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

Date: **October 5, 2012**

Prepared by: **Nicholas von Stackelberg, P.E.**
Water Quality Management Section

Facility: **Springville City Water Reclamation Facility**
Springville, UT
UPDES No. UT0020834

Receiving water: **Little Spring Creek (2B, 3D, 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: Little Spring Creek

The maximum daily discharge is 6.6 MGD and the maximum monthly discharge is 5.7 MGD for the facility. These discharge limits were determined by Springville City and includes projected growth in the next five years and a factor of safety.

Receiving Water
The receiving water for Outfall 001 is Little Spring Creek, which is tributary to Big Spring Creek, Mill Race and Provo Bay of Utah Lake.

Per UAC R317-2-13.5.a, the designated beneficial uses for Little Spring Creek from the confluence of Big Spring Creek to headwaters are 2B, 3D, 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 3D - Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, 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 Little Spring Creek, the 20th percentile of flow measurements from water quality monitoring conducted by RB&G Engineering Inc. from 1987 - 1992 was calculated to estimate seasonal critical flow in the receiving water (Table 1).

Table 1: Seasonal critical low flow

Season	Flow (cfs)	
	Headwater Spring	Little Spring Creek
Summer	6.2	0.8
Fall	7.3	1.8
Winter	6.7	2.0
Spring	5.2	1.7

TMDL

Little Spring Creek and Big Spring Creek are not listed as impaired for any parameters according to the 2010 303(d) list. Utah Lake is listed as impaired for Total Phosphorus and Total Dissolved Solids.

Mixing Zone

The discharge is considered instantaneously fully mixed since the discharge is mixed with the headwater spring within a manhole structure. Therefore, no mixing zone is allowed.

Since the discharge is considered fully mixed, the critical low flow was simulated for both chronic and acute conditions.

Parameters of Concern

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

Water Quality Modeling

A QUAL2Kw model of the receiving water was built based on physiographic information from Google Earth and site data collected by DWQ staff. The model extends from the plant discharge at the open channel along Spring Creek Road to the pond located at the southeast corner of the intersection of Mountain Springs Parkway and Utah Highway 75 (in front of Flowserve).

Insufficient observed data was available for model calibration. The rate parameters used in the model were the same as those used for the Spanish Fork WWTP QUAL2Kw model, which was calibrated under contract by Utah State University. Little Spring Creek was considered to have similar stream characteristics to Dry Creek.

Receiving water quality data was obtained from monitoring site 4996290 Spring Creek above Springville WWTP. The average seasonal value was calculated for each constituent with available data in the receiving water.

The QUAL2Kw model was used for determining the WQBELs. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water.

Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

The wasteload model is 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 2: WET Limits for IC_{25}

Season	Percent Effluent
Summer	59%
Fall	55%
Winter	57%
Spring	63%

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 Little Spring Creek resulting from the plant discharge was predicted by the model, however, the DO did not fall below the standard and limits beyond secondary standards are not required for DO and BOD_5 (Table 3).

The chronic and acute ammonia limits were determined using the QUAL2Kw model.

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

A simple mixing analysis was conducted for conservative constituents such as dissolved metals. The simple mixing analysis WQBELs are summarized in Appendix B.

Models and supporting documentation are available for review upon request.

Table 3: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		6.6	1 day		5.7	30 days
Ammonia (mg/L)[1]	Varies	8.0	1 hour	Varies	1.75	30 days
Min. Dissolved Oxygen (mg/L)	3.0	5.0	Instantaneous	5.0	5.0	30 days
BOD_5 (mg/L)	None	35	7 days	None	25	30 days

1: Ammonia limit due to toxicity requirements

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, and the pollutant concentration and load from the facility is not being increased under this permit renewal.

WLA Document: *springville_potw_wla_2012_final.docx*
QUAL2Kw Wasteload Model: *springville_potw_wla_2012_final.xlsm*

WASTELOAD ANALYSIS [WLA] Date: 10/5/2012
Appendix A: QUAL2Kw Analysis for Eutrophication

Discharging Facility:	Springville WWTP	
UPDES No:	UT-0020834	
Permit Flow [MGD]:	5.7 Maximum Monthly Flow	
	6.6 Maximum Daily Flow	
Receiving Water:	Little Spring Creek	
Stream Classification:	2B, 3D, 4	
Stream Flows [cfs]:	6.2 Summer (July-Sept)	Critical Low Flow
	7.3 Fall (Oct-Dec)	
	6.7 Winter (Jan-Mar)	
	5.2 Spring (Apr-June)	
Fully Mixed:	YES	
Acute River Width:	100%	
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. Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Headwater/Upstream Information	Summer	Fall	Winter	Spring
Flow (cfs)	6.2	7.3	6.7	5.2
Temperature (deg C)	20.9	12.8	8.7	13.6
Specific Conductance (µmhos)	1158	1158	1158	1158
Inorganic Suspended Solids (mg/L)	4.0	4.7	12.6	8.4
Dissolved Oxygen (mg/L)	9.0	9.0	9.9	9.3
$CBOD_5$ (mg/L)	2.5	1.5	1.8	3.9
Organic Nitrogen (mg/L)	0.500	0.500	0.500	0.500
NH4-Nitrogen (mg/L)	0.031	0.043	0.028	0.029
NO3-Nitrogen (mg/L)	0.850	0.850	0.850	0.850
Organic Phosphorus (mg/L)	0.000	0.000	0.000	0.000
Inorganic Ortho-Phosphorus (mg/L)	4.500	4.500	4.500	4.500
Phytoplankton (µg/L)	0.0	0.0	0.0	0.0
Detritus [POM] (mg/L)	0.4	0.5	1.4	0.9
Alkalinity (mg/L)	235	235	235	235
pH	8.4	8.0	8.1	8.1

Discharge Information	Summer	Fall	Winter	Spring
Flow (cfs)	5.7	5.7	5.7	5.7
Temperature (deg C)	22.8	16.2	12.7	17.5
Inorganic Suspended Solids (mg/L)	10.8	12.5	16.2	15.1
NO3-Nitrogen (mg/L)	12.908	13.040	15.418	12.298
Organic Phosphorus (mg/L)	0.000	0.000	0.000	0.000
Alkalinity (mg/L)	235	235	235	235
pH	7.6	8.0	7.7	7.7

Tributary Information	Summer	Fall	Winter	Spring
Flow (cfs)	0.8	1.8	2.0	1.7
Temperature (deg C)	20.9	12.8	8.7	13.6
Specific Conductance (µmhos)	1158.0	1158.0	1158.0	1158.0
Inorganic Suspended Solids (mg/L)	4.0	4.7	12.6	8.4
Dissolved Oxygen (mg/L)	9.0	9.0	9.9	9.3
$CBOD_5$ (mg/L)	2.5	1.5	1.8	3.9
Organic Nitrogen (mg/L)	0.5	0.5	0.5	0.5
NH4-Nitrogen (mg/L)	0.0	0.0	0.0	0.0
NO3-Nitrogen (mg/L)	0.9	0.9	0.9	0.9
Organic Phosphorus (mg/L)	0.0	0.0	0.0	0.0
Inorganic Ortho-Phosphorus (mg/L)	4.5	4.5	4.5	4.5
Phytoplankton (µg/L)	0.0	0.0	0.0	0.0
Detritus [POM] (mg/L)	0.4	0.5	1.4	0.9
Alkalinity (mg/L)	235.0	235.0	235.0	235.0
pH	8.4	8.0	8.1	8.1

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 will be met with an effluent limitation as follows:

Chronic	Standard	Summer	Fall	Winter	Spring
Flow (MGD)	N/A	5.7			5.7
Organic Nitrogen (mg/L)	N/A	5.0			5.0
NH4-Nitrogen (mg/L)	Varies	1.8			2.0
Inorganic Phosphorus (mg/L)	N/A	5.0			5.0
$CBOD_5$ (mg/L)	N/A	25.0			25.0
Dissolved Oxygen [30-day Ave] (mg/L)	5.0	5.0			5.0

Acute	Standard	Summer	Fall	Winter	Spring
Flow (cfs)	N/A	6.6			6.6
Organic Nitrogen (mg/L)	N/A	10.0			10.0
NH4-Nitrogen (mg/L)	Varies	8.0			8.0
Inorganic Phosphorus (mg/L)	N/A	10.0			10.0
$CBOD_5$ (mg/L)	N/A	35.0			35.0
Dissolved Oxygen [Minimum] (mg/L)	3.0	5.0			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	0.001	m/d
Oxygen:		
Reaeration model	Internal	
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	0.242802	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.2625675	/d
Temp correction	1.07	
Settling velocity	0.087906	m/d
Ammonium:		
Nitrification	2.817054	/d
Temp correction	1.07	
Nitrate:		
Denitrification	1.756367	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.24334	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.227735	/d
Temp correction	1.07	
Settling velocity	0.103774	m/d
Inorganic P:		
Settling velocity	0.06798	m/d
Sed P oxygen attenuation half sat constant	0.99342	mgO2/L

Phytoplankton:		
Max Growth rate	2.57133	/d
Temp correction	1.07	
Respiration rate	0.1432355	/d
Temp correction	1.07	
Death rate	0.45734	/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	15	ugN/L
Settling velocity	0.0645665	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	8.663865	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.1046738	/d
Photo-respiration rate parameter	0.39	unitless
Temp correction	1.07	
Excretion rate	0.05015	/d
Temp correction	1.07	
Death rate	0.1437	/d
Temp correction	1.07	
External nitrogen half sat constant	127.576	ugN/L
External phosphorus half sat constant	89.161	ugP/L
Inorganic carbon half sat constant	1.10E-04	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Half saturation	
Light constant	71.6656	langleys/d
Ammonia preference	15.2922	ugN/L
Subsistence quota for nitrogen	0.9375732	mgN/gD
Subsistence quota for phosphorus	0.058037	mgP/gD
Maximum uptake rate for nitrogen	640.4095	mgN/gD/d
Maximum uptake rate for phosphorus	190.7675	mgP/gD/d
Internal nitrogen half sat ratio	1.8677685	
Internal phosphorus half sat ratio	4.4374015	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	3.773984	/d
Temp correction	1.07	
Settling velocity	0.097025	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Min. Air Temperature, F	57.7	29.5	24.0	45.0
Max. Air Temperature, F	90.5	51.0	44.9	74.2
Dew Point, Temp., F	58.6	35.0	30.3	48.5
Wind, ft./sec. @ 21 ft.	9.8	7.5	7.6	9.2
Cloud Cover, %	10%	10%	10%	10%

Other Inputs:	
Bottom Algae Coverage	100%
Bottom SOD Coverage	100%
Prescribed SOD, $gO_2/m^2/day$	0

WASTELOAD ANALYSIS [WLA] Date: 10/5/2012

Appendix B: Simple Mixing Analysis for Conservative Constituents

Discharging Facility:	Springville WWTP		
UPDES No:	UT-0020834		
Permit Flow [MGD]:	5.7	Maximum Monthly Flow	
	6.6	Maximum Daily Flow	
Receiving Water:	Little Spring Creek		
Stream Classification:	2B, 3D, 4		
Stream Flows [cfs]:	6.2	Summer (July-Sept)	Critical Low Flow
	7.3	Fall (Oct-Dec)	
	6.7	Winter (Jan-Mar)	
	5.2	Spring (Apr-June)	
Fully Mixed:	YES		
Acute River Width:	100%		
Chronic River Width:	100%		

Modeling Information

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

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis. Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Headwater/Upstream Information

	Headwater Spring cfs	Little Spring Creek cfs
Summer	6.2	0.8
Fall	7.3	1.8
Winter	6.7	2.0
Spring	5.2	1.7

Discharge Information

	Flow MGD
Maximum Daily	6.6
Maximum Monthly	5.7

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)

Physical Parameter	Maximum Concentration
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 3D Waters)

Inorganics Parameter	Chronic Standard (4 Day Average) Standard	Acute Standard (1 Hour Average) Standard
Phenol (mg/L)		0.010
Hydrogen Sulfide (Undissociated) [mg/L]		0.002

Dissolved Metals	Chronic Standard (4 Day Average)[1]			Acute Standard (1 Hour Average)[1]		
Parameter	Standard	Background[2]	Limit	Standard	Background[2]	Limit
Aluminum (µg/L)	87.0	58.3	118.0	750.0	58.3	1395.0
Arsenic (µg/L)	150.0	100.5	203.4	340.0	100.5	563.3
Cadmium (µg/L)	0.5	0.3	0.6	4.9	0.3	9.2
Chromium VI (µg/L)	11.0	7.4	14.9	16.0	7.4	24.0
Chromium III (µg/L)	157.0	105.2	212.9	1206.7	105.2	2233.8
Copper (µg/L)	19.6	13.1	26.6	31.9	13.1	49.3
Cyanide (µg/L)	5.2	3.5	7.1	22.0	3.5	39.3
Iron (µg/L)				1000.0	670.0	1307.7
Lead (µg/L)	6.7	4.5	9.1	172.3	4.5	328.8
Mercury (µg/L)	0.012	0.008	0.016	2.4	0.0	4.6
Nickel (µg/L)	112.9	75.6	153.1	1016.5	75.6	1893.8
Selenium (µg/L)	4.6	3.1	6.2	18.4	3.1	32.7
Silver (µg/L)				15.6	10.4	20.3
Tributylin (µg/L)	0.072	0.048	0.098	0.46	0.05	0.84
Zinc (µg/L)	256.8	172.0	348.3	254.7	172.0	331.8

1: Based upon a Hardness of 250 mg/l as CaCO3

2: Background concentration assumed 67% of chronic standard

Organics [Pesticides]	Chronic Standard (4 Day Average)			Acute Standard (1 Hour Average)		
Parameter	Standard	Background[1]	Limit	Standard	Background[1]	Limit
Aldrin (µg/L)				1.5	1.0	2.0
Chlordane (µg/L)	0.0043	0.0029	0.0058	1.2	0.0	2.3
DDT, DDE (µg/L)	0.001	0.001	0.001	0.55	0.00	1.06
Diazinon (µg/L)	0.17	0.11	0.23	0.17	0.11	0.22
Dieldrin (µg/L)	0.0056	0.0038	0.0076	0.24	0.00	0.46
Endosulfan, a & b (µg/L)	0.056	0.038	0.076	0.11	0.04	0.18
Endrin (µg/L)	0.036	0.024	0.049	0.086	0.024	0.144
Heptachlor & H. epoxide (µg/L)	0.0038	0.0025	0.0052	0.26	0.00	0.50
Lindane (µg/L)	0.08	0.05	0.11	1.0	0.1	1.9
Methoxychlor (µg/L)				0.03	0.02	0.04
Mirex (µg/L)				0.001	0.001	0.001
Nonylphenol (µg/L)	6.6	4.4	9.0	28.0	4.4	50.0
Parathion (µg/L)	0.0130	0.0087	0.0176	0.066	0.009	0.119
PCB's (µg/L)	0.014	0.009	0.019			
Pentachlorophenol (µg/L)	15.0	10.1	20.3	19.0	10.1	27.3
Toxephene (µg/L)	0.0002	0.0001	0.0003	0.73	0.00	1.41

1: Background concentration assumed 67% of chronic standard

Radiological	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Gross Alpha (pCi/L)	15	10.1	20.3

1: Background concentration assumed 67% of chronic standard; TDS is based on observed ambient data

Effluent Limitation for Protection of Agriculture (Class 4 Waters)

	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Total Dissolved Solids (mg/L)	1200	700	1740
Boron (µg/L)	75	50.3	101.7
Arsenic (µg/L)	100	67.0	135.6
Cadmium (µg/L)	10	6.7	13.6
Chromium (µg/L)	100	67.0	135.6
Copper (µg/L)	200	134.0	271.3
Lead (µg/L)	100	67.0	135.6
Selenium (µg/L)	50	33.5	67.8
Gross Alpha (pCi/L)	15	10.1	20.3

1: Background concentration assumed 67% of chronic standard; TDS is based on observed ambient data