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

Date: **July 20, 2023**

Prepared by: **Suzan Tahir**
Standards and Technical Services

Facility: **Magna Wastewater Treatment Plant**
UPDES No. UT0021440

Receiving water: **C-7 Ditch**

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

002	C-7 Ditch → Lee Creek → Great Salt Lake	4 MGD (7.43 cfs, Max Design Flow, Average Monthly) 8 MGD (14.86 cfs, Maxim Daily)

Receiving Water

The receiving water for Outfall 001is the C-7 Ditch, which does not have designated beneficial uses. The C-7 Ditch was determined to be a drainage ditch that does not have downstream agricultural users of the water. Therefore, per UAC R317-2-13.10, the presumptive beneficial uses for all drainage canals and ditches statewide are 2B and 3E.

- *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 3E: Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.*

The C-7 Ditch is tributary to Lee Creek, which does not have designated beneficial uses. Per UAC R317-2-13.13, the presumptive beneficial uses for all waters not specifically classified are 2B and 3D.

- *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.*

Flow

The critical flow for the wasteload analysis is typically considered the lowest stream flow for seven consecutive days with a recurrence interval of once every ten years (7Q10). Flow records from USGS stream gage #10172640 Lee Creek Near Magna, UT, for the period 2002 – 2023 were obtained, however the most recent data for the gauge were for the period 2006-2008. Therefore, the 7Q10 was estimated as the lowest seven-day average and the record of the gage for that period was considered more representative of the current higher flow regime in the creek. It was insufficient to statistically calculate the 7Q10 flow.

The discharge at the gage includes flows from C-7 Ditch, Kersey Creek, Magna WWTP, Lee Creek and groundwater (Table 1). The average discharge from Magna WWTP was calculated from DWQ monitoring records from 1999 – 2008. Critical low flow from Kersey Creek and groundwater was assumed to be zero. No flow records were available for C-7 Ditch and Lee Creek above the confluence with C-7 Ditch; the critical low flow was assumed to be 67% from C-7 Ditch and 33% from Lee Creek above C-7 Ditch.

Table 1: Annual Critical Low Flow

Source	Critical Low Flow (cfs)
C-7 Ditch	9.42
Kersey Creek above Magna WWTP	0.0
Magna WWTP	3.81
Lee Creek above C-7 Ditch	4.71
Groundwater	0.0
Lee Creek at USGS Gage	*17.93*

Receiving water quality data was obtained from sampling stations 4991430 Lee Creek at I-80 Crossing. The seasonal annual value was calculated for each constituent with available data in the receiving water.

Protection of Downstream Uses

Per UAC R317-2-8, *all actions to control waste discharges under these rules shall be modified as necessary to protect downstream designated uses*. For this discharge, numeric aquatic life use criteria do not apply to the immediate receiving water (C-7 Ditch), but do apply to downstream receiving waters (Lee Creek). Therefore, Lee Creek is considered the limiting condition in this wasteload allocation to ensure protection of aquatic life uses.

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.

The actual length of the mixing zone was not determined; however, it was presumed to remain within the maximum allowable mixing zone dimensions. Acute limits were calculated using 50% of the annual critical low flow.

Parameters of Concern

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

TMDL

The receiving water, Lee Creek from Great Salt Lake to headwaters near 2100 South (UT16020204-036_00) supports all designated uses according to the 303(d) list in the *2021 Utah Integrated Report*.

Water Quality Modeling

A QUAL2Kw model of the receiving water was populated based on physiographic information from Google Earth and site data collected by DWQ staff. The model extends from C-7 Ditch through Lee Creek to the outlet to Gilbert Bay (Figure 1). The QUAL2Kw model was used for determining WQBELs related to eutrophication of the receiving waters, including BOD_5, phosphorus, nitrogen and dissolved oxygen.

The QUAL2Kw model was also used to determine the limits for ammonia toxicity. The water quality criterion for chronic ammonia toxicity is dependent on temperature and pH, and the water quality criterion for acute ammonia toxicity is dependent on pH. Effluent concentrations were adjusted so that water quality standards were not exceeded in the receiving water. QUAL2Kw rates, input and output are summarized in Appendix A.

Insufficient observed data was available for model calibration. The rate parameters used in the model were the same as those used for the Box Elder Creek/Brigham City WWTP QUAL2Kw, which was calibrated under contract by Utah State University (Neilson et al. 2012). C-7 Ditch and Lee Creek were considered to have similar stream characteristics to Box Elder Creek. Synoptic data needs to be collected in the future in order to calibrate the model.

A mass balance mixing analysis was calculated for conservative constituents such as dissolved metals. The WQBELs determined using the mass balance mixing analysis are summarized in Appendix B.

The limits for total residual chlorine were determined assuming a decay rate of 37 /day (at 20 ºC), based on a chlorine decay assessment (Carollo 2016). The chlorine decay in C-7 Ditch should be verified once the effluent pipeline is constructed and discharging. A total travel time of 240 minutes was estimated [35 minutes in the effluent pipe (4,000 lineal feet at 1.9 feet per second velocity) and 205 minutes in C-7 Ditch prior to confluence with Lee Creek (7,350 lineal feet at 0.6 feet per second velocity)]. The analysis for TRC is summarized in Appendix C.

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

Models and supporting documentation are available for review upon 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
Annual	40%

Ammonia

The QUAL2Kw model was utilized to determine annual limits for ammonia based on summer season conditions. Ammonia exerts an oxygen demand on the water column through nitrification to nitrate and is toxic to aquatic life above certain thresholds that are pH and temperature dependent. Seasonal limits were determined that meet both in-stream DO criteria and in-stream toxicity criteria. Annual average pH and seasonal average temperature was used for determining chronic limits (30-day average) and maximum pH was used for determining acute limits (1-hour).

Effluent Limits

The effect of the effluent on the DO in the receiving water was evaluated using the QUAL2Kw model. A DO sag in C-7 Ditch downstream from the plant discharge was predicted by the model; however, the DO concentration recovered by the confluence with Lee Creek and secondary standards for BOD_5 are sufficient to meet DO criteria.

Table 3: Water Quality Based Effluent Limits Summary

Effluent Constituent	Acute			Chronic		
	Standard	Limit	Averaging Period	Standard	Limit	Averaging Period
Flow (MGD)		8.0	1 day		4.0	30 days
Ammonia (mg/L)	Varies	30.0	1 hour	Varies	7.0	30 days
Min. Dissolved Oxygen (mg/L)[2]	3.0	5.0	Instantaneous	5.0	5.0	30 days
BOD_5 (mg/L)	NA	35	7 days	NA	25	30 days
Total Residual Chlorine (mg/L)						
Summer		17.7			17.2	
Fall	0.019	2.7	1 hour	0.011	2.6	4 days
Winter		1.3			1.3	
Spring		2.7			2.6	

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 this wasteload is renewal for an existing outfall.

Documents

WLA Document: *Magna_WLA_2023m Final.docx*
QUAL2Kw Wasteload Model: *Magna_ WLA_2023.xlsm*

References:

Carollo. 2016. *Chlorine Decay Assessment*. Magna Water District.

Epic Engineering. 2016. *WWTP Outfall Bypass Pipeline – Alternative Comparison Summary Memo*. Prepared for Magna Water District.

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*.

Utah Division of Water Quality. 2022. *Final 2022 Integrated Report on Water Quality*

Utah Division of Water Quality. 2021. *Utah Wasteload Analysis Procedures Version 2.0*.