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

Date: **June 24, 2020**

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Standards and Technical Services Section

Facility: **Bear River City Lagoons**
UPDES No. UT0020311

Receiving water: **Malad River (2B, 3C)**

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 001D: Malad River → Bear River
Outfall 002 & Outfall 003: Tributary to Malad River → Bear River

The maximum daily discharge for the facility is 0.36 MGD.

Receiving Water
The receiving water for Outfall 001 is the Malad River, which is tributary to the Bear River and drains to the Bear River Bay of the Great Salt Lake. Per UAC R317-2-13, the designated beneficial uses for Malad River and tributaries, from confluence with Bear River to state line are 2B and 3C.

- *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*

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 Malad River at Bear River City, the 20th percentile of flow measurements observed at monitoring site 4902040 Malad River above Bear City Lagoons for 2010-2020 was calculated to estimate annual critical flow in the receiving water (Table 1).

Table 1: Malad River critical low flow

Season	**Flow (cfs)**
Annual	2.5

TMDL

The Malad River was not assessed due to insufficient data in *Utah's Final 2016 Integrated Report*. The Malad River is tributary to the Bear River, which is listed as impaired for dissolved oxygen, total dissolved solids and benthic macroinvertebrates in the 2016 303(d) list.

The *Lower Bear River and Tributaries TMDL*, which was approved by EPA in 2002, addressed the dissolved oxygen impairment by establishing instream concentration and load allocations for total phosphorous (TP) in the watershed. Point sources identified in the TMDL were Tremonton City, Bear River City, and Corrine City WWTPs. Based on the revised implantation plan Bear City Lagoons were allocated 3.1 lb/day of TP (see attached documentation).

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 mixing zone was not delineated as part of this WLA, but was assumed to remain within the maximum allowable mixing zone specified in the rule.

Parameters of Concern

The potential in-stream parameters of concern identified for the discharge/receiving water may include metals (as a function of hardness),total dissolved solids (TDS), total residual chlorine (TRC), total ammonia (TAN), total suspended solids (TSS), dissolved oxygen (DO), BOD_5, total phosphorus (TP) and pH.

Water Quality Modeling

A QUAL2Kw model of the Malad River was built that extends from the 5575 North Road crossing to the confluence with the Bear River (approximately 4.9 km). The kinetic rate parameters were taken from a QUAL2Kw model of the Malad River that was built and calibrated and utilized for the Tremonton Wastewater Treatment Plant WLA (DWQ 2013).

Receiving water quality data was obtained from monitoring site 4902040 Malad River above Bear City Lagoons for 2010-2020. The average seasonal value was calculated for each constituent with available data in the receiving water.

The QUAL2Kw model was used for determining WQBELs related to eutrophication and dissolved oxygen. 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. Where WQBELs exceeded secondary standards or categorical limits, the concentration in the model was set at the secondary standard or categorical limit.

The QUAL2Kw model was also used to determine the effluent limits for ammonia. 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.

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

Models and supporting documentation are available for review upon request.

<u>WET Limits</u>
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	3%
Fall	18%
Winter	11%
Spring	22%

<u>Antidegradation Level I Review</u>
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.

<u>Documents:</u>
WLA Document: *BearRiver_WLA_2020.docx*
QUAL2Kw Wasteload Model: *Bear River WLA_2020.xlsm*
Bear River City Lagoons.docx (a document received from the watershed coordinator Mike D.Allred on June23rd 2020)

References:

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

Field Data Collection for QUAL2Kw Model Build and Calibration Standard Operating Procedures Version 1.0. 2012. Utah Division of Water Quality.

Using QUAL2K Modeling to Support Nutrient Criteria Development and Wasteload Analyses in Utah. 2012. Neilson, B.T., A.J. Hobson, N. von Stackelberg, M. Shupryt, and J.D. Ostermiller.

Utah's Final 2016 Integrated Report. 2017. Utah Division of Water Quality.

Tremonton WWTP WLA. 2013. Utah Division of Water Quality.

WASTELOAD ANALYSIS [WLA] Date: 7/2/2020
Appendix A: QUAL2Kw Analysis Results

Discharging Facility:	Bear River City Lagoons		
UPDES No:	UT0020311		
Permit Flow [MGD]:	0.36	Max. Daily	
	0.36	Max. Monthly Average	
Receiving Water:	Malad River		
Stream Classification:	2B, 3C		
Stream Flows [cfs]:	21.70	Summer (July-Sept)	Critical Low Flow
	2.60	Fall (Oct-Dec)	
	4.70	Winter (Jan-Mar)	
	2.00	Spring (Apr-June)	
Instantaneously Fully Mixed:	No		
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.
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)	21.7	2.6	4.7	2.0
Temperature (deg C)	22.4	4.6	8.3	21.1
Specific Conductance (µmhos)	1,448	6,499	5,374	5,024
Inorganic Suspended Solids (mg/L)	88.2	19.5	54.1	104.6
Dissolved Oxygen (mg/L)	10.6	16.0	14.9	19.1
Dissolved Oxygen Diel Range (mg/L)	3.3	2.0	2.0	2.0
$CBOD_5$ (mg/L)	1.5	1.5	1.5	1.5
Organic Nitrogen (mg/L)	0.555	0.587	0.499	0.781
NH4-Nitrogen (mg/L)	0.110	1.143	0.547	0.479
NO3-Nitrogen (mg/L)	0.876	2.077	0.881	0.680
Organic Phosphorus (mg/L)	0.026	0.114	0.049	0.070
Inorganic Ortho-Phosphorus (mg/L)	0.105	0.457	0.198	0.278
Phytoplankton (µg/L)	21.5	9.5	0.0	146.5
Detritus [POM] (mg/L)	9.3	6.5	19.1	27.8
Alkalinity (mg/L)	390	390	390	390
pH	8.4	8.2	8.4	8.6

Discharge Information

Acute	Summer	Fall	Winter	Spring
Flow (cfs)	0.4	0.4	0.4	0.4
Temperature (deg C)	21.0	3.4	7.8	16.8
Specific Conductance (µmhos)	1,639	1,654	1,455	1,485
Inorganic Suspended Solids (mg/L)	0.0	1.0	6.8	2.9
Dissolved Oxygen (mg/L)	4.0	4.0	4.0	4.0
$CBOD_5$ (mg/L)	65.0	65.0	65.0	65.0
Organic Nitrogen (mg/L)	1.959	1.295	1.685	2.117
NH4-Nitrogen (mg/L)	17.800	14.000	17.000	6.000
NO3-Nitrogen (mg/L)	0.057	0.990	0.129	0.131
Organic Phosphorus (mg/L)	0.290	0.108	0.164	0.382
Inorganic Ortho-Phosphorus (mg/L)	1.160	0.432	0.656	1.528
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	2.000	2.000	14.500	9.067
Alkalinity (mg/L)	300	300	300	300
pH	8.9	8.7	8.8	8.6

Chronic	Summer	Fall	Winter	Spring
Flow (cfs)	0.4	0.4	0.4	0.4
Temperature (deg C)	21.0	3.4	7.8	16.8
Specific Conductance (µmhos)	1,639	1,654	1,455	1,485
Inorganic Suspended Solids (mg/L)	0.0	1.0	6.8	2.9
Dissolved Oxygen (mg/L)	4.0	4.0	4.0	4.0
$CBOD_5$ (mg/L)	45.0	45.0	45.0	45.0
Organic Nitrogen (mg/L)	1.959	1.295	1.685	2.117
NH4-Nitrogen (mg/L)	22.000	3.000	6.000	2.000
NO3-Nitrogen (mg/L)	0.057	0.990	0.129	0.131
Organic Phosphorus (mg/L)	0.290	0.108	0.164	0.382
Inorganic Ortho-Phosphorus (mg/L)	1.160	0.432	0.656	1.528
Phytoplankton (µg/L)	0.000	0.000	0.000	0.000
Detritus [POM] (mg/L)	2.000	2.000	14.500	9.067
Alkalinity (mg/L)	300	300	300	300
pH	8.9	8.7	8.8	8.6

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 Limitation for Biological Oxygen Demand (BOD_5) based upon Secondary Standards

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent BOD5 limitation as follows:

	Concentration		
Season	**Chronic**	**Acute**	
Summer	45.0	65.0	mg/L as CBOD5
Fall	45.0	65.0	mg/L as CBOD5
Winter	45.0	65.0	mg/L as CBOD5
Spring	45.0	65.0	mg/L as CBOD5

Effluent Limitation for Dissolved Oxygen (DO) based upon Secondary Standards

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

	Concentration		
Season	**Chronic**	**Acute**	
Summer	4.0	4.0	mg/L
Fall	4.0	4.0	mg/L
Winter	4.0	4.0	mg/L
Spring	4.0	4.0	mg/L

Effluent Limitation for Total Ammonia based upon Water Quality Standards

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

	Total Ammonia		
Season	**Chronic**	**Acute**	
Summer	22.0	17.8	mg/L as N
Fall	3.0	14.0	mg/L as N
Winter	6.0	17.0	mg/L as N
Spring	2.0	6.0	mg/L as N

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	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	0.103	/d
Temp correction	1.047	
Fast CBOD:		
Oxidation rate	10	/d
Temp correction	1.047	
Organic N:		
Hydrolysis	0.89483527	/d
Temp correction	1.07	
Settling velocity	0.091262	m/d
Ammonium:		
Nitrification	1.7040043	/d
Temp correction	1.07	
Nitrate:		
Denitrification	1.76751272	/d
Temp correction	1.07	
Sed denitrification transfer coeff	0.159155	m/d
Temp correction	1.07	
Organic P:		
Hydrolysis	0.96655348	/d
Temp correction	1.07	
Settling velocity	0.040271	m/d
Inorganic P:		
Settling velocity	0.11043	m/d
Sed P oxygen attenuation half sat constant	0.13709	mgO2/L

Phytoplankton:		
Max Growth rate	2.9996	/d
Temp correction	1.07	
Respiration rate	0.0464108	/d
Temp correction	1.07	
Death rate	0.149325	/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	16.0685	ugN/L
Settling velocity	0.00939	m/d
Bottom Plants:		
Growth model	Zero-order	
Max Growth rate	2.036895	gD/m2/d or /d
Temp correction	1.07	
First-order model carrying capacity	100	gD/m2
Basal respiration rate	0.2547098	/d
Photo-respiration rate parameter	0.01	unitless
Temp correction	1.07	
Excretion rate	0.155962	/d
Temp correction	1.07	
Death rate	0.34128	/d
Temp correction	1.07	
External nitrogen half sat constant	75.5788	ugN/L
External phosphorus half sat constant	93.0243	ugP/L
Inorganic carbon half sat constant	7.83E-05	moles/L
Bottom algae use HCO3- as substrate	Yes	
Light model	Half saturation	
Light constant	43.0758	langleys/d
Ammonia preference	16.21275	ugN/L
Subsistence quota for nitrogen	38.2721	mgN/gD
Subsistence quota for phosphorus	2.582105	mgP/gD
Maximum uptake rate for nitrogen	883.188	mgN/gD/d
Maximum uptake rate for phosphorus	95.5036	mgP/gD/d
Internal nitrogen half sat ratio	2.009455	
Internal phosphorus half sat ratio	3.4393945	
Nitrogen uptake water column fraction	1	
Phosphorus uptake water column fraction	1	
Detritus (POM):		
Dissolution rate	0.0800015	/d
Temp correction	1.07	
Settling velocity	0.00714	m/d
pH:		
Partial pressure of carbon dioxide	370	ppm

Atmospheric Inputs:	Summer	Fall	Winter	Spring
Max. Air Temperature, F	89.1	47.7	38.8	70.4
Min. Air Temperature, F	58.6	26.6	20.7	44.2
Dew Point, Temp., F	57.2	34.0	28.6	47.3
Wind, ft./sec. @ 21 ft.	7.7	6.1	6.2	7.8
Cloud Cover, %	0.1	0.1	0.1	0.1

Other Inputs:		
Bottom Algae Coverage	100.0%	
Bottom SOD Coverage	100.0%	
Prescribed SOD	0.0	gO2/m2/d

WASTELOAD ANALYSIS [WLA] Date: 7/2/2020
Appendix B: Mass Balance Mixing Analysis for Conservative Constituents

Discharging Facility:	Bear River City Lagoons		
UPDES No:	UT0020311		
Permit Flow [MGD]:	0.36	Maximum Monthly Flow	
	0.36	Maximum Daily Flow	
Receiving Water:	Malad River		
Stream Classification:	2B, 3C		
Stream Flows [cfs]:	21.70	Summer (July-Sept)	Critical Low Flow
	2.60	Fall (Oct-Dec)	
	4.70	Winter (Jan-Mar)	
	2.00	Spring (Apr-June)	
Instantaneously Fully Mixed:	No		
Acute River Width:	50%		
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

	Malad River
	cfs
Summer	21.7
Fall	2.6
Winter	4.7
Spring	2.0

Discharge Information

	Flow
	MGD
Maximum Daily	0.36
Maximum Monthly	0.36

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 3C Waters)

Physical Parameter	Maximum Concentration
Temperature (deg C)	27
Temperature Change (deg C)	4

Inorganics	Chronic Standard (4 Day Average)	Acute Standard (1 Hour Average)
Parameter	Standard	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)	N/A[3]		NONE	750	503	5571
Arsenic (µg/L)	150	101	2078	340	101	5005
Cadmium (µg/L)	1.6	1.1	22.7	5.0	1.1	81.1
Chromium VI (µg/L)	11.0	7.4	152.4	16.0	7.4	184.1
Chromium III (µg/L)	182	122	2525	1,401	122	26,315
Copper (µg/L)	22.9	15.3	317.3	37.8	15.3	476.0
Cyanide (µg/L)	22.0	14.7	304.8	5.2	14.7	-180.6
Iron (µg/L)				1,000	670	7,428
Lead (µg/L)	8.1	5.4	112.6	209	5.4	4166
Mercury (µg/L)	0.012	0.008	0.166	2.4	0.0	49.0
Nickel (µg/L)	132	88.3	1825	1,186	88.3	22,571
Selenium (µg/L)	4.6	3.1	63.7	18.4	3.1	316.8
Silver (µg/L)				21.3	14.3	158.1
Tributylin (µg/L)	0.072	0.048	0.998	0.46	0.05	8.48
Zinc (µg/L)	300	201	4153	297	201	2176

1: Based upon a Hardness of 300 mg/l as CaCO3

2: Background concentration assumed 67% of chronic standard

3: Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as $CaC0_3$ in the receiving water after mixing, the 87 ug/L chronic criterion (expressed as total recoverable) will not apply, and aluminum will be regulated based on compliance with the 750 ug/L acute aluminum criterion (expressed as total recoverable).

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	11.1
Chlordane (µg/L)	0.0043	0.0029	0.0596	1.2	0.0	24.5
DDT, DDE (µg/L)	0.001	0.001	0.014	0.55	0.00	11.25
Diazinon (µg/L)	0.17	0.11	2.36	0.17	0.11	1.26
Dieldrin (µg/L)	0.0056	0.0038	0.0776	0.24	0.00	4.84
Endosulfan, a & b (µg/L)	0.056	0.038	0.776	0.11	0.04	1.52
Endrin (µg/L)	0.036	0.024	0.499	0.086	0.024	1.291
Heptachlor & H. epoxide (µg/L)	0.0038	0.0025	0.0527	0.26	0.00	5.28
Lindane (µg/L)	0.08	0.05	1.11	1.0	0.1	19.4
Methoxychlor (µg/L)				0.03	0.02	0.22
Mirex (µg/L)				0.001	0.001	0.007
Nonylphenol (µg/L)	6.6	4.4	91.5	28.0	4.4	487.3
Parathion (µg/L)	0.0130	0.0087	0.1801	0.066	0.009	1.182
PCB's (µg/L)	0.014	0.009	0.194			
Pentachlorophenol (µg/L)	15.0	10.1	207.8	19.0	10.1	193.3
Toxephene (µg/L)	0.0002	0.0001	0.0028	0.73	0.00	14.95

1: Background concentration assumed 67% of chronic standard

Radiological	Maximum Concentration		
Parameter	Standard	Background[1]	Limit
Gross Alpha (pCi/L)	15	10.1	-12.6

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

1.0 BEAR RIVER CITY LAGOONS (UT0020311)

The Bear River City Lagoons were put into operation in 1974 to treat residential sewage from Bear River City. The design flow of the treatment facility is 0.36 mgd. The facility consists of a pump station, a pressurized 6-inch line, followed by a six cell facultative lagoon system (Utah DEQ 2016a). The facility constructed a 12 million gallon land application reservoir in 2015.

The Bear River City lagoons are permitted to discharge through four outfalls.

- **Outfall 001** is treated effluent that is discharged from an 8-inch concrete pipe to the Malad River.
- **Outfall 001D** is to a retention basin for land disposal.
- **Outfall 002** is from the bottom drain of the retention basin to a ditch tributary of the Malad River.
- **Outfall 003** is from an emergency overflow spillway from the retention basin to a tributary of the Malad River.

1.1 EFFLUENT CHARACTERIZATION

The available TP and flow data for this facility are shown in **Figure 1**. It appears that flows from the facility decreased substantially beginning in 2009 about the time TP concentration data became available. To facilitate this analysis, only those flows collected after September 2009 were considered.

Average monthly flows, based on records from September 2009 through June 2016, range from 0.19 mgd to 0.26 mgd (**Figure 2**). Discharge TP concentrations range from 0.70 mg/l to 3.10 mg/l. There do not appear to be any decernable seasonal or long-term trends in discharge TP concentration (**Figure 3**).

TP discharge loads range from 0.69 lb/d to 5.7 lb/d[1]. As with concentration, there do not appear to be any obvious seasonal trends (**Figure 4** and **Table 1**).

[1] Loads were calculated using paired TP and flow data.

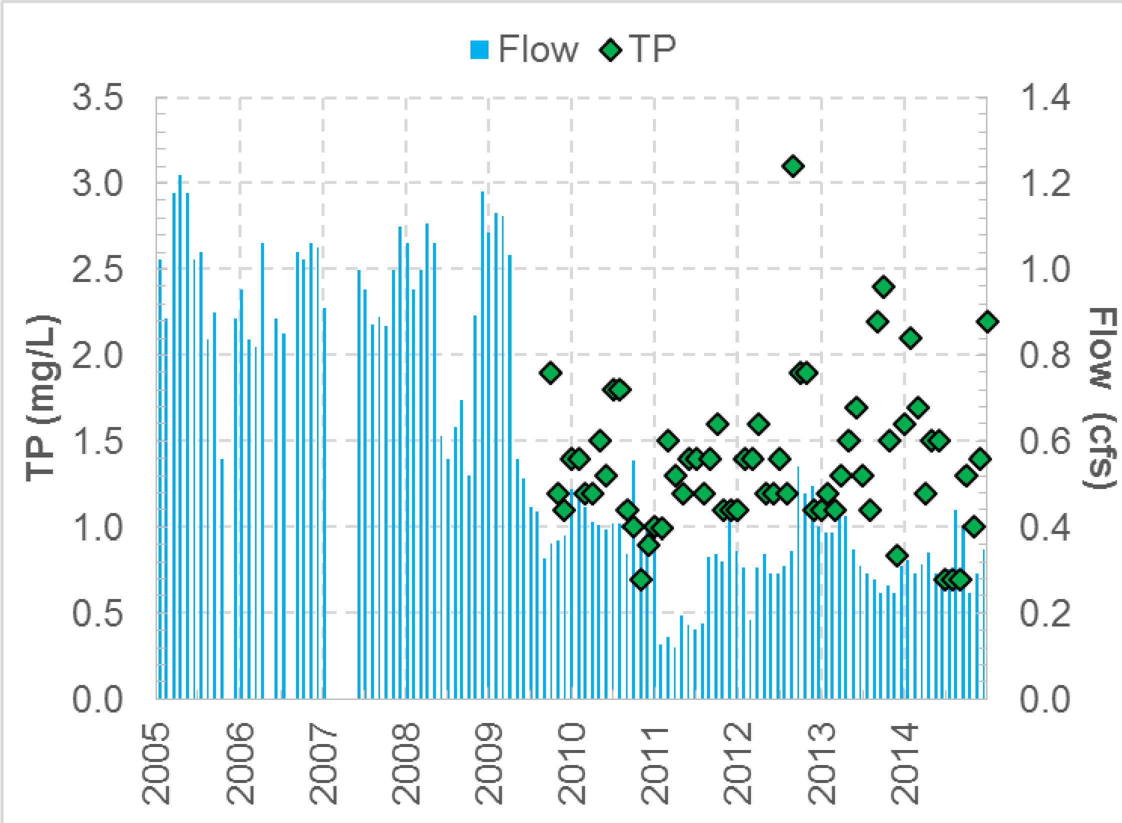

Figure 1. Summary of TP and flow data at the Bear River City lagoons.

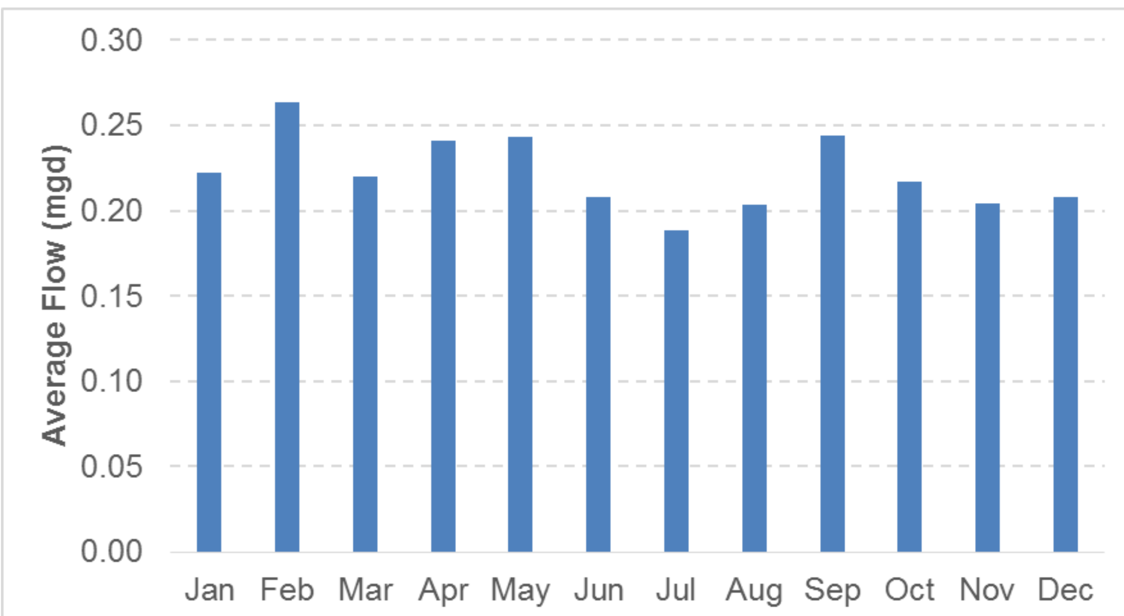

Figure 2. Average monthly flow at the Bear River City lagoons (2009-2015).

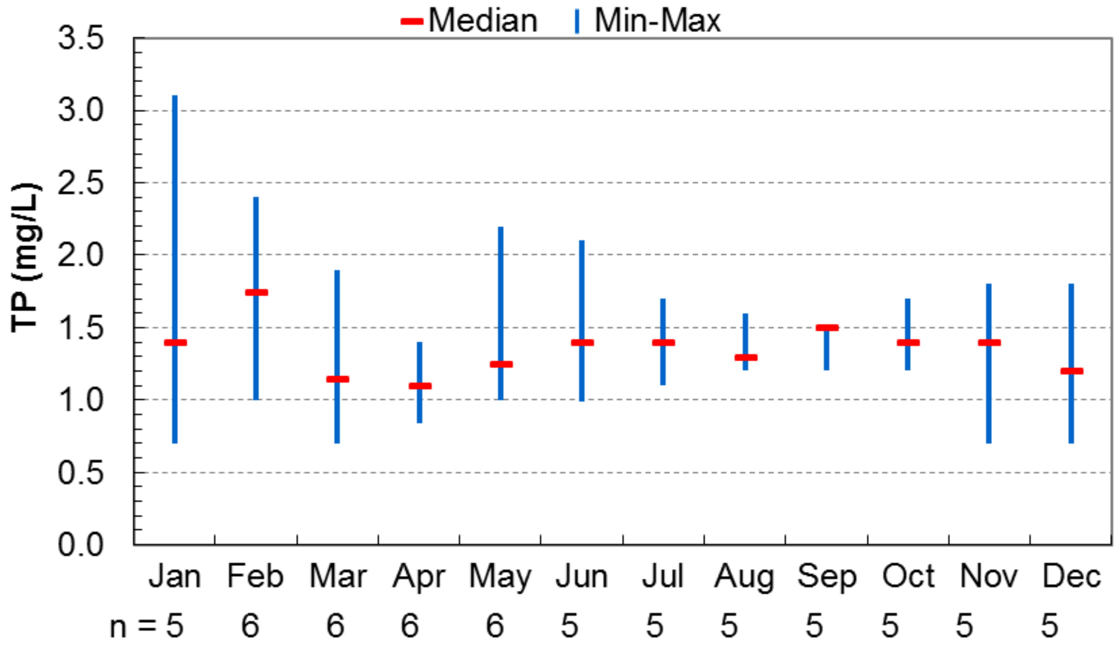

Figure 3. Monthly summary of TP concentrations in treated effluent at the Bear River City lagoons.

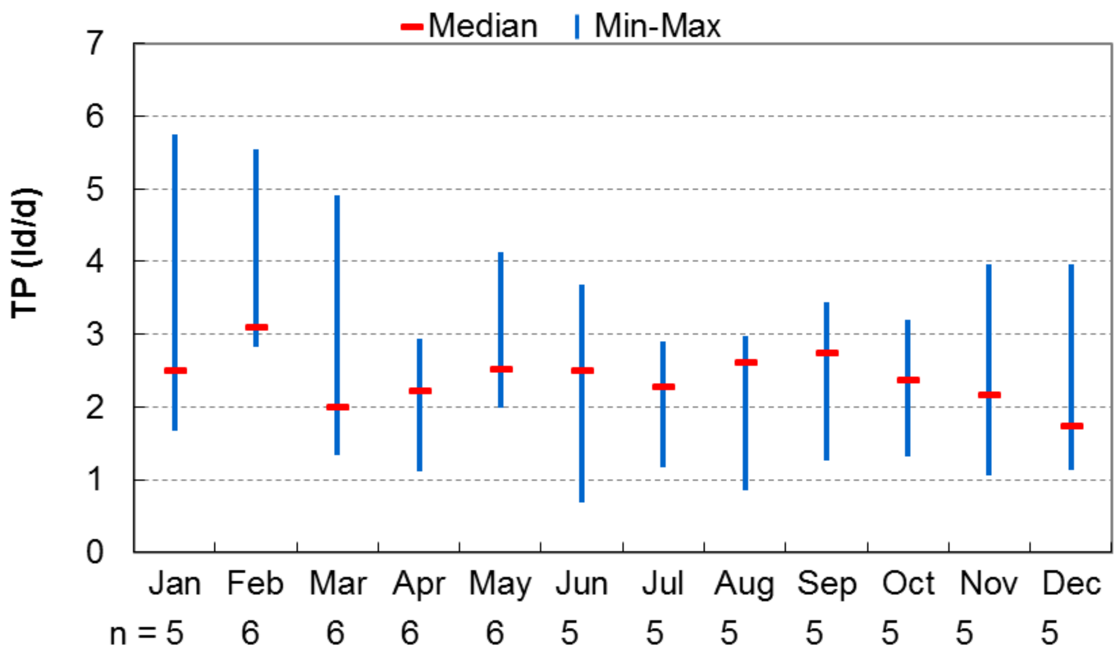

Figure 4. Monthly summary of TP loads in treated effluent at the Bear River City lagoons.

Table 1. Average monthly TP loads (lb/d) discharged from the Bear River City lagoons

Month	Bear River City lagoons UT0020311
January	3.05
February	3.53
March	2.34
April	2.16
May	2.82
June	2.54
July	2.09
August	2.23
September	2.58
October	2.31
November	2.13
December	2.00

Note: Loads (lb/d) were calculated using paired TP and flow data.

1.2 WASTELOAD ALLOCATION

The following presents a WLA for the Bear River City lagoons based on the total phosphorus rule.

1.2.1 WLA Calculated Using Total Phosphorus Rule

A WLA of 3.1 lb/d was calculated by multiplying the average annual load (2.5 lb/d) by 125 percent. A daily average load for each calendar month was calculated by averaging paired TP and flow from February 2010 through May 2015. The daily average load for each month was then multiplied by the number of days per month and summed; the summation was divided by 365 days per year to yield the average annual load in lb/d.

1.3 IMPACT ANALYSIS

The current average annual load is 2.47 lb/d, which was calculated using monthly averages of paired TP and effluent flow data from February 2010 through May 2015. Implementing the phosphorus loading cap would result in an increase (on average) of 0.63 lb/d (**Table 2**).

Table 2. WLAs and Necessary load reductions at the Bear River City lagoons to achieve the WLA

	Phosphorus Loading Cap
Wasteload allocation	
TP (mg/L)	n/a
Flow (mgd)	n/a
WLA (lb/d)	3.1
Necessary reduction [a]	
Load reduction (lb/d)	0.63 increase
Relative reduction (%)	25% increase

Note a.: Necessary reduction from the existing load (2.47 lb/d) to achieve the WLA.

Generally, no reduction would be necessary for the phosphorus loading cap because the rule allows for a future discharge from a lagoon system to discharge 125 percent of current average conditions (R317-1-3.3(B)). However, because this WLA is calculated as an average of current loads, load reductions could be necessary for larger loads that exceed 125 percent of the current average load.

Of the 64 loads calculated with paired TP and flow data from February 2010 through May 2015, 15 loads exceeded 3.1 lb/d, and thus, would have required reductions (range 3 to 46 percent).