Nutrient, Sediment, and Dissolved Oxygen TMDLs for Dead Colt Creek Dam in Ransom County, North Dakota

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1.0 INTRODUCTION AND DESCRIPTION OF THE WATERSHED

Dead Colt Creek Dam is a recreational and flood control impoundment located in Ransom County in southeast North Dakota (Figure 1). The reservoir was created in 1983 by damming Dead Colt Creek southeast of Lisbon, North Dakota. It was constructed to create a recreational facility and to provide flood protection. There are 55 miles of tributary streams in the Dead Colt Creek Dam watershed upstream of Dead Colt Creek Dam.

The Dead Colt Creek Dam watershed is a 41,400 acre watershed located in Ransom and Sargent counties (Figure 1). The watershed of Dead Colt Creek Dam lies completely within the Northern Glaciated Plains ecoregion (46); which is characterized by a flat to gently rolling landscape composed of glacial till. The subhumid conditions foster a grassland, transitional between the tall and shortgrass prairie. Though the till soil is very fertile, agricultural success is subject to annual climatic fluctuations. Table 1 summarizes some of the geographical, hydrological, and physical characteristics of Dead Colt Creek Dam and its watershed.

Table 1. General Characteristics of the Dead Colt Creek Dam and Its Watershed.

Legal Name	Dead Colt Creek Dam
Major Drainage Basin	Lower Sheyenne
Nearest Municipality	Lisbon, North Dakota
Assessment Unit ID	ND-09020204-005-L_00
County Location	Ransom County, North Dakota
Physiographic Region	Northern Glaciated Plains
Latitude	46˚22'10"
Longitude	-97˚37'21
Surface Area	98.5 acres
Watershed Area	41,400 acres
Average Depth	18 feet
Maximum Depth	40.5 feet
Volume	1,767.8 acre-feet
Tributaries	Dead Colt Creek
Type of Waterbody	Constructed Reservoir
Dam Type	Constructed Earthen Dam
Fishery Type	Bluegill, Largemouth Bass, Smallmouth Bass, Walleye, White Crappie, and Yellow Bullhead

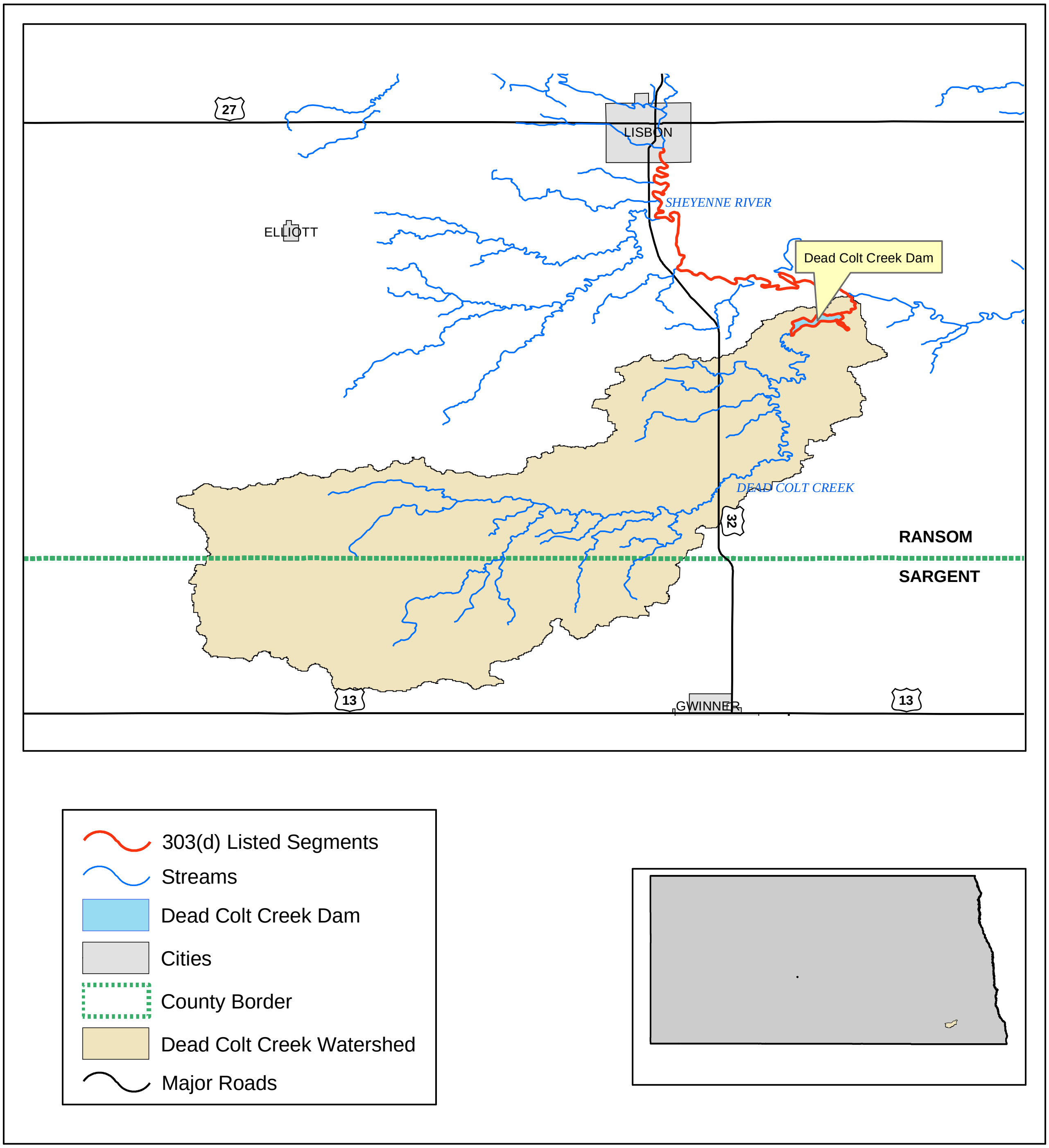

Figure 1. General Location of Dead Colt Creek Dam and the Dead Colt Creek Dam Watershed.

1.1 Clean Water Act Section 303(d) Listing Information

Based on North Dakota's Clean Water Act 2004 Section 303(d) List of Impaired Waters Needing Total Maximum Daily Loads (TMDLs), Dead Colt Creek Dam is an impaired waterbody (Table 2). Based on its Trophic State Index (TSI) score, aquatic life and recreation uses of Dead Colt Creek Dam are impaired. Aquatic life is listed as impaired due to nutrients, sedimentation, and low dissolved oxygen. Recreational use is impaired due to nutrients. North Dakota's Section 303(d) list does not provide any information on potential sources of these impairments. Dead Colt Creek Dam has been classified as a Class 3 warm-water fishery. Class 3 lakes or reservoirs are "capable of supporting growth and propagation of nonsalmonid fishes and associated aquatic biota" (NDDoH, 1991).

Table 2. Dead Colt Creek Dam Section 303(d) Listing Information (NDDH, 2004).

Assessment Unit ID	ND-09020204-005-L_00
Waterbody Name	Dead Colt Creek Dam
Water Quality Standard Class	3 - Warm-water fishery
Beneficial Uses and Use Support Status	Fish and Other Aquatic Biota (fully supporting, but threatened), Recreation (fully supporting, but threatened)
Pollutants of Concern	Nutrients, Dissolved Oxygen, Sedimentation
Priority	High
First Appeared on 303(d) list	1998

1.2 Topography

The topography of the area is characterized by regular patterns of hills and shallow depressions. Soils in the watershed are formed from rocky, gravelly, or sandy glacial till and are moderately well drained. Slopes range from nearly level to steep with average slopes between 2 and 9 percent (NDDoH, 1993). The watershed of Dead Colt Creek Dam slopes gently from the headwaters to the reservoir. Elevations in the watershed range from approximately 420-feet (MSL) in the headwaters to approximately 350-feet (MSL) in the vicinity of the reservoir. Figure 2 shows a relief image of the Dead Colt Creek Dam watershed.

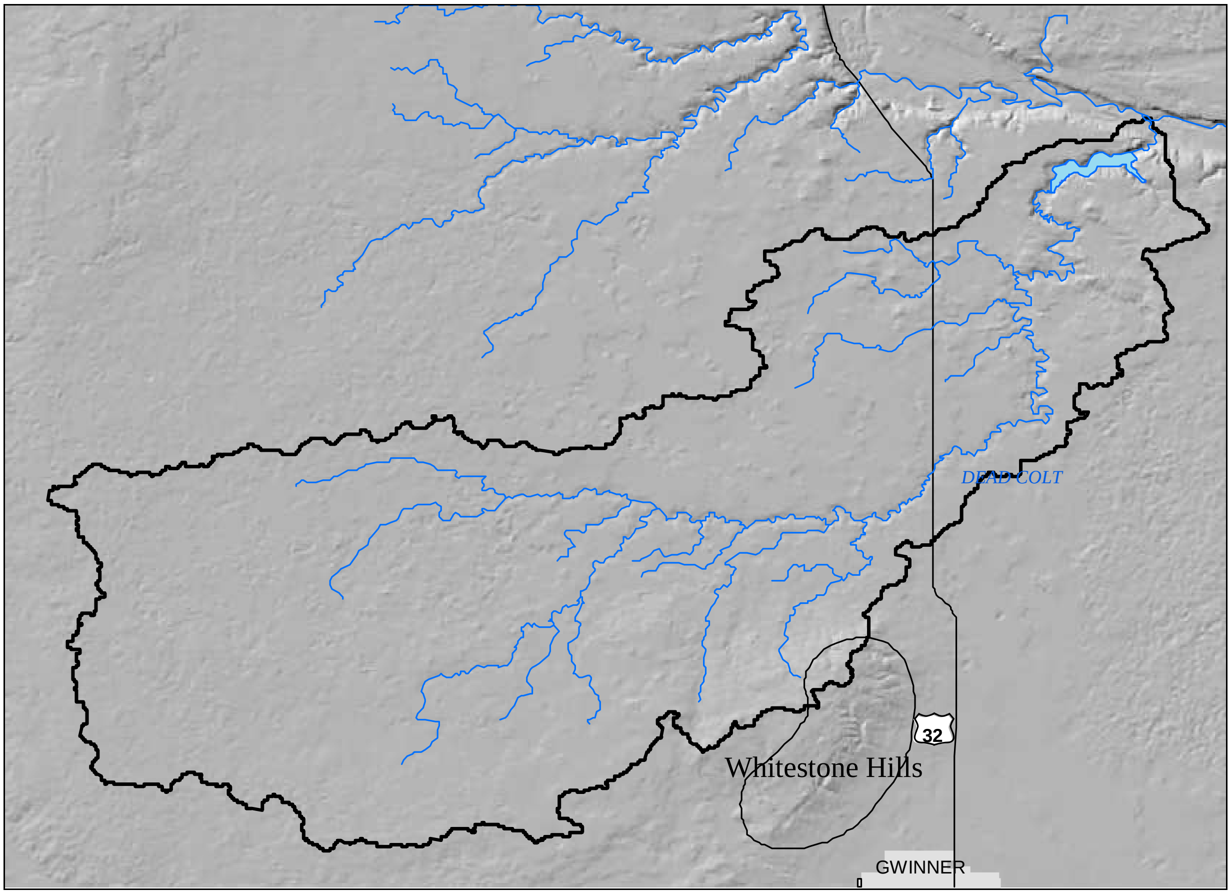

Figure 2. Shaded Relief Map of the Dead Colt Creek Watershed.

1.3 Land Use/Land Cover

Land use in the Dead Colt Creek Dam watershed is primarily agricultural (98.9%). Approximately 81.6%, 13.8%, and 3.5% of land within the watershed is used for cropland, CRP, and pasture, respectively (Figure 3). The remainder of the land is low-density residential land or water. There are no large urban areas within the watershed. However, there are several small farmsteads spread throughout the area.

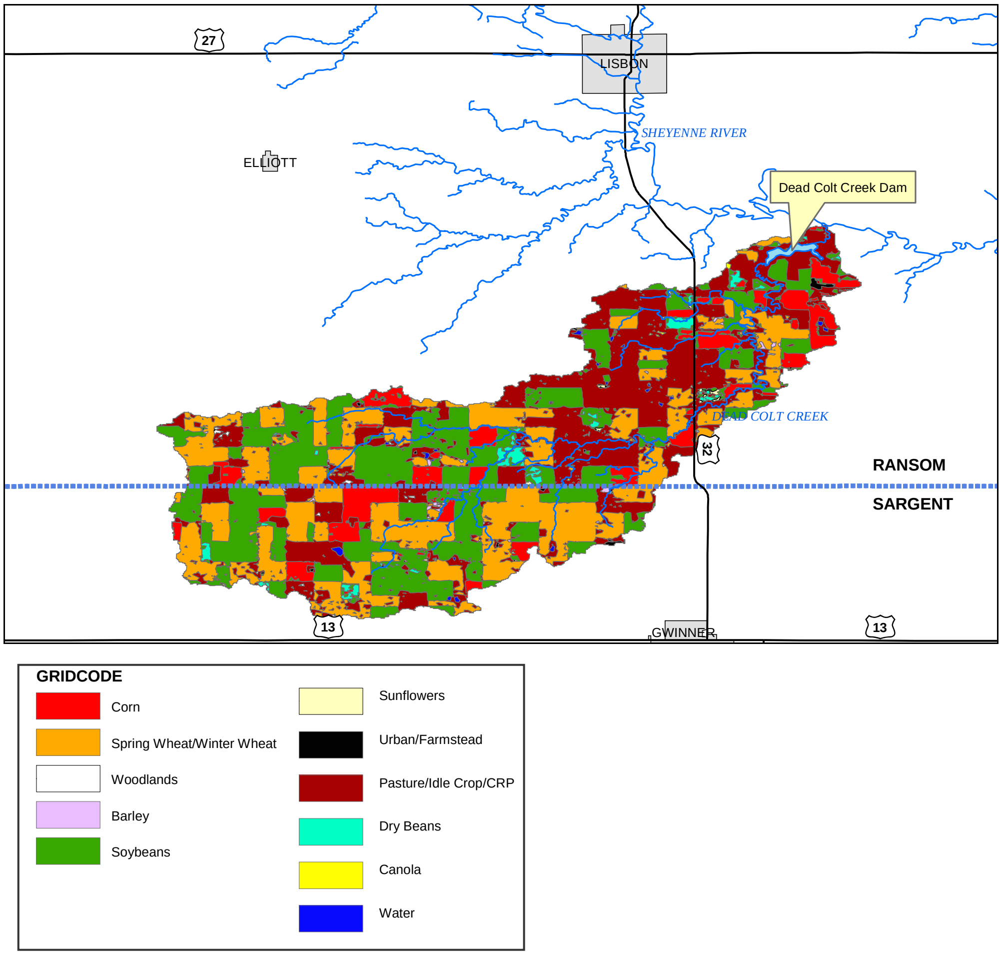

Figure 3. Land Use Data Coverage for 2002-2003. (Compiled from data collected by National Agricultural Statistics Service and the North Dakota State Extension Service).

1.4 Climate and Precipitation

Dead Colt Creek Dam and its watershed lie within the southeastern climate division of North Dakota. Southeastern North Dakota has a typical continental climate, characterized by large annual, daily, and day-to-day temperature changes; light to moderate precipitation; and nearly continuous air movement. Average annual precipitation in Lisbon, North Dakota between 1931 and 1997 was 19.70 inches per year (Figure 4) (NCDC, 2004). June is the wettest month of the year with average precipitation of 3.58 inches. Precipitation events tend to be brief and intense and occur mainly in the summer months (May through August), with little precipitation from November through March. The annual mean temperature for Lisbon is 41.1˚F.

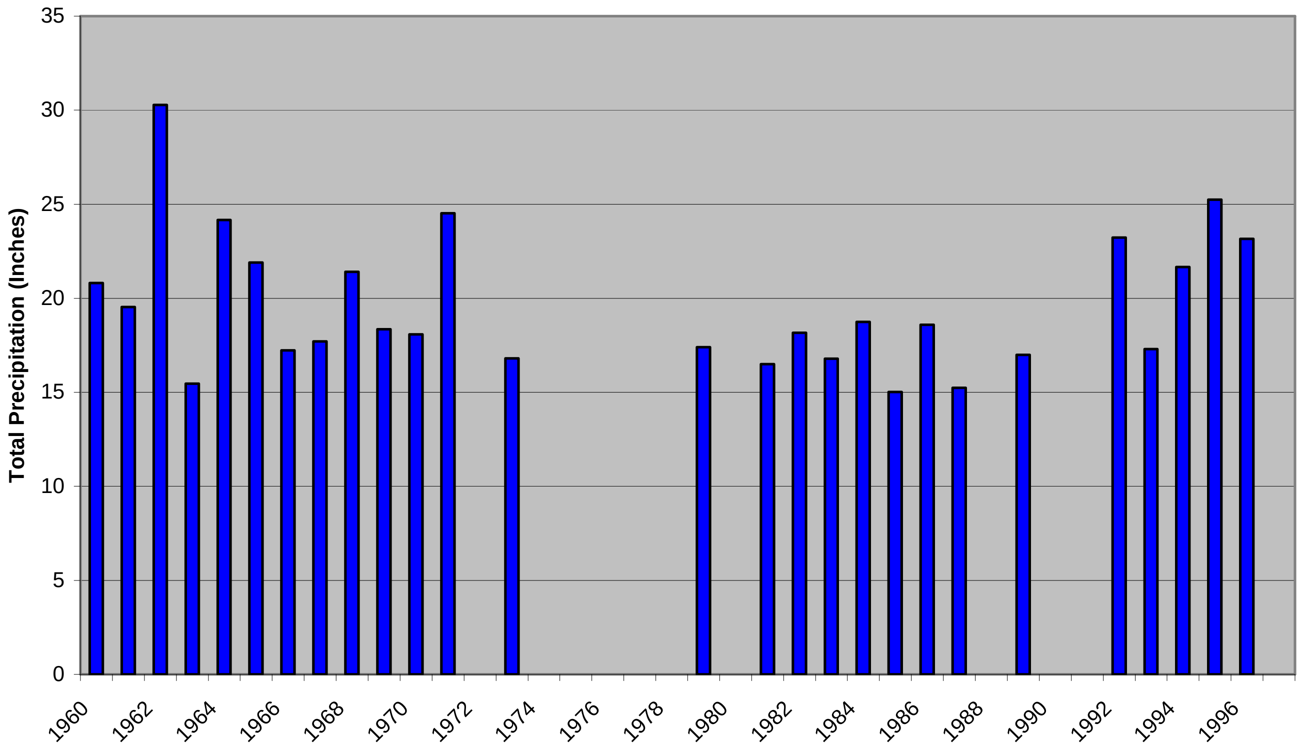

Figure 4. Total Annual Precipitation at Lisbon, North Dakota from 1960-1997. Incomplete data were available for 1972, 1974-1978, 1980, 1988, 1990-1991, and 1997.

1.5 Available Water Quality Data

A Lake Water Quality Assessment Project (LQWA) was conducted on Dead Colt Creek Dam in 1992-1993. Two samples were taken in the summer of 1992 and once during the winter of 1993. Samples were collected at one site located in the deepest area of the lake (380340). Water column samples consisted of three separate depths in the summer (1, 5, and 10 meters) and during the winter (1, 5, and 9 meters). During summer sampling in 1992 Dead Colt Creek Dam thermally stratified on July 29th between five and seven meters and on Sept 1st between six and seven meters. Dissolved oxygen samples taken during summer sampling demonstrated a fluctuation in concentration. In July, dissolved oxygen ranged from 10.6 mg L^{-1} at the surface to <1 mg L^{-1}. During the September sampling dissolved oxygen ranged from 5.2 mg L^{-1} at the surface to 0.2 mg L^{-1} near the bottom. Winter samples collected showed weak thermal stratification occurring at four to six meters with dissolved oxygen concentrations ranging from 7.6 mg L^{-1} to 0.1 mg L^{-1}

The 1992-1993 LWQA project characterized Dead Colt Creek Dam as having relatively high concentrations of total phosphate as P (0.196 mg L^{-1}) and nitrate + nitrite as N (0.161 mg L^{-1}). Other sample parameters and average volume weighted mean concentrations are provided in (Table 5).

Trophic status was also determined using the water quality data collected during the LWQA project. Dead Colt Creek Dam was identified as being hypereutrophic with secchi disk transparency depths ranging between 1.2 and 2.1-meters, chlorophyll-a concentrations of 4 and 1 $\mu g\ L^{-1}$ and total phosphate as P concentrations at the surface of 66 and 223 $\mu g\ L^{-1}$. Further supporting the hypereutrophic assessment is Dead Colt Creek Dam's were: 1) phytoplankton community which was dominated by blue-green algae; 2) rapid dissolved oxygen depletion in the hypolimnion; 3) large macrophyte biomass; 4) frequent nuisance algal blooms; 5) history of fish kills.

In 2002, the Dead Colt Creek Dam TMDL Project was created. Data were collected in and around Dead Colt Creek Dam by the Ransom County Soil Conservation District (SCD) personnel between March 2002 and October 2003. Surface water quality parameters were monitored in and around Dead Colt Creek Dam at 4 stations (Figure 5). Two stations were located within the reservoir; one in the deepest part of the lake and one near the inlet. Dead Colt Creek, which feeds Dead Colt Creek Dam, was sampled at its inlet to the reservoir and at its outlet from the reservoir.

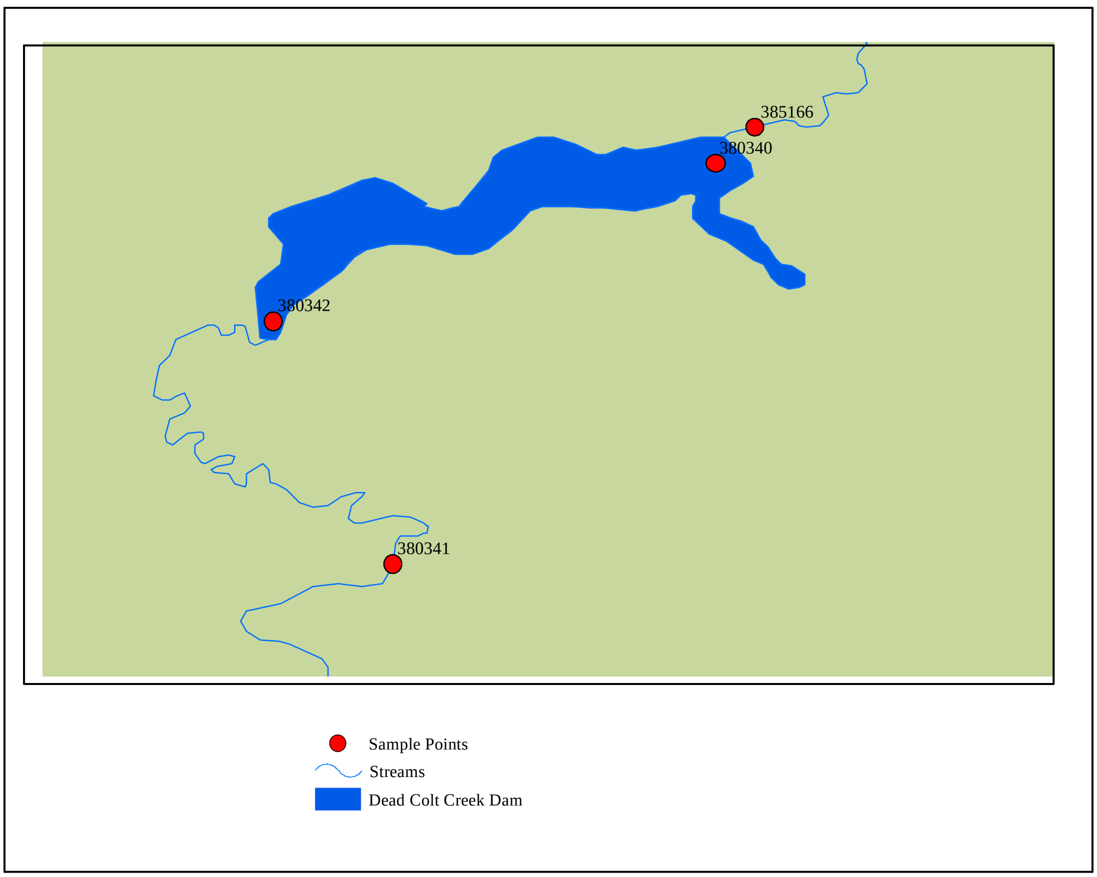

Figure 5. Dead Colt Creek Dam Sample Locations and Station IDs.

Most lake samples were collected at least twice per month between March and July 2002 and between May and July 2003. Monthly sampling was conducted during other months. Sampling and analysis variables are shown in Table 3.

Table 3. Dead Colt Creek Dam Sampling and Analysis Variables.

Field Measurements	General Chemical Variables	Nutrient Variables	Biological Variables
Secchi Disk Transparency	pH	Total Phosphorus	Chlorophyll-a
Temperature	Specific Conductance	Dissolved Phosphorus	Phytoplankton
Dissolved Oxygen	Major Anions and Cations	Total Nitrogen	
	Total Suspended Solids	Total Kjeldahl Nitrogen	
	Total Dissolved Solids	Nitrate plus Nitrite Nitrogen	
	Total Alkalinity	Ammonia Nitrogen	

1.5.1 Nutrient Data

Surface water quality parameters were monitored in Dead Colt Creek Dam at two stations between March 2002 and October 2003. A data summary table for the two monitoring stations in the lake is summarized in Table 4. A volume-weighted mean was calculated using this stratified sampling technique to describe the general chemical characteristics of the reservoir. The volume-weighted mean was calculated by weighting the parameter analyzed by the percentage of water volume represented at each depth interval. Average concentrations of total phosphorus and dissolved phosphorus at the deepest site were above those of the inlet site. Total Kjeldahl nitrogen and nitrate/nitrite were also higher in the deepest part of the lake compared to the inlet. Dead Colt Creek Dam has a total nitrogen to total phosphorus ratio of 16.1. Ratios above 7.2 generally indicate that phosphorus is the limiting nutrient (Chapra, 1997).

Table 4. Data Summary for Dead Colt Creek Dam TMDL Project 2002-2003.

Parameter	Inlet Site #380342					Volume-Weighted Mean	Deepest Site #380340					Volume-weighted Mean
	N	Max	Median	Avg	Min		N	Max	Median	Avg	Min	
Total Phosphorus (mg L^{-1})	8	0.076	0.033	0.034	0.004	0.031	20	0.769	0.034	0.134	0.004	0.072
Dissolved Phosphorus (mg L^{-1})	8	0.026	0.017	0.015	0.004	0.015	20	0.563	0.015	0.087	0.004	0.042
Total Nitrogen (mg L^{-1})	8	1.330	0.945	0.941	0.728	0.910	20	3.520	0.988	1.218	0.727	1.062
Total Kjeldahl Nitrogen (mg L^{-1})	8	1.230	0.925	0.910	0.708	0.833	20	3.500	0.968	1.186	0.707	0.911
Nitrate/Nitrite (mg L^{-1})	8	0.100	0.020	0.031	0.020	0.077	20	0.090	0.020	0.032	0.020	0.151
chlorophyll-a (µg/L)	7	24.00	6.00	11.33	4.00	12.00	5	33.00	16.00	15.00	4.00	9.00
Secchi Disk (meters)	3	2.40	1.30	1.60	1.00	1.90	8	2.70	1.75	1.83	1.00	1.8

Nutrient concentrations from Dead Colt Creek Dam in 2002-2003 were compared to data collected from other lakes in the area as well as to data collected from Dead Colt Creek Dam in 1992-1993. Nutrients concentrations reported for the 1992-1993 LWQA were higher when compared to the 2002-2003 Dead Colt Creek Dam Assessment. The 2002-2003 Dead Colt Creek Dam Assessment showed reductions in nutrient concentrations such as nitrate-nitrite, total nitrogen, and total Kjeldahl nitrogen, and total phosphorus when compared to the 1992-1993 data (Table 5).

Table 5. Regional Lake Water Quality Compared to Dead Colt Creek Dam Water Quality[1] (NDDH, 1993).

		Max	Median	Avg	Min	Avg	Avg
Total Phosphorus	$mg\ L^{-1}$	0.283	0.137	0.155	0.066	0.134	0.196
Nitrate/Nitrite	$mg\ L^{-1}$	0.140	0.065	0.075	0.033	0.032	0.161
Total Kjeldahl Nitrogen	$mg\ L^{-1}$	2.84	1.39	1.69	1.23	1.186	1.85
Total Nitrogen	$mg\ L^{-1}$	2.91	1.45	1.76	1.31	1.218	2.73
Dissolved Oxygen	$mg\ L^{-1}$	6.83	6.33	6.18	5.26	5.69	4.37

[1] Data from 5 regional lakes were used for the comparison, none are on the North Dakota 303(d) list.
Values for Dead Colt Creek Dam are averages of the raw data.

Dead Colt Creek Dam is listed on the 303(d) list as fully supporting, but threatened. As such, total phosphorus is high. However, it is lower than that reported for surrounding lakes. The total kjeldahl nitrogen, total nitrogen, and nitrate/nitrite concentration values were lower for Dead Colt Creek Dam when compared to surrounding area lakes and LWQA data.

1.5.2 Dissolved Oxygen and Temperature

Dissolved oxygen and temperature were monitored at the deepest and inlet sites of Dead Colt Creek Dam from March 2002-October 2003. Raw data is provided in Appendix C, while Figures 6 and 7 illustrate the results of the temperature and dissolved oxygen data for the deepest monitoring site, respectively. Samples were collected at 1-meter intervals during ice over and open water periods. During the summer sampling of 2002, Dead Colt Creek Dam was thermally stratified on June 28, 2002 between four and five meters of depth. At that time dissolved oxygen concentrations ranged from 8.6 $mg\ L^{-1}$ at the surface, dropping from 5.48 $mg\ L^{-1}$ to 3.96 $mg\ L^{-1}$ at 4-5 meters and to 0.09 $mg\ L^{-1}$ at the bottom. Based on the 2002 and 2003 data there appears to be a period during the summer season when dissolved oxygen consistently falls below the 5 $mg\ L^{-1}$ state standard in the hypolimnion. When comparing the dissolved oxygen concentration in Dead Colt Creek Dam to the other area lakes (Table 5), Dead Colt Creek Dam dissolved oxygen concentrations were notably lower. The inlet sites' temperature and dissolved oxygen data is represented in Figures 8 and 9, respectively. Samples were not taken on June 6, 2002 and February 19, 2003 due to equipment malfunctions. With the exception of measurements taken near the bottom, the inlet site appears to have dissolved oxygen levels above the state standard. The cause-and-effect relationship between nutrients, water temperature, plant growth and decomposition, and low dissolved oxygen levels is well established.

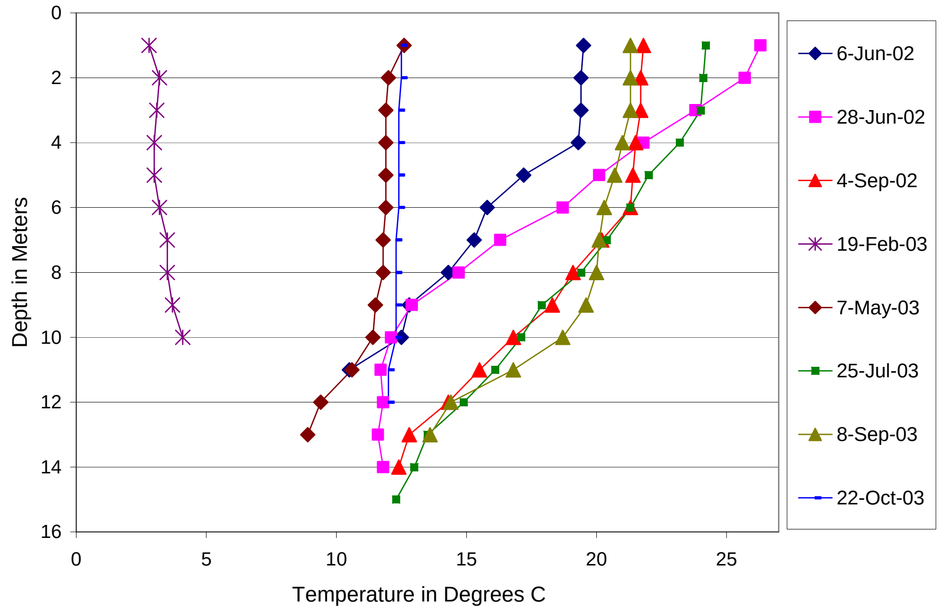

Figure 6. Summary of Temperature Data for the Dead Colt Creek Dam Deepest Area Site (380340).

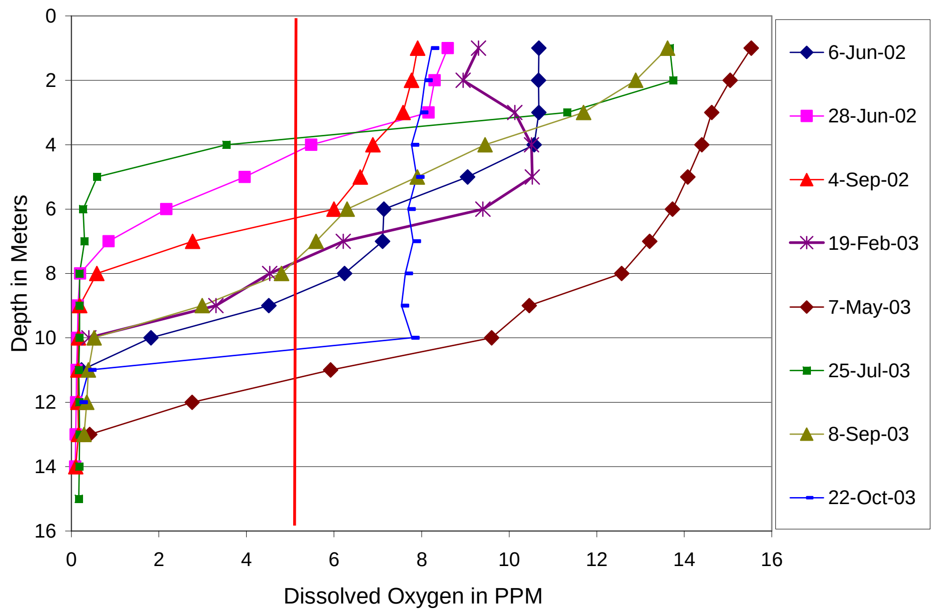

Figure 7. Summary of Dissolved Oxygen Concentration for the Dead Colt Creek Dam Deepest Area Site (380340).

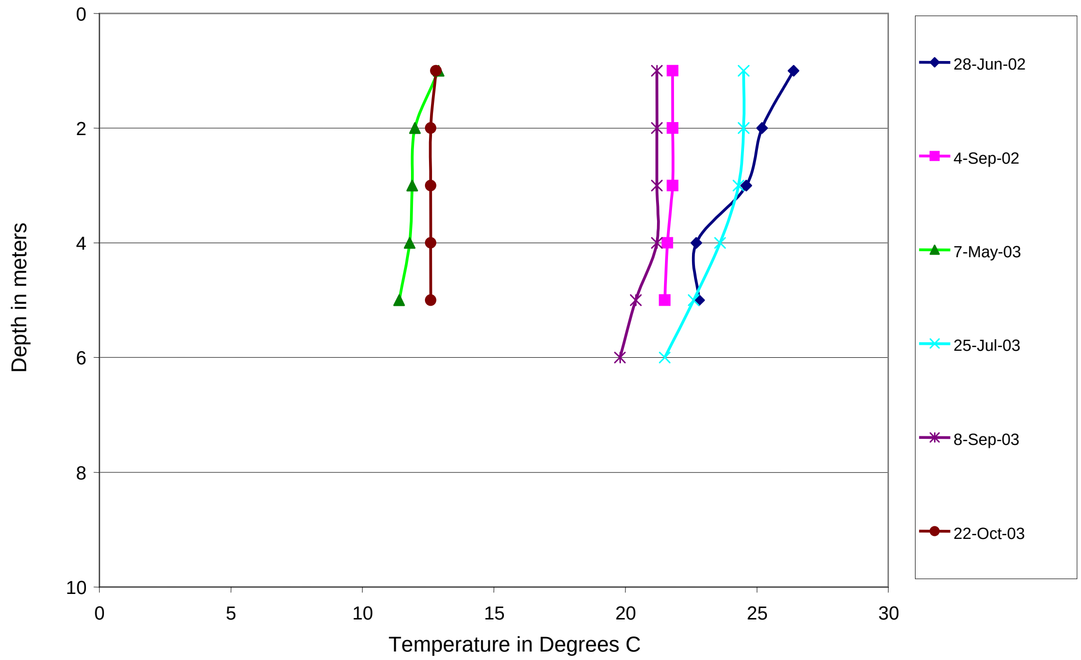

Figure 8. Summary of Temperature Data for the Dead Colt Creek Dam Inlet Area Site (380342).

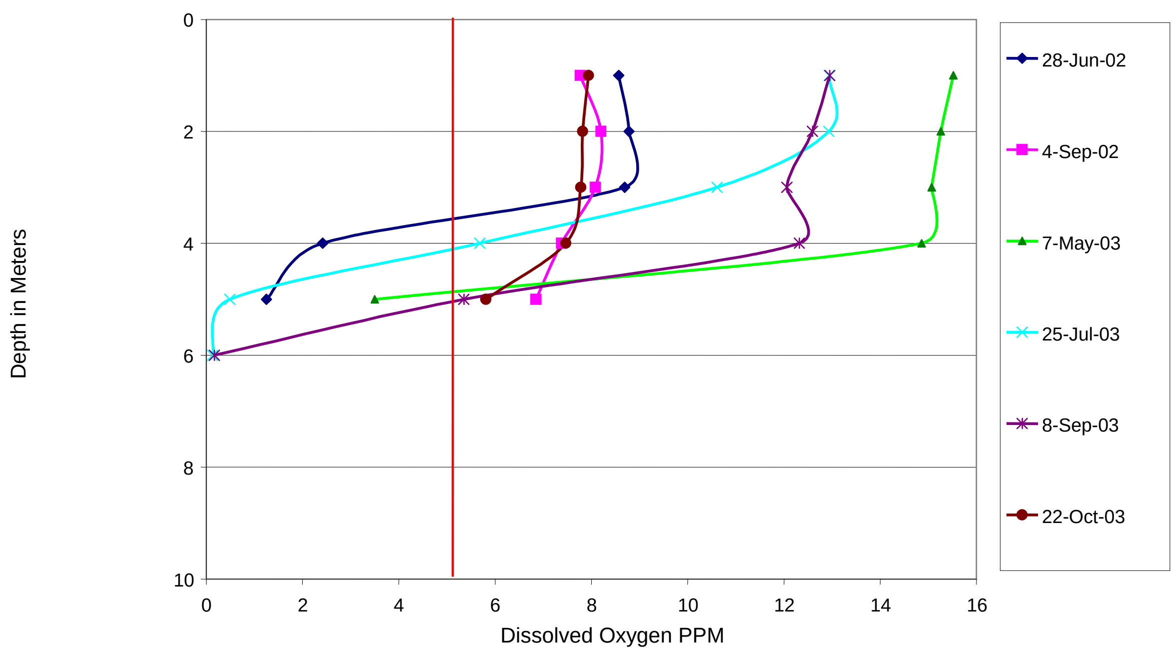

Figure 9. Summary of Dissolved Oxygen Concentration for the Dead Colt Ceek Dam Inlet Area Site (380342).

1.5.3 Secchi Depth and In-lake Total Suspended Solids

Secchi depth data were collected by SCD staff between March 2002 and October 2003 (Table 6). As shown in Table 4, the average Secchi depths for the inlet and deepest sampling sites were 1.9-meters and 1.8-meters, respectively, with an average Secchi depth for Dead Colt Creek Dam of 1.82-meters. Based on Secchi depth, the TSI score for this reservoir is 51.5 (well within the eutrophic range).

While Secchi depths were taken for only 5 months of the year, these data show that visibility through the water column was lowest in July, September, and October. The greatest Secchi depths were measured early in the growing season in May and June (Table 6).

Table 6. Average Monthly Secchi Depths in Dead Colt Creek Dam (2002-2003).

Month	Average Secchi Depth (M)	Month	Average Secchi Depth (M)
January	NA	July	1.3
February	NA	August	NA
March	NA	September	1.45
April	NA	October	1.8
May	2.15	November	NA
June	2.85	December	NA

Water clarity in a reservoir can be affected by many factors. Algal biomass, total suspended solids, and other debris can all affect Secchi depths. Monthly total suspended solids (TSS) data indicate that algal biomass is the main factor limiting water clarity in Dead Colt Creek Dam. Table 7 shows that during the time of year when TSS is typically greatest (spring and early summer), Secchi depth was the greatest and during mid to late summer, when algal biomass and plant matter are typically at a maximum, Secchi depth was lowest. Due to this fact, a reduction in nutrient loading into the reservoir should decrease algal biomass and increase water clarity.

Table 7. Monthly Average TSS Concentrations for Dead Colt Creek Dam (2002-2003).

Month	Average TSS (mg/L)	Month	Average TSS (mg/L)
January	NA	July	8.0
February	NA	August	NA
March	7.4	September	NA
April	12.8	October	5.0
May	14.6	November	NA
June	17.8	December	NA

1.5.4 Tributary Total Suspended Solids

Thirty-nine total suspended solids (TSS) samples were collected by Ransom county SCD staff between March 2002 and July 2003. TSS samples were collected from the inlet and the outlet to the reservoir. TSS concentrations at the inlet and outlet sites were 14.7 and 7.2 mg L^{-1}, respectively (Table 8). These data indicate that sediment is being retained within the reservoir. As shown in Table 8, TSS concentrations in samples taken from the outlet were less than half of that of the inlet.

Table 8. Average Total Suspended Solids Concentrations for the Dead Colt Creek Dam Inlet and Outlet Sites (2002-2003).

Site ID	Site Description	Average TSS (mg/L)
380341	Inlet	14.7
385186	Outlet	7.2

2.0 WATER QUALITY STANDARDS

The Clean Water Act requires that Total Maximum Daily Loads (TMDLs) be developed for waters on a state's Section 303(d) list. A TMDL is defined as “the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background” such that the capacity of the waterbody to assimilate pollutant loadings is not exceeded. The purpose of a TMDL is to identify the pollutant load reductions or other actions that should be taken so that impaired waters will be able to attain water quality standards. TMDLs are required to be developed with seasonal variations and must include a margin of safety that addresses the uncertainty in the analysis. Separate TMDLs are required to address each pollutant or cause of impairment (eg., nutrients, sediment).

2.1 Narrative Water Quality Standards

The North Dakota Department of Health has set narrative water quality standards, which apply to all surface waters in the state. The narrative standards pertaining to nutrient impairments are listed below (NDDoH, 2001).

- All waters of the state shall be free from substances attributable to municipal, industrial, or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to humans, animals, plants, or resident aquatic biota.

- No discharge of pollutants, which alone or in combination with other substances shall:
    1) Cause a public health hazard or injury to environmental resources;
    2) Impair existing or reasonable beneficial uses of the receiving waters; or

3) Directly or indirectly cause concentrations of pollutants to exceed applicable standards of the receiving waters.

In addition to the narrative standards, the NDDoH has set a biological goal for all surface waters in the state. The goal states that "the biological condition of surface waters shall be similar to that of sites or waterbodies determined by the department to be regional reference sites" (NDDoH, 2001)

2.2 Numeric Water Quality Standards

Dead Colt Creek Dam is classified as a Class 3 warm water fishery. Class 3 fisheries are defined as waterbodies "capable of supporting growth and propagation of nonsalmonid fishes and associated aquatic biota" (NDDoH, 1991). All classified lakes in North Dakota are assigned aquatic life, recreation, irrigation, livestock watering, and wildlife beneficial uses. The North Dakota State Water Quality Standards also state that lakes shall use the same numeric criteria as Class 1 streams. This includes the state standard for dissolved oxygen set at no less than 5 mg L^{-1}. State standards for lakes and reservoirs also specify guidelines for nitrogen (1.0 mg L^{-1} as nitrate) and phosphorus (0.1 mg L^{-1} as total phosphorus) (Table 9).

Table 9. Numeric Standards Applicable to North Dakota Lakes and Reservoirs (NDDoH , 2001)

Parameter		Guidelines	Limit
Guidelines for Classified Lakes			
	Nitrates (dissolved)	1.0 mg L^{-1}	Maximum allowed[1]
	Phosphorus (total)	0.1 mg L^{-1}	Maximum allowed[1]
	Dissolved Oxygen	5 mg L^{-1}	Not less than
Guidelines for goals in a lake improvement or maintenance program			
	NO_3 as N	0.25 mg L^{-1}	Goal
	PO_4 as P	0.02 mg L^{-1}	Goal

[1] **"Interim guideline limits"**

3.0 TMDL TARGETS

A TMDL target is the value that is measured to judge the success of the TMDL effort. TMDL targets should be based on state water quality standards, but can also include site-specific values when no numeric criteria are specified in the standard. The following sections summarize water quality targets for Dead Colt Creek Dam based on its beneficial uses. If the specific target is met, it is assumed the reservoir will meet applicable water quality standards, including its designated beneficial uses.

3.1 Trophic State Index

The assessment methodology for lakes and reservoirs described in North Dakota's 2004 Integrated Section 305(b) and Section 303(d) Water Quality Assessment Report indicates that Carlson's Trophic State Index (TSI) is the primary indicator used to assess beneficial uses of the state's lakes and reservoirs (NDDH, 2004). Trophic status is the measure of productivity of a lake or reservoir and is directly related to the level of nutrients (phosphorus and nitrogen) entering the lake or reservoir from its watershed. Lakes tend to become eutrophic (more productive) with higher nitrogen and phosphorus inputs. Eutrophic lakes often have nuisance algal blooms, limited water clarity, and low dissolved oxygen concentrations that can result in impaired aquatic life and recreational uses. Carlson's TSI attempts to measure the trophic state of a lake using nitrogen, phosphorus, chlorophyll-a, and Secchi disk depth measurements (Carlson, 1977).

Based on Carlson’s TSI and water quality data collected between March 2002 and October 2003, Dead Colt Creek Dam was generally assessed as a eutrophic to hypereutrophic lake (Table 10). Hypereutrophic lakes are characterized by large growths of weeds, bluegreen algal blooms, and low dissolved oxygen concentrations. These lakes experience frequent fish kills and are generally characterized as having excessive rough fish populations (carp, bullhead, sucker) and poor sport fisheries. Because of the frequent algal blooms and excessive weed growth, these lakes are also undesirable for recreational uses such as swimming and boating.

Table 10. Carlson’s Trophic State Indices for Dead Colt Creek Dam.

Parameter	Relationship	Units	TSI Value	Trophic Status
Chlorophyll-*a*	TSI (Chl-a) = 30.6 + 9.81[ln(Chl-a)]	µg/L	52.15	eutrophic
Total Phosphorus (TP)	TSI (TP) = 4.15 + 14.42[ln(TP)]	µg/L	65.82	hypereutrophic
Secchi Depth (SD)	TSI (SD) = 60 - 14.41[ln(SD)]	meters	51.53	eutrophic
Total Nitrogen (TN)	TSI (TN) = 54.45 + 14.43[ln(TN)]	mg L^{-1}	55	eutrophic

TSI < 40 - Oligotrophic (least productive)
TSI 40-50 Mesotrophic
TSI 50-60 Eutrophic
TSI > 60 - Hypereutrophic (most productive)

The reasons for the different TSI values estimated for Dead Colt Creek Dam are varied. According to the phosphorus TSI value, Dead Colt Creek Dam is an extremely productive lake (hypereutrophic) (Figure 10). Carlson and Simpson (1996) suggest that if the phosphorus and secchi depth TSI values are relatively similar and higher than the chlorophyll-*a* TSI value, then dissolved color or nonalgal particulates dominate light attenuation. It follows that, as is the case with Dead Colt Creek Dam, if the secchi depth and chlorophyll-*a* TSI values are similar, then chlorophyll-*a* is dominating light attenuation. Carlson and Simpson (1996) also state that a nitrogen index value might be a more universally applicable nutrient index than a phosphorus index, but it also means that a correspondence of the nitrogen index with the chlorophyll-a index cannot be used to indicate nitrogen limitation.

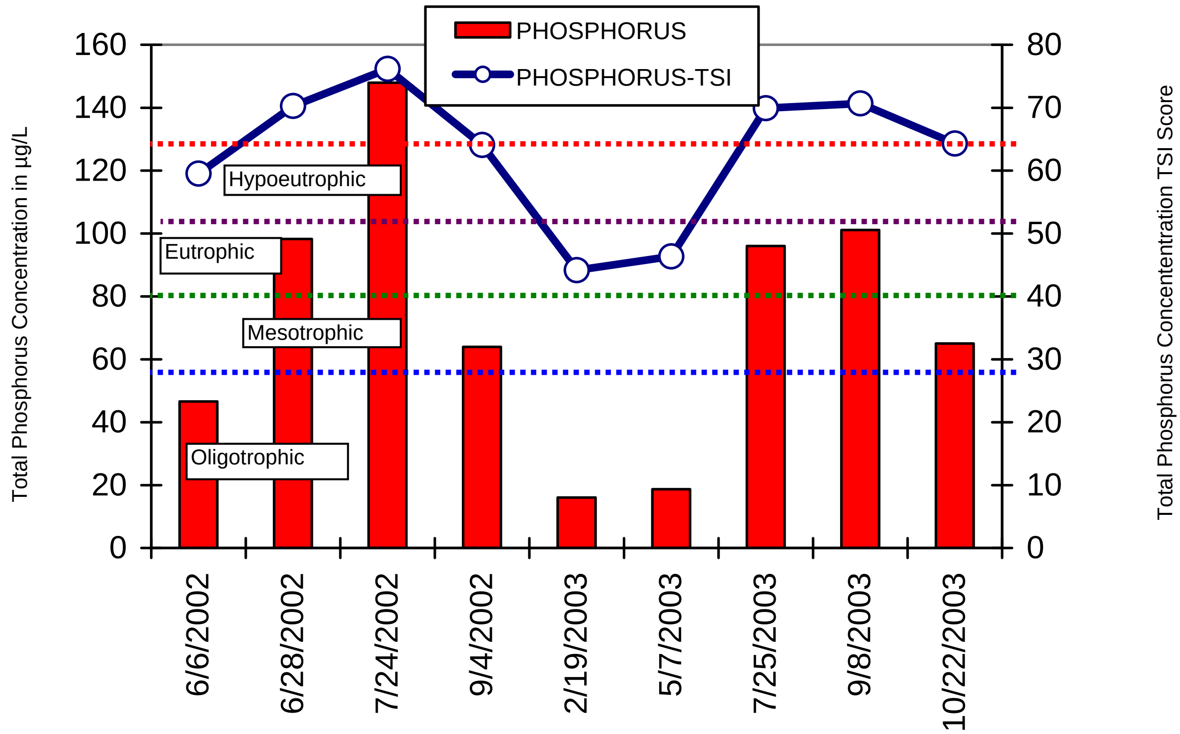

Figure 10. Total P Concentrations and TSI Values for June 2002 to October 2003 Samples.

A Carlson's TSI target of 57.55 based on total phosphorus was chosen for the Dead Colt Creek Dam endpoint. This equates to a trophic status category of eutrophic during all times of the year. The TMDL goal based on phosphorus was chosen in part, based on AGNPS modeling and the ability to reduce in-lake annual mean total phosphorus by 70%. The total phosphorus reduction of 70% is equivalent to an in-lake total phosphorus concentration of 0.041 mg L^{-1}. The TSI target was chosen based on knowledge that: 1) phosphorus is the limiting nutrient in Dead Colt Creek Dam; 2) AGNPS modeling shows that a 70% reduction is the maximum attainable phosphorus reduction by instituting BMPs on the critical cells in the watershed; and 3) a 70% reduction in phosphorus will reduce chlorophyll-*a* concentration, increase water clarity and dissolved oxygen, and decrease the productivity level of the reservoir. If the specified TMDLTSI target of 57.55 based on total P is met, the reservoir can be expected to meet the applicable water quality standards for aquatic life and recreational beneficial uses.

4.0 SIGNIFICANT SOURCES

There are no known point sources upstream of Dead Colt Creek Dam. The pollutants of concern originate from non-point sources. Most of the land upstream from Dead Colt Creek Dam is farmed. The remainder is used for pasture or kept as permanent herbaceous cover. There are no urban areas within the watershed. There are also no lake homes around the reservoir. However, there are many small farmsteads spread throughout the area.

The vast majority of nutrient loads are transported with overland runoff from agricultural areas. Precipitation directly to the lake's surface is another possible source of nutrients. During the assessment period of Dead Colt Creek Dam, very little precipitation was received in the watershed. Due to less than average precipitation, the hydraulic residence time during the study was 4.48 years. Existing land use and AGNPS modeling (see Section 5.7 AGNPS Modeling) within the Dead Colt Creek Dam watershed indicates that the majority of NPS loading is likely coming from cropland, (81.6 percent of land within the watershed is cropped). A small percentage (3.5%) of land in the watershed is used for pasture. It is possible that a small amount of nutrient loading also originates from land used for pasture. Best management practices will also be implemented on land used for pasture in order to address loading from these lands.

5.0 TECHNICAL ANALYSIS

Establishing a relationship between in-stream water quality targets and pollutant source loading is a critical component of TMDL development. Identifying the cause-and-effect relationship between pollutant loads and the water quality response is necessary to evaluate the loading capacity of the receiving waterbodies. The loading capacity is the amount of a pollutant that can be assimilated by the waterbody while still attaining and maintaining water quality standards. This section discusses the technical analysis used to estimate existing loads to Dead Colt Creek Dam and the predicted trophic response of the reservoir to reductions in loading capacity.

5.1 Tributary Load Analysis

To facilitate the analysis and reduction of tributary inflow and outflow water quality and flow data the FLUX program was employed. The FLUX program, also developed by the US Corps of Engineers Waterways Experiment Station (Walker, 1996), uses six calculation techniques to estimate the average mass discharge or loading that passes a given river or stream site. FLUX estimates loadings based on grab sample chemical concentrations and the continuous daily flow record. Load is therefore defined as the mass of a pollutant during a given time period (e.g., hour, day, month, season, year). The FLUX program allows the user, through various iterations, to select the most appropriate load calculation technique and data stratification scheme, either by flow or date, which will give a load estimate with the smallest statistical error, as represented by the coefficient of variation. Output from the FLUX program is then provided as an input file to calibrate the BATHTUB eutrophication response model. For a complete description of the FLUX program the reader is referred to Walker (1996).

5.2 BATHTUB Trophic Response Model

The BATHTUB model (Walker, 1996) was used to predict and evaluate the effects of various nutrient load reduction scenarios on Dead Colt Creek Dam. BATHTUB performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network. The model accounts for advective and diffusive transport and nutrient sedimentation. Eutrophication related water quality conditions are predicted using empirical relationships previously developed and tested for reservoir applications.

The BATHTUB model is developed in three phases. The first two phases involve the analysis and reduction of the tributary and in-lake water quality data. The third phase involves model calibration. In the data reduction phase, the in-lake and tributary monitoring data collected as part of the project were summarized in a format which can serve as inputs to the model.

The tributary data were analyzed and reduced by the FLUX program. FLUX uses tributary inflow and outflow water quality and flow data to estimate average mass discharge or loading that passes a river or stream site using six calculation techniques. Load is therefore defined as the mass of pollutant during a given unit of time. In the case of Dead Colt Creek Dam the FLUX program came up with an annual phosphorus load of 638 kg/yr. The FLUX model then allows the user to pick the most appropriate load calculation technique with the smallest statistical error. Output for the FLUX program is then used to calibrate the BATHTUB model.

The reservoir data were reduced in Excel using three computational functions. These include: 1) the ability to display concentrations as a function of depth, location, or date; 2) summary statistics (mean, median, etc.); and 3) an evaluation of trophic status. The output data from the Excel program were then used to calibrate the BATHTUB model.

When the input data from the FLUX and Excel programs are entered into the BATHTUB model the user has the ability to compare predicted conditions (model output) to actual conditions using general rates and factors. The BATHTUB model is then calibrated by combining tributary load estimates for the project period with in-lake water quality estimates. The model is termed calibrated when the predicted estimates for the trophic response variables are similar to observed estimates from the project monitoring data. BATHTUB then has the ability to predict total phosphorus concentration, chlorophyll-a concentration, and secchi disk transparency and the associated TSI scores as a means of expressing trophic response.

As stated above BATHTUB can compare predicted vs. actual conditions. After calibration, the model was run based on observed concentrations of phosphorus and nitrogen, to derive an estimated an annual average total phosphorus load of 638 kg and annual average total nitrogen load of 1,837.7 kg. The model was then run to evaluate the effectiveness of a number of nutrient reduction alternatives including: 1) reducing externally derived nutrient loads; 2) reducing internally available nutrients; and 3) reducing both external and internal nutrient loads.

In the case of Dead Colt Creek Dam, BATHTUB modeled two nutrient reduction alternatives. The first alternative reduced externally derived phosphorus. Phosphorus was used in the initial set of simulation models based on its known relationship to eutrophication and that it is controllable with the implementation of watershed Best Management Practices (BMPs) or lake restoration methods. Changes in trophic response were evaluated by reducing external derived phosphorus loading by 25, 50, 70, and 80 percent. Simulated reductions were achieved by reducing phosphorus concentrations in contributing tributaries and other externally delivery sources. Flow was held constant due to uncertainty in of estimating changes in hydraulic discharge with the implementation of BMPs.

Alternative one estimated that a 50 percent reduction in only external phosphorus loading to Dead Colt Creek Dam would decrease the average total phosporus and chlorophyll-a in lake concentration and increase secchi disk transparency depth, but would not result in a noticeable change in trophic state to the average lake user. The amount of green and clarity of the lake would still be in the hypereutrophic range.

To acquire a noticeable change in the tropic status the BATHTUB model predicted that a 70 percent reduction in total phosphorus loads would achieve the target of 0.041 mg L^{-1} (Table 11). This reduction in phosphorus is predicted to result in a reservoir in the near eutrophic range.

Table 11. Observed and Predicted Values for Trophic Status by Reducing Total Phosphorus in Dead Colt Creek Dam by 25, 50, 70, & 80%.

		Predicted Value			
Variable	**Observed Value[1]**	**25%**	**50%**	**70%**	**80%**
Average Total Phosphorus (mg/L)	0.072	0.063	0.052	0.041	0.034
Phosphorus-based Trophic Status Index Score	65.82	63.94	60.82	57.57	54.9

Alternative two simulated reducing externally available phosphorus and nitrogen. This model was run to predict any changes in trophic response in Dead Colt Creek Dam by reducing externally derived phosphorus loads by 70 percent and externally derived nitrogen load by 20, 50, and 60 percent. Reduction simulations were derived by reducing nutrient concentrations in the contributing tributary and other externally derived sources. As explained above, flow was held constant due to the uncertainty in estimates of hydraulic discharge through BMP implementation. The model results indicate little to no additional improvements in predicted trophic state will be achieved by reducing nitrogen load (Table 12) in addition to reducing total phosphorus loading.

Table 12. Observed and Predicted Values for Trophic Status by Reducing Total P by 70% and by Reducing Total Nitrogen in Dead Colt Creek Dam by 20, 50, and 60%.

		Predicted Value		
Variable	**Observed Value[1]**	**20%**	**50%**	**60%**
Total Phosphorus (mg/L)	0.072	0.041	0.041	0.041
Total Nitogen (mg/L)	1.062	0.899	0.684	0.612
Phosphorus Trophic Status Index	65.82	57.57	57.57	57.57
Chlorophyll-a Trophic Status Index	52.15	51.16	50.78	50.54

5.3 AGNPS Watershed Model

In order to identify significant NPS pollutant sources in the Dead Colt Creek Dam watershed and to assess the relative reductions in nutrient (nitrogen and phosphorus) and sediment loading that can be expected from the implementation of BMPs in the watershed, an AGNPS 3.65 Model analysis was employed.

The primary objectives for using the AGNPS 3.65 model were to: 1) evaluate NPS contributions within the watersheds; 2) identify critical pollutant source areas within the watershed; and 3) evaluate potential pollutant (nitrogen, phosphorus, and sediment) reduction estimates that can be achieved through the implementation of various BMP implementation scenarios.

The AGNPS 3.65 model is a single event model that has twenty input parameters. Sixteen parameters were used to calculate nutrient/sediment output, surface runoff and erosion. The parameters used where receiving cell, aspect, SCS curve, percent slope, slope shape, slope length, Manning's roughness coefficient, K-factor, C-factor, P-factor, surface conditions constant, soil texture, fertilizer inputs, point source indicators, COD factor and channel indicator.

The AGNPS 3.65 model was used in conjunction with an intensive land use survey to determine critical areas within the Dead Colt Creek Watershed. Criteria used during the landuse assessment where percent cover on cropland and pasture/range conditions. These criteria were used to determine the C factor for each cell. The initial model was run using current conditions determined during the land use assessment. A 25yr/24hr storm event (4.10-inches.) in Ransom County was applied to the model to evaluate relative pollutant yields from each 40-acre cell. Each quarter, quarter of land was given a cell number. Each cell represents 40-acres of land. A total of 35,680-acres were input into the program representing 892 cells. The results for each subwatershed were analyzed statistically. Critical cells were identified using the 25th percentile method. Cells with sediment phosphorous levels above 2.96 lbs/ac or cells with soluble phosphorous runoff concentrations above 0.41ppm were identified as critical. The model identified 397 cells in the watershed (14,480 acres of cropland and 844 acres of pasture/rangeland) as being "critical" or 38.4% of the watershed area.

The model was run a second time depicting a best case scenario, in which all critical cropland and pasture/rangeland cells were treated with BMPs. The BMPs used during the second run were no till, nutrient management, prescribed grazing and pasture/hayland plantings. The BMPs were reflected within the model by making changes in the input parameters. Treatment of these critical cells will reduce nitrogen loading by 68%, phosphorus loading by 60%, and sediment loading by 43%.

Once nutrient loadings are decreased, algal biomass will decline, dissolved oxygen will increase, and the overall trophic status of the reservoir will improve.

5.4 Dissolved Oxygen

It is expected that the substantial reductions in nutrient concentrations will result in increased dissolved oxygen levels by decreasing algal biomass in the water column. Since there is inadequate information at present to establish a quantitive relationship between the nutrient target and dissolved oxygen it is the Department's best professional judgment that the prescribed reductions in phosphorus loading in Dead Colt Creek Dam will address the dissolved oxygen impairment.

5.5 Sediment

A sediment balance was calculated for Dead Colt Creek Dam (Table 13). The time period over which this amount of storage occurred was 1.56 years, therefore, sediment accumulated within the reservoir at a rate of 19,480.2 kg/yr.

Mulholland and Elwood (1982) state that the average accumulation of sediment within reservoirs is 2 cm/yr. Based on a conversion from mass of sediment storage to depth of sediment storage, it can be assumed that Dead Colt Creek Dam is accumulating sediment at a current rate that is considered acceptable for reserviors.

Table 13. Sediment balance for Dead Colt Creek Dam (2002-2003).

	Inflow (kg)	Outflow (kg)	Storage (kg)
Total Suspended Solids	33582.9	3291.2	30291.7

In order to perform the conversion from mass to depth, the particle density of soil is needed. In most mineral soils the average density of particles is in the range of 2.6 to 2.7 g/cm³. This narrow range reflects the predominance of quartz and clay minerals in the soil matrix. An average particle density of 2.65 g/cm³ (the density of quartz) is often applied to soils comprised principally of silicate materials. Since soils in the Dead Colt Creek watershed are mineral soils, the particle density of silicate minerals can be used to calculate a depth of sediment accumulation within the reservoir. However, for the sake of providing an implicit margin of safety, the low end of the range (2.6 g/cm^3) will be used to calculate the equivalent depth of 19,480 kg of sediment in Dead Colt Creek Dam.

Based on a sediment loading rate of 19,480,200 g/yr times a sediment density of 2.60 g/cm, the sediment volume deposited in Dead Colt Creek Dam is 7,492,385 cm^3 each year.

$$19{,}480{,}200 \text{ g/yr} * (2.60 \text{ g/cm}^3)^{-1} = 7{,}492{,}385 \text{ cm}^3\text{/yr}$$

Based on a surface area of 124-acres (5,018,101,963.78 cm^2), the annual sedimentation rate is 0.0015 cm per year [(7,492,385 cm^3/yr)/ (5,018,101,963.78 cm^2)].

This estimated annual sediment accumulation rate is well below the average sedimentation rate of typical reservoirs.

Further support for the removal of TSS as a pollutant of concern can also be found in literature. As Waters (1995) states suspended sediment concentration less than 25 mg L^{-1} is not harmful to fisheries; between 25 and 80 mg L^{-1} reduces fish yield; between 80 and 400 mg L^{-1} is unlikely to display a good fishery; and suspended sediment concentration greater than 400 mg L^{-1} will exhibit a poor fishery. Therefore, research by Waters (1995) supports the view that mean TSS concentrations in Dead Colt Creek Dam of 12.5 mg L^{-1} is not considered harmful to aquatic life threshold. In fact, only one sample out of thirty-nine exceeded the 25 mg L^{-1} concentration stated by Waters (1995) as harmful. Therefore it is the recommendation of the TMDL that, in the next North Dakota 303 (d) list cycle Dead Colt Creek Dam should be delisted for sediment impairments.

Justification for delisting is also based on the Natural Resource Conservation Service (NRCS) Sedimentation Rate Standard for reservoirs. The NRCS Sedimentation Standard is estimated as 1/4 of an inch of sediment eroded from the watershed drainage area delivered and detained in the sediment pool over the 50-year expected life of project. This is a conservative estimate used primarily in northeastern North Dakota. Detailed surveys conducted on Renwick Dam in the Tongue River Watershed have discovered a sedimentation rate of approximately 1/8 of an inch. In the case of the Renwick Dam survey, delivery of the sediments was tied to severe storm events in the spring when soil had been recently tilled and had no cover. To calculate the allowable sedimentation rate for Dead Colt Creek Dam based on the NRCS standard the approximate rate of 1/8 of an inch will be used.
Assuming,
Watershed Area = 115 mi^2
and
NRCS Sedimentation Rate Standard equals 1/8 inch over 50 yrs
Then,
Watershed Area = 115 mi^2 = (607,200 ft*607,200 ft) = 3.6869184 x 10^{11} ft^2;

Sediment Volume =
(3.6869184 x 10^{11} ft^2 * 1/8 inch)/12 inches = 3,840,540,000 ft^3;

Predicted amount of sediment in Dead Colt Creek Dam at 1/8 inch over 50 years =
(3,840,540,000 ft^3 * 28,316.8467117 cm^3) = 1.0875198247 x 10^{14} cm^3;
Compare this too,
The calculated annual sedimentation rate from observed data entering Dead Colt Creek Dam =
19,480,200 g/yr * $(2.60\ g/cm^3)^{-1}$ = 7,492,385 cm^3/yr

Calculated amount of sediment accumulation rate from observed data entering Dead Colt Creek Dam over 50 years
(7,492,385 cm^3/yr * 50 yrs) = 374,619,250 cm^3

Using a sedimentation rate standard of 1/8 inch over 50 years, Dead Colt Creek Dam's predicted sediment accumulation rate could be 1.0875198247 x 10^{14} cm^3. When compared with the current sedimentation accumulation rate into the reservoir over 50 years of 374,619,250 cm^3. Dead Colt Creek Dam appears to be well under the predicted sedimentation rate standard.

6.0 MARGIN OF SAFETY AND SEASONALITY

6.1 Margin of Safety

Section 303(d) of the Clean Water Act and EPA's regulations require that "TMDLs should be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety (MOS) can either be incorporated into conservative assumptions used to develop the TMDL (implicit) or added as a separate component of the TMDL (explicit).

In order to meet the TMDL target of 0.041 mg L^{-1} total phosphorus (TSI Score = 57.55), the BATHTUB model estimates that a 70% reduction in total phosphorus loading is necessary. Based on data collected for this assessment, the current annual total phosphorus load is 638 kg/yr. Assuming BMPs are implemented on the critical areas (or 15,324 acres) within the watershed, then total phosphorus loading from the watershed should be reduced by 70% to 191.4 kg. Assuming a 10% explicit margin of safety, then 19.1 kg will be set aside as a margin of safety resulting in the remaining 172.3 kg allocated to the load allocation and waste load allocations in the TMDL.

The residence time of water within the reservoir during the study period was 4.48 years due to precipitation being well below average. In years with average precipitation, the residence time of water will decrease, moving phosphorus out of the reservoir. Less phosphorus in the water equates to less lake production resulting in lower chlorophyll-*a* concentration and higher secchi depths. This, along with conservative assumptions for modeling and hypolimnetic withdrawal, provides an implicit margin of safety for the stated reduction goal.

Post-implementation monitoring related to the effectiveness of the BMPs can also be used to assure attainment of the TMDL targets, through the use of adaptive management during the implementation phase.

6.2 Seasonality

Section 303(d)(1)(C) of the Clean Water Act and the EPA's regulations require that a TMDL be established with seasonal variations. Dead Colt Creek Dam's TMDL addresses seasonality because the BATHTUB model incorporates seasonal differences in its prediction of annual total phosphorus and nitrogen loadings.

7.0 TMDL

7.1 Nutrient TMDL

Table 14 summarizes the nutrient TMDL for Dead Colt Creek Dam in terms of loading capacity, wasteload allocations, load allocations, and a margin of safety. A TMDL can generically be described by the following equation.

TMDL = LC = WLA + LA + MOS

Where:

LC = loading capacity, or the greatest loading a waterbody can receive without violating water quality standards;

WLA = wasteload allocation, or the portion of the TMDL allocated to existing or future point sources;

LA = load allocation, or the portion of the TMDL allocated to existing or future non-point sources;

MOS = margin of safety, or an accounting of the uncertainty about the relationship between pollutant loads and receiving water quality. The margin of safety can be provided implicitly through analytical assumptions or explicitly by reserving a portion of the loading capacity.

Table 14. Summary of the Phosphorus TMDL for Dead Colt Creek Dam.

Category	Total Phosphorus (kg/yr)	Explanation
Existing Load	638.0	From observed data
Loading Capacity	191.4	70 percent total reduction based on BATHTUB and AGNPS modeling
Wasteload Allocation	0.0	No point sources
Load Allocation	172.3	Entire loading capacity minus MOS is allocated to non-point sources
MOS	19.1	10% of the Loading Capacity (191.4 kg/yr) is reserved as an explicit margin of safety

Based on data collected in 2002 and 2003, the existing load to Dead Colt Creek Dam is estimated at 638.0 kg. Assuming a 70% based on BATHTUB and AGNPS modeling results in Dead Colt Creek Dam reaching a TMDL target total phosphorus concentration of 0.041 mg L^{-1}, then the TMDL or Loading Capacity is 191.4 kg. Assuming10% of the (19.1 kg/yr) is assigned to the MOS and there are no point sources in the watershed all of the remaining loading capacity (172.3 kg/yr) is assigned to the load allocation.

7.2 Sediment TMDL

No reduction necessary, delist for sediment.

7.3 Dissolved Oxygen TMDL

AgNPS and BATHTUB models indicate that excessive nutrient loading is responsible for the low dissolved oxygen levels in Dead Colt Creek Dam. Wetzel (1983) summarized, "The loading of organic matter to the hypolimnion and sediments of productive eutrophic lakes increases the consumption of dissolved oxygen. As a result, the oxygen content of the hypolimnion is reduced progressively during the period of summer stratification."

Carpenter et al. (1998), has shown that nonpoint sources of phosphorous has lead to eutrophic conditions for many lake/reservoirs across the U.S. One consequence of eutrophication is oxygen depletions caused by decomposition of algae and aquatic plants. They also document that a reduction in nutrients will eventually lead to the reversal of eutrophication and attainment of designated beneficial uses. However, the rates of recovery are variable among lakes/reservoirs. This supports the Department of Health's viewpoint that decreased nutrient loads at the watershed level will result in improved oxygen levels, the concern is that this process takes a significant amount of time (5-15 years).

In Lake Erie, heavy loadings of phosphorous have impacted the lake severely. Monitoring and research from the 1960's has shown that depressed hypolimnetic DO levels were responsible for large fish kills and large mats of decaying algae. Binational programs to reduce nutrients into the lake have resulted in a downward trend of the oxygen depletion rate since monitoring began in the 1970's. The trend of oxygen depletion has lagged behind that of phosphorous reduction, but this was expected (See: http://www.epa.gov/glnpo/lakeerie/dostory.html).

Nürnberg (1995, 1995a, 1996, 1997), developed a model that quantified duration (days) and extent of lake oxygen depletion, referred to as an anoxic factor (AF). This model showed that AF is positively correlated with average annual total phosphorous (TP) concentrations. The AF may also be used to quantify response to watershed restoration measures which makes it very useful for TMDL development. Nürnberg (1996), developed several regression models that show nutrients control all trophic state indicators related to oxygen and phytoplankton in lakes/reservoirs. These models were developed from water quality characteristics using a suite of North American lakes. NDDoH has calculated the morphometric parameters such as surface area (A_o = 41,400 acres; 167.5 km^2), mean depth (z = 18.3 feet; 5.58 meters), and the ratio of mean depth to the surface area ($z/A_o^{0.5}$ = 0.43) for Dead Colt Creek Dam which show that these parameters are within the range of lakes used by Nürnberg. Based on this information, NDDoH is confident that Nürnberg's empirical nutrient-oxygen relationship holds true for North Dakota lakes and reservoirs. NDDoH is also confident that prescribed BMPs will reduce external loading of nutrients to the Dam which will reduce algae blooms and therefore increase oxygen levels over time.

Best professional judgment concludes that as levels of phosphorus are reduced by the implementation of best management practices, dissolved oxygen levels will improve. This is supported by the research of Thornton, et al (1990). They state that, "... as organic deposits were exhausted, oxygen conditions improved."

To insure that the implementation of BMPs will reduce phosphorus levels and result in a corresponding increase in dissolved oxygen, water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan.

8.0 ALLOCATION

This TMDL will be implemented by several parties on a volunteer basis. Phosphorus loads into the reservoir will be reduced by 70 % by treating of the AGNPS identified critical areas (Figure 11). There are 397 cells within the Dead Colt Creek watershed identified as "critical" by AGNPS modeling. These cells represent a total area of 14,480 (cropland) and 844 (pasture/rangeland) acres, or 38.4% of the watershed. If 38.4% of the critical watershed areas can be treated with appropriate BMPs, then the specified reduction is possible. Further, internally derived phosphorus reductions will also be achieved through hypolimnetic withdrawal within the reservoir.

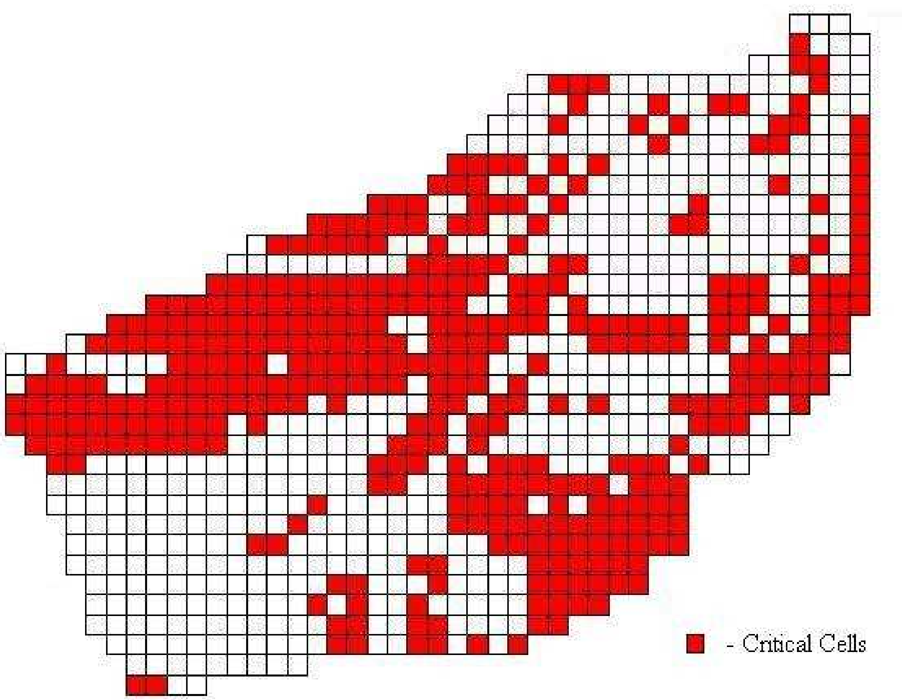

Figure 11. AGNPS Identification of Critical Areas for BMP Implementation.

9.0 PUBLIC PARTICIPATION

To satisfy the public participation requirement of this TMDL, a hard copy of the TMDL for Dead Colt Creek Dam and a request for comment has been mailed to participating agencies, partners, and to those who request a copy. Those included in the mailing of a hard copy are as follows:

- Ransom County Soil Conservation District
- Ransom County Water Resource Board
- Natural Resources Conservation Service (Ransom County Field Office)
- US Environmental Protection Agency, Region 8
- U.S. Fish and Wildlife Service

In addition to mailing copies of this TMDL for Dead Colt Creek Dam to interested parties, the TMDL has been posted on the North Dakota Department of Health, Division of Water Quality web site at **http://www.health.state.nd.us/wq/**. A 30 day public notice soliciting comment and participation has also been published in the following newspapers:

- Ransom County Gazette & Extra
- Fargo Forum
- Bismarck Tribune

The 30 day public notice was held from February 14 to March 14, 2006 and comments were received from the following agencies: United States Fish and Wildlife Service and North Dakota Game and Fish. Formal comments can be found in Appendix D. Informal comments and the North Dakota Department of Health's response to all comments received are in Appendix E and F.

10.0 MONITORING

To insure that the implementation of BMPs will reduce phosphorus levels and result in a corresponding increase in dissolved oxygen, water quality monitoring will be conducted in accordance with an approved Quality Assurance Project Plan (QAPP).

Specifically, monitoring will be conducted for all variables that are currently causing impairments to the beneficial uses of the waterbody. These include, but are not limited to nutrients (i.e., nitrogen and phosphorus) and dissolved oxygen. Once a watershed restoration plan (e.g. 319 PIP) is implemented, monitoring will be conducted in the lake/reservoir beginning two years after implementation and extending 5 years after the implementation project is complete.

11.0 TMDL IMPLEMENTATION STRATEGY

Implementation of TMDLs is dependent upon the availability of Section 319 NPS funds or other watershed restoration programs (e.g. USDA EQIP), as well as securing a local project sponsor and the required matching funds. Provided these three requirements are in place, a project implementation plan (PIP) is developed in accordance with the TMDL and submitted to the ND

Nonpoint Source Pollution Task Force and US EPA for approval. The implementation of the best management practices contained in the NPS pollution management project is voluntary. Therefore, success of any TMDL implementation project is ultimately dependent on the ability of the local project sponsor to find cooperating producers.

Monitoring is an important and required component of any PIP. As a part of the PIP, data are collected to monitor and track the effects of BMP implementation as well as to judge overall project success. Quality Assurance Project Plans (QAPPs) detail the strategy of how, when and where monitoring will be conducted to gather the data needed to document the TMDL implementation goal(s). As data are gathered and analyzed, watershed restoration tasks are adapted to place BMPs where they will have the greatest benefit to water quality.

12.0 ENDANGERED SPECIES ACT COMPLIANCE

States are encouraged to participate with the U.S. Fish and Wildlife Service and the US EPA in documenting threatened and endangered species on the Endangered Species List. In an effort to assist in Endangered Species Act compliance, a request for a list of endangered and/or threatened species was made to the U.S. Fish and Wildlife Service (Figure 12 and 13). A hard copy of the draft TMDL report will also be sent to the U.S. Fish and Wildlife Services Bismarck, North Dakota office for review. The following is a list of threatened or endangered species specific to the Dead Colt Creek Dam and Ransom County.

- Bald Eagle (Haliaeetus leucocephalus), Threatened

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

JUN 17 2005

Mr. Michael Hargiss
North Dakota Department of Health
2301 8th Avenue North
Fargo, North Dakota 58102

Dear Mr. Hargiss:

This letter is in response to your June 10, 2005, request for a current list of threatened, endangered, and candidate species for Barnes and Ransom Counties, North Dakota. The information will be used by the North Dakota Department of Health in the preparation of water quality Total Maximum Daily Load (TMDL) reports for Dead Colt Creek Dam in Ransom County and Armordale Dam in Barnes County.

A list of federally endangered, threatened, and candidate species that may be present within the proposed TMDL areas is enclosed. This list fulfills requirements of the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act.

If a Federal agency authorizes, funds, or carries out a proposed action, the responsible Federal agency, or its delegated agent, is required to evaluate whether the action "may affect" listed species. If the Federal agency determines the action "may affect" listed species, then the responsible Federal agency shall request formal section 7 consultation with this office. If the evaluation shows a "no effect" determination on listed species, further consultation is not necessary. If a private entity receives Federal funding for a construction project, or if any Federal permit is required, the Federal agency may designate the fund recipient or permittee as its agent for purposes of section 7 consultation.

If you require further information, please contact Terry Ellsworth of my staff at (701) 250-4481, or at the letterhead address above.

Sincerely,

Jeffrey K. Towner

Jeffrey K. Towner
Field Supervisor
North Dakota Field Office

Figure 12. Correspondence Letter Received from the U.S. Fish and Wildlife Service.

FEDERAL THREATENED AND CANDIDATE SPECIES
FOUND IN RANSOM COUNTY
NORTH DAKOTA
June 2005

THREATENED SPECIES

Birds

Bald eagle (Haliaeetus leucocephalus): Migrates spring and fall statewide but primarily along the major river courses. It concentrates along the Missouri River during winter and is known to nest in the floodplain forest.

Plants

W. prairie-fringed orchid (Platanthera praeclara): Locally common in moist swales on Sheyenne National Grasslands. Largest known U.S. population is on the Sheyenne.

CANDIDATE SPECIES

Invertebrates

Dakota skipper (Hesperia dacotae): Found in native prairie containing a high diversity of wildflowers and grasses. Habitat includes two prairie types: 1) low (wet) prairie dominated by bluestem grasses, wood lily, harebell, and smooth camas; 2) upland (dry) prairie on ridges and hillsides dominated by bluestem grasses, needlegrass, pale purple and upright coneflowers and blanketflower.

Figure 13. Threatened and Endangered Species List and Designated Critical Habitat.

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Appendix A

A Calibrated Trophic Response Model (BATHTUB) for Dead Colt Creek Dam As a Tool to Calibrate Various Nutrient Reduction Alternatives Based on Data Collected by the Ransom County Soil Conservation District from June 6, 2001 through October 22, 2003

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July 9, 2004

Introduction

In order to meet the project goals as set forth by the project sponsors of improving the trophic condition of Dead Colt Creek Dam to levels capable of maintaining the reservoirs beneficial uses (e.g., fishing, recreation, and drinking water supply), and the objectives of this project which are to: (1) develop a nutrient and sediment budget for the reservoir; (2) identify the primary sources and causes of nutrients and sediments to the reservoir; and (3) examine and make recommendations for reservoir restoration measures which will reduce documented nutrient and sediment loadings to the reservoir, a calibrated trophic response model was developed for Dead Colt Creek Dam. The model enables investigations into various nutrient reduction alternatives relative to the project goal of improving Dead Colt Creek Dam's trophic status. The model will allow resource managers and the public to relate changes in nutrient loadings to the trophic condition of the reservoir and to set realistic lake restoration goals that are scientifically defensible, physically achievable and socially acceptable.

For purposes of this project, the BATHTUB program was use to predict changes in trophic status based on changes in nutrient loading. The BATHTUB program, developed by the US Army Corps of Engineers Waterways Experiment Station (Walker 1996), applies an empirically derived eutrophication model to reservoirs. The model is developed in three phases. The first two phases involve the analysis and reduction of the tributary and in-lake water quality data. The third phase involves model calibration. In the data reduction phase, the in-lake and tributary monitoring data collected as part of the project are summarized, or reduced, in a format which can serve as inputs to the model. The following is a brief explanation of the computer software, methods, and procedures used to complete each of these phases.

<u>Tributary Data</u>

To facilitate the analysis and reduction of tributary inflow and outflow water quality and flow data the FLUX program was employed. The FLUX program, also developed by the US Corps of Engineers Waterways Experiment Station (Walker 1996), uses six calculation techniques to estimate the average mass discharge or loading that passes a given river or stream site. FLUX estimates loadings based on grab sample chemical concentrations and continuous daily flow record. Load is therefore defined as the mass of a pollutant during a given unit of time (e.g., hour, day, month, season, year). The FLUX program allows the user, through various iterations, to select the most appropriate load calculation technique and data stratification scheme, either by flow or date, which will give a load estimate with the smallest statistical error, as represented by the coefficient of variation. Output from the FLUX program is then provided as an input file to calibrate the BATHTUB eutrophication response model. For a complete description of the FLUX program the reader is referred to Walker (1996).

Lake Data

Dead Colt Creek Dam's in-lake water quality data was reduced using Microsoft Excel. The data was reduced in Excel to provide three computational functions, including: (1) the ability to display constitute concentrations as a function of depth, location, or date; (2) summary statistics (e.g., mean, median and standard error in the mixed layer of the lake or reservoir); and (3) track the temporal trophic status. As is the case with FLUX, output from the Excel program is used as input to calibrate the BATHTUB model.

Bathtub Model Calibration

As stated previously, the BATHTUB eutrophication model was selected for this project as a means evaluating the effects of various nutrient reduction alternatives on the predicted trophic status of Dead Colt Creek Dam. BATHTUB performs water and nutrient balance calculations in a steady-state. The BATHTUB model also allows the user to spatially segment the reservoir. Eutrophication related water quality variables (e.g., total phosphorus, total nitrogen, chlorophyll-*a*, secchi depth, organic nitrogen, orthophosphorous, and hypolimnetic oxygen depletion rate) are predicted using empirical relationships previously developed and tested for reservoir systems (Walker 1985).

Within the BATHTUB program the user can select from six schemes based on reservoir morphometry and the needs of the resource manager. Using BATHTUB the user can view the reservoir as a single spatially averaged reservoir or as single segmented reservoir. The user can also model parts of the reservoir, such as an embayment, or model a collection of reservoirs. For purposes of this project, Dead Colt Creek Dam was modeled as a single, spatially averaged, reservoir.

Once input is provided to the model from FLUX and Excel, the user can compare predicted conditions (i.e., model output) to actual conditions. Since BATHTUB uses a set of generalized rates and factors, predicted vs. actual conditions may differ by a factor of 2 or more using the initial, un-calibrated, model. These differences reflect a combination of measurement errors in the inflow and outflow data, as well as unique features of the reservoir being modeled.

In order to closely match an actual in-lake condition with the predicted condition, BATHTUB allows the user to modify a set of calibration factors (Table 1). For a complete description of the BATHTUB model the reader is referred to Walker (1996).

Table 1. Selected model parameters, number and name of model, and where appropriate the calibration factor used for the calibrated Dead Colt Creek Dam Bathtub Model.

Model Option	Model Selection	Calibration Factor
Conservative Substance	1 Computed	NA
Phosphorus Balance	1 2ND Order, Available P	1.00
Phosphorus – Ortho P	1	0.50
Nitrogen Balance	5 Bachman Flushing	1.37
Organic Nitrogen	5	1.80
Chlorophyll-a	1 P, N, Light, T	1.88
Secchi Depth	3 Vs. Total P	2.60
Phosphorus Calibration	1 Decay Rates	NA
Nitrogen Calibration	1 Decay Rates	NA
Availability Factors	2 All Models Except 2	NA
Mass-Balance Tables	0 Use Observed Concentrations	NA

Results

The trophic response model, BATHTUB, has been calibrated to match Dead Colt Creek Dam's trophic response for the project period June 6, 2001through October 22, 2003. This is accomplished by combining tributary loading estimates for the project period with in-lake water quality estimates.

Tributary flow and concentration data for the project period are reduced by the FLUX program and the in-lake water quality data for the project period is reduced utilizing Excel. The output from these two programs is then provided as input to the BATHTUB model. The model is calibrated through several iterations, first by selecting appropriate empirical relationships for model coefficients (e.g., nitrogen and phosphorus sedimentation, nitrogen and phosphorus decay, oxygen depletion, and algal/chlorophyll growth), and second by adjusting model calibration factors for those coefficients (Table 1). The model is termed calibrated when the predicted estimates for the trophic response variables are similar to observed estimates made from project monitoring data.

The two most important nutrients controlling trophic response in Dead Colt Creek Dam are nitrogen and phosphorus. The observed average annual concentration of total nitrogen and total phosphorus compared well with those of the calibrated model. The Bathtub model predicts Dead Colt Creek Dam to have an annual average total phosphorus concentration of 0.073 mg L^{-1} and an annual average total nitrogen concentration of 1.063 mg L^{-1} compared to observed values for total phosphorus and total nitrogen of 0.072 mg L^{-1} and 1.062 mg L^{-1}, respectively (Table 2).

Other measures of trophic response predicted by the model are average annual chlorophyll-a concentration and average secchi disk transparency. The calibrated model did a good job of predicting average chlorophyll-a concentration and secchi disk transparency within the reservoir (Table 2).

Table 2. Observed and Predicted Values for Selected Trophic Response Variables for the Calibrated "BATHTUB" Model.

Variable	Value	
	Observed	Predicted
Total Phosphorus as P (mg/L)	0.072	0.073
Total Phosphorus – Ortho Phosphorus	0.030	0.030
Total Nitrogen as N (mg/L)	1.062	1.063
Organic Nitrogen as N (mg/L)	0.928	0.923
Chlorophyll-a (μg/L)	9.0	9.0
Secchi Disk Transparency (meters)	1.80	1.78
Carlson's TSI for Phosphorus	65.82	65.99
Carlson's TSI for Chlorophyll-a	52.15	52.16
Carlson's TSI for Secchi Disk	51.53	51.71

Once predictions of total phosphorus, chlorophyll-a, and secchi disk transparency are made, the model calculates Carlson's Trophic Status Index (TSI) (Carlson 1977) as a means of expressing predicted trophic response (Table 1). Carlson's TSI is an index that can be used to measure the relative trophic state of a lake or reservoir. Simply stated, trophic state is how much production (i.e., algal and weed growth) occurs in the waterbody. The lower the nutrient concentrations are in the waterbody the lower the production and the lower the trophic state or level, while increased nutrient concentrations in a lake or reservoir increase the production of algae and weeds which make the lake or reservoir more eutrophic or of a higher trophic state. Oligotrophic is the term which describes the least productive lakes and hypereutrophic is the term used to describe lakes and reservoirs with excessive nutrients and production.

Figure 1 provides a graphic summary of the TSI range for each trophic level compared to values for each of the trophic response variables. The calibrated model provided predictions of trophic status which are similar to the observed TSI values for the project period (Table 1). Predicted and observed TSI value for phosphorus suggest Dead Colt Creek Dam is highly eutrophic to hypereutrophic, while the TSI value chlorophyll-a and secchi disk indicates the reservoir is highly mesotrophic to eutrophic. Figure 2 shows the annual temporal distribution of Dead Colt Creek Dam's trophic state based on total phosphorus as phosphate, chlorophyll-a concentrations, and secchi disk depth transparency.

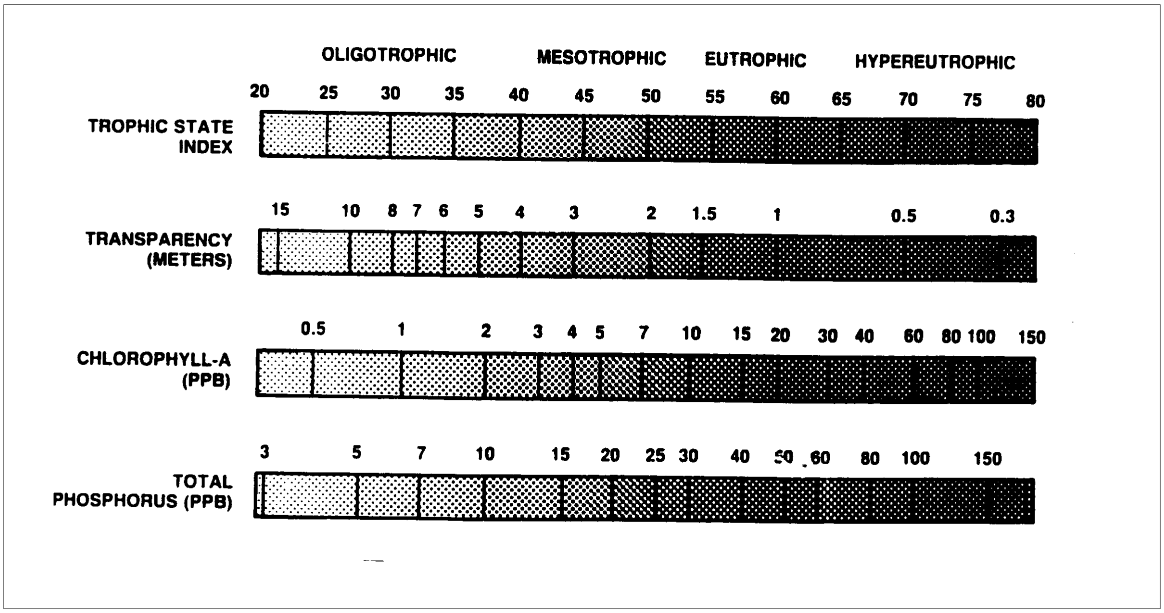

Figure 1. Graphic depiction of Carlson's Trophic Status Index.

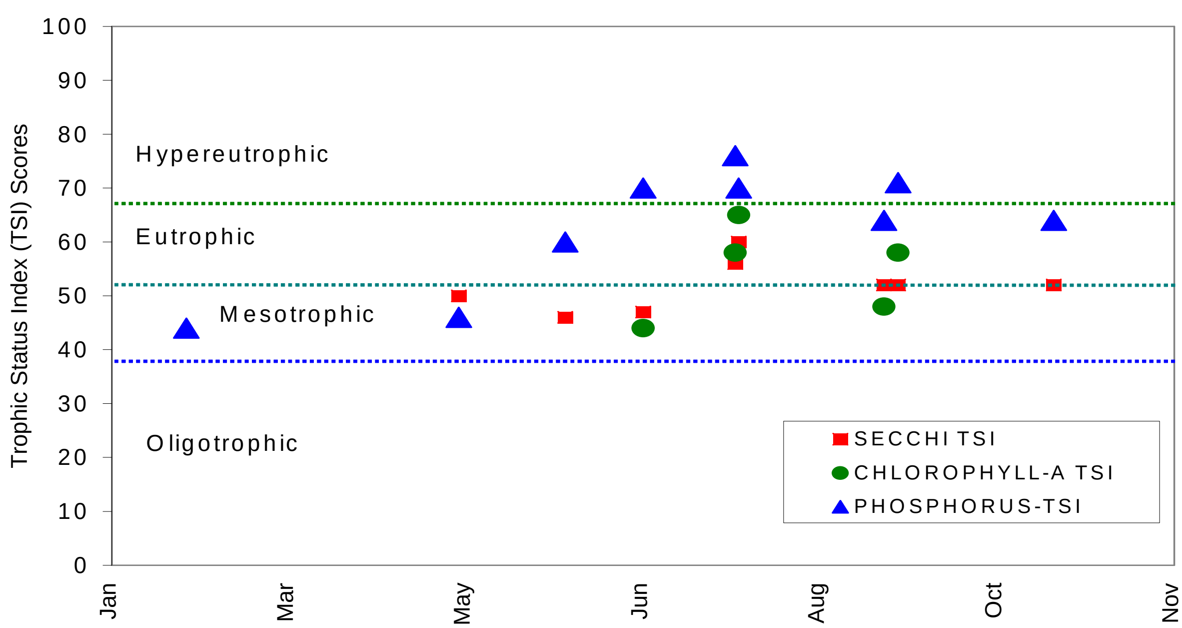

Figure 2. Temporal distribution of Carlson's Trophic Status Index scores for Dead Colt Creek Dam.

Model Predictions

Once the model is calibrated to existing conditions, the model can be used to evaluate the effectiveness of any number of nutrient reduction or lake restoration alternatives. This evaluation is accomplished comparing predicted trophic state, as reflected by Carlson's TSI, with currently observed TSI values.

Modeled nutrient reduction alternatives are presented in three basic categories: (1) reducing externally derived nutrient loads; (2) reducing internally available nutrients; and (3) reducing both external and internal nutrient loads. For Dead Colt Creek Dam only external nutrient loads were addressed. In the initial set of model simulations only phosphorus was reduced. Phosphorus was initially selected because it is known to cause eutrophication and because it is controllable through the implementation of watershed Best Management Practices (BMPs) and/or lake restoration methods. In the second series of simulations both phosphorus and nitrogen load reduction was simulated as the AGNPS model 3.65 indicated both could be effectively controlled through BMP implementation.

Alternative 1: Reduce externally derived phosphorus

Predicted change in trophic response to Dead Colt Creek Dam was evaluated by reducing externally derived phosphorus load by 25, 50, 70 and 80 percent. These reductions were simulated in the model by reducing the phosphorus concentrations in the contributing tributary and other externally delivery sources by 25, 50, 70, and 80 percent. Since there is no reliable means of estimating how much hydraulic discharge would be reduced through the implementation of BMPs, flow was held constant.

The model results of alternative 1 indicate that if it were possible to reduce external phosphorus loading to Dead Colt Creek Dam by 50 percent, the average annual total phosphorus and chlorophyll-a concentration in the lake would decrease and secchi disk transparency depth would increase a significantly (Table 3) (Figure 3). It is un-likely, however, that this improvement would result in a noticeable change in trophic state to the average lake user as the amount of green in the lake and overall clarity would still be in the eutrophic range.

The model results suggests to insure a noticeable change in reservoir trophic status, a 70 percent reduction in external phosphorus loading would most likely have to be achieved (Table 3, Figure 3). With a 70 percent reduction in external phosphorus load, the model predicts a reduction in Carlson's TSI chlorophyll-a scores from 52.15 to 45.31 and secchi disk depth scores from 51.53 to 50.22 representing the middle and upper mesotrophic ranges respectively.

Table 3. Observed and Predicted Values for Selected Trophic Response Variables Assuming a 25, 50, 70, and 80 Percent Reduction in External Phosphorus Loading.

		Predicted			
	Observed	25 %	50 %	70 %	80 %
Total Phosphorus as P (mg/L)	0.072	0.063	0.052	0.041	0.034
Total Nitrogen as N (mg/L)	1.062	1.063	1.063	1.063	1.063
Organic Nitrogen as N (mg/L)	0.911	0.917	0.907	0.857	0.832
Chlorophyll-a (μg/L)	9.00	8.87	8.63	7.39	6.80
Secchi Disk Transparency (meters)	1.80	1.98	2.30	2.77	3.19
Carlson's TSI for Phosphorus	65.82	63.94	60.82	57.57	54.90
Carlson's TSI for Chlorophyll-a	52.15	52.01	52.87	50.22	49.40
Carlson's TSI for Secchi Disk	51.53	50.15	47.78	45.31	43.2

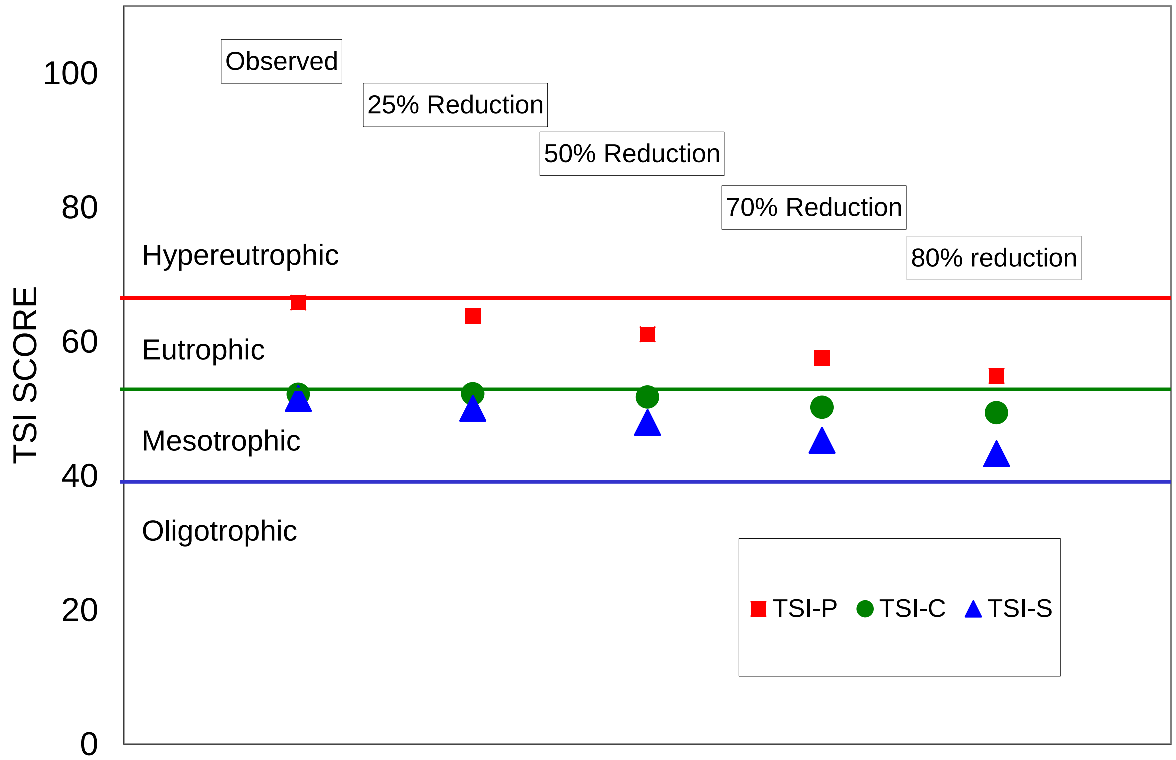

Figure 3. Observed and predicted trophic response to reduced phosphorus loads to Dead Colt Creek Dam of 25, 50, 70, and 80 percent.

Alternative 2: Reducing externally available phosphorus and nitrogen

A second set of model runs were made to predict the change in trophic response in Dead Colt Creek Dam by simulating the reductions in externally derived phosphorus loads by 70 percent and externally derived nitrogen load by 20, 50, and 60 percent. These reductions were simulated in the model by reducing the nutrient concentrations in the contributing tributary and other external delivery sources. Since there is no reliable means of estimating how much hydraulic discharge would be reduced through the implementation of BMPs, flow was held constant.

The model results of alternative 2 are interesting in that little to no additional improvements are predicted to Dead Colt Creek Dam's trophic state by significantly reducing the nitrogen load (Table 4, Figure 4).

Table 4. Observed and Predicted Values for Selected Trophic Response Variables Assuming a 70 Percent Reduction in Phosphorus External Load and a 20, 50, and 60 Percent Reduction in External Phosphorus Loading.

		Predicted		
Variable	Observed	20 %	50 %	60 %
Total Phosphorus as P (mg/L)	0.072	0.041	0.041	0.041
Total Nitrogen as N (mg/L)	1.062	0.899	0.684	0.612
Organic Nitrogen as N (mg/L)	0.911	0.888	0.875	0.867
Chlorophyll-a (μg/L)	9.00	8.14	7.82	7.63
Secchi Disk Transparency (meters)	1.80	2.77	2.77	2.77
Carlson's TSI for Phosphorus	65.82	57.57	57.57	57.57
Carlson's TSI for Chlorophyll-a	52.15	51.16	50.78	50.54
Carlson's TSI for Secchi Disk	51.53	45.31	45.31	45.31

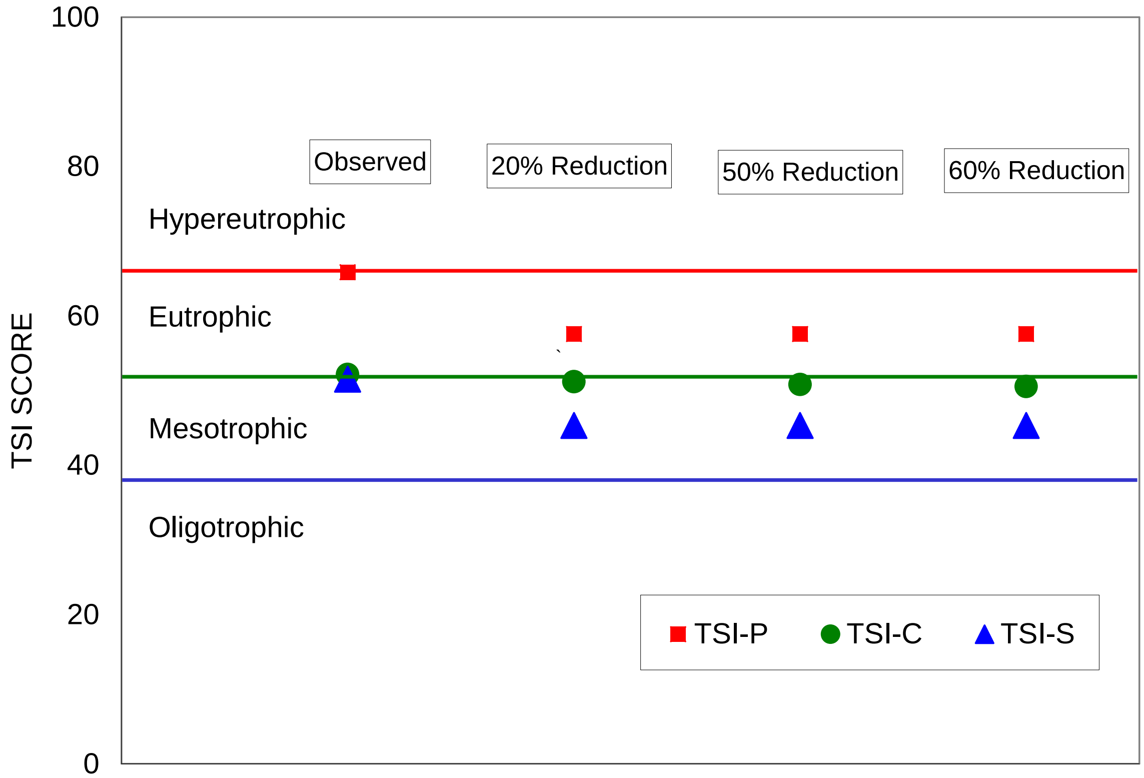

Figure 4. Observed and predicted trophic response to a reduced phosphorus load to Dead Colt Creek Dam of 70 percent, coupled with nitrogen reductions of 20, 50, and 60 percent.

Appendix B
Flux Data

Dead Colt Creek Inlet 380341 period of record 03-13-02 through 12-31-02

VAR=NH3&4-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	13	13	100.0	.071	.569	-.288	.266
***	297	13	13	100.0	.071	.569		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020313 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	40.1	49.4	.3113E+03	699.41	.357
2 Q WTD C	5.0	6.1	.3061E+01	86.83	.285
3 IJC	4.9	6.1	.2706E+01	85.81	.272
4 REG-1	9.1	11.2	.5226E+02	158.51	.646
5 REG-2	3.1	3.8	.8597E+01	53.39	.778
6 REG-3	7.0	8.7	.1850E+02	122.72	.497

VAR=TD-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	11	11	100.0	.071	.581	.539	.028
***	297	11	11	100.0	.071	.581		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020408 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	296.3	364.4	.2100E+05	5162.08	.398
2 Q WTD C	36.0	44.3	.2682E+02	627.68	.117
3 IJC	37.0	45.4	.1931E+02	643.77	.097
4 REG-1	11.7	14.4	.5166E+02	204.59	.498
5 REG-2	30.5	37.5	.1264E+03	530.76	.300
6 REG-3	25.3	31.1	.3247E+02	440.23	.183

VAR=NO2+NO3- METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	13	13	100.0	.071	.569	-.542	.382
***	297	13	13	100.0	.071	.569		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020313 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	416.2	511.9	.8343E+05	7251.85	.564
2 Q WTD C	51.7	63.5	.1651E+04	900.26	.640
3 IJC	48.5	59.6	.1451E+04	844.40	.639
4 REG-1	160.1	196.9	.5597E+05	2789.17	1.202
5 REG-2	28.6	35.2	.2035E+05	498.63	4.053
6 REG-3	257.8	317.1	.9997E+05	4492.10	.997

VAR=T-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	13	13	100.0	.071	.569	-.132	.452
***	297	13	13	100.0	.071	.569		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020313 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	1276.2	1569.5	.1799E+06	22234.65	.270
2 Q WTD C	158.4	194.8	.1785E+04	2760.24	.217
3 IJC	155.0	190.6	.1535E+04	2700.74	.206
4 REG-1	1408.5	256.5	.8971E+04	3633.43	.369
5 REG-2	135.1	166.2	.3724E+04	2354.06	.367
6 REG-3	198.1	243.6	.3656E+04	3450.66	.248

VAR=T-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	13	13	100.0	.071	.569	.096	.626
***	297	13	13	100.0	.071	.569		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020313 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	336.7	414.1	.2032E+05	5865.94	.344
2 Q WTD C	41.8	51.4	.2184E+02	728.21	.091
3 IJC	42.5	52.3	.1814E+02	740.35	.081
4 REG-1	34.2	42.1	.5477E+03	596.62	.556
5 REG-2	44.1	54.3	.5123E+02	769.19	.132
6 REG-3	38.6	47.5	.1870E+03	672.27	.288

VAR=TSS METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	297	13	13	100.0	.071	.569	-.145	.293
***	297	13	13	100.0	.071	.569		

FLOW STATISTICS
FLOW DURATION = 297.0 DAYS = .813 YEARS
MEAN FLOW RATE = .071 HM3/YR
TOTAL FLOW VOLUME = .06 HM3
FLOW DATE RANGE = 20020310 TO 20021231
SAMPLE DATE RANGE = 20020313 TO 20020717

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	4330.0	5325.0	.1706E+07	75438.19	.245
2 Q WTD C	537.5	661.1	.1544E+05	9365.00	.188
3 IJC	525.9	646.7	.1379E+05	9161.85	.182
4 REG-1	728.1	895.4	.3443E+05	12685.08	.207
5 REG-2	448.1	551.1	.4074E+05	7806.67	.366
6 REG-3	671.6	826.0	.1300E+05	11701.55	.138

Dead Colt Creek Inlet 380341 period of record 01/01/03 through 09/28/03

VAR=NH3&4-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	2 70	11	11	100.0	1.404	13.981	.168	.445
***	270	11	11	100.0	1.404	13.981		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	606.5	820.5	.1921E+06	584.34	.534
2 Q WTD C	60.9	82.4	.1515E+04	58.69	.472
3 IJC	62.5	84.5	.1802E+04	60.17	.502
4 REG-1	41.4	56.0	.1017E+04	39.87	.570
5 REG-2	86.2	116.6	.4801E+04	83.08	.594
6 REG-3	76.1	103.0	.2953E+04	73.33	.528

VAR=TD-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	270	7	7	100.0	1.404	10.116	.177	.340
***	270	7	7	100.0	1.404	10.116		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	2732.1	3695.9	.2474E+07	2632.13	.426
2 Q WTD C	379.2	513.0	.2618E+05	365.35	.315
3 IJC	384.7	520.4	.2794E+05	370.61	.321
4 REG-1	267.3	361.6	.4707E+05	257.50	.600
5 REG-2	583.1	788.8	.1977E+06	561.78	.564
6 REG-3	421.0	569.5	.3047E+05	405.60	.306

VAR=NO2+NO3- METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	270	11	11	100.0	1.404	13.981	.410	.164
***	270	11	11	100.0	1.404	13.981		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	7173.0	9703.5	.3049E+08	6910.66	.569
2 Q WTD C	720.4	974.6	.2611E+06	694.06	.524
3 IJC	727.4	984.0	.2637E+06	700.76	.522
4 REG-1	280.9	380.0	.6974E+05	270.61	.695
5 REG-2	1082.9	1465.0	.6631E+06	1043.33	.556
6 REG-3	963.4	1303.2	.1257E+07	928.14	.860

VAR=T-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	270	11	11	100.0	1.404	13.981	.138	.065
***	270	11	11	100.0	1.404	13.981		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	20801.9	28140.3	.6800E+08	20041.07	.293
2 Q WTD C	2089.2	2826.2	.3540E+06	2012.80	.211
3 IJC	2079.2	2812.6	.3856E+06	2003.11	.221
4 REG-1	1521.3	2058.0	.1827E+06	1465.66	.208
5 REG-2	2855.1	3862.3	.1317E+07	2750.66	.297
6 REG-3	2083.3	2818.3	.2473E+06	2007.13	.176

VAR=T-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	270	11	11	100.0	1.404	13.981	.198	.021
***	270	11	11	100.0	1.404	13.981		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	5680.6	7684.6	.4353E+07	5472.81	.271
2 Q WTD C	570.5	771.8	.5692E+04	549.65	.098
3 IJC	572.2	774.1	.5649E+04	551.29	.097
4 REG-1	361.5	489.1	.1867E+05	348.31	.279
5 REG-2	829.9	1122.7	.3021E+05	799.59	.155
6 REG-3	590.3	798.6	.1320E+05	568.72	.144

VAR=TSS METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	270	11	11	100.0	1.404	13.981	.194	.319
***	270	11	11	100.0	1.404	13.981		

FLOW STATISTICS
FLOW DURATION = 270.0 DAYS = .739 YEARS
MEAN FLOW RATE = 1.404 HM3/YR
TOTAL FLOW VOLUME = 1.04 HM3
FLOW DATE RANGE = 20030101 TO 20030927
SAMPLE DATE RANGE = 20030514 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	309870.1	419185.4	.8802E+11	298536.90	.708
2 Q WTD C	31121.4	42100.4	.7460E+09	29983.18	.649
3 IJC	33057.0	44718.7	.8986E+09	31847.94	.670
4 REG-1	19945.0	26981.2	.2940E+09	19215.55	.635
5 REG-2	45095.8	61004.6	.1812E+10	43446.47	.698
6 REG-3	22495.0	30430.7	.2696E+09	21672.28	.540

Combined 2002 and 2003 Load analysis for Dead Colt Creek Dam's Inlet

VAR=NH3&4-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	24	24	100.0	.704	6.716	-.149	.248
***	568	24	24	100.0	.704	6.716		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020313 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	626.4	402.8	.4478E+05	571.86	.525
2 Q WTD C	65.7	42.2	.3547E+03	59.98	.446
3 IJC	66.9	43.0	.4175E+03	61.06	.475
4 REG-1	91.9	59.1	.5759E+03	83.90	.406
6 REG-3	78.0	50.2	.4688E+03	71.24	.432

VAR=TD-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	18	18	100.0	.704	4.289	.123	.264
***	568	18	18	100.0	.704	4.289		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020408 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	2581.4	1660.0	.5022E+06	2356.66	.427
2 Q WTD C	424.0	272.6	.5777E+04	387.05	.279
3 IJC	424.8	273.1	.6287E+04	387.77	.290
4 REG-1	339.5	218.3	.2428E+04	309.90	.226
5 REG-2	789.0	507.4	.5678E+05	720.31	.470
6 REG-3	579.1	372.4	.1459E+05	528.71	.324

VAR=NO2+NO3- METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	24	24	100.0	.704	6.716	-.008	.971
***	568	24	24	100.0	.704	6.716		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020313 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	7347.4	4724.7	.7012E+07	6707.74	.560
2 Q WTD C	770.6	495.5	.6232E+05	703.52	.504
3 IJC	775.4	498.6	.6371E+05	707.88	.506
4 REG-1	783.8	504.0	.7523E+05	715.60	.544
5 REG-2	718.7	462.1	.1040E+07	656.09	2.207
6 REG-3	2037.1	1310.0	.1062E+07	1859.76	.787

VAR=T-N METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	24	24	100.0	.704	6.716	-.046	.492
***	568	24	24	100.0	.704	6.716		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020313 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	21379.2	13747.8	.2122E+08	19517.93	.335
2 Q WTD C	2242.3	1441.9	.8505E+05	2047.08	.202
3 IJC	2228.8	1433.2	.9274E+05	2034.77	.212
4 REG-1	2485.5	1598.3	.9341E+05	2269.10	.191
5 REG-2	1231.9	792.2	.1253E+07	1124.66	1.413
6 REG-3	2598.2	1670.8	.7813E+05	2372.04	.167

VAR=T-P METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	24	24	100.0	.704	6.716	.071	.298
***	568	24	24	100.0	.704	6.716		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020313 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	5826.0	3746.4	.1444E+07	5318.78	.321
2 Q WTD C	611.0	392.9	.1360E+04	557.84	.094
3 IJC	611.5	393.2	.1374E+04	558.26	.094
4 REG-1	520.9	335.0	.3704E+04	475.58	.182
5 REG-2	921.1	592.3	.3348E+05	840.87	.309
6 REG-3	739.8	475.7	.3185E+04	675.36	.119

VAR=TSS METHOD= 2 Q WTD C

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	568	24	24	100.0	.704	6.716	.025	.782
***	568	24	24	100.0	.704	6.716		

FLOW STATISTICS
FLOW DURATION = 568.0 DAYS = 1.555 YEARS
MEAN FLOW RATE = .704 HM3/YR
TOTAL FLOW VOLUME = 1.10 HM3
FLOW DATE RANGE = 20020310 TO 20030928
SAMPLE DATE RANGE = 20020313 TO 20030701

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	303261.5	195011.0	.1939E+11	276860.10	.714
2 Q WTD C	31806.6	20453.1	.1788E+09	29037.61	.654
3 IJC	33636.9	21630.1	.2126E+09	30708.53	.674
4 REG-1	30071.7	19337.5	.1273E+09	27453.70	.583
5 REG-2	38272.7	24611.1	.7083E+09	34940.77	1.081
6 REG-3	16465.2	10587.9	.2067E+08	15031.77	.429

2002 Dead Colt Creek Dam Flux Loading Analysis Outlet

VAR=NH3&4 METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	6	6	100.0	.192	.285	.136	.926
***	202	6	6	100.0	.192	.285		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020313 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	6.0	10.9	.1482E+02	56.86	.353
2 Q WTD C	4.1	7.3	.5533E+01	38.26	.321
3 IJC	4.1	7.4	.5896E+01	38.54	.329
4 REG-1	3.8	6.9	.1606E+01	36.25	.182
5 REG-2	4.0	7.2	.4962E+01	37.76	.308
6 REG-3	5.1	9.3	.1224E+02	48.28	.378

VAR=TD-P METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	5	5	100.0	.192	.306	-3.000	.327
***	202	5	5	100.0	.192	.306		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020326 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	2.2	3.9	.5318E+01	20.39	.590
2 Q WTD C	1.4	2.4	.2324E+01	12.77	.623
3 IJC	1.3	2.4	.2396E+01	12.54	.644
4 REG-1	5.5	10.0	.1994E+02	51.99	.448
5 REG-2	13.6	24.6	.1880E+03	128.49	.557
6 REG-3	2.5	4.6	.2256E+02	23.83	1.040

VAR=NO2+NO3- METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	6	6	100.0	.192	.285	-.194	.200
***	202	6	6	100.0	.192	.285		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020313 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	31.5	57.0	.3573E+02	297.60	.105
2 Q WTD C	21.2	38.4	.2655E+01	200.23	.042
3 IJC	21.2	38.3	.2693E+01	199.77	.043
4 REG-1	22.9	41.4	.4571E+01	216.21	.052
5 REG-2	21.9	39.7	.2549E+01	207.01	.040
6 REG-3	21.1	38.2	.2720E+01	199.49	.043

VAR=T-N METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	6	6	100.0	.192	.285	.037	.852
***	202	6	6	100.0	.192	.285		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020313 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	79.3	143.5	.3850E+03	748.72	.137
2 Q WTD C	53.4	96.5	.3703E+02	503.76	.063
3 IJC	53.4	96.6	.3959E+02	504.04	.065
4 REG-1	52.6	95.1	.3659E+02	496.51	.064
5 REG-2	53.2	96.1	.3133E+02	501.59	.058
6 REG-3	53.6	96.8	.4779E+02	505.37	.071

VAR=T-P METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	6	6	100.0	.192	.285	-1.885	.258
***	202	6	6	100.0	.192	.285		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020313 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	3.2	5.8	.2248E+01	30.15	.260
2 Q WTD C	2.2	3.9	.1411E+01	20.29	.306
3 IJC	2.1	3.8	.1407E+01	19.92	.311
4 REG-1	4.5	8.2	.8842E+01	42.83	.362
5 REG-2	6.5	11.7	.7770E+02	60.91	.755
6 REG-3	2.8	5.0	.4223E+01	25.99	.413

VAR=TSS METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	202	6	6	100.0	.192	.285	.344	.545
***	202	6	6	100.0	.192	.285		

FLOW STATISTICS
FLOW DURATION = 202.0 DAYS = .553 YEARS
MEAN FLOW RATE = .192 HM3/YR
TOTAL FLOW VOLUME = .11 HM3
FLOW DATE RANGE = 20020310 TO 20020927
SAMPLE DATE RANGE = 20020313 TO 20020916

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	502.7	909.0	.5631E+05	4744.12	.261
2 Q WTD C	338.3	611.6	.1772E+05	3191.95	.218
3 IJC	339.9	614.7	.1888E+05	3207.90	.224
4 REG-1	295.2	533.7	.2880E+04	2785.38	.101
5 REG-2	331.4	599.2	.1605E+05	3126.96	.211
6 REG-3	342.4	619.1	.2255E+05	3231.19	.243

Combined 2002 and 2003 Load analysis for Dead Colt Creek Dam's Outlet

VAR=NH3&4 METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	10	10	100.0	.222	1.568	.942	.088
***	567	10	10	100.0	.222	1.568		

FLOW STATISTICS
FLOW DURATION = 567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE = .222 HM3/YR
TOTAL FLOW VOLUME = .34 HM3
FLOW DATE RANGE = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020313 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	2351.6	1514.8	.1784E+07	6824.56	.882
2 Q WTD C	332.8	214.4	.8525E+04	965.88	.431
3 IJC	349.8	225.3	.9639E+04	1015.13	.436
4 REG-1	52.8	34.0	.1424E+03	153.23	.351
5 REG-2	315.3	203.1	.1064E+08	914.98	16.057
6 REG-3	2185.1	1407.6	.1157E+15	6341.60	7642.058

VAR=TD-P METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	8	8	100.0	.222	1.877	.704	.239
***	567	8	8	100.0	.222	1.877		

FLOW STATISTICS
FLOW DURATION = 567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE = .222 HM3/YR
TOTAL FLOW VOLUME = .34 HM3
FLOW DATE RANGE = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020326 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	381.5	245.7	.5112E+05	1107.08	.920
2 Q WTD C	45.1	29.1	.2258E+03	130.90	.517
3 IJC	47.5	30.6	.2530E+03	137.95	.519
4 REG-1	10.0	6.5	.8001E+01	29.12	.438
5 REG-2	62.5	40.3	.1205E+06	181.35	8.622
6 REG-3	190.2	122.5	.1978E+08	551.94	36.298

VAR=NO2+NO3- METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	10	10	100.0	.222	1.568	-.772	.034
***	567	10	10	100.0	.222	1.568		

FLOW STATISTICS
FLOW DURATION =   567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE =   .222 HM3/YR
TOTAL FLOW VOLUME =   .34 HM3
FLOW DATE RANGE   = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020313 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	76.3	49.2	.1365E+03	221.49	.238
2 Q WTD C	10.8	7.0	.2980E+03	31.35	2.481
3 IJC	7.6	4.9	.3375E+03	22.13	3.739
4 REG-1	48.9	31.5	.2221E+04	141.95	1.496
6 REG-3	26.3	16.9	.1259E+02	76.27	.210

VAR=T-N   METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	10	10	100.0	.222	1.568	.362	.068
***	567	10	10	100.0	.222	1.568		

FLOW STATISTICS
FLOW DURATION =   567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE =   .222 HM3/YR
TOTAL FLOW VOLUME =   .34 HM3
FLOW DATE RANGE   = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020313 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	4578.6	2949.4	.6381E+07	13287.68	.856
2 Q WTD C	648.0	417.4	.1878E+05	1880.60	.328
3 IJC	673.2	433.7	.2124E+05	1953.71	.336
4 REG-1	319.3	205.7	.3272E+04	926.64	.278
5 REG-2	1439.9	927.5	.4212E+08	4178.75	6.997
6 REG-3	786.2	506.5	.1416E+09	2281.79	23.493

VAR=T-P METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	10	10	100.0	.222	1.568	.524	.218
***	567	10	10	100.0	.222	1.568		

FLOW STATISTICS
FLOW DURATION = 567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE = .222 HM3/YR
TOTAL FLOW VOLUME = .34 HM3
FLOW DATE RANGE = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020313 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	372.4	239.9	.4354E+05	1080.71	.870
2 Q WTD C	52.7	34.0	.1687E+03	152.95	.383
3 IJC	55.1	35.5	.1908E+03	159.88	.389
4 REG-1	18.9	12.2	.9690E+01	54.91	.255
5 REG-2	97.4	62.8	.2508E+06	282.71	7.980
6 REG-3	127.8	82.3	.2758E+07	370.77	20.181

VAR=TSS METHOD= 3 IJC

COMPARISON OF SAMPLED AND TOTAL FLOW DISTRIBUTIONS

STR	NQ	NC	NE	VOL%	TOTAL FLOW	SAMPLED FLOW	C/Q SLOPE	SIGNIF
1	567	10	10	100.0	.222	1.568	.329	.112
***	567	10	10	100.0	.222	1.568		

FLOW STATISTICS
FLOW DURATION = 567.0 DAYS = 1.552 YEARS
MEAN FLOW RATE = .222 HM3/YR
TOTAL FLOW VOLUME = .34 HM3
FLOW DATE RANGE = 20020310 TO 20030927
SAMPLE DATE RANGE = 20020313 TO 20030714

METHOD	MASS (KG)	FLUX (KG/YR)	FLUX VARIANCE	CONC (PPB)	CV
1 AV LOAD	22427.0	14447.0	.1518E+09	65086.60	.853
2 Q WTD C	3174.1	2044.7	.4104E+06	9211.68	.313
3 IJC	3291.2	2120.2	.4636E+06	9551.68	.321
4 REG-1	1668.6	1074.8	.5140E+05	4842.40	.211
5 REG-2	7237.3	4662.1	.6788E+09	21003.85	5.589
6 REG-3	3694.7	2380.0	.4003E+09	10722.53	8.406

VAR=NH3&4 METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	Model Mass (kg)	Model Conc (ppb)	Interpolated Mass (kg)	Interpolated Conc (ppb)
2002	297.00	6	.106	107.6	1015.13	103.0	972.01
2003	271.00	4	.239	242.2	1015.13	242.4	1016.11
ALL	568.00	10	.345	349.8	1015.13	345.4	1002.55

VAR=TD-P METHOD= 3 IJC

TABULATION OF MISSING DAILY FLOWS:

VAR=TD-P METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	Model Mass (kg)	Model Conc (ppb)	Interpolated Mass (kg)	Interpolated Conc (ppb)
2002	297.00	6	.106	14.2	134.24	13.7	128.82
2003	271.00	4	.239	32.0	134.24	31.8	133.37
ALL	568.00	10	.345	46.3	134.24	45.5	131.97

VAR=NO2+NO3- METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	Model Mass (kg)	Model Conc (ppb)	Interpolated Mass (kg)	Interpolated Conc (ppb)
2002	297.00	6	.106	2.3	22.13	3.2	30.00
2003	271.00	4	.239	5.3	22.13	5.3	22.04
ALL	568.00	10	.345	7.6	22.13	8.4	24.49

VAR=T-N METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	Model Mass (kg)	Model Conc (ppb)	Interpolated Mass (kg)	Interpolated Conc (ppb)
2002	297.00	6	.106	207.0	1953.71	200.3	1889.70
2003	271.00	4	.239	466.2	1953.71	466.5	1955.16
ALL	568.00	10	.345	673.2	1953.71	666.8	1935.03

VAR=T-P METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	------Model------ Mass (kg)	Conc (ppb)	----Interpolated---- Mass (kg)	Conc (ppb)
2002	297.00	6	.106	16.9	159.88	16.3	153.71
2003	271.00	4	.239	38.1	159.88	38.2	160.06
ALL	568.00	10	.345	55.1	159.88	54.5	158.11

VAR=TSS METHOD= 3 IJC

Load Time Series

Date	Days	Sample Count	Volume (hm3)	-----Model------ Mass (kg)	Conc (ppb)	----Interpolated---- Mass (kg)	Conc (ppb)
2002	297.00	6	.106	1012.2	9551.65	982.5	9270.92
2003	271.00	4	.239	2279.0	9551.68	2278.8	9550.81
ALL	568.00	10	.345	3291.2	9551.68	3261.3	9464.73

Appendix C
Dissolved Oxygen and Temperature Raw Data

Dissolved Oxygen and Temperature Raw Data Table

Site #	Date	Depth	Temp	DO
380340	6/6/2002	1	19.5	10.68
380340	6/6/2002	2	19.4	10.67
380340	6/6/2002	3	19.4	10.68
380340	6/6/2002	4	19.3	10.57
380340	6/6/2002	5	17.2	9.05
380340	6/6/2002	6	15.8	7.14
380340	6/6/2002	7	15.3	7.11
380340	6/6/2002	8	14.3	6.24
380340	6/6/2002	9	12.8	4.51
380340	6/6/2002	10	12.5	1.82
380340	6/6/2002	11	10.5	0.23
380340	6/28/2002	1	26.3	8.6
380340	6/28/2002	2	25.7	8.3
380340	6/28/2002	3	23.8	8.16
380340	6/28/2002	4	21.8	5.48
380340	6/28/2002	5	20.1	3.96
380340	6/28/2002	6	18.7	2.17
380340	6/28/2002	7	16.3	0.85
380340	6/28/2002	8	14.7	0.2
380340	6/28/2002	9	12.9	0.15
380340	6/28/2002	10	12.1	0.14
380340	6/28/2002	11	11.7	0.12
380340	6/28/2002	12	11.8	0.11
380340	6/28/2002	13	11.6	0.1
380340	6/28/2002	14	11.8	0.09
380340	9/4/2002	1	21.8	7.91
380340	9/4/2002	2	21.7	7.77
380340	9/4/2002	3	21.7	7.58
380340	9/4/2002	4	21.5	6.89
380340	9/4/2002	5	21.4	6.6
380340	9/4/2002	6	21.3	6
380340	9/4/2002	7	20.2	2.77
380340	9/4/2002	8	19.1	0.58

380340	9/4/2002	9	18.3	0.19
380340	9/4/2002	10	16.8	0.16
380340	9/4/2002	11	15.5	0.15
380340	9/4/2002	12	14.3	0.15
380340	9/4/2002	13	12.8	0.16
380340	9/4/2002	14	12.4	0.1
380340	2/19/2003	1	2.8	9.3
380340	2/19/2003	2	3.2	8.95
380340	2/19/2003	5	3	10.53
380340	2/19/2003	6	3.2	9.4
380340	2/19/2003	7	3.5	6.21
380340	2/19/2003	8	3.5	4.53
380340	2/19/2003	9	3.7	3.3
380340	2/19/2003	10	4.1	0.4
380340	5/7/2003	1	12.6	15.53
380340	5/7/2003	2	12	15.05
380340	5/7/2003	3	11.9	14.63
380340	5/7/2003	4	11.9	14.4
380340	5/7/2003	5	11.9	14.08
380340	5/7/2003	6	11.9	13.73
380340	5/7/2003	7	11.8	13.21
380340	5/7/2003	8	11.8	12.57
380340	5/7/2003	9	11.5	10.46
380340	5/7/2003	10	11.4	9.6
380340	5/7/2003	11	10.6	5.92
380340	5/7/2003	12	9.4	2.76
380340	5/7/2003	13	8.9	0.42
380340	7/25/2003	1	24.2	13.67
380340	7/25/2003	2	24.1	13.75
380340	7/25/2003	3	24	11.33
380340	7/25/2003	4	23.2	3.54
380340	7/25/2003	5	22	0.59
380340	7/25/2003	6	21.3	0.27
380340	7/25/2003	7	20.4	0.3
380340	7/25/2003	8	19.4	0.19
380340	7/25/2003	9	17.9	0.19
380340	7/25/2003	10	17.1	0.19
380340	7/25/2003	11	16.1	0.17
380340	7/25/2003	12	14.9	0.18
380340	7/25/2003	13	13.5	0.19
380340	7/25/2003	14	13	0.18
380340	7/25/2003	15	12.3	0.17
380340	9/8/2003	1	21.3	13.62
380340	9/8/2003	2	21.3	12.89

380340	9/8/2003	3	21.3	11.7
380340	9/8/2003	4	21	9.45
380340	9/8/2003	5	20.7	7.9
380340	9/8/2003	6	20.3	6.3
380340	9/8/2003	7	20.1	5.59
380340	9/8/2003	8	20	4.8
380340	9/8/2003	9	19.6	2.99
380340	9/8/2003	10	18.7	0.52
380340	9/8/2003	11	16.8	0.39
380340	9/8/2003	12	14.4	0.35
380340	9/8/2003	13	13.6	0.29
380340	10/22/2003	1	12.5	8.23
380340	10/22/2003	2	12.5	8.08
380340	10/22/2003	3	12.4	7.98
380340	10/22/2003	4	12.4	7.77
380340	10/22/2003	5	12.4	7.89
380340	10/22/2003	6	12.4	7.69
380340	10/22/2003	7	12.3	7.81
380340	10/22/2003	8	12.3	7.63
380340	10/22/2003	9	12.3	7.54
380340	10/22/2003	10	12.3	7.78
380340	10/22/2003	11	12	0.4
380340	10/22/2003	12	12	0.2
380342	6/6/2002		No Data Available	
380342	6/28/2002	1	26.4	8.57
380342	6/28/2002	2	25.2	8.78
380342	6/28/2002	3	24.6	8.69
380342	6/28/2002	4	22.7	2.42
380342	6/28/2002	5	22.8	1.25
380342	9/4/2002	1	21.8	7.77
380342	9/4/2002	2	21.8	8.2
380342	9/4/2002	3	21.8	8.08
380342	9/4/2002	4	21.6	7.38
380342	9/4/2002	5	21.5	6.85
380342	2/19/2003		No Data Available	
380342	5/7/2003	1	12.9	15.52
380342	5/7/2003	2	12	15.26
380342	5/7/2003	3	11.9	15.07
380342	5/7/2003	4	11.8	14.86
380342	5/7/2003	5	11.4	3.5
380342	7/25/2003	1	24.5	12.94
380342	7/25/2003	2	24.5	12.93

380342	7/25/2003	3	24.3	10.61
380342	7/25/2003	4	23.6	5.68
380342	7/25/2003	5	22.6	0.49
380342	7/25/2003	6	21.5	0.13
380342	9/8/2003	1	21.2	12.95
380342	9/8/2003	2	21.2	12.59
380342	9/8/2003	3	21.2	12.06
380342	9/8/2003	4	21.2	12.32
380342	9/8/2003	5	20.4	5.35
380342	9/8/2003	6	19.8	0.17
380342	10/22/2003	1	12.8	7.94
380342	10/22/2003	2	12.6	7.82
380342	10/22/2003	3	12.6	7.78
380342	10/22/2003	4	12.6	7.47
380342	10/22/2003	5	12.6	5.81

Appendix D
Formal Comments

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

MAR - 9 2006

Mr. Jim Collins Jr.
Section 303(d) TMDL Coordinator
Water Quality Division
North Dakota Department of Health
918 East Divide Avenue
Bismarck, ND 58501-1947

Dear Mr. Collins:

The U.S. Fish and Wildlife Service has reviewed the draft Dead Colt Creek Dam Nutrient, Sediment and Dissolved Oxygen Total Maximum Daily Loads (TMDL), and offers the following comments.

The North Dakota Department of Health (Department) has identified Dead Colt Creek Dam as being water quality limited. Dead Colt Creek Dam is a 124 surface acre reservoir located in south-central Ransom County, North Dakota. The Reservoir's watershed is 41,400 acres in size, and land-use is dominated by agriculture (81.6% of the watershed is cropland). Dead Colt Creek is a tributary to the Sheyenne River. The Reservoir's fishery is comprised of bluegill, largemouth bass, smallmouth bass, walleye, and white crappie.

Dead Colt Creek Dam is on the Department's Section 303(d) List of Impaired Waters Needing TMDLs. Aquatic life in the reservoir is listed as impaired due to nutrients, sedimentation, and low dissolved oxygen. Recreational use is impaired due to nutrients. The draft TMDL indicates there are no waste allocations from point sources in the watershed. The pollutant load to Dead Colt Creek Dam is attributed to nonpoint sources.

The draft TMDL document identifies the pollutant reductions and actions that should be taken to achieve water quality standards. Section "8.0 ALLOCATION" of the draft states the TMDL would be implemented through volunteer use of best management practices on 14,480 acres of cropland and 844 acres of pastureland within the watershed. The document would benefit from a discussion of the voluntary actions currently being implemented in the watershed. For example, the Ransom County Soil Conservation District, in cooperation with the Department, has received funding to implement a Clean Water Act, Section 319 watershed clean-up project for the expressed purpose of restoring the aquatic life and recreation uses of Dead Colt Creek Dam. The draft also identifies hypolimnetic withdrawals within the reservoir as a means to help achieve pollutant load reductions. However, there is no discussion on the dam's capability for deepwater withdrawals or how the resultant loading would affect the downstream reach of Dead Colt Creek.

Section "10.0 ENDANGERED SPECIES ACT COMPLIANCE" of the draft lists the threatened bald eagle and western prairie fringed orchid, and candidate Dakota skipper as federally listed species specific to Dead Colt Creek Dam and Ransom County. The orchid and skipper should be removed from your list. Dead Colt Creek Dam and its watershed do not have habitat suitable for these two species. Both the orchid and skipper are found in the eastern part of Ransom County, almost exclusively on the Sheyenne National Grasslands.

Lastly, we suggest incorporating a Monitoring Strategy into the draft. The TMDL provides a quantifiable goal: 70% reduction in phosphorus loading to the reservoir, yet no strategy to measure success. Monitoring success and implementation of the TMDL would provide a basis to ultimately remove the water body from the 303(d) list. We suggest the monitoring strategy include a time frame for implementation and target dates for achieving the set goals. Additionally, the strategy could discuss what steps or actions will be taken if monitoring reveals the goals and TMDLs are not being met.

Thank you for the opportunity to review the draft TMDL for Dead Colt Creek Dam. If you have any questions, please do not hesitate to contact Kevin Johnson, of my staff, or contact me directly at 701-250-4481 or at the letterhead address.

Sincerely,

Jeffrey K. Towner

Jeffrey K. Towner
Field Supervisor
North Dakota Field Office

Appendix E
Informal Comments

NORTH DAKOTA
DEPARTMENT *of* HEALTH

ENVIRONMENTAL HEALTH SECTION
Gold Seal Center, 918 E. Divide Ave.
Bismarck, ND 58501-1947
701.328.5200 (fax)
www.ndhealth.gov

February 9, 2006

Scott Elstad
North Dakota Game & Fish Department
100 N. Bismarck Expy
Bismarck, ND 58501-55095

Jim, thanks for the opportunity! Scott only minor comment

Dear Scott,

Attached is a draft copy of Dead Colt Creek Dam Nutrient, Sediment and Dissolved Oxygen Total Maximum Daily Loads (TMDLs) for your review and comment. Section 303(d) of the Clean Water Act (CWA) and its accompanying regulations (CFR Part 130 Section 7) requires each state to identify waterbodies (i.e., lakes, reservoirs, rivers, streams and wetlands) that are considered water quality limited and require load allocations, waste load allocations, or total maximum daily loads. A waterbody is considered water quality limited when it is known that its water quality does not meet applicable water quality standards or is not expected to meet applicable water quality standards. Section 303(d) of the CWA requires states to write TMDLs on waterbodies that are water quality limited and listed on the states 303(d) list. This list has become known as the "TMDL list."

Following an opportunity for public comment, the state must submit TMDLs to the U.S. Environmental Protection Agency (EPA). The EPA then has 30 days to either approve or disapprove the TMDL. The purpose of this notice is to solicit public comment prior to formally submitting the TMDL to the EPA Regional Administrator.

If you elect to comment on the Dead Colt Creek Dam Nutrient, Sediment and Dissolved Oxygen TMDLs, you may do so in writing within 30 days of the date this letter. All comments should include the name, address, and telephone number of the person submitting comments and a statement of the relevant facts upon which they are based. All comments should be submitted to the attention of the Section 303(d) TMDL Coordinator, North Dakota Department of Health, Division of Water Quality, Gold Seal Center, 918 East Divide Avenue, 4th Floor, Bismarck, ND 58501-1947. Should you have questions regarding this TMDL, you may contact me by phone at 701-328-5210 or via email at jcollins@state.nd.us or Mike Hargiss in our Fargo field office at 701-476-4123 or via email at mhargiss@state.nd.us.

Sincerely,

Jim Collins Jr.
Environmental Scientist
Division of Water Quality

JC:dlp
Attachment

Appendix F
Department Response to Comments

During the 30 day public notice soliciting comment and participation for the Dead Colt Creek Dam Nutrient, Sediment, and Dissolved Oxygen TMDL held from February 14 to March 14, 2006. The North Dakota Department of Health received a formal letter from Mr. Jeffrey K.Towner Field Supervisor of the United States Fish and Wildlife Service dated March 9, 2006. Below are the comments made, the section(s) they address and the departments' response. Informal comments were also received during the 30 day public notice period from Mr. Scott Elstad of the North Dakota Game and Fish Department. The NDGF comments pertained to updated lake volumes for Dead Colt Creek Dam. The NDDOH responded to these comments by adjusting tables and language discussing the volume of the lake in the Dead Colt Creek Dam TMDL.

United States Fish and Wildlife Service Comments

Section 8.0 Allocation

Comment from USFWS: "The document would benefit from a discussion of the voluntary actions currently being implemented in the watershed. For example, the Ransom County Soil Conservation District, in cooperation with the Department, has received funding to implement a Clean Water Act, Section 319 watershed clean-up project for the expressed purpose of restoring the aquatic life and recreation uses of Dead Colt Creek Dam. The draft also identifies hypolimnetic withdrawals within the reservoir as a means to help achieve pollutant load reductions. However, there is no discussion on the dam's capability for deepwater withdrawals or how the resultant loading would affect the downstream reach of Dead Colt Creek."

NDDoH Response: Comments concerning the Ransom County SCDs Section 319 project are addressed in Section 11.0 BMP Implementation Strategy of the TMDL. Dead Colt Creek Dam is capable of hypolimnetic withdrawal and the Department has concerns regarding dissolved oxygen and ammonia coming from low level withdrawals. Future withdrawals will involve water quality monitoring in Dead Colt Creek and Sheyenne River.

Section 10.0 Endangered Species Act Compliance

Comment: "Section 10.0 Endangered Species Act Compliance of the draft lists the threatened bald eagle and western prairie fringed orchid, and candidate Dakota skipper as federally listed species specific to Dead Colt Creek Dam and Ransom County. The orchid and skipper should be removed from your list. Dead Colt Creek Dam and its watershed do not have habitat suitable for these two species. Both the orchid and skipper are found in the eastern part of Ransom County, almost exclusively on the Sheyenne National Grasslands."

NDDoH Response: The western prairie fringed orchid and Dakota skipper were removed from the TMDL per request of the USFWS. Also the Endangered Species Act Compliance section was moved to Section 12.0 of the TMDL.

Monitoring Strategy

Comment from USFWS: "We suggest incorporating a Monitoring Strategy into the draft. We suggest the monitoring strategy include a time frame for implementation and target dates for achieving the set goals. Additionally, the strategy could discuss what steps or actions will be taken if monitoring reveals the goals and TMDLs are not being met."

NDDoH Response: A Monitoring and BMP Implementation Strategy were added to the TMDL per request of the USFWS and can be found in sections 10.0 and 11.0 of the Dead Colt Creek Dam TMDL.