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

Date: **December 18, 2012**

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Water Quality Management Section

Facility: **Price River Water Improvement District Wastewater Treatment Plant, Wellington, UT**
UPDES No. UT0021814

Receiving water: **Price River (2B, 3C, 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: Price River

The maximum daily design discharge is 8 MGD and the maximum monthly design discharge is 4 MGD for the facility. The facility has had steady operations for the past five years and only anticipates limited growth during the permit duration; therefore, a maximum daily discharge of 3.0 MGD and maximum monthly discharge of 2.2 MGD were used for the wasteload analysis.

Receiving Water
The receiving water for Outfall 001 is the Price River, which is tributary to the Green River, and the Colorado River.

Per UAC R317-2-13.1.b, the designated beneficial uses for the Price River from the confluence with the Green River to the Carbon Canal Diversion at Price City Golf Course are 2B, 3C, and 4.

- *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 3C - Protected for nongame fish and other 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). Due to a lack of flow records for the Price River downstream of the irrigation diversions, the 20^{th} percentile of flow measurements from water quality monitoring conducted above the facility outfall was calculated to estimate the annual critical flow in the receiving water (14.0 cfs). Insufficient flow data was available to estimate seasonal low flow.

For chronic conditions, the critical low flow was simulated; for acute conditions, 50% of the critical low flow was simulated.

TMDL

A TMDL for total dissolved solids (TDS) was completed for this segment of the Price River (*Price River, San Rafael River, and Muddy Creek TMDLs for Total Dissolved Solids, West Colorado Watershed Management Unit, Utah; EPA Approval Date August 4, 2004*). A site specific standard was recommended for TDS. Per UAC R317-2-14 Table 2.14.1, a site specific standard of 1,700 mg/L applies to the Price River and tributaries from Soldier Creek to Carbon Canal Diversion.

Mixing Zone

The 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.

Based on field observations of specific conductivity across the cross-section during the synoptic survey data collection, the discharge was fully mixed approximately 75 meters downstream of the discharge point. Therefore, the allowable mixing zone is 75 meters.

Parameters of Concern

The potential parameters of concern identified for the discharge/receiving water were total suspended solids (TSS), total dissolved solids (TDS), dissolved oxygen (DO), BOD_5, total phosphorus (TP), total nitrogen (TN), total ammonia (TAM), E. coli, pH, and total residual chlorine (TRC) as determined in consultation with the UPDES Permit Writer.

Water Quality Modeling

A QUAL2Kw model of the receiving water was built and calibrated under contract by Utah State University (USU). The model was calibrated to synoptic survey data collected in the summer of 2010 by USU and DWQ (8/30 to 9/1/2010). The model extends from immediately above the plant discharge to the crossing at Ridge Road (approximately 0.8 km).

Receiving water quality data was obtained from monitoring site 4992390 Price River above Price WWTP at Wellington Bridge. The average seasonal value was calculated for each constituent with available data in the receiving water.

For determining the receiving water criteria and limits due to ammonia toxicity, the effluent was assumed to have a pH of 7.3 for chronic conditions and 7.6 for acute conditions. Average seasonal temperatures were used for the effluent.

The calibrated model was used for determining WQBELs. Effluent concentrations were adjusted so that water quality standards were not exceeded at the end of the mixing zone. Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

The calibration model and the wasteload model are available for review by request.

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.

Table 1: WET Limits for IC_{25}

Season	Percent Effluent
Summer	18%
Fall	18%
Winter	18%
Spring	18%

Effluent Limits

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A DO sag downstream in the Price River resulting from the plant discharge was observed and predicted by the model due to decay of BOD in the effluent and benthic algal growth and decomposition resulting from nutrients in the effluent. However, the DO sag was not predicted to exceed water quality criteria and recovery was beginning to occur within the model extents. The benthic algae growth appeared to be limited by light as a result of high turbidity due to suspended solids. Therefore, limits beyond secondary standards are not required for DO and BOD_5 (Table 2).

QUAL2Kw rates, input and output for DO and nutrient related constituents are summarized in Appendix A.

A simple mixing analysis was conducted for constituents not related to DO and nutrients such as dissolved metals and TRC. The simple mixing analysis WQBELs are summarized in Appendix B.

Models and supporting documentation are available for review upon request.

Table 2: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute		Chronic	
	Standard	Limit	Standard	Limit
Flow (MGD)		3.0		2.2
Ammonia (mg/L)[1]	Varies[2]	16.0	Varies[3]	10.0
Dissolved Oxygen Min. (mg/L)	3.0	5.0	5.0	5.0
BOD_5 (mg/L)	None	35	None	25
TRC (mg/L)	0.019	0.076	0.011	0.056
1: Ammonia limit due to toxicity requirements. 2: Standard varies with pH. 3: Standard varies with pH and temperature.				

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 discharge, as pollutant concentration and load will not increase under this permit renewal.

WLA Document: *price_potw_wla_2012_final.docx*
QUAL2Kw Calibration Model: *Qual2kw Price Calibration 1.1.xls*
QUAL2Kw Wasteload Model: *price_potw_wla_2012.xlsm*

WASTELOAD ANALYSIS [WLA] Date: 12/18/2012
Appendix A: QUAL2Kw Analysis Results

DiscRarging Facility:	Price Water Improvement District WWTP		
UPDES No:	UT-0021814		
Permit Flow [MGD]:	3.00	Maximum Daily Flow	
	2.20	Maximum Monthly Flow	
Receiving Water:	Price River		
Stream Classification:	2B, 3C, 4		
Stream Flows [cfs]:	14.00	Summer (July-Sept)	Critical Low Flow
	14.00	Fall (Oct-Dec)	
	14.00	Winter (Jan-Mar)	
	14.00	Spring (Apr-June)	
Acute River Width:	50%		
Chronic River Width:	100%		

Modeling Information

A QUAL2Kw model was used to determine these effluent limits.

Model Inputs

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

Headwater/Upstream Information	Summer	Fall	Winter	Spring
Flow (cfs)	14.0	14.0	14.0	14.0
Temperature (deg C)	16.4	4.6	6.0	9.6
Specific Conductance (µmhos)	1943	2242	1137	955
Inorganic Suspended Solids (mg/L)	265.2	33.7	304.8	309.8
Dissolved Oxygen (mg/L)	7.2	11.9	9.6	9.2
$CBOD_5$ (mg/L)	3.7	3.7	3.7	3.7
Organic Nitrogen (mg/L)	0.400	0.400	0.400	0.400
NH4-Nitrogen (mg/L)	0.088	0.025	0.042	0.042
NO3-Nitrogen (mg/L)	0.925	0.647	0.280	0.203
Organic Phosphorus (mg/L)	0.242	0.023	0.261	0.239
Inorganic Ortho-Phosphorus (mg/L)	0.015	0.010	0.010	0.013
Phytoplankton (µg/L)	7.000	7.000	7.000	7.000
Detritus [POM] (mg/L)	66.3	8.4	76.2	77.5
Alkalinity (mg/L)	219	219	219	219
pH	8.3	8.3	8.5	8.6

Discharge Information - Chronic	Summer	Fall	Winter	Spring
Flow (mgd)	2.2			
Temperature (deg C)	21.0			
Specific Conductance (µmhos)	1795			
Inorganic Suspended Solids (mg/L)	6.1			
Dissolved Oxygen (mg/L)	5.0			
$CBOD_5$ (mg/L)	25.0			
Organic Nitrogen (mg/L)	5.000			
NH4-Nitrogen (mg/L)	10.000			
NO3-Nitrogen (mg/L)	12.050			
Organic Phosphorus (mg/L)	5.000			
Inorganic Ortho-Phosphorus (mg/L)	5.000			
Phytoplankton (µg/L)	11.000			
Detritus [POM] (mg/L)	0.0			
Alkalinity (mg/L)	208			
pH	7.3			

Discharge Information - Acute	Summer	Fall	Winter	Spring
Flow (mgd)	3.0			
Temperature (deg C)	21.0			
Specific Conductance (μmhos)	1795			
Inorganic Suspended Solids (mg/L)	6.1			
Dissolved Oxygen (mg/L)	5.0			
$CBOD_5$ (mg/L)	35.0			
Organic Nitrogen (mg/L)	10.000			
NH4-Nitrogen (mg/L)	16.000			
NO3-Nitrogen (mg/L)	12.050			
Organic Phosphorus (mg/L)	5.000			
Inorganic Ortho-Phosphorus (mg/L)	5.000			
Phytoplankton (μg/L)	11.000			
Detritus [POM] (mg/L)	0.0			
Alkalinity (mg/L)	208			
pH	7.6			

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

Effluent Limitations

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 reflect the environmental conditions expected at low stream flows.

Effluent Limitations based upon Water Quality Standards for DO and Ammonia Toxicity

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

Chronic	Standard	Summer	Fall	Winter	Spring
Flow (MGD)	N/A	2.2			
Organic Nitrogen (mg/L)	N/A	None			
NH4-Nitrogen (mg/L)	Varies	10.0			
NO3-Nitrogen (mg/L)	N/A	None			
Inorganic Phosphorus (mg/L)	N/A	None			
$CBOD_5$ (mg/L)	N/A	25.0			
Dissolved Oxygen [30-day Ave] (mg/L)	5.0	5.0			

Acute	Standard	Summer	Fall	Winter	Spring
Flow (cfs)	N/A	3.0			
Organic Nitrogen (mg/L)	N/A	None			
NH4-Nitrogen (mg/L)	Varies	16.0			
NO3-Nitrogen (mg/L)	N/A	None			
Inorganic Phosphorus (mg/L)	N/A	None			
$CBOD_5$ (mg/L)	N/A	35.0			
Dissolved Oxygen [Minimum] (mg/L)	3.0	5.0			

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.

Coefficients and Other Model Information

Parameter	*Value*	*Units*
Stoichiometry:		
Carbon	40	gC
Nitrogen	7.2	gN
Phosphorus	1	gP
Dry weight	100	gD
Chlorophyll	1	gA
Inorganic suspended solids:		
Settling velocity	0.2	m/d
Oxygen:		
Reaeration model	USGS(pool-riffle)	
Temp correction	1.024	
Reaeration wind effect	None	
O2 for carbon oxidation	2.69	gO2/gC
O2 for NH4 nitrification	4.57	gO2/gN
Oxygen inhib model CBOD oxidation	Exponential	
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2
Oxygen inhib model nitrification	Exponential	
Oxygen inhib parameter nitrification	0.60	L/mgO2
Oxygen enhance model denitrification	Exponential	
Oxygen enhance parameter denitrification	0.60	L/mgO2
Oxygen inhib model phyto resp	Exponential	
Oxygen inhib parameter phyto resp	0.60	L/mgO2
Oxygen enhance model bot alg resp	Exponential	
Oxygen enhance parameter bot alg resp	0.60	L/mgO2
Slow CBOD:		
Hydrolysis rate	0	/d
Temp correction	1.047	
Oxidation rate	0.103	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.2532525	/d
Temp correction	1.07	
Settling velocity	0.186698	m/d
Ammonium:		
Nitrification	0.052449	/d
Temp correction	1.07	
Nitrate:		
Denitrification	0.3067175	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.74405	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.1347925	/d
Temp correction	1.07	
Settling velocity	0.132374	m/d
Inorganic P:		
Settling velocity	1.9476	m/d
Sed P oxygen attenuation half sat constant	0.10486	mgO2/L

Phytoplankton:		
Max Growth rate	2.424195	/d
Temp correction	1.07	
Respiration rate	0.2453945	/d
Temp correction	1.07	
Death rate	0.07159	/d
Temp correction	1	
Nitrogen half sat constant	15	ugN/L
Phosphorus half sat constant	2	ugP/L
Inorganic carbon half sat constant	1.30E-05	moles/L
Phytoplankton use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	57.6	langleys/d
Ammonia preference	16.82115	ugN/L
Settling velocity	0.098591	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	15.75627	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.0691094	/d
Photo-respiration rate parameter	0.01	unitless
Temp correction	1.07	
Excretion rate	0.3327	/d
Temp correction	1.07	
Death rate	1.66875	/d
Temp correction	1.07	
External nitrogen half sat constant	350.448	ugN/L
External phosphorus half sat constant	67.2535	ugP/L
Inorganic carbon half sat constant	7.41E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Smith	
Light constant	68.6698	mgO^2/L
Ammonia preference	17.5728	ugN/L
Subsistence quota for nitrogen	0.8808192	mgN/gD
Subsistence quota for phosphorus	0.0874835	mgP/gD
Maximum uptake rate for nitrogen	743.668	mgN/gD/d
Maximum uptake rate for phosphorus	144.8225	mgP/gD/d
Internal nitrogen half sat ratio	1.597312	
Internal phosphorus half sat ratio	4.9713625	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	0.279779	/d
Temp correction	1.07	
Settling velocity	0.0739985	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Max. Air Temperature, F	88.2	51.8	42.9	72.4
Min. Air Temperature, F	50.5	17.7	14.1	36.2
Dew Point, Temp., F	54.5	29.9	26.0	44.3
Wind, ft./sec. @ 21 ft.	6.6	5.8	5.8	8.4
Cloud Cover, %	0.1	0.1	0.1	0.1

Other Inputs:

Bottom Algae Coverage	100.0%	
Bottom SOD Coverage	100.0%	
Prescribed SOD	0.1	gO2/m2/d

WASTELOAD ANALYSIS [WLA] Date: 12/18/2012

Appendix B: Simple Mixing Analysis Results

Discharging Facility:	Price Water Improvement District WWTP		
UPDES No:	UT-0021814		
Permit Flow [MGD]:	3.00	Maximum Daily Flow	
	2.20	Maximum Monthly Flow	
Receiving Water:	Price River		
Stream Classification:	2B, 3C, 4		
Stream Flows [cfs]:	14.00	Summer (July-Sept)	Critical Low Flow
	14.00	Fall (Oct-Dec)	
	14.00	Winter (Jan-Mar)	
	14.00	Spring (Apr-June)	
Acute River Width:	50%		
Chronic River Width:	100%		

Modeling Information

A simple mixing analysis was used to determine these effluent limits.

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

Effluent Limitations

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 reflect the environmental conditions expected at low stream flows.

Effluent Limitations for Protection of Recreation (Class 2B Waters)

Parameter	Maximum Concentration
Physical	
pH Minimum	6.5
pH Maximum	9.0
Bacteriological	
E. coli (30 Day Geometric Mean)	206 (#/100 mL)
E. coli (Maximum)	668 (#/100 mL)

Effluent Limitations for Protection of Aquatic Wildlife (Class 3C Waters)

Parameter	Maximum Concentration
Physical	
Temperature	Max (deg C)
Summer	26.4
Fall	14.7
Winter	16.0
Spring	19.7

Inorganics	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
	Standard	Limit	Unit	Standard	Limit	Unit
Total Residual Chlorine (TRC)	0.011	0.056	mg/L	0.019	0.048	mg/L
Phenol				0.010	0.018	mg/L
Hydrogen Sulfide (Undissociated)				0.002	0.004	mg/L

Dissolved Metals

	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	**Standard**	**Limit**	**Unit**	**Standard**	**Limit**	**Unit**
Aluminum	87.0	265.9	µg/L	750.0	1315.5	µg/L
Arsenic	150.0	458.5	µg/L	340.0	596.4	µg/L
Cadmium	0.6	2.0	µg/L	7.7	13.6	µg/L
Chromium VI	11.0	33.6	µg/L	16.0	28.1	µg/L
Chromium III	230.7	705.0	µg/L	1773.3	3110.5	µg/L
Copper	29.3	89.5	µg/L	49.6	87.0	µg/L
Cyanide	22.0	67.2	µg/L	5.2	9.1	µg/L
Iron				1000.0	1754.1	µg/L
Lead	10.9	33.5	µg/L	280.8	492.6	µg/L
Mercury	0.012	0.037	µg/L	2.4	4.2	µg/L
Nickel	168.0	513.6	µg/L	1512.9	2653.7	µg/L
Selenium	4.6	14.1	µg/L	18.4	32.3	µg/L
Silver				34.9	61.2	µg/L
Tributylin	0.072	0.220	µg/L	0.46	0.81	µg/L
Zinc	382.4	1168.8	µg/L	379.3	665.3	µg/L

Based upon a Hardness of 400 mg/l as CaCO3
Ambient concentration assumed 1/2 of water quality standard

Organics [Pesticides]

	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	**Concentration**			**Concentration**		
Aldrin				1.500	2.631	µg/L
Chlordane	0.0043	0.013	µg/L	1.200	2.105	µg/L
DDT, DDE	0.001	0.003	µg/L	0.550	0.965	µg/L
Diazinon	0.17	0.520	µg/L	0.17	0.298	µg/L
Dieldrin	0.0056	0.017	µg/L	0.240	0.421	µg/L
Endosulfan, a & b	0.056	0.171	µg/L	0.110	0.193	µg/L
Endrin	0.036	0.110	µg/L	0.086	0.151	µg/L
Heptachlor & H. epoxide	0.0038	0.012	µg/L	0.260	0.456	µg/L
Lindane	0.08	0.245	µg/L	1.000	1.754	µg/L
Methoxychlor				0.030	0.053	µg/L
Mirex				0.001	0.002	µg/L
Nonylphenol	6.6	20.173	µg/L	28.0	49.113	µg/L
Parathion	0.0130	0.040	µg/L	0.066	0.116	µg/L
PCB's	0.014	0.043	µg/L			
Pentachlorophenol	15.00	45.848	µg/L	19.000	33.327	µg/L
Toxephene	0.0002	0.001	µg/L	0.730	1.280	µg/L

Radiological

Parameter	**Maximum Concentration**
Gross Alpha	15 pCi/L

Effluent Limitation for Protection of Agriculture (Class 4 Waters)

Parameter	**Maximum Concentration**			
	Standard	**Limit**	**Unit**	
Total Dissolved Solids	1700	1700	mg/L	Site specific standard
Boron	75	229	µg/L	
Arsenic	100	306	µg/L	
Cadmium	10	31	µg/L	
Chromium	100	306	µg/L	
Copper	200	611	µg/L	
Lead	100	306	µg/L	
Selenium	50	153	µg/L	
Gross Alpha	15	46	pCi/L	