Q10 estimates (Appendix I). However, these estimates were based on historic operating practices at the Tongue River dam and do not reflect current storage capacity and release strategy. The Department reanalyzed the flow data for the more recent period (Lloyd, 2004). ARM 17.30.635(4) states that when flow records are insufficient to calculate a 7Q10, the Department shall use an acceptable stream flow for the design of disposal systems. In this case, the permit limits will be based on the minimum instream flow of 70 cfs based on the current release strategy of the reservoir and observed flow in the Tongue in the previous five-year period. The Department recognizes that, at certain times of the year, flow in the Tongue River may drop below 70 cfs. No additional conditions are necessary in the permit at this time due to the following rationale:

1. PRG proposes to meet the applicable standards for EC and SAR in the treatment unit prior to discharge. Therefore EC and SAR standards will not be exceeded during any flow condition.
2. Limits for other parameters are based on nondegradation criteria (15 percent of standard for toxics) and that periodic, short-term exceedance of nondegradation criteria will not adversely affect beneficial uses.

Little or no baseline recent water chemistry data exists for the Tongue River below the reservoir. For the purpose of developing permit limits, background water quality for the Tongue River was estimated from USGS station 06307500 for the period of record 1995 to current (Appendix III). Water chemistry data was collected at this site from 1975 until 1995 for a variety of parameters. However, only the data from 1995 to present is used to evaluate receiving water quality because earlier data does not reflect recent development in the basin. The baseline water quality used to evaluate the impacts and develop permit limits for the proposed discharge is based on the median where more than one sample is available or on the single June 6, 1995 USGS analysis (Appendix III). The suspended solid concentration for this sample was 98 mg/L and is not considered reflective of water quality at other flow conditions.

Montana's nondegradation rules require that any person proposing an activity that may cause degradation provide an analysis of the receiving water, including natural variation and fluctuations for the parameters which may change as a result of the proposed activity [ARM 17.30.706(4)]. PRG did not submit baseline data in fulfillment of this requirement and adequate baseline data does not exist; therefore, the applicant will be required to collect baseline water quality above the point of discharge for the applicable parameters (Section VII.d).

b. Mixing Zone

The Board has adopted rules granting the issuance of mixing zones in permits pursuant to 75-5-301(4), MCA. The Department may grant a mixing zone for specific parameters subject to water quality based effluent limits pursuant to Title 17, Chapter 30, Subchapter 5. Mixing zones may not be granted for parameters subject to federal effluent limit guidelines. No mixing zone will be granted that will impair beneficial uses [ARM 17.30.506(1)]. Chronic, acute, and human health standards may not be exceeded outside of the mixing zone [ARM 17.30.507(1)(a)]. Acute standards may not be exceeded in any part of the mixing zone [ARM 17.30.507(1)(b)] except under certain conditions and the general prohibitions of ARM 17.30.637(1) apply to state water within the mixing zone. The rule states that the Department will determine what type of a mixing zone is appropriate in issuing a permit based on information submitted by the applicant.

The applicant has not applied for a mixing zone. The proposed treatment units will meet the numeric limitation for EC and SAR prior to discharge to the receiving water. However, after the application was analyzed, it was determined that a number of parameters will exceed the nondegradation criteria in the effluent prior to mixing in the receiving water (pH, temperature, fluoride, aluminum, cadmium, and selenium) or the status is unknown (mercury). In order to meet the criteria for these constituents the applicant will be required to complete a mixing zone analysis prior to issuance of the final permit.

In supplemental information, the applicant has requested that the entire low flow of the Tongue River be used as a mixing zone (Casey Osborn, February 5, 2004). Based on the estimated volume of the discharge (1.6 MGD) and 7Q10 of the receiving water, the dilution ratio is calculated to be 28 (Appendix I). The Department has determined that a standard mixing zone (ARM 17.30.516) is appropriate provided that the applicant demonstrates that the discharge is mixed within 2 river widths, and meets the other criteria of ARM 17.30.506.

Supplemental information submitted by PRG on the outfall structure states that an energy dissipation device would be place on the end of the pipe in order to decrease hydraulic energy associated with the discharge (Water Management Plan, Western Land Services, August, 2003). Because rapid mixing is dependent on initial conditions such as momentum flux, buoyancy and outfall geometry in the near field, the proposed design may inhibit rapid mixing of the effluent.

The Department will grant a standard mixing zone subject to the following conditions:

1. The applicant collects site-specific information as required in ARM 17.30.516(4) and demonstrates through the use of a suitable model (Cormix or Plumes) that the length of the mixing zone is less than two river widths at all flow conditions.
2. The applicant submits updated specific design criteria for the effluent diffuser.
3. The applicant submits a water quality assessment satisfying the criteria of ARM 17.30.506(1) and (2)(a) through (f).

c.) Applicable Water Quality Standards

Montana water quality standards require that no discharge may commence that either alone or in combination with other wastes or activities, will violate, or can reasonable be expected to violate any

water quality standard, including Montana's nondegradation policy (ARM 17.30.637(2)). Water quality-based effluent limits (WQBEL) must be developed for parameters of concern (POC) when there is a "reasonable potential" for the discharge to cause or contribute to an exceedance of water quality standards. A reasonable potential (RP) determination is discussed in the next section.

As a new source, the discharged water must comply with the criteria of ARM 17.30.715 in order for the Department to determine that the resulting change in water quality is nonsignificant under Montana nondegradation Policy [75-5-303, MCA]. These narrative criteria modify the existing numeric water quality standards for point source dischargers in order to protect the assimilative capacity and high quality nature of the receiving water. Montana's Nondegradation policy and implementing regulation establish criteria for determining whether an activity will cause degradation giving greater significance to carcinogens and toxics and lesser significance to less harmful substances [75-5-301(5)(c), MCA]. Pollutant categories are established for regulated parameters in Department Circular WQB-7 (January 2004). Categories and nonsignificance criteria for parameters of concern are summarized in Appendix II and III and discussed below for the parameters of concern.

- *For pollutants classed as carcinogens and for pollutants with a bioconcentration factor greater than 300, no increase in the concentration in the receiving water is allowed (ARM 17.30.715(1)(b)).* Potential carcinogens in effluent include radiological parameters, typically radium 226 and 228, arsenic, beryllium and mercury. At present there is inadequate information to determine the instream concentration of these parameters (Section IV.a). No mixing zone will be allowed for these parameters.

- *For pollutants classed as toxic or nutrients, any increase in concentration in the receiving water that exceeds the trigger values listed in WQB-7 or for toxics, if the resulting concentration is no greater than 15% of the lowest applicable water-quality-based standard or conforms with ARM 17.30.715(1)(g) (nutrients).* Parameters in this category include dissolved oxygen, ammonia, nitrate nitrogen, fluoride, nutrients (total inorganic nitrogen and phosphorus) and several metals (Appendix III). Trigger value increases are based on a change in water quality above background or instream concentration before or upstream of the discharge. There is insufficient data, or no data for many constituents in this category to establish the baseline water quality to measure change. Reasonable potential for all toxic parameters will be based on 15 percent of the applicable standard. For nutrients, the narrative criterion of ARM 17.30.715(1)(g) will be used.

- *For harmful parameters for which water quality standards have been adopted, other than nitrogen, phosphorus, and carcinogenic, bioconcentrating, or toxic parameters, a change is nonsignificant if the increase in concentration in the receiving water outside of the mixing zone is less than 10% of the applicable standard and the existing water quality level is less than 40% of the standard (ARM 17.30.715(1)(f)).* This category includes, temperature, pH, and iron (for aquatic life) listed as harmful in Appendix III. For class B-2 waters, the standard states that a 1 degree F increase above naturally occurring is allowed within the range of 32 to 66 degrees F and any decrease in temperature must be limited to less than two degree F (ARM 17.30.624 (2)(e)). Normal temperature variation in the receiving water varies several degrees during the course of a day due to solar input and other factors. The pH standard for B-2 water limits any

induced variation to 0.5 standards units. pH also varies significantly during the day due to photosynthetic activity, temperature change and other factors. For these reasons nonsignificance determination will be based on the water quality standards for these constituents (pH and temperature). Pursuant to ARM 17.30.717(3), (Section VIII) the Department considers these changes for temperature and pH nonsignificant. For iron, the nonsignificance criterion is 10% of the standard, or 0.1mg/L.

- *For any parameter for which there are only narrative water quality standards (e.g., nutrients), changes in the receiving-water concentration may not have a measurable effect on any existing or anticipated use or cause measurable changes in aquatic life or ecological integrity (ARM 17.30.715(1)(g)).* Narrative standards apply to substances or conditions for which sufficient information does not exist to develop a water quality standard and any other substances that may impair the uses of state waters and include alkalinity, chloride, hardness, sediment, sulfate, total dissolved solids, boron, iron and manganese and nutrients. In order for the Department to determine if these constituents will have a measurable effect on the designated uses of B-2 water, the following criteria will be applied:

Use	Parameter	Criteria, mg/L	Source
Aquatic Life	Suspended Solids	30.	1984 Montana 305(b) Report
Drinking Water	Total Dissolved Solids (TDS) Iron, dissolved Manganese, dissolved	500 0.3 0.05	EPA – Secondary Maximum Contaminate Level EPA-822-B-96-002, Oct, 1996
Agriculture	Boron	0.75	1984 Montana 305(b) Report

The criteria for iron and manganese are based on dissolved measurement in accordance with ARM 17.30.624(1)(h) which states that the concentration of parameters applicable to drinking waters are based on the that portion that remains after conventional treatment. The applicant will be required to monitor chemical oxygen demand (COD), total organic carbon, oil and grease, common ions and nutrients. For these parameters the concentration in the effluent is not believed to be present in sufficient quantity to affect a beneficial use. Monitoring will be required to validate this conclusion.

- *General prohibitions of ARM 17.30.637(1) state that state water must be free from substances attributable to municipal, industrial or agricultural practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsion; (b) create floating debris or scum, or cause a visible oil film (or be present in excess of 10 mg/L); (c) produce odors, colors or other conditions which create a nuisance or render undesirable tastes to fish; (d) create toxic or harmful conditions to human, animal, plant or aquatic life; and (e) create conditions which produce undesirable aquatic life.* These prohibitions apply to all state waters including mixing zones unless specifically modified by the mixing zone, however, limited toxicity in mixing zones may be allowed if a chemical specific limit is adopted in the discharge permit.

d. Reasonable Potential

Water quality-based effluent limits (WQBEL) must be developed for parameters of concern (POC) when there is a "reasonable potential" for the discharge to cause or contribute to an exceedance of water quality standards. In cases were there is adequate data to determine if the POC has a reasonable potential to exceed the applicable water quality standard, a conventional mass balance analysis is employed. Receiving water input parameters are based on estimated background water quality for the Tongue River (Appendix II) and the estimated low flow (70 cfs). Input parameters for effluent are design flow (Q_E) and estimated effluent quality (C_E). Upper bound estimates of effluent quality for most parameters are based on a multiplier of 1.5 that estimates the upper bound of a lognormal distribution.

$$C_{RP} = \frac{C_E Q_E + C_S Q_S}{Q_E + Q_S} \qquad \textit{(eq. 1)}$$

where:
C_{RP} = receiving water concentration (RWC) after mixing, mg/*L*
C_E = effluent concentration, 95-th percentile, Appendix I, mg/*l*
C_S = RWC upstream of discharge, Appendix III, mg/L
Q_R = receiving water design low flow, 7-day, 10-year low flow (70 cfs).
Q_E = effluent design flow (2.5 cfs).
(*See Appendix II for actual values used in calculations for C_{RP}, C_E, C_S*)

Results of this analysis are given in Appendix II. For any POC, if the RWC (C_{RP}) exceeds the applicable nondegradation based water quality standard (C_R, Appendix II), then a WQBEL will be developed in the next section and included in the permit. This analysis indicates that WQBEL are required for the following POC: pH, cadmium and selenium. In addition, monitoring requirement and conditions will be established for several parameters for which insufficient data exists, including radium (radiological), arsenic, and mercury. There is also insufficient information to set limits for nutrients and organic constituents. A WQBEL limit will also be included for total suspended solids, electrical conductivity, measured as specific conductance (SC) and SAR.

e). Proposed Water Quality Based Effluent Limits (WQBEL).

The Department is required to set limitations on the volume, strength and other significant characteristics of the wastes to be discharged in the permit [75-5-402(3), MCA] in order to comply with Montana water quality standards, nondegradation policy and mixing zone requirements. Permit limits must be expressed in terms of mass, except for pollutants such as pH, temperature, radiation or other pollutants [ARM 17.30.1345(8)]. Montana water quality standards state that dischargers issued permits under the MPDES rules may not cause receiving water concentrations to exceed the applicable standards in Department Circular WQB-7 when stream flow exceeds the design flow of the receiving waters (ARM 17.30.624(2)(i)). WQBEL are developed for those parameters that have a reasonable potential to exceed water quality standards. The proposed discharge must also comply with the numeric standards for electric conductivity (EC) and sodium adsorption ratio (SAR) (ARM 17.30.670). In addition, dischargers issued permits must comply with the General Treatment Standards and General Prohibition Rule in ARM 17.30.635 and 637 that are discussed below.

For mass-based constituents based on aquatic life standards, WQBEL are expressed in terms of units of concentration and calculated as a maximum daily limit (MDL) and 30-day or average monthly limit (AML) assuming a lognormal distribution of the effluent (EPA, 1991). Effluent limits for constituents that are based on human health standards are expressed in terms of AML. MDL and AML are statistically derived from the wasteload allocation based on the lognormal distribution and expected monthly sample size. A wasteload allocation (WLA) is calculated using the following formula:

$$WLA = C_D = \frac{C_R(Q_S + Q_D) - (C_S Q_S)}{Q_D} \qquad (eq.\ 2)$$

where:

C_S = mean background concentration, mg/*l*

C_D = allowable discharge concentration, mg/*l*

C_R = in-stream concentration limit for pollutant (from non degradation criteria, Circular WQB-7, or other appropriate water quality standard).

Q_S = $_7Q_{10}$ = 7-day, 10-year, low-flow value for the receiving stream, (70 cfs).

Q_D = design flow of discharge (2.5 cfs).

The MDL and AML are then derived from a standard set of assumptions based on sample frequency and effluent variability (EPA, 1991). In the absence of an approved TMDL the wasteload allocation is assigned to the discharger. The permit contains standard provisions that allow the permit to be reopened if a TMDL is approved and the wasteload allocation is modified due to other sources in the basin.

Equation (2) requires that baseline water quality in the receiving water be known at design conditions (typically 7Q10) for those parameters that have a reasonable potential to exceed water quality standards. As previously stated there is insufficient baseline water quality data to calculate water quality based limits for parameters. Permit limits will be established on a case-by-case basis that are protective of water quality, including nondegradation and will allow the discharge to commence while the permittee collects additional baseline data. For several parameters (mercury, cadmium and selenium), reasonable potential was determined to exist based on detection limits that were not adequate to quantify the effluent or receiving waters at nondegradation levels. The analysis indicates that copper exceeds the nondegradation threshold, however, based on the single 1995 analysis, the receiving water exceeds that chronic water quality standard. The permittee will be required to monitor for this parameter.

Carcinogens and Bioconcentrating Parameters

Mercury. The lowest applicable water quality standard for mercury is 0.05 µg/L based on human health; there is no acute standard for human health. There is insufficient background information to develop a WQBEL based on ambient water quality. Mercury is known to be present in coal but its solubility in water is low, it can be expected in trace levels but should not be detectable in routine sampling. ARM 17.30.715 requires that there be no increase in the concentration of this parameter above background. The permittee will be required to monitor both the upstream ambient water quality and effluent quality to determine if an increase has occurred (Requirement VII.B.1**)**. No mixing zone is allowed for mercury.

Radium. The human health standard for radium is 5 pCi/L in state surface water; there is no acute standard for human health. There is insufficient background information to develop a WQBEL based on ambient water quality. Radium-226 and -228 are the most abundant of several naturally occurring radioactive compounds that may be present in produced water (USDOE, January 2004). They are derived from the radioactive decay of uranium. ARM 17.30.715 requires that there be no increase in the concentration of this parameter above background. The permittee will be required to monitor both the upstream ambient water quality and effluent quality to determine if an increase has occurred (Requirement VII.B.1). No mixing zone is granted for radiological parameters.

Arsenic. The lowest applicable standards for arsenic is 18 µg/L based on human health (WQB-7, January 2004). ARM 17.30.715 requires that there be no increase in the concentration of this parameter above background. There is insufficient background information to develop a WQBEL based on ambient water quality. The permittee will be required to monitoring both the upstream ambient water quality and effluent quality to determine if an increase has occurred (Requirement VII.B.1). No mixing zone is granted for arsenic.

For mercury, radium and arsenic the following WQBEL limit is:

- The concentration of mercury, radium and arsenic in the effluent, prior to mixing with the receiving water shall not exceed the concentration of these parameters in the Tongue River upstream of the point of discharge.

The permittee will be required to conduct monthly sampling for these constituents and review the data on an annual basis. The annual mean of the effluent (Outfall 001) shall not exceed the annual mean concentration of the Tongue River ambient monitoring site. No waste load allocation will be established for these parameters due to the lack of data. The data collected will be used to establish a numeric waste load allocation when the permit is renewed.

Toxic Parameters

Cadmium and Selenium. The AML and MDL for these constituents will be based on compliance with the nondegradation criteria (NDC) in the effluent prior to mixing. The nondegradation criterion is 15% of the applicable standard (acute and chronic aquatic life). No mixing zone is granted for these parameters.

	Chronic WQS	Chronic NDC	Acute WQS	Acute NDC
Cadmium, µg/L	0.36	0.054	3.2	0.48
Selenium, µg/L	5	0.75	20	3

Nutrients

The proposed discharge will exceed trigger values in WQB-7 for nutrients (nitrogen and phosphorus) (ARM 17.30.715(1)(c)). The project increase is 0.012 and 0.003 mg/L for nitrogen and phosphorus, the trigger values are 0.01 and 0.001 mg/L, respectively. Measurable increases in nutrients may result in an increase in algal biomass leading to depletion of oxygen and changes in community composition producing undesirable aquatic growth. Nutrient increases that exceed the trigger level are nonsignificant if the increase does not have a measurable change in community composition or cause a change in aquatic life or ecological integrity (ARM 17.30.715(g)). Because of the lack on adequate baseline on nutrient chemistry and algal community composition and biomass, the permittee will be required to monitoring these conditions to determine if a permit limit is necessary.

Harmful Parameters

pH. The water quality standard for pH is based on change in ambient, or induced variation of 0.5 standard units (ARM 17.30.624((2)(c)). Background data indicates that the pH varies between 7.7 and 8.4 units. The permittee proposes to maintain the pH of the effluent above 6.5 SU. The analysis indicates the resulting pH in the receiving water would be 7.4 SU (EPA WLANH3). The permittee submitted data indicating that in treated effluent and Tongue River water mixed at a dilution ratio of 10:1 does not exceed the acceptable limit (7.7 SU). Based on this analysis, the pH limit on the discharge should not cause unacceptable impacts if the pH of the effluent is maintained between 6.5 to 8.4 SU.

Sediment. ARM 17.30.624(2)(f) states that no increase in sediment or other suspended sediment is allowed that would render the waters harmful or detrimental to fish or other uses. Background concentrations vary between 8 and 98 mg/L. In the absence of numeric criteria the Department has used 30 mg/L as a level that is protective of these uses. No mixing zone will be granted for sediment due to the potential to block passage of fish.

Other Parameters

Specific Conductance and Sodium Adsorption Ratio (SAR). The standard for specific electric conductance (SC) and SAR are based on compliance with the standard in ARM 17.30.670 for the irrigation (March 2 through October 30) and non-irrigation (November 1 thru March 1) seasons. Since these standards will be met prior to mixing with the receiving water, a mixing zone is not granted.

Whole Effluent Toxicity (WET). The general prohibitions (ARM 17.30.637(1)) prohibit acute or chronic toxicity in state water, except chronic toxicity may be allowed when the Department establishes an acceptable limit in the permit and uses are not threatened or impaired (ARM 17.30.505(2) and ARM 17.30.602(16)). Acute toxicity is not allowed in any portion of the mixing zone except for limited circumstance (ARM 17.30.602(16) and 17.30.507(1)(b)). Because the permit contains numeric effluent limits for aquatic life based on nondegradation level (15% of standard), no chronic or acute toxicity is expected for these constituents. Annual chronic and acute toxicity testing will be required to determine if additional constituents are present in the discharge that may cause toxicity.

f. Waste Load Allocation

A waste load allocation establishes the basis for existing source determination under Montana nondegradation policy [75-5-303, MCA], defines a total maximum daily load (TMDL) for the receiving waters and fulfills the requirements of the District Court Order (*Friends of the Wild Swam v. EPA, et al*, CV 97-35-M-DWM, September 21, 2000). The wasteload allocations for total suspended solids, specific conductance, total dissolved solids, SAR and sodium are presented in Appendix VI. There is insufficient information to develop a wasteload allocation for metals and other parameters of concern (arsenic, radiological, organics and nutrients). The permit contains monitoring requirements that will be used to define waste load allocations in future permit renewals, or the development of a basin wide TMDL.

A TMDL must achieve compliance with the applicable water quality standards after mixing of the effluent and include a margin of safety (75-5-703(1), MCA). For mass based parameters, downstream concentrations are determined based on the mass loading equation (eq.1) and converted to pounds per day, as follows:

Load (lbs/day) = Concentration (mg/L) X Flow (cfs) X 5.39

w*here, 5.39 is a conversion factor.*

Because SAR is expressed as a ratio between sodium and the major cations, calcium (Ca) and magnesium (Mg), and load cannot be accurately determined. SAR is determined as follows:

$$\text{SAR} = \frac{[Na]}{\sqrt{([Ca]+[Mg]/2)}} \qquad \text{eq. 3}$$

where, [ ], is the concentration, expressed in milliequivalents per liter (meq/L).

For SAR, the concentrations and loads were calculated using equation (1) for the individual constituents of SAR, that is, calcium, magnesium and sodium and equation (3). The Sodium allocation is based on expected treatment efficiencies provided by the applicant. The amount of sodium and calcium will vary seasonally. The waste load allocation for sodium is based on 87 and 131 mg/L in the irrigation and non-irrigation season, respectively (Appendix IV).

EC was converted to total dissolved solids (TDS) as follows:

TDS (mg/L) = EC (µS/m) x .65

All waste load allocations are expressed as a 30-day average monthly value. Because the permit contains effluent limits for these parameters and a limit on flow, load limits in the permit are not necessary. This waste load allocation will be submitted to EPA for approval as a point source TMDL.

V. FINAL EFFLUENT LIMITS

The final wastewater effluent limits for Outfall 001 are based on the WQBEL developed in Section IV and apply to the treated effluent prior to mixing with the receiving water.

a) Numeric Limitations – Outfall 001

The following effluent limitations apply to Outfall 001 January 1 – December 31

Parameter, units	**Concentration (1)**		**Rationale/Basis**
	Maximum Daily Limit	**Monthly Average Limit**	
Total Suspended Solids, mg/L	30	25	ARM 17.30.624(2)(f)
Cadmium, µg/L	0.48	0.054	ARM 17.30.715(1)(c)
Selenium, µg/L	3.0	0.75	ARM 17.30.715(1)(c)
Footnotes: (1) See definitions in Part 1.A of permit.			

b) Other Limitations:

1. The instantaneous pH shall remain between 6.5 and 8.4 standard units.

2. The instantaneous discharge rate (volume) of the effluent shall not exceed 2.5 cfs.

3. The concentration of mercury, radium and arsenic in the effluent, prior to mixing with the receiving water shall not exceed the concentration of these parameters as measured in the Tongue River upstream of the point of discharge.

4. The effluent is composed entirely of produced water from coal bed methane development; no sewage, industrial or other wastes may be added to the treatment system.

5. The concentration of oil and grease shall not exceed 10 mg/L.

The following effluent limitations apply to Outfall 001 March 1 thru October 31:

Parameter	Maximum Daily Limit (1)	Monthly Average Limit (1)	Rationale/Basis
Specific Conductance, µS/m	1,500	1,000	ARM 17.30.670(3)(a)
Sodium Adsorption Ratio (SAR)	4.5	3.0	ARM 17.30.670(3)(a)
Footnotes: (1) See definitions in Part 1.A of permit.			

The following effluent limitations apply to Outfall 001 November 1 thru the last day of February:

Parameter	Maximum Daily Limit (1)	Monthly Average Limit (1)	Rationale/Basis
Specific Conductance, µS/m	2,500	1,500	ARM 17.30.670(2)(a)
Sodium Adsorption Ratio (SAR)	7.5	5.0	ARM 17.30.670(2)(a)
Footnotes: (1) See definitions in Part 1.A of permit.			

VI. MONITORING REQUIREMENTS

Treated effluent will discharge continuously to the Tongue River during normal operations. Effluent monitoring will be conducted at a sampling point constructed at the discharge pipe from the containment pond outfall. Effluent volume will also be measured with a continuous effluent flow-recording device or a totalizing device.

The permittee shall monitor the quality of the effluent discharged from Outfall 001 for the parameters and at the frequencies listed in Table 1 and Table 2. Sample collection, preservation, holding times and test procedures for the analysis of pollutants must conform to current regulation as published in 40 CFR 136. Samples or measurements shall be representative of the volume and nature of the monitored discharge, in accordance with Part I of the permit. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

a. Effluent Monitoring – Permit Compliance

Table 1 parameters are required to determine compliance with the permit limits developed in Section V.

In addition to the monitoring requirement in Table 1 and 2, the permittee shall comply with the following special conditions, which will be required in the permit:

1. Prior to construction of the treatment works, the permittee shall submit a line drawing, plans or specifications in sufficient detail for the Department to determine how the permittee will monitor flow and sample the effluent in accordance with the terms of this section, specifically Tables 1 & 2. This report is subject to Department approval pursuant to Part II, III and IV of the permit.

2. The permittee shall develop a quality assurance, quality control (QA/QC) plan for monitoring flow and sampling the effluent in accordance with the terms and conditions of the permit. The plan shall also address instream monitoring and other monitoring required as a condition of this permit. The permittee shall also notify the Department of the location where records required in Part II of the Permit would be kept. This plan shall be maintained onsite and made available to the operator, or other person responsible for monitoring and sampling. A copy shall be provided to the Department, for approval in accordance with Part II, III and IV of the permit.

Table 1

Parameter	Frequency [1]	Sample Type [2]	Minimum Level
Effluent Flow Rate, gpm	Continuous	Instantaneous [3]	[4]
pH, SU	Daily	Instantaneous	0.1
Specific Conductivity, µS/cm	Daily	Instantaneous	10
Sodium, mg/L	Weekly	Grab	1.
Calcium, mg/L	Weekly	Grab	1.
Magnesium, mg/L	Weekly	Grab	1.
Total Dissolved Solids, mg/L	Weekly	Grab	10
Sodium Adsorption Ratio, (SAR)	Weekly	Calculate	0.1
Total Suspended Solids, mg/L	Weekly	Grab	10
Cadmium, Total Recoverable, mg/L	Monthly	Grab	0.0001
Selenium, Total Recoverable, mg/L	Monthly	Grab	0.001
Arsenic, Total Recoverable, mg/L	Monthly	Grab	0.001
Mercury, Total Recoverable, mg/L	Monthly	Grab	0.0001
Radium, Total, pCi/L	Monthly	Grab	0.1

Footnotes:
(1) Refers to the frequency of observation or measurement.
(2) See the definitions in Part I.A. of the permit.
(3) Requires the use of recording device or totalizing device.
(4) Part II.B requires that flow measurements must be within 10% of the measured flow.

b. Compliance Determination

For the parameters monitored in Part I of the permit (Section V of SOB), the following procedures shall be included in the permit:

1. Average Monthly Limit (AML) or 30-day Average is the arithmetic mean of all samples collected during the calendar month, as defined in Part I.A of the permit. If only one sample is collected in the calendar month then the results of this sample are reported as the AML and shall be reported on the DMR form. Analytical results that are less than the minimum levels (ML) specified in Table 1 and 2 are reported on the DMR as zero or, if calculating a monthly average, the value of "0" is used to calculate the AML.

2. For the term of the permit, the permittee shall submit an annual report demonstrating compliance with Condition V.b.3, for mercury, arsenic and radium. The effluent shall be considered in compliance with this limit if the concentration in the effluent does not exceed the upstream concentration (based on the results on monitoring required in Section VII.d) as measured by one-sided Wilcoxon signed rank test at the 99 percent level of confidence ($p<0.01$) (Helsel and Hirsh, 1995, or equivalent) for the calendar year. Sample pair shall be by month. A nonparametric test is employed because it is expected that most of these sample results will be below the limit of detection. For ambient samples the permittee may employ a detect limit below the minimum level established in Table 1 and 3. The report shall be submitted in accordance with Part II and IV.G of the permit. If the results of this analysis indicate a significant increase in the concentration in the effluent the Department may reopen

the permit in accordance with Part I.V (of the permit) and establish and effluent limit.

c. Supplemental Effluent Monitoring

Table 2 parameters are required to fulfill the requirements of ARM 17.30.1322(10)(e)(i), (ii) and (iii) as discussed in Section II.b of this SOB. The permittee will be required to monitor the effluent at the frequency listed in Table 2 during the first 2 years after the effective date of this permit and in year 4 of the permit (prior to permit renewal).

d. Instream Monitoring

The development of water quality based limits and waste load allocations (Section IV) and the determination of nonsignificance (Section VIII) require that the Department analyze any change in water quality as a result of the proposed activity and set limits to prohibit the degradation of state waters. There was insufficient information to develop water quality based limits for the parameters that were determined to have a reasonable potential to exceed standards, including carcinogens and radiological parameters, toxic parameters and nutrients, therefore the permittee will be required to conduct instream monitoring to ensure the limits herein comply with Montana's Nondegradation policy. This monitoring will be used to adjust permit limits, as necessary, when the permit is renewed, or sooner if conditions warrant. For arsenic, mercury and radium, the permittee will be required to perform annual evaluations to ensure that no increase has occurred.

The permittee is required to conduct upstream monitoring in accordance with the parameters and frequencies listed in Table 3. The location shall be permanently marked in the field at a distance upstream of the discharge not more that 0.5 miles outside of the area influenced by the discharge. Within 60 days of the effective date of this permit, the permittee shall notify the Department in writing of the exact sample location (latitude, longitude and physical description).

Table 2[3]

Parameter, units	Frequency [1]	Sample Type [2]	Minimum Level
Temperature, °C	Weekly	Instantaneous	1
Nitrite + Nitrate, as N, mg/L	Monthly	Grab	0.05
Kjeldahl Nitrogen, Total, as N, mg/L	Monthly	Grab	0.1
Ammonia, as N, mg/L	Monthly	Grab	0.05
Total Nitrogen, mg/L [6]	Monthly	Calculate	0.1
Phosphorous, Total, mg/L	Monthly	Grab	0.01
Biochemical Oxygen Demand, mg/L	Semi Annual	Composite	5
Chemical Oxygen Demand, mg/L	Semi Annual	Composite	10
Total Organic Carbon, mg/L	Semi Annual	Composite	0.5
Radioactivity, Alpha-Total, pCi/L	Semi Annual	Composite	1
Radioactivity, Beta-Total, pCi/L	Semi Annual	Composite	1
Fluoride, mg/L	Semi Annual	Composite	1
Aluminum, Dissolved, mg/L	Semi Annual	Composite	0.01
Barium, Total Recoverable, mg/L	Semi Annual	Composite	0.01
Boron, Total Recoverable, mg/L	Semi Annual	Composite	0.01
Copper, Total Recoverable, mg/L	Semi Annual	Composite	0.001
Iron, Dissolved, mg/L	Semi Annual	Composite	0.01
Iron, Total Recoverable, mg/L	Semi Annual	Composite	0.01
Lead, Total Recoverable mg/L	Semi Annual	Composite	0.001
Strontium, Total Recoverable, mg/L	Semi Annual	Composite	0.1
Manganese, Total Recoverable, mg/L	Semi Annual	Composite	0.01
Zinc, Total Recoverable, mg/L	Semi Annual	Composite	0.01
Phenols, Total, mg/L	Semi Annual	Grab	0.1
Cyanide, Total, mg/L	Semi Annual	Grab	0.005
Oil & Grease, mg/L	Semi Annual	Grab	1
~~Toxicity, acute [4]~~	~~Annual~~	~~Composite~~	~~NA~~
Toxicity, chronic [5]	Annual	Composite	NA

Footnotes:
(1) Refers to the frequency of observation or measurement.
(2) See the definitions in Part I.A. of the permit.
(3) The parameter must be monitored in the first two years after the effective date of the permit and in the fourth year of the permit.
(4) ~~Acute test shall utilize Flathead Minnow (*Pimephales promelas*) EPA Method 2001.0 and *Daphnia magna*, EPA Method 2012.0~~. Changed in response to comments, see final permit.
(5) Chronic test shall utilize Flathead Minnow (*Pimephales promelas*) EPA Method 1000.0 and *Ceriodaphnia dubia*, EPA Method 1002.0.
(6) Total nitrogen is sum of Kjeldhl nitrogen and nitrite plus nitrate nitrogen.
NA – Not Applicable

Table 3

Parameter	Frequency [1]	Sample Type [2]	Minimum Level
pH, SU	Monthly	Instantaneous	0.1
Temperature, °C	Monthly	Instantaneous	1
Specific Conductivity, µS/cm	Monthly	Instantaneous	10
Sodium Adsorption Ratio, SAR[3]	Monthly	Calculate	0.1
Sodium, mg/L	Monthly	Grab	1
Total Dissolved Solids, mg/L	Monthly	Grab	10
Cadmium, Total Recoverable, mg/L	Monthly	Grab	0.0001
Selenium, Total Recoverable, mg/L	Monthly	Grab	0.001
Arsenic, Total Recoverable, mg/L	Monthly	Grab	0.001
Barium, Total Recoverable, mg/L	Monthly	Grab	0.01
Mercury, Total Recoverable, mg/L	Monthly	Grab	0.0001
Radium, Total, pCi/L	Monthly	Grab	0.1
Copper, Total Recoverable, mg/L	Monthly	Grab	0.001
Lead, Total Recoverable, mg/L	Monthly	Grab	0.001
Strontium, Total Recoverable, mg/L	Monthly	Grab	0.1
Nitrite + Nitrate, as N, mg/L	Monthly	Grab	0.01
Kjeldahl Nitrogen, Total, as N, mg/L	Monthly	Grab	0.1
Ammonia, as N, mg/L	Monthly	Grab	0.05
Total Nitrogen, mg/L	Monthly	Calculate [4]	0.1
Phosphorous, Total, mg/L	Monthly	Grab	0.001

Footnotes:
(1) Refers to the frequency of observation or measurement.
(2) See the definitions in Part I.A. of the permit.
(3) Requires concurrent analysis of calcium and magnesium; this data is not required to be submitted.
(4) Total nitrogen is sum of Kjeldhl nitrogen and nitrite plus nitrate nitrogen.

VII. NONSIGNIFICANCE DETERMINATION

The Montana Water Quality Act states that it is unlawful to cause degradation of state waters without an authorization issued pursuant to 75-5-303, MCA [75-5-605(1)(d), MCA]. ARM 17.30.706(2) states that the Department will determine whether a proposed activity may cause degradation for all activities which are permitted, approved licensed or otherwise authorized by the Department, such as issuance of a discharge permit. This facility constitutes a new source and is therefore subject to the nondegradation requirements.

The Department has set the effluent limits and conditions in the permit to comply with the criteria of ARM 17.30.715 (Criteria for Determination of Nonsignificant Changes in Water Quality), thus the proposed discharge is nonsignificant based on Montana's Nondegradation rules and Policy (75-5-301(5) and 303, MCA). The proposed discharge may result in measurable changes in water quality downstream of the mixing zone for nutrient (nitrogen and phosphorous) and changes in temperature and pH above the criteria of 715(1)(f) (See Section 1.c). The Department has determined these changes are nonsignificant pursuant to ARM 17.30.715(3) provided that the permittee is in compliance with the effluent limits and conditions of the permit. The permittee will be required to conduct effluent and supplemental instream and biological monitoring to determine compliance with this finding.

Wasteload allocations for the parameters listed in Appendix IV were defined for this facility based on nonsignificance threshold values defined under Montana Nondegradation Rules (ARM 17.30.701, *et seq.*).

VIII. SPECIAL CONDITION AND SCHEDULES OF COMPLIANCE

1. Mixing Zone

The Department will grant a standard mixing zone subject to the following conditions:

a. The permittee shall submit site-specific information as required in ARM 17.30.516(4) and demonstrate through the use of a suitable model (Cormix or Pumes) that the length of the mixing zone is less than two river widths at all flow conditions.

b. The permittee shall submit an updated design for the effluent diffuser or demonstrate that the proposed outfall conforms to the criteria of Section IX.1.a (above).

c. The applicant shall submit a water quality assessment satisfying the criteria of ARM 17.30.506(1) and (2)(a) through (f).

Items a. – c. must be submitted to the Department prior to issuance of a final permit.

2. Nutrient Monitoring

Prior to issuance of the final permit, the permittee will submit a study plan for department review and approval to assess the periphyton community in accordance with Department's Standard Operating Procedure (SOP - Section 12.0, Revision 0, Date 3/31/99) for Periphyton Composition and Structure (12.1.2.4,) and Standing Crop (12.1.2.3). The permittee will be required to sample three reaches, a reference site upstream of the discharge (below the reservoir) and one site located immediately downstream of the discharge within the mixing zone (within two river widths), and a suitable location below the mixing zone. This condition is necessary to ensure compliance with ARM 17.30.515(1)(g) and the Department's nonsignificance determination (Section VIII). Sampling shall be conducted annually between July 15 and August 15 for the term of the permit.

IX Other Information

On September 21, 2000, a U.S. District Judge issued an order stating that until all necessary total maximum daily loads (TMDLs) under Section 303(d) of the Clean Water Act are established for a particular water quality limited segment (WQLS), the State is not to issue any new permits or increase permitted discharges under the MPDES program. The order was issued in the lawsuit Friends of the Wild Swan v. U.S. EPA. et al., CV 97-35-M-DWM, District of Montana, Missoula Division. The DEQ finds that the issuance of this proposed permit does not conflict with the order, because: 1) the water body was listed on the 1996 303(d) list for flow alteration and was subsequently removed from the 2000 and 2002 lists for lack of sufficient credible data to support the listing; 2) EPA has determined that no TMDLs are necessary for water bodies impaired by "pollution" such as flow alteration; 3) the permit limits flow to a level deemed nonsignificant under the criteria of ARM 17.30.715(1); and, 4) the Department has prepared a waste load allocation in the event a TMDL is determined to be necessary for as part of the TMDL for the listed water body that addresses flow.

IX. INFORMATION SOURCES

(1) ARM Title 17, Chapter 30, Sub-chapter 5 - Mixing Zones in Surface and Ground Water

(2) ARM Title 17, Chapter 30, Sub-chapter 6 - Surface Water Quality Standards

(3) ARM Title 17, Chapter 30, Sub-chapter 7 - Nondegradation of Water Quality

(4) ARM Title 17, Chapter 30, Sub-chapter 13 - Montana Pollutant Discharge Elimination System (MPDES) Standards

(5) Circular WQB-7 (January 2004), Montana Numeric Water Quality Standards

(6) Lloyd, Jim, DEQ Internal DEQ Memorandum: Tongue River Flow Analysis February 20, 2004.

(7) Helsel, D.L. and R.M. Hirsch, 1995. Statistical Methods in Water Resources. Elservier.

(8) MPDES Permit Application Form 1 and Form 2D, with a Water Management Plan for the "Coal Creek Federal Project Pod" prepared for Powder River Gas, LLC by Western Land Services, received by the Department on August 18, 2003.

(9) Montana Water Quality Act, MCA 75-5-101 *et seq.*

(10) "Montana List of Waterbodies in Need of Total Maximum Daily Load Development," 303(d) list, dated 1996 and 2002

(11) USDOE, 2004, A White Paper Describing Produced Water from Production of Crude Oil, Natural Gas, and Coal Bed Methane. January 2004

Appendix I. Design Flow Estimates for Tongue River and Proposed PRG Discharge.

Condition	**Source** [1]	**Flow (CFS)**	**Dilution Ratio** [2]
Annual 7-day, 10-year low Flow	USGS	23	15.3
Annual 7-day, 10-year low Flow, adjusted	DEQ	33	13.2
Seasonal Low Flow March – June	USGS	34	13.6
Seasonal Low Flow July – October	USGS	68	27.2
Season Low Flow November – February	USGS	56	22.4
Tongue River	DNRC	70	28
Effluent	PRG	2.5	-

Notes:
(1) See text for discussion of estimates.
(2) Stream dilution flow is defined as 7-day, 10-year low flow of the stream segment without discharge divided by mean annual flow of the discharge (ARM 17.30.516(3)(a)).

Appendix II. Estimated effluent quality and applicable water quality standards (NA-Not Applicable; ND-No Data; UK-Unknown or cannot be determined).

Parameter, units	Source		Average Value	Variation Factor	Upper Bound Estimate	Non-degradation Criteria	Estimated RWC	Potential Exceed.
Physcial								
Temperature, degrees Celsius, Winter	1		60	NA	60	33	33.0	N
Temperature, degrees Celsius, Summer	1		65	NA	65	56-58	57.5	N
Discharge, instantaneous, cfs	1		2.5	NA	2.5	77	72.5	N
pH, field, standard units	1		6.5	NA	6.5	7.7-8.7	7.5	Y
Suspended sediment, mg/L	1		15	NA	150	25	16.9	N
Total Dissolved Solids, mg/L			650	1.5	975	500	370.0	N
Dissolved oxygen, mg/L			ND	NA		8	UK	UK
Organics								
Biochemical Oxygen Demand, mg/L	1		14	1.5	21	NA	UK	UK
Chemical Oxygen Demand, mg/L	1		12	1.5	18	NA	UK	UK
Total Organic Carbon, mg/L			ND	ND	ND	NA	UK	UK
Oil and Grease, mg/L	1		5	1.5	7.5	NA	UK	UK
Nutrients/Ammonia								
Ammonia, mg/L, as N, Summer	1		0.1	1.5	0.15	0.27	0.052	N
Ammonia, mg/L, as N, Winter	1		0.1	1.5	0.15	0.14	0.052	N
Ammonia plus org. nitrogen, mg/L as N								
Nitrite plus nitrate, mg/L, as N	1		1.	1.5	1.5	1.50	0.170	N
Total Nitrogen, mg/L			1	1.5	1.5	See Text	0.652	Y
Orthophosphate, mg/L, as P						See Text	0.019	N
Phosphorus, mg/L	1		0.15	1.5	0.225	See Text	0.053	Y
Common Ions								
Calcium, mg/L,	3		51	(1)	51	NA	46.2	NA
Magnesium, mg/L	3	<	1	(1)	1	NA	24.2	NA
Sodium, mg/L	3		131	(1)	131		33.5	NA
Potassium, mg/L		<	1			NA	UK	NA
Chloride, mg/L,			38	1.5	57	NA	3.9	N
Sulfate, mg/L,	1/2		3	1.5	4.5	NA	92.8	N
Fluoride, mg/L	1		3.98	1.5	5.97	0.6	0.3	N
Alkalinity, mg/L as CaCO3						NA	UK	N
Bicarbonate, mg/L	3		522	1.5	783	NA	252.6	N
Hardness, mg/L as CaCO3						NA	UK	N

Appendix II (con't). Estimated effluent quality and applicable water quality standards (NA-Not Applicable; ND-No Data; UK-Unknown or cannot be determined).

Parameter, units	Source		Average Value	Variation Factor	Upper Bound Estimate	Non-degradation Criteria	Estimated RWC	Potential Exceed.
Seasonal Irrigation								
Specific conductance, mS/cm, Winter	3		960	1.5	1440	1,500	723	N
Specific conductance, mS/CM, Summer	3		960	1.5	1440	1,000	586	N
Sodium Adsorption Ratio (SAR), Winter	3		5	1.5	7.5	5		N
Sodium Adsorption Ratio (SAR), Summer	3		3	1.5	4.5	3		N
Radiological								
Alpha emitter, pCi/L	2		3.2+/-4.6			no increase	UK	UK
Radium, -226, -228, pCi/L	2		NA			no increase	UK	UK
Metals, Total, unless specified (cadmium, copper, lead, nickel and zinc standard calculated using hardness of 150 mg/L)								
Aluminum, dissolved, mg/L	1		.1	1.5	0.15	0.013	UK	UK
Arsenic, mg/L	1	<	.001	1.5	0.0015	0.001	0.0010	N
Barium, mg/L	1		.02	1.5	0.03	0.300	UK	Y
Beryllium, mg/L						NA	UK	UK
Boron, mg/L						0.75	UK	UK
Cadmium, mg/L	1	<	.0001	1.5	0.00015	0.0001	0.0010	Y
Chromium, mg/L	1	<	.001	1.5	0.0015	0.015	0.0020	N
Copper, mg/L	1	<	.001	1.5	0.0015	0.002	0.0107	Y
Iron, dissolved, mg/L						0.3	0.0261	N
Iron, mg/L	1	<	.05	1.5	0.075	0.400	UK	UK
Lead, mg/L,	2	<	.001	1.5	0.0015	0.001	0.0029	Y
Manganese, dissolved, mg/L						0.05	0.0097	NA
Mercury, mg/L						no increase	0.0001	UK
Nickel, mg/L						0.0110	0.0029	N
Selenium, mg/L	1	<	.001	1.5	0.0015	0.0008	0.0010	Y
Strontium, mg/L						0.0006	UK	UK
Zinc, mg/L	1	<	.001	1.5	0.0015	0.0254	0.0097	N

1. Feb. 5, 2004 Letter - supplement
2. Feb 16, 2004 letter - supplement
3. March 4, 2004 PRC

Appendix III. Estmated receiving water characteristics for Tongue River (NA-Not Applicable; ND-No Data; UK-Unknown or cannot be determined).

Parameter, units	Quaneco 5/22/2003	USGS 6/9/95	USGS Median	USGS Minimum	USGS Maximum	Estimated Background	Water Quality Standard	Non-degradation Criteria	Category (WQB-7)
Physcial									
Temperature, F, Winter		55	36.5	33.8	39.2	32	+/- 1 degree F	same	Harmful
Temperature, F, Summer		ND	57.2	33.8	73	57.2	+/- 1 degree F	same	Harmful
Discharge, instantaneous, cfs		2,910	302	2.6	3,290	70	NA	77	Narrative
pH, field, standard units		7.9	8.2	7.7	8.4	8.2	+/- 0.5 units	same	Harmful
Suspended sediment, mg/L		98	17	8	98	17	No Increase	25	Narrative
Total Dissolved Solids, mg/L	420					360		500	Narrative
Dissolved oxygen, mg/L		9.2	10.6	7.4	14	9.2	8	same	Toxic
Organics									
Biochemical Oxygen Demand, mg/L						ND		NA	Narrative
Chemical Oxygen Demand, mg/L						ND		NA	Narrative
Total Organic Carbon, mg/L						ND		NA	Narrative
Oil and Grease, mg/L						ND	10	NA	Narrative
Nutrients/Ammonina									
Ammonia, mg/L, as N, Summer		0.06	0.055	0.04	0.09	0.05	1.79	0.27	Toxic
Ammonia, mg/L, as N, Winter		na				0.05	0.94	0.14	Toxic
Ammonia plus org. nitrogen, mg/L as N		.5	0.5	0.4	0.7	0.5		NA	
Nitrite plus nitrate, mg/L, as N		0.09	0.14	0.09	0.34	0.14	10	1.50	Toxic
Total Nitrogen, mg/L		na				0.64		See Text	Nutrient
Orthophosphate, mg/L, as P		.02	0.02	0.01	0.07	0.02		See Text	Nutrient
Phosphorus, mg/L		0.11	0.05	0.01	0.11	0.05		See Text	Nutrient
Common Ions									
Calcium, mg/L,	60	25	46	25	64	46		NA	
Magnesium, mg/L	37	9.9	25	10	38	25		NA	
Sodium, mg/L	36	6.9	21	7	30	30		NA	Narrative
Potassium, mg/L		1.9	2.8	1.4	5.3	2.8		NA	
Chloride, mg/L,	4.3	0.9	2.7	0.9	4.7	2.7		NA	Narrative
Sulfate, mg/L,		26	96	26	150	96		NA	Narrative
Fluoride, mg/L		0.1	0.2	0.1	0.2	0.2	4	0.6	Toxic
Alkalinity, mg/L as CaCO3	211	91	163	91	233	163		NA	Narrative
Bicarbonate, mg/L	243	ND				243		NA	Narrative
Hardness, mg/L as CaCO3		53	151	53	218	151		NA	Narrative

Appendix III (con't). Estmated receiving water characteristics for Tongue River (NA-Not Applicable; ND-No Data; UK-Unknown or cannot be determined).

Parameter, units	Quaneco 5/22/2003	USGS 6/9/95	USGS Median	USGS Minimum	USGS Maximum	Estimated Background	Water Quality Standard	Non-degradation Criteria	Category (WQB-7)
Seasonal Irrigation									
Specific conductance, mS/cm, Winter		ND	698	485	776	698	1,500	1,500	NA
Specific conductance, mS/CM, Summer	644	238	556	208	931	556	1,000	1,000	NA
Sodium Adsorption Ratio (SAR), Winter		ND				0.62	5	5	NA
Sodium Adsorption Ratio (SAR), Summer	0.9	0.3	0.62	0.3	0.78	0.62	3	3	NA
Radiological									
Alpha emitter, pCi/L						ND	1.5	no increase	Carcinogen
Radium, -226, -228, pCi/L						ND	5	no increase	Carcinogen
Metals, Total, unless specified (cadmium, copper, lead, nickel and zinc standard calculated using hardness of 150 mg/L)									
Aluminum, dissolved, mg/L						ND	0.087	0.013	Toxic
Arsenic, mg/L		<0.001				0.001	0.018	no increase	Carcinogen
Barium, mg/L		ND				ND	2	0.300	Toxic
Beryllium, mg/L		<0.01				0.01	0.004	no increase	Carcinogen
Boron, mg/L		0.02	0.05	0.02	0.07	0.02	0.75	0.75	Narrative
Cadmium, mg/L		<0.001				0.001	0.00036	0.00005	Toxic
Chromium, mg/L (Total)		0.0021				0.002	0.1	0.015	Toxic
Copper, mg/L		0.011				0.011	0.0132	0.001	Toxic
Iron, dissolved, mg/L		.12	0.027	0.007	0.12	0.027	0.3	0.3	Narrative
Iron, mg/L		1.7				ND	UK	0.10	Harmful
Lead, mg/L,		0.003				0.003	0.0053	0.001	Toxic
Manganese, dissolved, mg/L		0.01				0.01	none	0.05	Narrative
Mercury, mg/L		<0.0001				0.0001	0.00005	no increase	Carcinogen
Nickel, mg/L		0.003				0.003	0.073	0.011	Toxic
Selenium, mg/L		<0.001				0.001	0.005	0.0008	Toxic
Strontium, mg/L		ND				ND	0.0042	0.001	Toxic
Zinc, mg/L		0.010				0.01	0.169	0.025	Toxic

Appendix IV. Total Maximum Daily Load for MT0030660, Powder River Gas, LLC

Pollutant	Waste Load Allocation (Effluent)			Load Allocation (Upstream)			Total Maximum Daily Load (Downstream)			Averaging Period
	Flow (cfs)	Conc. (mg/L)	Load (lbs/day)	Flow (cfs)	Conc. (mg/L)	Load (lbs/day)	Flow (cfs)	Conc. (mg/L)	Load (lbs/day)	
Total Suspended Solids	2.5	25	337	70	17	6,414	72.5	17.2	6,751	30-day Average
November 1 to last day of February										
Sodium Adsorption Ratio	2.5	5	NA	70	0.88	NA	72.5	0.99	NA	30-day Average
Sodium, mg/L	2.5	131	1,765	70	30	11,319	72.5	33.5	13,084	30-day Average
Electric Conductivity, uS/cm	2.5	1,500	NA	70	698	NA	72.5	726	NA	30-day Average
Total Dissolved Solids, mg/L	2.5	975	13,138	70	454	171,181	72.5	472	184,319	30-day Average
March 1 to October 31										
Sodium Adsorption Ratio	2.5	3	NA	70	0.88	NA	72.5	0.95	NA	30-day Average
Sodium, mg/L	2.5	87	1,172	70	30	11,319	72.5	32	12,491	30-day Average
Electric Conductivity, uS/cm	2.5	1,000	NA	70	556	NA	72.5	571	NA	30-day Average
Total Dissolved Solids, mg/L	2.5	650	8,759	70	361	136,356	72.5	371	145,115	30-day Average