DESIGN REPORT

FOR

EAGLE LAKE - McLEOD COUNTY

DU-MN-451-1

DUCKS UNLIMITED

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

James A. Streifel ________________ 11/4/13 ________

James A. Streifel, P.E. Date

For Ducks Unlimited, Inc.

License No. 47359

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<u>APPENDICES</u>

I. INTRODUCTION

The Minnesota Department of Natural Resources along with Buffalo Creek Watershed District, have requested that Ducks Unlimited evaluate the options available for managing water levels on Eagle Lake in an effort to improve wildlife habitat and water quality conditions. Temporary water level draw downs are utilized as a management tool to help eradicate rough fish by winterkill and thus improving conditions for beneficial vegetation establishment. Once rough fish have been removed and vegetation established, water quality and wildlife habitat conditions generally will improve.

The existing control structure at the lake outlet is a sheet pile weir structure that is in poor shape. The pile cap has rusted off and each of the earthen abutments have subsided. In addition to the condition of the structure, it does not have variable water level management capability and a control section placed on the upstream end of the County Highway 7 culvert downstream limits the elevation to which the lake could be drawn down. The control section is a concrete box riser with a trapezoidal notch weir designed to manage lake discharge rates.

The goal of this project is to improve water quality in Eagle Lake by providing the ability to manage water levels and rough fish populations. This design report will analyze the existing hydraulic conditions and compare them with the proposed design. The proposed design will attempt to closely match existing conditions in relation to lake water levels and discharge rates.

II. EAGLE LAKE DATA

Eagle Lake is located in Section 4, T115N; R30W of McLeod County. The north end of the lake is located within Ras-Lyn WMA while the south portion of the lake is private ownership. The lake data is as follows:

- Ordinary High Water Elevation (OHW) = 1052.6
- Existing Weir Elevation = 1052.7 (Average over uneven rusted structure). DNR records indicate original weir elevation set at 1052.8.
- Weir Length Approximately 33'
- Surface Area at Full Service Level of 1052.8 = 353 acres (From LiDAR)
- Volume at Full Service Level = 914 acre-feet
- Watershed = 19.8 mi^2
- Bottom of Lake Elevation = ±1048
- Water Elevation on 7-11-2012 = 1052.6

III. PRELIMINARY RISK ASSESSMENT

Currently the existing structure on Eagle Lake is failing due to rusting of the sheet pile members and ice action which has caused some deflection of the weir itself. The height of the existing dam is approximately 2 feet and the proposed height for the dam replacement would be 4.8 feet.

Outflow from the lake travels down an open channel for approximately 800 feet before crossing County Highway 7 through a 60" RCP. After crossing Highway 7, the water course then becomes County Ditch No. 33 which discharges into Buffalo Creek approximately 3 miles downstream. There is one residence adjacent to the channel reach between the lake and Highway 7.

Based upon Minnesota Dam Safety guidelines, the proposed height of the dam would not rise to the definition of a dam and considered "exempt". It is recommended that the hazard classification be considered Type III. Where *"property losses restricted mainly to rural buildings and local county and township roads, which are an essential part of the transportation system serving the area involved."*

IV. SURVEY STATEMENT

Ducks Unlimited performed a topographic survey at Eagle Lake in July of 2012. The control for the survey was calibrated to a DNR benchmark with a listed elevation of 1056.37 feet on the NGVD 29 datum. The benchmark was set on April 24, 2006 at the public access on NW side of Eagle Lake. It is described as a horizontal 3/8" x 8" spike in notched side of a 1.9' cottonwood, 63' from WE, 34' E of CL of access road. All elevations referenced in this report and on the construction plans will be on the NGVD 29 datum.

V. HYDROLOGIC ANALYSIS AND RESULTS

Inflows into Eagle Lake are from a 19.8 square mile watershed. The watershed was delineated using the USGS website (http://water.usga.gov/osw/streamstats/minnesota.html) that features the online application *Minnesota StreamStats*. The application can also be used to calculate estimated peak flowrates for the delineated watershed. Minnesota SteamStats incorporates regression equations for estimating peak flows on ungaged streams as developed in USGS "*Water Resources Investigations Report 97-4249*, **Techniques for Estimating Peak Flow on Small Stream in Minnesota**" by David L. Lorenz, George H. Carlson and Chris A. Sanocki.

In addition to the regression equation results determined from StreamStats, the NRCS TR-20 method was also used to determine estimated peak flowrates. The NRCS method generally produces a more conservative estimate of runoff volume and will therefore be used to model the existing and design conditions.

The watershed characteristics and peak streamflow statistics predicated by the regression equations in the StreamStats application are summarized in Table 1.

Drainage Area (square miles) = 19.8 *Stream Slope (feet/mile) = 3.03* *Percent Lakes and Ponds (percent) = 4.68* *Generalized Runoff (inches) = 4.58* **Peak Flow Estimate for Eagle Lake Watershed**	
Event	**Flow (cfs)**
1 Year	50.1
2 Year	70.3
5 Year	136
10 Year	193
25 Year	279
50 Year	354
100 Year	440

Table 1. Peak Flow Estimate Using Regression Equations

V.1 Existing Conditions

As mentioned previously, because the NRCS method produces a more conservative estimate of runoff volume, it was used to model and route the existing conditions. To model the existing conditions, *HydroCAD 10.0* Stormwater Modeling Software was used. HydroCAD incorporates the NRCS TR-20 runoff method to produce runoff hydrographs for various design storms. The hydrographs were routed through the lake and existing water control structures. This yielded outflow hydrographs that determined peak discharges at maximum lake elevations corresponding to the various runoff events.

The existing structure at the Eagle Lake outlet is in very poor condition with most of the pile cap missing. The weir length was measured as 33 feet with an average elevation across its length of 1052.7. The structure was treated as a sharp crested weir.

To account for the effects of tailwater on the structure hydraulics, the County Highway 7 structure downstream was also modeled. The structure consists of a 6' x 8' concrete box riser end section with a trapezoidal notch weir installed on the end of a 60" diameter RCP. The invert of the notch is 1049.8 and the top of the box riser (weir elevation) is 1052.8. A sloped concrete section with trash guard sits atop the concrete box riser. This structure was modeled as a custom weir/orifice.

The hydrologic data and assumptions used for the TR-20 stormwater model are shown in Table 2 below.

Runoff Area = 19.8 mi^2 (12,672 acres)
T_c = 1,062 minutes
CN = 65
Anticedent Moisture Content (AMC) = 2
24 Hr. Type II Rainfall Distribution

24 Hr. Rainfall Depths (McLeod County, MN) from "Rainfall Frequency Atlas of the United States" by the U.S. Weather Bureau

1 - Year = 2.31"	10 - Year = 4.17"	100 - Year = 5.93"
2 - Year = 2.72"	25 - Year = 4.75"	
5 - Year = 3.56"	50 - Year = 5.33"	

Table 2. TR-20 Stormwater Model Design Parameters

The results of the HydroCAD stormwater model for the existing conditions are shown in the tables 3 and 4 below.

Existing Eagle Lake sheet pile weir outlet structure					
Event	Inflow (cfs)	Outflow (cfs)	HW Elev. (feet)	TW Elev. (feet)	Storage (Acre-Feet)
1-Year	158	29	1053.17	1053.04	1,070
2-Year	267	39	1053.44	1053.38	1,204
5-Year	550	62	1053.99	1053.95	1,565
10-Year	797	82	1054.38	1054.34	1,880
25-Year	1,056	103	1054.73	1054.69	2,211
50-Year	1,335	125	1055.07	1055.03	2,568
100-Year	1,369	148	1055.40	1055.36	2,958
Starting elevation at Eagle Lake assumed to be 1052.7 at the start of each event					

Table 3. Existing Eagle Lake Structure Hydraulics

Existing CSAH 7 Structure				
Event	Inflow (cfs)	Outflow (cfs)	HW Elevation (feet)	TW Elevation (feet)
1-Year	29	29	1053.04	Below HW
2-Year	39	39	1053.38	Below HW
5-Year	62	62	1053.95	Below HW
10-Year	82	82	1054.34	Below HW
25-Year	103	103	1054.69	Below HW
50-Year	125	125	1055.03	Below HW
100-Year	148	148	1055.36	Below HW
Starting elevation at Eagle Lake assumed to be 1052.7 at the start of each event				

Table 4. Existing County Highway 7 Structure Hydraulics

Based upon the stormwater model and existing structure hydraulics, the downstream structure begins to control outflow from Eagle Lake at approximately a 5 year runoff event. Tailwater produced by the control section at the lake outlet limits the amount of discharge from the lake. Therefore, lake elevations during runoff events exceeding this frequency, are controlled by the downstream structure.

VI. PROPOSED DESIGN

The design objectives for the Eagle Lake project are:

1. Evaluate options available for providing the ability to manage water levels on the lake sufficient to induce a periodic winterkill of rough fish.
2. Any changes to the existing structures shall not cause a increase in discharge rates downstream of Highway 7.
3. Evaluate the options or necessity of a fish barrier to prevent rough fish migration from downstream.

After considering various structure types and designs which will provide the variable level water management desired on Eagle Lake, a sheet pile weir structure with two stoplog bays is recommended. The sheet pile weir would replace the existing structure at its present location. The proposed sheet pile structure will have a variable crest weir consisting of removable stoplogs capable of lowering the water level in Eagle Lake by 4.5' to approximate elevation 1048.0. The full service level (FSL) will be set at 1052.8. A catwalk would be installed to provide access for operation and maintenance. Earthen abutments would be constructed to elevation 1057.0 to tie in the ends of the structure and provide the needed freeboard at maximum lake elevations.

Ducks Unlimited has installed numerous sheet pile structures of similar design which have proven to be reliable and efficient. The design allows debris to pass more freely and if silt fills in on the upstream side, an excavator can be used to remove it. The proposed sheet pile section and structural steel would be much heavier than that which was installed originally.

By removing or modifying the control section on the 60" RCP at CSAH 7, the Eagle Lake outlet structure would control water elevations and discharge. This would have the added benefit of reducing the headwater elevations at the highway and eliminating a potential maintenance problems associated with the existing trash screen. The channel between Eagle Lake and CSAH 7 would have to be lowered to match the lake drawdown elevation and the existing invert of the 60" culvert.

The results of the HydroCAD model for the proposed design are shown in the tables 5 and 6.

VI.1 Structure Hydraulic Analysis and Results

Eagle Lake Outlet Structure with Proposed Weir					
Event	Inflow (cfs)	Outflow (cfs)	HW Elevation (feet)	TW Elevation (feet)	Storage (acre-feet)
1-Year	158	12	1053.31	1048.93	1,136
2-Year	267	22	1053.57	1049.36	1,277
5-Year	550	48	1054.09	1050.24	1,641
10-Year	797	74	1054.45	1050.92	1,951
25-Year	1,056	103	1054.79	1051.65	2,272
50-Year	1,335	138	1055.11	1052.48	2,613
100-Year	1,639	176	1055.42	1053.43	2,982
Starting elevation at Eagle Lake assumed to be 1052.8 at the start of each event					

Table 5. Proposed Sheet Pile Weir Structure Hydraulics

CSAH 7 With Control Section Removed (60" RCP Culvert)				
Event	Inflow (cfs)	Outflow (cfs)	HW Elevation (feet)	TW Elevation (feet)
1-Year	12	12	1048.93	Below HW
2-Year	22	22	1049.36	Below HW
5-Year	48	48	1050.24	Below HW
10-Year	74	74	1050.92	Below HW
25-Year	103	103	1051.65	Below HW
50-Year	138	138	1052.48	Below HW
100-Year	176	176	1053.43	Below HW
Starting elevation at Eagle Lake assumed to be 1052.8 at the start of each event				

Table 6. Modified Highway 7 Structure Hydraulics

Comparing the existing and proposed conditions shows that the calculated discharge rates with the proposed sheet pile weir reduces or equals the discharge through a 25-year runoff event. There is a slight increase for a 50-year event and a larger increase during a 100-year event while maintaining approximately the same maximum headwater elevation. Reducing the weir length of the proposed sheet pile weir could reduce the 100-year outflow but the maximum lake elevation would rise correspondingly. It can also be seen that the headwater elevation at CSAH 7 is reduced significantly for all runoff events.

VI.2 Fish Barrier Analysis

Options available for a fish barrier at this site could include the installation of screens on the proposed Eagle Lake sheet pile weir or a potential velocity barrier downstream. Screens consisting of vertical bars hung from the structure or placed into the stoplog channels can be an effective barrier against adult fish but tend to collect debris. These types of barriers then require intensive maintenance to prevent the screens from becoming plugged and causing reduced structure capacity. Given the size of the watershed and potential for debris, this would not be an optimal alternative.

For a velocity barrier to be effective, a critical velocity must be maintained over a range of anticipated flowrates and tailwater conditions. This is usually found in areas where sufficient drop exits to increase the slope of a culvert over a specified distance to create those critical velocities. Given the length of the existing culvert and its current grade, it was analyzed to determine the estimated velocities. If the control section is removed or modified, the then open culvert has a slope of .74% over 135 feet. This is slightly less than what would normally be recommended to produce an effective velocity barrier. But given the length of the culvert, it was analyzed to determine if predicted velocities might still be sufficient to prevent fish from moving through it for various flowrates. Some assumptions were made on the downstream channel sections and grade for tailwater determination. FishXing software program was used to check the culvert hydraulics and under all conditions indicated the culvert should prevent fish from being able to travel through the culvert upstream.

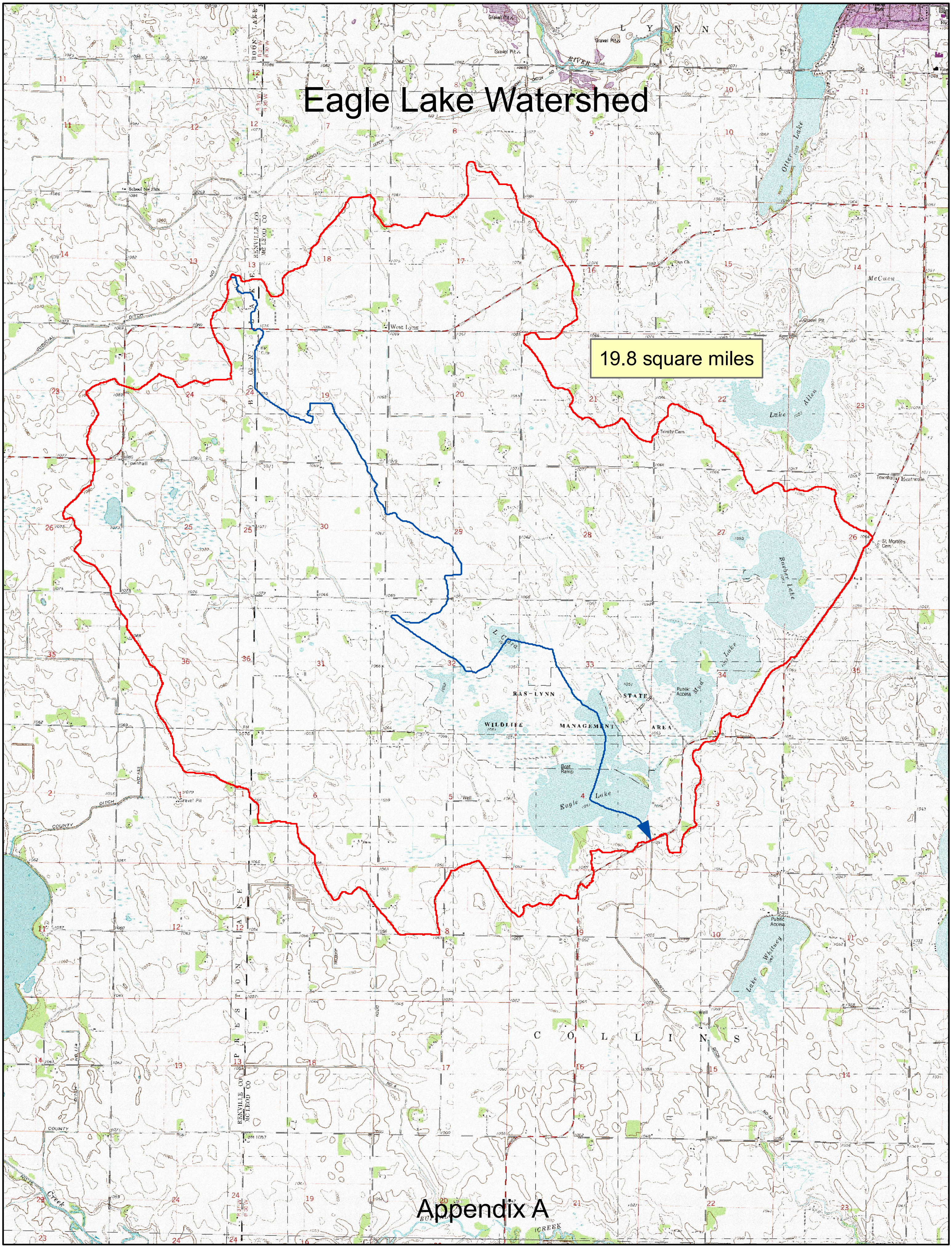
Given the results of the culvert hydraulics for the modified conditions, it is recommended it be used as a fish barrier. If in the future it proves to be ineffective at preventing fish movement, a horizontal type barrier could be considered.

VII. CONCLUSION AND RECOMMENDATIONS

In order to achieve the project goals, it is recommended that the existing Eagle Lake sheet pile weir structure be removed and a new water control structure installed that will closely match the existing discharge rates. The new structure would include the ability to drawdown and manage lake levels. To be able to achieve the desired drawdown elevation, the downstream channel has to be lowered and the highway control section modified. By installing a new water control structure and modifying the highway structure, water levels would be controlled upstream rather than at the highway for all runoff events. The proposed system should also be able to prevent rough fish from moving through the culvert during most runoff events.

Preliminary design plans are included with this report and standard construction specifications are available upon request. A full soils investigation is recommended prior to the finalization of any design plans. A soils investigation will be planned in the near future.

Eagle Lake Watershed



Appendix A

Eagle Lake Design

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS

DATE: 1-NOVEMBER-2013 TIME: 9:52:21

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*  INPUT DATA  *
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I.--HEADING

'Eagle Lake Structure Design

II.--CONTROL

CANTILEVER WALL DESIGN
FACTOR OF SAFETY FOR ACTIVE PRESSURES = 1.50
FACTOR OF SAFETY FOR PASSIVE PRESSURES = 1.50

III.--WALL DATA

ELEVATION AT TOP OF WALL = 1052.80 FT.

IV.--SURFACE POINT DATA

IV.A.--RIGHTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
0.00	1048.00

IV.B.--LEFTSIDE

DIST. FROM WALL (FT)	ELEVATION (FT)
0.00	1048.00

V.--SOIL LAYER DATA

V.A.--RIGHTSIDE

SAT. WEIGHT (PCF)	MOIST WEIGHT (PCF)	ACTIVE COEFFICIENT	PASSIVE COEFFICIENT	BOTTOM ELEVATION (FT)
110.00	120.00	0.30	3.00	

V.B.--LEFTSIDE

SAT. WEIGHT (PCF)	MOIST WEIGHT (PCF)	ACTIVE COEFFICIENT	PASSIVE COEFFICIENT	BOTTOM ELEVATION (FT)
135.00	135.00	0.30	3.00	1045.50
110.00	120.00	0.30	3.00	

VI.--WATER DATA

UNIT WEIGHT = 62.40 (PCF)
RIGHTSIDE ELEVATION = 1052.80 (FT)
LEFTSIDE ELEVATION = 1048.00 (FT)
NO SEEPAGE

VII.--VERTICAL SURCHARGE LOADS

NONE

VIII.--HORIZONTAL LOADS

NONE

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS

DATE: 1-NOVEMBER-2013 TIME: 9:52:23

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* SOIL PRESSURES FOR *
* CANTILEVER WALL DESIGN *
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I.--HEADING

'Eagle Lake Structure Design

II.--SOIL PRESSURES

RIGHTSIDE SOIL PRESSURES DETERMINED BY INPUT COEFFICIENTS AND THEORY OF ELASTICITY EQUATIONS FOR SURCHARGE LOADS.

LEFTSIDE SOIL PRESSURES DETERMINED BY INPUT COEFFICIENTS AND THEORY OF ELASTICITY EQUATIONS FOR SURCHARGE LOADS.

	NET	<---LEFTSIDE--->		<------NET------> (SOIL + WATER)		<--RIGHTSIDE--->	
ELEV. (FT)	WATER (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
1052.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1051.8	62.4	0.0	0.0	62.4	62.4	0.0	0.0
1050.8	124.8	0.0	0.0	124.8	124.8	0.0	0.0
1049.8	187.2	0.0	0.0	187.2	187.2	0.0	0.0
1048.8	249.6	0.0	0.0	249.6	249.6	0.0	0.0
1048.0	299.5	0.0	0.0	299.5	299.5	0.0	0.0
1047.8	299.5	43.6	4.4	258.8	323.7	2.9	28.6
1047.0	299.5	217.8	21.8	96.0	420.5	14.3	142.8
1046.8	299.5	261.4	26.1	55.3	444.7	17.1	171.4
1046.5	299.5	320.5	32.1	0.0	477.6	21.0	210.2
1045.8	299.5	479.2	47.9	-148.2	565.8	31.4	314.2
1045.5	299.5	544.5	54.5	-209.3	602.1	35.7	357.0
1044.8	299.5	644.5	64.4	-299.2	692.0	45.7	457.0
1043.8	299.5	787.3	78.7	-427.8	820.6	60.0	599.8
1042.8	299.5	930.1	93.0	-556.3	949.1	74.3	742.6
1041.8	299.5	1072.9	107.3	-684.8	1077.6	88.5	885.4
1040.8	299.5	1215.7	121.6	-813.3	1206.1	102.8	1028.2
1039.8	299.5	1358.5	135.8	-941.8	1334.6	117.1	1171.0
1038.8	299.5	1501.3	150.1	-1070.4	1463.2	131.4	1313.8
1037.8	299.5	1644.1	164.4	-1198.9	1591.7	145.7	1456.6
1036.8	299.5	1786.9	178.7	-1327.4	1720.2	159.9	1599.4
1035.8	299.5	1929.7	193.0	-1455.9	1848.7	174.2	1742.2
1034.8	299.5	2072.5	207.2	-1584.4	1977.2	188.5	1885.0
1033.8	299.5	2215.3	221.5	-1713.0	2105.8	202.8	2027.8
1032.8	299.5	2358.1	235.8	-1841.5	2234.3	217.1	2170.6
1031.8	299.5	2500.9	250.1	-1970.0	2362.8	231.3	2313.4
1030.8	299.5	2643.7	264.4	-2098.5	2491.3	245.6	2456.2
1029.8	299.5	2786.5	278.6	-2227.0	2619.8	259.9	2599.0
1028.8	299.5	2929.3	292.9	-2355.6	2748.4	274.2	2741.8
1027.8	299.5	3072.1	307.2	-2484.1	2876.9	288.5	2884.6
1026.8	299.5	3214.9	321.5	-2612.6	3005.4	302.7	3027.4
1025.8	299.5	3357.7	335.8	-2741.1	3133.9	317.0	3170.2
1024.8	299.5	3500.5	350.0	-2869.6	3262.4	331.3	3313.0
1023.8	299.5	3643.3	364.3	-2998.2	3391.0	345.6	3455.8
1022.8	299.5	3786.1	378.6	-3126.7	3519.5	359.9	3598.6

1021.8	299.5	3928.9	392.9	-3255.2	3648.0	374.1	3741.4
1020.8	299.5	4071.7	407.2	-3383.7	3776.5	388.4	3884.2
1019.8	299.5	4214.5	421.4	-3512.2	3905.0	402.7	4027.0
1018.8	299.5	4357.3	435.7	-3640.8	4033.6	417.0	4169.8
1017.8	299.5	4500.1	450.0	-3769.3	4162.1	431.3	4312.6

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHORED OR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS
DATE: 1-NOVEMBER-2013 TIME: 9:52:27

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*  SUMMARY OF RESULTS FOR  *
*  CANTILEVER WALL DESIGN  *
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I.--HEADING
'Eagle Lake Structure Design

II.--SUMMARY

RIGHTSIDE SOIL PRESSURES DETERMINED BY INPUT COEFFICIENTS
AND THEORY OF ELASTICITY EQUATIONS FOR SURCHARGE LOADS.

LEFTSIDE SOIL PRESSURES DETERMINED BY INPUT COEFFICIENTS
AND THEORY OF ELASTICITY EQUATIONS FOR SURCHARGE LOADS.

```
WALL BOTTOM ELEV. (FT)     :     1038.33
      PENETRATION (FT)     :        9.67

MAX. BEND. MOMENT (LB-FT)  :  4.4520E+03
      AT ELEVATION (FT)    :     1043.18

MAX. SCALED DEFL. (LB-IN^3):  4.3841E+08
      AT ELEVATION (FT)    :     1052.80
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NOTE: DIVIDE SCALED DEFLECTION MODULUS OF
ELASTICITY IN PSI TIMES PILE MOMENT
OF INERTIA IN IN^4 TO OBTAIN DEFLECTION
IN INCHES.

PROGRAM CWALSHT-DESIGN/ANALYSIS OF ANCHOREDOR CANTILEVER SHEET PILE WALLS
BY CLASSICAL METHODS
DATE: 1-NOVEMBER-2013 TIME: 9:52:27

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* COMPLETE OF RESULTS FOR  *
*  CANTILEVER WALL DESIGN  *
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I.--HEADING

'Eagle Lake Structure Design

II.--RESULTS0. (LB))

ELEVATION (FT)	BENDING MOMENT (LB-FT)	SHEAR (LB)	SCALED DEFLECTION (LB-IN^3)	NET PRESSURE (PSF)
1052.80	0.0000E+00	0.	4.3841E+08	0.00
1051.80	1.0400E+01	31.	3.8947E+08	62.40
1050.80	8.3200E+01	125.	3.4056E+08	124.80
1049.80	2.8080E+02	281.	2.9181E+08	187.20
1048.80	6.6560E+02	499.	2.4357E+08	249.60
1048.00	1.1502E+03	719.	2.0578E+08	299.52
1047.80	1.2996E+03	775.	1.9651E+08	258.82
1047.00	1.9848E+03	917.	1.6045E+08	96.00
1046.80	2.1698E+03	932.	1.5174E+08	55.30
1046.53	2.4243E+03	939.	1.4016E+08	0.00
1045.80	3.0953E+03	885.	1.1073E+08	-148.22
1045.50	3.3533E+03	832.	9.9394E+07	-209.28
1044.80	3.8768E+03	654.	7.5041E+07	-299.24
1043.80	4.3594E+03	290.	4.6010E+07	-427.76
1042.80	4.4143E+03	-202.	2.4450E+07	-556.28
1041.80	3.9129E+03	-822.	1.0439E+07	-684.80
1041.32	3.4394E+03	-1164.	6.1930E+06	-746.21
1040.80	2.7477E+03	-1451.	3.0904E+06	-350.35
1039.80	1.2483E+03	-1422.	4.3992E+05	407.75
1038.80	1.5660E+02	-635.	5.1973E+03	1165.84
1038.33	0.0000E+00	0.	0.0000E+00	1523.85

NOTE: DIVIDE SCALED DEFLECTION MODULUS OF ELASTICITY IN PSI TIMES PILE MOMENT OF INERTIA IN IN^4 TO OBTAIN DEFLECTION IN INCHES.

III.--WATER AND SOIL PRESSURES

		<-------------SOIL PRESSURES-------------->			
		<----LEFTSIDE----->		<---RIGHTSIDE---->	
ELEVATION (FT)	WATER PRESSURE (PSF)	PASSIVE (PSF)	ACTIVE (PSF)	ACTIVE (PSF)	PASSIVE (PSF)
1052.80	0.	0.	0.	0.	0.
1051.80	62.	0.	0.	0.	0.
1050.80	125.	0.	0.	0.	0.
1049.80	187.	0.	0.	0.	0.
1048.80	250.	0.	0.	0.	0.
1048.00	300.	0.	0.	0.	0.
1047.80	300.	44.	4.	3.	29.
1047.00	300.	218.	22.	14.	143.
1046.80	300.	261.	26.	17.	171.
1046.53	300.	321.	32.	21.	210.
1045.80	300.	479.	48.	31.	314.
1045.50	300.	545.	54.	36.	357.
1044.80	300.	644.	64.	46.	457.
1043.80	300.	787.	79.	60.	600.
1042.80	300.	930.	93.	74.	743.
1041.80	300.	1073.	107.	89.	885.
1041.32	300.	1141.	114.	95.	954.
1040.80	300.	1216.	122.	103.	1028.
1039.80	300.	1358.	136.	117.	1171.
1038.80	300.	1501.	150.	131.	1314.
1038.33	300.	1644.	164.	146.	1457.
1036.80	300.	1787.	179.	160.	1599.

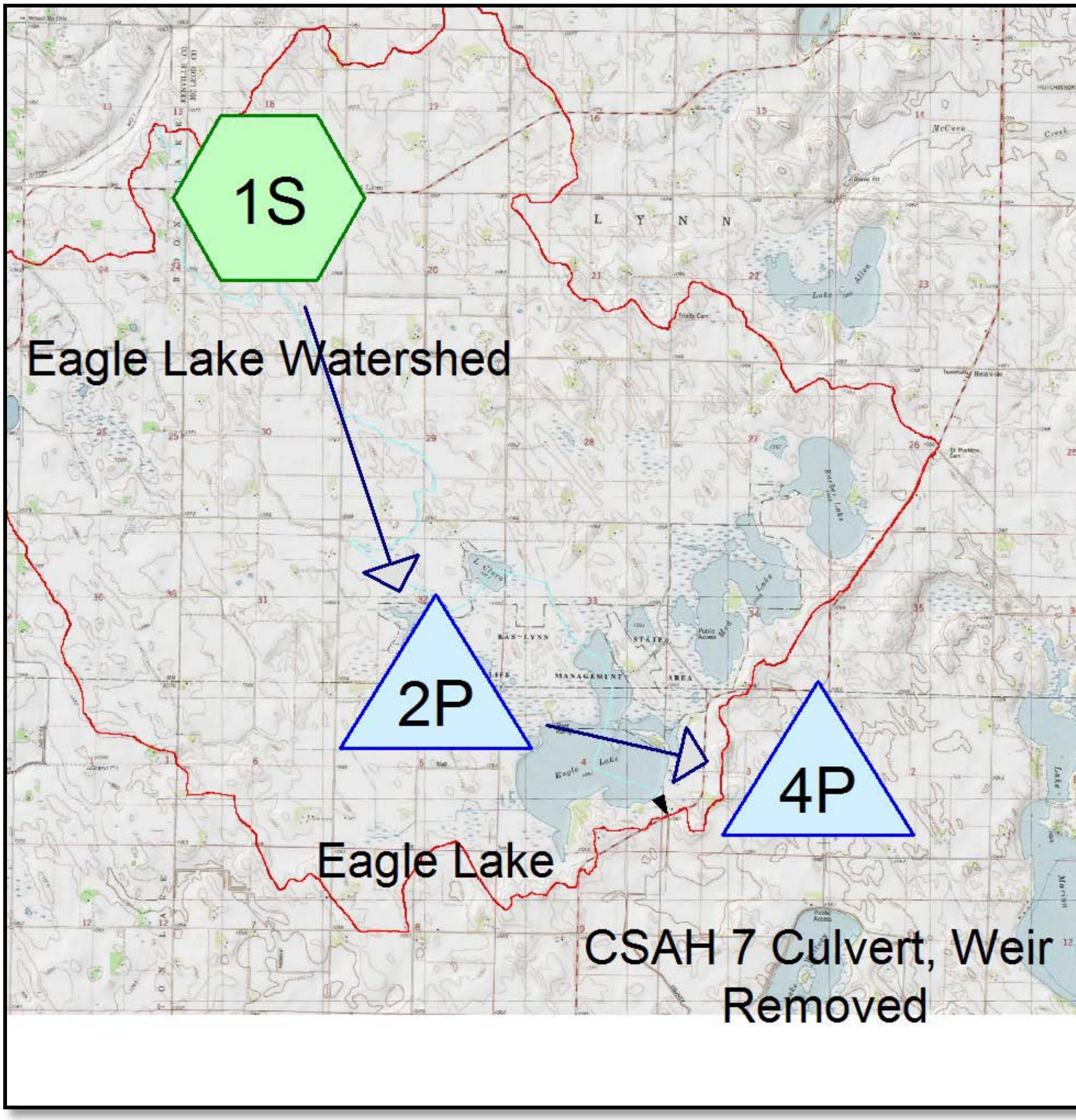

Figure 1. HydroCAD Model Routing Diagram

Eagle Lake Sheet Pile Weir Structure

Appendix D

Eagle Lake Sheet Pile Weir Abutment

Appendix D

County Highway 7 Control Structure

Appendix D