Utah Division of Water Quality
Statement of Basis
Wasteload Analysis for Ammonia for South Davis Sewer District

Date: **March 9, 2016**

Facility: **South Davis Sewer District**
South and North Wastewater Treatment Plants

Pollutant: **Chronic Ammonia**

Receiving water: **Jordan River and State Canal**

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.

This addendum supersedes the chronic ammonia allocation in the combined wasteload analysis for the Jordan River POTWs.

Discharges

The wasteload allocation is for South Davis Sewer District's (SDSD) South and North Wastewater Treatment Plants (WWTP). UAC R317-8-4.3(2)(a) states: In the case of POTWs, permit effluent limitations, standards, or prohibitions will be calculated based on design flow. The maximum monthly average discharges at design capacity were used in this wasteload allocation (Table 1), as provided by South Davis Sewer District.

Table 1: SDSD design capacity discharges

Facility	Monthly Average (MGD)
SDSD South WWTP	4
SDSD North WWTP	12

Effluent water quality data were obtained from UDWQ monitoring, Jordan River/Farmington Bay Water Quality Council (JRFBWQC) monitoring, and Discharge Monitoring Reports (DMR) and Monthly Operating Reports (MOR) from each facility.

Receiving Waters

The receiving waters for this wasteload allocation are the Jordan River and State Canal. Per UAC R317-2-14, the designated beneficial uses for the Jordan River and State Canal are shown in Table 2.

Table 2: Beneficial uses for receiving waters

Facility	Receiving Water	Beneficial Uses
SDSD South WWTP	Jordan River, from Farmington Bay to North Temple Street	2B, 3B*,3D, 4
SDSD North WWTP	State Canal, from Farmington Bay to confluence with the Jordan River	2B, 3B*,3D, 4
* Site specific criteria for dissolved oxygen. See UAC R317.2.14 Table 2.14.5.		

Per UAC R317-2-6, following is the description for each beneficial use listed in Table 2.

- *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 3B - Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.*
- *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). The seasonal 7Q10 flows calculated in the *Jordan River Flow Analysis* report (Borup and Haws, 1999) were used for the critical low flows for the tributaries and diversions along the Jordan River. The groundwater flow in each reach of the Jordan River was modified to match the groundwater flows in the August 2009 calibrated QUAL2Kw model used for the TMDL (Stantec 2010, UDWQ 2010), which were based on seasonal averages from the USGS groundwater model. The 5-year average flows for each POTW was used to determine upstream conditions. The flow diversions at Surplus Canal and Burnham Dam were modified so that the flow delivered to the lower Jordan River and State Canal matched Borup and Haws (1999).

Receiving and tributary water quality data were obtained from UDWQ and JRFBWQC monitoring sites. The average seasonal value was calculated for each constituent with available data in the receiving water for the period 2004 - 2014.

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. The actual length of the mixing zone was not determined; however, it was presumed to remain within the maximum allowable mixing zone dimensions for each discharge.

Parameters of Concern

The parameter of concern considered in this wasteload allocation is total ammonia nitrogen (TAN).

Ammonia Criteria and Fish Early Life Stages

The water quality criterion for chronic ammonia toxicity is dependent on temperature and pH. The chronic ammonia criterion is also dependent on the presence or absence of fish early life stages (ELS). An evaluation was conducted to determine the presence or absence of ELS in the lower Jordan River and State Canal. The provisional determination was that ELS are absent in the lower Jordan River and State Canal from November through February, subject to Division of Wildlife Resources review. A summary of this evaluation is attached to this WLA.

Water Quality Modeling

A QUAL2Kw model of the Jordan River was populated and calibrated as part of the TMDL study (Stantec Consulting 2010, UDWQ 2010). The model was subsequently validated to a synoptic survey conducted by UDWQ and the Jordan River/Farmington Bay Water Quality Council (JRFBWQC) during July 2014 (UDWQ 2015). The model validation identified areas for future improvement of the model; however, the model was considered suitable for application to the wasteload allocation for ammonia.

The TMDL model of the Jordan River extends 52.4 miles from the outlet of Utah Lake to Burton Dam. For the purposes of the WLA, the model was broken at Burnham Dam (approximately 1.7 miles upstream of Burton Dam) and extended down State Canal to the Farmington Bay Waterfowl Management Area (approximately 3.5 miles downstream from Burnham Dam). The following point sources were added to the State Canal: A-1 Drain, South Davis Sewer District North WWTP, and outlet channel from Bountiful Pond (Mill Creek and Stone Creek). In addition, the Jordan Basin WRF discharge was added to the Jordan River, as this discharge was not active at the time of the TMDL model development.

The Jordan River WLA QUAL2Kw model was used for determining the WQBEL for ammonia. Effluent concentrations were adjusted up to the current permit limits so that water quality criteria were not exceeded in the receiving water. Background condition for each plant was characterized by assuming each upstream plant was operating at average flow rate with average ammonia concentration in the effluent. For calculating the chronic ammonia criterion, fish early life stages (ELS) were assumed present March through October and absent November through February.

The calibration, validation and wasteload models are available for review by request.

Ammonia Limits

The water quality based effluent limits determined as part of this combined wasteload allocation are summarized in Table 3.

Table 3: Ammonia Limits Summary

Effluent Constituent	Averaging Period	SDSD South WWTP	SDSD North WWTP
Flow (MGD)	Monthly	4.0	12.0
Ammonia Chronic (mg/L)			
Summer (Jul-Sep)	Monthly	8.0	8.0
October		8.0	8.0
November-December		20.0	10.0
January-February		15.0	12.0
March		8.0	8.0
Spring (Apr-Jun)		12.0	12.0

QUAL2Kw rates, input and output are summarized in Appendix A.

Models and supporting documentation are available for review upon request.

Prepared by:
Nicholas von Stackelberg, P.E.
Standards and Technical Services Section

Files:

WLA Document: *sdsd_potw_nh3_wla_2015_draft_2016-03-09.docx*
QUAL2Kw Calibration Model: *jordan_aug2009_q2kw_calib_2010-8-26.xls*
QUAL2Kw Validation Model: *jordan_q2kw_synoptic_2014-07-22.xlsm*
QUAL2Kw Wasteload Model: *jordan_potw_q2kw_wla_2015.xlsm*

References:

Borup, B. and N. Haws. 1999. *Jordan River Flow Analysis*. Brigham Young University, Civil and Environmental Engineering Department, Provo, Utah. Prepared for State of Utah, Department of Environmental Quality, Division of Water Quality.

Cirrus Ecological Solutions and Stantec Consulting. 2013. *Jordan River Total Maximum Daily Load Water Quality Study – Phase 1*. Prepared for State of Utah, Department of Environmental Quality, Division of Water Quality.

Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller. 2012. *Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah*. Prepared for State of Utah, Department of Environmental Quality, Division of Water Quality.

Stantec Consulting. 2010. *Jordan River TMDL: 2010 QUAL2Kw Model Calibration Technical Memo Public Draft*. Prepared for State of Utah, Department of Environmental Quality, Division of Water Quality. February 22, 2010. 18 pp.

Utah DWQ. 2010. *Jordan River TMDL QUAL2Kw model refinement*. Prepared by N. Von Stackelberg P.E., State of Utah, Department of Environmental Quality, Division of Water Quality.

Utah DWQ. 2012. *Utah Wasteload Analysis Procedures Version 1.0*. State of Utah, Department of Environmental Quality, Division of Water Quality.

Utah DWQ 2012. *Field Data Collection for QUAL2Kw Model Build and Calibration Standard Operating Procedures Version 1.0*. State of Utah, Department of Environmental Quality, Division of Water Quality.

Utah DWQ. 2014. *Utah's 2014 Integrated Report*. State of Utah, Department of Environmental Quality, Division of Water Quality.

Utah DWQ. 2015. *Jordan River Summer 2014 Synoptic Survey and QUAL2Kw Model Validation Report*. Prepared by N. Von Stackelberg P.E., State of Utah, Department of Environmental Quality, Division of Water Quality.

WASTELOAD ANALYSIS [WLA] Date: 3/9/2016
Appendix A: QUAL2Kw Analysis for Ammonia

Discharging Facility: South Davis Sewer District South and North Plants
Receiving Water: Jordan River and State Canal

Fully Mixed: No
Acute River Width: 50%
Chronic River Width: 100%

Modeling Information

A QUAL2Kw model was used to determine these effluent limits.

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.

Model Inputs

The following were utilized as inputs for the analysis.

Headwater - Utah Lake	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	709.0	16.0	16.0	16.0	16.0	501.0
Temperature, Mean (deg C)	21.5	11.7	9.7	4.2	5.9	15.2
Temperature, Diel Range (deg C)	3.0	2.5	2.5	2.0	2.0	2.5
Specific Conductance (µmhos)	1635	1750	1750	1729	1729	1374
Inorganic Suspended Solids (mg/L)	73.5	21.7	21.7	17.1	17.1	40.4
Dissolved Oxygen, Mean (mg/L)	6.1	9.0	9.0	11.7	11.7	8.0
Dissolved Oxygen, Diel Range (mg/L)	2.5	2.0	2.0	1.5	1.5	2.0
$CBOD_5$ (mg/L)	3.0	3.0	3.0	3.0	3.0	3.0
Organic Nitrogen (mg/L)	0.900	0.900	0.900	0.900	0.900	0.900
NH4-Nitrogen (mg/L)	0.297	0.290	0.290	0.165	0.165	0.104
NO3-Nitrogen (mg/L)	0.800	0.800	0.800	0.800	0.800	0.800
Organic Phosphorus (mg/L)	0.052	0.012	0.012	0.018	0.018	0.017
Inorganic Ortho-Phosphorus (mg/L)	0.045	0.035	0.035	0.040	0.040	0.040
Phytoplankton (µg/L)	27.3	9.0	9.0	15.0	15.0	8.1
Detritus [POM] (mg/L)	17.9	6.3	6.3	7.9	7.9	9.3
Alkalinity (mg/L)	188	192	192	213	213	200
pH	8.4	8.0	8.0	8.1	8.1	8.4

Discharge Information - Jordan Basin WRF Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	10.1	10.5	10.5	9.9	9.9	9.3
Temperature (deg C)	22.1	18.7	18.7	15.6	15.6	18.3
Specific Conductance (µmhos)	1791	1791	1791	1791	1791	1791
Inorganic Suspended Solids (mg/L)	1.5	1.5	1.5	1.5	1.5	1.5
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	15.0	15.0	15.0	15.0	15.0	15.0
Organic Nitrogen (mg/L)	0.500	0.500	0.500	0.500	0.500	0.500
NH4-Nitrogen (mg/L)	0.158	0.158	0.158	0.158	0.158	0.158
NO3-Nitrogen (mg/L)	7.800	7.800	7.800	7.800	7.800	7.800
Organic Phosphorus (mg/L)	0.080	0.080	0.080	0.080	0.080	0.080
Inorganic Ortho-Phosphorus (mg/L)	0.320	0.320	0.320	0.320	0.320	0.320
Phytoplankton (µg/L)	0.400	0.400	0.400	0.400	0.400	0.400
Detritus [POM] (mg/L)	0.5	0.5	0.5	0.5	0.5	0.5
Alkalinity (mg/L)	200	200	200	200	200	200
pH	7.5	7.5	7.5	7.5	7.5	7.5

Discharge Information - South Valley WRF

Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	21.7	20.7	20.7	20.2	20.2	20.3
Temperature (deg C)	22.0	20.0	18.1	14.4	14.7	18.0
Specific Conductance (µmhos)	1557	1487	1487	1605	1605	1517
Inorganic Suspended Solids (mg/L)	6.0	6.0	6.0	6.0	6.0	6.0
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	15.0	15.0	15.0	15.0	15.0	15.0
Organic Nitrogen (mg/L)	1.250	1.250	1.250	1.250	1.250	1.250
NH4-Nitrogen (mg/L)	0.086	0.113	0.113	0.135	0.135	0.113
NO3-Nitrogen (mg/L)	17.000	17.000	17.000	17.000	17.000	17.000
Organic Phosphorus (mg/L)	0.400	0.200	0.200	0.300	0.300	0.500
Inorganic Ortho-Phosphorus (mg/L)	2.700	3.100	3.100	2.800	2.800	2.700
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	191	169	169	169	169	180
pH	7.5	7.5	7.5	7.5	7.5	7.5

Discharge Information - Central Valley WRF

Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	51.8	49.7	49.7	51.1	51.1	56.9
Temperature (deg C)	21.8	18.4	16.1	12.8	13.3	16.9
Specific Conductance (µmhos)	1335	1314	1314	1403	1403	1403
Inorganic Suspended Solids (mg/L)	5.5	5.5	5.5	5.5	5.5	5.5
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	27.0	28.0	28.0	28.0	28.0	28.0
Organic Nitrogen (mg/L)	2.000	2.000	2.000	2.000	2.000	2.000
NH4-Nitrogen (mg/L)	1.247	1.269	1.269	2.266	2.266	0.990
NO3-Nitrogen (mg/L)	12.500	12.500	12.500	12.500	12.500	12.500
Organic Phosphorus (mg/L)	0.200	0.200	0.200	0.400	0.400	0.300
Inorganic Ortho-Phosphorus (mg/L)	2.900	2.800	2.800	2.600	2.600	2.700
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	168	169	169	177	177	179
pH	7.3	7.4	7.4	7.2	7.2	7.2

Discharge Information - South Davis Sewer District South WWTP

Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	3.4	3.4	3.4	3.4	3.4	3.4
Temperature (deg C)	23.0	19.5	16.7	12.6	13.8	18.7
Specific Conductance (µmhos)	2733	2722	2722	2923	2923	2808
Inorganic Suspended Solids (mg/L)	12.0	12.0	12.0	12.0	12.0	12.0
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	20.0	25.0	25.0	25.0	25.0	25.0
Organic Nitrogen (mg/L)	2.000	2.000	2.000	2.000	2.000	2.000
NO3-Nitrogen (mg/L)	10.000	10.000	10.000	10.000	10.000	10.000
Organic Phosphorus (mg/L)	0.500	0.400	0.400	0.800	0.800	0.500
Inorganic Ortho-Phosphorus (mg/L)	1.100	1.000	1.000	1.000	1.000	1.200
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	296	294	294	334	334	300
pH	7.5	7.4	7.4	7.5	7.5	7.6

Discharge Information - South Davis Sewer District North WWTP Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	7.2	7.2	7.2	7.2	7.2	7.2
Temperature (deg C)	23.4	20.2	18.2	12.4	12.5	17.4
Specific Conductance (µmhos)	1856	2047	2047	2032	2032	1908
Inorganic Suspended Solids (mg/L)	4.0	4.0	4.0	4.0	4.0	4.0
Dissolved Oxygen (mg/L)	5.0	5.0	5.0	5.0	5.0	5.0
$CBOD_5$ (mg/L)	20.0	25.0	25.0	25.0	25.0	25.0
Organic Nitrogen (mg/L)	3.500	3.500	3.500	3.500	3.500	3.500
NO3-Nitrogen (mg/L)	8.000	8.000	8.000	8.000	8.000	8.000
Organic Phosphorus (mg/L)	0.822	2.007	2.007	1.607	1.607	0.666
Inorganic Ortho-Phosphorus (mg/L)	1.169	1.702	1.702	1.698	1.698	1.386
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	14.0	14.0	14.0	14.0	14.0	14.0
Alkalinity (mg/L)	300	300	300	300	300	300
pH	7.1	7.2	7.2	7.2	7.2	7.3

Tributary - Little Cottonwood Creek	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	7.0	2.0	2.0	2.0	2.0	7.0
Temperature, Mean (deg C)	17.9	10.4	6.4	4.4	6.8	9.2
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1399	1348	1348	1944	1944	504
Inorganic Suspended Solids (mg/L)	27.1	8.4	8.4	6.6	6.6	25.1
Dissolved Oxygen, Mean (mg/L)	8.1	9.9	9.9	11.5	11.5	10.6
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	3.2	3.2	3.2	4.5	4.5	3.0
Organic Nitrogen (mg/L)	0.650	0.650	0.650	0.650	0.650	0.650
NH4-Nitrogen (mg/L)	0.100	0.100	0.100	0.100	0.100	0.100
NO3-Nitrogen (mg/L)	0.700	0.700	0.700	0.700	0.700	0.700
Organic Phosphorus (mg/L)	0.020	0.010	0.010	0.010	0.010	0.020
Inorganic Ortho-Phosphorus (mg/L)	0.040	0.030	0.030	0.030	0.030	0.030
Phytoplankton (µg/L)	25.0	4.7	4.7	11.5	11.5	11.1
Detritus [POM] (mg/L)	8.3	7.8	7.8	10.3	10.3	7.8
Alkalinity (mg/L)	173	239	239	218	218	123
pH	8.3	8.0	8.0	7.9	7.9	8.2

Tributary - Big Cottonwood Creek	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	15.0	8.0	8.0	13.0	13.0	16.0
Temperature, Mean (deg C)	18.1	11.1	7.7	5.7	7.3	9.4
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1241	1083	1083	1554	1554	449
Inorganic Suspended Solids (mg/L)	20.7	7.0	7.0	8.3	8.3	21.5
Dissolved Oxygen, Mean (mg/L)	8.7	10.2	10.2	11.1	11.1	10.3
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	3.0	3.0	3.0	4.0	4.0	3.0
Organic Nitrogen (mg/L)	0.600	0.600	0.600	0.600	0.600	0.600
NH4-Nitrogen (mg/L)	0.060	0.060	0.060	0.060	0.060	0.060
NO3-Nitrogen (mg/L)	0.500	0.500	0.500	0.500	0.500	0.500
Organic Phosphorus (mg/L)	0.010	0.005	0.005	0.010	0.010	0.010
Inorganic Ortho-Phosphorus (mg/L)	0.040	0.025	0.025	0.030	0.030	0.030
Phytoplankton (µg/L)	19.4	5.6	5.6	9.1	9.1	7.5
Detritus [POM] (mg/L)	7.8	9.1	9.1	10.3	10.3	7.6
Alkalinity (mg/L)	186	197	197	224	224	121
pH	8.4	8.1	8.1	8.1	8.1	8.2

Tributary - Mill Creek above CVWRF	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	9.5	6.4	6.4	7.6	7.6	14.0
Temperature, Mean (deg C)	18.2	9.8	7.9	8.2	10.2	12.1
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1128	1049	1049	1028	1028	902
Inorganic Suspended Solids (mg/L)	13.6	16.7	16.7	12.9	12.9	11.9
Dissolved Oxygen, Mean (mg/L)	8.0	9.7	9.7	11.9	11.9	9.4
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	3.0	3.0	3.0	3.0	3.0	3.7
Organic Nitrogen (mg/L)	0.600	0.600	0.600	0.600	0.600	0.600
NH4-Nitrogen (mg/L)	0.050	0.050	0.050	0.050	0.050	0.050
NO3-Nitrogen (mg/L)	1.500	1.500	1.500	1.500	1.500	1.500
Organic Phosphorus (mg/L)	0.020	0.025	0.025	0.015	0.015	0.005
Inorganic Ortho-Phosphorus (mg/L)	0.040	0.025	0.025	0.030	0.030	0.045
Phytoplankton (µg/L)	8.0	2.2	2.2	4.4	4.4	3.1
Detritus [POM] (mg/L)	7.5	5.7	5.7	12.2	12.2	8.4
Alkalinity (mg/L)	218	244	244	238	238	200
pH	7.9	7.9	7.9	7.8	7.8	7.9

Tributary - Decker Lake Outlet	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	8.5	8.5	8.5	8.5	8.5	8.5
Temperature, Mean (deg C)	20.2	6.8	6.8	5.0	5.0	16.1
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1777	2248	2248	2387	2387	1661
Inorganic Suspended Solids (mg/L)	48.1	36.0	36.0	14.6	14.6	38.1
Dissolved Oxygen, Mean (mg/L)	6.5	10.7	10.7	13.7	13.7	8.0
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	4.6	3.1	3.1	3.2	3.2	4.4
Organic Nitrogen (mg/L)	0.930	0.930	0.930	0.930	0.930	0.930
NH4-Nitrogen (mg/L)	0.140	0.140	0.140	0.140	0.140	0.140
NO3-Nitrogen (mg/L)	1.200	1.200	1.200	1.200	1.200	1.200
Organic Phosphorus (mg/L)	0.030	0.020	0.020	0.025	0.025	0.040
Inorganic Ortho-Phosphorus (mg/L)	0.070	0.050	0.050	0.040	0.040	0.050
Phytoplankton (µg/L)	19.0	19.0	19.0	19.0	19.0	19.0
Detritus [POM] (mg/L)	10.4	5.5	5.5	11.7	11.7	8.2
Alkalinity (mg/L)	235	255	255	252	252	214
pH	8.2	8.3	8.3	8.3	8.3	8.2

Tributary - 1300 South Drain	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	2.0	1.5	1.5	1.0	1.0	1.5
Temperature, Mean (deg C)	19.5	12.3	12.3	9.0	9.0	12.3
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1106	1061	1061	1632	1632	605
Inorganic Suspended Solids (mg/L)	11.0	11.0	11.0	11.0	11.0	11.0
Dissolved Oxygen, Mean (mg/L)	6.9	6.9	6.9	6.9	6.9	6.9
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	2.3	2.3	2.3	2.3	2.3	2.3
Organic Nitrogen (mg/L)	0.370	0.370	0.370	0.370	0.370	0.370
NH4-Nitrogen (mg/L)	0.020	0.020	0.020	0.020	0.020	0.020
NO3-Nitrogen (mg/L)	0.850	0.850	0.850	0.850	0.850	0.850
Organic Phosphorus (mg/L)	0.050	0.050	0.050	0.050	0.050	0.050
Inorganic Ortho-Phosphorus (mg/L)	0.000	0.000	0.000	0.000	0.000	0.000
Phytoplankton (µg/L)	2.5	0.9	0.9	0.8	0.8	0.7
Detritus [POM] (mg/L)	3.4	3.4	3.4	3.4	3.4	3.4
Alkalinity (mg/L)	210	210	210	210	210	210
pH	8.1	8.1	8.1	8.1	8.1	8.1

Tributary - 900 South Drain	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	6.0	5.5	5.5	3.0	3.0	4.5
Temperature, Mean (deg C)	20.9	12.6	12.6	9.0	9.0	12.6
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1106	1061	1061	1632	1632	605
Inorganic Suspended Solids (mg/L)	31.7	31.7	31.7	31.7	31.7	31.7
Dissolved Oxygen, Mean (mg/L)	7.5	7.5	7.5	7.5	7.5	7.5
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_6$ (mg/L)	2.1	2.1	2.1	2.1	2.1	2.1
Organic Nitrogen (mg/L)	0.600	0.600	0.600	0.600	0.600	0.600
NH4-Nitrogen (mg/L)	0.090	0.090	0.090	0.090	0.090	0.090
NO3-Nitrogen (mg/L)	1.750	1.750	1.750	1.750	1.750	1.750
Organic Phosphorus (mg/L)	0.110	-0.890	-0.890	-1.890	-1.890	-2.890
Inorganic Ortho-Phosphorus (mg/L)	0.150	1.150	1.150	2.150	2.150	3.150
Phytoplankton (µg/L)	2.5	0.9	0.9	0.8	0.8	0.7
Detritus [POM] (mg/L)	8.1	8.1	8.1	8.1	8.1	8.1
Alkalinity (mg/L)	250	250	250	250	250	250
pH	7.9	7.9	7.9	7.9	7.9	7.9

Tributary - North Temple Drain	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (cfs)	1.0	0.0	0.0	1.0	1.0	2.0
Temperature, Mean (deg C)	19.3	9.1	9.1	9.6	9.6	10.7
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1106	1061	1061	1632	1632	605
Inorganic Suspended Solids (mg/L)	4.8	1.9	1.9	5.5	5.5	12.8
Dissolved Oxygen, Mean (mg/L)	7.9	9.0	9.0	8.9	8.9	9.5
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	3.0	3.3	3.3	3.0	3.0	3.2
Organic Nitrogen (mg/L)	0.700	0.700	0.700	0.700	0.700	0.700
NH4-Nitrogen (mg/L)	0.050	0.050	0.050	0.050	0.050	0.050
NO3-Nitrogen (mg/L)	1.200	1.200	1.200	1.200	1.200	1.200
Organic Phosphorus (mg/L)	0.010	0.005	0.005	0.000	0.000	0.010
Inorganic Ortho-Phosphorus (mg/L)	0.030	0.025	0.025	0.020	0.020	0.040
Phytoplankton (µg/L)	2.5	0.9	0.9	0.8	0.8	0.7
Detritus [POM] (mg/L)	2.5	2.5	2.5	2.5	2.5	2.5
Alkalinity (mg/L)	238	239	239	252	252	222
pH	8.0	8.5	8.5	8.1	8.1	8.3

Minor Tributaries - Quality	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Temperature, Mean (deg C)	19.6	12.9	12.9	12.3	12.3	14.8
Temperature, Diel Range (deg C)	0.0	0.0	0.0	0.0	0.0	0.0
Specific Conductance (µmhos)	1671	2022	2022	2281	2281	1614
Inorganic Suspended Solids (mg/L)	63.3	31.2	31.2	18.8	18.8	86.8
Dissolved Oxygen, Mean (mg/L)	7.6	8.9	8.9	9.7	9.7	9.4
Dissolved Oxygen, Diel Range (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	3.0	3.0	3.0	3.0	3.0	3.0
Organic Nitrogen (mg/L)	0.930	0.930	0.930	0.930	0.930	0.930
NH4-Nitrogen (mg/L)	0.070	0.070	0.070	0.070	0.070	0.070
NO3-Nitrogen (mg/L)	3.200	3.200	3.200	3.200	3.200	3.200
Organic Phosphorus (mg/L)	0.045	0.020	0.020	0.020	0.020	0.085
Inorganic Ortho-Phosphorus (mg/L)	0.055	0.050	0.050	0.040	0.040	0.050
Phytoplankton (µg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Detritus [POM] (mg/L)	10.9	5.0	5.0	7.2	7.2	10.6
Alkalinity (mg/L)	252	325	325	362	362	277
pH	8.1	8.1	8.1	8.0	8.0	7.9

Minor Tributaries - Flow (MGD)	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Corner Canyon Creek	2.0	0.0	0.0	0.0	0.0	3.0
Midas Creek (Butterfield)	1.0	1.0	1.0	1.0	1.0	2.0
Willow Creek	3.0	1.0	1.0	1.0	1.0	3.0
Dry Creek	1.0	0.0	0.0	0.0	0.0	2.0
9000 South Conduit	1.0	0.0	0.0	0.0	0.0	1.0
Bingham Creek	2.0	0.0	0.0	0.0	0.0	2.0

Diversions - Flow (cfs)	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Jordan Valley Pump Station	-14.5	-13.0	-13.0	-13.0	-13.0	-14.5
Utah Lake Distribution Canal	-125.0	0.0	0.0	0.0	0.0	-81.0
Utah & Salt Lake Canal	-224.0	0.0	0.0	0.0	0.0	-145.0
East Jordan & Draper Canal	-222.0	0.0	0.0	0.0	0.0	-150.0
South Jordan Canal	-63.0	0.0	0.0	0.0	0.0	-85.0
Jordan & Salt Lake Canal	-35.0	0.0	0.0	0.0	0.0	-30.0
Beckstead Ditch	-5.0	0.0	0.0	0.0	0.0	0.0
North Jordan Canal	-61.0	-73.0	-73.0	-63.0	-63.0	-62.0
Gardner Mill Race	-3.0	0.0	0.0	0.0	0.0	0.0
Brighton Canal	-30.0	0.0	0.0	0.0	0.0	-20.0
Surplus Canal	-152.0	-158.1	-158.1	-183.3	-183.3	-125.0
Jordan River at Burnham Dam	-72.8	-40.8	-40.8	-16.8	-16.8	-80.8

Groundwater - Quality	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Temperature, Mean (deg C)	16.0	16.0	16.0	16.0	16.0	16.0
Specific Conductance (µmhos)	2000	2000	2000	2000	2000	2000
Inorganic Suspended Solids (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Dissolved Oxygen, Mean (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
$CBOD_5$ (mg/L)	2.0	2.0	2.0	2.0	2.0	2.0
Organic Nitrogen (mg/L)	0.500	0.500	0.500	0.500	0.500	0.500
NH4-Nitrogen (mg/L)	0.500	0.500	0.500	0.500	0.500	0.500
NO3-Nitrogen (mg/L)	2.000	2.000	2.000	2.000	2.000	2.000
Organic Phosphorus (mg/L)	0.050	0.050	0.050	0.050	0.050	0.050
Inorganic Ortho-Phosphorus (mg/L)	0.100	0.100	0.100	0.100	0.100	0.100
Phytoplankton (µg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Detritus [POM] (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (mg/L)	300	300	300	300	300	300
pH	8.0	8.0	8.0	8.0	8.0	8.0

Groundwater - Flow (cfs)	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Segment 8	12.9	12.9	12.9	12.9	12.9	12.9
Segment 7	21.5	21.5	21.5	21.5	21.5	21.5
Segment 6	81.2	81.2	81.2	81.2	81.2	81.2
Segment 5	9.6	9.6	9.6	9.6	9.6	9.6
Segment 4	14.2	14.2	14.2	14.2	14.2	14.2
Segment 3	16.4	16.4	16.4	16.4	16.4	16.4
Segment 2	0.0	0.0	0.0	0.0	0.0	0.0
Segment 1	0.0	0.0	0.0	0.0	0.0	0.0

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

Effluent Limitations

Effluent Limitations based upon Water Quality Standards for Ammonia
In-stream criteria of downstream segments for Ammonia will be met with an effluent limitation as follows:

Chronic	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Flow (MGD)	N/A					
SDSD South WWTP	4.0	4.0	4.0	4.0	4.0	4.0
SDSD North WWTP	12.0	12.0	12.0	12.0	12.0	12.0
NH4-Nitrogen (mg/L) Fish ELS Present						
SDSD South WWTP	8.0	8.0	7.5	7.0	8.0	12.0
SDSD North WWTP	8.0	8.0	7.5	7.0	8.0	12.0
NH4-Nitrogen (mg/L) Fish ELS Absent						
SDSD South WWTP	N/A	N/A	20.0	15.0	N/A	N/A
SDSD North WWTP	N/A	N/A	10.0	12.0	N/A	N/A

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	0.2	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.4	/d
Temp correction	1.07	
Settling velocity	0.05	m/d
Ammonium:		
Nitrification	2	/d
Temp correction	1.07	
Nitrate:		
Denitrification	0.05	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.05	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.05	/d
Temp correction	1.07	
Settling velocity	0.05	m/d
Inorganic P:		
Settling velocity	0.5	m/d
Sed P oxygen attenuation half sat constant	0.05	mgO2/L

Phytoplankton:		
Max Growth rate	2	/d
Temp correction	1.07	
Respiration rate	0.1	/d
Temp correction	1.07	
Death rate	0.1	/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	25	ugN/L
Settling velocity	0.05	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	50	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	50	gD/m2
Basal respiration rate	0.042	/d
Photo-respiration rate parameter	0.389	unitless
Temp correction	1.07	
Excretion rate	0.1	/d
Temp correction	1.05	
Death rate	0.1	/d
Temp correction	1.07	
External nitrogen half sat constant	163	ugN/L
External phosphorus half sat constant	48	ugP/L
Inorganic carbon half sat constant	1.30E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Half saturation	
Light constant	50	langleys/d
Ammonia preference	1	ugN/L
Subsistence quota for nitrogen	30	mgN/gD
Subsistence quota for phosphorus	0.4	mgP/gD
Maximum uptake rate for nitrogen	447	mgN/gD/d
Maximum uptake rate for phosphorus	114	mgP/gD/d
Internal nitrogen half sat ratio	2.9	
Internal phosphorus half sat ratio	1.8	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	0.1	/d
Temp correction	1.07	
Settling velocity	0.1	m/d
pH:		
Partial pressure of carbon dioxide	347	ppm
TRC:		
Decay rate	0.8	/d

Atmospheric Inputs:	Jul-Sep	Oct	Nov-Dec	Jan-Feb	Mar	Apr-Jun
Min. Air Temperature, F	61.9	65.7	29.9	24.9	52.6	46.3
Max. Air Temperature, F	90.4	40.4	50.0	43.4	31.8	72.0
Dew Point, Temp., F	58.6	43.6	35.0	30.3	36.3	48.5
Wind, ft./sec. @ 21 ft.	9.8	7.5	7.5	7.6	7.6	9.2
Cloud Cover, %	10%	10%	10%	10%	10%	10%