January 20, 2010

✳ Bonestroo

Mr. Kevin Kleinschmidt
Lincoln County Forestry, Land & Parks Department
801 North Sales Street, Suite 106
Merrill, Wisconsin 54452

Re: Harrison Dam Failure Analysis Addendum
        Bonestroo File No.: 004715-09001-0

Dear Mr. Kleinschmidt:

Bonestroo submitted a Dam Failure Analysis Report in December 2009 for the Harrison Dam located in the NE ¼ of the SE ¼, Section 17, Township 35 North, Range 8 East, Town of Harrison, Lincoln County, Wisconsin. Bonestroo has made a revision to the HEC-RAS model since that submittal. The breach in the Dam Failure Model was adjusted to have the failure triggered at the time of the peak flow of the 100-year storm event. This was done to provide the worst-case scenario for the dam failure.

The base flow of the dam in place model was adjusted to match the dam nonexistent model which has the base flow as the 2-year peak flow. The dam failure model has the base flow as the 100-year peak flow to provide the worst-case scenario for the model.

Base flood and flood shadow elevations on plan view figures are adjusted to Lincoln County database. Site development and management decisions would require consideration of actual site elevations referenced to this study and National Geodetic Vertical Datum of 1929.
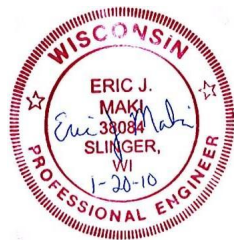
It would be our pleasure to meet with you to discuss the findings and contents of this addendum.

Sincerely,

BONESTROO

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 Wisconsin.

Eric J. Maki, PE
Registered Engineer

Date: 01/20/10   Reg. No. WI-38084-006

Hydrology

Hydrology estimates were developed for the Harrison Dam Failure Model using HEC-HMS 3.3 and the Regression Equation.

The watershed for the Dam is 3.105 square miles. The flows to the storage area and Big Pine Creek were also considered. The watershed for the storage area is 0.269 square miles and Big Pine Creek is 11.26 square miles.

Table 1. Flow in cubic feet per second (CFS) for the 100 year (1%) storm event.

Location	HEC-HMS V. 3.3 (CFS)	Regression Eq. National Stream Flow Statistics Program V. 4.0
Harrison Lake	1424.1*	305
Storage Area	57.6*	31.2
Big Pine Creek	10020.8*	1610

* Value used for modeling

Table 2. Flow in cubic feet per second (CFS) for the 2 year (50%) storm event.

Location	HEC-HMS V. 3.3 (CFS)	Regression Eq. National Stream Flow Statistics Program V. 4.0
Harrison Lake	463.8*	-----
Storage Area	18.7*	-----
Big Pine Creek	3212.7*	-----

* Value used for modeling

Analytical Procedures

Five cross-sections were included from a bathymetric map developed to represent the reservoir of Harrison Lake and for use in HEC-RAS to establish area and volume relationship in the reservoir.

The breach was modeled as embankment failure at the low spot on the east side of the Dam. The bottom width of the breach was 10 foot and the top width was 32 feet. The side slope of the breach was 1:1. The elevation at the bottom of the breach is 1561 and the elevation of the river immediately downstream is 1560.7. The time for the breach to develop is 0.25 hour. Summary elevation data from the model appear below in Table 4.

Table 3. Unsteady flow data.

Model	Base Flow	Hydrograph
Dam nonexistent	Q2	Q2 + Q100
Dam in place	Q2	Q2 + Q100
Dam failure	Q100	Q100 + Q100

Table 4. Comparison summary of modeled water levels at key cross sections.

Cross Section	100-year dam nonexistent	100-year with dam in place	100-year with dam failure
(RS 1100.55) Below Harrison Dam	1568.66	1568.77	1570.06
(RS 1017.18) Largest Increase	1517.34	1517.37	1522.30
(RS 1007) Above confluence of North Branch of Pine Creek and Big Pine Creek	1510.38	1510.42	1511.14

For undeveloped areas, the analysis needs to be carried to within 1.0' of the regional computed dam nonexistent profile. As shown in Table 4, at river-station 1007, the 100-year with dam failure flood elevation is 0.76 feet greater than the 100-year dam nonexistent flood elevation. Therefore, this analysis was carried to convergence.

Table 5. HEC-RAS 4.0 Project Model Filenames

Harrison Dam Model	Project	Plan
Dam nonexistent	09_1214MAB.prj	Plan 4
Dam in place	09_1214MAB.prj	Plan 6
Dam failure	09_1214MAB.prj	Plan 7

Figure 2 – Harrison Lake Bathymetric Map
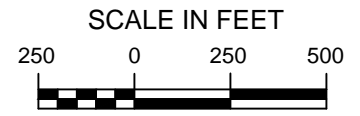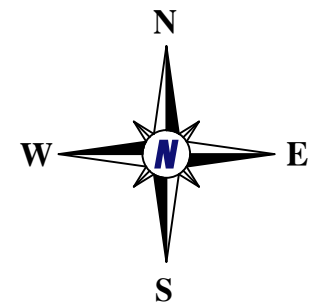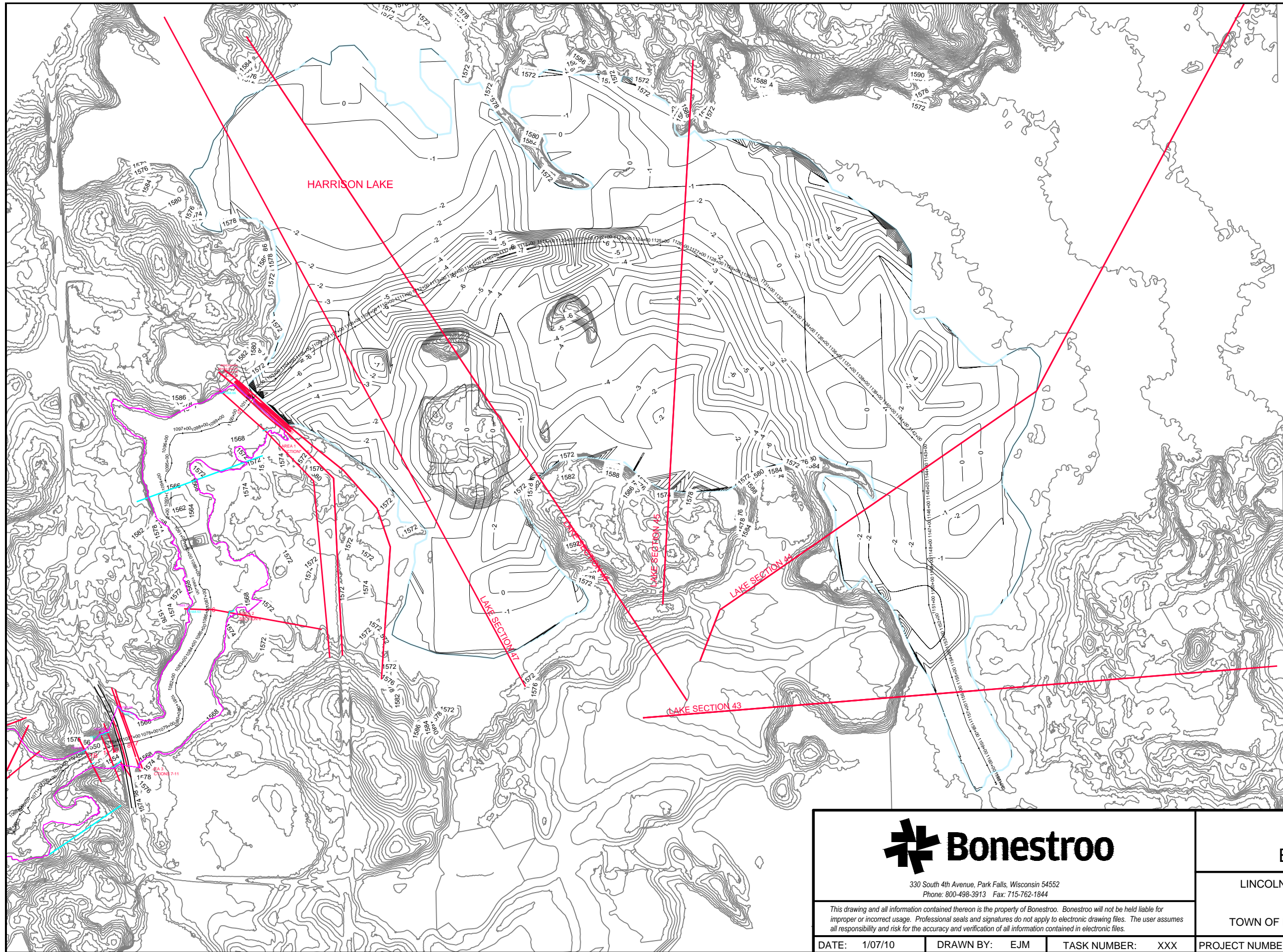
HARRISON LAKE

LAKE SECTION 47

LAKE SECTION 43

N
W · E
S

SCALE IN FEET

250   0   250   500

Bonestroo

330 South 4th Avenue, Park Falls, Wisconsin 54552
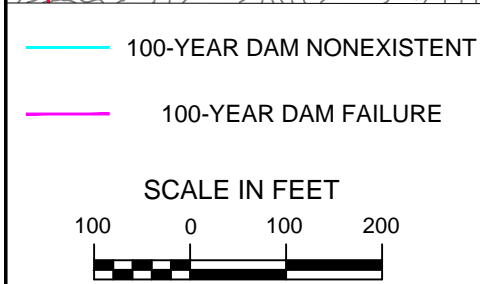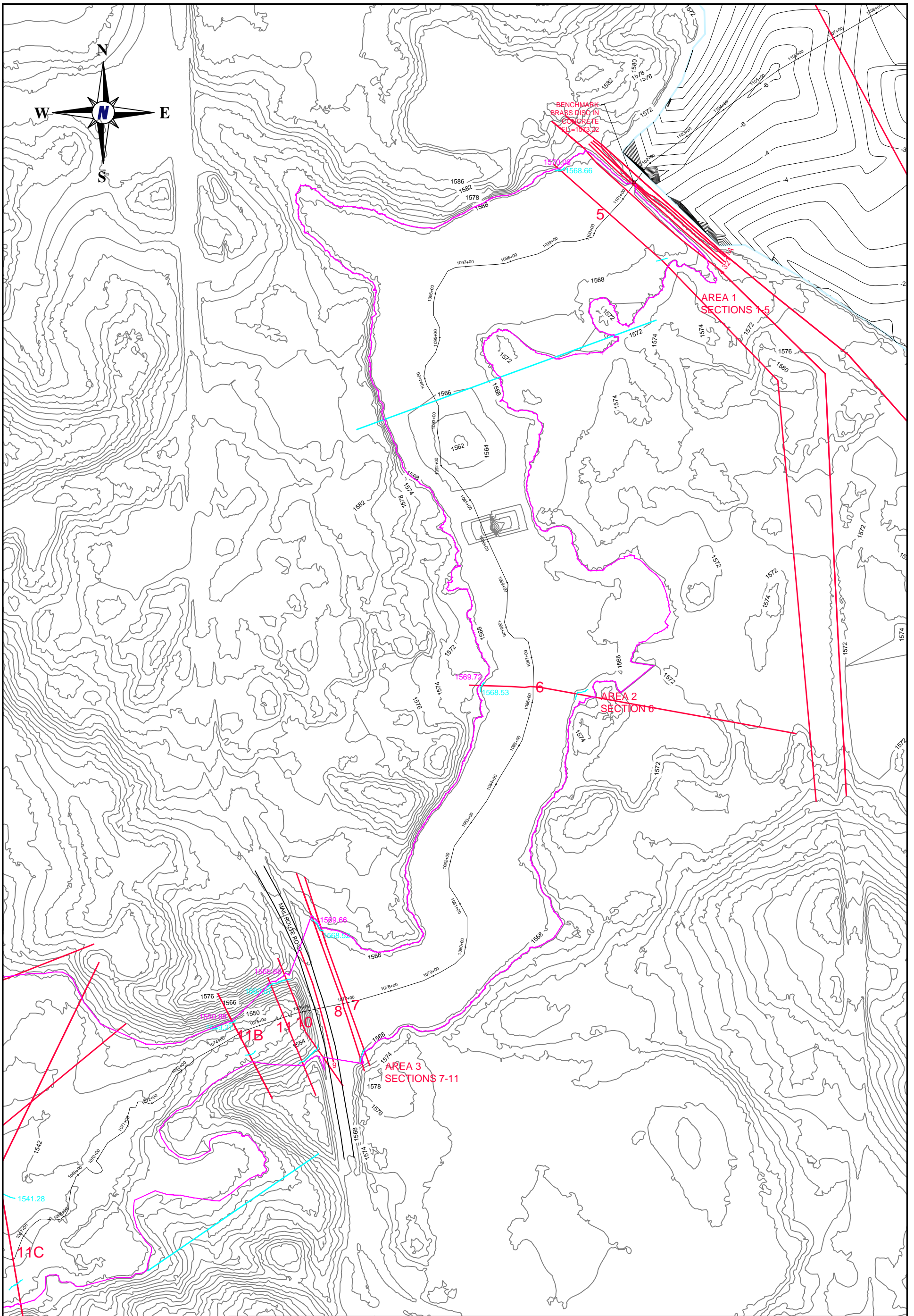Phone: 800-498-3913   Fax: 715-762-1844

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HARRISON LAKE
BATHYMETRIC MAP

LINCOLN COUNTY FORESTRY, LAND AND PARKS
DEPARTMENT
HARRISON LAKE
TOWN OF HARRISON, LINCOLN COUNTY, WISCONSIN

| DATE: | 1/07/10 | DRAWN BY: | EJM | TASK NUMBER: | XXX | PROJECT NUMBER: | 004715-09002-0 | SHEET | 2 |

Figures 3-6 – Plan Views

N
W   E
S

BENCHMARK
BRASS DISC IN
CONCRETE
EL=1573.22

5

AREA 1
SECTIONS 1-5

1569.72
1568.53

6

AREA 2
SECTION 6

MAIN ROUTE ROAD

1569.66
1568.36

1565.68

1576
1566
1550

8 7

1B 11 10

9

1576

AREA 3
SECTIONS 7-11

1578

1541.28

11C

1542

SCALE IN FEET

100   0   100   200

—— 100-YEAR DAM NONEXISTENT

—— 100-YEAR DAM FAILURE

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330 South 4th Avenue, Park Falls, Wisconsin 54552
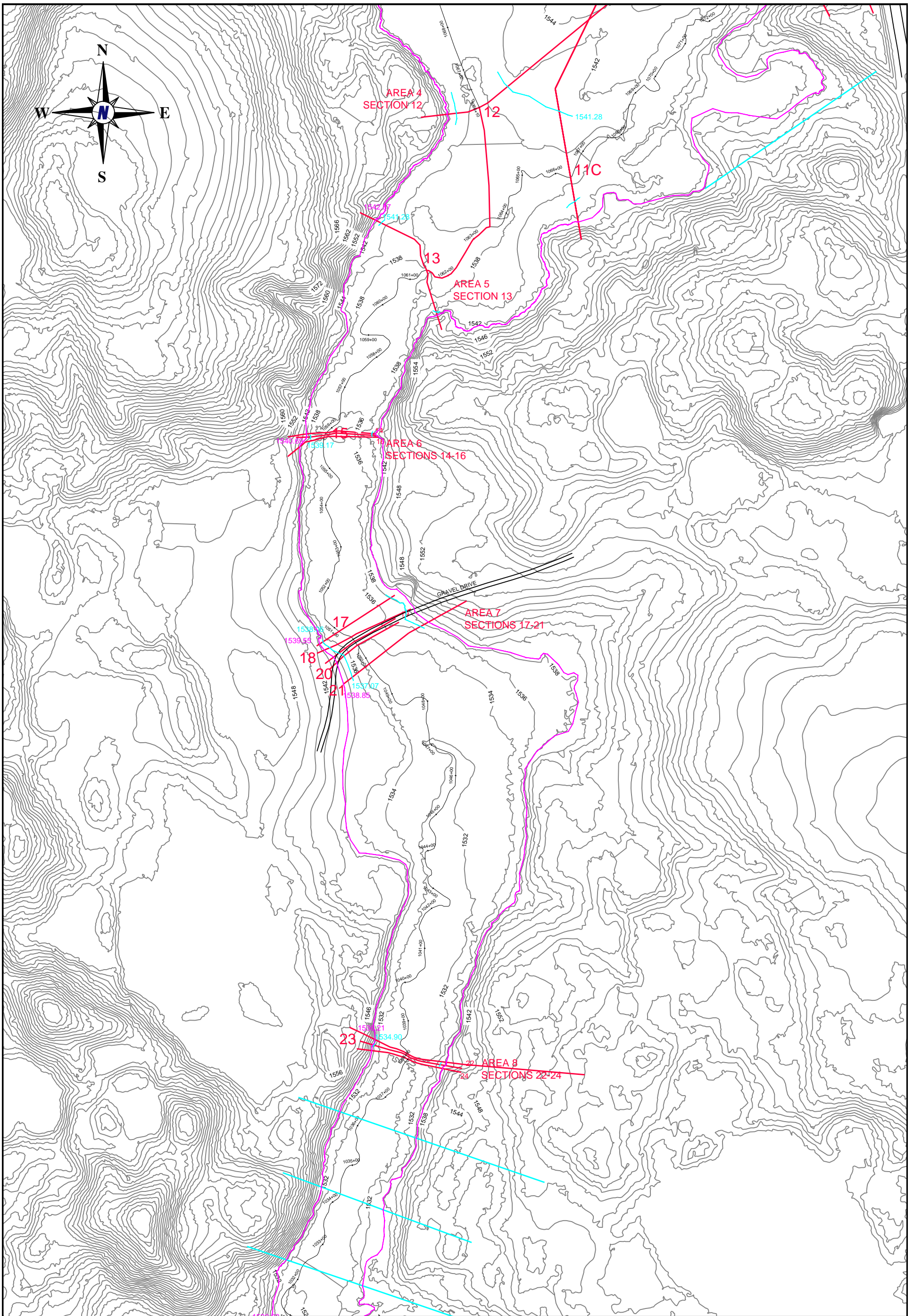Phone: 800-498-3913   Fax: 715-762-1844

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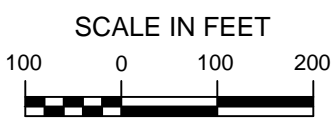| DATE:	1/07/10	DRAWN BY:	EJM	TASK NUMBER:	XXX

PLAN VIEW

LINCOLN COUNTY FORESTRY, LAND AND PARKS
DEPARTMENT
HARRISON LAKE
TOWN OF HARRISON, LINCOLN COUNTY, WISCONSIN

PROJECT NUMBER:	004715-09002-0	SHEET	3

PLAN VIEW

N
W E
S

AREA 4
SECTION 12
12
1541.28
11C

13
AREA 5
SECTION 13

AREA 6
SECTIONS 14-16

GRAVEL DRIVE
17
AREA 7
SECTIONS 17-21
18
20
21

23
AREA 8
SECTIONS 22-24

100-YEAR DAM NONEXISTENT
100-YEAR DAM FAILURE

SCALE IN FEET
100   0   100   200

Bonestroo

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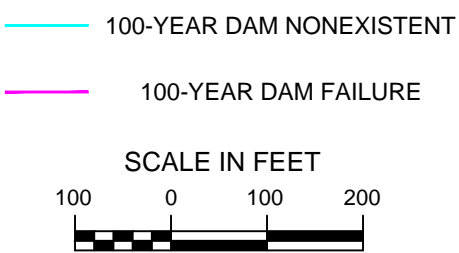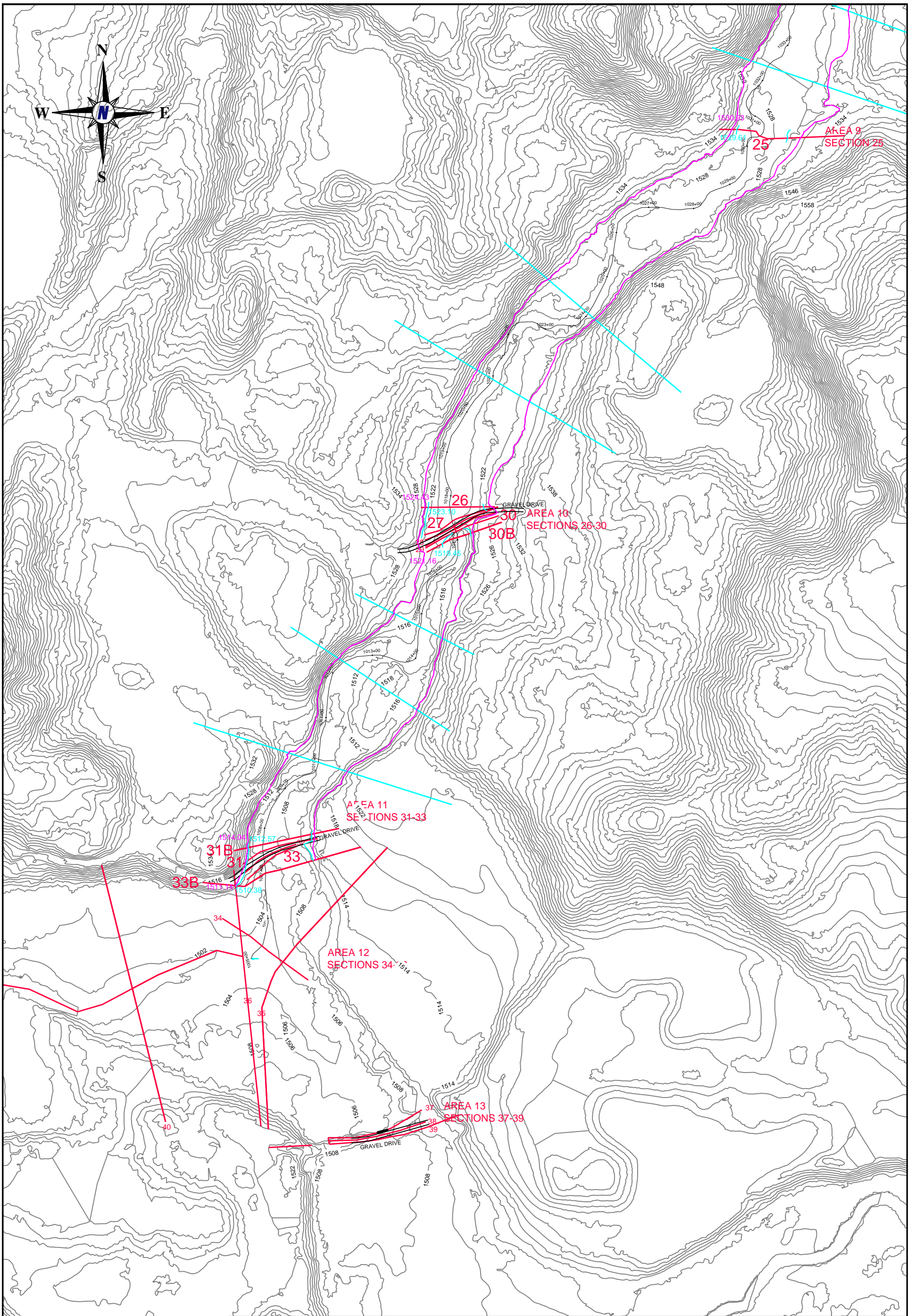Phone: 800-498-3913   Fax: 715-762-1844

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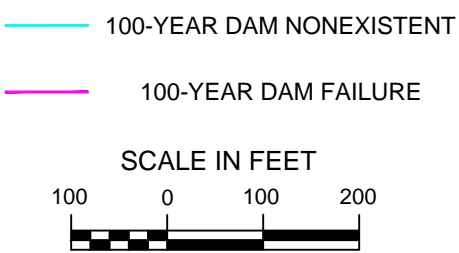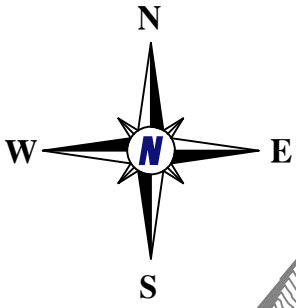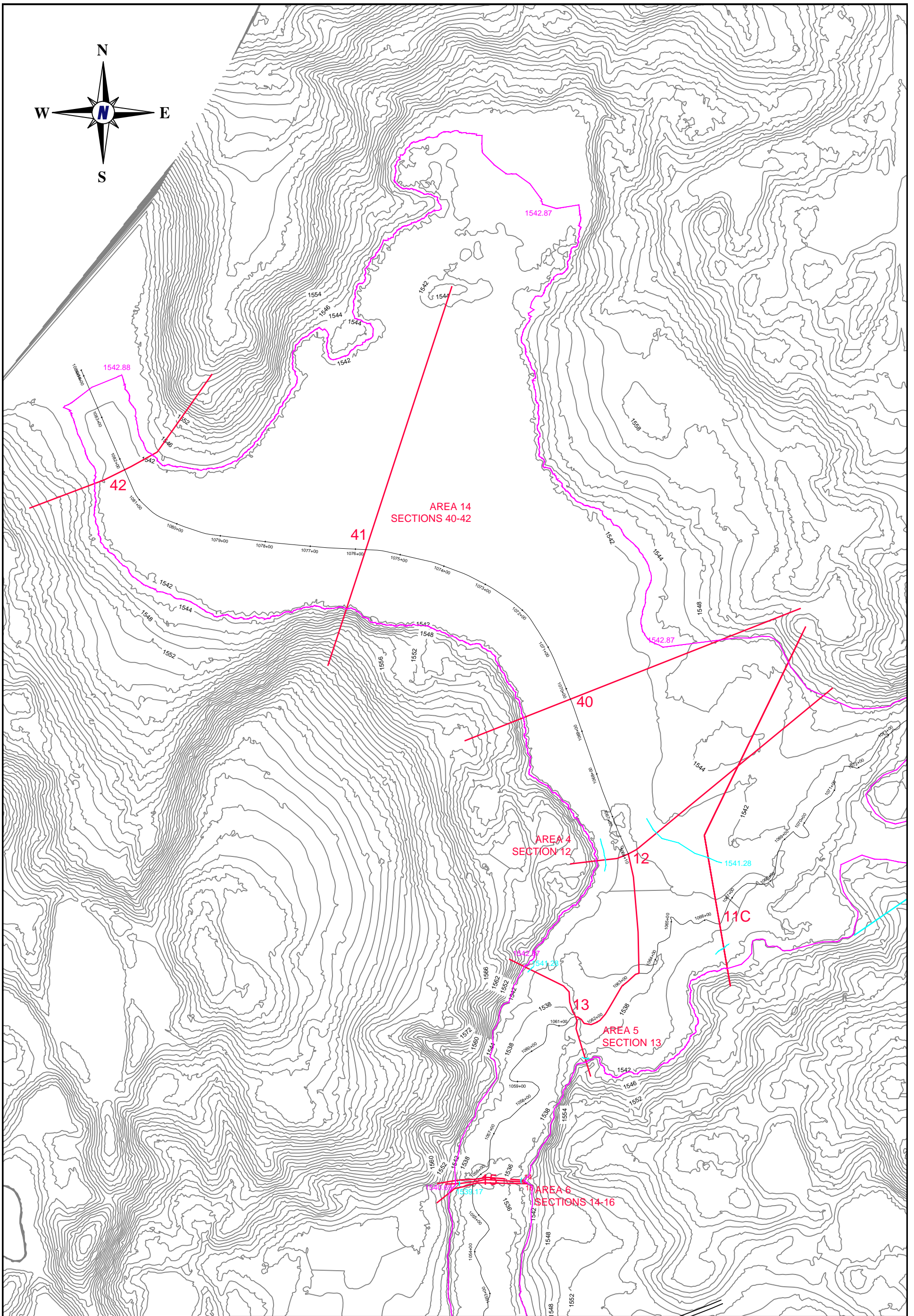| DATE: | 1/07/10 | DRAWN BY: | EJM | TASK NUMBER: | XXX | PROJECT NUMBER: | 004715-09002-0 | SHEET | 4 |

PLAN VIEW

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DEPARTMENT
HARRISON LAKE
TOWN OF HARRISON, LINCOLN COUNTY, WISCONSIN

— 100-YEAR DAM NONEXISTENT

— 100-YEAR DAM FAILURE

SCALE IN FEET
100   0   100   200

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N
W — E
S

1542.88

42

AREA 14
SECTIONS 40-42

41

1542.87

40

AREA 4
SECTION 12

12

1541.28

11C

1542.87
1541.28

13

AREA 5
SECTION 13

15

AREA 6
SECTIONS 14-16

1542.87

1539.17

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—— 100-YEAR DAM NONEXISTENT

—— 100-YEAR DAM FAILURE

SCALE IN FEET

100   0   100   200

PLAN VIEW

LINCOLN COUNTY FORESTRY, LAND AND PARKS
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HARRISON LAKE
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