



Road Safety Audit

MNTH 200

R.P. 48.5 to R.P. 74.3 - within the boundaries of the
White Earth Indian Reservation

March 2018

Prepared by:

SRF Consulting Group

White Earth Public Works Division



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Introduction

Minnesota Trunk Highway 200 (MNTH 200) is an east-west route in northern Minnesota that extends 201 miles from the North Dakota/Minnesota border east to thru the cities of Ada, Mahnomen and Walker to its eastern terminus approximately 45 miles west of Duluth, near the City of Floodwood. MNTH 200 provides access to the headwaters of the Mississippi River located with Itasca State Park. MNTH 200 also dissects the White Earth Indian Reservation located in northwest Minnesota.

Within the White Earth Reservation, MNTH 200 is the primary east-west route connecting predominately native communities with the two largest employers on the Reservation; Shooting Star Casino and Event Center and White Earth Nation tribal government. Vehicular traffic is the dominate means of travel along the MNTH 200 corridor. However, bike/pedestrian traffic is a prominent means of transportation along the corridor within the Reservation boundaries.

Background

State and Tribal transportation professionals have been actively involved to reduce death and injury that occur too frequently on the State and Tribal roadways. The Toward Zero Deaths initiative was established in Minnesota in 2003 and is the states cornerstone traffic safety program. The initiative includes employing an interdisciplinary approach to reducing traffic crashes, injuries, and deaths on Minnesota roads. The TZD program uses available data to identify areas for improvement and utilize proven countermeasures.

The West Central Minnesota TZD was developed in 2012. Counties that make up West Central TZD include; Becker, Clay, Douglas, Grant, Mahnomen, Otter Tail, Pope, Stevens, Traverse and Wilkin. Towards Zero Deaths (TZD)

The top four contributing factors in Minnesota road fatalities for 2015 were:

- Speed – 78
- Distractions - 74
- Impaired Driving - 95
- Failing to buckle up – 91

Source: Minnesota Department of Public Safety

MnDOT District 4 completed a road resurface of 20 miles and grade raises in four locations to reduce flood risk along MNTH 200 in the fall of 2016. The road resurface project stretched from the City of Mahnomen to the Mahnomen/Clearwater County line. The results of the project include:

- Smoother road surface
- Reduced flood risk



- Improved safety and mobility for motorists
- Ensures transportation system will continue to serve the state for many years

Although the MnDOT 2016 road resurface and grade raise project helped ensure the MNTH 200 transportation system will continue to serve the state in the future, the project did not address the lack of shoulder width along the corridor and steep ditch in-slopes.

Figure 1: Minnesota Traffic Fatalities, 1910 -2015

MINNESOTA TRAFFIC FATALITIES, 1910 - 2015
Since 1961: Vehicle Miles Traveled (Billions) and Fatality Rates (Per 100 Million VMT)

YEAR (1)	Fatal- ities (2)	YEAR (3)	Fatal- ities (4)	YEAR (5)	Fatal- ities (6)	YEAR (7)	Fatal- ities (8)	Vehicle Miles (9)	Fatal Rate (10)	YEAR (11)	Fatal- ities (12)	Vehicle Miles (13)	Fatal Rate (14)	YEAR (15)	Fatal- ities (16)	Vehicle Miles (17)	Fatal Rate (18)
1910	23	1929	505	1948	552	1961	724	14.5	4.99	1980	863	28.5	3.03	1999	626	50.7	1.24
1911	26	1930	561	1949	540	1962	692	15.1	4.58	1981	763	28.6	2.67	2000	625	52.4	1.19
1912	39	1931	622	1950	532	1963	798	15.3	5.22	1982	581	29.2	1.98	2001	568	53.2	1.07
1913	46	1932	486	1951	610	1964	841	16.2	5.19	1983	558	30.5	1.83	2002	657	54.4	1.21
1914	88	1933	525	1952	534	1965	875	16.8	5.21	1984	584	32.2	1.81	2003	655	55.4	1.18
1915	85	1934	641	1953	637	1966	977	17.7	5.52	1985	610	33.1	1.84	2004	567	56.5	1.00
1916	143	1935	596	1954	639	1967	965	18.7	5.16	1986	572	34.2	1.67	2005	559	56.5	0.99
1917	161	1936	649	1955	577	1968	1,060	19.9	5.33	1987	530	35.1	1.51	2006	494	56.6	0.87
1918	183	1937	630	1956	637	1969	988	20.8	4.75	1988	615	36.4	1.69	2007	510	57.4	0.89
1919	171	1938	609	1957	684	1970	987	22.4	4.41	1989	605	37.6	1.61	2008	455	57.3	0.79
1920	178	1939	576	1958	708	1971	1,024	23.4	4.38	1990	568	38.8	1.47	2009	421	56.9	0.74
1921	216	1940	577	1959	662	1972	1,031	24.9	4.14	1991	531	39.3	1.35	2010	411	56.8	0.72
1922	260	1941	626	1960	724	1973	1,024	25.2	4.06	1992	581	41.3	1.41	2011	368	56.7	0.65
1923	328	1942	439			1974	852	24.6	3.46	1993	538	42.3	1.27	2012	395	57.0	0.69
1924	366	1943	274			1975	777	25.6	3.04	1994	644	43.4	1.48	2013	387	57.0	0.68
1925	361	1944	356			1976	809	27.0	3.00	1995	597	44.1	1.35	2014	361	57.0	0.63
1926	326	1945	449			1977	856	28.1	3.05	1996	576	45.9	1.26	2015	411	59.1	0.70
1927	369	1946	536			1978	980	28.8	3.40	1997	600	46.9	1.28				
1928	435	1947	572			1979	881	29.0	3.04	1998	650	48.5	1.34				

NOTE: VMT data provided by the Minnesota Department of Transportation

MNTH 200 Safety and White Earth Nation

The White Earth Nation has identified improving safety concerns along MNTH 200 as a priority in the future. MNTH 200 covers over 32 miles of the White Earth Reservation. This route provides a vital connection between the City of Mahnomen, small predominately Native American communities, tribal government services, farms and residences throughout the rural areas within the Reservation. The White Earth Reservation is 1,296 square miles, with a population of approximately 10,437. The principal city in the Reservation is Mahnomen, with a population of approximately 1,214. White Earth Nation proudly owns and operates the Shooting Star Casino and Event Center in Mahnomen. MNTH 200 provides the only direct east/west corridor to the City of Mahnomen and/or Shooting Star Casino and Event Center.

White Earth Public Transit provides six-day transit services for three routes along the MNTH 200 corridor. White Earth Public Transit provides two transfer hub locations for transit riders to switch routes. One of two transit transfer hub locations are located at the Shooting Star Casino and Event Center therefore a safe and adequate corridor along MNTH 200 is very important to MnDOT and the White Earth Nation.



Based upon MnDOT crash data for MNTH 200 in Mahnomen and Clearwater Counties for the past five years, the following crash facts were developed:

- 34 percent of crash types were overturn/rollover
- 21 percent of crash types were motor vehicle in transport
- 15 percent of crash types were embankment/ditch/curb
- 3 percent of crashes were fatal
- 18 percent of crashes were incapacitating

MNTH 200 is a candidate for a Road Safety Audit based on the following:

- High Profile Sites – CSAH 4, CSAH 7, Perch Lake, Roy Lake
- Safety Oriented – Steep ditch inslope, narrow shoulders, poorly lit intersections, limited pedestrian walkways
- Based on crash data for Mahnomen and Clearwater Counties for the past five years, the following crash facts were developed.
 - Peak hours
 - Fatal crashes – males
 - Fatal crashes – collision
 - Fatal crash – percentage of total crashes
 - Most frequent crash type

Figure 2: Mahnomen CSAH 4/MNTH 200 Intersection



Figure 3: Perch Lake/MNTH 200



Figure 4: Roy Lake/MNTH 200



Figure 5: Clearwater CSAH 7/MNTH 200



Road Safety Audit Process

SRF has developed a successful, multi-disciplinary process for performing RSAs that is based upon extensive research, data analysis, and input from State, Federal and Tribal partners and our experience with other RSA studies.

The completion of the MNTH 200 RSA involved numerous steps. This report chronicles the final outcomes of the RSA: a list of effective safety improvement strategies for MnDOT and White Earth Nation to consider for improving safety on the corridor as well as specific intersections or segments of the roadway audited. SRF's RSA process included assembling 5/10 years of state crash data, reviewing traffic volume information, and identifying intersections and roadway segment location with greater than expected numbers of fatal and severe crashes. Combining this information with sites identified by the following: MnDOT Traffic Engineer, Mahnomen County Engineer, Bureau of Indian Affairs (BIA) Regional Highway Engineer and White Earth Assistant Director of Public Works.

A total of 22 sites were selected for the comprehensive RSA as part of the field data gathering portion of the audit. The sites identified were further analyzed and key information was used to develop recommendations

The MNTH 200 Road Safety Audit involved several steps, which are listed below:



Data Collection – Documents published (MnDOT District 2 & 4 Safety Plans, Mahnomen County Roadway Safety Plan and Clearwater County Roadway Safety Plan) for the MNTH 200 corridor were studied to understand existing and proposed geometric, operational, and safety characteristics of the MNTH 200 corridor. This data was reviewed prior to the field review, analyzed by the RSA team and shared with the White Earth Public Works Division.

Site Review – The RSA team met and discussed this information with the White Earth Public Works Division staff, the MNTH 200 corridor study design staff, and other RSA participants at a kick-off meeting held prior to conducting the field review of the corridor. It should be noted that tribal public safety department representatives were invited to the kick-off meeting and field review, but could not attend. The RSA team then conducted a comprehensive assessment of the MNTH 200 corridor.

Design Alternative Review – The RSA team reviewed the various identifying areas and/or characteristics that may cause safety concerns and, when appropriate, provided strategies to mitigate the potential safety issue. Information obtained during the data collection task supplemented the RSA team’s review of the various alternatives.

Presentation and Documentation – Findings and recommendations from the RSA site review and design alternative review were presented by the RSA team to the Public Works Division staff and the MNTH 200 corridor study design team. The final step in the RSA process was the official documentation of these recommendations in this report.

RSA Team

The RSA field assessment of the MNTH 200 corridor was completed by SRF’s multi-disciplinary team on May 8, 2017. The RSA team was comprised of experience traffic operations and safety professionals, listed below:

- Jeff Bednar, (SRF) Traffic Safety Specialist
- Jamie Wark, (SRF) White Earth Long Range Transportation Plan Project Manager
- Michael Bowman, (White Earth) Public Works Division Assistant Director
- Thomas Swenson, PE (MnDOT) District 4 Traffic Engineer
- Kurt Slettvedt, (BIA) Midwest Region Highway Engineer
- Jon Large, PE, (Mahnomen County) County Highway Engineer

RSA Information Sources

Several sources of information were used in the RSA process. GIS based mapping along with MnDOT CMAT crash reports assisted the RSA team in the review of existing conditions along MNTH 200 and the proposed design alternatives. Specific resources used in the analysis include the following:

- MNTH 200 traffic volumes and traffic forecasts
- MnDOT crash reports
- GIS site mapping and aerial photography
- White Earth Long Range Transportation Plan
- MnDOT Alternative CAD files



- MNTH 200 Road Safety Audit Field Inspections and Field Notes
- Mahnomon County, MnDOT, Bureau of Indian Affairs (BIA) staff knowledge of site history and issues
- MnDOT County Road Safety Plans
- MnDOT District Safety Plans

Understanding the RSA Recommendations

The recommendations documented in this report will outline the audit team’s specific findings after reviewing the existing MNTH 200 corridor as well as the reconstruction design alternative. The site-specific, primarily engineering-related safety improvements suggested by the RSA process have been grouped into the following categories and are numbered for reference, not prioritization.

These suggestions do one or more of the following:

1. Highly Recommended Improvements

These suggestions do one or more of the following:

- a) Correct observed non-standard installation or practice
- b) Correct a safety issues (e.g., sight-distance or obstruction that can be tied directly to engineering judgment and/or best practices
- c) Can be directly tied to crash experience

2. Potential High Impact Improvements

These suggestions generally go over and above the minimum Manual on Uniform Traffic Control Devices (MUTCD) standard or are more difficult to tie directly to increased safety performance. For example, cross-walk signing and striping have been shown in many cases to have no effect on safety performance; yet many jurisdictions and agencies sign and mark based on individual preferences and policies. These recommendations/suggestions leave a high level of discretion regarding future implementation by MnDOT/White Earth Public Works Division.

3. Suggestions to Consider

These suggestions were identified as potential actions/improvements; however, they may be unconventional and/or unproven with respect to known research and/or the experience of the team. These considerations are for informational purposes and are up to MnDOT/White Earth Public Works Division discretion to pursue.



Strategic Highway Safety Plan Recommendations

State Highway Safety Plan Review

As part of the Minnesota Strategic Highway Safety Plan (SHSP), a detailed review of fatal and serious injury crash records for years 2008-2012 were performed to verify a 2013 analysis which recommended safety improvements that were representative of the most significant traffic safety issues facing drivers, pedestrians and bicyclists. Crash data was broken down by county within each ATP District and the seven primary contributing factors in fatal and serious injury crashes were determined. The seven primary factors contributing to fatal and serious injury crashes are as follows:

- Unbelted Occupants
- Impaired User
- Inattentive Driver
- Speed
- Older Driver
- Younger Driver
- Invalid License

The following counter measures strategies suggested by the SHSP should be considered as improvements not only for proactive safety improvement projects, but also as appropriate for ALL sites in Mahnomen and Clearwater Counties, including the 21 audited locations to be discussed later in this report. Therefore, the following strategies will generally not be listed as recommendations in the site-specific section of this report.

Mahnomen County Roadway Safety Plan Recommendations

The following counter measure strategies suggested by the Mahnomen County Roadway Safety Plan should be considered as improvements not only for proactive safety improvement projects, but also for all sites in Mahnomen County.

Eight types of projects were identified for implementation on the high priority rural highway segments. The project types are listed below with associated costs.

- 2' Shoulder Paving + Safety Wedge + Rumble Strip – Estimated Cost: \$40,000 per mile
- Rumble Strip – Estimated Cost: \$3,000 per mile
- Centerline Rumble Strip – Estimated Cost \$1,500 per mile
- Rumble StripE (Edgeline or Centerline) – Estimated Cost: \$3,500 per mile
- 6" Wet Reflective Epoxy in Grooves - Estimated Cost: \$8,500 per mile
- 6" Latex Marking – Estimated Cost: \$650 per mile
- Chevrons + 2' Shoulder Paving in Critical Radius Curves – Estimated Cost: \$40,000 per miles plus \$3,300 per curve for chevrons
- Field Access Removal/Consolidation – Estimated Cost: \$5,000 per access



Clearwater County Roadway Safety Plan Recommendations

The following counter measure strategies suggested by the Clearwater County Roadway Safety Plan should be considered as improvements not only for proactive safety improvement projects, but also for all site in Clearwater County.

Six types of projects were considered for implementation on each of the high priority rural highway segments.

- 2' Shoulder Paving + Safety Wedge + Rumble Strip – Estimated Cost: \$40,000 per mile
- Rumble Strip – Estimated Cost: \$3,000 per mile
- Rumble StripE (Edgeline or Centerline) – Estimated Cost: \$3,500
- 6" Wet Reflective Epoxy in Grooves - Estimated Cost: \$8,500 per mile
- 6" Latex Marking – Estimated Cost: \$650 per mile
- Centerline Rumble Strip – Estimated Cost: \$3,000

Existing Condition Review

The MNTH 200 RSA report focused on 21 project objectives: examine existing conditions along MNTH 200 and suggest safety improvement strategies, review various corridor design alternatives and suggest safety considerations and set the stage for the White Earth Nation to pursue future funding sources to improvement safety concerns along the corridor. The following pages outline the results of the MNTH 200 existing conditions review. The format for this section will provide the following information for each site audited: a photograph and/or aerial photo of the team's observations of each site, the potential issues, and specific safety improvement suggestions for MnDOT's/White Earth Public Works Division's consideration.



Location #1 – RP 48.5 to 66.2 HIGH LANE DEPARTURE, SEVERE CRASHES ALONG CORRIDOR
Location #2 – RP 48.5 to 66.2 NARROW SHOULDERS
Location #3 – RP 48.5 to 74.3 TH 200 CORRIDOR CRASH RATES HIGHER THAN SIMILAR ROADS
Location #4 – RP 48.5 to 74.3 STEEP INSLOPES, DEEP DITCHES, STEEP APPROACH SLOPES
Location #5 – RP 48.5 to 74.3 NO PASSING ZONES (NPZ)
Location #6 – RP 48.5 to 74.3 HIGH FIXED OBJECT SEVERE CRASH RATE TYPE
Location #7 – RP 54.2 MNTH 200/MAHNOMEN CSAH 3 INTERSECTION LIGHTING
Location #8 – RP 55.2 MNTH 200 HORIZONTAL CURVE
Location #9 – RP 55.2 CURVED INTERSECTIONS, HIGHER EB RIGHT-TURN DECELERATION CONFLICTS
Location #10 – RP 60.5 STEEP DITCH INSLOPE IMPROVEMENT
Location #11 – RP 61.15 HIGH RIGHT-TURN DECELERATION CONFLICTS
Location #12 – RP 61.9 STEEP DITCH INSLOPE IMPROVEMENT
Location #13 – RP 63.15 MNTH 200/MAHNOMEN CSAH 4 INTERSECTION LIGHTING
Location #14 – RP 65.6 to 65.9 MNTH 200 ENHANCED EDGELINE INSTALLATION
Location #15 – RP 65.7 CHEVRON INSTALLATION
Location #16 – RP 65.7 CHEVRON INSTALLATION
Location #17 – RP 65.9 MNTH 200 CLEAR ZONE IMPROVEMENTS
Location #18 – RP 66.2 MNTH 200/CLEARWATER CSAH 7 INTERSECTION SITE DISTANCE ISSUES
Location #19 – RP 66.2 MNTH 200/CLEARWATER CSAH 7 INTERSECTION LIGHTING
Location #20 – RP 66.3 to 74.3 ENHANCED EDGELINE INSTALLATION
Location #21 – RP 69.9 MNTH 200/AUGINAUSH ROAD INTERSECTION LIGHTING
Location #22 – RP 70.9 BRIDGE OBJECT MARKER PANELS ON GUARD RAIL



Site Specific Recommendations

The following section details the observations, concerns and recommendations of SRF's RSA Team following the site visit to MNTH 200 on Monday, May 8, 2017. Twenty-two separate sites or roadway segments were identified and assessed by SRF's multidisciplinary safety team. Each site or segment is described and a summary of the crash history based upon available law enforcement crash reports is provided. Specific field observations, concerns and recommended safety improvements for MNTH 200 officials to consider for each site are provided for review.



Site #1 - RP 48.5 to 66.2 HIGH LANE DEPARTURE, SEVERE CRASHES ALONG CORRIDOR

This roadway segment of MNTH 200 is located within to the east of the City of Mahanomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/CSAH 7 (Mahanomen/Clearwater County line). An aerial photo of Site 1 is shown in Figure 6.

Crash History:

- There were reported twenty-four crashes along this corridor between 2011 and 2015.
- There were no fatalities and four incapacitating injuries.
- The predominant type of crashes were off road single vehicles.
- Sustained FAR (Fatal and Serious) Index = 1.21.



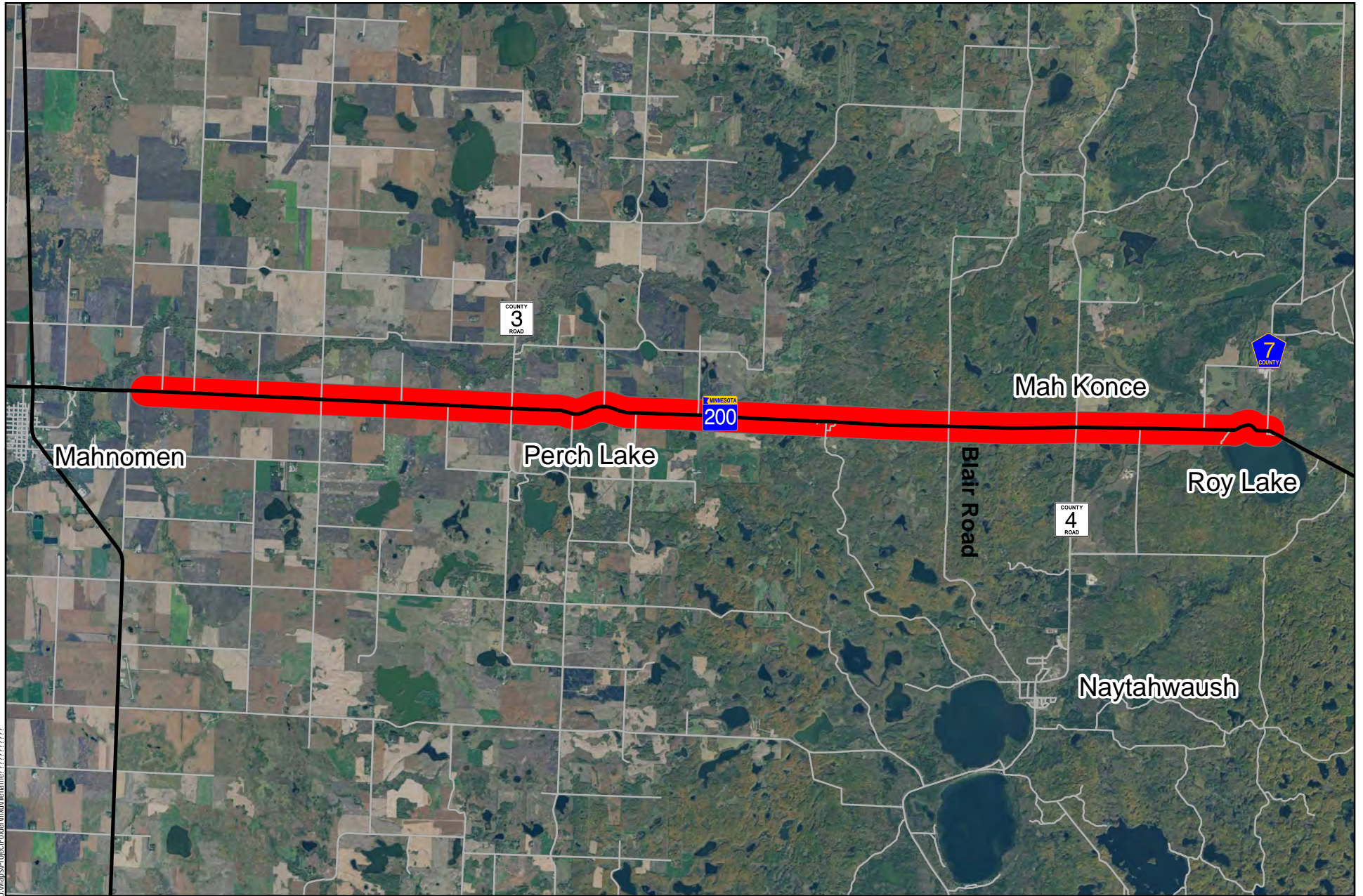
MNTH 200 near T-190 Mill and Overlay 2016

General Observation:

- This section of roadway has narrow shoulders, steep in-slopes to ditches and approaches. It also has a higher lane departure severe crash.
- MnDOT District 4 completed a Mill and Overlay project in 2016.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Edgeline rumble strips • Centerline rumble strips 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • Widen shoulders • Improve inslopes, approach slopes and ditch depths





Site #2 – R.P 48.5 to 66.2 NARROW SHOULDERS

This roadway segment of MNTH 200 is located within to the east of the City of Mahnomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/CSAH 7 (Mahnomen/Clearwater County line). An aerial photo of Site 2 is shown in Figure 7.

Crash History:

- There were reported twenty-four crashes along this corridor between 2011 and 2015.
- There were no fatalities and four incapacitating injuries.
- The predominant type of crashes were off road single vehicles.
- Sustained FAR (Fatal and Serious) Index = 1.21.

General Observation:

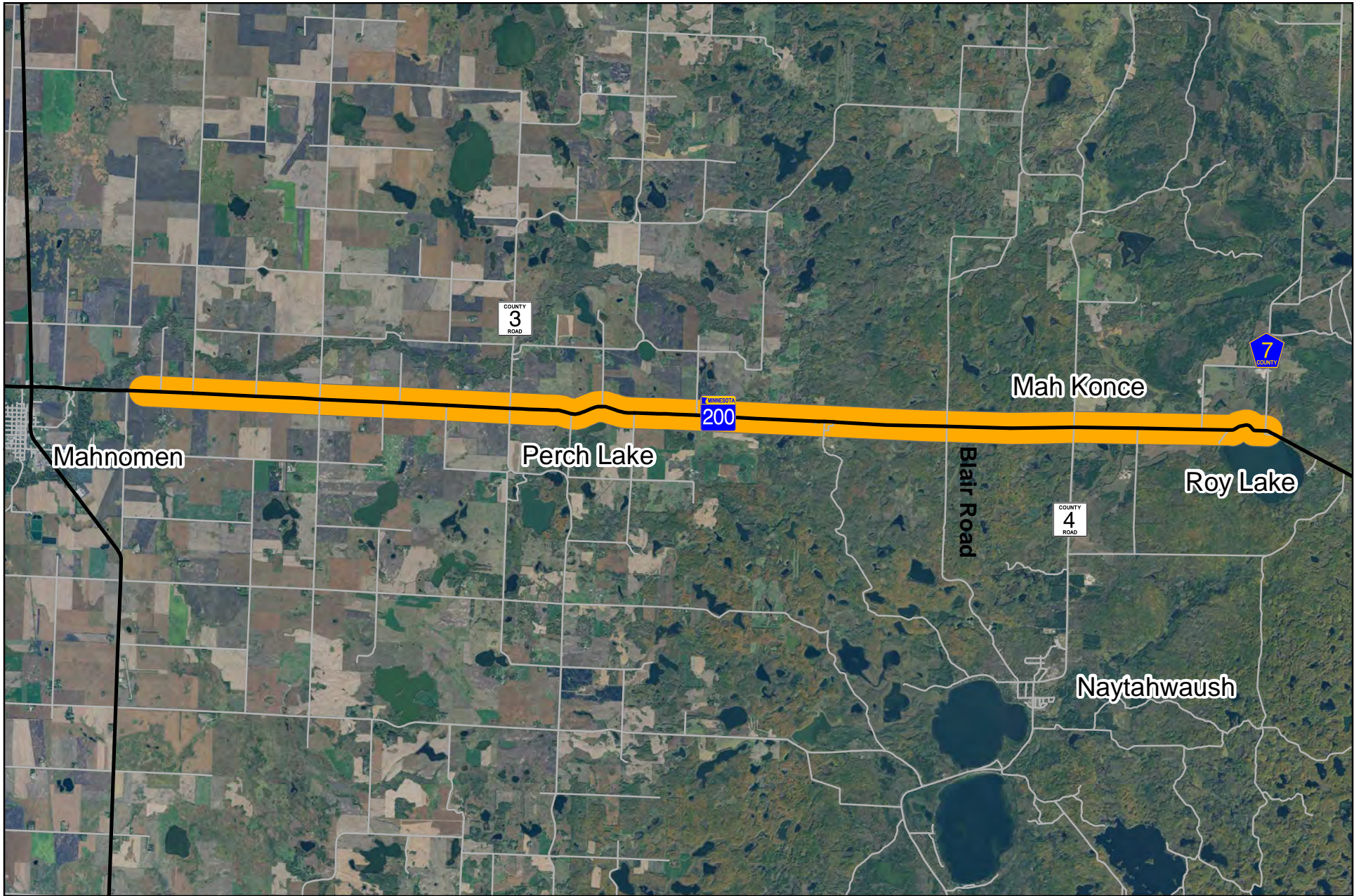
- This section of roadway has narrow shoulders, steep in-slopes to ditches and approaches.
- MnDOT District 4 completed a Mill and Overlay project in 2016.
- This segment of the roadway is very unforgiving for vehicles that
- leave the roadway.



MNTH 200 with narrow shoulders approaching Perch Lake.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Widen shoulders from two feet to six feet • Improve inslopes, approach slopes and ditch depths 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • Edgeline rumble strips • Centerline rumble strips





Site #3 – R.P. 48.5 to 74.3 MNTH 200 CORRIDOR CRASH RATES HIGHER THAN SIMILAR ROADS

This roadway segment of MNTH 200 is located to the east of the City of Mahnomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/MNTH 92 (Zerker). An aerial photo of Site 3 is shown in Figure 8.

Crash History:

- There were reported nine crashes along the MNTH 200 from CSAH 7 to Zerker corridor between 2006-2015.
- There were reported twenty-four crashes along the MNTH 200 E of Mahnomen to CSAH 7 corridor between 2011 and 2015.
- The predominant type of crashes were off road single vehicles.
- MNTH 200 E of Mahnomen to CSAH 7 Sustained FAR (Fatal and Serious) Index = 1.21
- MNTH 200 from CSAH 7 near Roy Lake to Zerker Sustained FAR (Fatal and Serious) Index = 1.26



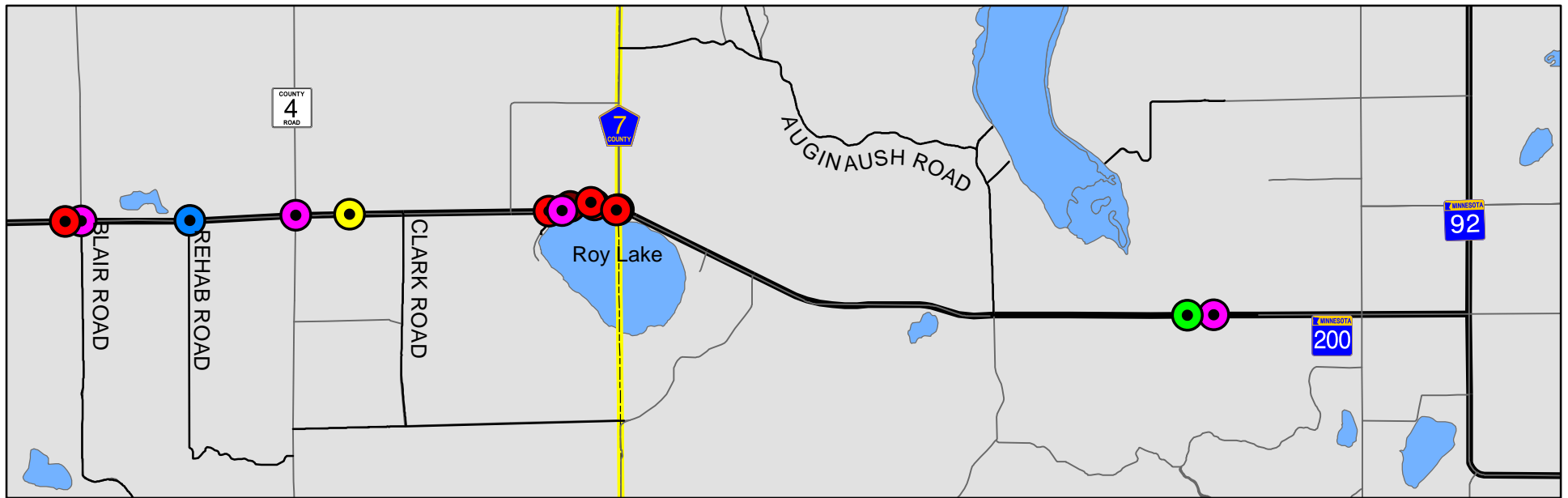
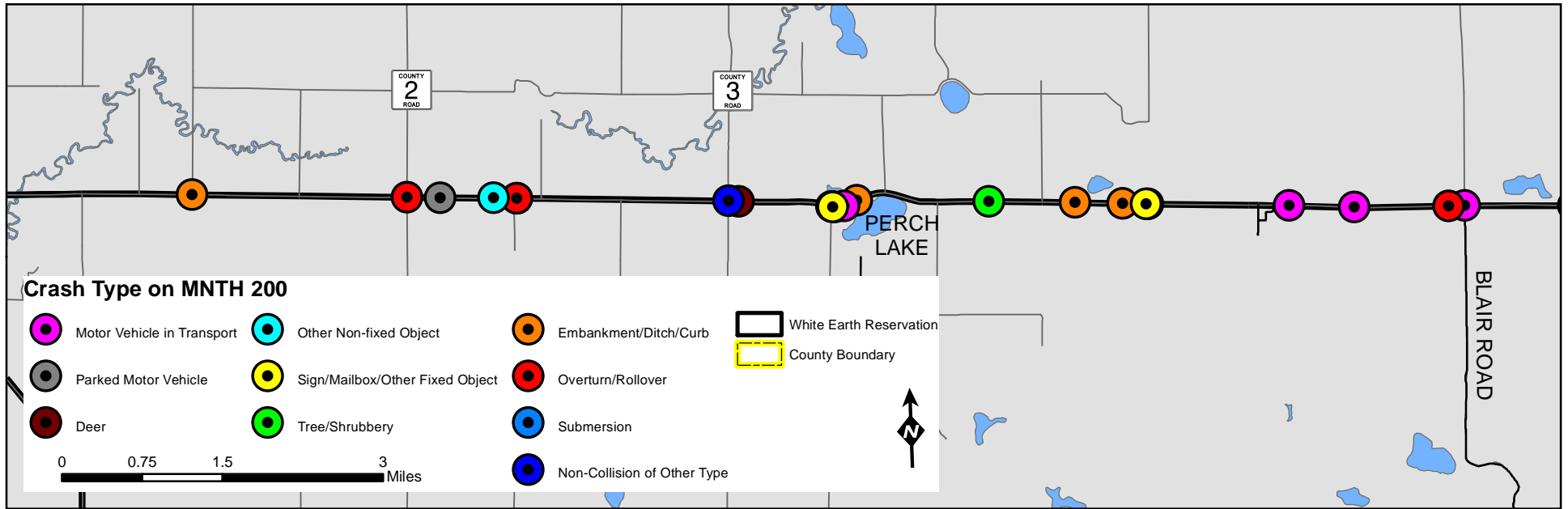
Westbound MNTH 200 crash location near Roy Lake

General Observation:

- This section of roadway has a higher crash rate than typical for similar type of roadways.
- Roadway section does not match typical section of MNTH 200 west Mahnomen and south of Zerker.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Widen shoulders from two feet to six feet • Improve inslopes, approach slopes and ditch depths 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • Edgeline rumble strips • Centerline rumble strips





Site #4 – R.P. 48.5 to 74.3 STEEP INSLOPES, DEEP DITCHES, STEEP APPROACH SLOPES

This roadway segment of MNTH 200 is located to the east of the City of Mahanomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/MNTH 92 (Zerkel). An aerial photo of Site 4 is shown in Figure 9.

Crash History:

- There were reported nine crashes along the MNTH 200 from CSAH 7 to Zerkel corridor between 2006-2015.
- There were reported twenty-four crashes along the MNTH 200 E of Mahanomen to CSAH 7 corridor between 2011 and 2015.
- The predominant type of crashes were off road single vehicles.
- MNTH 200 E of Mahanomen to CSAH 7 Sustained FAR (Fatal and Serious) Index = 1.21
- MNTH 200 from CSAH 7 near Roy Lake to Zerkel Sustained FAR (Fatal and Serious) Index = 1.26



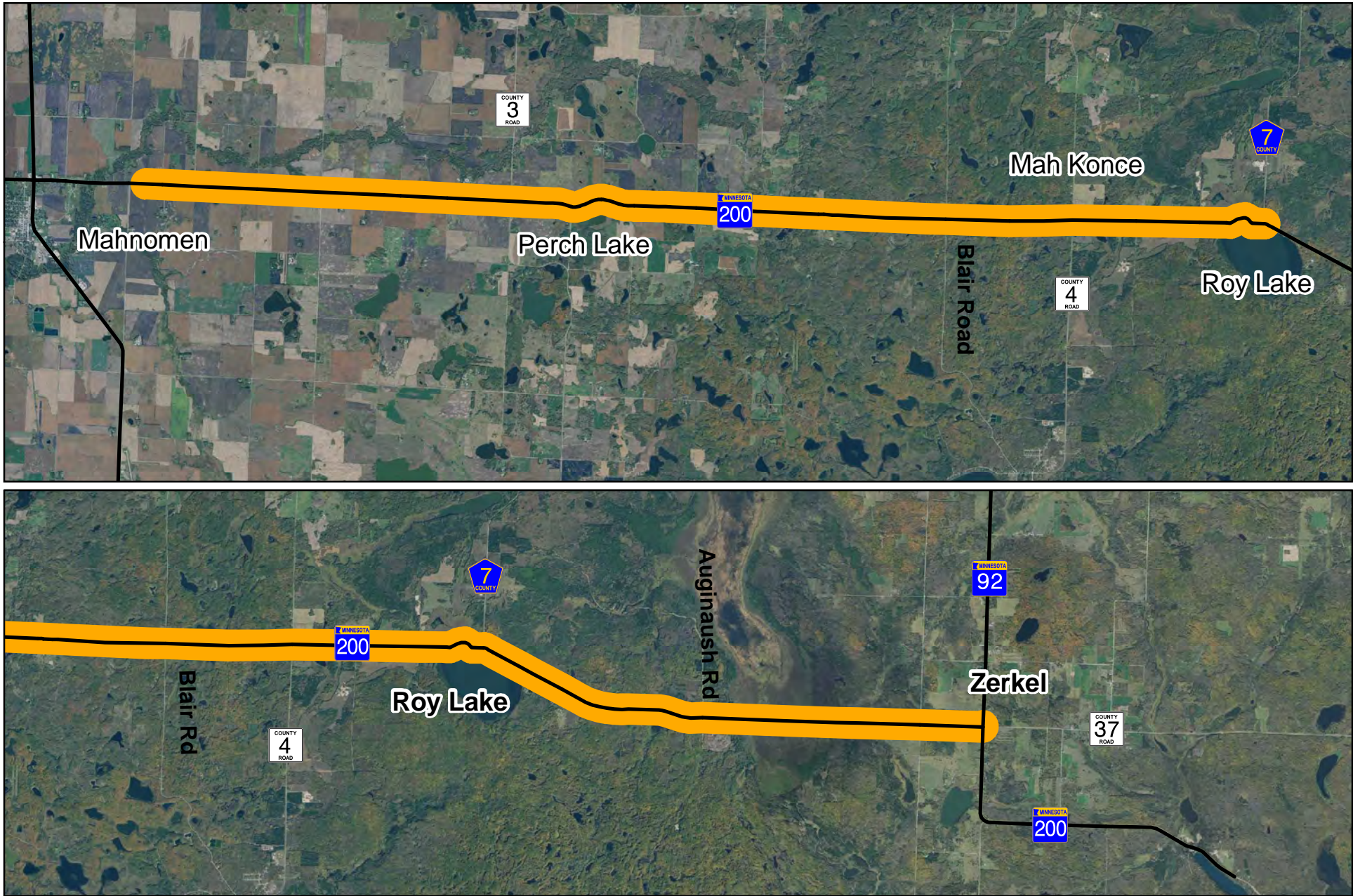
Steep inslope east of Blair Road

General Observation:

- This section of roadway has steep inslopes, deep ditches, steep approach slopes and deep water depths along the roadway.
- The roadway segment will require the elimination of hazards in the clear zone.
- Multiple inslopes bordering water feature that require guard rails and signage.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Widen shoulders from two feet to six feet • Improve inslopes, approach slopes and ditch depths 	<ul style="list-style-type: none"> • Install guard rails and signage near water features 	<ul style="list-style-type: none"> • Edgeline rumble strips • Centerline rumble strips





Site #5 – R.P. 48.5 to 74.3 NO PASSING ZONES (NPZ)

This roadway segment of MNTH 200 is located to the east of the City of Mahanomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/MNTH 92 (Zerke). An aerial photo of Site 5 is shown in Figure 10.

Crash History:

- There were reported nine crashes along the MNTH 200 from CSAH 7 to Zerke corridor between 2006-2015.
- There were reported twenty-four crashes along the MNTH 200 E of Mahanomen to CSAH 7 corridor between 2011 and 2015.
- The predominant type of crashes were off road single vehicles.
- MNTH 200 E of Mahanomen to CSAH 7 Sustained FAR (Fatal and Serious) Index = 1.21
- MNTH 200 from CSAH 7 near Roy Lake to Zerke Sustained FAR (Fatal and Serious) Index = 1.26



No Passing Zone (NPZ) near Perch Lake

General Observation:

- This section of roadway has a 28 percent of No Passing Zones (NPZ), which is much higher than typical.
- The passing segments that are present between the NPZ are inadequate in length.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Placement of wider pavement markings along corridor • Reduce percentage or NPZ locations 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • Inventory short passing segments for usability and potential inclusions to NPZs





Site #6 – R.P. 48.5 to 74.3 HIGH FIXED OBJECT SEVERE CRASH RATE TYPE

This roadway segment of MNTH 200 is located to the east of the City of Mahnomen. MNTH 200 runs east-west. The segment lies to the east of the intersection of MNTH 200/CSAH 25 to the intersection of MNTH 200/MNTH 92 (Zerkel) on the White Earth Indian Reservation. An aerial photo of Site 6 is shown in Figure 11.

Crash History:

- There were reported nine crashes along the MNTH 200 from CSAH 7 to Zerkel corridor between 2006-2015.
- There were reported twenty-four crashes along the MNTH 200 E of Mahnomen to CSAH 7 corridor between 2011 and 2015.
- There were 8 fixed object crashes along the corridor from May 2010 to May 2015.
- MNTH 200 E of Mahnomen to CSAH 7 Sustained FAR (Fatal and Serious) Index = 1.21
- MNTH 200 from CSAH 7 near Roy Lake to Zerkel Sustained FAR (Fatal and Serious) Index = 1.26



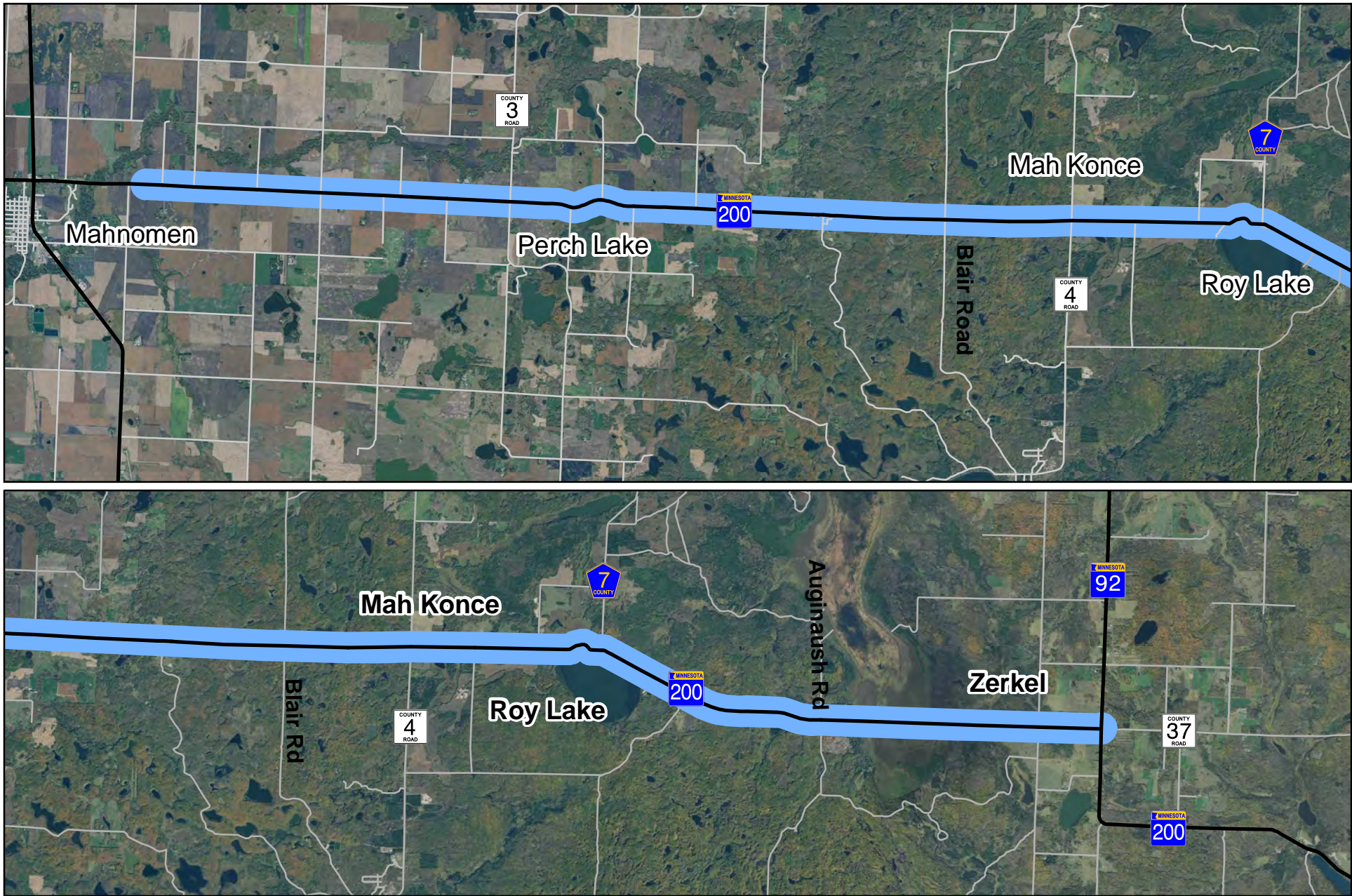
Fixed objects along roadway near Goodwin Lake

General Observation:

- Forested stretches of the corridor include fixed objects near clear zone areas
- Area near Roy Lake has fixed objects (trees within clear zone)
- Area near Goodwin Lake poses a danger for vehicles leaving the north side of the roadway and striking fixed objects

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Remove fixed object from clear zones along corridor 	<ul style="list-style-type: none"> • Remove fixed objects located near the clear zones that restrict sight distances and pose dangers 	<ul style="list-style-type: none"> • Develop inventory of fixed objects within clear zones





Site #7 – R.P. 54.2 MNTH 200/MAHNOMEN CSAH 3 INTERSECTION LIGHTING

This 90-degree intersection is side-street stop-controlled and located at the intersection of MNTH 200 and Mahnomen CSAH 3 on the White Earth Indian Reservation. An aerial photo of Site 7 is shown in Figure 12.

Crash History:

- There has been one recorded crash at this site in the past five years.
- The one recorded crash was of low severity and consisted of a collision with a moving vehicle.

General Observation:

- There is no existing lighting at this intersection.
- CSAH 3 AADT is greater than 200.



Poorly lit intersection at intersection of MNTH 200 and CSAH 3

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Improve street lighting to provide lighting to entire intersection. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Install new stop signs.





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Site #8 – R.P. 55.2 MNTH 200 HORIZONTAL CURVE

This roadway segment of MNTH 200 is located approximately nine miles east of the City of Mahanomen, near Perch Lake on the White Earth Indian Reservation. An aerial photo of Site 8 is shown in Figure 13.

Crash History:

- There have been three recorded crashes at this site in the past five years.
- Of the three recorded crashes, there have been no fatal crashes and one incapacitating crashes.

General Observation:

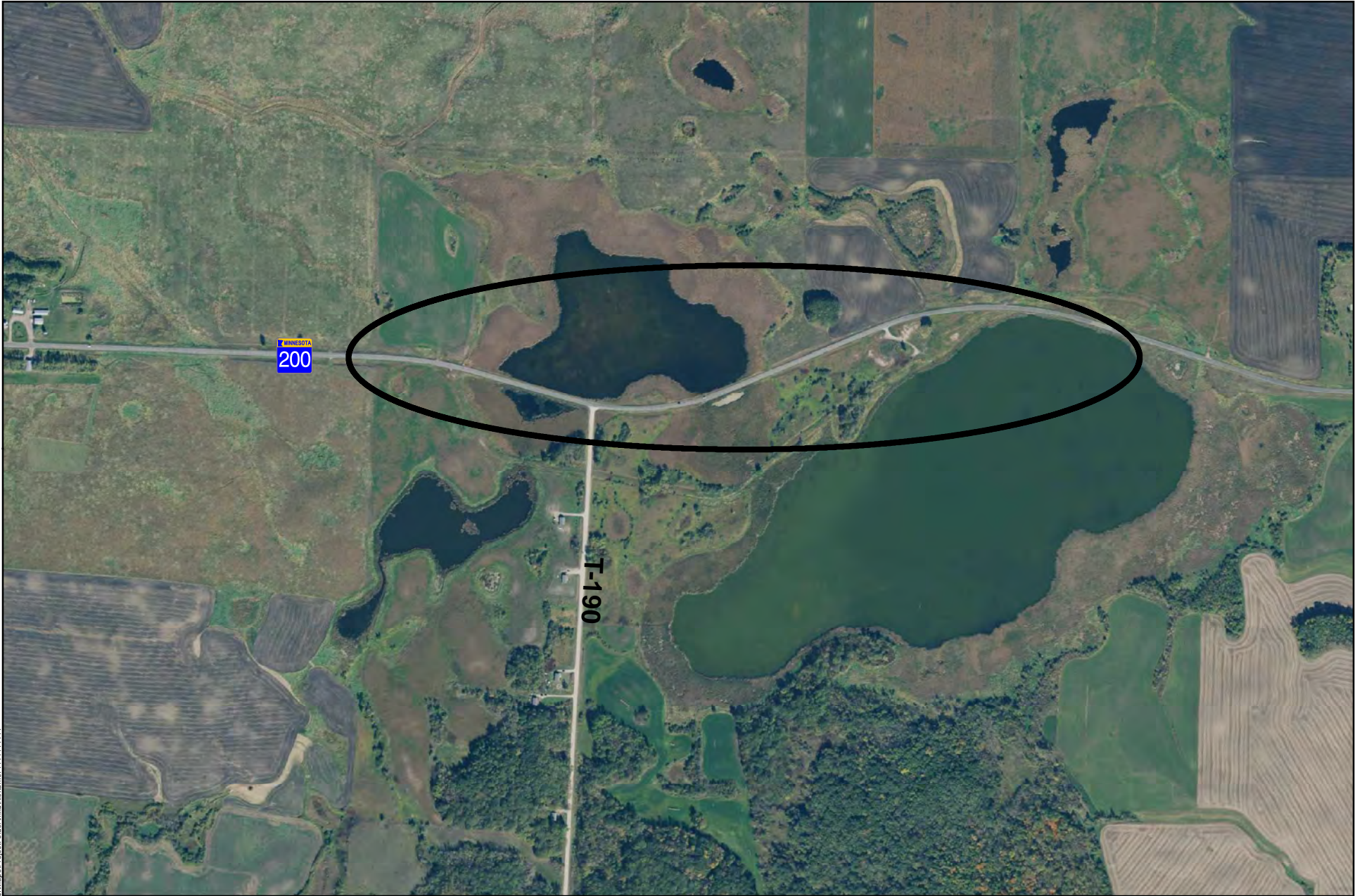
- This section of roadway has a high-risk curve ranking in the 2016 District 4 District Safety Plan Update.
- Relatively high traffic volumes exist on MNTH 200.



Horizontal curve at intersection of MNTH 200 and T-190

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install chevrons along the curves. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Additional signage to the east and west of the curves along the segment.





Site #9 – R.P. 55.2 CURVED INTERSECTION, HIGH EB RIGHT-TURN DECELERATION CONFLICTS

This roadway segment of MNTH 200 is located approximately nine miles east of the City of Mahanomen, near Perch Lake on the White Earth Indian Reservation. An aerial photo of Site 9 is shown in Figure 14.

Crash History:

- There have been three recorded crashes at this site in the past five years.
- Of the three recorded crashes, there have been no fatal crashes and one incapacitating crashes.

General Observation:

- There are a high number of East Bound right-turn deceleration conflicts, in addition to the intersection being along a curve.
- T-190 traffic is greater than 100 AADT



Curved intersection at MNTH 200 and T-190

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install eastbound right-turn lane. • Improve inslopes, approach slopes and ditch slopes. • Eliminate hazards in clear zones 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Adjust and add permanent signage to incorporate the addition of right-turn lane.





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Site #10 – R.P. 60.5 STEEP DITCH INSLOPE IMPROVEMENT

This segment of MNTH 200 is located approximately one half mile east of the intersection of MNTH 200/Mahnomen CR 122 on the White Earth Reservation. An aerial photo of Site 10 is shown in Figure 15.

Crash History:

- There was one lone crash recorded at this site in the past five years.
- The crash was not fatal and involved a collision with a moving vehicle.

General Observation:

- This section of roadway has no shoulders, steep in-slopes to ditches and approaches adjacent to a pond.



MNTH 200 one half mile west of Blair Road.

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Widen shoulders • Improve inslopes, approach slopes and ditch depths 	<ul style="list-style-type: none"> • Add guard rails along water feature 	<ul style="list-style-type: none"> • Use granite as shoulder material to minimize wetland impact.





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Site #11 – R.P. 61.15 HIGH RIGHT-TURN DECELERATION CONFLICTS

This 90-degree intersection is side-street stop-controlled and located at the intersection of MNTH 200/Mahnomen CR 122/Blair Road on the White Earth Reservation. An aerial photo of Site 11 is shown in Figure 16.

Crash History:

- There were two reported crashes at this site in the past five years.
- No fatal or injury crashes were recorded.
- Primary crash types were listed as collision with moving vehicle and overturn/rollover.

General Observation:

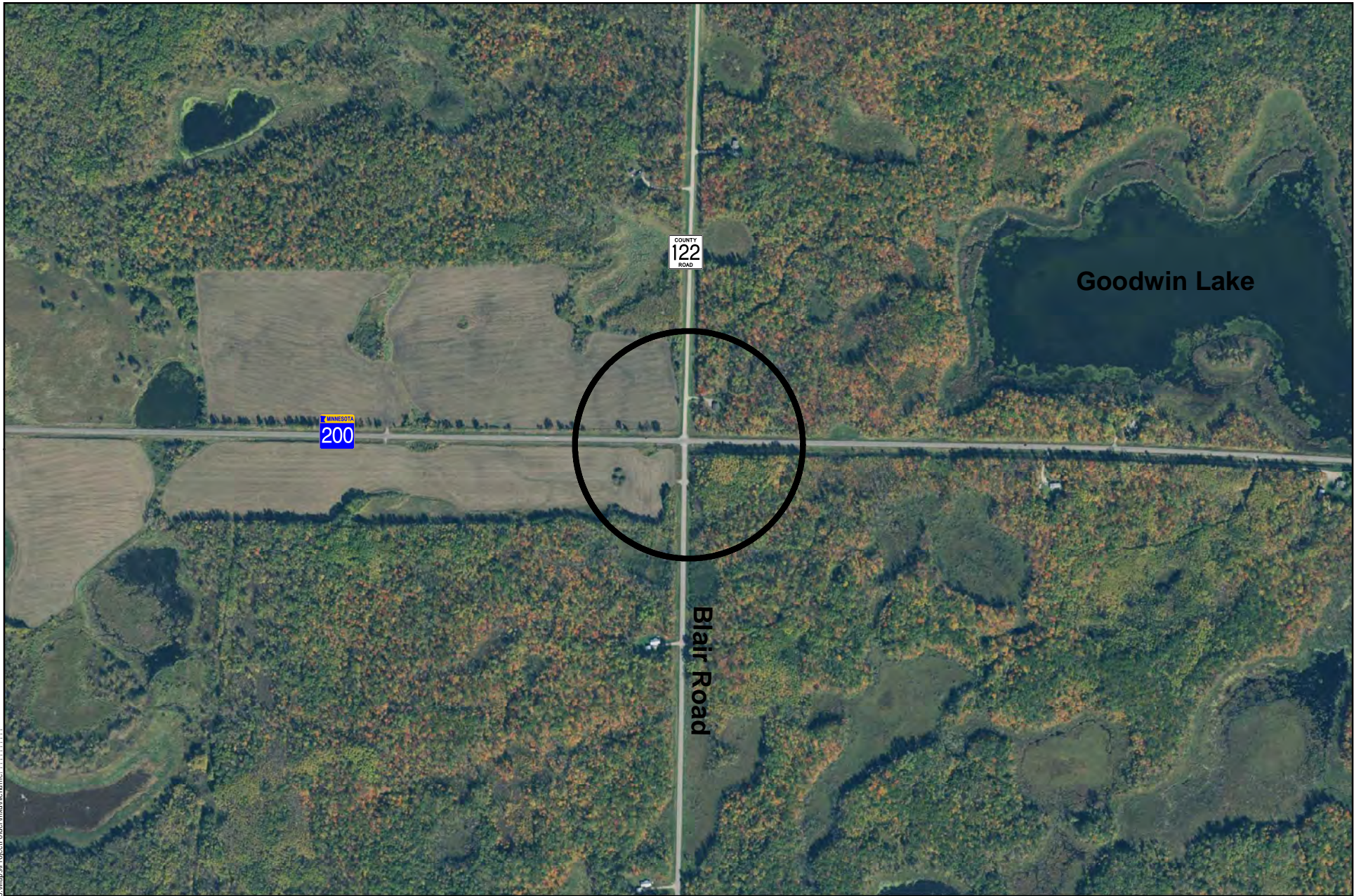
- There are a high number of right-turn deceleration conflicts, in addition to a having no lighting at the intersection.
- Blair Road has an AADT greater than 100



Deceleration conflict at MNTH 200 and Blair Road

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install right-turn lane 	<ul style="list-style-type: none"> • Install intersection lighting 	<ul style="list-style-type: none"> • Conduct updated traffic counts on Blair Road





Site #12 – R.P. 61.9 STEEP DITCH INSLOPE IMPROVEMENT

This segment of MNTH 200 is located approximately three quarter mile east of the intersection of MNTH 200/Mahnomen CR 122 on the White Earth Reservation. An aerial photo of Site 12 is shown in Figure 17.

Crash History:

- No crash data was collected for this site as it was added during the RSA by the RSA team when in the field.

General Observation:

- This section of roadway has no shoulders, steep in-slopes to ditches and approaches adjacent to a pond.



Steep ditch inslope near Goodwin Lake

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Widen shoulders • Improve inslopes, approach slopes and ditch depths 	<ul style="list-style-type: none"> • Add guard rail along water feature location 	<ul style="list-style-type: none"> • Use granite as a shoulder material to minimize wetland impact.





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Site #13 – R.P. 63.15 MNTH 200/MAHNOMEN CSAH 4 INTERSECTION LIGHTING

This 90-degree intersection is side-street stop controlled and located five miles north of the community of Naytahwaush. CSAH 4 runs north-south. An aerial photo of Site 13 is shown in Figure 18.

Crash History:

- There was one reported crash at this site in the past five years.
- The lone crash type was listed as collision with moving vehicle.
- No fatal or injury crashes were recorded.

General Observation:

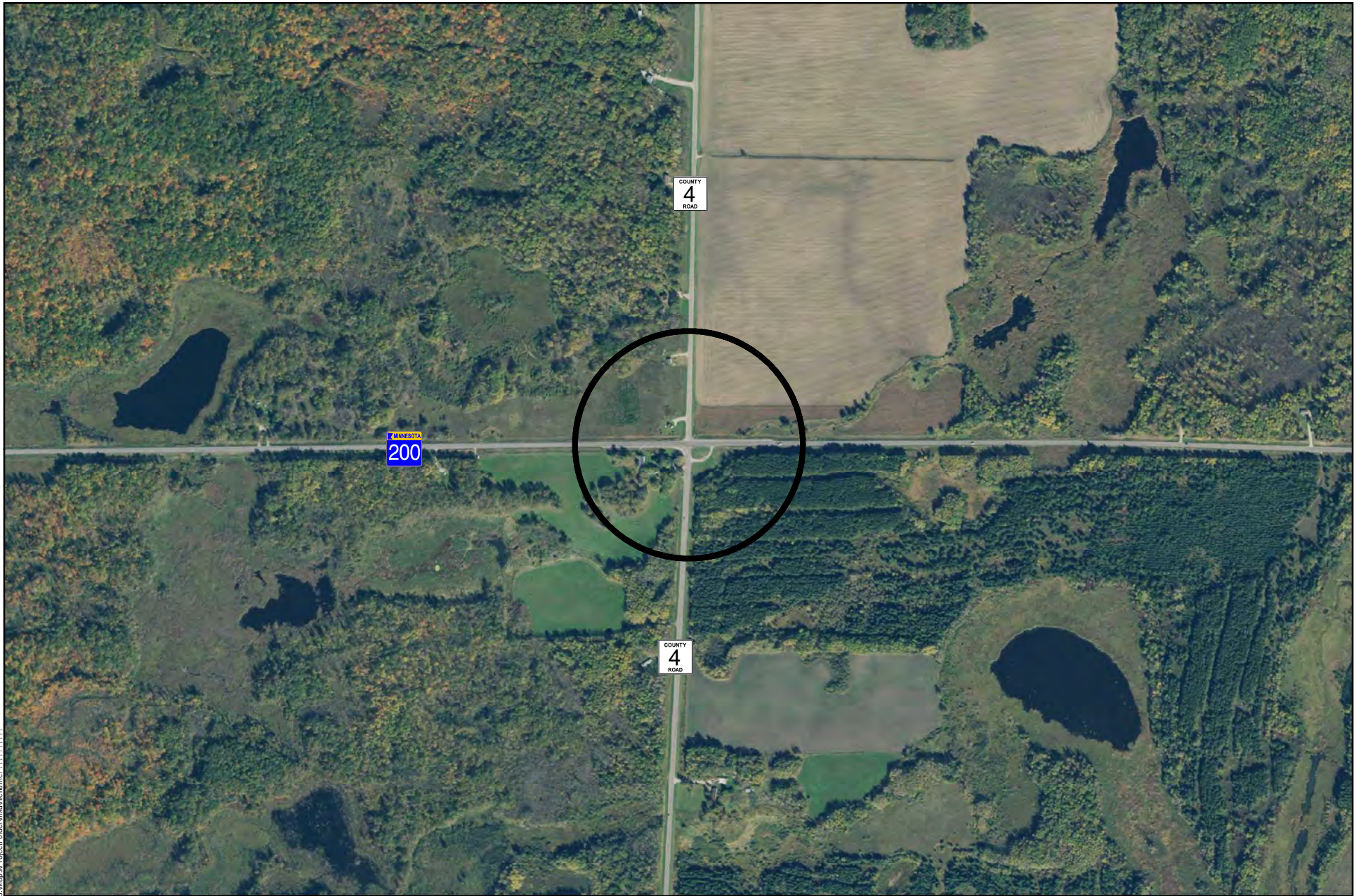
- Poorly lit intersection with pedestrian traffic
- Relatively high number of pedestrian traffic at this intersection.
- AADT on CSAH 4 is greater than 200



Poorly lit intersection at intersection of MNTH 200 and CSAH 4

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install intersection lighting 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Installation of new stop signs





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Site #14 – R.P. 65.6 to 65.9 MNTH 200 ENHANCED EDGELINE INSTALLATION

This stretch of MN TH 200 runs east-west with numerous horizontal curves and is approximately one half mile west of the Mahnomen/Clearwater County line on the White Earth Reservation. An aerial photo of Site 14 is shown in Figure 19.

Crash History:

- There were four reported crashes at this site in the past five years.
- Of the four crashes, two were crashes with fixed objects.
- No fatal crashes occurred or were recorded at this site.

General Observation:

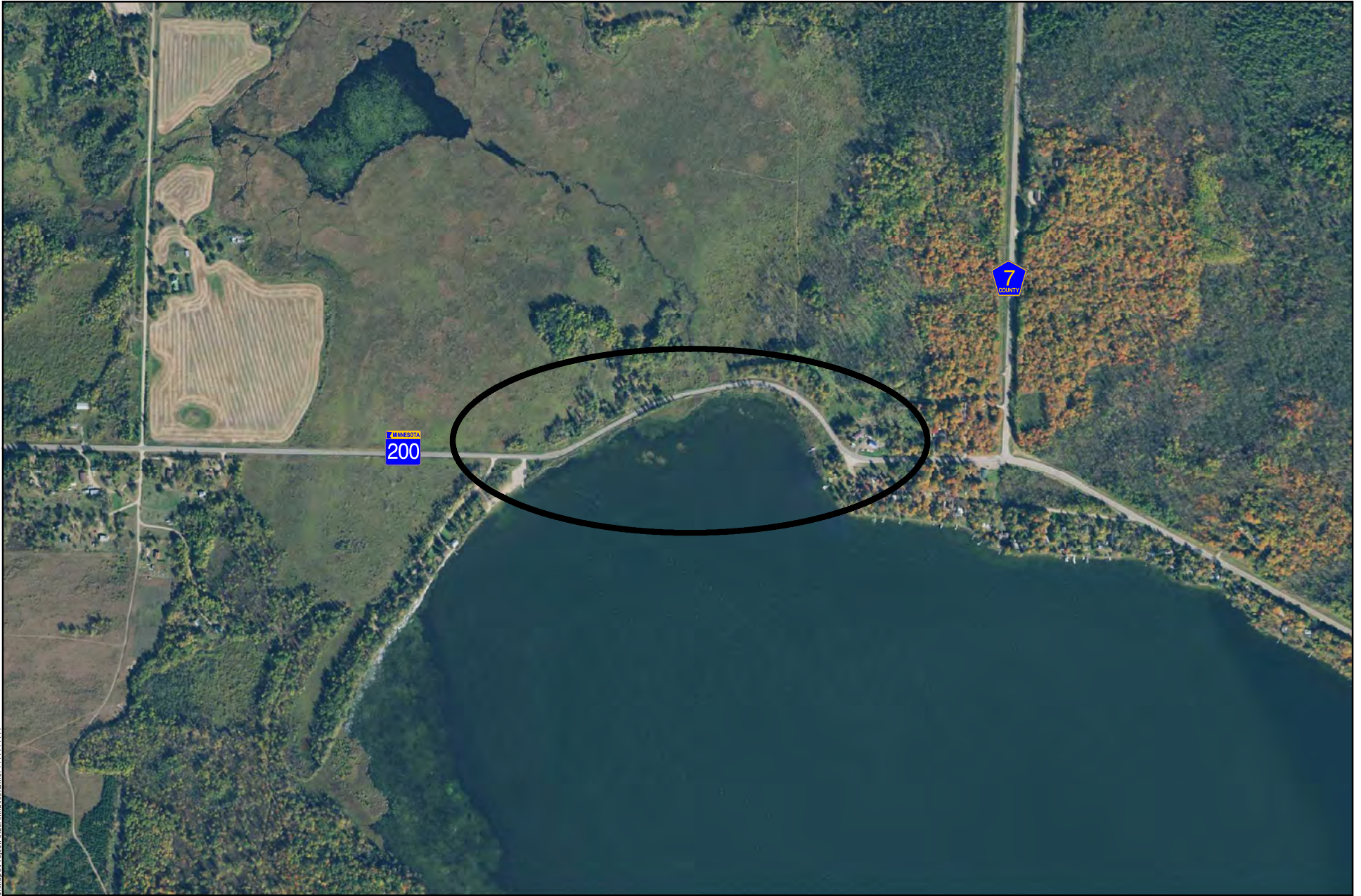
- This section of roadway is a high-risk segment due to several factors which include: critical radius curve density, narrow shoulder width, edge risk and access density.
- High access density, leaving several vulnerable locations for potential accidents
- Several curves along this corridor which cause poor site distances



Proposed stretch of enhanced edgeline installation near Roy Lake

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install enhanced edgelines (6" to 8") • Widen shoulders 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • 2016 MnDOT District 4 District Safety Plan Update recommended project





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Site #15 – R.P. 65.7 MNTH 200 CHEVRON INSTALLATION

This segment of MNTH 200 is located approximately one half mile west of the Mahnommen/Clearwater County line on the White Earth Reservation. An aerial photo of Site 15 is shown in Figure 20.

Crash History:

- There were five reported crashes at this site in the past five years.
- Of the five crashes, three were crashes with fixed objects.
- No fatal crashes occurred or were recorded at this site.

General Observation:

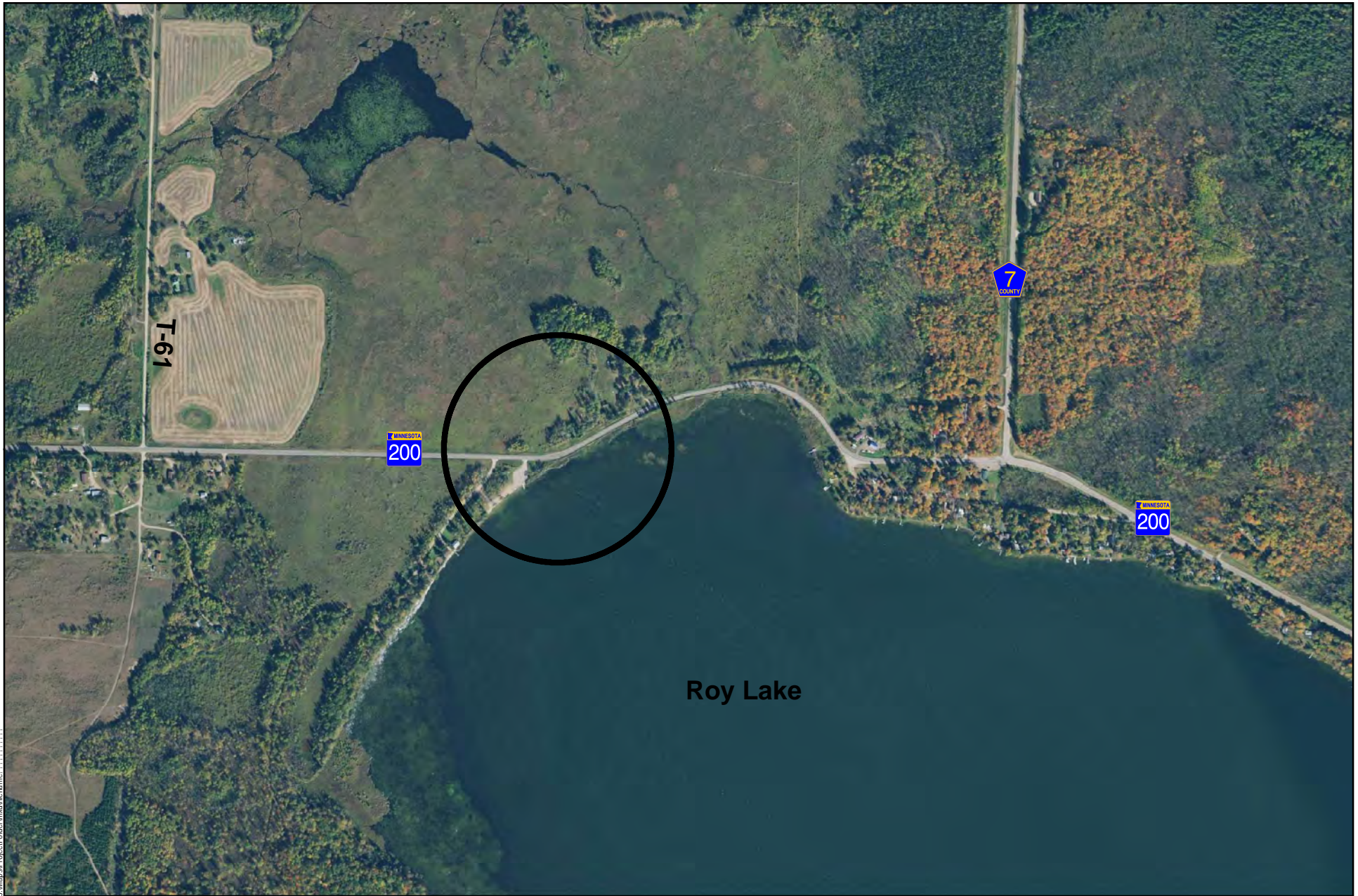
- This section of roadway has a sharp horizontal curve causing single vehicle crashes.
- A single sharp curve to left sign is present at the curve of Roy Lake.
- The gravel shoulder area in this curve area has experienced pot holes.



Horizontal curve at Roy Lake

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install chevrons along the horizontal curve 	<ul style="list-style-type: none"> • Additional signage prior to the curve 	<ul style="list-style-type: none"> • Consider realigning roadway to the north, however, this may not be environmentally or economically feasible





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Site #16 – R.P. 65.8 to 66.2 TRAFFIC CALMING MEASURES

This bridge is located approximately one mile east of Auginaush Road on MNTH 200 where the Wild Rice River crosses the roadway on the White Earth Reservation. An aerial photo of Site 16 is shown in Figure 21.

Crash History:

- There were five reported crashes at this site in the past five years.
- Of the five crashes, three were crashes with fixed objects.
- No fatal crashes occurred or were recorded at this site.

General Observation:

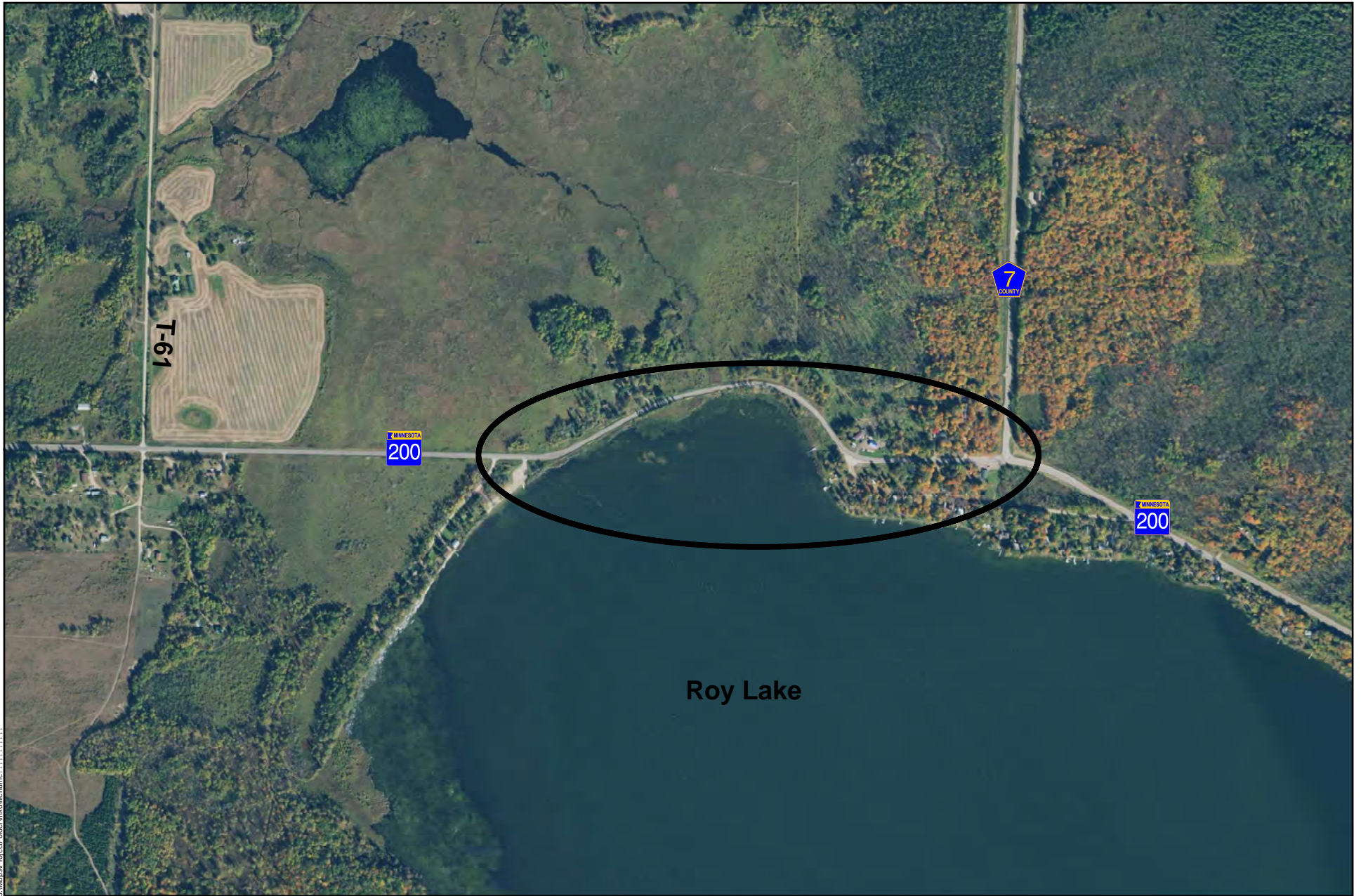
- This area has a high number of pedestrians who walk the roadway to get from C-Store to residences.
- Southern roadway shoulder has little clearance from Roy Lake



Roy Lake near Sunfish Rd

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Realign existing roadway to north • Install pedestrian walkway between realigned roadway and Roy Lake from Sunfish Rd to intersection of MNTH 200/Clearwater CSAH 7. 	<ul style="list-style-type: none"> • Install solar panel speed signs to inform in-coming traffic 	<ul style="list-style-type: none"> • Install lighting along corridor from Sunfish Rd to intersection of MNTH 200/CSAH 7





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Site #17 – R.P. 65.9 MNTH 200 CLEAR ZONE IMPROVEMENTS

This segment of MNTH 200 is located approximately one half mile west of the Mahnomon/Clearwater County line on the White Earth Reservation. An aerial photo of Site 17 is shown in Figure 22.

Crash History:

- There were five reported crashes at this site in the past five years.
- Of the five crashes, three were crashes with fixed objects.
- No fatal crashes occurred or were recorded at this site.

General Observation:

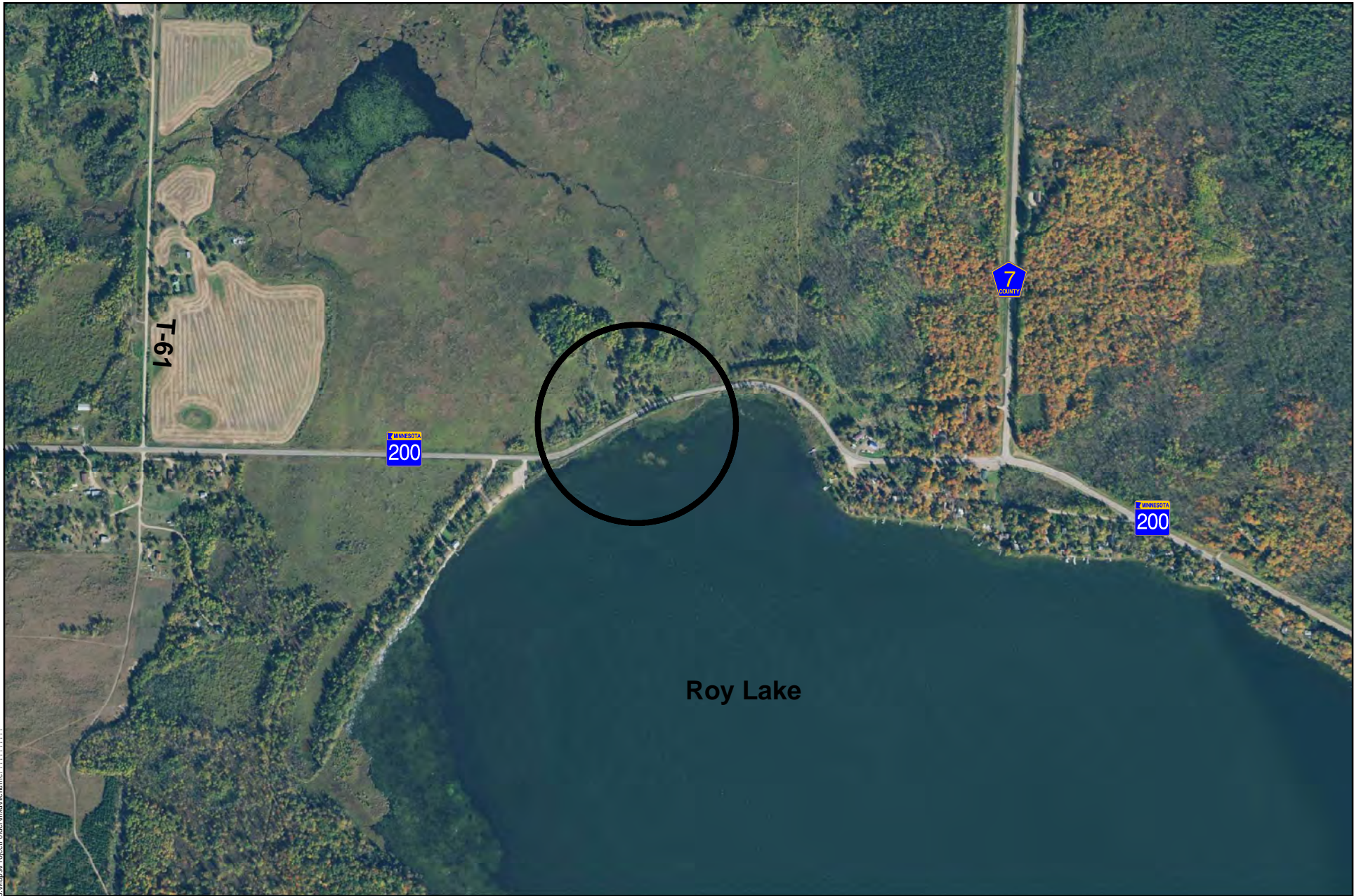
- This section of roadway has trees close to the highway in the clear zone causing site distance issues.
- A relatively high rate of the crashes that occurred (60%) were collision with fixed object.
- There are trees located within the clear zone along the segment causing site distance issues.



Fixed objects within clear zone at R.P. 65.9

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Eliminate fixed objects in clear zone • Widen shoulder 	<ul style="list-style-type: none"> • Edgeline rumble strips 	<ul style="list-style-type: none"> • Install safety barrier





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Site #18 – R.P. 66.2 MNTH 200/CLEARWATER CSAH 7 INTERSECTION SIGHT DISTANCE ISSUES

This T-intersection is side-street stop-controlled and located at the intersection of MNTH 200/Clearwater CSAH 7 on the White Earth Reservation. An aerial photo of Site 18 is shown in Figure 23.

Crash History:

- There have been two recorded crashes at this intersection in the past five years.
- There was one overturn/rollover crash at this location within the past five years.
- There was one collision with fixed object crash at this location within the past five years.

General Observation:

- Sight distance issues due to vehicles parking along the north side of MNTH 200 by convenience store.
- Relatively high volume of pedestrian traffic through this area.
- Season cabins/lake home traffic increases between June – August.



Intersection site distance issues MNTH 200/Clearwater CSAH 7

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Eliminate parking on the north side of MNTH 200 across from Roy Lake Store. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Define an access area at Roy Lake Store





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Site #19 – R.P. 66.2 MNTH 200/CLEARWATER CSAH 7 INTERSECTION LIGHTING

This T-intersection is side-street stop-controlled and located at the intersection of MNTH 200/Clearwater CSAH 7 on the White Earth Reservation. An aerial photo of Site 19 is shown in Figure 24.

Crash History:

- There have been two recorded crashes at this intersection in the past five years.
- There was one overturn/rollover crash at this location within the past five years.
- There was one collision with fixed object crash at this location within the past five years.

General Observation:

- This is a poorly lit intersection with pedestrian traffic, which makes it so unsafe for pedestrians.
- The intersection has a high vehicular volume
- Relatively high volume of pedestrian traffic in the area.



Poorly lit intersection MNTH 200/Clearwater CSAH 7

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install lighting in the intersection to improve visibility due to crashes that have occurred in dark conditions. 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Installation of new stop signs





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Site #20 – R.P. 66.3 to 74.3 ENHANCED EDGELINE INSTALLATION

This segment of roadway is located between the intersections of MNTH 200/Clearwater CSAH 7 and MNTH 92/MNTH 200 on the White Earth Reservation. An aerial photo of Site 20 is shown in Figure 25.

Crash History:

- There have been three recorded crashes along this segment in the past five years.
- There were two collision with moving vehicle type crashes along this segment within the past five years.
- There was one collision with fixed object crash at this location within the past five years.

General Observation:

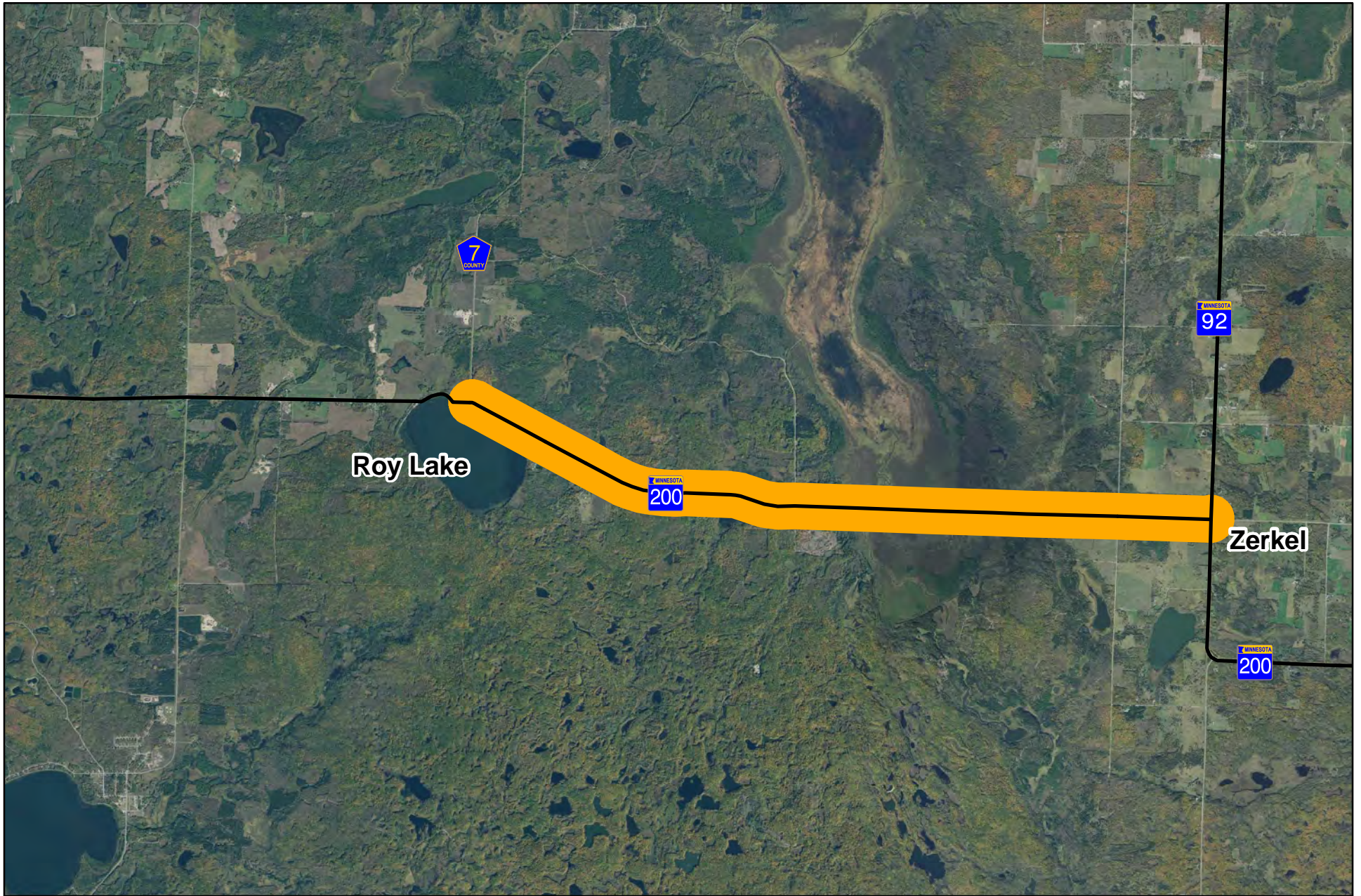
- This section of roadway is a high-risk segment due to several factors which include: critical radius curve density, narrow shoulder width, edge risk and access density.
- Sustained FAR Index = 1.26. A prominent number of the crashes are single vehicle ran off the road crashes.
- There is a high access density, leaving several vulnerable locations for potential accidents.



Roadway segment for proposed enhanced edgeline installation

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install enhanced edgelines (6"-8") • Widen shoulders 	<ul style="list-style-type: none"> • Install chevrons near horizontal curves 	<ul style="list-style-type: none"> • 2016 MnDOT District 4 District Safety Plan Update recommended project • Install edgeline rumble strips • Install centerline rumble strips





Site #21 – R.P. 69.9 MNTH 200/AUGINAUSH ROAD INTERSECTION LIGHTING

This 90 degree T intersection is side-street stop-controlled and located at the intersection of MNTH 200/Auginaush Road on the White Earth Reservation. An aerial photo of Site 21 is shown in Figure 26.

Crash History:

- No crash data was collected for this site as it was added during the RSA by the RSA team when in the field.

General Observation:

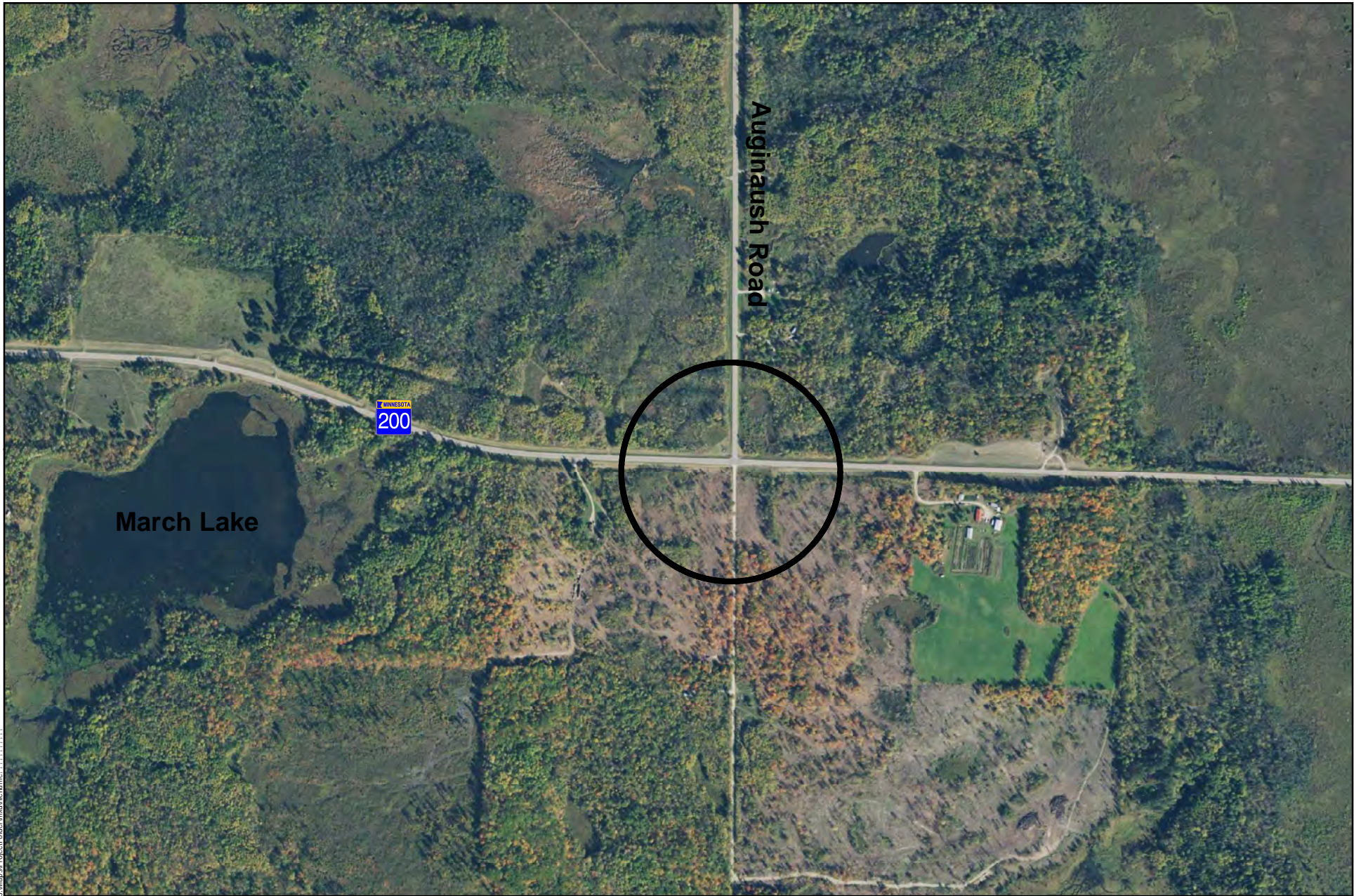
- The intersection is poorly lit with high pedestrian traffic making it extremely unsafe for the pedestrians
- CSAH 7 / 16 AADT > 100



Poorly lit intersection MNTH 200/ Auginaush Road

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install intersection lighting 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Conduct Auginaush Road traffic counts • Install EB right-turn lane





Site #22 – R.P. 70.9 BRIDGE OBJECT MARKER PANELS ON GUARD RAIL

This bridge is located approximately one mile east of Auginaush Road on MNTH 200 where the Wild Rice River crosses the roadway on the White Earth Reservation. An aerial photo of Site 22 is shown in Figure 27.

Crash History:

- No crash data was collected for this site as it was added during the RSA by the RSA team when in the field.

General Observation:

- There are no object markets on the guard rail terminal ends for the Wild Rice River Bridge



Wild Rice River Bridge guard rails

Highly Recommended	Potential High Impact	Suggested to Consider
<ul style="list-style-type: none"> • Install object marker panels and the guard rail terminal ends 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None





Summary

The White Earth Public Works Division is to be commended for undertaking an independent Road Safety Audit of MNTH 200. By systematically assessing areas of concern to MnDOT, Tribal and other safety stakeholders, important safety improvements can be considered, prioritized and implemented as resources to allow as resources to allow improvement of the performance and overall safety of MNTH 200.

This safety plan for the White Earth Nation was prepared as part of the Tribe’s Long Range Transportation Plan. The RSA was developed in coordination with MnDOT, BIA, County and Tribal transportation professionals.

Issues identified along the corridor provide documentation for potential corridor safety improvements. Issues identified provide the opportunity to improve overall roadway safety as well as address pedestrian safety issues. Roadway and pedestrian safety improvements can save lives. Documentation of roadway and pedestrian improvements are necessary for the purpose of obtaining funding and/or grants for improvement projects. The main issues identified in this RSA are summarized in Figure 28: Safety Issues

SAFETY ISSUE (Number and Description)		FAR Index	Suggestions
Crash Related Issues			
1	High Lane Departures, Severe Crashes Along Corridor	1.21	Highly Recommended: Install edgeline and Centerline rumble strips Potential High Impact: Install Chevrons near horizontal curves Suggested: Widen shoulders and improve inslopes, approach slopes and ditch depths.
3	Corridor Crash Rates Higher Than Similar Roads	1.21 Mahnomen to CSAH 7 1.26 CSAH 7 to Zerkel	Highly Recommended: Widen shoulders and improve inslopes, approach slopes and ditch depths Potential High Impacts: Install Chevrons near horizontal curves Suggested: Install edgeline and centerline rumble strips
6	High Fixed Object Severe Crash Rate Type	1.21 Mahnomen to CSAH 7 1.26 CSAH 7 to Zerkel	Highly Recommended: Removed fixed objects from clear zone areas Potential High Impact: Trim the trees near clear zones that restrict sight distances and pose dangers as fixed objects Suggested: Develop inventory of fixed objects with clear zone
Roadway Design Issues			



2	Narrow Shoulders	1.21	Highly Recommended: Widen shoulders and improve inslopes, approach slopes and ditch depths Potential High Impact: Install Chevrons near horizontal curves Suggested: Install edgeline and centerline rumble strips
4	Steep Inslopes, Deep Ditches, Steep Approach Slopes	1.21 Mahnommen to CSAH 7 1.26 CSAH 7 to Zerkel	Highly Recommended: Widen shoulders and improve inslopes, approach slopes and ditch depths Potential High Impact: Install guard rails and signage near water features Suggested: Install edgeline and centerline rumble strips
8	Horizontal Curve		Highly Recommended: Install Chevrons along the horizontal curves Suggested: Additional signage to the east and west of the curves
10	Steep Ditch Inslope Improvement		Highly Recommended: Widen shoulders and improve inslopes, approach slopes and ditch depths Potential High Impact: Add guard rails along water features Suggested: Install granite as shoulder material to minimize wetland impact
12	Deep Ditch Inslope Improvement		Highly Recommended: Widen shoulders and improve inslopes, approach slopes and ditch depths Suggested: Install granite as shoulder material to minimize wetland impact
Intersection Lighting Issues			
7	MNTH 200/Mahnommen CSAH 3 Intersection Lighting		Highly Recommended: Improve street lighting to improve lighting to intersection Suggested: Install new stop signs
13	MNTH 200/Mahnommen CSAH 4 Intersection Lighting		Highly Recommended: Install intersection lighting Suggested: Installation of new stop signs
19	MNTH 200/Clearwater CSAH 7 Intersection Lighting		Highly Recommended: Install intersection lighting Suggested: Installation of new stop sign
21	MNTH 200/Auginaush Road Intersection Lighting		Highly Recommended: Install intersection lighting



			Suggested: Conduct Auginaush Rd traffic counts and install EB right-turn lane
Deceleration Conflicts			
9	Curved Intersections, Higher EB Right-Turn Deceleration Conflicts		Highly Recommended: Install EB right-turn lane, improve inslopes, approach slopes and ditch depths, and eliminate hazards in the clear zones. Suggested: Adjust and add permanent signage to incorporate the addition of right-turn lane
11	High Right-Turn Deceleration Conflicts		Highly Recommended: Install right-turn lanes Potential High Impact: Install intersection lighting Suggested: Conduct updated traffic counts on Blair Road
Other (Misc.)			
5	No Passing Zones	1.21 Mahnomen to CSAH 7 1.26 CSAH 7 to Zerkel	Highly Recommended: Placement of wider pavement markings along corridor, and reduce percentage of No Passing Zone segments Potential High Impact: Install Chevrons near horizontal curves Suggested: Inventory short passing segments for usability and potential inclusions to No Passing Zones
14	Enhanced Edgeline Installation		Highly Recommended: Install enhanced edgelines and widen shoulders Potential High Impact: Install Chevrons near horizontal curves Suggested: 2016 MnDOT District 4 District Safety Plan Update recommended project
15	Traffic Calming Measures		Highly Recommended: Realign existing roadway to north Install pedestrian walkway between realigned roadway and Roy Lake from Sunfish Rd to intersection of MNTH 200/Clearwater CSAH 7. Potential High Impact: Install solar panel speed signs to inform in-coming traffic Suggested: Install lighting along corridor from Sunfish Rd to intersection of MNTH 200/CSAH 7



16	Chevron Installation		<p>Highly Recommended: Install Chevrons along the horizontal curves</p> <p>Potential High Impact: Additional signage prior to curve</p> <p>Suggested: Consider realignment roadway to the north</p>
17	MNTH 200 Clear Zone Improvements		<p>Highly Recommended: Eliminate fixed objects in clear zone and widen shoulders</p> <p>Potential High Impact: Install edgeline rumble strips</p> <p>Suggested: Install safety barrier</p>
18	Intersection Site Distance Issues		<p>Highly Recommended: Eliminate roadside parking on north side of MNTH 200 near Roy Lake Store</p> <p>Suggested: Define access area at Roy Lake Store</p>
20	Enhanced Edgeline Installation		<p>Highly recommended: Install enhanced edgelines and widen shoulders</p> <p>Potential High Impacts: Install Chevrons near horizontal curves</p>
222	Bridge Object Marker Panels on Guard Rails		<p>Highly Recommended: Install object marker panels and guard rail terminal ends</p>

