Utah Division of Water Quality
Statement of Basis
ADDENDUM
Wasteload Analysis and Antidegradation Level I Review

Date: **October 22, 2018**

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Standards and Technical Services Section

Facility: **Cottonwood–Wilberg Mine**
UPDES No. UT0022896

Receiving water: **Cottonwood Canyon Creek (1C, 3A, 2B, 4)**

This addendum summarizes the wasteload analysis that was performed to determine water quality based effluent limits (WQBEL) for this discharge. Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses (UAC R317-2-8). Projected concentrations are compared to numeric water quality standards to determine acceptability. The numeric criteria in this wasteload analysis may be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

Discharge

Outfall 001: continuous mine water discharge 0.54 MGD

Receiving Water
The receiving water for Outfalls 001 is Cottonwood Canyon Creek, an intermittent tributary of Cottonwood Creek.

Per UAC R317-2-13.1(b), the designated beneficial uses for Cottonwood Creek and tributaries from Highway U-57 crossing to headwaters are:

- *Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water*

- *Class 2B - Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.*

- *Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.*

- *Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.*

Typically, the critical flow for the wasteload analysis is considered the lowest stream flow for seven consecutive days with a ten year return frequency (7Q10). Cottonwood Canyon Creek is an intermittent stream that has no flow for large parts of the year. As a result, the annual critical low flow was determined to be zero. As a result, water quality based effluent limits revert to end-of-pipe water quality standards.

Cottonwood Canyon Creek water quality inputs were estimated due to a lack of available data.

TMDL

According to DWQ's 2016 303(d) Assessment, upper Cottonwood Creek and tributaries (UT14060009-007_00) is listed as impaired for pH (1C, 2B and 3A use classes), temperature (3A), and total dissolved solids (4).

A Total Maximum Daily Load (TMDL) addressing the TDS impairment for the Price River and tributaries was completed as part of the West Colorado River Watershed TMDL in August of 2004. As part of the TMDL, site specific standards were developed for a number of stream segments in the watershed. A site specific standard of 3,500 mg/l TDS was developed for Cottonwood Creek (and has since been incorporated into the Utah Water Quality Standards) from the confluence with Huntington Creek to Highway 57.

The Trail Mountain Mine as well as Wilburg-Cottonwood 001 discharge to Cottonwood Creek approximately 8 miles above this stream segment. The TMDL indicated a TDS permit limit of 1136 mg/l for the Trail Mountain Mine in order to be protective of downstream uses. The Approved TMDL is silent on the Wilburg-Cottonwood 001 discharge, but because mine discharges to the same segment as the Trail Mountain Mine, a 1,136 mg/l TDS permit limit is also recommended for this discharge to protect downstream water uses.

Mixing Zone

The maximum allowable mixing zone is 15 minutes of travel time for acute conditions, not to exceed 50% of stream width, and 2,500 feet for chronic conditions, per UAC R317-2-5. Water quality standards must be met at the end of the mixing zone.

Because the critical low flow for the receiving water is zero, no mixing zone was considered.

Parameters of Concern

The potential parameters of concern identified for the discharge/receiving water were TDS, pH, and iron based on review of the past permit and the impairment status of the receiving water. Addition parameters of concern may become apparent as a result of reasonable potential analysis, technology based standards, or other factors as determined by the UPDES Permit Writer.

WET Limits

The percent of effluent in the receiving water in a fully mixed condition, and acute and chronic dilution in a not fully mixed condition are calculated in the WLA in order to generate WET limits. The LC_{50} (lethal concentration, 50%) percent effluent for acute toxicity and the IC_{25} (inhibition concentration, 25%) percent effluent for chronic toxicity, as determined by the WET test, needs to be below the WET limits, as determined by the WLA. The WET limit for LC_{50} is typically 100% effluent and does not need to be determined by the WLA.

Because the critical low flow of the receiving water was determined to be zero, WET limits for Outfall 001 for IC_{25} should be based on 100% effluent.

Wasteload Allocation Methods

Effluent limits were determined for conservative constituents using a simple mass balance mixing analysis (UDWQ 2012). The mass balance analysis is summarized in Appendix A.

The water quality standard for chronic ammonia toxicity is dependent on temperature and pH, and the water quality standard for acute ammonia toxicity is dependent on pH. The AMMTOX Model developed by University of Colorado and adapted by Utah DWQ and EPA Region VIII was used to determine ammonia effluent limits (Lewis et al. 2002).

Models and supporting documentation are available for review upon request.

Antidegradation Level I Review

The objective of the Level I ADR is to ensure the protection of existing uses, defined as the beneficial uses attained in the receiving water on or after November 28, 1975. No evidence is known that the existing uses deviate from the designated beneficial uses for the receiving water. Therefore, the beneficial uses will be protected if the discharge remains below the WQBELs presented in this wasteload.

A Level II Antidegradation Review (ADR) is not required for this facility. The proposed permit is a simple renewal, with no increase in flow or concentration over that which was approved in the existing permit.

Documents:

WLA Document: *Wilberg_WLADoc10-19-18.docx*
Wasteload Analysis: *Wilberg_WLADoc10-19-18.xlsm*

References:

Utah Division of Water Quality. 2012. *Utah Wasteload Analysis Procedures Version 1.0.*

Utah Division of Water Quality. 2004. Price River, San Rafael River, and Muddy Creek TMDLs for Total Dissolved Solids, West Colorado Management Unit.

Lewis, B., J. Saunders, and M. Murphy. 2002. *Ammonia Toxicity Model (AMMTOX, Version2): A Tool for Determining Effluent Ammonia Limits*. University of Colorado, Center for Limnology.

Utah Division of Water Quality
Salt Lake City, Utah

WASTELOAD ANALYSIS [WLA] **15-Oct-18**
Addendum: Statement of Basis

Facilities: **Cottonwood-Wilberg Mine** **UPDES No: UT-0022896**
Discharging to: **Cottonwood Canyon Creek**
Design Flow: **0.54** **MGD**

I. Introduction

Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses [R317-2-8, UAC]. Projected concentrations are compared to numeric water quality standards to determine acceptability. The anti-degradation policy and procedures are also considered. The primary in-stream parameters of concern may include metals (as a function of hardness), total dissolved solids (TDS), total residual chlorine (TRC), un-ionized ammonia (as a function of pH and temperature, measured and evaluated interms of total ammonia), and dissolved oxygen.

Mathematical water quality modeling is employed to determine stream quality response to point source discharges. Models aid in the effort of anticipating stream quality at future effluent flows at critical environmental conditions (e.g., low stream flow, high temperature, high pH, etc).

The numeric criteria in this wasteload analysis may always be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

II. Receiving Water and Stream Classification

Cottonwood Canyon Creek:	1C, 2B, 3A, 4
Antidegradation Review:	Level I review completed. Level II review not required.

III. Numeric Stream Standards for Protection of Aquatic Wildlife

Total Ammonia (TNH3)	Varies as a function of Temperature and pH Rebound. See Water Quality Standards
Chronic Total Residual Chlorine (TRC)	0.011 mg/l (4 Day Average) 0.019 mg/l (1 Hour Average)
Chronic Dissolved Oxygen (DO)	6.50 mg/l (30 Day Average) 5.00 mg/l (7Day Average) 4.00 mg/l (1 Day Average
Maximum Total Dissolved Solids	1200.0 mg/l

Utah Division of Water Quality
Salt Lake City, Utah

Acute and Chronic Heavy Metals (Dissolved)

Parameter	4 Day Average (Chronic) Standard Concentration	Load*	1 Hour Average (Acute) Standard Concentration	Load*
Aluminum	87.00 ug/l**	0.392 lbs/day	750.00 ug/l	3.384 lbs/day
Arsenic	190.00 ug/l	0.857 lbs/day	340.00 ug/l	1.534 lbs/day
Cadmium	0.97 ug/l	0.004 lbs/day	12.27 ug/l	0.055 lbs/day
Chromium III	352.71 ug/l	1.591 lbs/day	7379.28 ug/l	33.291 lbs/day
ChromiumVI	11.00 ug/l	0.050 lbs/day	16.00 ug/l	0.072 lbs/day
Copper	40.59 ug/l	0.183 lbs/day	70.82 ug/l	0.320 lbs/day
Iron			1000.00 ug/l	4.511 lbs/day
Lead	28.44 ug/l	0.128 lbs/day	729.79 ug/l	3.292 lbs/day
Mercury	0.0120 ug/l	0.000 lbs/day	2.40 ug/l	0.011 lbs/day
Nickel	223.64 ug/l	1.009 lbs/day	2011.49 ug/l	9.075 lbs/day
Selenium	4.60 ug/l	0.021 lbs/day	20.00 ug/l	0.090 lbs/day
Silver	N/A ug/l	N/A lbs/day	72.99 ug/l	0.329 lbs/day
Zinc	514.84 ug/l	2.323 lbs/day	514.84 ug/l	2.323 lbs/day

* Allowed below discharge

**Chronic Aluminum standard applies only to waters with a pH < 7.0 and a Hardness < 50 mg/l as CaCO3

Metals Standards Based upon a Hardness of 558.81 mg/l as CaCO3

Organics [Pesticides]

Parameter	4 Day Average (Chronic) Standard Concentration	Load*	1 Hour Average (Acute) Standard Concentration	Load*
Aldrin			1.500 ug/l	0.007 lbs/day
Chlordane	0.004 ug/l	0.019 lbs/day	1.200 ug/l	0.005 lbs/day
DDT, DDE	0.001 ug/l	0.005 lbs/day	0.550 ug/l	0.002 lbs/day
Dieldrin	0.002 ug/l	0.009 lbs/day	1.250 ug/l	0.006 lbs/day
Endosulfan	0.056 ug/l	0.252 lbs/day	0.110 ug/l	0.000 lbs/day
Endrin	0.002 ug/l	0.010 lbs/day	0.090 ug/l	0.000 lbs/day
Guthion			0.010 ug/l	0.000 lbs/day
Heptachlor	0.004 ug/l	0.017 lbs/day	0.260 ug/l	0.001 lbs/day
Lindane	0.080 ug/l	0.361 lbs/day	1.000 ug/l	0.005 lbs/day
Methoxychlor			0.030 ug/l	0.000 lbs/day
Mirex			0.010 ug/l	0.000 lbs/day
Parathion			0.040 ug/l	0.000 lbs/day
PCB's	0.014 ug/l	0.063 lbs/day	2.000 ug/l	0.009 lbs/day
Pentachlorophenol	13.00 ug/l	58.605 lbs/day	20.000 ug/l	0.090 lbs/day
Toxephene	0.0002 ug/l	0.001 lbs/day	0.7300 ug/l	0.003 lbs/day

IV. Numeric Stream Standards for Protection of Agriculture

	4 Day Average (Chronic) Standard		1 Hour Average (Acute) Standard	
	Concentration	Load*	Concentration	Load*
Arsenic			100.0 ug/l	lbs/day
Boron			750.0 ug/l	lbs/day
Cadmium			10.0 ug/l	0.02 lbs/day
Chromium			100.0 ug/l	lbs/day
Copper			200.0 ug/l	lbs/day
Lead			100.0 ug/l	lbs/day
Selenium			50.0 ug/l	lbs/day
TDS, Summer			1200.0 mg/l	2.71 tons/day

V. Numeric Stream Standards for Protection of Human Health (Class 1C Waters)

	4 Day Average (Chronic) Standard		1 Hour Average (Acute) Standard	
Metals	Concentration	Load*	Concentration	Load*
Arsenic			ug/l	lbs/day
Barium			ug/l	lbs/day
Cadmium			ug/l	lbs/day
Chromium			ug/l	lbs/day
Lead			ug/l	lbs/day
Mercury			ug/l	lbs/day
Selenium			ug/l	lbs/day
Silver			ug/l	lbs/day
Fluoride (3)			ug/l	lbs/day
to			ug/l	lbs/day
Nitrates as N			ug/l	lbs/day
Chlorophenoxy Herbicides				
2,4-D			ug/l	lbs/day
2,4,5-TP			ug/l	lbs/day
Endrin			ug/l	lbs/day
ocyclohexane (Lindane)			ug/l	lbs/day
Methoxychlor			ug/l	lbs/day
Toxaphene			ug/l	lbs/day

VI. Numeric Stream Standards the Protection of Human Health from Water & Fish Consumption [Toxics]

	Maximum Conc., ug/l - Acute Standards			
	Class 1C		Class 3A, 3B	
Toxic Organics	[2 Liters/Day for 70 Kg Person over 70 Yr.]		[6.5 g for 70 Kg Person over 70 Yr.]	
Acenaphthene	ug/l	lbs/day	2700.0 ug/l	12.17 lbs/day
Acrolein	ug/l	lbs/day	780.0 ug/l	3.52 lbs/day
Acrylonitrile	ug/l	lbs/day	0.7 ug/l	0.00 lbs/day
Benzene	ug/l	lbs/day	71.0 ug/l	0.32 lbs/day
Benzidine	ug/l	lbs/day	0.0 ug/l	0.00 lbs/day
Carbon tetrachloride	ug/l	lbs/day	4.4 ug/l	0.02 lbs/day
Chlorobenzene	ug/l	lbs/day	21000.0 ug/l	94.67 lbs/day
1,2,4-Trichlorobenzene				
Hexachlorobenzene	ug/l	lbs/day	0.0 ug/l	0.00 lbs/day
1,2-Dichloroethane	ug/l	lbs/day	99.0 ug/l	0.45 lbs/day

1,1,1-Trichloroethane					
Hexachloroethane	ug/l	lbs/day	8.9	ug/l	0.04 lbs/day
1,1-Dichloroethane					
1,1,2-Trichloroethane	ug/l	lbs/day	42.0	ug/l	0.19 lbs/day
1,1,2,2-Tetrachloroethai	ug/l	lbs/day	11.0	ug/l	0.05 lbs/day
Chloroethane			0.0	ug/l	0.00 lbs/day
Bis(2-chloroethyl) ether	ug/l	lbs/day	1.4	ug/l	0.01 lbs/day
2-Chloroethyl vinyl ether	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
2-Chloronaphthalene	ug/l	lbs/day	4300.0	ug/l	19.38 lbs/day
2,4,6-Trichlorophenol	ug/l	lbs/day	6.5	ug/l	0.03 lbs/day
p-Chloro-m-cresol			0.0	ug/l	0.00 lbs/day
Chloroform (HM)	ug/l	lbs/day	470.0	ug/l	2.12 lbs/day
2-Chlorophenol	ug/l	lbs/day	400.0	ug/l	1.80 lbs/day
1,2-Dichlorobenzene	ug/l	lbs/day	17000.0	ug/l	76.64 lbs/day
1,3-Dichlorobenzene	ug/l	lbs/day	2600.0	ug/l	11.72 lbs/day
1,4-Dichlorobenzene	ug/l	lbs/day	2600.0	ug/l	11.72 lbs/day
3,3'-Dichlorobenzidine	ug/l	lbs/day	0.1	ug/l	0.00 lbs/day
1,1-Dichloroethylene	ug/l	lbs/day	3.2	ug/l	0.01 lbs/day
1,2-trans-Dichloroethyle	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
2,4-Dichlorophenol	ug/l	lbs/day	790.0	ug/l	3.56 lbs/day
1,2-Dichloropropane	ug/l	lbs/day	39.0	ug/l	0.18 lbs/day
1,3-Dichloropropylene	ug/l	lbs/day	1700.0	ug/l	7.66 lbs/day
2,4-Dimethylphenol	ug/l	lbs/day	2300.0	ug/l	10.37 lbs/day
2,4-Dinitrotoluene	ug/l	lbs/day	9.1	ug/l	0.04 lbs/day
2,6-Dinitrotoluene	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
1,2-Diphenylhydrazine	ug/l	lbs/day	0.5	ug/l	0.00 lbs/day
Ethylbenzene	ug/l	lbs/day	29000.0	ug/l	130.73 lbs/day
Fluoranthene	ug/l	lbs/day	370.0	ug/l	1.67 lbs/day
4-Chlorophenyl phenyl ether					
4-Bromophenyl phenyl ether					
Bis(2-chloroisopropyl) e	ug/l	lbs/day	170000.0	ug/l	766.37 lbs/day
Bis(2-chloroethoxy) met	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Methylene chloride (HM	ug/l	lbs/day	1600.0	ug/l	7.21 lbs/day
Methyl chloride (HM)	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Methyl bromide (HM)	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Bromoform (HM)	ug/l	lbs/day	360.0	ug/l	1.62 lbs/day
Dichlorobromomethane	ug/l	lbs/day	22.0	ug/l	0.10 lbs/day
Chlorodibromomethane	ug/l	lbs/day	34.0	ug/l	0.15 lbs/day
Hexachlorobutadiene(c)	ug/l	lbs/day	50.0	ug/l	0.23 lbs/day
Hexachlorocyclopentadi	ug/l	lbs/day	17000.0	ug/l	76.64 lbs/day
Isophorone	ug/l	lbs/day	600.0	ug/l	2.70 lbs/day
Naphthalene					
Nitrobenzene	ug/l	lbs/day	1900.0	ug/l	8.57 lbs/day
2-Nitrophenol	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
4-Nitrophenol	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
2,4-Dinitrophenol	ug/l	lbs/day	14000.0	ug/l	63.11 lbs/day
4,6-Dinitro-o-cresol	ug/l	lbs/day	765.0	ug/l	3.45 lbs/day
N-Nitrosodimethylamine	ug/l	lbs/day	8.1	ug/l	0.04 lbs/day
N-Nitrosodiphenylamine	ug/l	lbs/day	16.0	ug/l	0.07 lbs/day
N-Nitrosodi-n-propylami	ug/l	lbs/day	1.4	ug/l	0.01 lbs/day
Pentachlorophenol	ug/l	lbs/day	8.2	ug/l	0.04 lbs/day

Phenol	ug/l	lbs/day	4.6E+06	ug/l	2.07E+04 lbs/day
Bis(2-ethylhexyl)phthala	ug/l	lbs/day	5.9	ug/l	0.03 lbs/day
Butyl benzyl phthalate	ug/l	lbs/day	5200.0	ug/l	23.44 lbs/day
Di-n-butyl phthalate	ug/l	lbs/day	12000.0	ug/l	54.10 lbs/day
Di-n-octyl phthlate					
Diethyl phthalate	ug/l	lbs/day	120000.0	ug/l	540.97 lbs/day
Dimethyl phthlate	ug/l	lbs/day	2.9E+06	ug/l	1.31E+04 lbs/day
Benzo(a)anthracene (P/	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Benzo(a)pyrene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Benzo(b)fluoranthene (F	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Benzo(k)fluoranthene (F	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Chrysene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Acenaphthylene (PAH)					
Anthracene (PAH)	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Dibenzo(a,h)anthracene	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Indeno(1,2,3-cd)pyrene	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Pyrene (PAH)	ug/l	lbs/day	11000.0	ug/l	49.59 lbs/day
Tetrachloroethylene	ug/l	lbs/day	8.9	ug/l	0.04 lbs/day
Toluene	ug/l	lbs/day	200000	ug/l	901.62 lbs/day
Trichloroethylene	ug/l	lbs/day	81.0	ug/l	0.37 lbs/day
Vinyl chloride	ug/l	lbs/day	525.0	ug/l	2.37 lbs/day
					lbs/day
Pesticides					lbs/day
Aldrin	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Dieldrin	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Chlordane	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
4,4'-DDT	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
4,4'-DDE	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
4,4'-DDD	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
alpha-Endosulfan	ug/l	lbs/day	2.0	ug/l	0.01 lbs/day
beta-Endosulfan	ug/l	lbs/day	2.0	ug/l	0.01 lbs/day
Endosulfan sulfate	ug/l	lbs/day	2.0	ug/l	0.01 lbs/day
Endrin	ug/l	lbs/day	0.8	ug/l	0.00 lbs/day
Endrin aldehyde	ug/l	lbs/day	0.8	ug/l	0.00 lbs/day
Heptachlor	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Heptachlor epoxide					
PCB's					
PCB 1242 (Arochlor 12/	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1254 (Arochlor 12!	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1221 (Arochlor 12:	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1232 (Arochlor 12:	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1248 (Arochlor 12/	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1260 (Arochlor 12(	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
PCB-1016 (Arochlor 10'	ug/l	lbs/day	0.0	ug/l	0.00 lbs/day
Pesticide					
Toxaphene	ug/l		0.0	ug/l	0.00 lbs/day
Dioxin					
Dioxin (2,3,7,8-TCDD)	ug/l	lbs/day			

Metals				
Antimony	ug/l	lbs/day		
Arsenic	ug/l	lbs/day	4300.00 ug/l	19.38 lbs/day
Asbestos	ug/l	lbs/day		
Beryllium				
Cadmium				
Chromium (III)				
Chromium (VI)				
Copper				
Cyanide	ug/l	lbs/day	2.2E+05 ug/l	991.78 lbs/day
Lead	ug/l	lbs/day		
Mercury			0.15 ug/l	0.00 lbs/day
Nickel			4600.00 ug/l	20.74 lbs/day
Selenium	ug/l	lbs/day		
Silver	ug/l	lbs/day		
Thallium			6.30 ug/l	0.03 lbs/day
Zinc				

There are additional standards that apply to this receiving water, but were not considered in this modeling/waste load allocation analysis.

VII. Mathematical Modeling of Stream Quality

Model configuration was accomplished utilizing standard modeling procedures. Data points were plotted and coefficients adjusted as required to match observed data as closely as possible.

The modeling approach used in this analysis included one or a combination of the following models.

(1) The Utah River Model, Utah Division of Water Quality, 1992. Based upon STREAMDO IV (Region VIII) and Supplemental Ammonia Toxicity Models; EPA Region VIII, Sept. 1990 and QUAL2E (EPA, Athens, GA).

(2) Utah Ammonia/Chlorine Model, Utah Division of Water Quality, 1992.

(3) AMMTOX Model, University of Colorado, Center of Limnology, and EPA Region 8

(4) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

Coefficients used in the model were based, in part, upon the following references:

(1) Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens Georgia. EPA/600/3-85/040 June 1985.

(2) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

VIII. Modeling Information

The required information for the model may include the following information for both the upstream conditions at low flow and the effluent conditions:

Flow, Q, (cfs or MGD)	D.O. mg/l
Temperature, Deg. C.	Total Residual Chlorine (TRC), mg/l
pH	Total NH3-N, mg/l
BOD5, mg/l	Total Dissolved Solids (TDS), mg/l
Metals, ug/l	Toxic Organics of Concern, ug/l

Other Conditions

In addition to the upstream and effluent conditions, the models require a variety of physical and biological coefficients and other technical information. In the process of actually establishing the permit limits for an effluent, values are used based upon the available data, model calibration, literature values, site visits and best professional judgement.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis.

Utah Division of Water Quality
Salt Lake City, Utah

Current Upstream Information

	Stream Critical Low Flow cfs	Temp. Deg. C	pH	T-NH3 mg/l as N	BOD5 mg/l	DO mg/l	TRC mg/l	TDS mg/l
Summer (Irrig. Season)	0.00	0.0	0.0	0.10	1.00	9.93	0.00	0.0
Fall	0.00	0.0	0.0	0.10	1.00	---	0.00	0.0
Winter	0.00	0.0	0.0	0.10	1.00	---	0.00	0.0
Spring	0.00	0.0	0.0	0.10	1.00	---	0.00	0.0

Dissolved Metals	Al ug/l	As ug/l	Cd ug/l	CrIII ug/l	CrVI ug/l	Copper ug/l	Fe ug/l	Pb ug/l
All Seasons	2.385*	0.795*	0.0795*	0.795*	3.975*	0.8*	1.25*	0.795*

Dissolved Metals	Hg ug/l	Ni ug/l	Se ug/l	Ag ug/l	Zn ug/l	Boron ug/l	
All Seasons	0.0000	0.795*	1.59*	0.15*	0.0795*	1.59*	* ~80% MDL

Projected Discharge Information

Season	Flow, MGD	Temp.
Summer	0.54000	11.6
Fall	0.54000	11.6
Winter	0.54000	11.6
Spring	0.54000	11.6

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort coincide with the environmental conditions expected at low stream flows.

Effluent Limitation for Flow based upon Water Quality Standards

In-stream criteria of downstream segments will be met with an effluent flow maximum value as follows:

Season	Daily Average	
Summer	0.540 MGD	0.835 cfs
Fall	0.540 MGD	0.835 cfs
Winter	0.540 MGD	0.835 cfs
Spring	0.540 MGD	0.835 cfs

Flow Requirement or Loading Requirement

The calculations in this wasteload analysis utilize the maximum effluent discharge flow of 0.54 MGD. If the discharger is allowed to have a flow greater than 0.54 MGD during 7Q10 conditions, and effluent limit concentrations as indicated, then water quality standards will be violated. In order to prevent this from occuring, the permit writers must include the discharge flow limititation as indicated above; or, include loading effluent limits in the permit.

Effluent Limitation for Whole Effluent Toxicity (WET) based upon WET Policy

Effluent Toxicity will not occur in downstream segements if the values below are met.

WET Requirements	LC50 >	100.0% Effluent	[Acute]
	IC25 >	99.9% Effluent	[Chronic]

Effluent Limitation for Biological Oxygen Demand (BOD) based upon Water Quality Standards or Regulations

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent BOD limitation as follows:

Season	Concentration	
Summer	25.0 mg/l as BOD5	112.6 lbs/day
Fall	25.0 mg/l as BOD5	112.6 lbs/day
Winter	25.0 mg/l as BOD5	112.6 lbs/day
Spring	25.0 mg/l as BOD5	112.6 lbs/day

Effluent Limitation for Dissolved Oxygen (DO) based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent

Season	**Concentration**
Summer	5.00
Fall	5.00
Winter	5.00
Spring	5.00

In-stream criteria of downstream segments for Total Ammonia will be met with an effluent limitation (expressed as Total Ammonia as N) as follows:

Season		**Concentration**	**Load**
Summer	4 Day Avg. - Chronic	2.99 mg/l as N	13.4 lbs/day
	1 Hour Avg. - Acute	9.6 mg/l as N	43.3 lbs/day
Fall	4 Day Avg. - Chronic	4.4 mg/l as N	19.9 lbs/day
	1 Hour Avg. - Acute	10.8 mg/l as N	48.4 lbs/day
Winter	4 Day Avg. - Chronic	6.0 mg/l as N	26.8 lbs/day
	1 Hour Avg. - Acute	12.7 mg/l as N	57.3 lbs/day
Spring	4 Day Avg. - Chronic	4.4 mg/l as N	19.8 lbs/day
	1 Hour Avg. - Acute	10.6 mg/l as N	47.8 lbs/day

Acute limit calculated with an Acute Zone of Initial Dilution (ZID) to be equal to 100.%.

Effluent Limitation for Total Residual Chlorine based upon Water Quality Standards

In-stream criteria of downstream segments for Total Residual Chlorine will be met with an effluent limitation as follows:

Season		Concentration		Load	
Summer	4 Day Avg. - Chronic	0.011	mg/l	0.05	lbs/day
	1 Hour Avg. - Acute	0.019	mg/l	0.09	lbs/day
Fall	4 Day Avg. - Chronic	0.011	mg/l	0.05	lbs/day
	1 Hour Avg. - Acute	0.019	mg/l	0.09	lbs/day
Winter	4 Day Avg. - Chronic	0.011	mg/l	0.05	lbs/day
	1 Hour Avg. - Acute	0.019	mg/l	0.09	lbs/day
Spring	4 Day Avg. - Chronic	0.011	mg/l	0.05	lbs/day
	1 Hour Avg. - Acute	0.019	mg/l	0.09	lbs/day

Effluent Limitations for Total Dissolved Solids based upon Water Quality Standards

Season		Concentration		Load	
Summer	Maximum, Acute	1201.4	mg/l	2.70	tons/day
Fall	Maximum, Acute	1201.4	mg/l	2.70	tons/day
Winter	Maximum, Acute	1201.4	mg/l	2.70	tons/day
Spring	Maximum, Acute	1201.4	mg/l	2.70	tons/day

Colorado Salinity Forum Limits — Determined by Permitting Section

Effluent Limitations for Total Recoverable Metals based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Metals will be met with an effluent limitation as follows (based upon a hardness of 558.81 mg/l):

	4 Day Average Concentration		Load		1 Hour Average Concentration		Load	
Aluminum*	N/A		N/A		750.9	ug/l	3.4	lbs/day
Arsenic*	190.23	ug/l	0.6	lbs/day	340.4	ug/l	1.5	lbs/day
Cadmium	0.97	ug/l	0.0	lbs/day	12.3	ug/l	0.1	lbs/day
Chromium III	353.13	ug/l	1.0	lbs/day	7,388.1	ug/l	33.3	lbs/day
Chromium VI*	11.01	ug/l	0.0	lbs/day	16.0	ug/l	0.1	lbs/day
Copper	40.63	ug/l	0.1	lbs/day	70.9	ug/l	0.3	lbs/day
Iron*	N/A		N/A		836.4	ug/l	3.8	lbs/day
Lead	28.47	ug/l	0.1	lbs/day	730.7	ug/l	3.3	lbs/day
Mercury*	0.01	ug/l	0.0	lbs/day	2.4	ug/l	0.0	lbs/day
Nickel	223.91	ug/l	0.7	lbs/day	2,013.9	ug/l	9.1	lbs/day
Selenium*	4.60	ug/l	0.0	lbs/day	20.0	ug/l	0.1	lbs/day
Silver	N/A	ug/l	N/A	lbs/day	73.1	ug/l	0.3	lbs/day

Zinc	515.46 ug/l	1.5 lbs/day	515.5	ug/l	2.3 lbs/day
Cyanide*	5.21 ug/l	0.0 lbs/day	22.0	ug/l	0.1 lbs/day

*Limits for these metals are based on the dissolved standard.

Effluent Limitations for Heat/Temperature based upon Water Quality Standards

Summer	2.0 Deg. C.	35.6 Deg. F
Fall	2.0 Deg. C.	35.6 Deg. F
Winter	2.0 Deg. C.	35.6 Deg. F
Spring	2.0 Deg. C.	35.6 Deg. F

Effluent Limitations for Organics [Pesticides] Based upon Water Quality Standards

In-stream criteria of downstream segments for Organics [Pesticides] will be met with an effluent limit as follows:

	4 Day Average Concentration	Load	1 Hour Average Concentration		Load
Aldrin			1.5E+00	ug/l	1.05E-02 lbs/day
Chlordane	4.30E-03 ug/l	1.94E-02 lbs/day	1.2E+00	ug/l	8.38E-03 lbs/day
DDT, DDE	1.00E-03 ug/l	4.50E-03 lbs/day	5.5E-01	ug/l	3.84E-03 lbs/day
Dieldrin	1.90E-03 ug/l	8.56E-03 lbs/day	1.3E+00	ug/l	8.72E-03 lbs/day
Endosulfan	5.60E-02 ug/l	2.52E-01 lbs/day	1.1E-01	ug/l	7.68E-04 lbs/day
Endrin	2.30E-03 ug/l	1.04E-02 lbs/day	9.0E-02	ug/l	6.28E-04 lbs/day
Guthion	0.00E+00 ug/l	0.00E+00 lbs/day	1.0E-02	ug/l	6.98E-05 lbs/day
Heptachlor	3.80E-03 ug/l	1.71E-02 lbs/day	2.6E-01	ug/l	1.81E-03 lbs/day
Lindane	8.00E-02 ug/l	3.60E-01 lbs/day	1.0E+00	ug/l	6.98E-03 lbs/day
Methoxychlor	0.00E+00 ug/l	0.00E+00 lbs/day	3.0E-02	ug/l	2.09E-04 lbs/day
Mirex	0.00E+00 ug/l	0.00E+00 lbs/day	1.0E-02	ug/l	6.98E-05 lbs/day
Parathion	0.00E+00 ug/l	0.00E+00 lbs/day	4.0E-02	ug/l	2.79E-04 lbs/day
PCB's	1.40E-02 ug/l	6.30E-02 lbs/day	2.0E+00	ug/l	1.40E-02 lbs/day
Pentachlorophenol	1.30E+01 ug/l	5.85E+01 lbs/day	2.0E+01	ug/l	1.40E-01 lbs/day
Toxephene	2.00E-04 ug/l	9.01E-04 lbs/day	7.3E-01	ug/l	5.09E-03 lbs/day

Effluent Targets for Pollution Indicators
Based upon Water Quality Standards

In-stream criteria of downstream segments for Pollution Indicators will be met with an effluent limit as follows:

	1 Hour Average Concentration	Loading
Gross Beta (pCi/l)	50.0 pCi/L	
BOD (mg/l)	5.0 mg/l	22.6 lbs/day
Nitrates as N	4.0 mg/l	18.0 lbs/day
Total Phosphorus as P	0.05 mg/l	0.2 lbs/day
Total Suspended Solids	90.0 mg/l	406.0 lbs/day

Note: Pollution indicator targets are for information purposes only.

Effluent Limitations for Protection of Human Health [Toxics Rule]
Based upon Water Quality Standards (Most stringent of 1C or 3A & 3B as appropriate.)

In-stream criteria of downstream segments for Protection of Human Health [Toxics] will be met with an effluent limit as follows:

	Maximum Concentration Concentration	Load
Toxic Organics		
Acenaphthene	2.70E+03 ug/l	1.22E+01 lbs/day
Acrolein	7.81E+02 ug/l	3.52E+00 lbs/day
Acrylonitrile	6.61E-01 ug/l	2.98E-03 lbs/day
Benzene	7.11E+01 ug/l	3.20E-01 lbs/day
Benzidine	ug/l	lbs/day
Carbon tetrachloride	4.41E+00 ug/l	1.98E-02 lbs/day
Chlorobenzene	2.10E+04 ug/l	9.47E+01 lbs/day
1,2,4-Trichlorobenzene		
Hexachlorobenzene	7.71E-04 ug/l	3.47E-06 lbs/day
1,2-Dichloroethane	9.91E+01 ug/l	4.46E-01 lbs/day
1,1,1-Trichloroethane		
Hexachloroethane	8.91E+00 ug/l	4.01E-02 lbs/day
1,1-Dichloroethane		
1,1,2-Trichloroethane	4.21E+01 ug/l	1.89E-01 lbs/day
1,1,2,2-Tetrachloroethane	1.10E+01 ug/l	4.96E-02 lbs/day
Chloroethane		
Bis(2-chloroethyl) ether	1.40E+00 ug/l	6.31E-03 lbs/day
2-Chloroethyl vinyl ether		
2-Chloronaphthalene	4.31E+03 ug/l	1.94E+01 lbs/day
2,4,6-Trichlorophenol	6.51E+00 ug/l	2.93E-02 lbs/day
p-Chloro-m-cresol		
Chloroform (HM)	4.71E+02 ug/l	2.12E+00 lbs/day
2-Chlorophenol	4.00E+02 ug/l	1.80E+00 lbs/day
1,2-Dichlorobenzene	1.70E+04 ug/l	7.66E+01 lbs/day
1,3-Dichlorobenzene	2.60E+03 ug/l	1.17E+01 lbs/day

1,4-Dichlorobenzene	2.60E+03 ug/l	1.17E+01 lbs/day
3,3'-Dichlorobenzidine	7.71E-02 ug/l	3.47E-04 lbs/day
1,1-Dichloroethylene	3.20E+00 ug/l	1.44E-02 lbs/day
1,2-trans-Dichloroethylene1		
2,4-Dichlorophenol	7.91E+02 ug/l	3.56E+00 lbs/day
1,2-Dichloropropane	3.90E+01 ug/l	1.76E-01 lbs/day
1,3-Dichloropropylene	1.70E+03 ug/l	7.66E+00 lbs/day
2,4-Dimethylphenol	2.30E+03 ug/l	1.04E+01 lbs/day
2,4-Dinitrotoluene	9.11E+00 ug/l	4.10E-02 lbs/day
2,6-Dinitrotoluene		
1,2-Diphenylhydrazine	5.41E-01 ug/l	2.43E-03 lbs/day
Ethylbenzene	2.90E+04 ug/l	1.31E+02 lbs/day
Fluoranthene	3.70E+02 ug/l	1.67E+00 lbs/day
4-Chlorophenyl phenyl ether		
4-Bromophenyl phenyl ether		
Bis(2-chloroisopropyl) ether	1.70E+05 ug/l	7.66E+02 lbs/day
Bis(2-chloroethoxy) methane		
Methylene chloride (HM)	1.60E+03 ug/l	7.21E+00 lbs/day
Methyl chloride (HM)		
Methyl bromide (HM)		
Bromoform (HM)	3.60E+02 ug/l	1.62E+00 lbs/day
Dichlorobromomethane(HM)	2.20E+01 ug/l	9.92E-02 lbs/day
Chlorodibromomethane (HM)	3.40E+01 ug/l	1.53E-01 lbs/day
Hexachlorocyclopentadiene	1.70E+04 ug/l	7.66E+01 lbs/day
Isophorone	6.01E+02 ug/l	2.70E+00 lbs/day
Naphthalene		
Nitrobenzene	1.90E+03 ug/l	8.57E+00 lbs/day
2-Nitrophenol		
4-Nitrophenol		
2,4-Dinitrophenol	1.40E+04 ug/l	6.31E+01 lbs/day
4,6-Dinitro-o-cresol	7.66E+02 ug/l	3.45E+00 lbs/day
N-Nitrosodimethylamine	8.11E+00 ug/l	3.65E-02 lbs/day
N-Nitrosodiphenylamine	1.60E+01 ug/l	7.21E-02 lbs/day
N-Nitrosodi-n-propylamine	1.40E+00 ug/l	6.31E-03 lbs/day
Pentachlorophenol	8.21E+00 ug/l	3.70E-02 lbs/day
Phenol	4.61E+06 ug/l	2.07E+04 lbs/day
Bis(2-ethylhexyl)phthalate	5.91E+00 ug/l	2.66E-02 lbs/day
Butyl benzyl phthalate	5.21E+03 ug/l	2.34E+01 lbs/day
Di-n-butyl phthalate	1.20E+04 ug/l	5.41E+01 lbs/day
Di-n-octyl phthlate		
Diethyl phthalate	1.20E+05 ug/l	5.41E+02 lbs/day
Dimethyl phthlate	2.90E+06 ug/l	1.31E+04 lbs/day
Benzo(a)anthracene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Benzo(a)pyrene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Benzo(b)fluoranthene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Benzo(k)fluoranthene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Chrysene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Acenaphthylene (PAH)		
Anthracene (PAH)		
Dibenzo(a,h)anthracene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day
Indeno(1,2,3-cd)pyrene (PAH)	3.10E-02 ug/l	1.40E-04 lbs/day

Pyrene (PAH)	1.10E+04 ug/l	4.96E+01 lbs/day
Tetrachloroethylene	8.91E+00 ug/l	4.01E-02 lbs/day
Toluene	2.00E+05 ug/l	9.02E+02 lbs/day
Trichloroethylene	8.11E+01 ug/l	3.65E-01 lbs/day
Vinyl chloride	5.26E+02 ug/l	2.37E+00 lbs/day
Pesticides		
Aldrin	1.40E-04 ug/l	6.31E-07 lbs/day
Dieldrin	1.40E-04 ug/l	6.31E-07 lbs/day
Chlordane	5.91E-04 ug/l	2.66E-06 lbs/day
4,4'-DDT	5.91E-04 ug/l	2.66E-06 lbs/day
4,4'-DDE	5.91E-04 ug/l	2.66E-06 lbs/day
4,4'-DDD	8.41E-04 ug/l	3.79E-06 lbs/day
alpha-Endosulfan	2.00E+00 ug/l	9.02E-03 lbs/day
beta-Endosulfan	2.00E+00 ug/l	9.02E-03 lbs/day
Endosulfan sulfate	2.00E+00 ug/l	9.02E-03 lbs/day
Endrin	8.11E-01 ug/l	3.65E-03 lbs/day
Endrin aldehyde	8.11E-01 ug/l	3.65E-03 lbs/day
Heptachlor	2.10E-04 ug/l	9.47E-07 lbs/day
Heptachlor epoxide		
PCB's		
PCB 1242 (Arochlor 1242)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1254 (Arochlor 1254)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1221 (Arochlor 1221)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1232 (Arochlor 1232)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1248 (Arochlor 1248)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1260 (Arochlor 1260)	4.51E-05 ug/l	2.03E-07 lbs/day
PCB-1016 (Arochlor 1016)	4.51E-05 ug/l	2.03E-07 lbs/day
Pesticide		
Toxaphene	7.51E-04 ug/l	3.38E-06 lbs/day
Metals		
Antimony	ug/l	lbs/day
Arsenic	ug/l	lbs/day
Asbestos	ug/l	lbs/day
Beryllium		
Cadmium		
Chromium (III)		
Chromium (VI)		
Copper	ug/l	lbs/day
Cyanide	ug/l	lbs/day
Lead		
Mercury	ug/l	lbs/day
Nickel	ug/l	lbs/day
Selenium		
Silver		
Thallium	ug/l	lbs/day
Zinc		

Dioxin		
Dioxin (2,3,7,8-TCDD)	1.40E-08 ug/l	6.31E-11 lbs/day

Metals Effluent Limitations for Protection of All Beneficial Uses Based upon Water Quality Standards and Toxics Rule

	Class 4 Acute Agricultural ug/l	Class 3 Acute Aquatic Wildlife ug/l	Acute Toxics Drinking Water Source ug/l	Acute Toxics Wildlife ug/l	1C Acute Health Criteria ug/l	Acute Most Stringent ug/l	Class 3 Chronic Aquatic Wildlife ug/l
Aluminum		750.9				750.9	N/A
Antimony				4305.1		4305.1	
Arsenic	100.1	340.4				100.1	190.2
Barium							
Beryllium						0.0	
Cadmium	10.0	12.3				10.0	1.0
Chromium (III)		7388.1				7388.1	353.1
Chromium (VI)	100.1	16.0				16.01	11.01
Copper	200.2	70.9				70.9	40.6
Cyanide		22.0	220263.4			22.0	5.2
Iron		836.4				836.4	
Lead	100.1	730.7				100.1	28.5
Mercury		2.40		0.15		0.15	0.012
Nickel		2013.9		4605.5		2013.9	223.9
Selenium	50.1	20.0				20.0	4.6
Silver		73.1				73.1	
Thallium				6.3		6.3	
Zinc		515.5				515.5	515.5
Boron	750.9					750.9	
Sulfate	2002.4					2002.4	

Summary Effluent Limitations for Metals [Wasteload Allocation, TMDL]
[If Acute is more stringent than Chronic, then the Chronic takes on the Acute value.]

	WLA Acute ug/l	WLA Chronic ug/l	
Aluminum	750.9	N/A	
Antimony	4305.15		
Arsenic	100.1	190.2	Acute Controls
Asbestos			
Barium			
Beryllium			
Cadmium	10.0	1.0	
Chromium (III)	7388.1	353	
Chromium (VI)	16.0	11.0	
Copper	70.9	40.6	

Cyanide	22.0	5.2	
Iron	836.4		
Lead	100.1	28.5	
Mercury	0.150	0.012	
Nickel	2013.9	224	
Selenium	20.0	4.6	
Silver	73.1	N/A	
Thallium	6.3		
Zinc	515.5	515.5	
Boron	750.90		
Sulfate	2002.4		N/A at this Waterbody

Other Effluent Limitations are based upon R317-1.

E. coli	126.0	organisms per 100 ml

X. Antidegradation Considerations

The Utah Antidegradation Policy allows for degradation of existing quality where it is determined that such lowering of water quality is necessary to accommodate important economic or social development in the area in which the waters are protected [R317-2-3]. It has been determined that certain chemical parameters introduced by this discharge will cause an increase of the concentration of said parameters in the receiving waters. Under no conditions will the increase in concentration be allowed to interfere with existing instream water uses.

An Antidegradation Level I Review was conducted on this discharge and its effect on the receiving water. Based upon that review, it has been determined that an Antidegradation Level II Review is not required. The proposed permit is a simple renewal, with no increase in flow or concentration over that which was approved in the existing permit.

XI. Colorado River Salinity Forum Considerations

Discharges in the Colorado River Basin are required to have their discharge at a TDS loading of less than 1.00 tons/day unless certain exemptions apply. Refer to the Forum's Guidelines for additional information allowing for an exceedence of this value.

XII. Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving water beneficial uses with their associated water quality standards, including important down-stream segments, will not occur for the evaluated parameters of concern as discussed above if the effluent limitations indicated above are met.