Total Maximum Daily Loads

For

Fremont State Lakes

Parameters of Concern: *Phosphorus, Chlorophyll-a, Dissolved Oxygen, pH*

Waterbodies:
LP1-L0230, LP1-L0270, LP1-L0300
LP1-L0310, LP1-L0320, LP1-L0330
LP1-L0350, LP1-L0290

Nebraska Department of Environmental Quality
Planning Unit, Water Quality Division

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Executive Summary

Eight lakes in the Fremont State Lakes system (FLS) will be identified in the 2012 Integrated Report as category 5 waterbodies, being impaired by nutrients. As such, Total Maximum Daily Loads (TMDLs) must be developed in accordance with the Clean Water Act. This document presents eight (8) TMDLs for the above mentioned lakes for phosphorus as the impairment.

These TMDLs have been prepared to comply with the current (1992) regulations found at 40 CFR Part 130.7.

1. Name and geographic location of the impaired waterbodies for which the TMDLs are being developed.

Fremont State Lakes, Dodge County, Nebraska
Sections: 16, 17, 20 of T 17 North, R 8 East, and 13, 14 of T 17 North, R 7 East.
Lat: 41^{o} 25' 41" -- 41^{o} 27' 02"
Long: -96^{o} 31' 41" -- -96^{o} 35' 54"

2. Identification of the pollutant and applicable water quality standard

The parameter causing the impairment(s) of the water quality target/criteria designated beneficial uses and for which these TMDLs are being developed total phosphorus. Designated uses assigned to each lake include: primary contact recreation, aquatic life Warmwater Class A, agriculture water supply class A and aesthetics (NDEQ 2012). Excessive nutrients, specifically phosphorus, have been determined to be impairing aquatic life beneficial uses.

3. Quantification of the pollutant load that may be present in the waterbody and still allows attainment and maintenance of the water quality standards.

Empirical data, the Canfield-Bachmann natural lake water quality model, and observed relationships between nutrient concentrations were employed to determine the maximum phosphorus load that if achieved should result in full beneficial use attainment. The loading capacity outlined in the table below represents the average daily loading that could occur while still maintaining all beneficial uses.

Lake #	Waterbody ID	Loading Capacity (lbs/yr)	Loading Capacity (lbs/day)
Lake #1	LP1-L0290	14.9	0.041
Lake #2	LP1-L0300	16.6	0.045
Lake #3	LP1-L0310	3.5	0.010
Lake #4	LP1-L0330	6.1	0.017
Lake #5	LP1-L0320	13.7	0.038
Lake #7-8	LP1-L0350	13.7	0.038
Lake #16	LP1-L0270	14.6	0.040
Lake #17	LP1-L0230	5.2	0.014

4. Quantification of the amount or degree by which the current pollutant load in the waterbody, including upstream sources that are being accounted for as background loading deviates from the pollutant load needed to attain and maintain water quality standards.
Empirical data, the Canfield-Bachmann natural lake water quality model, and post implementation data from Fremont #20 were employed to determine the deviation from current phosphorus loads. These values for phosphorus are outlined in the table below.

Lake #	Waterbody ID	Current Load (lbs/yr)	Loading Capacity (lbs/yr)	Deviation (lbs/yr)
Lake #1	LP1-L0290	28.2	14.9	13.3
Lake # 2	LP1-L0300	30.7	16.6	14.1
Lake # 3	LP1-L0310	6.7	3.5	3.2
Lake # 4	LP1-L0330	11.9	6.1	5.8
Lake # 5	LP1-L0320	187.2	13.7	173.5
Lake # 7-8	LP1-L0350	33.1	13.7	19.4
Lake # 16	LP1-L0270	20.9	14.6	6.3
Lake # 17	LP1-L0230	9.7	5.2	4.5

5. Identification of the pollutant source categories.
Nonpoint and natural sources of nutrients have been identified as the cause of impairment to The FLSs.

6. Wasteload allocations for pollutants from point sources.
No point sources discharge in the watershed, therefore the wasteload allocations for phosphorus will be set at zero (0).

7. Load allocations for pollutants from nonpoint sources.
For this TMDL the phosphorus load allocation (including natural background) was developed using empirical data, the Canfield-Bachmann natural lake water quality model, required phosphorous loadings were based on empirical chlorophyll-a and total nitrogen relationships for the Fremont State Lake System. The allocations outlined in the table below represent the average daily loads, and therefore represent the average case for loadings of phosphorous to the Fremont state lake system.

Lake #	Waterbody ID	Load Allocation (lbs/yr)	Load Allocation (lbs/day)
Lake #1	LP1-L0290	13.4	0.037
Lake #2	LP1-L0300	14.9	0.041
Lake #3	LP1-L0310	3.2	0.009
Lake #4	LP1-L0330	5.5	0.015
Lake #5	LP1-L0320	12.3	0.034
Lake #7-8	LP1-L0350	12.3	0.034
Lake #16	LP1-L0270	13.1	0.036
Lake #17	LP1-L0230	4.7	0.013

8. Margin of safety.

These TMDLs contain an explicit margin of safety of 10% and are identified for each lake in the table below. These values for the MOS are based off the average daily loading values, and therefore represent the average case.

Lake #	Waterbody ID	Margin of Safety (lbs/yr)	Margin of Safety (lbs/day)
Lake #1	LP1-L0290	1.5	0.004
Lake #2	LP1-L0300	1.7	0.005
Lake #3	LP1-L0310	0.4	0.001
Lake #4	LP1-L0330	0.6	0.002
Lake #5	LP1-L0320	1.4	0.004
Lake #7-8	LP1-L0350	1.4	0.004
Lake #16	LP1-L0270	1.5	0.004
Lake #17	LP1-L0230	0.5	0.001

9. Consideration for seasonal variation.

The pollutants of concern are delivered on a year round basis and the assessment of the data considers annual average conditions. However, in-lake and watershed model inputs require that seasonal changes (e.g. vegetative cover, precipitation) be accounted for. Because nonpoint sources have been identified as the largest contributor, management practices and implementation will be targeted at those times when the nonpoint source influence is the greatest. This usually revolves around the precipitation events of mid to late spring when there is a high potential for run-off of sediment, phosphorus (attached to sediment), and nitrogen. The effects of the excess pollutant loadings are: large quantities of algae growth occurring during the growing season, potential for future dissolved oxygen impairments and sediment reducing the volume of the lake.

10. Allowances for reasonably foreseeable increases in pollutant loads.

There was no allowance for future growth included in these TMDLs.

11. Implementation Plan
An implementation plan has been developed and will be utilized to reduce water column total phosphorus. Implementation includes the removal of "rough fish" and treatment of the lake with aluminum.

The TMDL included in the following text can be considered a "phased TMDL" and as such is an iterative approach to managing water quality based on the feedback mechanism of implementing a required monitoring plan that will determine the adequacy of load reductions to meet water quality standards and revision of the TMDL in the future if necessary. A description of the future monitoring (Section 4.0) that is planned has been included. Monitoring is essential to all TMDLs in order to:

- Assess the future beneficial use status;
- Determine if the water quality is improving, degrading or remaining status quo;
- Evaluate the effectiveness of implemented best management practices.

The additional data collected should be used to determine if the implemented TMDL and watershed management plan have been or are effective in addressing the identified water quality impairments. As well the data and information can be used to determine if the TMDLs have accurately identified the required components (i.e. loading/assimilative capacity, load allocations, in lake response to pollutant loads, etc.) and if revisions are appropriate.

1.0 Introduction

In the 2012 Nebraska Integrated Report, eight lakes in the FLS will be included on Nebraska's Section 303(d) list of impaired waters. All of these listings are related to eutrophication parameters including phosphorus, nitrogen, chlorophyll-a, algal toxins, pH, and dissolved oxygen. This TMDL will be focused on nutrient management, particularly phosphorus, to address all eutrophication impairments found within the FLS system.

The degradation of water quality in sandpit lakes is a concern in Nebraska. Currently, over 800 publicly and privately owned sandpit lakes exist in the State. These lakes are used extensively for recreation by a large, diverse group of people with various interests (i.e. swimming, fishing, SCUBA-diving, hunting). Nutrient loading, particularly phosphorus, has led to accelerated eutrophication of many sandpits throughout the State and has greatly reduced their recreational usage. Lakes in the FLS system were created as early as the 1940s, and many are now experiencing water quality problems related to eutrophication.

Excessive nutrient loadings play a significant role in accelerating eutrophication in lakes (EPA 1999), thus it is appropriate to develop a TMDL for the pollutant (phosphorus) rather than the response variables (low DO, pH, toxic algae). Therefore, based on the above and as required by Section 303(d) of the Clean Water Act and 40 CFR Part 130.7, phosphorus TMDLs will be developed to address the TP, chlorophyll-a, pH, DO, and algal toxins impairments in the Fremont lake system.

1.1 Background Information

The Fremont State Lakes System (FLS) is located in Dodge County on the west side of Fremont, NE (Figure 1.1). It is part of the Fremont Lakes State Recreation Area (SRA) and includes 20 sandpit lakes with approximately 300 surface acres of water that lie adjacent to the Platte River. The lakes and associated area are owned by the State of Nebraska and operated by the Nebraska Game and Parks Commission (NGPC) who manages the recreational facilities as well as the fishery. The FLS has a limited watershed and no towns exist within the boundary however; Fremont (population 26,397) lies approximately two miles to the east. These highly used lakes provide a multitude of uses to more than 800,000 visitors per year.

1.1.1 Waterbody Description

1.1.1.1 Waterbody Name: Fremont Lake No. 17 (LP1-L0230), Fremont Lake No. 16 (LP1-L0270), Fremont Lake No. 2 (LP1-L0300), Fremont Lake No. 3 (LP1-L0310), Fremont Lake No. 5 (LP1-L0320), Fremont Lake No. 4 (LP1-L0330), Fremont Lake No. 7 & 8 (LP1-L0350), Fremont Lake No. 1 (LP1-L0290)

1.1.1.2 Major River Basin: Missouri

1.1.1.3 Minor River Basin: Lower Platte

1.1.1.4 Hydrologic Unit Code: 10200202

1.1.1.5 Assigned Beneficial Uses: Primary contact recreation, Aquatic Life Warmwater Class A, Agricultural Water Supply Class A and Aesthetics (Title 117 – Nebraska Surface Water Quality Standards) (NDEQ 2012). Table 1.1.1.5 below outlines the assigned beneficial uses.

1.1.1.6 Major Tributaries: None

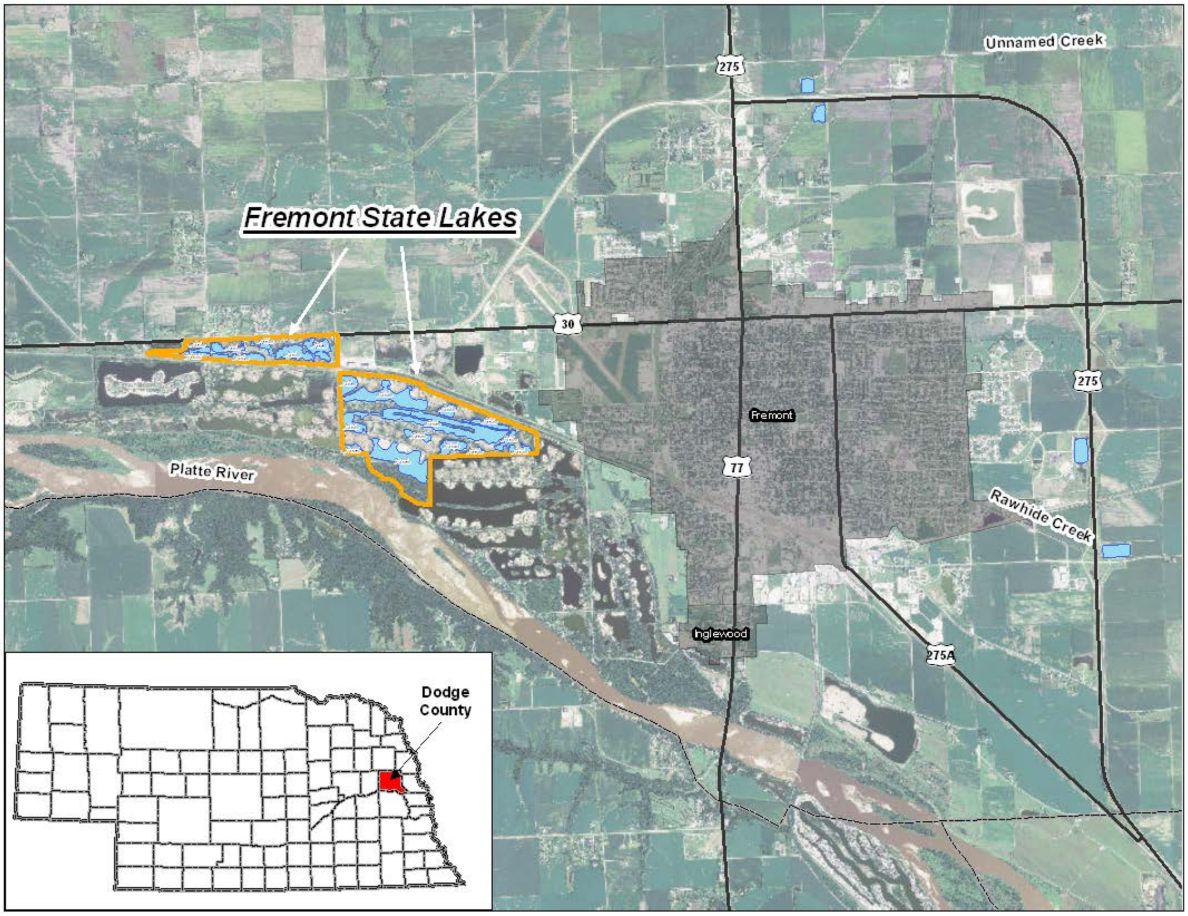

Figure 1.1: Fremont State Lake system

Waterbody ID	Lake #	Recreation	Aquatic Life Warmwater	Public Drinking Water Supply	Agriculture Water Supply	Industrial Water Supply	Aesthetics	Overall Assessment	2010 IR
LP1-L0290	1	•	A		A		•	I	5
LP1-L0300	2	•	A		A		•	I	5
LP1-L0310	3	•	A		A		•	I	5
LP1-L0330	4	•	A		A		•	I	5
LP1-L0320	5	•	A		A		•	I	5
LP1-L0350	7&8	•	A		A		•	I	5
LP1-L0270	16	•	A		A		•	I	5
LP1-L0230	17	•	A		A		•	I	5

Table 1.1.1.5: Beneficial Uses and 2012 Integrated Report Impairments (impairments in red)

1.1.2 Watershed Characterization

1.1.2.1 Physical Features: FLS is a sandpit lake system with a limited watershed and is located in the Western Corn Belt Plains (Level III) ecoregion as defined by Chapman, et al. (2001). The lakes are part of the Fremont Lake State Recreation Area that is managed by the NGPC. The area directly surrounding the lake consists of the recreation area and deciduous forest areas.

1.1.2.2 Climate: Winters in the watershed are cold with precipitation mainly occurring as snowfall. Summers can be hot but with occasional cool spells (Figure 1.1.2.2a). Annual precipitation in the area is approximately 30 inches (HPCC 2011). The majority of the precipitation occurs between May and September. (Figure 1.1.2.2b).

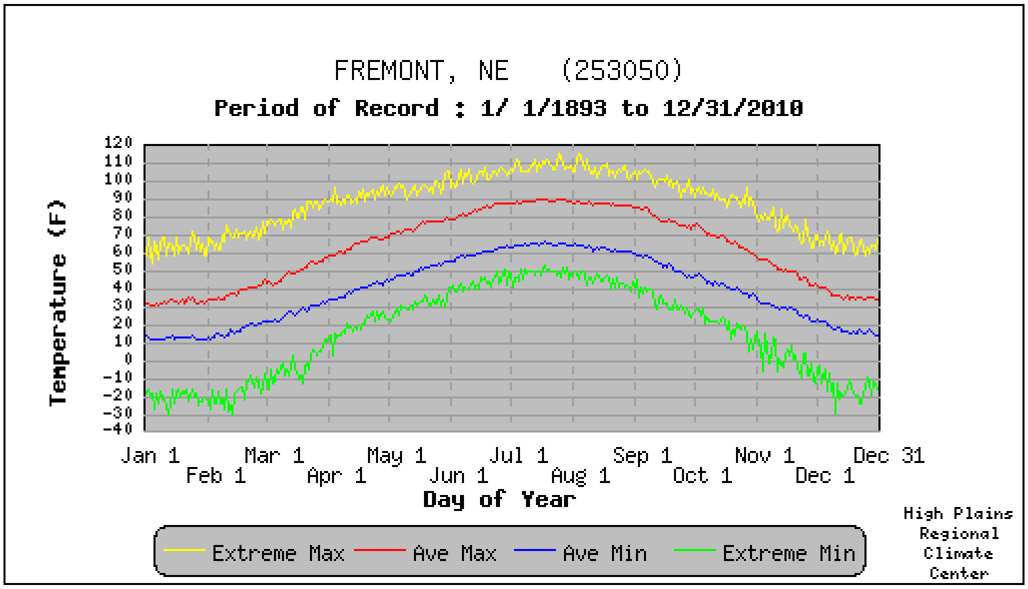

Figure1.1.2.2a: Average Temperature for FLS near Fremont, NE

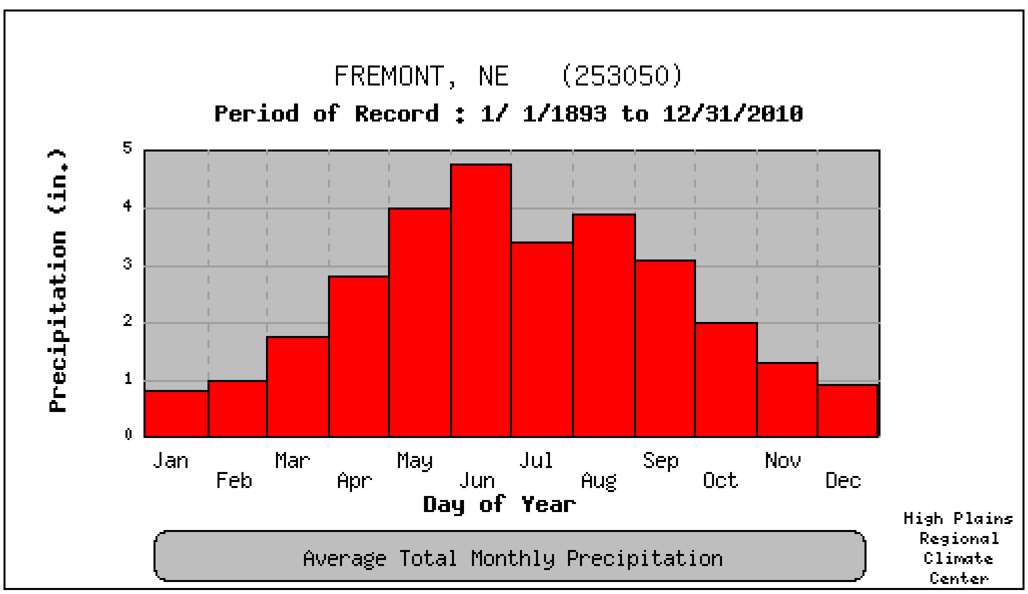

Figure 1.1.2.2b: Average Monthly Precipitation for FLS near Fremont, NE

1.1.2.3 Demographics: While no municipality lies in the limited watershed, the City of Fremont – populations 26,397 lies approximately 2 miles to the east. As well, the City of Omaha and Lincoln are approximately 24 miles to the southeast and 41 miles to the south, respectively.

1.1.2.4 Land Uses: The limited watershed of approximately 1,850 acres consists of a state recreation area and deciduous forest. The Fremont State Lake system has no significant contributing watershed, and as such the analysis of land use percentages were not included in this TMDL

2.0 Phosphorus TMDL

2.1 Problem Identification

As mentioned, eight lakes in the FLS have been identified as Category 5 waterbodies on the 2012 Nebraska Surface Water Quality Integrated Report, as being impaired by nutrients. The following sections detail the extent and nature of the water quality impairments related to phosphorus in the lakes previously identified in Table 1.1.1.5.

All available data for lakes in the FLS were assessed against current thresholds identified in the *Methodologies for the 2012 Nebraska Integrated Report* for the 2012 Section 303(d) list of impaired waters. Of the 20 lakes located in the FLS, eight are listed as impaired on Nebraska's Section 303(d) list. A total of 30 different listings originate from these eight lakes. All impairment listings are related to the Aquatic Life Use and stem from eutrophication. Impairment causes include total phosphorus, total nitrogen, chlorophyll-a, dissolved oxygen, and pH.

Five additional lakes were listed as impaired for nutrients in the 2012 reporting cycle than were listed in the 2010 integrated report. Table 2.1.1 summarize the impairments listed in the Fremont State Lake System in the 2012 reporting cycle.

Lake 16 is meeting total phosphorus targets, however, this lake is still in violation of the chlorophyll-a targets. Phosphorous targets for this lake need to be more aggressive in order to achieve chlorophyll-a concentrations below 10 mg/m^3.

2012 Listings		Impairments - Aquatic Life				Parameters of Concern			
Lake #	Category	Nutrients	D.O.	pH	Algal Toxins	TP	TN	Chl-a	Unknown/Other
Lake #1	5	X	X	X		X		X	X
Lake #2	5	X				X	X	X	
Lake #3	5	X	X			X	X	X	X
Lake #4	5	X		X		X	X	X	X
Lake #5	5	X	X	X		X	X	X	X
Lake #7&8	5	X		X		X	X	X	X
Lake #16	5	X		X			X	X	X
Lake #17	5	X		X		X	X	X	X

Table 2.1.1 – 2012 Integrated Report Listings for Fremont State Lake Impairments

2.1.1 Water Quality Criteria Violated and/or Beneficial Uses Impaired

The aquatic life beneficial use was assessed to be impaired due to excessive nutrients in the lakes identified in table 1.1.1.5 above.

2.1.2 Data Sources

The NDEQ has collected various water quality data and information on a semi-regular basis from 2004 through 2010. NDEQ has continued to collect such information in accordance with basin rotation and pre- and post-project monitoring. The existing data includes, water transparency, dissolved oxygen, temperature, conductivity, pH, pesticides, chlorophyll-a, nitrogen series, dissolved and total phosphorus and total suspended solids.

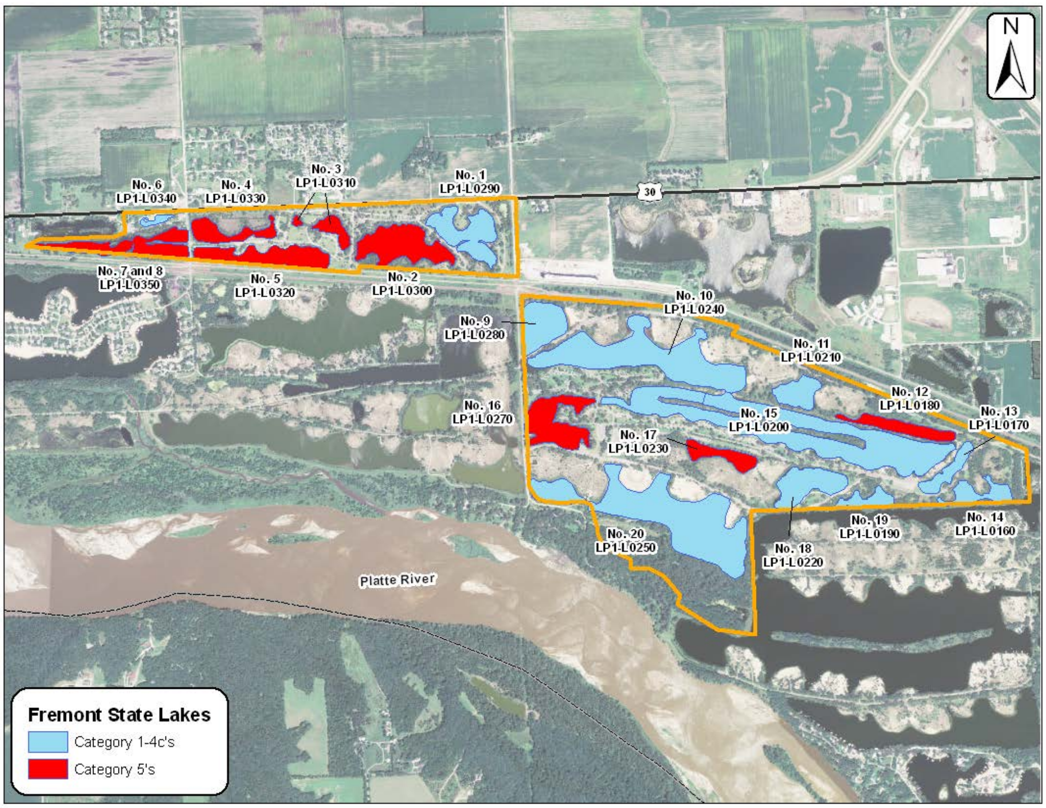

Figure 2.1: Impaired Lakes in Fremont Lakes System

2.1.3 Water Quality Assessment

Assessment methodologies for nutrients in lakes, reservoirs & sandpits have varied since the 2004 Integrated Reporting cycle. For the 2008 Integrated Report, NDEQ utilized a classification scheme developed by the University of Nebraska. This approach developed 24 classes, each containing numeric nutrient (nitrogen, phosphorus, and chlorophyll-a) water quality targets, with which lakes, reservoirs & sandpits are grouped by. For the 2004 and 2006 Integrated Reports, Carlson's TSI was utilized for assessment purposes.

For the 2010 Integrated Report, UNL's nutrient classification system did not provide acceptable values according to Region 7. A meeting was held in August of 2009 to develop nutrient assessment thresholds for Nebraska's Natural Lakes, Reservoirs, Sandpits for the 2010 Integrated Report. The result of that meeting established Nutrient assessment thresholds for two regions of the state (NDEQ 2012). These regions follow major basin boundaries within Nebraska and generally establish eastern and western threshold values. One exception is that Sand Hill lakes located in both regions are not assessed due to the lack of anthropogenic impairments. Targets were established for total phosphorus, total nitrogen, and chlorophyll-a for both regions and can be found in table 2.1.3 below.

Region	Total P (µg/l)	Chlorophyll-a (µg/l)	Dissolved Oxygen (mg/l)	pH
Eastern (Big Blue, Elkhorn, Little Blue, Lower Platte & Missouri Tributaries Basins)	50	10	>5	6.5-9.0
Western (Loup, Middle Platte, Niobrara, North Platte, Republican, South Platte & White Basins)	40	8	>5	6.5-9.0

Table 2.1.3: 2012 IR Assessment Thresholds/Standards

In 2012, as part of the triennial review of Title 117, EPA approved the above outlined standards for nutrients in lakes. These new standards can be viewed in Chapter 4 Section 003.05 of Title 118 (NDEQ 2012). The FLS lies within the Lower Platte River Basin and therefore assessment thresholds are: Total Phosphorus = 50 µg/l, and Chlorophyll-a = 10 µg/l.

Dissolved Oxygen and pH impairments are based on the Title 117 surface water quality standards (NDEQ 2012). The Standard for Warmwater Class A (Aquatic Life) beneficial use is that the Dissolved Oxygen exceeds 5.0 mg/l, and the pH ranges between 6.5 and 9.0

Because the criteria for aquatic life are more stringent than those criteria for the other designated uses of Fremont Lakes, attainment of the total phosphorous loadings will assure full support of all the designated uses potentially impacted by nutrients. Therefore successful implementation of this TMDL for total phosphorous will also fully support the other designated uses of Fremont Lakes.

2.1.4 Water Quality Conditions

As stated previously, the impairments in the Fremont State Lake System will be targeted through limiting Phosphorous and Chlorophyll. Table 2.1.4.1 below shows average values for TP, TN, and Chlorophyll-a assessments for the eight lakes in question in this TMDL document. Values for each parameter that exceed the assessment threshold are highlighted in red. Seven of the eight lakes exceeded the total phosphorus and total nitrogen thresholds of 50 µg/l, and 1000 µg/l respectively. All eight lakes exceeded the chlorophyll-a threshold of 10 µg/l.

WBID	Lake #	Data Period	Total Phosphorus		Chlorophyll-a	
			n	Value (µg/l)	n	Value (µg/l)
LP1-L0290	Lake #1	2008-2010	19	**56.5**	4	**19.9**
LP1-L0300	Lake #2	2006-2010	23	**55.8**	20	**29.2**
LP1-L0310	Lake #3	2008	11	**56.9**	11	**16.7**
LP1-L0330	Lake #4	2008-2010	18	**57.8**	16	**24.5**
LP1-L0320	Lake #5	2008-2010	21	**180**	16	**78.6**
LP1-L0350	Lake #7&8	2008	11	**65.4**	11	**24.7**
LP1-L0270	Lake #16	2008	11	47.6	11	**19.2**
LP1-L0230	Lake #17	2008	11	**56**	11	**28.1**

Table 2.1.4.1: 2012 Assessment results for various lakes in the FLS
Red Text indicates concentrations above Assessment Thresholds

Dissolved Oxygen (D.O.) and pH are assessed based on a binomial distribution to determine impairment to the Aquatic Life Beneficial use based on the number of samples collected which exceed water quality standards. Tables 2.1.4.2 and 2.1.4.3 outlined the number of samples collected for D.O and pH, the number exceeding water quality standards, and the number of samples allowed to exceed standards before listing as impaired.

WBID	Lake #	pH Samples Collected (#)	pH Samples > 9.0 (#)	Samples Allowed to Exceed (#)	Waterbody Status
LP1-L0290	Lake #1	21	6	4	**Impaired**
LP1-L0300	Lake #2	66	10	11	Support
LP1-L0310	Lake #3	22	4	5	Support
LP1-L0330	Lake #4	32	6	6	**Impaired**
LP1-L0320	Lake #5	32	9	6	**Impaired**
LP1-L0350	Lake # 7&8	22	6	5	**Impaired**
LP1-L0270	Lake #16	22	10	5	**Impaired**
LP1-L0230	Lake #17	22	7	5	**Impaired**

Table 2.1.4.2: 2012 pH Assessment results for various lakes in the FLS

WBID	Lake #	DO Profiles Collected (#)	D.O Samples < 5.0 mg/l (#)	Samples Allowed to Exceed (#)	Waterbody Status
LP1-L0290	Lake #1	14	4	4	**Impaired**
LP1-L0300	Lake #2	13	3	4	Support
LP1-L0310	Lake #3	13	5	4	**Impaired**
LP1-L0330	Lake #4	13	2	4	Support
LP1-L0320	Lake #5	14	4	4	**Impaired**
LP1-L0350	Lake # 7&8	12	2	4	Support
LP1-L0270	Lake #16	13	3	4	Support
LP1-L0230	Lake #17	12	1	4	Support

Table 2.1.4.3: 2012 D.O. Assessment results for various lakes in the FLS

Of the lakes assessed in the Fremont Lake System, six lakes are impaired for high pH, and three lakes are listed for low dissolved oxygen. It is believed that the phosphorous loadings within the Fremont State Lake System are triggering the pH and D.O. impairments.

The Carlson Trophic State index provides relative information regarding the state of eutrophication in lakes, and can be calculated using nutrient concentrations as shown below (Carlson, 1977). For the Fremont State Lake system the calculated TSI values can be seen in Table 2.1.4.

$$TSI = (9.81) \times \ln(Chl\_a) + 30.6$$

Or

$$TSI = 14.42 \times \ln(TP) + 4.15$$

WBID	Lake #	Total Phosphorous		Chlorophyll a	
		Value (µg/l)	TSI	Value (µg/l)	TSI
LP1-L0290	Lake #1	56.5	62	19.9	60
LP1-L0300	Lake #2	55.8	62	29.2	64
LP1-L0310	Lake #3	56.9	62	16.7	58
LP1-L0330	Lake #4	57.8	63	24.5	62
LP1-L0320	Lake #5	180	79	78.6	73
LP1-L0350	Lake #7&8	65.4	64	24.7	62
LP1-L0270	Lake #16	47.6	60	19.2	60
LP1-L0230	Lake #17	56	62	28.1	63

Table 2.1.4 – Trophic State Indices in the Fremont State Lake System

Trophic State Indicies in the Fremont State Lake System range between 62 and 79 which indicate the lakes are in a state of Eutrophy or Hypereutrophy. Under these conditions, an increasing supply of nutrients, especially phosphorous will often result in dominance of blue green algae (Carlson, 1977). Blue green algae possess adaptations which allow them to out compete true algae, such as the ability to fix their own nitrogen, or the ability to move within the water column to improve productivity and avoid predation. Blue green algae have the capability to produce algal toxins which pose a public health risk to those utilizing the lakes for recreation.

Toxin levels have been observed to increase as algae density increases and often spikes when “blooms” occur. While some species of green algae are beneficial to fish and other aquatic life, some species of blue-green algae are known to be toxic to animal and humans (Brakhage 2004). Nutrient concentrations, particularly phosphorus, play a role in the quantity of algae produced. Most Nebraska lakes have ample supply of phosphorus to produce significant algae blooms (Brakhage 2004).

While there are no lakes currently on the impaired list for the algal toxins produced by blue green algae, all twelve lakes monitored since 2008 have had detectable concentrations. Three of the twelve lakes monitored for toxins have had maximum concentrations above the beach posting target of 20 ppb but there were too few high measurements to warrant an impaired status. The algal toxin impairment for Lake #2 was removed in the 2012 integrated report for this reason. Since eutrophication in these lakes will continue to make conditions more suitable for blue green algae, toxin concentrations are expected to increase if measures to reduce nutrient concentrations are not taken.

Algae typically derive cellular carbon from carbon dioxide within the water column. Since carbon dioxide lowers pH levels in water, as the removal of carbon dioxide increases with increased algal productivity the result is an increase in pH. Since all of the impairments for pH within the Fremont State Lake System are related to high pH, controlling algal productivity within the system serve to lower the pH levels within the water quality standards.

The dissolved oxygen impairments within the system can also be linked to algal productivity. Algae consume dissolved oxygen during respiration over night, and high density of algae growth has the ability to remove large amounts of D.O. from the water column. Furthermore, the bacteria responsible for the breakdown of dead and decaying algae also require D.O. from the water column. In hypereutrophic conditions the above mechanisms can often cause the D.O. in lakes to drop below the water quality standard for Aquatic Life, and can contribute to an increased frequency of fish kills.

In summary, all of the impairments within the Fremont State Lake System can be linked to algal concerns. Reducing phosphorous and chlorophyll a concentrations within the system will inhibit algal production, allowing for the water quality standards to be met. For that reason, these TMDLs focus on reduction of phosphorous and chlorophyll-a concentrations.

2.1.5 Potential Pollutant Sources

2.1.5.1 Point Sources: No point sources, permitted under the National Pollutant Discharge Elimination System (NPDES) program has been identified in the FLS's watershed

2.1.5.2 Nonpoint Sources: Nonpoint phosphorus sources identified in the FLS's watershed include: bank erosion, groundwater inflow and deposition and decomposition of vegetative material from the surrounding landscape. Runoff from the recreation areas, e.g., camping, septic or pit toilets, dumping, pet walking/waste, dump stations, showers, and waste from wildlife are also potential non-point sources.

2.1.5.3 Natural Sources: Natural background phosphorus can be contributed from precipitation events however; natural source will not be separated from the nonpoint source contribution.

2.2 TMDL Endpoint

The endpoint for the nutrient TMDL is based upon narrative criteria, numeric water quality targets and stakeholder defined water quality goals. As described below, phosphorus loading targets, in comparison with current load estimates, allowed for the determination of an acceptable load (desired endpoint) and the needed reduction necessary to attain full support designation and stakeholder-defined goals.

2.2.1 Numeric Water Quality Criteria

In 2012, as part of the triennial review of Title 117, EPA approved NDEQs nutrient standards for lakes. These new standards can be viewed in Chapter 4 Section 003.05 of Title 118 (NDEQ 2012). The FLS lies within the Lower Platte River Basin and therefore assessment thresholds are: Total Phosphorus = 50 µg/l, and Chlorophyll-a = 10 µg/l.

2.2.2 Selection of Critical Environmental Conditions

Although the TMDLs are based off data collected during NDEQs basin rotation monitoring between May-September, the loading to meet the conditions is an annual load. Samples are taken during the recreation season because problems related with eutrophication generally occur during the warmer spring and summer months, and are therefore more likely to impact human health and recreation activities during this timeframe. This approach takes into consideration that nutrients being lost from the water column and trapped in the bottom sediments have the potential to re-enter the water column at a later time.

Nutrient data for the Fremont Lake System has been collected as outlined in Section 2.1.2. From this data, regressions predicting total nitrogen, and chlorophyll-a concentrations based on measured total phosphorous concentrations were developed and used to predict chlorophyll concentrations under the proposed loading condition. The resulting regressions are included below, and the data used to create the regressions can be viewed in Appendix B.

Parameter		**Chlorophyll-a**
Model Equation		Log(TP) = 1.12 + 0.461 Log(Chl_A)
Data Range		2006 - 2010
N		121
S^2 Mean Square Error		0.026
R^2		56.4%
P Values	**Slope**	<0.000
	Intercept	<0.000

Table 2.2.2.1: Models using Chlorophyll-a for Fremont State Lakes

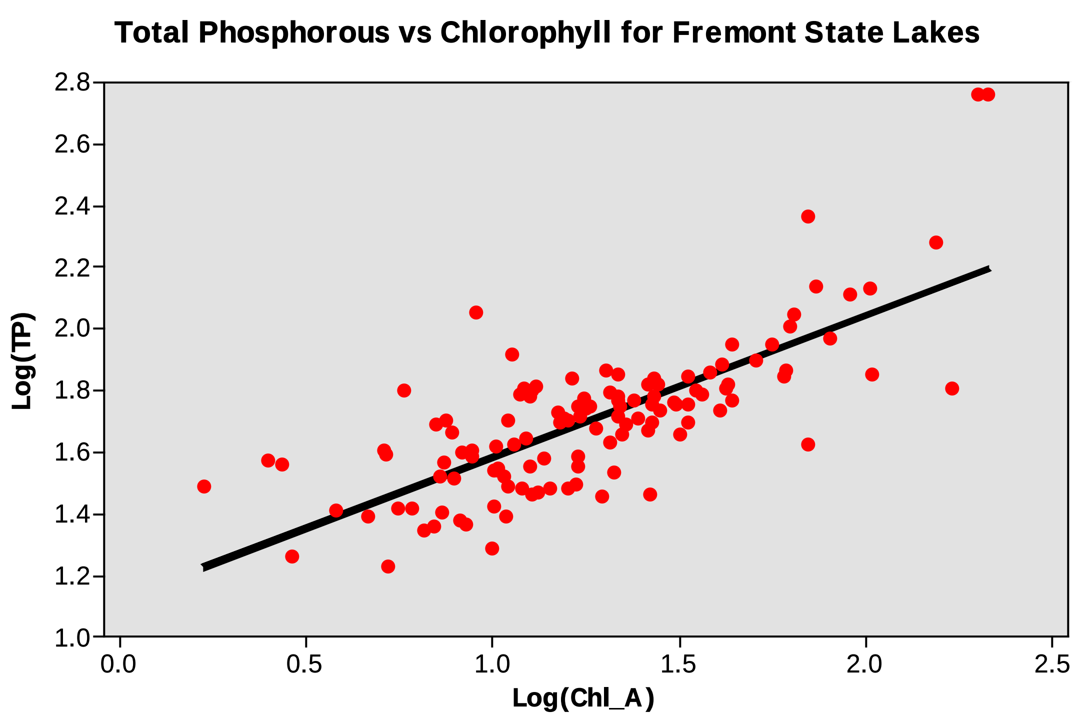

Figure 2.2.3.1: Total Phosphorous vs. Chlorophyll-a

Based on the developed regressions, the critical endpoint concentration for phosphorous can be estimated since the standards for total phosphorous, and chlorophyll-a are known. For example; The maximum total phosphorous concentration resulting in a predicted chlorophyll-a value within water quality standard (10 µg/l Chlorophyll-a) is equal to:

$$\text{Log(TP)} = 1.12 + 0.461\ \text{Log(Chl\_a)} \quad \text{OR} \quad \text{Log}(TP_{target}) = 1.12 + 0.461\ \text{Log}(10)$$

Where:

TP = Required Total Phosphorous Concentration (µg/l)

Therefore:

$$\text{Log(TP)} = 1.12 + 0.461 = 1.581 \quad \text{OR} \quad TP_{target} = 38.1\ \mu g/l$$

The results of this analysis are summarized in Table 2.2.2.2 below.

Parameter of Concern	Assessment Threshold (µg/l)	Required Concentration to Meet Phosphorous WQS (µg/l)
Total Phosphorous	50	50.0
Chlorophyll-a	10	38.1

Table 2.2.2.2: Critical environmental conditions based on pollutant regressions.

From this analysis it can be determined that the predicted total phosphorous concentrations required to meet the chlorophyll-a target of 10 µg/l, is 38.1 µg/l. Since all of the lakes included in this TMDL are exceeding chlorophyll-a limits, the critical environmental condition will be set as 38.1 µg/l of total phosphorous throughout the lakes.

As discussed in section 2.1.4 the Carlson Trophic State Index (TSI) can provide relative information regarding the eutrophic state of a lake. In this case TSI will also be used to provide reasonable assurance that the pH and D.O impairments associated with eutrophication will vanish if the above targets are met. For the critical conditions outlined above, the resulting TSI values can be calculated as:

$$\text{TSI} = (9.81) \times \ln(\text{Chl\_}a) + 30.6 = 9.81 \times \ln(10) + 30.6 = \mathbf{53}$$

$$\text{TSI} = 14.42 \times \ln(\text{TP}) + 4.15 = 14.42 \times \ln(38.1) + 4.15 = \mathbf{57}$$

These TSI values correspond to a state of high level mesotrophy or low level eutrophy in which the waterbody is moderately clear with a low probability of low D.O and macrophyte problems during the summer. Therefore the critical conditions for TP, and chlorophyll-a, if met, should provide a water quality state where the probability of high pH, and Low D.O. impairments is minimal.

2.2.3 Waterbody Pollutant Loading Capacity

The loading capacity for these nutrient TMDLs is defined as the amount of phosphorus each of the previously identified FLSs can receive on an average annual basis and still meet the applicable in-lake water quality targets. Utilizing the Canfield-Bachman (Canfield and Bachmann 1981) prediction model for natural lakes, annual loading capacities for phosphorus were identified for each FLS. Table 2.2.3 summarizes the loading capacity for the impaired lakes in the Fremont State Lake system.

During the implementation of these models, a hydraulic residence time of 5 years was assumed. Since the Fremont State Lake System is heavily influenced by groundwater fluxes between the lakes, has little to no inflow, and no outflow, the residence time is difficult to predict. Assuming that all of storage loss in the lake comes from evaporation, with average evaporation for the region at 43 inches/year (NDEQ 2007); the hydraulic residence time for the deepest lake (Lake #7&8 at 145 inches) would be equal to:

$$\theta = \frac{Depth}{Evaporation} = \frac{145\ in}{43\frac{in}{yr}} = 3.37\ years$$

Note that since this estimation of residence time was calculated assuming only loss to evaporation, the actual residence time would likely be less. Furthermore, Lake #7&8 is the deepest of the lakes, therefore residence times for the other lakes would also be lower. Since higher residence times yield lower loading capacities, using a 5 year hydraulic residence time is a conservative assumption.

Lake #	Waterbody ID	Loading Capacity (lbs)
Lake #1	LP1-L0290	14.9
Lake #2	LP1-L0300	16.6
Lake #3	LP1-L0310	3.5
Lake #4	LP1-L0330	6.1
Lake #5	LP1-L0320	13.7
Lake #7-8	LP1-L0350	13.7
Lake #16	LP1-L0270	14.6
Lake #17	LP1-L0230	5.2

Table 2.2.3: Loading Capacities for identified FLS lakes

2.3 Pollutant Source Assessment

For this TMDL, the pollutant assessment is based upon the water quality information collected from the eight identified FLS lakes.

2.3.1 Existing Pollutant Conditions

A summary of the average water quality conditions by lake are summarized in Table 2.1.4.

2.3.2 Deviation from Acceptable Pollutant Loading Capacity

In order to meet the in-lake nutrient assessment thresholds, the average annual total phosphorus concentration must be reduced from in each of the eight lakes in question. To accomplish this, the existing total phosphorus loads must be reduced by anywhere between 13-91% for a given lake. Table 2.3.2 below shows each lakes total phosphorous reductions necessary to meet all nutrient assessment thresholds. In all cases, in order to meet the chlorophyll-a thresholds, the resulting TP concentrations are actually lower than the assessment thresholds of 50 µg/l.

Lake #	Waterbody ID	Current Load (lbs/yr)	Loading Capacity (lbs/yr)	Deviation (lbs/yr)	% Reduction Needed
Lake #1	LP1-L0290	28.2	14.9	13.3	47%
Lake #2	LP1-L0300	30.7	16.6	14.1	46%
Lake #3	LP1-L0310	6.7	3.5	3.2	48%
Lake #4	LP1-L0330	11.9	6.1	5.8	49%
Lake #5	LP1-L0320	187.2	13.7	173.5	93%
Lake #7-8	LP1-L0350	33.1	13.7	19.4	59%
Lake #16	LP1-L0270	20.9	14.6	6.3	30%
Lake #17	LP1-L0230	9.7	5.2	4.5	46%

Table 2.3.2: Deviation from pollutant loading capacity

2.3.3 Identification of Pollutant Sources

Because no point sources have been identified in the FLS watershed, the pollutant load is believed to originate from nonpoint and natural sources.

2.4 Pollutant Allocation

A TMDL is defined as:

$$\text{TMDL} = \text{Loading Capacity} = \text{WLA} + \text{LA} + \text{Background} + \text{MOS}$$

As stated above in table 2.3.2, the phosphorus loading capacity for the eight lakes in question varies from 2.8-13.2 lbs/yr. To achieve the defined phosphorus loading capacity the required allocations are contained in the following sections.

2.4.1 Wasteload Allocations

The wasteload allocation for this TMDL will be “zero” – 0 lbs/year (0 kg/year) for all eight lakes.

2.4.2 Load Allocations

The phosphorus load allocation distributed among the nonpoint and natural sources are outlined in table 2.4.2 below.

Lake #	Waterbody ID	Loading Allocation (lbs/yr)	Loading Allocation (lbs/day)
Lake #1	LP1-L0290	13.4	0.037
Lake #2	LP1-L0300	14.9	0.041
Lake #3	LP1-L0310	3.2	0.009
Lake #4	LP1-L0330	5.5	0.015
Lake #5	LP1-L0320	12.3	0.034
Lake #7-8	LP1-L0350	12.3	0.034
Lake #16	LP1-L0270	13.1	0.036
Lake #17	LP1-L0230	4.7	0.013

Table 2.4.2: Load Allocations for identified FLS lakes

2.4.3 Margin of Safety

An implicit margin of safety affects this TMDL by way of conservative assumptions in the hydraulic residence times used in the development of the Canfield Bachmann Models. Additionally, an explicit 10% margin of safety will be defined for these TMDLs to ensure contaminant levels will be protective of the assigned beneficial uses, and are outlined in table 2.4.3 below. More specifically, the explicit margin of safety will be equal to 10% of the loading capacity.

Lake #	Waterbody ID	Margin of Safety (lbs/yr)	Margin of Safety (lbs/day)
Lake #1	LP1-L0290	1.5	0.004
Lake #2	LP1-L0300	1.7	0.005
Lake #3	LP1-L0310	0.4	0.001
Lake #4	LP1-L0330	0.6	0.002
Lake #5	LP1-L0320	1.4	0.004
Lake #7-8	LP1-L0350	1.4	0.004
Lake #16	LP1-L0270	1.5	0.004
Lake #17	LP1-L0230	0.5	0.001

Table 2.4.3: Margin of Safety for identified FLS lakes

2.4.4 Expression of TMDLs as Daily Loads

The TMDL has established an annual average phosphorus load that if achieves should meet the water quality targets. A recent court decision often referred to as Anacostia decision have dictated that TMDL include a “daily” load (*Friends of the Earth, Inc. v. EPA, et al.).*

Expressing this TMDL in daily time steps could mislead the reader by implying a daily response to a daily load. It is important to recognize that the growing season mean is affected by many factors such as the following: internal lake nutrient loading, water residence time, wind action and the interaction between light penetration, nutrients, sediment load and algal response. Because of this the TMDL will be expressed as an ‘average daily load” and a “maximum daily load”. The average daily load is calculated by dividing the long term average (LTA), or the loading capacity by the averaging time (365 days). Table 2.4.4.1 shows the average daily loadings for the Fremont lake system.

Lake	WBID	Loading Capacity (lbs/yr)	Average Daily Loading (lbs/day)
Lake #1	LP1-L0290	14.9	0.041
Lake #2	LP1-L0300	16.6	0.045
Lake #3	LP1-L0310	3.5	0.010
Lake #4	LP1-L0330	6.1	0.017
Lake #5	LP1-L0320	13.7	0.038
Lake #7-8	LP1-L0350	13.7	0.038
Lake #16	LP1-L0270	14.6	0.040
Lake #17	LP1-L0230	5.2	0.014

Table 2.4.4.1: Average Daily Loading for the Fremont State Lakes

To translate the long term average to maximum daily values EPA Region 7 has suggested the approach described in the Technical Support Document for Water Quality Based Toxics Control (EPA/505/2-90-001) (TSD). The maximum daily load (MDL) equals:

$$MDL = LTA \times e^{(z\theta - 0.5\theta^2)}$$

Where:

LTA = Long-term average, or the Loading Capacity

z = 1.645 for 95% occurrence probability

θ =Constant based on the coefficient of variation in the data set (CV) and is calculated as:

$$\theta^2 = ln|CV^2 + 1|$$

Performing this analysis yields the “maximum daily load” as summarized in Table 2.4.4.2.

Lake	WBID	Loading Capacity (lbs/yr)	CV	θ	$e^{(z\theta - 0.5\theta^2)}$	Maximum Daily Load (lbs)
Lake #1	LP1-L0290	14.9	1.04	0.86	2.835	0.116
Lake #2	LP1-L0300	16.6	0.62	0.57	2.172	0.099
Lake #3	LP1-L0310	3.5	0.53	0.50	2.003	0.019
Lake #4	LP1-L0330	6.1	0.39	0.38	1.730	0.029
Lake #5	LP1-L0320	13.7	1.08	0.88	2.886	0.108
Lake #7-8	LP1-L0350	13.7	0.3	0.29	1.552	0.058
Lake #16	LP1-L0270	14.6	0.36	0.35	1.671	0.067
Lake #17	LP1-L0230	5.2	0.18	0.18	1.320	0.019

Table 2.4.4.2: Maximum Daily load for the Fremont State Lakes

3.0 Implementation Plan

The development of an implementation plan is an integral part of the overall waterbody/watershed management process and one of the key pieces of information necessary for the process is the level of reduction needed for beneficial use attainment. As a result of the limited watershed options for addressing the pollutant load are also limited. Removal of the nutrients via hydraulic or mechanical dredging has been ruled out not being cost effective.

Phosphorus precipitation/inactivation is being targeted as the primary treatment reduction. This procedure targets the removal of phosphorus from the water column by the used of aluminum salts, a technique that has been long used in advanced wastewater treatment.

3.1 Reasonable Assurance

Effective management of nonpoint source pollution in Nebraska necessarily requires a cooperative and coordinated effort by many agencies and organizations. To address the phosphorus and nutrient impairments in the Fremont State Lake system the NDEQ has partnered with the Nebraska Game and Parks Commission and the University of Nebraska-Lincoln to collectively prepare an watershed management plan.

Additionally, the Department has identified the Fremont State Lake system project as a high priority for receipt of CWA Section 319 grant monies.

4.0 Future Monitoring

At this time, the Fremont State Lake system has been targeted for alum treatments as part of a Section 319 Non-point source project, the treatments are intended to start during the summer of 2012. Monitoring of the water quality in the lake system will be conducted for the duration of the project, and after the project has been completed. Specifically, the NDEQ will coordinate weekly monitoring of the swimming beach for algal toxins (microcystin) concentration. In-lake monitoring will also be conducted as part of the 2012 basin lake monitoring network to determine if the alum treatments were successful at reducing and maintaining the in-lake, growing season total phosphorus at a level below the applicable water quality criteria.

Additionally, at this time a research project between the University of Nebraska Lincoln, and the Nebraska Department of Environmental Quality has been developed to examine internal loadings from the Fremont Lake System prior to, and after the alum treatments.

Additional monitoring will generally be consistent with NDEQ's ambient and basin rotation monitoring schedule. The next time the rotation will be within the Lower Platte River basin for rotation monitoring will be in 2015.

5.0 Public Participation

The availability of the TMDLs in draft form was published on NDEQ's Internet site with the public comment period running from approximately September 1st to October 1st 2012. Interested stakeholders (Appendix A) were also informed via email of the availability of the draft TMDLs. No comments were received as part of this public notice period.

6.0 References

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Appendix A

Federal, State Agency and Private Organizations Included in TMDL Implementation.

FEDERAL

- Bureau of Reclamation
- Environmental Protection Agency
- Fish and Wildlife Service
- Geological Survey
- Department of Agriculture - Farm Services Agency
- Department of Agriculture - Natural Resources Conservation Service

STATE

- Nebraska Association of Resources Districts
- Department of Agriculture
- Department of Environmental Quality
- Department of Roads
- Department of Water Resources
- Department of Health and Human Services
- Environmental Trust
- Game and Parks Commission
- Natural Resources Commission
- University of Nebraska Institute of Agriculture and Natural Resources (IANR)
- UN-IANR: Agricultural Research Division
- UN-IANR: Cooperative Extension Division
- UN-IANR: Conservation and Survey Division
- UN-IANR: Nebraska Forest Service
- UN-IANR: Water Center and Environmental Programs

LOCAL

- Natural Resources Districts
- County Governments (Zoning Board)
- City/Village Governments

NON-GOVERNMENTAL ORGANIZATIONS

- Nebraska Wildlife Federation
- Pheasants Forever
- Nebraska Water Environment Association
- Nebraska Corn Growers Association, Wheat Growers, etc.
- Nebraska Cattlemen’s Association, Pork Producers, etc
- Other specialty interest groups
- Local Associations (i.e. homeowners associations)

Appendix B

Data used for TP vs. Chlorophyll-a regression analysis

All available data for the Fremont State Lake System were used in the development of the TP vs. Chlorophyll-a regression. Specifically, the data used for the regressions were not limited to the impaired lakes, but the system as a whole.

Date	Site Name	TP (µg/L)	Chlorophyll-a (µg/L)	Log(TP)	Log(Chl_A)
5/7/2008	FSL #1	19.3	9.98	1.29	1.00
5/21/2008	FSL #1	18.3	2.90	1.26	0.46
6/2/2008	FSL #1	26.2	5.60	1.42	0.75
6/16/2008	FSL #1	30.1	11.96	1.48	1.08
7/2/2008	FSL #1	38.0	13.64	1.58	1.13
7/14/2008	FSL #1	35.4	10.34	1.55	1.01
7/30/2008	FSL #1	23.9	8.14	1.38	0.91
8/13/2008	FSL #1	30.6	11.04	1.49	1.04
8/27/2008	FSL #1	28.7	19.74	1.46	1.30
9/12/2008	FSL #1	29.4	13.18	1.47	1.12
9/26/2008	FSL #1	22.1	6.56	1.34	0.82
5/9/2006	LLP1FRMT0203	40.0	5.13	1.60	0.71
6/7/2006	LLP1FRMT0203	60.1	12.53	1.78	1.10
5/7/2008	LLP1FRMT0203	25.3	7.30	1.40	0.86
5/21/2008	LLP1FRMT0203	34.4	10.14	1.54	1.01
6/2/2008	LLP1FRMT0203	28.8	12.76	1.46	1.11
6/16/2008	LLP1FRMT0203	47.6	19.00	1.68	1.28
7/2/2008	LLP1FRMT0203	60.2	27.20	1.78	1.43
7/14/2008	LLP1FRMT0203	72.8	20.00	1.86	1.30
7/30/2008	LLP1FRMT0203	44.1	12.30	1.64	1.09
8/13/2008	LLP1FRMT0203	31.3	16.82	1.50	1.23
8/27/2008	LLP1FRMT0203	38.3	16.96	1.58	1.23
9/12/2008	LLP1FRMT0203	49.8	26.80	1.70	1.43
9/26/2008	LLP1FRMT0203	56.9	31.00	1.76	1.49
5/28/2009	LLP1FRMT0203	230.7	69.58	2.36	1.84
7/28/2009	LLP1FRMT0203	60.1	21.62	1.78	1.33
8/31/2009	LLP1FRMT0203	64.4	171.22	1.81	2.23
9/23/2009	LLP1FRMT0203	41.9	69.91	1.62	1.84
5/7/2008	FSL #3	38.8	5.16	1.59	0.71
5/21/2008	FSL #3	60.7	36.60	1.78	1.56
6/2/2008	FSL #3	82.5	11.22	1.92	1.05
6/16/2008	FSL #3	63.1	5.78	1.80	0.76
7/2/2008	FSL #3	65.3	13.12	1.81	1.12
7/14/2008	FSL #3	55.7	18.14	1.75	1.26
7/30/2008	FSL #3	55.7	16.86	1.75	1.23
8/13/2008	FSL #3	49.8	33.40	1.70	1.52
8/27/2008	FSL #3	54.7	17.88	1.74	1.25

9/12/2008	FSL #3	59.6	17.50	1.78	1.24
9/26/2008	FSL #3	39.9	8.28	1.60	0.92
5/7/2008	FSL #4	35.5	16.86	1.55	1.23
5/21/2008	FSL #4	61.0	11.80	1.79	1.07
6/2/2008	FSL #4	50.2	7.54	1.70	0.88
6/16/2008	FSL #4	37.3	2.50	1.57	0.40
6/16/2008	FSL #4	36.0	2.72	1.56	0.43
7/2/2008	FSL #4	30.6	1.67	1.49	0.22
7/14/2008	FSL #4	49.2	7.04	1.69	0.85
7/30/2008	FSL #4	48.6	22.80	1.69	1.36
7/30/2008	FSL #4	45.5	22.20	1.66	1.35
8/13/2008	FSL #4	56.9	33.40	1.76	1.52
8/27/2008	FSL #4	63.2	35.00	1.80	1.54
9/12/2008	FSL #4	102.3	62.72	2.01	1.80
9/26/2008	FSL #4	73.6	61.12	1.87	1.79
5/28/2009	LLP1FRMT0403	113.0	8.98	2.05	0.95
6/30/2009	LLP1FRMT0403	40.0	8.79	1.60	0.94
7/28/2009	LLP1FRMT0403	69.5	60.29	1.84	1.78
8/31/2009	LLP1FRMT0403	58.3	43.74	1.77	1.64
9/23/2009	LLP1FRMT0403	46.3	7.77	1.67	0.89
5/7/2008	FSL #5	58.2	23.80	1.76	1.38
5/21/2008	FSL #5	50.3	15.90	1.70	1.20
6/2/2008	FSL #5	93.0	79.84	1.97	1.90
6/16/2008	FSL #5	63.7	42.00	1.80	1.62
7/2/2008	FSL #5	58.4	21.60	1.77	1.33
7/14/2008	FSL #5	69.0	16.26	1.84	1.21
7/30/2008	FSL #5	52.1	21.80	1.72	1.34
8/13/2008	FSL #5	70.9	103.68	1.85	2.02
8/27/2008	FSL #5	65.6	42.56	1.82	1.63
9/12/2008	FSL #5	129.3	90.88	2.11	1.96
9/26/2008	FSL #5	88.7	56.16	1.95	1.75
5/28/2009	LLP1FRMT0503	136.2	73.97	2.13	1.87
6/30/2009	LLP1FRMT0503	134.9	102.74	2.13	2.01
7/28/2009	LLP1FRMT0503	189.5	153.95	2.28	2.19
8/31/2009	LLP1FRMT0503	573.3	199.32	2.76	2.30
9/23/2009	LLP1FRMT0503	578.2	213.08	2.76	2.33
5/7/2008	FSL #7	41.8	11.38	1.62	1.06
5/21/2008	FSL #7	50.5	11.04	1.70	1.04
6/2/2008	FSL #7	53.3	14.92	1.73	1.17
6/16/2008	FSL #7	62.8	12.74	1.80	1.11
6/16/2008	FSL #7	63.6	12.06	1.80	1.08
7/2/2008	FSL #7	51.8	17.24	1.71	1.24
7/14/2008	FSL #7	51.2	15.48	1.71	1.19
7/14/2008	FSL #7	49.8	15.08	1.70	1.18
7/30/2008	FSL #7	65.9	26.20	1.82	1.42
8/13/2008	FSL #7	70.8	21.60	1.85	1.33
8/27/2008	FSL #7	89.1	43.60	1.95	1.64
9/12/2008	FSL #7	111.8	64.48	2.05	1.81

9/26/2008	FSL #7	70.4	33.20	1.85	1.52
5/3/2002	FSL #7	22.6	6.97	1.35	0.84
6/17/2002	FSL #7	26.3	10.10	1.42	1.00
7/16/2002	FSL #7	28.9	26.36	1.46	1.42
8/14/2002	FSL #7	33.9	21.18	1.53	1.33
5/7/2008	FSL #16	32.9	7.18	1.52	0.86
5/21/2008	FSL #16	36.9	7.36	1.57	0.87
6/2/2008	FSL #16	35.5	12.58	1.55	1.10
6/16/2008	FSL #16	32.4	7.88	1.51	0.90
7/2/2008	FSL #16	38.4	8.80	1.58	0.94
7/14/2008	FSL #16	33.1	10.74	1.52	1.03
7/14/2008	FSL #16	34.5	10.34	1.54	1.01
7/30/2008	FSL #16	41.6	10.24	1.62	1.01
8/13/2008	FSL #16	54.3	40.80	1.73	1.61
8/27/2008	FSL #16	76.7	41.00	1.88	1.61
9/12/2008	FSL #16	72.1	38.00	1.86	1.58
9/26/2008	FSL #16	69.1	27.00	1.84	1.43
5/7/2008	FSL #17	45.4	31.60	1.66	1.50
5/21/2008	FSL #17	56.7	26.60	1.75	1.42
6/2/2008	FSL #17	78.4	50.72	1.89	1.71
6/16/2008	FSL #17	61.8	20.60	1.79	1.31
7/2/2008	FSL #17	57.5	30.80	1.76	1.49
7/14/2008	FSL #17	56.1	22.00	1.75	1.34
7/30/2008	FSL #17	50.8	24.60	1.71	1.39
8/13/2008	FSL #17	46.4	26.20	1.67	1.42
8/27/2008	FSL #17	42.8	20.60	1.63	1.31
9/12/2008	FSL #17	66.1	27.60	1.82	1.44
9/26/2008	FSL #17	54.0	28.20	1.73	1.45
5/7/2008	FSL #18	16.8	5.24	1.23	0.72
5/21/2008	FSL #18	24.6	10.80	1.39	1.03
6/2/2008	FSL #18	30.1	15.82	1.48	1.20
6/16/2008	FSL #18	23.2	8.44	1.37	0.93
7/2/2008	FSL #18	24.7	4.62	1.39	0.66
7/14/2008	FSL #18	25.6	3.78	1.41	0.58
7/30/2008	FSL #18	25.9	6.10	1.41	0.79
8/13/2008	FSL #18	30.2	14.16	1.48	1.15