www.us12study.com

KLJ

US 12 CORRIDOR STUDY

May 2017

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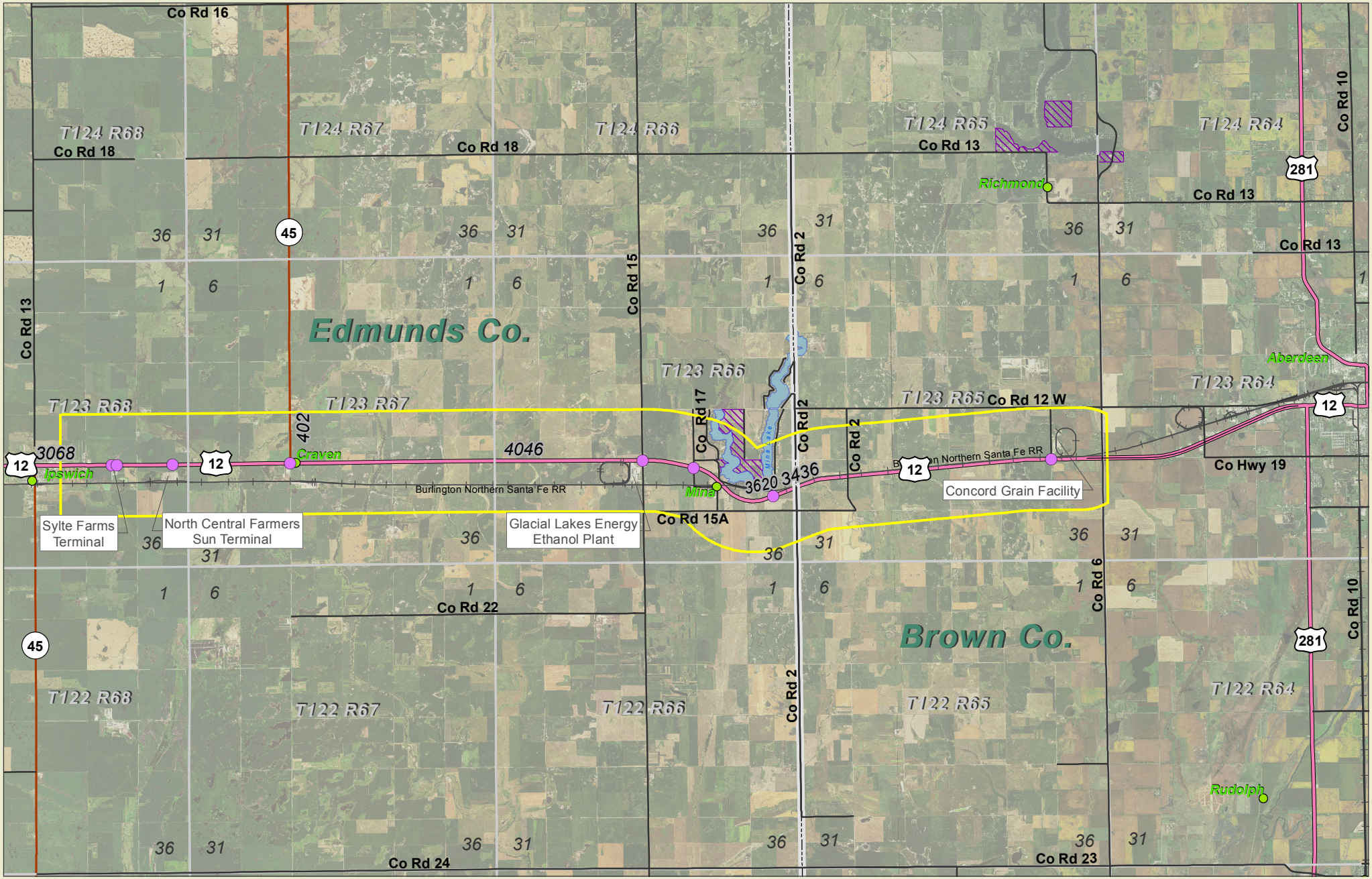
I. BACKGROUND

STUDY AREA

The South Dakota Department of Transportation (SDDOT) in conjunction with the South Dakota Highway Patrol (SDHP) and the Federal Highway Administration (FHWA) determined the need for a corridor study for a portion of US Highway 12 (US 12) corridor in eastern Edmunds County and western Brown County in South Dakota. SDDOT and KLJ sought stakeholder and public input to better understand the corridor's needs and address concerns. The study corridor starts at the east Ipswich city limits (MRM 263.85) and ends at the beginning of the divided section west of Aberdeen (MRM 283.88), approximately 20 miles. The full extent of the study area is seen in Figure I-1.

US 12 between Aberdeen and Ipswich is currently a two-lane rural roadway with an average annual daily traffic (AADT) between 3,000 and 4,000. Several severe crashes have occurred within the study area over the past five years. The corridor is also experiencing an increase in heavy vehicle traffic volumes due to development and expansion of agricultural processing and storage facilities along the corridor. An increase in the volume of large farming equipment and trucks is perceived by the public as a significant safety issue among the public when slower vehicles (especially those with extra-long loads) must share space with cars. Residents, stakeholders and the general public have voiced a concern for safety through the corridor. Several alternatives have been developed to accommodate the future traffic volume and class distribution anticipated along the corridor.

The corridor level analysis presented in this report looks at four corridor Build Alternatives discussed herein along with two sub-alternatives, with a focus on intersection improvements at eight of the most critical study intersections (See Figure I-1). This study uses crash and traffic data collected in 2015 and at two times in 2016 to evaluate traffic operations and safety, develop alternatives and make recommendations. The alternatives developed in the study are weighed based on their cost-benefit analysis using the *challenger-defender* method.



US 12 Corridor Study

- Study Intersection
- Project Boundary
- City
- Railroad
- Lake
- SD Parks and Rec Areas
- US Highway
- State Highway
- County Highway
- Township
- County Boundary
- 3068 2015 Average Daily Traffic (ADT)

N W E S

0 0.5 1 2 Miles

Orthophoto Source: NAIP
Date of Photography: 2014

US 12 Project Area Map

Figure I-1

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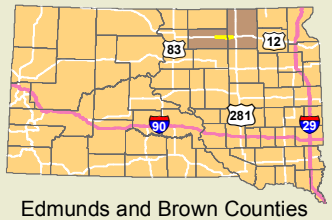


Edmunds and Brown Counties

II. EXISTING CONDITIONS

The existing conditions were analyzed to determine a baseline for operations along the US 12 study corridor. The existing access locations, safety (crash analysis) and intersection and corridor capacity analysis were studied to understand how the corridor operates today and to identify a series of alternatives that would improve corridor operations and safety.

ACCESS ANALYSIS

The segment of US 12 included in this corridor study is classified by SDDOT as a Rural Principal Arterial. The primary function of a principal arterial is to convey traffic, with a secondary function of providing access to abutting properties. Roadways and driveways having access along the corridor introduce conflict points into the traffic flow. Reducing the number of accesses onto US 12 where feasible, decreases conflict points and improves the overall safety and capacity of the study corridor.

Chapter 17 of the SDDOT Design Manual states that there should be a maximum of five accesses per mile per side and a minimum access spacing of 1000 feet for rural highways. Table II-1 below separates the 20.5 mile study corridor into two mile sections.

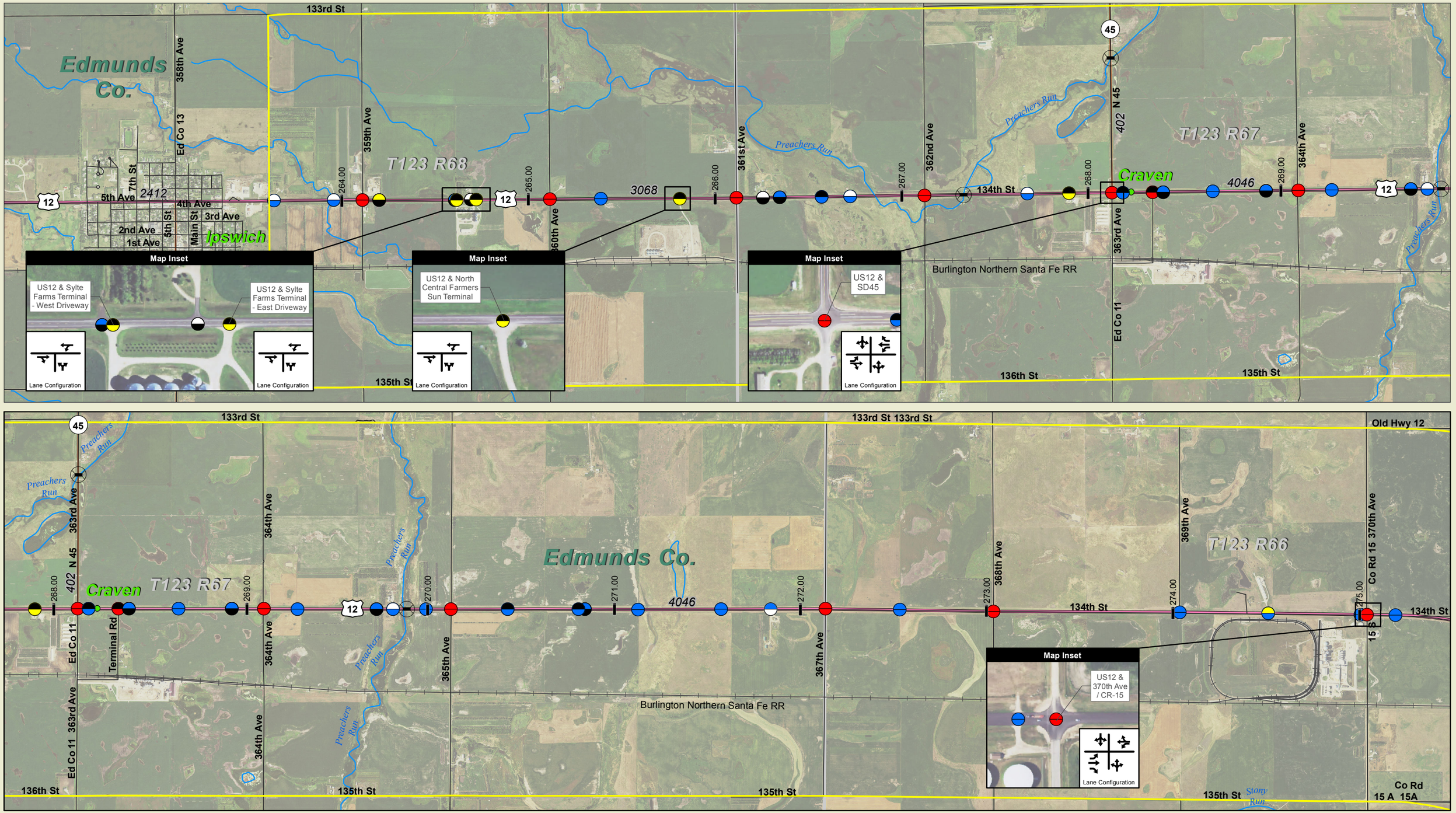
ACCESS ANALYSIS SUMMARY

Current access configurations along US 12 can be seen in Figures II-1 and II-2. Access locations onto US 12 are classified into one of four (4) categories: 1) Private Drive; 2) Field Approach; 3) Commercial/Industrial; and Public Roadway.

In general, the number of access points per mile did not exceed the maximum recommended accesses for a rural principal arterial listed in Chapter 17 of the SDDOT Design Manual, except for the two-mile section east of Craven (SD 45/US 12), which had one additional access on the north side than the maximum recommended 5 access per side per mile. Other sections throughout the corridor did not exceed the maximum number of access points per side per mile. In general, it is good practice to relocate major access points when feasible to section line roads to reduce the total number of access points. Access reduction typically improves the safety and capacity of roadways by reducing the number of conflict points.

Table II-1: Access Analysis

Section-Range-Township	Section Lines Roads	Access North /2 Miles	Access South /2 Miles	Recommended Access/2 Miles	Excess/ Deficient Access North	Excess/ Deficient Access South
22-123-68 23-123-68 24-123-68	Beginning of Study Corridor to 361st Ave	9	9	11	-2	-2
19-123-67 20-123-67	361st Ave to SD 45/363rd Ave	7	7	9	-2	-2
21-123-67 22-123-67	SD45/363rd Ave to 365th Ave	10	9	9	1	0
23-123-67 24-123-67	365th Ave to 367th Ave	6	7	9	-3	-2
19-123-66 20-123-66	367th Ave to Field Drives (369th Ave)	4	4	9	-5	-5
21-123-66 22-123-66	Field Drives (369th Ave) to CR17/371st Ave	7	7	9	-2	-2
26-123-66 25-123-66	CR17/371st Ave to 372nd Ave	6	5	9	-3	-4
30-123-65 29-123-65	373rd Ave to 376th Ave	3	5	9	-6	-4
28-123-65 27-123-65	376th Ave to 378th Ave	3	5	9	-6	-4
26-123-65 25-123-65	378th Ave to 382nd Ave	4	9	9	-5	0



US 12 Corridor Study

Access Points
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

- MRMs
- Structures
- Project Boundary
- City

- Railroad
- Streams/Rivers
- Lake
- US Highway
- State Highway
- Roads

- Township
- County Boundary
- SD Parks and Rec Areas
- 3068 2015 Average Daily Traffic (ADT)

N W E S

0 1,000 2,000 Feet

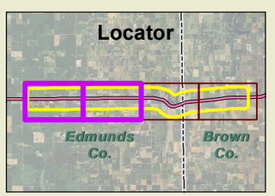
Orthophoto Source: NAIP
Date of Photography: 2014

Access

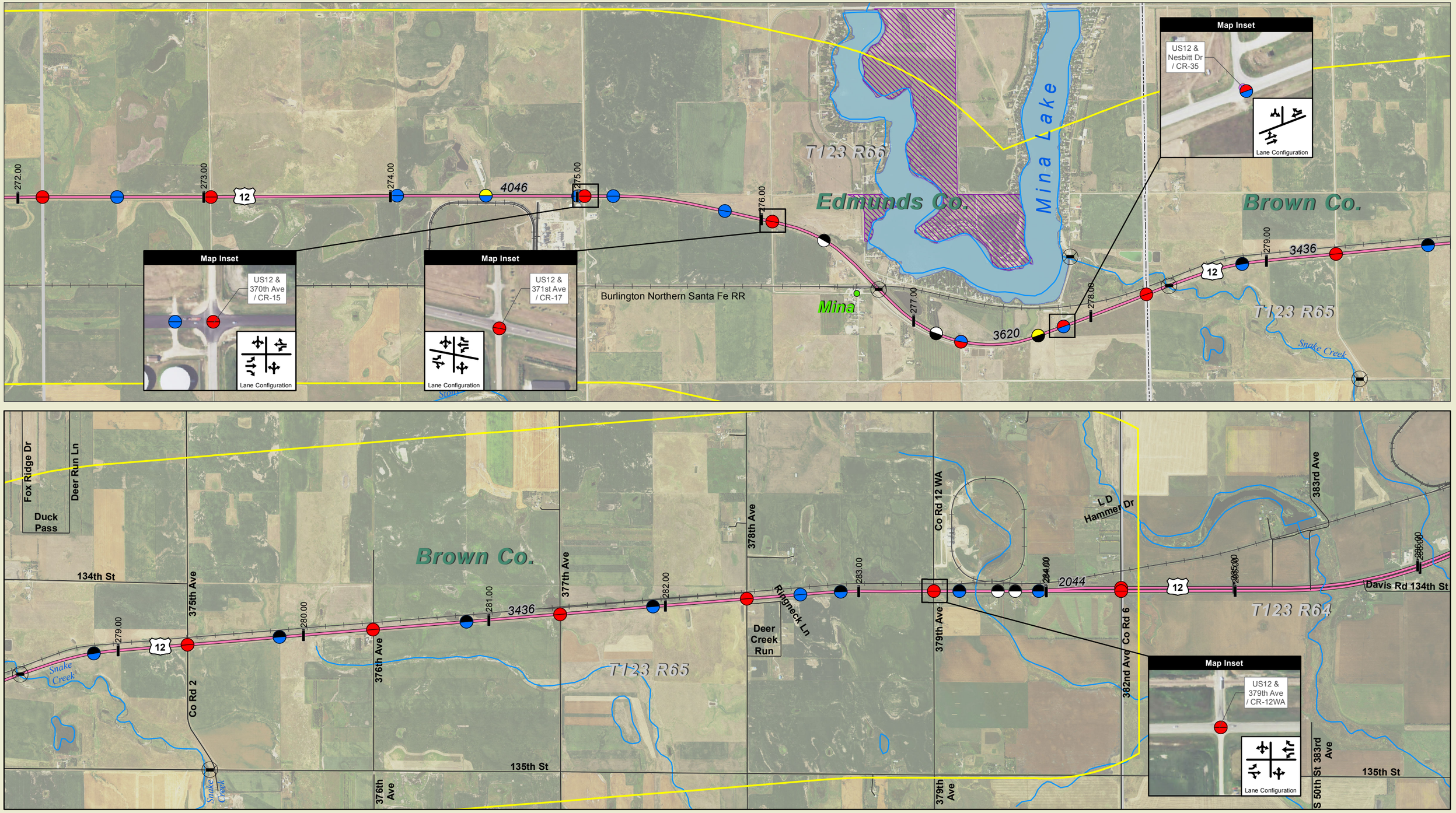
Figure II-1

KLJ

Locator



US 12 Corridor Study



Access Points

- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

- MRMs
- Structures
- Project Boundary
- City

- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads

- Township
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- 3068 2015 Average Daily Traffic (ADT)

N W E S

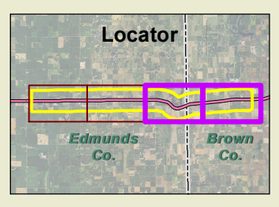
0 1,000 2,000 Feet

Orthophoto Source: NAIP
Date of Photography: 2014

Access

Figure II-2

KLJ



SAFETY

The 20 mile stretch of US 12 between Ipswich to Aberdeen has had several severe crashes over the past five years. With the increase to approximately 20 percent heavy vehicle truck traffic and the expansion of agricultural activities along the study corridor, it is important to ensure that the appropriate typical section is selected for both existing and future traffic volumes and to identify any roadway geometry deficiencies to improve the safety of the roadway. The public has voiced concern over the safety of US 12, especially after the three fatal crashes that occurred within 16 months (2014-2015).

The existing crash data was evaluated to identify any existing, correctable crash patterns. Additional safety analysis was evaluated using the Interactive Highway Safety Design Model (IHSDM) Crash Prediction module, however this information is discussed later in Chapter VI.

Crash Analysis

A crash analysis was performed for the study period of January 1, 2011 to December 31, 2015. See Table II-2 for a summary of crashes at each intersection, along with crashes along certain roadway segments between intersections. Wild animal crashes are listed in the table, however, no further analysis was performed on wild animal crashes. Figures II-3 and II-4 summarize the five-year crash data along the study corridor.

CRASH OVERVIEW

There were 244 crashes within the study corridor including animal crashes.

- Five of the crashes resulted in fatalities.
- Four of the crashes resulted in incapacitating injuries.

Fatal and Incapacitating Injury Crashes

Throughout the study corridor, five crashes resulted in fatalities and four crashes resulted in incapacitating injuries. Based on the crash reports, three of the five fatal crashes had alcohol or drug use reported. None of the crashes resulting in incapacitating injuries had alcohol or drug use reported.

FATAL CRASHES

- Three head-on crashes.
- Two non-intersection angle crashes.
- All five crashes involved a vehicle crossing into the opposing lane.
- Two of the crashes had weather as a contributing factor with ice/slush causing the vehicle to fishtail or slide into the opposing lane.
- One fatal crash was alcohol related.
- Two fatal crashes were drug related.

INCAPACITATING INJURY CRASHES

- Two non-intersection angle crashes:
  - One crash was from farm equipment which fell off a semi and hit a car in the opposing lane.
  - One crash was caused from a vehicle which slid into the opposing lane of traffic.
- One head-on crash:

    - Crash occurred because the vehicle attempted to pass a stopped vehicle preparing to turn left and collided with a vehicle in the opposing lane.
- One single-vehicle crash:
    - Crash was from a vehicle which failed to stop due to a vehicle malfunction in which the throttle was stuck and the driver was unable to stop until colliding with a trailer of a stopped vehicle.

Intersection Specific Crashes

A crash rate per million entering vehicles (MEV) was calculated for any intersection where a crash occurred. The South Dakota statewide average crash rate is 0.27 crashes per MEV. Three intersections had crash rates that exceeded the statewide average:

- US 12 and 361st Avenue
- US 12 and SD 45
- US 12 and CR 15

See Table II-2 for the crash rate per MEV for each of the intersections. Any intersection that had at least one crash was evaluated below.

US 12 and 361st Avenue

Two crashes were reported at the intersection of US 12 and 361st Avenue.

- One crash was a sideswipe crash between two westbound vehicles. A tractor truck/trailer was making a right-turn onto 361st Avenue and the car traveling behind the tractor truck/trailer attempted to pass on the shoulder.
- The second crash involved an eastbound vehicle which slid off the road due to icy conditions and hit a barb wire fence.
- The crash rate for this intersection is 0.30 crashes per MEV, which is higher than the statewide average crash rate of 0.27 crashes per MEV.

US 12 and SD 45

One crash was reported at the intersection of US 12 and SD 45. The crash occurred when a truck carrying a grain trailer failed to stop and rear-ended a snowplow with a trailer. The driver of the grain truck claimed that the throttle was stuck. The crash rate at this intersection is 0.28 crashes per MEV, which is slightly higher than the statewide average crash rate of 0.27 crashes per MEV.

US 12 and 365th Avenue

One crash was reported at the intersection of US 12 and 365th Avenue. A westbound vehicle was stopped waiting to turn left onto 365th Avenue. Another westbound vehicle approaching the intersection failed to see the stopped vehicle in time, and swerved into the eastbound lane and had a head-on crash with an eastbound vehicle, resulting in incapacitating injuries for all occupants of both vehicles.

US 12 AND CR 15/370TH AVENUE

Two crashes were reported at the intersection of US 12 and 370th Avenue.

- One crash was an angle crash which occurred during icy conditions when a vehicle attempted a right-turn at a high speed.
- The second crash was also an angle crash when a westbound vehicle attempted to make a U-turn to go east on US 12 and it collided with a second vehicle which was eastbound on US 12.
- The crash rate at this intersection is 0.37 crashes per MEV, which is higher than the statewide average of 0.27 crashes per MEV.

US 12 AND NESBITT DRIVE

One crash occurred at the intersection of US 12 and Nesbitt Drive. The crash was an angle crash caused by a westbound vehicle which attempted to make a right-turn onto Nesbitt Drive too fast and collided with a southbound stopped vehicle.

US 12 AND 375TH AVENUE

One angle crash occurred at the intersection of US 12 and 375th Avenue. A westbound truck made a wide right-turn and hit a westbound car stopped to provide the truck space to execute the turn.

US 12 AND 378TH AVENUE

One angle crash occurred at the intersection of US 12 and 378th Avenue. A southbound left-turning vehicle failed to yield the right-of-way and was hit by a westbound vehicle.

Corridor Crash Analysis

In addition to evaluating intersection crashes, the roadway segment crashes were also analyzed. Any segment that included a fatal crash or a higher frequency of crashes (.27/MEV) than the statewide average for similar rural principal arterial corridors was reviewed in detail and is summarized below.

IPSWICH TO NORTH CENTRAL FARMERS SUN TERMINAL

Six crashes occurred between the beginning of the study corridor to the North Central Farmers Sun Terminal. All six of the crashes were single-vehicle crashes. Two of the six crashes were due to an animal being in the roadway. Three of the six crashes had icy roads as a contributing factor.

NORTH CENTRAL FARMERS SUN TERMINAL TO SD 45

Two non-intersection angle crashes occurred between the North Central Farmers Sun Terminal and SD 45.

One of the angle crashes was due to a driver being distracted by the radio and hitting the side of the trailer in front of it. The second angle crash was due to a left turning vehicle failing to yield to a through vehicle.

SD 45 TO COUNTY ROAD 17/371ST AVENUE

Sixteen crashes occurred from SD 45 to Country Road 17/371st Avenue. Three crashes resulted in fatalities when the drivers drifted into the opposing lane of traffic; two of the crashes had icy road conditions as contributing factors and the third crash had drug use as a main factor. Of the remaining thirteen crashes, there were:

- One angle crash:

- One crash was caused from an improper passing maneuver while a truck attempted to make a left-turn into a private drive.

» One head-on crash:
- Crash was caused by a driver that fell asleep and drifted into the opposing lane.

» One rear-end crash:
- Crash was caused by a vehicle that rear-ended another vehicle stopped due to roadway construction.

» One same direction sideswipe:
- Crash was caused from two vehicles that attempted to pass the same vehicle at the same time.

» Six single-vehicle crashes:
- Two crashes were due to icy road conditions.
- One crash was due to a vehicle that attempted to avoid a deer.
- Three crashes were due to drivers that drove off the road during dry conditions. Alcohol use was reported as a contributing factor in two of the crashes.

» Three other crashes:
- Three crashes were caused from objects/material that fell out of vehicles and trucks and damaged vehicles.

COUNTY ROAD 17/371ST AVENUE TO COUNTY ROAD 2/375TH AVENUE

Seven crashes occurred from the intersection of CR 17/371st Avenue to CR 2/375th Avenue. One crash was a fatal head-on crash that had alcohol as a contributing factor. Of the remaining six crashes, there were:

» One rear-end crash
- Crash caused when a vehicle struck another vehicle stopped to turn left.

» Four single-vehicle crashes
- Three crashes were due to a vehicle that drove off the road during dry conditions. Alcohol was a contributing factor in two of the crashes. Drug use was a contributing factor in the third crash.
- One crash was weather related with blowing snow decreasing driver visibility that caused the driver to strike the Snake Creek Bridge structure.

» One other crash
- One crash was due to a vehicle striking a cow in the middle of the roadway.

COUNTY ROAD 2/375TH AVENUE TO 382ND AVENUE

Eleven crashes occurred between CR 2/375th Avenue to 382nd Avenue. One of the crashes was a fatal angle crash that occurred when a vehicle crossed into the opposing lane of traffic; drug use was a factor in the crash. Of the remaining ten crashes, there were:

» One angle crash:
- Crash was caused from improper passing during icy conditions.

» Two rear-end crashes:
- Both crashes were caused from distracted drivers that rear-ended the vehicle that was in front of them. One crash report listed a cell phone as the distraction. The other crash did not list the specific distraction in the crash report.

» One opposite direction sideswipe crash:
- A vehicle pulled over onto the shoulder due to poor visibility from blowing snow. A truck crossed the centerline and sideswiped the vehicle that was stopped on the shoulder.

» Six single-vehicle crashes
  - Three crashes were due to icy road conditions.
  - One crash was due to a distracted driver who drove off the roadway during dry conditions. The driver was cleaning up a spilled drink when he drove off the road.
  - One crash was a wild animal crash.
  - One crash was due to a vehicle malfunction that caused the vehicle to start on fire.

SUMMARY

Most crashes throughout the corridor were related to weather, distracted driving, wild animals or drug/alcohol use. Many of these crashes would not be amenable to correction with engineering improvements. Some of the head-on crashes and sideswipe crashes could be mitigated by adding additional passing opportunities throughout the corridor so that faster moving vehicles could pass slower moving vehicles without entering the opposing lane of traffic. In addition, some of the rear-end crashes could be mitigated by adding or extending turn lanes at the approaches. However, many of the left-turn related rear-end crashes that were occurring throughout the corridor were at private drives or low-volume public roadways, where turn lanes would not be warranted.

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Table II-2: Crash Data Summary

Location	Number of Crashes	Crash Rate (MEV)	Crash Type							Crash Severity[1]				
			Angle	Non-Intersection Angle	Head-On/ Sideswipe Opposite	Rear-End	Sideswipe Same	Single-Vehicle	Animal	Fatal	Inj A	Inj B	Inj C	PDO
US 12 between Ipswich to Sylte Farms Terminal West Driveway	20	N/A	-	-	-	-	-	1	19	-	-	-	-	20
US 12 and Sylte Farms Terminal West Driveway	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-
US 12 between Sylte Farms Terminal West Driveway and East Driveway	1	N/A	-	-	-	-	-	1	-	-	-	1	-	-
US 12 and Sylte Farms Terminal East Driveway	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-
US 12 between Sylte Farms Terminal East Driveway to North Central Farmers Sun Terminal	14	N/A	-	-	-	-	-	3	11	-	-	-	1	13
US 12 and North Central Farmers Sun Terminal	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-
US 12 between North Central Farmers Sun Terminal and 361st Ave	3	N/A	-	-	-	-	-	-	3	-	-	-	-	3
US 12 and 361st Ave	2	0.30	-	-	-	-	1	1	-	-	-	-	-	2
US 12 between 361st Ave and SD 45	24	N/A	-	-	2	-	-	-	22	-	-	-	-	24
US 12 and SD 45	2	0.28	-	-	-	1	-	-	1	-	1	-	-	1
US 12 between SD 45 and 366th Ave	35	N/A	-	-	6	1	1	2	25	2	2	2	1	28
US 12 between 366th Ave and 370th Ave/CR-15	17	N/A	-	-	2	1	-	-	14	1	-	-	-	16
US 12 and 370th Ave/CR-15	3	0.37	2	-	-	-	-	-	1	-	-	1	-	2
US 12 between 370th Ave/CR-15 and 371st Ave/CR-17	9	N/A	-	-	-	-	-	4	5	-	-	-	1	8
US 12 and 371st Ave/CR-17	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-
US 12 between 371st Ave/CR-17 to Nesbitt Dr/CR-35	20	N/A	-	-	1	1	-	2	16	1	-	2	-	17
US 12 and Nesbitt Dr/CR-35	1	0.14	1	-	-	-	-	-	-	-	-	-	-	1
US 12 between Nesbitt Dr/CR-35 to 375th Ave	15	N/A	-	-	-	-	-	3	12	-	-	-	1	14
US 12 and 375th Ave	1	0.14	1	-	-	-	-	-	-	-	-	-	-	1
US 12 between 375th Ave to 379th Ave/CR-12WA	25	N/A		1	3	2	-	4	15	1	1	1	-	22
US 12 and 379th Ave/CR-12WA	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-
US 12 between 379th Ave/CR-12WA to CR-6	8	N/A	-	-	-	-	-	2	6	-	-	-	-	8
TOTAL	200		4	1	14	6	2	23	150	5	4	7	4	180

Crash Severity[1]: Fatal - Fatality, InjA - Incapacitating Injury, InjB - Non-Incapacitating Injury, InjC - Possible Injury, PDO - Property Damage Only, WA - Wild Animal

Study Intersections | Non-Study Intersections | Segment Crashes

Edmunds Co.

359th Ave

264.00

2412

12

12

Ipswich

3068

265.00

360th Ave

134th St

266.00

361st Ave

267.00

362nd Ave

T123 R68

T123 R67

45

State Hwy 45 N 45

402

268.00

Craven

4046

12

269.00

364th Ave

-------> See Panel Below

363rd Ave

Ed Co 11

Northern Santa Fe RR

136th St

135th St

36

37

Map Inset

US12 & Sylte Farms Terminal - West Driveway

US12 & Sylte Farms Terminal - East Driveway

Lane Configuration

Lane Configuration

Map Inset

US12 & North Central Farmers Sun Terminal

Lane Configuration

Map Inset

US12 & SD45

Lane Configuration

45

State Hwy 45 N 45

402

<------- See Panel Above

3068

268.00

Craven

269.00

364th Ave

270.00

365th Ave

12

271.00

4046

272.00

367th Ave

273.00

368th Ave

12

134th St

274.00

369th Ave

275.00

Co Rd 15

-------> See Next Page

363rd Ave

Ed Co 11

T123 R67

T123 R66

Edmunds Co.

370th Ave

Burlington Northern Santa Fe RR

Glacial Lakes Energy Ethanol Plant

135th St

135th St

15 A Co Rd 15A

36

31

US 12 Corridor Study

N W E S

0 1,000 2,000 4,000 Feet

Crash Severity

- Fatal
- Incapacitating Injury
- Non-Incapacitating Injury
- Possible Injury
- Property Damage Only

Crash Type *

- ★ Angle
- ♦ Head-on (front to front)
- ● No collision between 2 MV in transport
- ◗ Sideswipe
- ▲ Rear End (front to rear)

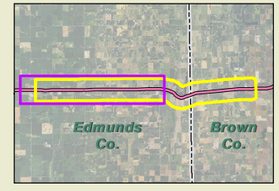
*Animal Crashes Excluded

- MRMs
- Project Boundary
- Lake
- Township
- County Boundary
- Railroad
- US Highway
- State Highway
- Roads
- High MEV intersection (exceeds .27MEV)
- Study Intersection
- 3068 2015 Average Daily Traffic (ADT)

Crash Data

Figure II-3

KLJ



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281.00
282.00
284.00

367th Ave
368th Ave
369th Ave
370th Ave
371st Ave
372nd Ave
373rd Ave
375th Ave
376th Ave
377th Ave
378th Ave
379th Ave
382nd Ave

Co Rd 15
Co Rd 17
Co Rd 31
W Lake Dr
Co Rd 30
Nesbitt Dr
S Shore Dr
Co Rd 35
Co Rd 12 WA
Co Rd 2
Co Rd 6

134th St
134 1/2 St
135th St
15 A
Co Rd 15A

12
4046
3436
3620
2044

T123 R66
T123 R67
T123 R65
T123 R64

Edmu
Mina
Brown Co.

Mina Lake

Burlington Northern Santa Fe RR

Concord Grain Facility

Ringneck Ln

36
31

Map Inset
US12 & 370th Ave / CR-15
Lane Configuration

Map Inset
US12 & 371st Ave / CR-17
Lane Configuration

Map Inset
US12 & Nesbitt Dr / CR-35
Lane Configuration

Map Inset
US12 & 379th Ave / CR-12WA
Lane Configuration

US 12 Corridor Study

0 1,000 2,000 4,000 Feet

Crash Severity
- Fatal
- Incapacitating Injury
- Non-Incapacitating Injury
- Possible Injury
- Property Damage Only

Crash Type *
- ★ Angle
- ♦ Head-on (front to front)
- ● No collision between 2 MV in transport
- ◗ Sideswipe
- ▲ Rear End (front to rear)

- MRMs
- Project Boundary
- Lake
- Township
- County Boundary
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- Roads
- High MEV intersection (exceeds .27MEV)
- Study Intersection
- 3068 2015 Average Daily Traffic (ADT)

*Animal Crashes Excluded

Crash Data

Figure II-4

KLJ

Edmunds Co.
Brown Co.

TRAFFIC AND CAPACITY ANALYSIS

TRUCK TRAFFIC

The SDDOT's Roadway Information System (RIS) Traffic File Historic Traffic demonstrates overall trends in traffic along the US 12 Corridor. Historic data point to gradual increases in truck traffic since 2001. Since 2010, percentage has stayed within two percent as shown in Table I-1. SDDOT typically takes mainline counts on US 12 in May or June of count years.

Table II-3: SDDOT Historic Traffic Data

RIS Traffic File Historic Traffic									
Year	MRM 263.1 (Near Ipswich)			MRM 268.13 (By SD 45)			MRM 277.29 (Near Mina)		
	ADT	Truck%	TAADT	ADT	Truck%	TAADT	ADT	Truck%	TAADT
2015	3,068	24.8%	760	4,046	17.7%	720	3,620	20.8%	750
2014	3,040	24.8%	750	4,010	17.7%	710	3,660	20.8%	760
2013	2,885	26.5%	760	3,802	18.9%	720	3,383	18.7%	630
2012	2,851	26.1%	740	3,977	18.6%	740	3,539	19.4%	690
2011	2,767	24.3%	670	3,232	18.6%	600	3,595	18.6%	670
2010	2,700	25.5%	690	3,285	19.7%	650	3,655	19.7%	720
2009	2,365	22.7%	540	2,880	18.0%	520	3,505	18.0%	630
2008	2,000	15.7%	310	2,700	12.9%	350	3,285	12.9%	420
2007	1,809	14.1%	260	2,540	19.7%	500	3,100	19.7%	610
2006	1,740	14.1%	250	2,445	19.7%	480	2,985	19.7%	590
2005	1,697	14.1%	240	2,554	19.1%	490	2,975	19.1%	570
2004	1,758	14.1%	250	2,648	14.8%	390	3,090	14.8%	460
2003	1,657	20.7%	340	2,643	16.0%	420	3,080	16.0%	490
2002	1,797	20.2%	360	2,744	13.6%	370	3,125	13.6%	430
2001	1,883	10.7%	200	2,876	10.7%	310	3,275	10.7%	350

TRUCK DISTRIBUTION

The US 12 Corridor experiences a large percentage of truck traffic with both an origin and destination within the study area. Information provided by the stakeholders, as well as the traffic counts, were used to create an assessment of truck origins and destinations. Based observed field data, historic counts and consultation with major generators, there are approximately 200 trucks, or 25 percent of total TAADT, in the 12-hour period that do not have an origin or destination within the study area. Therefore, on average, 75 percent of the truck traffic along US 12 has an origin and/or destination between Aberdeen and Ipswich.

TRUCK LENGTH

Based on input from the stakeholder meetings, a large share of the agricultural related trucks on the US 12 corridor are doubles or singles with pups, a small additional trailer. Depending on axle configurations these vehicles are classified as one of three types: WB-67D (single axle trailer and pup), WB-92B (double axle trailer and single axle pup) or WB-109D

(double axle trailer and pup). This has increased the efficiency for truck freight along the corridor, but has also increased the length of trucks. Most these longer trucks typically have an origin and destination within the US 12 study area.

The additional truck length also presents considerations for existing and future proposed turn lane design along the US 12 corridor. A typical double trailer truck is approximately 100 feet long. The SDDOT Design Manual lists that an unwarranted turn lane should only have a length of 100 feet, which is inadequate for intersections where double trailer trucks are making turning movements. The current unwarranted standards in the SDDOT Design Manual don't appear to reflect the conditions for turn lane storage or truck deceleration along the US 12 Corridor.

PLATOONING

Speed data was collected using pneumatic tube counters. This data indicated up to 20 percent of vehicles platoon behind other vehicles during harvest conditions. Since traffic data can only be collected in spot locations, the amount of platooning that occurs throughout the corridor may vary based on the proximity to the truck generators and speed reduction zones. This variation was unable to be quantified, however, it would be anticipated that there would be more platooning near the truck generators. Public comments expressed strong concern and frustration with truck acceleration impacts on travel speeds. Therefore, later sections of this report do identify opportunities to break up platooning adjacent to existing truck terminals were entering and existing truck vehicles is most pronounced. The number of vehicles that were platooning was determined by the proximity in time crossing the tubes (within a few seconds) and the similarity in speeds between the vehicles.

TRUCK TERMINALS

As the Study process proceeded, the Truck Terminals along US 12 were determined to be adequate proxies for seasonal fluctuation in traffic along the corridor. Early in the study development process truck traffic was established as a critical issue along the US 12 Corridor. As such, the Study Advisory Team (SAT) took special attention to evaluate and review truck dynamics along the corridor. A discussion with each major terminal was included as part of the early input phase of the US 12 Corridor Study. There are five major truck generators in the US 12 study corridor:

- Sylte Farm Terminal
- North Central Farmers Elevator – Craven
- North Central Farmers Elevator – Sun Terminal
- Glacial Lake Ethanol Plant (GLE)
- Concord Grain Facility.

Table I-2 below compares the May 2016 truck counts, the adjusted average truck counts and the estimated peak counts provided by the terminals, to the October truck counts. In general, the October counts were higher than the adjusted average counts. In the case of Sylte Farms and the Sun Terminal, the October counts were slightly higher than the estimated peak conditions. The Craven Terminal, Glacial Lakes Ethanol (GLE) and Concord Grain had October counts that were lower than the estimated peak.

The adjusted average and estimated peak truck counts are likely still valid, since it was indicated that the time the October counts were taken may have been outside peak harvest conditions. The estimated peak for GLE may not necessarily coincide with the peak harvest time, since the production is primarily based on the price of ethanol, which varies outside of harvest season.

After applying the October adjustment factor to the collected October counts, the ADTs were typically between 200 to 300 ADT of the May counts. The SAT consented to and verified that the adjusted average counts would be a good representation of the average conditions along the study corridor.

Table II-4: TAADT October Counts Comparison

Terminal	May 2016 Counts	Adjusted Average Counts	Estimated Peak (1)	October 2016 Counts	October vs. Adj. Average	October vs. Est. Peak
Sylte Farms	60	60	140	160*	100	20
Sun Terminal	40	100	210	228	128	18
Craven/SD 45	75	100	360	259	260	-101
Glacial Lakes/CR15	360	460	900	367	-93	-533
Concord/CR 12WA	60	100	600	401	301	-199

* Assumed same percentage of cars from May 2016 counts
(1) Reported by Terminals as part of early input process

Recommended Traffic Analysis Adjustments

A significant issue identified through the development of the US 12 Corridor Study was related to gradual increases in truck traffic along the corridor and the propensity to see seasonal peaks in this truck. As noted above, KLJ and SDDOT collected data along US 12 in May and October 2016. Anecdotal and qualitative data was also gathered at the Stakeholder Meetings to assist in developing an understanding of the traffic dynamics throughout the US 12 Corridor. Several major truck generators along US 12 provided additional information about the amount of trucks entering and exiting their facilities throughout the year. In some cases, additional data was provided regarding location specific origin and destination of the trucks along the corridor. Data sourced from the stakeholder meetings were nearly identical to the numbers provided by key generators following the stakeholder meetings.

After anecdotal and qualitative data was collected through the public input process, the May 2016 counts were determined to not have captured the seasonal high for heavy truck traffic. For this reason, KLJ developed an alternative methodology for projecting future traffic to incorporate an average truck generation for the five major generators along the US 12 Corridor. To validate this approach, KLJ and the SDDOT collected two-way hourly segment counts and 12-hour intersection turning movement counts in October 2016. These counts confirmed the adjusted future traffic projections as representative of an average day on the corridor. The counts also confirmed the peak truck generation from the public input process and measure how additional heavy truck traffic generated during the fall harvest season impacts the corridor.

The October 2016 counts were compared against the May 2016 and the adjusted average counts. The adjusted average was found to be a fair representation of the AADT of the corridor, specifically truck traffic. The passenger vehicle traffic collected in May was determined to be an accurate collection based on recent historic trends and the October 2016 counts.

Since the number of trucks represented in the May 2016 counts was considered generally low compared to the average day, the number of trucks entering and exiting major terminals was increased to match an average day as provided by the terminals. For example, Concord Grain indicated that on an average day throughout the year, there would be a truck annual average daily traffic (TAADT) of 100 trucks entering and exiting the facility. The current May counts only show a TAADT of 60 trucks entering and exiting the facility. To adjust for the difference from the May counts and the indicated

average day, an additional 40 truck trips would be added to the existing conditions before being projected forward to 2021 and 2045.

Since the truck origin and destination have been evaluated based on the traffic counts and information provided by the truck generators, the additional trucks that would be added into the base condition would be assigned according to the existing origin and destination patterns.

The October data verified that the adjusted average counts would likely be a good representation for the average conditions throughout the corridor. The SAT consented to using the adjusted average data for the 2016, 2021 and 2045 forecast analysis. This was most significant when considering truck turning movements at the major terminals.

2016 Intersection Capacity Analysis

The adjusted average conditions were used for the intersection capacity analysis. The study intersections were analyzed using existing geometry, existing traffic control and the 2016 peak hour volumes. Figure II-4 shows the turning movement counts approved by the Study Advisory Team for development of the US 12 Corridor Study.

The projected traffic volumes used an annual growth rate of 1.45 for the 30-year (2045) analysis, based on guidance from the SDDOT. The five year (2021) peak hour traffic volumes were projected using a linear rate between the existing volumes and the 2045 volumes.

A Level of Service (LOS) analysis was conducted for each study intersection based on the Highway Capacity Manual (HCM) methodology. This analysis estimates current and projected intersection operations.

LEVEL OF SERVICE (LOS) CONCEPTS

LOS for a two-way stop-controlled (TWSC) intersection is determined by the computed or measured control delay; LOS for a TWSC intersection is defined for each minor movement but not defined for the intersection as a whole. Refer to Table II-5 for a control delay range expressed as seconds of delay per vehicle and the corresponding LOS letter grade. The LOS letter grade is analogous with school grades; A represents minimal delay and very efficient operations while F represents a complete breakdown of traffic operations and long delays. SDDOT requires LOS B or better on US 12, a rural principal arterial.

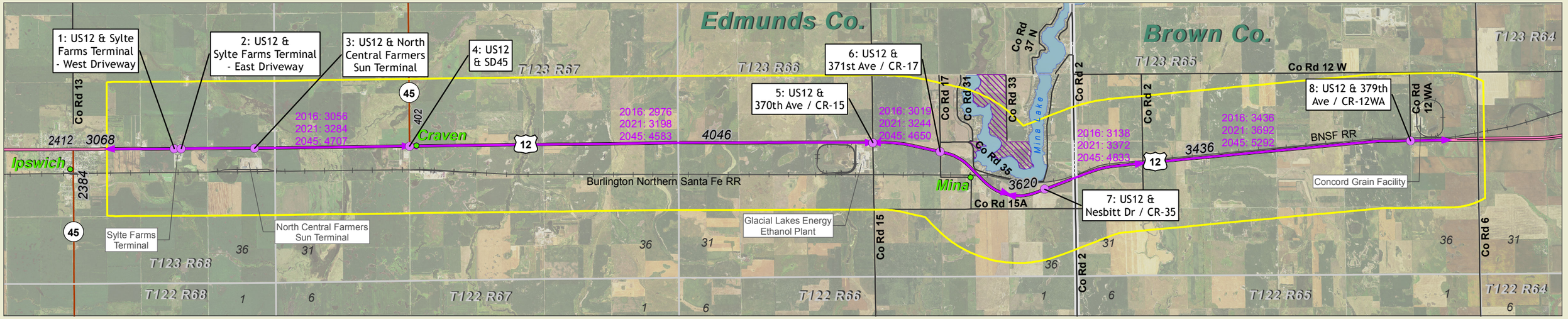
Table II-5: Level of Service Control Delay

LOS	TWSC Intersections (s/veh)
A	0-10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	>50

Capacity Analysis Results

Intersection capacity analyses were performed for weekday A.M. and P.M. peak hour traffic conditions. Intersection and approach LOS for 2016, 2021 and 2045 can be seen in Table II-6.

- US 12 & Sylte Farms Terminal – West Driveway
  - Existing Traffic Control – Northbound Stop Control
  - The westbound left turning movement and the northbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & Sylte Farms Terminal – East Driveway
  - Existing Traffic Control – Northbound Stop Control
  - The westbound left turning movement and the northbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & North Central Farmers Sun Terminal
  - Existing Traffic Control – Northbound Stop Control
  - The westbound left turning movement and the northbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & SD 45
  - Existing Traffic Control – Northbound and Southbound Stop Control
  - The westbound and eastbound left turning movements and the northbound and southbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & 370th Avenue/CR 15
  - Existing Traffic Control – Northbound and Southbound Stop Control
  - The westbound and eastbound left turning movements and the northbound and southbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & 371st Avenue/CR 17
  - Existing Traffic Control – Northbound and Southbound Stop Control
  - The westbound and eastbound left turning movements and the northbound and southbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & Nesbitt Drive/CR 35
  - Existing Traffic Control – Southbound Stop Control
  - The eastbound left turning movement and the southbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.
- US 12 & 379th Avenue/CR 12 WA
  - Existing Traffic Control – Northbound and Southbound Stop Control
  - The westbound and eastbound left turning movements and the northbound and southbound approach operate at LOS B or better during the 2016, 2021, and 2045 A.M. and P.M. peak hour conditions.



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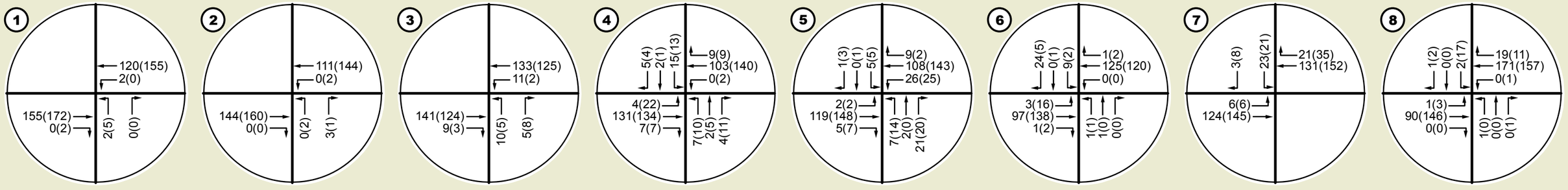
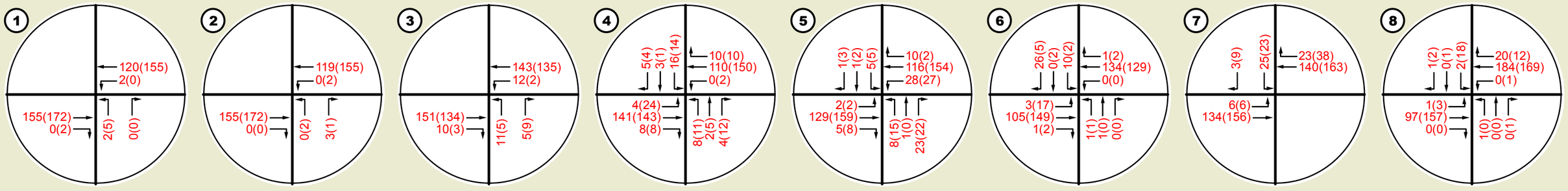
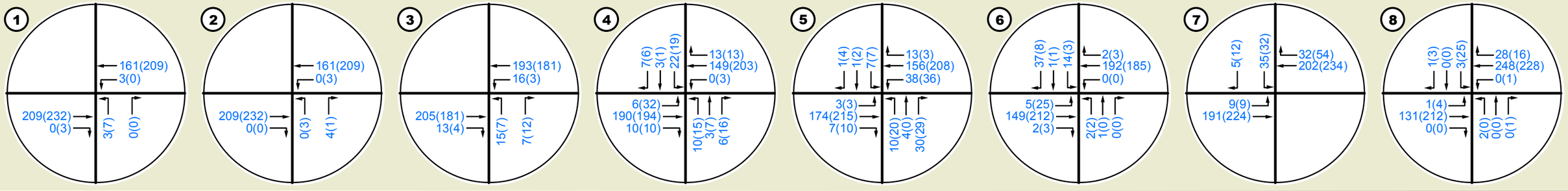


2021



2045



US 12 Corridor Study

- Average Daily Traffic
- Study Intersection
- Project Boundary
- City
- Railroad
- Lake
- US Highway
- State Highway
- County Highway
- Township
- County Boundary
- SD Parks and Rec Areas
- 3068 2015 Average Daily Traffic (ADT)

N W E S

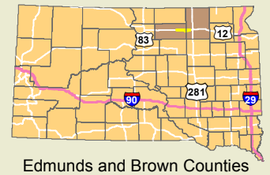
0 0.5 1 2 Miles

Orthophoto Source: NAIP
Date of Photography: 2014

Existing and Projected Traffic

Figure II-5

KLJ



Edmunds and Brown Counties

Table II-6: 2016, 2021 and 2045 Intersection Capacity Analysis

Intersection	Peak Period	2016 Level of Service/ Delay (seconds)					2021 Level of Service/ Delay (seconds)					2045 Level of Service/ Delay (seconds)				
		Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB
US 12 & Sylte Farms Terminal - West Driveway	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	7.7	10.5	-	-	-	7.8	11.0	-	-	-	7.9	12.0	-
	P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	8.4	10.7	-	-	-	8.5	11.3	-	-	-	8.8	12.6	-
US 12 & Sylte Farms Terminal - East Driveway	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	8.2	10.0	-	-	-	8.3	10.2	-	-	-	8.5	10.7	-
	P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	8.4	10.5	-	-	-	8.5	11.0	-	-	-	8.8	12.2	-
US 12 & North Central Farmers Sun Terminal	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	7.8	10.5	-	-	-	7.9	11.1	-	-	-	8.1	12.3	-
	P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
		-	-	7.7	10.1	-	-	-	7.8	10.4	-	-	-	7.9	11.1	-
US 12 & SD 45	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
		-	7.6	7.7	10.6	10.5	-	7.6	7.8	11.1	11.0	-	7.8	7.9	12.1	12.2
	P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
		-	7.7	7.7	10.9	11.2	-	7.8	7.8	11.4	12.0	-	8.0	7.9	13.0	14.0
US 12 & 370th Ave/CR15	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
		-	7.7	8.3	10.6	10.7	-	7.8	8.4	11.0	11.4	-	7.9	8.7	12.1	13.1
	P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
		-	7.8	8.5	11.4	10.9	-	7.8	8.6	12.1	11.7	-	8.0	8.9	14.0	13.4
US 12 & 371st Ave/CR17	A.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	B
		-	7.5	7.4	10.5	9.4	-	7.5	7.4	10.9	9.6	-	7.6	7.5	11.9	10.2
	P.M.	-	A	A	B	A	-	A	A	B	B	-	A	A	B	B
		-	7.5	7.5	10.5	9.6	-	7.5	7.5	11.1	10.0	-	7.7	7.7	12.5	10.7
US 12 & Nesbitt Dr/CR35	A.M.	-	A	-	-	A	-	A	-	-	B	-	A	-	-	B
		-	7.6	-	-	9.9	-	7.7	-	-	10.3	-	7.9	-	-	11.2
	P.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
		-	7.7	-	-	10.0	-	7.8	-	-	10.4	-	8.0	-	-	11.4
US 12 & 379th Ave/CR12WA	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
		-	8.1	7.6	10.3	10.8	-	8.2	7.7	10.8	11.3	-	8.4	7.8	11.9	12.7
	P.M.	-	A	A	A	B	-	A	A	A	B	-	A	A	A	B
		-	8.3	7.8	9.0	11.1	-	8.4	7.8	9.1	11.9	-	8.7	8.0	9.5	13.6

2016 Corridor Capacity Analysis

LOS analyses were conducted for three roadway segments. The capacity analysis utilized lane width, access density, directional hourly volume (DHV), percent no passing zones and other factors to determine how each segment operates. HCS 2010, a software that implements the Highway Capacity Manual, was used to calculate segment LOS.

LEVEL OF SERVICE (LOS) CONCEPTS[1]

Table II-7 shows the indicators for LOS for corridor segments. There are two measures for Class I Highways (highways where motorists expect to travel at relatively high speeds). Average Travel Speed (ATS) is defined as the average speed of vehicles within a segment. Percent of Time Spent Following (PTSF) is the average percentage of time a vehicle spends traveling behind slower vehicles due to the inability to pass. The percent No Passing Zones (%NPZ) was measured from using aerial photographs and old SDDOT plans. The lower LOS of the two is taken to be representative of the corridor LOS. Table II-8 shows the 2016, 2021, and 2045 corridor LOS. Field collected speed data from the tube counts was used in the 2016 corridor level of service analysis; however, 2021 and 2045 corridor level of service speeds were based off of the HCM 2010 methods for estimating the base free flow speed. All other factors remained the same between the 2016, 2021 and 2045 analysis.

Table II-7: Corridor Level of Service

LOS	Class I Highway	
	ATS (mi/h)	PTSF (%)
A	>55	≤ 35
B	>50-55	>35-50
C	>45-50	>50-65
D	>40-45	>65-80
E	≤40	>80

US 12 between Ipswich to 369th Avenue (Field Drives)

This segment of US 12 between Ipswich and 369th Avenue is expected to operate at LOS B through 2021, but falls to LOS C by 2045.

US 12 between 369th Avenue (Field Drives) to 373rd Avenue

This segment of US 12 between 369th Avenue and 373rd Avenue is expected to operate at LOS B through 2021, but falls to LOS C by 2045.

[1] Discussion in the Level of Service Concepts section is taken from: "Highway Capacity Manual 2010", Transportation Research Board, 2010, Chapters 15.

US 12 between 373rd Avenue to 382nd Avenue

This segment of US 12 between 373rd Avenue to 382nd Avenue is expected to operate at LOS B through 2021, but falls to LOS C by 2045.

Summary of Corridor Levels of Service

Table II-8: 2016, 2021 and 2045 Corridor Level of Service

Intersection	2016 LOS		2021 LOS		2045 LOS	
	ATS (mi/h)	PTSF (%)	ATS (mi/h)	PTSF (%)	ATS (mi/h)	PTSF (%)
US 12 between Ipswich to 369th Ave (Field Drives)	A	B	A	B	A	C
	61.0	39.2	62.4	42.8	61.3	50.6
US 12 between 369th Ave (Field Drives) to 373rd Ave	A	B	A	B	A	C
	61.1	36.8	62.5	41.1	61.3	50.3
US 12 between 373rd Ave to 382nd Ave	A	B	A	B	A	C
	60.9	45.5	62.7	45.3	61.4	53.4

TURN LANE ANALYSIS

Warrant Analysis

The SDDOT Design Manual Chapter 15 provides guidelines for turn lane installation for non-signalized intersections. Criteria include:

- Traffic volumes. The volume criteria is based on the amount of traffic turning from the major approach onto the minor approach and the number of opposing and/or approaching vehicles on the major approaches. For left- and right-turn lanes, installation should be considered when the turning volume and the opposing and/or approaching vehicles intersect within a shaded area of the figure provided by SDDOT. Figure II-5 and Figure II-6 show the SDDOT graphs to warrant a left- and right-turn lane, respectively based on the volume criteria from Chapter 15 of the SDDOT Design Manual.
- Crash experience.
- Special cases.

The SDDOT Design Manual Chapter 12 provides guidance for designing warranted and non-warranted turn lanes.

- Non-warranted turn lanes have a minimum full-width length of 100 feet with a 120 feet taper length.
- Warranted turn lanes have a full-width length based on the number of vehicles arriving in the average two-minute period within the peak hour.

Table II-9 shows the existing length of the turn lanes, turn lane warrants, and the minimum length required from the SDDOT Design Manual.

No turn lanes were warranted based on the volume criteria for 2016. The minimum storage length for unwarranted turn lanes is 100 feet. None of the existing turn lanes were less than 100 feet; however, since this is a high speed roadway, adding longer turn lanes for deceleration may improve the safety for turning vehicles.

The following turn lane would be warranted by 2021:

- Westbound left-turn lane at US 12 and CR 15.

The following turn lanes would be warranted by 2045:

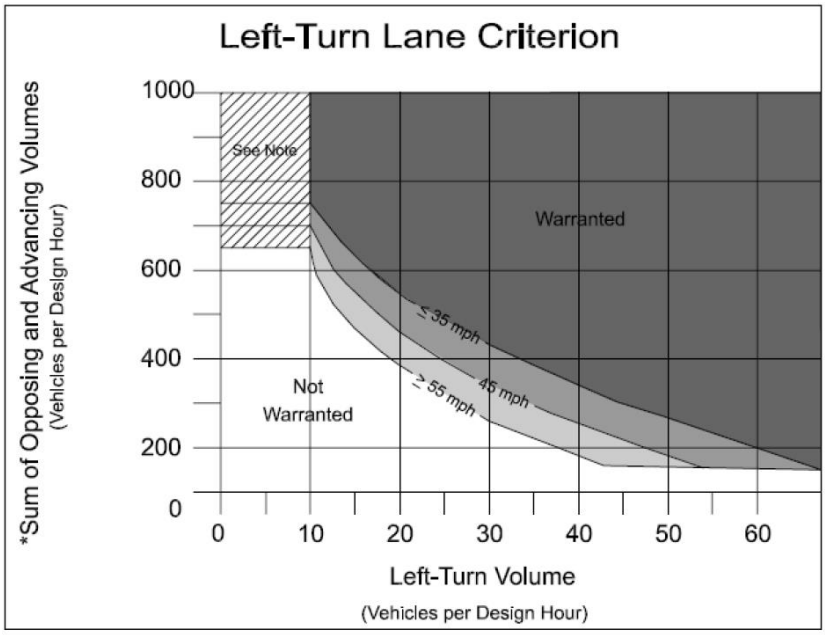
- Eastbound left-turn lane at US 12 and SD 45
- Westbound left-turn lane at US 12 and CR 15
- Eastbound left-turn lane at US 12 and CR 17

All future warranted turn lanes are already in place.

Turn Lane Lengths

The minimum length for warranted turn lanes is 400 feet at 65 miles per hour with additional storage length to accommodate the 95th percentile queue. The minimum 400 feet required for warranted turn lanes is to provide adequate length for vehicles to decelerate before making a turning maneuver. As alternative development starts, consideration should be given to design intersections that do not currently warrant turn lanes to the minimum design for warranted turn lanes to provide adequate length to decelerate before the intersection.

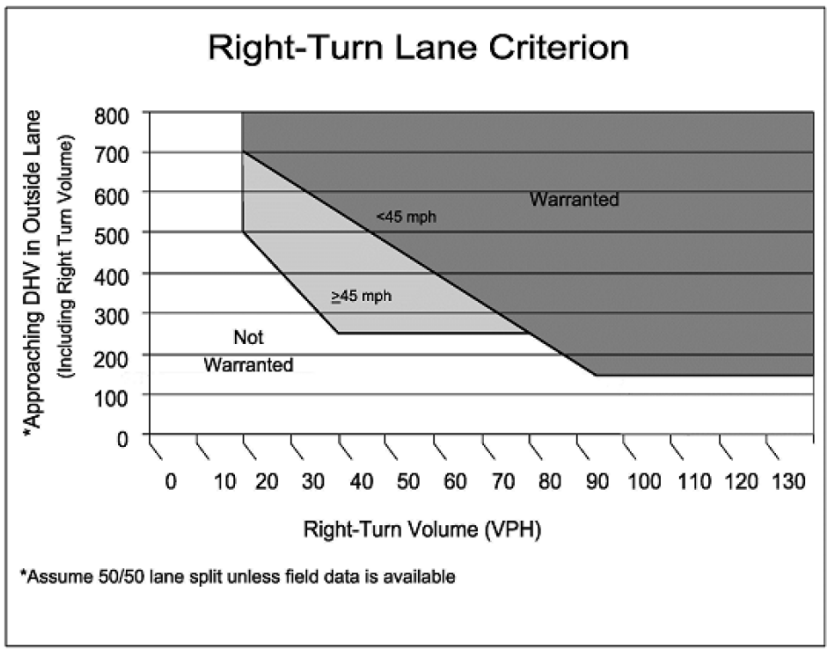
Figure II-6: Left-Turn Lane Criterion from Chapter 15 of the SDDOT Design Manual



Source: Oregon DOT Analysis Procedures Manual 2008

*(Advancing Vol/ # of Advancing Through Lanes)+
(Opposing Vol/ # of Opposing Through Lanes)

Figure II-7: Right-Turn Lane Criterion from Chapter 15 of the SDDOT Design Manual



Based on traffic counts completed by SDDOT, approximately 20 of the traffic along the US 12 mainline corridor is truck traffic. This is consistent with the KLJ intersection counts which shows approximately 20 percent of the traffic as truck traffic through County Road 15. The intersection counts at County Road 17, Nesbitt Drive, and County Road 12-WA show lower truck percentages varying from 2 percent at County Road 12-WA to 15 percent at Nesbitt Drive. Since this is a corridor that is impacted by harvest, the truck percentage would be anticipated to increase during harvest. The volume criteria for the

turn lanes was reevaluated with the increased truck turning movements during harvest time with the October counts, however, the turning movements would still be too low to warrant turn lanes based solely on the volume criteria.

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Table II-9: Summary of Turn Lane Warrant Analyses

Intersection	Existing Speed Limit	Turn Lane	Existing Turn Lane Length	SDDOT Design Manual Minimum Unwarranted Turn Length	SDDOT Design Manual Minimum Warranted Length*	2016			2021			2045		
						Peak Hour Turn Volume	Peak Hour Approaching Volumes (RT) Peak Hour Approaching+ Opposing Volumes (LT)	Turn Lane Warranted	Peak Hour Turn Volume	Peak Hour Approaching Volumes (RT) Peak Hour Approaching+ Opposing Volumes (LT)	Turn Lane Warranted	Peak Hour Turn Volume	Peak Hour Approaching Volumes (RT) Peak Hour Approaching+ Opposing Volumes (LT)	Turn Lane Warranted
US 12 & Sylte Farms Terminal-West Driveway	65	Westbound Left	N/A	100'	400'	2	255	No	2	275	No	3	370	No
		Eastbound Right	N/A	100'	400'	2	160	No	2	172	No	3	232	No
US 12 & Sylte Farms Terminal-East Driveway	65	Westbound Left	N/A	100'	400'	2	144	No	2	327	No	3	441	No
		Eastbound Right	N/A	100'	400'	0	160	No	0	172	No	0	232	No
US 12 & North Central Farmers Sun Terminal	65	Westbound Left	N/A	100'	400'	11	283	No	12	304	No	16	411	No
		Eastbound Right	N/A	100'	400'	7	141	No	10	151	No	13	205	No
US 12 & SD 45	65	Westbound Left	279'	100'	400'	2	312	No	2	335	No	3	452	No
		Westbound Right	159'	100'	400'	9	142	No	10	152	No	13	206	No
		Eastbound Left	172'	100'	400'	22	292	No	24	313	No	32	423	Yes
		Eastbound Right	N/A	100'	400'	7	156	No	8	167	No	10	226	No
US 12 & 370th Ave/CR15	65	Westbound Left	500'	100'	400'	25	302	No	27	325	Yes	36	439	Yes
		Westbound Right	N/A	100'	400'	2	168	No	2	181	No	3	244	No
		Eastbound Left	500'	100'	400'	2	325	No	2	350	No	3	472	No
		Eastbound Right	500'	100'	400'	7	150	No	8	161	No	10	218	No
US 12 & 371st Ave/CR17	65	Westbound Left	240'	100'	400'	0	278	No	0	299	No	0	403	No
		Westbound Right	100'	100'	400'	2	120	No	2	129	No	3	174	No
		Eastbound Left	490'	100'	400'	16	262	No	17	282	No	23	380	Yes
		Eastbound Right	N/A	100'	400'	2	138	No	2	166	No	3	223	No
US 12 & Nesbitt Dr/CR35	65	Westbound Right	425'	100'	400'	35	152	No	38	163	No	51	220	No
		Eastbound Left	N/A	100'	400'	6	260	No	7	356	No	9	481	No
US 12 & 379th Ave/CR12WA	65	Westbound Left	100'	100'	400'	1	317	No	1	341	No	1	460	No
		Westbound Right	625'	100'	400'	19	171	No	20	184	No	16	229	No
		Eastbound Left	540'	100'	400'	3	315	No	3	339	No	4	457	No
		Eastbound Right	N/A	100'	400'	0	149	No	0	160	No	0	216	No

* Additional storage length is required in addition to the minimum warranted length to accommodate the 95th percentile queue

III. PUBLIC INPUT & ISSUE IDENTIFICATION

PUBLIC INVOLVEMENT PROCESS

SDDOT deployed a robust public participation plan throughout the development of the US 12 Corridor Study. Public input regarding US 12 was collected through a variety of means. Public meetings and focus groups allowed stakeholders and concerned residents to review study area issues and express comments or concerns regarding existing and projected conditions. Public input and comments were taken via the US 12 Corridor Study website at www.us12study.com, through email and written comments. SDDOT deployed portable message signs along each end of US 12 to announce both public meetings. Public notices for all project public input meetings were advertised in both the Aberdeen American News and Ipswich Tribune.

PUBLIC INPUT MEETINGS

Public Input Meeting (PIM) #1 was held June 30th, 2016. Staff from SDDOT and KLJ provided an formal presentation regarding the background and intent of the US 12 Corridor Study. After the presentation, project information was displayed in an open house format with staff on hand to answer questions. The comments and contact information of participants involved in PIM #1 were collected and stored for further contact and analysis of comments.

PIM #2 was held January 30th, 2017 from 5:30 pm to 7:00 pm at the Ipswich High School. Approximately 95 people attended the open house public meeting. Staff from SDDOT and KLJ provided a formal presentation regarding the background and intent of the US 12 Corridor Study as well as an overview of the alternatives being studied. The formal open presentation was preceded and followed by an open house format in which project information was displayed on poster boards regarding the US 12 Corridor Study with staff on hand to answer any questions.

Figure III-1: Participants at PIM#2 Open House

Focus Group Meetings

As part of the US 12 Corridor Study, a series of stakeholder meetings were conducted on June 29th and 30th, 2016 and January 30th, 2017, to gather more specific input from agencies or entities having an investment in the US 12 Corridor. In cooperation with the Study Advisory Team (SAT) a list of stakeholder groups was identified. To assist in fostering a productive conversation, focus group invitees were grouped into meeting times to allow for a more topical discussion regarding specific interest areas along US 12.

List of Focus Groups Invitees (By "Interest Area")

- Aberdeen/Brown County
- Mina Lake/Edmunds County
- Ipswich Area
- North Central Farmers Cooperative
- Glacial Lakes Ethanol
- Concord Grain Facility (follow up conference call on July 20th)
- Sylte Farms

Study Advisory Team

The US 12 Corridor Study was guided by a Study Advisory Team (SAT). The SAT met six times between May 2016 and February 2017. The SAT meetings were used to develop project alternatives, analyze traffic assumptions, screen financial and other impacts and provide corridor study technical guidance. SAT membership included the following:

- Michael Behm, SDDOT – Planning & Engineering
- John Less, SDDOT – Road Design
- Lt. Doug Coughlin, SDHP
- Dan Martell, SDDOT – Aberdeen Region
- Jeff Senst, SDDOT – Aberdeen Region
- Phil Dwight, SDDOT – Aberdeen Area
- Scott Schneider, SDDOT – Aberdeen Region
- Brace Prouty, SDDOT – Project Development
- Becky Hoffman, SDDOT – Project Development
- Andy Vandel, SDDOT – Project Development
- Steve Gramm, SDDOT – Project Development
- Mark Hoines, FHWA
- Jeff Brosz, SDDOT – Transportation Inventory Management

ISSUES IDENTIFICATION

As part of the early public involvement process for the development of the US 12 Corridor Study, a series of issues were developed that generally summarized those major themes expressed by the SAT and the general public. What follows is a summary of those issues. As the corridor study proceeded these issues were used to assist in the development of and consideration of project alternatives.

Recent Improvements

There was a general sentiment from participants that efforts over the past several years by SDDOT and SDHP are helping. The addition of turn lanes, centerline rumple strips and improved enforcement were acknowledged by meeting participants, although their effect seems to have mixed reception. Concerns were cited related to noise caused by the rumble strips, specifically in the Mina area.

Turn Lane Concerns

There was a general consensus among focus group participants (and reflected in comments received from the public) that the lengths of the existing turn lanes along the US 12 Corridor are inadequate at several of the intersections within the study area. (Note: Meeting participants were informed that current turn lanes along US 12 meet SDDOT standards.) Given the propensity for seasonal peaks of truck traffic, most current turn lanes and tapers need to be increased in all cases. A major concern was the perceived need for acceleration and deceleration lanes at major origins/destinations along the corridor.

Current and Projected Economic Development

A corridor-level concern involves economic development in the area. As ag-related businesses become established and expand, new truck and other traffic can be expected to impact US 12.

A new soybean processing plant planned for 2019 will be built east of Aberdeen. It is anticipated that this new facility will draw nearly 500 trucks per day. However, given the traffic patterns in the area, it is anticipated that most of this traffic will be drawn from areas east of Aberdeen. Nonetheless, stakeholders felt that this new soybean facility would add some amount of new truck traffic to US 12 between Aberdeen and Ipswich.

Brown County stakeholders suggested a review of the recent report published by the First District Association of Local Governments, *Brown County Rural Development Site Analysis*, which evaluated sites in Brown County for either a concentrated animal feeding operation (CAFO) or agricultural related industrial development (AID). The report rated 25 sites as "good" for a CAFO, one of which was located in Mercer Township (west of Aberdeen). Based on metrics used by USDA, AID sites are more likely to generate significant amounts of truck traffic.

The report further rated 368 sites in Brown County as "good" for AID. Of these 368 sites, 57 were located in Mercer Township (west of Aberdeen), 41 were located in Warner Township (South and east of Aberdeen) and 29 were located in Aberdeen Township. A primary criterion for being rated a "good" site was proximity within one mile of rail, meaning that in all cases sites in Mercer Township would be located in relative proximity to US 12.

A similar analysis was completed by the USDA for Edmunds County. The *Edmunds County Rural Development Site Analysis* also points to future potential CAFO and AID development potential. Comparatively speaking, the number of potential CAFO sites in Edmunds County was much higher than in Brown County. The number of AID sites in Edmunds

County is far less than in Brown County, with only a total of 65 potential sites identified. As with Brown County, most of the imminent potential in Edmunds County exists primarily along the US 12 Corridor, or north along SD 45.

These reports provide no specific future projections for growth along the US 12 corridor. However, they are a proxy for the notion that the study area is ideal for continued agricultural related development, similar to the proposed soy bean process plants proposed west of Aberdeen.

Economic development stakeholders indicated that there has been some discussion about the potential addition of another elevator north of US 12 at the intersection of County Road 19 (384th Avenue). There is currently a loop track in place in the northwest quadrant of US 12 and County Road 19 at the location of the current Wheat Growers-West Terminal.

ECONOMIC DEVELOPMENT IMPACTS OF TRAFFIC CONDITIONS

While traffic conditions along US 12 in the study area are a concern, local economic development groups do not feel they are dampening the region's overall economic outlook. Stakeholders indicated the expansion of US 12 to four lanes on the east end of Aberdeen has aided in economic development in that area. However, it was stressed that the lack of a four-lane section west of Aberdeen is not an economic development concern, currently. If traffic volumes increase, that perception could change. The concern currently is safety, not necessarily mobility. The overall sentiment of economic development stakeholders was positive regarding the efforts to incrementally improve conditions along US 12. In many cases they suggested a cooperative attitude in assisting SDDOT with efforts to allocate needed investments along the corridor.

RESIDENTIAL & COMMERCIAL DEVELOPMENT

There was very little suggestion that substantial commercial (non-agricultural) and residential development is imminent along the US 12 corridor, particularly between Aberdeen and Mina. The White Tail Meadows subdivision, just south of US 12 along 378th Avenue, was recently platted and is currently being developed. There are eight to 10 lots currently developed, with only about five remaining available; however, those are currently flood prone.

There is some commercial and residential development along Brown County Road 12W. However, development in this area has been light. Much of the traffic along County Road 12W finds its way back into Aberdeen along US 281.

MINA

The Mina Lake area is becoming more of a year-round residential area. The pending expansion of the sewage lagoons at Mina Lake are not likely to support substantial future residential development. The expansion is simply to meet existing capacity needs for sewer discharge based on the current development pattern. It was reported there are a total of 337 permanent households (between 445 and 500 permanent residents) around Mina Lake. Most Mina Lakes residents work in Aberdeen or, if retired, use Aberdeen as the primary destination for medical appointments or shopping.

The golf course adjacent to Mina Lake was sold and converted to a mini ranch with a single home on it. The balance of available land would potentially allow for no more than 10 houses. Over the past year or so, there has been some additional platting along West Lake Drive with seven building starts, and four more are pending.

Land south of 133rd Street and West of 372nd Avenue is outside of the Mina Lakes Recreation Area and could be developed. However, none of these properties would have frontage on Mina Lake. In total, this area equals about 210 acres. Development potential is not considered imminent for these lands.

Ipswich

The community of Ipswich has seen some new residential growth in the last five years, however the population has grown by only 9 residents between 2000 and 2014. In 2014, of the approximately 498 total jobs held by Ipswich residents, 142 (28.5%) were in Aberdeen. Enrollment in the school has increased slightly in recent years. The school district indicated that it currently operates three to five buses a day along US 12 during the schoolyear, going as far east as Mina. No trends are noticeable that would change projected trends on US 12.

Comment Analysis & Potential Solutions

Comments by focus group participants and the general public were tallied and analyzed by common theme or issue. A summary of themes is presented in Table III-1. Safety concerns represented only 16.0 percent of explicit comments, however it is probable that all comments were concerned with the issue of safety. A very common theme was general support for a four-lane alternative for this section of US 12; 23.9 percent of all comments suggested a conversion to some kind of four-lane roadway and often portrayed such a conversion as the inevitable solution. Commenters also noted the increasing truck and farming traffic in the corridor and the dangers these larger vehicles can pose. With several grain-related facilities along the corridor, farm and truck traffic is perceived as being very dense.

Commenters were somewhat split on the effectiveness of rumble strips – placed in center or along the shoulder. Turn lane improvements were also popular and regarded in the language of many of the comments as a minimum measure to improve safety, especially with regards to trucks and farming vehicles with extra-long loads. Other comments listed in Table III-1 were less common.

Table III-1: Comment Analysis

Issue/Theme	Frequency	Percentage
Support Four-Lane Section	45	23.90%
Farm & Truck Traffic Concerns	38	20.20%
Safety Concerns	30	16.00%
Turn Lane Improvements	19	10.10%
Add Passing Lanes	12	6.40%
Do Not Support Rumble Strips	10	5.30%
Driver Behavior	9	4.80%
More No-Passing Zones	7	3.70%
Support Rumble Strips	6	3.20%
Construction Issues (Impacts of 4-lane)	5	2.70%
Improved Enforcement	4	2.10%
Speed Limits	3	1.60%
Total	188	100%

ALTERNATE/RELIEVER ROUTES

One potential solution brought up by stakeholders involved other corridors adjacent to US 12. Several county roads within the study area carry substantial volumes of traffic to-and-from destinations along and adjacent to US 12. One

recurring comment in the focus groups was the sentiment to ensure adequate capacity of adjacent county roads in both Brown County and Edmunds County. Additionally, it was suggested that some of these adjacent county roads may assist in providing a "bypass" or "reliever" function during certain times of the year for certain movements within the study area.

Of particular interest was Brown County 6, Brown County 12 and Edmunds County 15.

- Brown County 12 currently provides an east-west connection from Mina Lake to US 281, and was noted as providing about 20 percent of the trips into and out of the Concord Grain Terminal during peak harvest conditions.
- Brown County Road 6 was viewed as a corridor which has the potential to carry some level of truck and farm related traffic, as it runs north-south (perpendicular) to US 12, connecting both the landfill and Richmond Lake.
- Edmunds County 15 provides north-south connections into the GLE facility on US 12. GLE reported that only about 15 percent of its inbound traffic comes off of County Road 15. However, of that amount nearly half requires a crossing of US 12.

Edmunds County 24/Brown County 2/23 were also identified as future potential east-west reliever route to US 12. These corridors run between SD 45 and US 281. It was pointed out that North Central Farmers Elevator also has an operation at the intersection of Brown County 23 and US 281 in Warner.

ENFORCEMENT

A major talking point in each of the Focus Groups was safety and enforcement along the US 12 corridor. Participants indicated that they appreciated the increased enforcement on the part of SDHP, but felt more attention was needed to the corridor. It was stressed by SDHP that in the summer months, patrol staff are stretched thin.

Each Focus Group was given an overview of the crash analysis completed along the corridor. Meeting participants suggested that speed and distracted driving are both issues along the corridor. SDHP was present at each meeting and highlighted the recent enforcement efforts started in the first half of 2016. Redirected SDHP efforts along US 12 within the first six months of 2016 doubled tickets for speeding and hazardous driving, compared to the first six months of 2015. Of this increase, the majority were related to three specific areas:

- Seatbelt violations
- Speeding one to five miles per hour over the limit
- Hazardous moving violations

SAFETY

Several meeting participants suggested that in addition to turn lane improvements, a large share of the concerns along the corridor may well be addressed through smaller scale safety improvements. The following are the suggestions provided:

- Intersection warning systems – Advance notification systems and other improvements to enhance safety approaching at major intersections along the corridor. Deployment of dynamic systems could respond to peak conditions as they occur.

- Additional signing – Improved and updated signage along the corridor may assist in improved driver awareness and expectancy for the conditions along the corridor.
- Driver awareness – Related to signing, improve driver awareness during periods of peak truck traffic. Continue to work with major trucking groups and agricultural operations to promote positive (and patient) driver behavior. More importantly, continue to develop public service announcements and educational campaigns to improve driver responsibility and awareness at all times; and in particularly during peak conditions. It was noted that the GLE currently does a lot of outreach among its network for haulers regarding safety along the US 12 corridor.
- Dynamic Message Signs (DMS) – Deploy either temporary or permanent DMS along the US 12 corridor to alert motorists as to static or dynamic conditions along the corridor. This may be most helpful for "through" traffic which may often not be aware of conditions along the corridor.

PASS THROUGH TRAVELERS

It was generally understood that there is increased local awareness of the conditions along US 12. However, during the summer months, US 12 sees a sharp increase in tourist traffic, with out-of-state travelers, on occasion hauling a boat or other recreational trailer. This sentiment furthers the potential for either permanent or temporary DMS along the corridor to alert motorists to the dynamic conditions along the US 12 Corridor.

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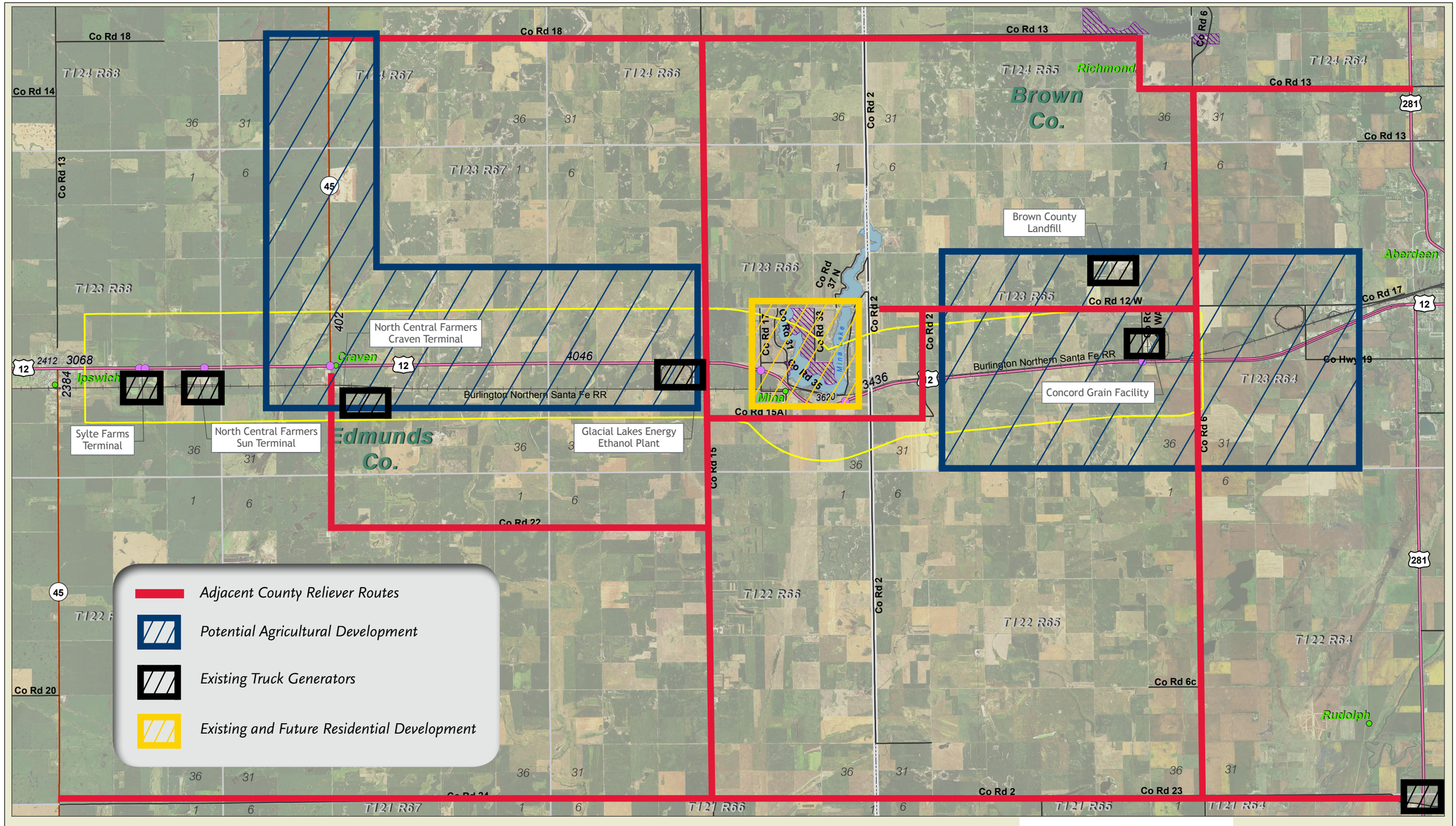


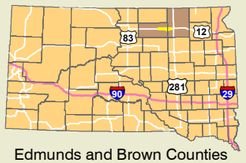
US 12 Corridor Study

Study Intersection
Project Boundary
City
Railroad
Lake
US Highway
State Highway
County Highway
Township
County Boundary
SD Parks and Rec Areas
3068 2015 Average Daily Traffic (ADT)

0 0.5 1 2 Miles

Orthophoto Source: NAIP
Date of Photography: 2014

US 12 Issues Identification



Edmunds and Brown Counties

IV. ALTERNATIVES EVALUATION METHODOLOGY

After evaluating the existing and projected conditions along the corridor and receiving public input, alternatives were developed to address potential operational and safety concerns and respond to comments expressed by the public. This chapter summarizes the criteria used to determine where certain improvements were applicable and the process used used to evaluate alternatives.

ALTERNATIVES EVALUATION CRITERIA

Four main alternatives were developed to address safety and capacity throughout the US 12 study corridor. Criteria from the SDDOT Design Manual and the Green Book were used to assist in developing alternatives. In some cases, neither source was conclusive in providing quantitative guidance to warranting certain improvements. Engineering judgement and SDDOT past practice was also used in developing and evaluating project alternatives.

Methodologies and Guidance

Criteria, warrants and justification for selecting various alternatives were collected from multiple sources. The SDDOT Design Manual was the first point of reference for developing the criteria/warrants for evaluating the installation of different improvements along US 12. Additional sources were used to supplement the SDDOT Design Manual where specific guidance was not included. Found below is a summary of the methods reviewed and the criteria selected for determining alternative justification for the US 12 Corridor.

ALTERNATIVE 1: INTERSECTION IMPROVEMENTS

Intersection improvements included lighting, dynamic messaging signs (DMS), turn lane modifications, deceleration lanes and access modifications. Intersection-related improvements are specifically to be considered as part of Alternative 1.

Turn Lane Additions/Modifications

Turn lane additions and modifications were based on guidance from the SDDOT Design Manual[2]. Recommendations for turn lanes occur using the special cases criteria, since there are railroad crossings throughout the corridor – especially in the section from 375th Ave east where the tracks are much closer to US 12 - and some geometric/safety concerns at the terminals where there are large numbers of trucks turning onto and off of US 12.

Only three of the turn lanes will meet the minimum warrants to install turn lanes by 2045. No intersection will meet the minimum crash criteria for installing turn lanes. Therefore, nearly all recommended turn lane improvements will be unwarranted based on existing and projected conditions. Given the high volume and seasonal fluctuations of truck traffic, major terminal intersections are considered a priority for turn lane lengthening and additions.

In general, if turn lanes are provided at the terminals or other intersections with the US 12 Corridor, turn lane length should meet the minimum warranted length to provide adequate length for the trucks to pull off of the mainline, otherwise, no turn lanes should be provided so that mainline vehicles are not deceived by trucks only being able to partially pull off of the mainline.

Acceleration Lanes

[2] SDDOT Design Manual Chapter 12 and 15

Acceleration lanes would provide additional space for trucks to accelerate without causing a capacity issue for mainline through traffic. Three primary sources[3][4][5] of guidance were used in evaluating the potential for additional acceleration/deceleration lanes along the US 12 Corridor.

While there is qualitative criteria and warrants for acceleration lanes, there does not appear to be any concrete quantitative evaluators for acceleration lanes. There are a few instances where trucks may benefit from acceleration lanes, but the capacity and crash data does not indicate that acceleration lanes are warranted. Therefore, the development of potential acceleration lanes along US 12 will be premised on the guidance provided by SDDOT:

- There is a definitive pattern of crash types correctable by the provision of an acceleration lane at a specific location.
- There is a demonstrable capacity issue that will be mitigated by the provision of acceleration lanes at a specific location.

Based on this guidance, acceleration lanes are not justified or warranted on the US 12 corridor.

Access Consolidation

Principal arterials have the primary function of moving traffic with a secondary function of providing access. Consolidating access on a principal arterial has the benefit of improving safety and increasing the capacity of the mainline roadway. Chapter 17 of the SDDOT Design Manual recommends an access density on rural roadways of five accesses per side per mile.

Based on the findings from the access section of Chapter II, most of the US 12 corridor is within the recommended access density, having five accesses per side per mile or less. Access consolidation would be recommended in locations where there are close proximities of access and where accesses could potentially be consolidated, especially to section line roadways. The potential for access consolidation will need to be vetted with the property owner(s) and the SDDOT for feasibility.

Intersection Lighting

Intersection lighting allows vehicles on both the mainline and the minor approaches to be aware of the upcoming intersection. It also is beneficial for drivers to identify if there are vehicles in the approach. Intersection lighting recommendations were based on guidance from SDDOT Design Manual Chapter 15.

The primary warrants used for determining if intersection lighting should be installed are the volume warrant, the geometrics warrant and the railroad warrant. The other warrants will not be met or applicable for the US 12 study corridor. Most terminals indicated that they maintain typical business hours, so traffic to-and-from the terminals would primarily be during the day. For this reason, intersections that are exclusively for terminals would likely not need intersection lighting, as vehicles would not be turning into or out of the approach during night hours. However, one other intersection (12WA) current meet warrants, and based on public input other intersections should be monitored lighting.

[3] SDDOT Guidance from August 30th Email

[4] AASHTO: A Policy on Geometric Design of Highways and Streets 6th Edition (2011)

[5] MNDOT Chapter 5 Road Design Manual

Dynamic Message Signs (DMS)

Because SDDOT has previously recommended the deployment of DMS along the US 12 corridor, DMS deployment will be considered a viable alternative for consideration.

Dynamic message signs inform travelers of changing conditions of the roadway. They may notify the driver of icy or slushy conditions, or that there was a crash ahead and a detour is in place. DMS would be especially effective during peak traffic periods where truck traffic is most pronounced.

Figure IV-1: Dynamic Message Sign Along Rural Corridor

ALTERNATIVE 2: PASSING LANES

Given the heavy volume of slower moving truck traffic, passing lanes would provide opportunities to reduce platooning and driver frustration related to slower moving vehicles. The development of passing lanes along the US 12 Corridor is by design guidance given in American Association of State Highway and Transportation Officials (AASHTO)'s *A Policy on Geometric Design of Highways and Streets 6th Edition (2011)* (popularly known as the Green Book):

- Passing lanes are generally used to increase the capacity of the mainline roadway. Table 3-31 in the Green Book indicates that for a one-lane flow rate of 100 to 200 vehicles per hour, a half-mile passing lane length is the optimum length for efficient passing. The Green Book also indicates that passing lanes over one mile in length should only be used in situations where flow rates are higher than 700 vehicles per hour in one direction, otherwise the operational benefits of a passing lane are greatly reduced.

The recommended passing lane length will be between 0.8 and 1.1 miles. The lane-addition taper will be 520 feet and the lane-drop taper would be 780 feet. Development of passing lanes would be such that deployment would be considered intermittently to reducing platooning along the corridor in each of three primary corridor segments:

- Ipswich to Craven Corner/SD 45
- Craven Corner/SD 45 to Mina
- Mina to Aberdeen

Passing lane sections will be explored as both a three-lane section and a four-lane section. The three-lane section is applied at intermittent location in isolated sections. The four-lane section is applied at isolated locations and in some cases would serve to reduce the amount of space needed for intermittent placement of the three-lane section.

Figure IV-2: Alternating Passing Lane Typical Three-Lane Section and Plan View

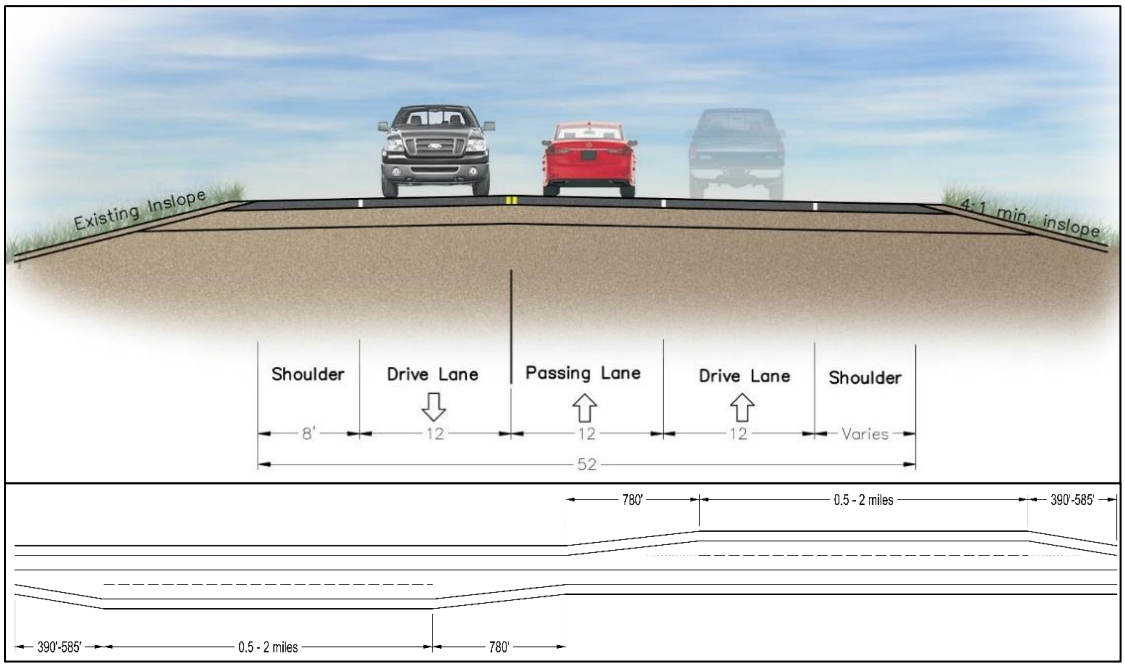
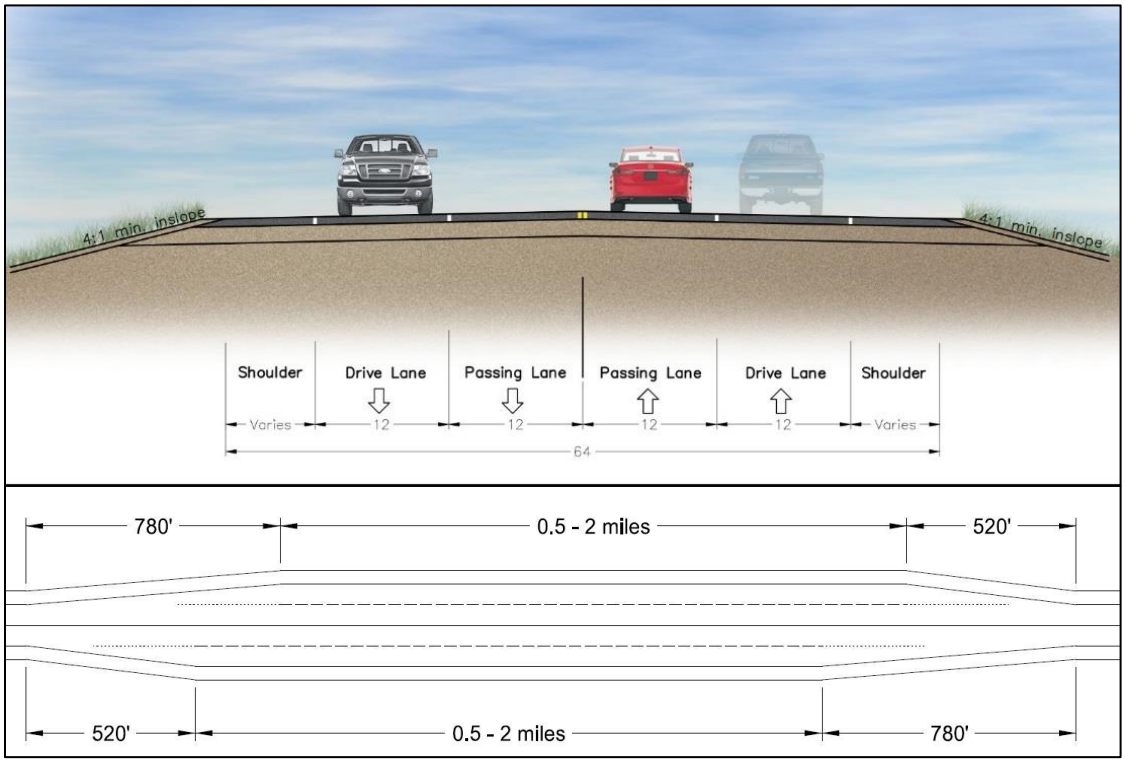


Figure IV-3: Combined Passing Lane Typical Four-Lane Section and Plan View



FOUR-LANE SECTION

A four-lane undivided section and four-lane divided depressed section will be evaluated. The SDDOT Design Manual is the primary reference for development of criteria for development of a four-lane section along sections of US 12.

Figure IV-4: Four-Lane Divided Typical Section

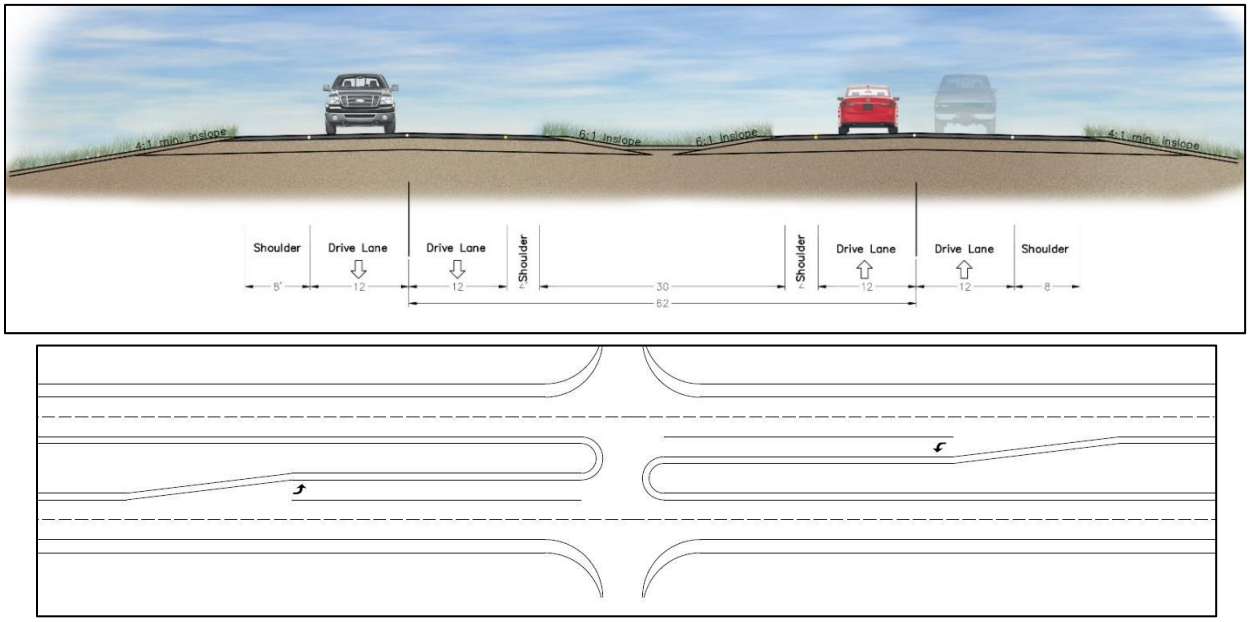
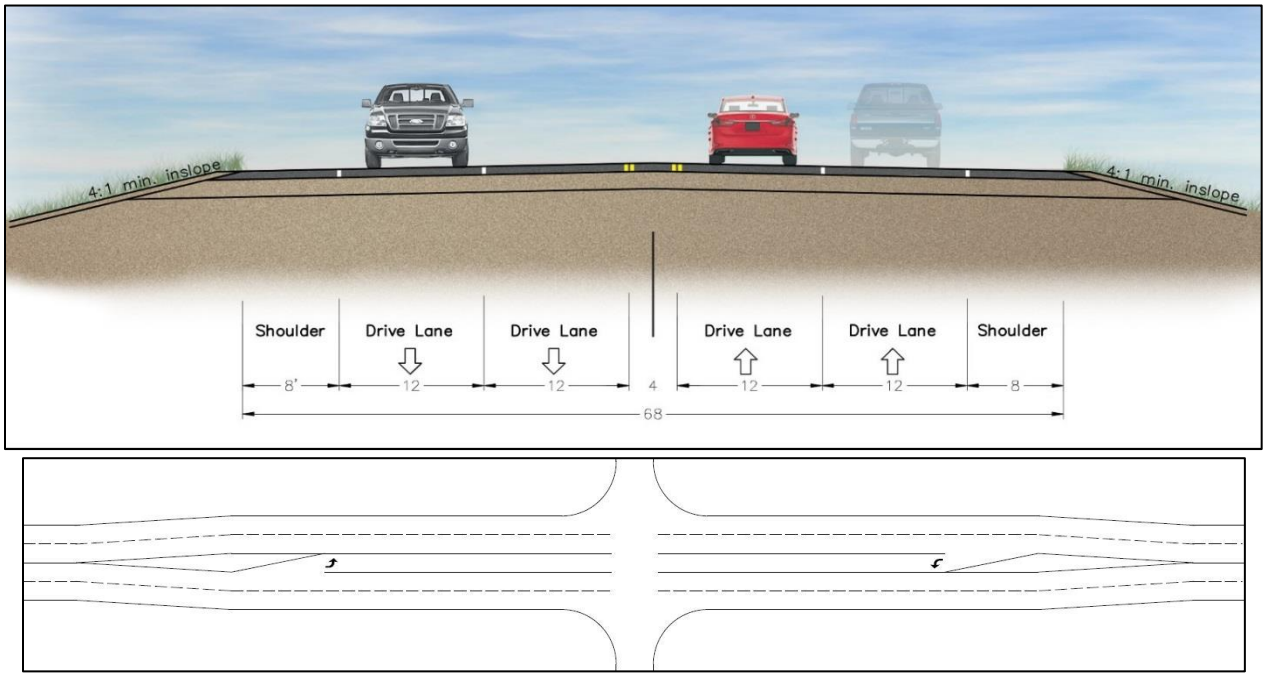


Figure IV-5: Four-Lane Undivided Typical Section



The SDDOT Design Manual indicates that typically a two-lane roadway would be used for AADTs less than 8,000. A four-lane roadway would be considered for AADTs between 8,000 and 20,000. (SDDOT Design Manual Chapter 15, Table 15-10). However, factors such as terrain, volume of left-turn movements, traffic signals, number of access points and major intersecting roadways should also be considered when determining the number of lanes for a highway.

Projected 2045 volumes along US 12 would still be below 8,000 ADT. Based solely on the traffic volumes, a four-lane roadway would not be warranted. Current truck traffic along the US 12 corridor would be considered a primary factor in justifying the development of a four-lane section; justification would be based primarily on additional benefits it provides in the area of mobility and safety compared to other alternatives, like intersection improvements and passing lanes.

The development of the four-lane section would typically be unwarranted based on existing guidance, even though LOS reaches C by end of the planning horizon.

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V. ALTERNATIVES DEVELOPMENT AND ANALYSIS

Based on the criteria discussed above, alternatives were developed to address existing and projected needs along the US 12 corridor. The warrants and justifications discussed in Chapter IV were used to recommend improvements along the US 12 Corridor. Four main alternatives were determined appropriate at the concept level to address existing and projected future needs along the US 12 corridor:

- Alternative 1: Intersection and spot improvements to address identified needs along the corridor.
- Alternative 2: Passing lanes at strategic locations along the US 12 corridor.
- Alternative 3: Development of a four-lane undivided highway.
- Alternative 4: Development of a four-lane divided highway.

What follows is an overview and summary of each of these specific alternatives applied through the US 12 Corridor.

ALTERNATIVE 1: INTERSECTION IMPROVEMENTS

Alternative 1 considers potential solutions including turn lanes additions, modified access, DMS, intersection lighting as well as a series of sub-alternatives focused most specifically at the primary study intersections and related to grain terminals along US 12 (Figure V-1). Costs shown for Alternative include a 15% contingency, but separate line item for engineering or right of way costs.

SEGMENT 1: SYLTE TERMINAL TO 361ST AVENUE

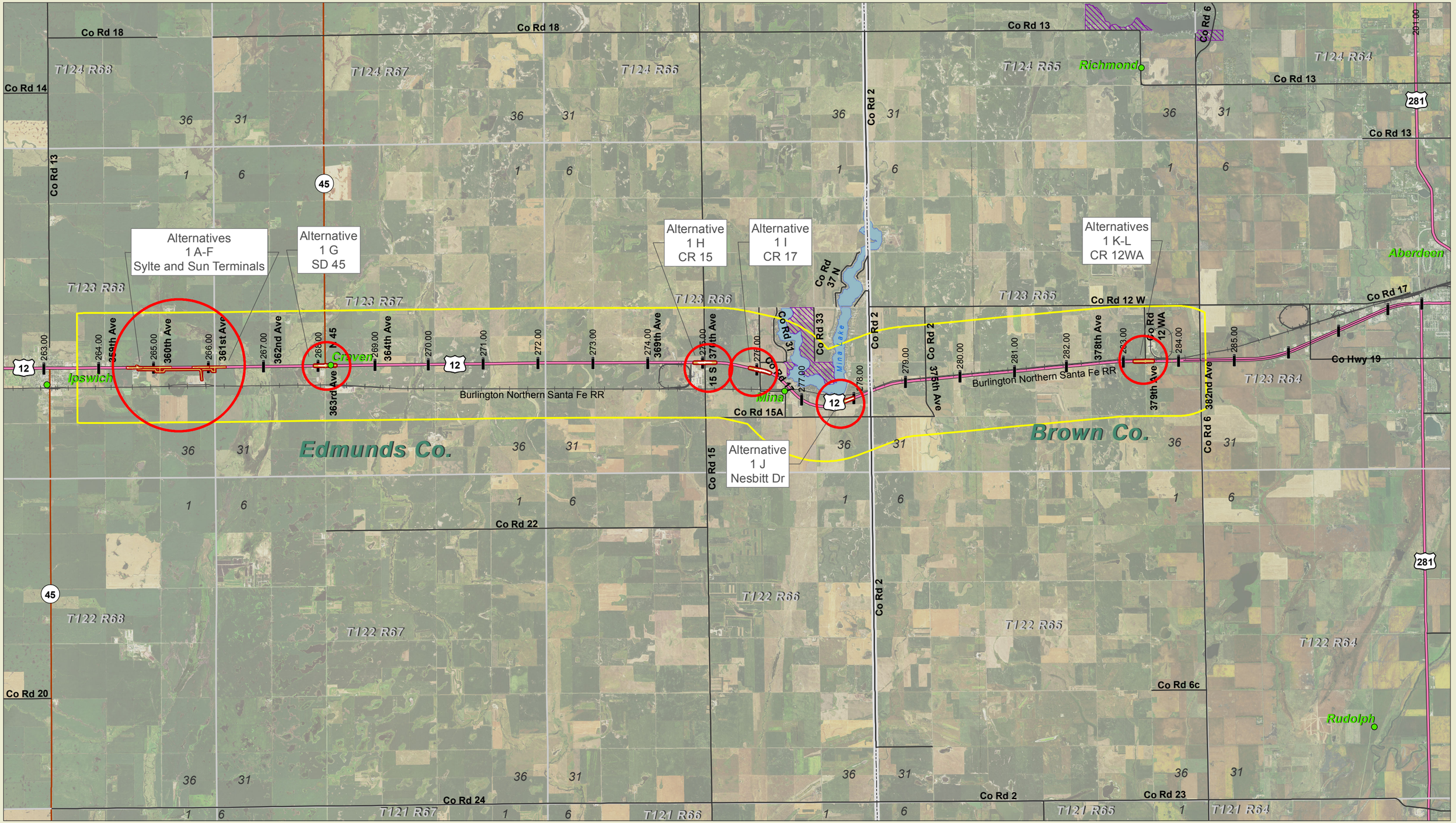
For the westernmost stretch of the US 12 corridor, six specific sub-alternatives have been developed to address existing and projected issues. This stretch of corridor includes both the Sylte Terminal and the Sun Terminal.

SYLTE & SUN TERMINAL TURN LANE ADDITIONS

There are two existing accesses into the Sylte Terminals. Based on the existing traffic counts there is currently no designation of access, so trucks have the option of using both accesses to enter and exit the facility. However, based on consultation with Sylte Farms, they are typically using the west access for inbound and east access for outbound trucks.

The turning volumes into the Sylte terminals do not warrant the addition of turn lanes based on the volume criteria. The nearness to Ipswich is an additional factor for adding an eastbound right-turn lane, as most passenger vehicles will be accelerating up to 65 miles per hour and not necessarily watching for trucks turning so soon after leaving Ipswich. To improve safety, an eastbound right-turn lane and a westbound left-turn lane should be considered. The discussion of how best to implement turn lane improvements at Sylte Farms is discussed within several sub-alternatives.

Turn lanes would not be warranted based solely on the volume criteria at the Sun Terminal access. However, moving trucks off mainline to make a turn could improve the capacity of the mainline as well as the safety of the roadway. An eastbound right-turn lane and westbound left-turn lane should be considered for trucks destined for the Sun Terminal. The discussion of how best to implement turn lane improvements at the Sun Terminal is discussed within several sub-alternatives. The sub-alternatives for Segment 1 are shown in Figure V-2.



US 12 Corridor Study

MRMs
Project Boundary
Impact Areas
City
Railroad
Lake
US Highway
State Highway
County Highway
Township
County Boundary
SD Parks and Rec Areas

N W E S

0 0.5 1 2 Miles

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 1
Intersection Improvements

Figure V-1

KLJ

Edmunds and Brown Counties

Sub-alternative 1-1A – Designate one access for entering and one access for exiting Sylte and relocate the private drive to the north to align with east Sylte access

Sub-alternative 1-1A consists of an eastbound right-turn and westbound left-turn lane at the Sylte west access. As noted, the west access is currently used for inbound trucks. The turn lane additions would be coordinated with the current unofficial inbound and outbound operation at Sylte. This sub-alternative would relocate the private drive with the east access to provide better spacing between access points on US 12. Improvements should be developed at each access to support the recommended turning conditions. Figure V-2 shows planning level layouts for options available at Sytle access.

Sub-alternative 1-1B – Consolidate Sylte to One (west) Access

Sub-alternative 1-1B maintains the west access and removes the east access. Substantial modifications would need to be considered at the west access to ensure dual truck movements can be accommodated at this location.

Sub-alternative 1-1C – Relocate the Sylte and Sun Terminal Access to 360th Avenue

Sub-alternative 1-1C eliminates all Sylte and Sun Terminal accesses to US12 and moves access to 360th Avenue. To support this sub-alternative, a frontage road system would be constructed from the Sylte facility and the Sun Terminal facility, connecting at 360th Avenue. Combining these accesses would consolidate two truck generators to one access onto and off of US 12 and recommended turn lane additions would occur at a public section-line roadway instead of private drives.

This sub-alternative would develop a westbound right-turn lane and eastbound left-turn lane at 360th Avenue. Any additional private development along this section of US 12 could then make use of this improved intersection and frontage road system.

While each individual set of turn lane improvements at Sylte and Sun Terminal do not currently meet warrants, the combined turning volumes of the two truck generators would be closer to meeting warrants. Based on combined traffic projections, the westbound left-turn lane would likely be warranted by 2045 based on the volume warrants; the eastbound right-turn lane would be below the minimum volume threshold to be warranted. Turning movement counts were not collected at the intersection of US 12 and 360th Avenue, which appears to be a well-maintained county road with good connectivity. It is likely that additional background traffic would be turning onto and off of US 12, which may bring volumes to minimum thresholds for turn lane warrants.

Sub-alternative 1-1D – Maintain current Sun Terminal Access

Sub-alternative 1-1D consists of the previously discussed turn lane improvements to the existing access at the Sun Terminal.

Sub-alternative 1-1E – Relocate Sun Terminal access to 361st Avenue

The Sun Terminal access is approximately 1700 feet west of the intersection of US 12 and 361st Avenue. Sub-alternative 1-1E relocates the current access for Sun Terminal to 361st Avenue and requires the development of frontage road between 361st Avenue and Sun Terminal. Improvements would also be needed to 361st Avenue, which is an unimproved township roadway south of US 12. Consolidating the turning movements onto 361st Avenue would still be below the minimum volume warrants for installing turn lanes. An eastbound right-turn

lane and westbound left-turn lane would be provided at 361st Avenue and the current Sun Terminal access would be closed.

Relocating the Sun Terminal to 361st Avenue would keep all additional intersection improvements on a public, section-line road instead of at a private drive. Any additional private development along this section of US 12 could then make use of this improved intersection and frontage road system.

SUB-ALTERNATIVE 1-1F – DYNAMIC MESSAGE SIGN (DMS)

Sub-alternative 1-1F consists of the installation of a DMS west of the Sylte access to inform eastbound drivers of changing road conditions.

SUMMARY OF SEGMENT 1 SUB-ALTERNATIVES

Table V-2 below shows the cost estimate for the various sub-alternatives in for Segment 1. Figure V-2 shows the proposed sub-alternatives for Segment 1.

Table V-1: Segment 1 Sylte to 361st Avenue Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-1A	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 106,940
	Westbound Left-Turn Lane	0.10	Mile	$ 1,254,766.18	$ 130,705
	Relocate Private Drive	1.00	EA	$ 15,000.00	$ 15,000
				Total	$ 253,000
Sub-alternative 1-1B	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 106,940
	Westbound Left-Turn Lane	0.10	Mile	$ 1,254,766.18	$ 130,705
	East Access Closure	1.00	EA	$ 5,000.00	$ 5,000
				Total	$ 243,000
Sub-alternative 1-1C	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 109,317
	Westbound Left-Turn Lane	0.14	Mile	$ 1,254,766.18	$ 180,610
	Access Closure	3.00	EA	$ 5,000.00	$ 15,000
	Access Relocation	3.00	EA	$ 10,000.00	$ 30,000
	Frontage Road Construction	1.47	Mile	$ 203,965.15	$ 300,346
				Total	$ 636,000
Sub-alternative 1-1D	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 109,317
	Westbound Left-Turn Lane	0.14	Mile	$ 1,254,766.18	$ 180,610
				Total	$ 290,000
Sub-alternative 1-1E	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 114,070
	Westbound Left-Turn Lane	0.14	Mile	$ 1,254,766.18	$ 180,610
	Access Closure	2.00	EA	$ 5,000.00	$ 10,000
	Access Relocation	2.00	EA	$ 10,000.00	$ 20,000
	Frontage Road Construction	0.52	Mile	$ 203,965.15	$ 105,073
				Total	$ 430,000
Sub-alternative 1-1F	DMS	1.00	EA	$ 63,250.00	$ 63,250
				Total	$ 64,000

Segment 2: US 12 and SD 45

Sub-alternative 1-2G – Turn Lane Additions/Modifications

There is currently an eastbound left-turn lane, a westbound left-turn lane, and a westbound right-turn lane at the intersection of US 12 and SD 45. Sub-alternative 1-2G consists of the addition of an eastbound right-turn lane.

The turn lane lengths were evaluated to meet the deceleration and storage needs for each direction. The westbound left-turn lane would be extended to have 400 feet of deceleration length and 100 feet of additional storage length, since this would be a primary truck movement. While the eastbound left-turn and westbound right-turn movements would not be experiencing as much truck traffic as the other movements at this intersection, it is recommended to extend the turn lanes to a minimum 400 feet of deceleration length to provide vehicles the chance to slow down without causing delay on the mainline roadway.

Summary of Segment 2 Sub-alternatives

Table V-3 below shows the cost estimate for the sub-alternatives in Segment 2.

Table V-2: Segment 2 US 12 & SD 45 Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-2G	Eastbound Left-Turn Lane	0.11	Unit	$ 1,254,766.18	$ 134,269
	Eastbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 109,317
	Westbound Left-Turn Lane	0.07	Mile	$ 1,254,766.18	$ 89,117
	Westbound Right-Turn Lane	0.06	Mile	$ 1,254,766.18	$ 78,423
				Total	$ 412,000

Segment 3: US 12 and CR 15

There is an existing eastbound left-turn, eastbound right-turn and westbound left-turn lane at US 12 and CR 15. The installed turn lanes were evaluated to ensure that the storage length is sufficient for average conditions.

Sub-alternative 1-3H – Turn Lane Additions/Modifications

A westbound right-turn lane would be installed to maintain driver expectation in which other major intersections include a right turn lane. The westbound right-turn lane would have 400 feet of deceleration length but would need no additional storage length.

The existing turn lanes are all 575 feet long, which exceeds the minimum length for warranted turn lanes and provides additional storage for trucks to queue before making the turn. No additional turn lane modifications would be recommended to the existing turn lanes.

SUMMARY OF SEGMENT 3 SUB-ALTERNATIVES

Table V-4 below shows the cost estimate for the sub-alternatives in Segment 3.

Table V-3: Segment 3 US 12 & CR 15 Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-3H	Westbound Right-Turn Lane	0.09	Mile	$ 1,254,766.18	$ 106,940
				Total	$ 107,000

SEGMENT 4: US 12 AND CR 17

The existing turn lanes were evaluated to see if additional length may be needed for deceleration and storage.

SUB-ALTERNATIVE 1-4K – TURN LANE ADDITIONS/MODIFICATIONS

Since CR 17 is one of the major roads into the Mina area, it is recommended to extend the westbound right-turn lane to include the full 400 feet of deceleration length, so that turning vehicles do not cause delay on the mainline. Table V-5 below shows the cost estimate for the sub-alternatives in Segment 4.

Table V-4: Segment 4 US 12 & CR 17 Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-4I	Deceleration Lane	0.06	Mile	$ 1,254,766.18	$ 76,046
				Total	$ 77,000.00

SEGMENT 5: US 12 AND NESBITT DRIVE

The existing turn lanes were evaluated to see if additional length may be needed for deceleration and storage.

SUB-ALTERNATIVE 1-5J – CONVERT EASTBOUND BYPASS SECTION TO LEFT-TURN LANE

The existing eastbound bypass lane near Nesbitt Drive has led to some driver confusion when drivers mistake the bypass lane as the beginning of a passing lane. This sub-alternative would convert the existing eastbound bypass lane to an eastbound left-turn lane into Nesbitt Drive. Table V-6 below shows the cost estimate for the sub-alternatives in Segment 5.

Table V-5: Segment 5 US 12 & Nesbitt Drive Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-5J	Turn Lane Arrows	3	EA	$ 382	$ 1,145
	Restripe-Center Turn Lane	0.17	Mile	$ 4,684.64	$ 799
				Total	$ 2,000.00

Segment 6: US 12 and CR 12 WA

Since there is a railroad crossing just north of the intersection which daily volumes of 3 trains, the existing length of turn lanes were evaluated to determine appropriate length for the deceleration and storage of vehicles, especially during a train event. The existing turn lane lengths would be adequate to store up to three trucks, as well as provide a sufficient deceleration length for the trucks to slow without impeding mainline traffic. The westbound left-turn lane is only 150 feet in length, however, this is a very limited movement at this intersection, so additional length would likely not be needed.

Sub-Alternative 1-6K – Dynamic Message Signs

DMS would be installed east of the CR 12WA intersection to inform travelers of changing road conditions. Justification for a DMS at this location similar that for the location on the western end of the corridor.

Sub-Alternative 1-6L - Intersection Lighting

Intersection lighting would be installed at this intersection due to the proximity of the railroad crossing north of US 12.

Summary of Segment 6 Sub-Alternatives

Table V-7 below shows the cost estimate for the sub-alternatives in Segment 6.

Table V-6: Segment 6 US 12 & CR 12WA Cost Estimate

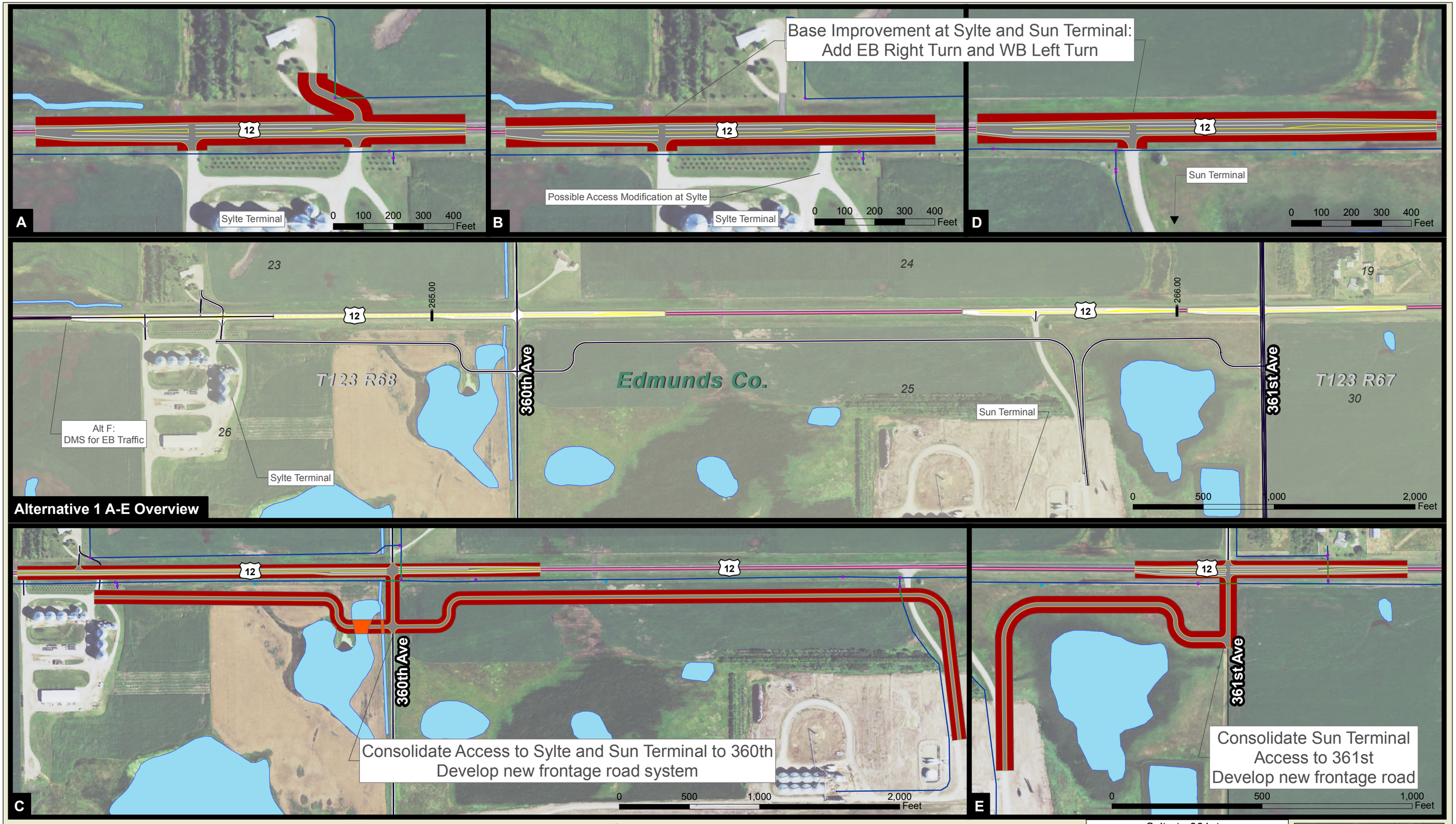
	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 1-6K	DMS	1.00	EA	$ 63,250.00	$ 63,250
				Total	$ 64,000
Sub-alternative 1-6L	Intersection Lighting	1.00	EA	$ 5,175.00	$ 5,175
				Total	$ 6,000

Summary of Alternative 1

The total cost estimate for this alternative is $1.3 million, as shown in Table V-1.

Table V-7: Alternative 1 Cost Estimate

Alternative 1 - Intersection Improvements	
Segment	Cost
Segment 1	$543,000
Segment 2	$463,750
Segment 3	$159,000
Segment 4	$77,000
Segment 5	$2,000
Segment 6	$70,000
Total	**$1,314,750**



US 12 Corridor Study

Existing US 12 ROW
Impact Area
Impacted Wetlands
Railroad
Streams/Rivers
Lake/Wetlands
US Highway
Roads
MRMs
City
Township
Project Boundary
County Boundary
SD Parks and Rec Areas
Impacted Mains
Other Mains
Pump
Water Misc
Valve
Blowoff Assembly

N W E S

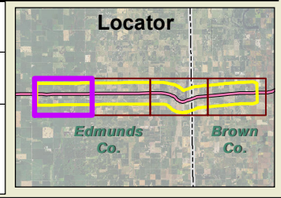
Orthophoto Source: NAIP
Date of Photography: 2014

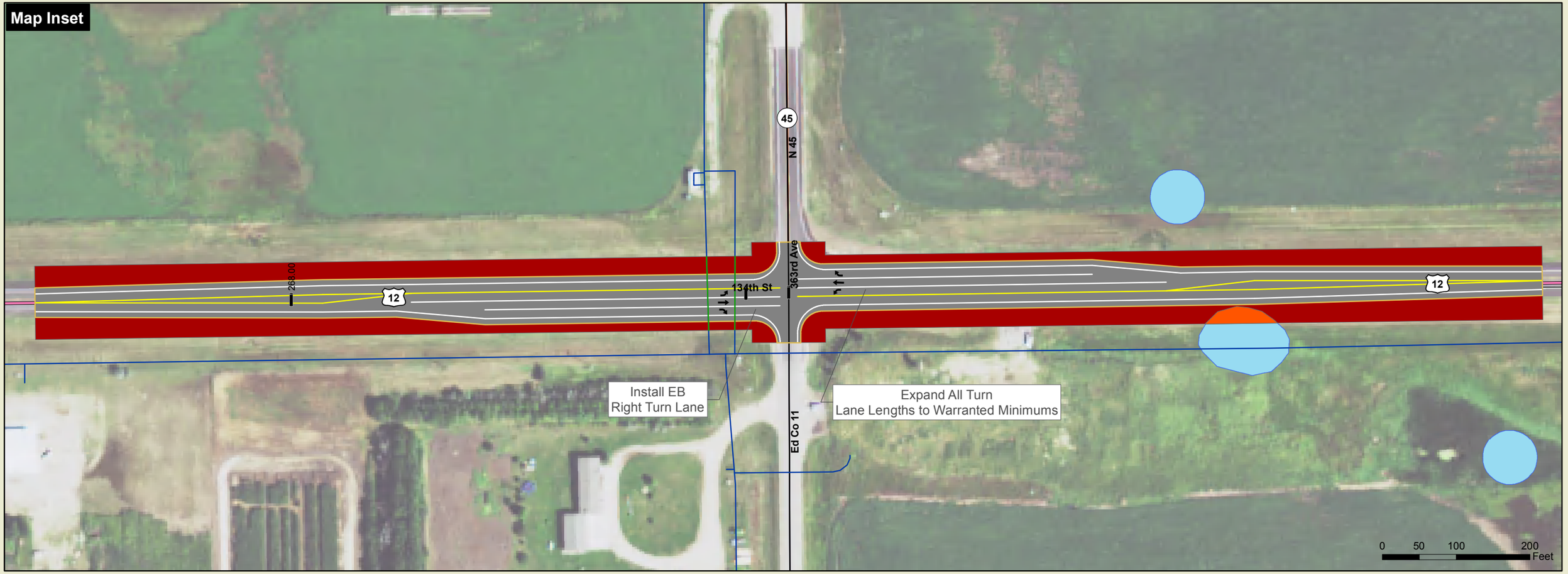
Sylte to 361st
Alternative 1 A-E

Figure V-2

KLJ

Locator





US 12 Corridor Study

Existing US 12 ROW
Impact Area
Impacted Wetlands
Railroad
Streams/Rivers
Lake/Wetlands
Roads
MRMs
City
Township
Project Boundary
County Boundary
SD Parks and Rec Areas
Impacted Mains
Other Mains
Pump
Water Misc
Valve
Blowoff Assembly

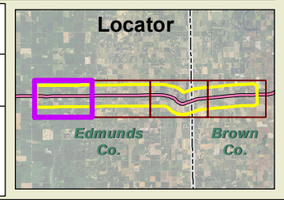
N W E S

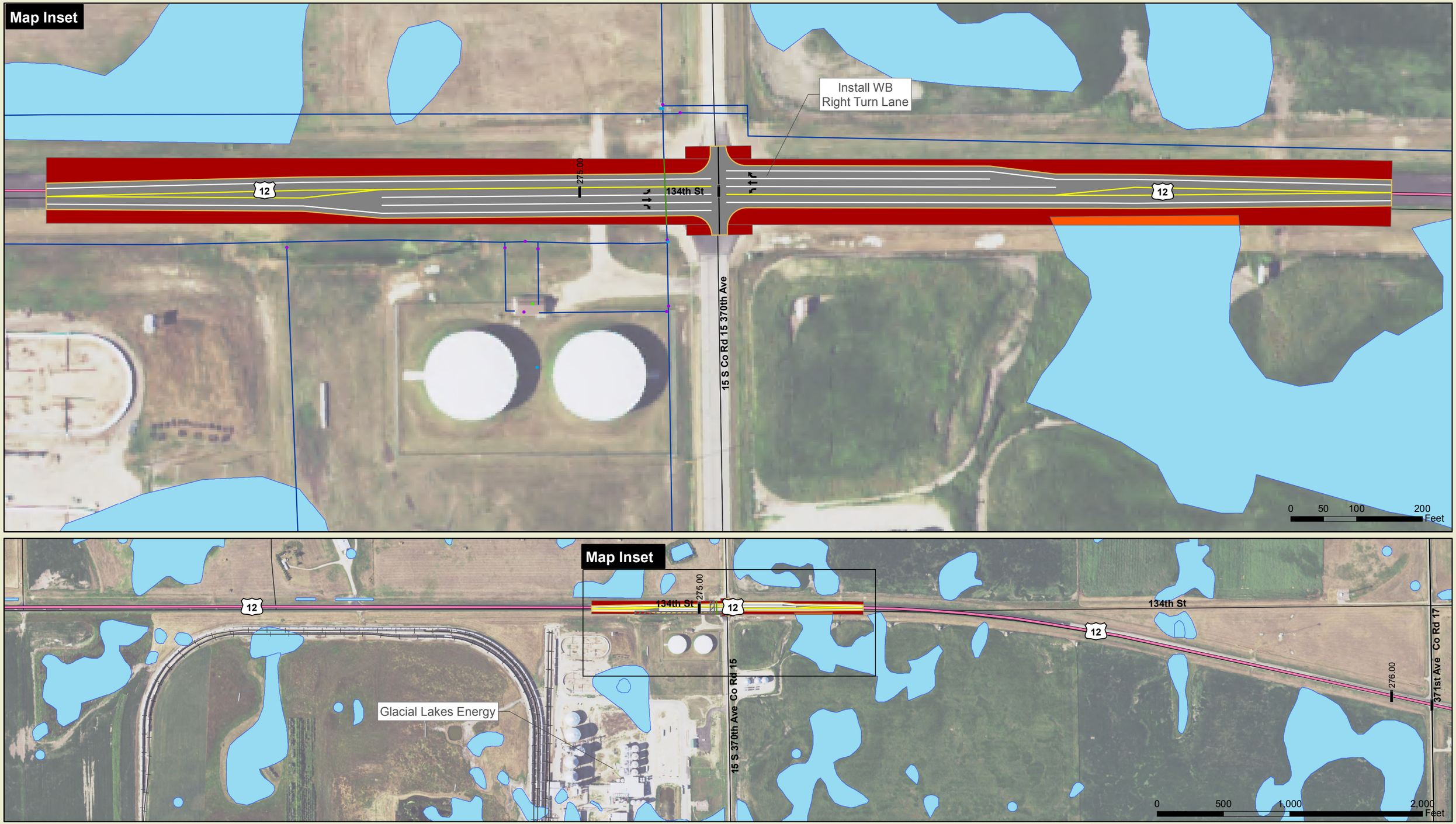
Orthophoto Source: NAIP
Date of Photography: 2014

SD 45
Alternative 1 G

Figure V-3

KLJ





US 12 Corridor Study

- Existing US 12 ROW
- Impact Area
- Impacted Wetlands
- Railroad
- Streams/Rivers
- Lake/Wetlands
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Other Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly

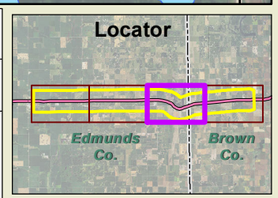
N W E S

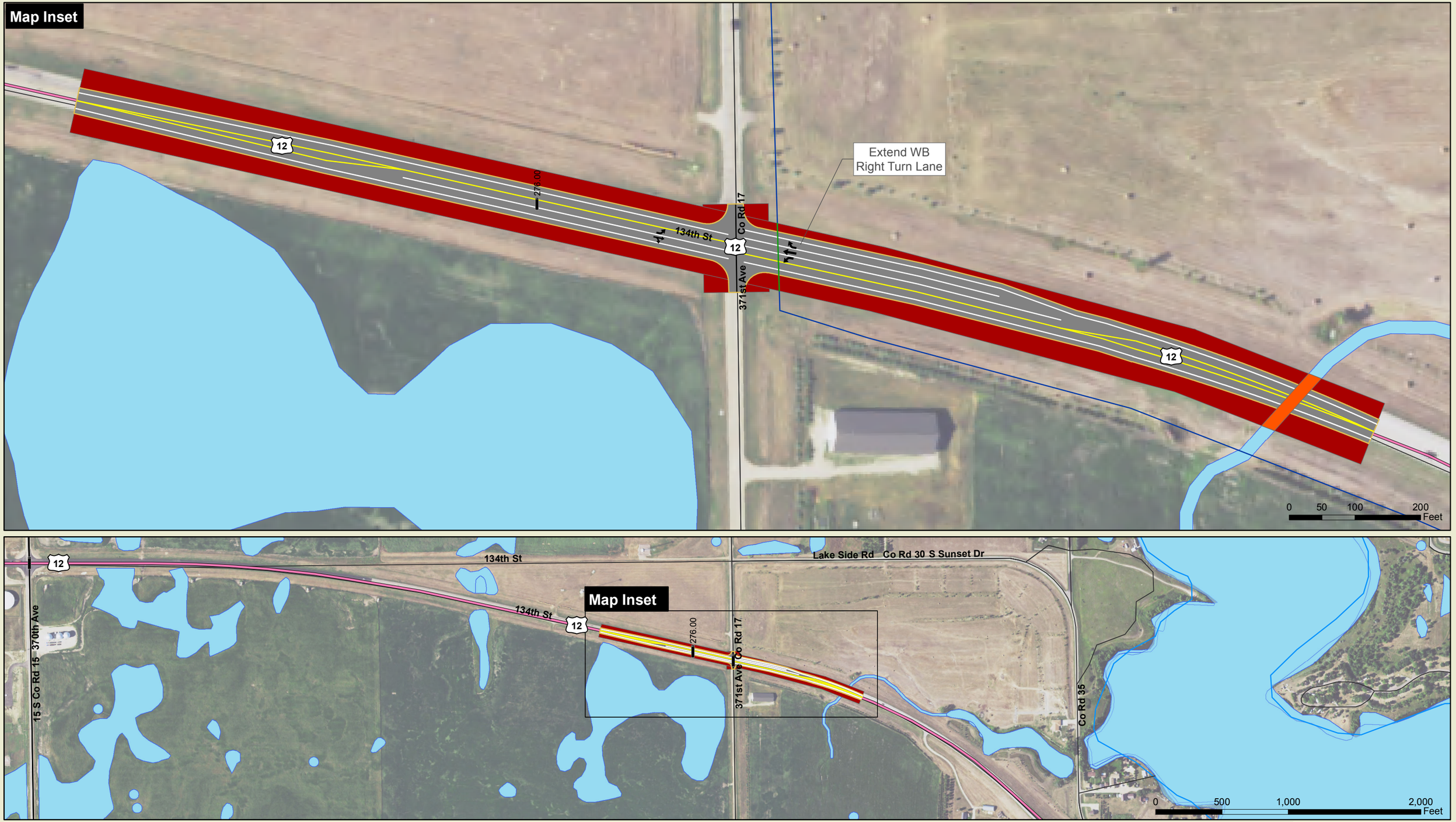
Orthophoto Source: NAIP
Date of Photography: 2014

CR 15
Alternative 1 H

Figure V-4

KLJ



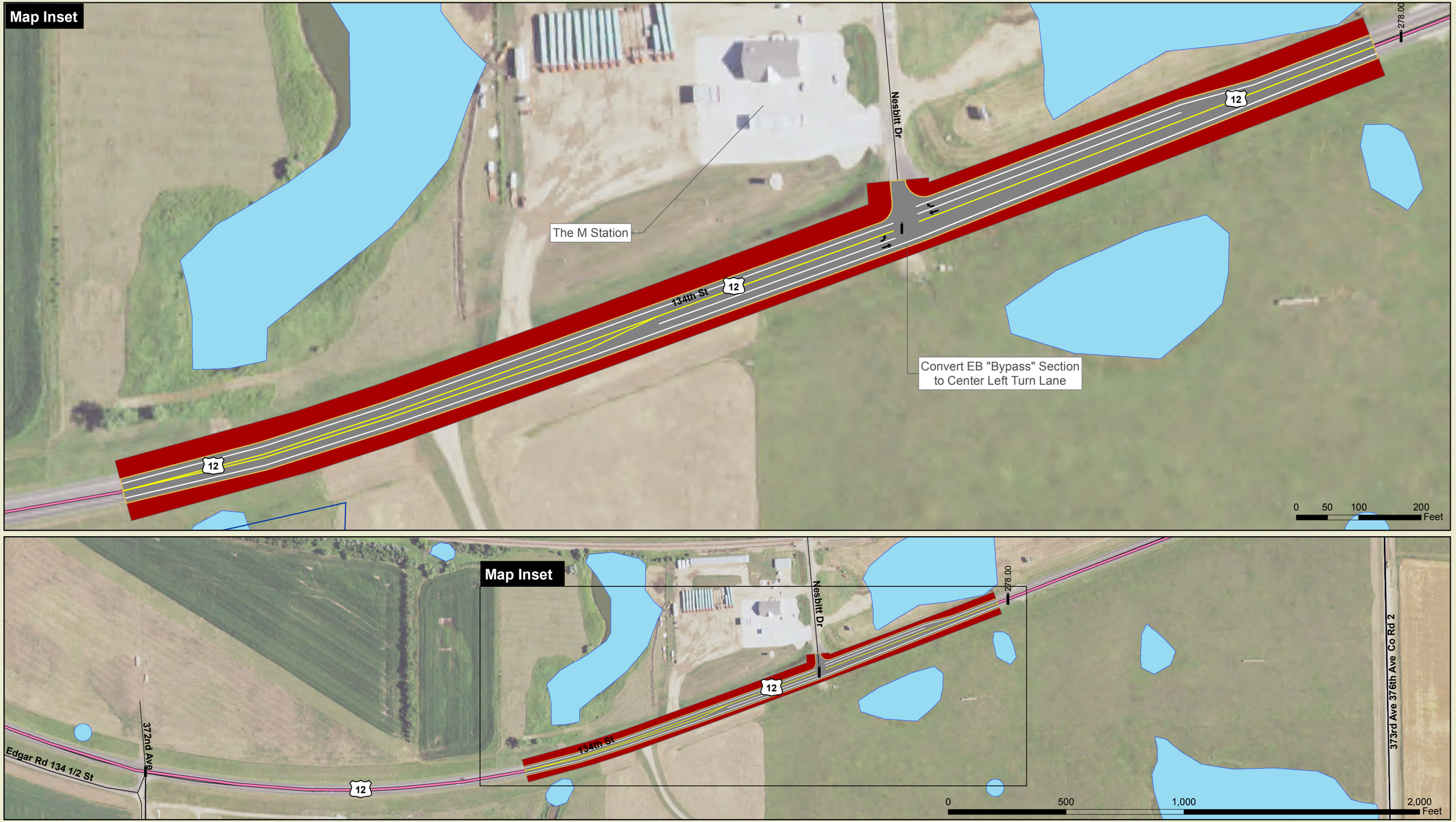


US 12 Corridor Study

CR 17
Alternative 1 I

Figure V-5

KLJ



US 12 Corridor Study

Existing US 12 ROW
Impact Area
Impacted Wetlands
Railroad
Streams/Rivers
Lake/Wetlands
Other Mains
Roads
MRMs
City
Township
Project Boundary
County Boundary
SD Parks and Rec Areas
Impacted Mains
Other Mains
Pump
Water Misc
Valve
Blowoff Assembly

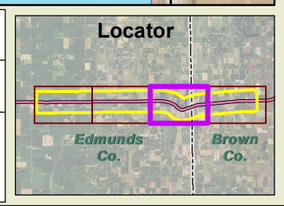
N W E S

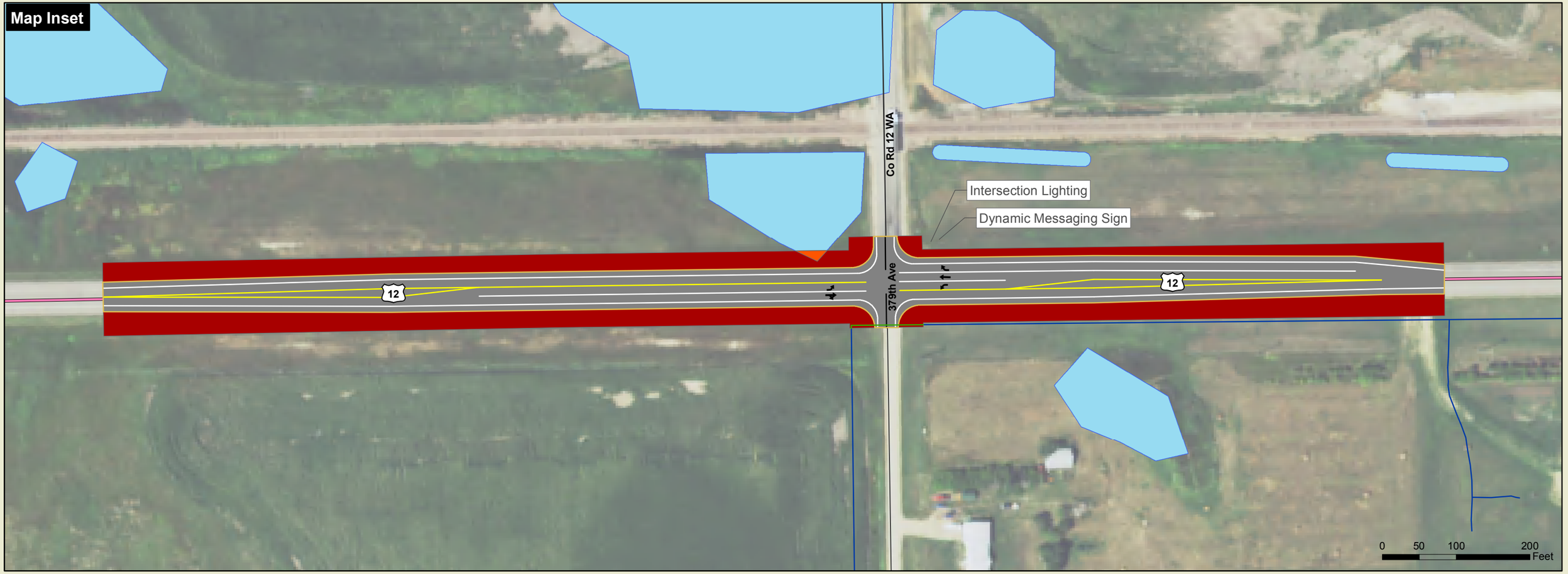
Orthophoto Source: NAIP
Date of Photography: 2014

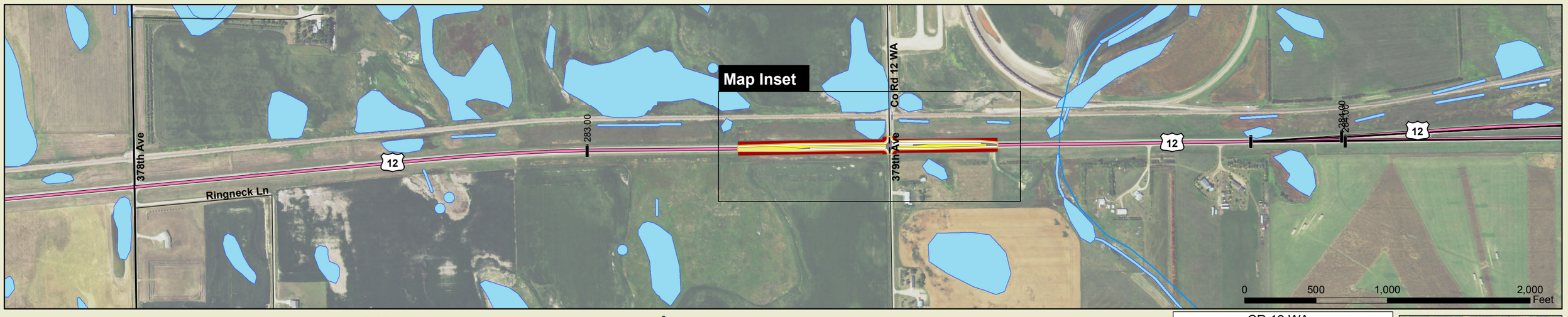
Nesbitt Dr
Alternative 1 J

Figure V-6

KLJ







US 12 Corridor Study

Existing US 12 ROW
Impact Area
Impacted Wetlands
Railroad
Streams/Rivers
Lake/Wetlands
Roads
MRMs
City
Township
Project Boundary
County Boundary
SD Parks and Rec Areas
Impacted Mains
Other Mains
Pump
Water Misc
Valve
Blowoff Assembly

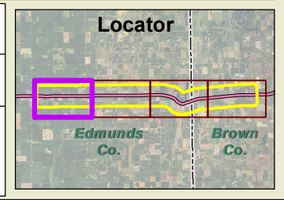
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

CR 12 WA
Alternative 1 K-L

Figure V-7

KLJ



ALTERNATIVE 2: PASSING LANES

Given the heavy volume of slower moving truck traffic, passing lanes provide opportunities to reduce platooning and driver frustration related to slower moving vehicles. Alternative 2 consists of the development of a Super 2, a two-lane highway with wider paved shoulders and periodic passing lanes. Intersection improvements from Alternative 2 improvements could considered additive to Alternative 1 intersection improvements, however costs shown in this section are inclusive of only Alternative 2 passing lane improvements. Alternative 2 costs are inclusive of a 15% contingency, but don't include a separate cost for PE or right of way.

SUB-ALTERNATIVE 2-1 – EASTBOUND PASSING LANES WITH THREE-LANE SECTION

Sub-alternatives 2-1A through 2-1D consider eastbound passing lanes through the development of a three-lane section.

SUB-ALTERNATIVE 2-1A – 361ST AVENUE TO SD 45

This provides the opportunity to reduce platooning outside of Ipswich. Specifically, this passing section allows faster vehicles to pass slower moving trucks and farm equipment which turn at SD 45 to access the Craven Terminal.

SUB-ALTERNATIVE 2-1B – 361ST AVENUE TO LANE DROP AT SD 45

Sub-alternative 2B would add an eastbound passing section to reduce platooning outside of Ipswich but carry the passing section to the intersection of US 12 and SD 45, where it would end as a right-turn lane drop.

SUB-ALTERNATIVE 2-1C – 365TH AVENUE TO 367TH AVENUE

There are three major truck generators between Ipswich and SD 45: Sylte, Sun Terminal and the Craven Terminal. This passing lane section would provide vehicles the opportunity to pass any slower moving trucks on the mainline following the intersection of SD 45.

SUB-ALTERNATIVE 2-1D – 375TH AVENUE TO 377TH AVENUE

After leaving Mina, this would reduce any platooning that has been formed through Mina and new trucks which may have turned westbound from the GLE plant.

SUB-ALTERNATIVE 2-2 – WESTBOUND PASSING LANES WITH THREE-LANE SECTION

Sub-alternatives 2-2E and 2-2F consist of westbound passing lanes through the development of a three-lane section.

SUB-ALTERNATIVE 2-2E – 369TH AVENUE TO 367TH AVENUE

Located west of GLE, this passing lane section would provide opportunities for vehicles to get around slower moving trucks. It would also help reduce any platooning that has formed through the Mina area.

SUB-ALTERNATIVE 2-2F – CR12WA TO 377TH AVENUE

This passing lane section would help reduce any platooning caused from the four-lane to two-lane conversion as well as pass any trucks that have turned onto US 12 from the Concord Grain Terminal.

Sub-Alternative 2-3 – Passing Lanes with Four-Lane Section

Sub-alternatives 2-3G and 2-3H consist of a four-lane passing section on two different segments of the US 12 Corridor.

Sub-Alternative 2-3G – 366th Avenue to 368th Avenue

Sub-alternative 2G consists of the development of a four-lane undivided section between 366th and 368th Avenue. Instead of installing alternating passing lanes in Sub-alternatives 2B and 2D, the passing lanes would be installed concurrently as a four-lane undivided section.

Sub-Alternative 2-3H – 376th Avenue – 378th Avenue

Sub-alternative 2H consists of the development of a four-lane undivided section between 376th and 378th Avenue. Instead of installing alternating passing lanes in Sub-alternatives 2C and 2E, the passing lanes would be installed concurrently as a four-lane undivided section.

Summary of Alternative 2

Table V-8 below shows the cost estimate for Alternative 2. Total cost assumptions for the three lane passing sections assume implementation of Alternative 2-1B.

Table V-8: Alternative 2 Cost Estimate

	Improvement	Quantity	Unit	Unit Cost	Total Cost
Sub-alternative 2-1A - 361st to SD 45	Eastbound Passing Lane	1.57	Mile	$1,254,766	$1,971,266
				Total	$1,980,000
Sub-alternative 2-1B - 361st to SD 45	Eastbound Passing Lane	1.57	Mile	$1,254,766	$1,971,266
	Eastbound Right-Turn Lane (inside lane drop at SD 45)	0.11	Mile	$1,254,766	$134,269
				Total	$2,110,000
Sub-alternative 2-1C - 365th to 367th	Eastbound Passing Lane	1.45	Mile	$1,254,766	$1,824,639
				Total	$1,830,000
Sub-alternative 2-1D - 375th to 377th	Eastbound Passing Lane	2.22	Mile	$1,254,766	$2,791,142
				Total	$2,800,000
Sub-alternative 2-2E - 369th to 367th	Westbound Passing Lane	1.60	Mile	$1,254,766	$2,005,725
				Total	$2,010,000
Sub-alternative 2-2F - CR 12WA to 377th	Westbound Passing Lane	1.74	Mile	$1,254,766	$2,188,711
				Total	$2,190,000
Sub-alternative 2-3G - 366th to 368th	Four-Lane Undivided Section	2.16	Mile	$2,182,202	$4,711,573
				Total	$4,720,000
Sub-alternative 2-3H - 376th to 378th	Four-Lane Undivided Section	2.25	Mile	$2,182,202	$4,920,287
				Total	$4,930,000
	Subtotal Three-Lane (Alts 2B, 2C, 2D, 2E and 2F)				$10,940,000

Note: *Alternative 2 estimates include a 15% contingency, however no additional costs for right of way or engineering*

US 12 Corridor Study

2A
Eastbound Passing Lane

2B
Eastbound Passing Lane
Dropping to Turn Lane @ SD45

2C
Eastbound Passing Lane

2D
Eastbound Passing Lane

2E
Westbound Passing Lane

2F
Westbound Passing Lane

2G
4-Lane

2H
4-Lane

Edmunds Co.

Brown Co.

Ipswich

Craven

Mina

Richmond

Aberdeen

Rudolph

Burlington Northern Santa Fe RR

Co Rd 18

Co Rd 14

Co Rd 13

Co Rd 22

Co Rd 24

Co Rd 20

Co Rd 6c

Co Rd 12 W

Co Rd 17

Co Hwy 19

Co Rd 15

Co Rd 15A

Co Rd 31

Co Rd 33

Co Rd 35

Co Rd 37 N

Co Rd 2

Co Rd 6

Co Rd 12 WA

Lake Mina

T124 R68

T124 R67

T124 R66

T124 R65

T124 R64

T123 R68

T123 R67

T123 R66

T123 R65

T123 R64

T122 R68

T122 R67

T122 R66

T122 R65

T122 R64

T121 R67

T121 R66

T121 R65

T121 R64

263.00 264.00 265.00 266.00 267.00 268.00 269.00 270.00 271.00 272.00 273.00 274.00 275.00 276.00 277.00 278.00 279.00 280.00 281.00 282.00 283.00 284.00 285.00

359th Ave 360th Ave 361st Ave 362nd Ave 363rd Ave 364th Ave 365th Ave 367th Ave 368th Ave 369th Ave 370th Ave 371st Ave 372nd Ave 373rd Ave 376th Ave 377th Ave 378th Ave 379th Ave 382nd Ave

Legend

- MRMs
- Project Boundary
- 2 A-E Impact Area
- 2 B, G and H Impact Area
- City
- Railroad
- Lake
- US Highway
- State Highway
- County Highway
- Township
- County Boundary
- SD Parks and Rec Areas

N W E S

0 0.5 1 2 Miles

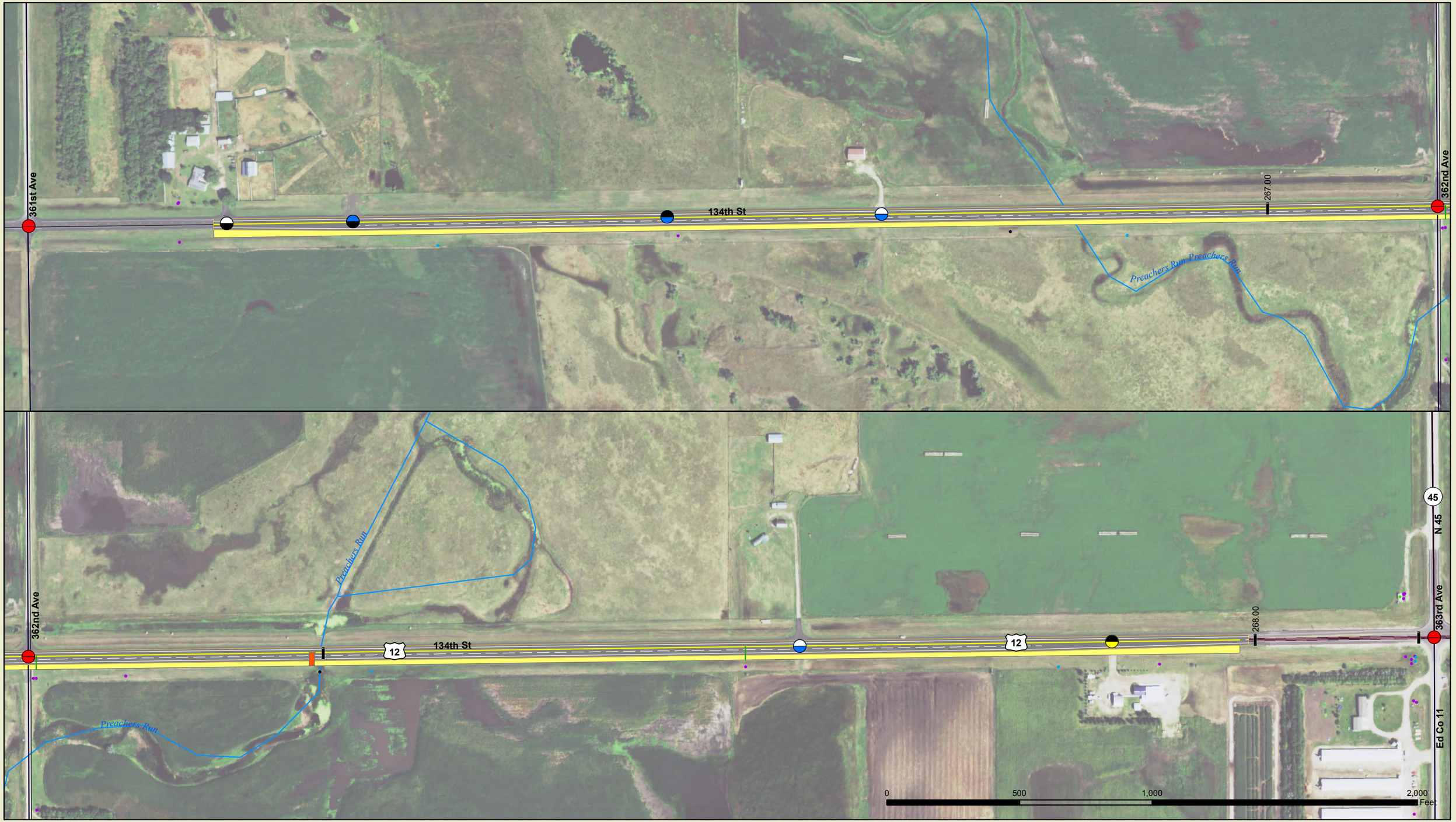
Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2
Passing Lanes Overview

Figure V-8

KLJ

Edmunds and Brown Counties



US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane Impact Area
- Passing Lane Impact Area
- Railroad ROW
- Impacted Wetlands
- Railroad
- Streams/Rivers
- Lake
- US Highway
- State Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

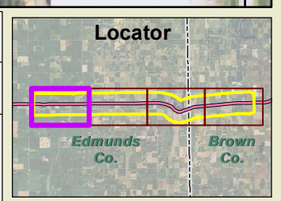
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 A
3-Lane Eastbound Passing Lane

Figure V-9

KLJ



US 12 Corridor Study

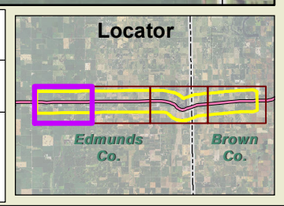
- Existing US 12 ROW
- Passing Lane Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- State Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

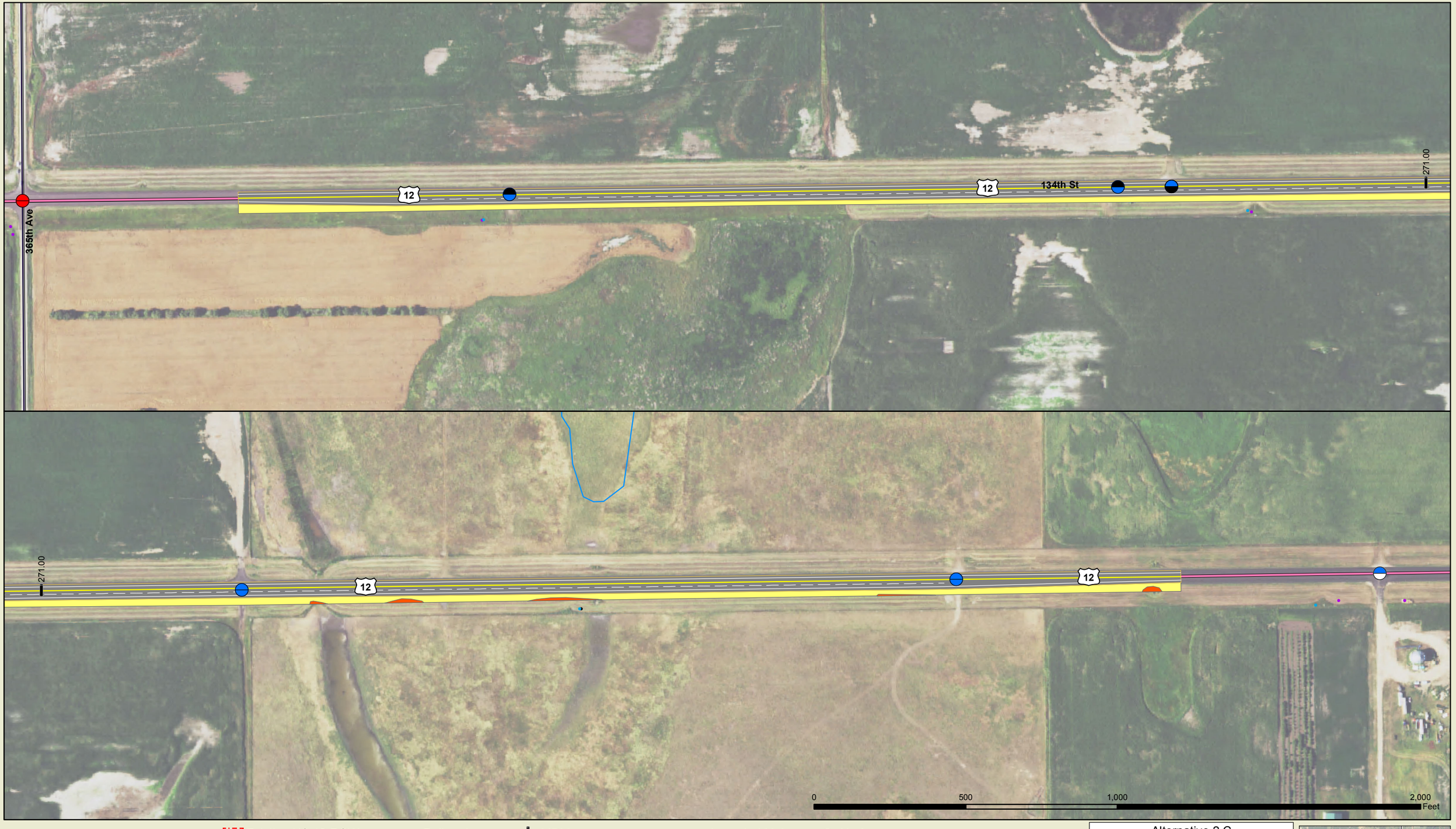
Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 B
3-Lane Eastbound Passing Lane

Figure V-10

KLJ





US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

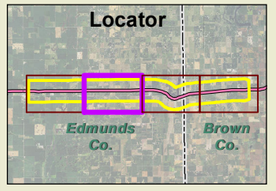
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 C
3-Lane Eastbound Passing Lane

Figure V-11

KLJ



US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

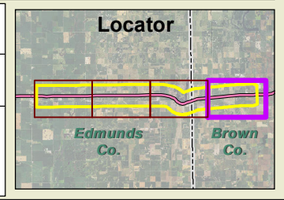
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 D
3-Lane Eastbound Passing Lane

Figure V-12

KLJ



US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

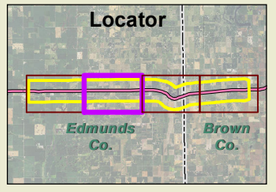
N W E S

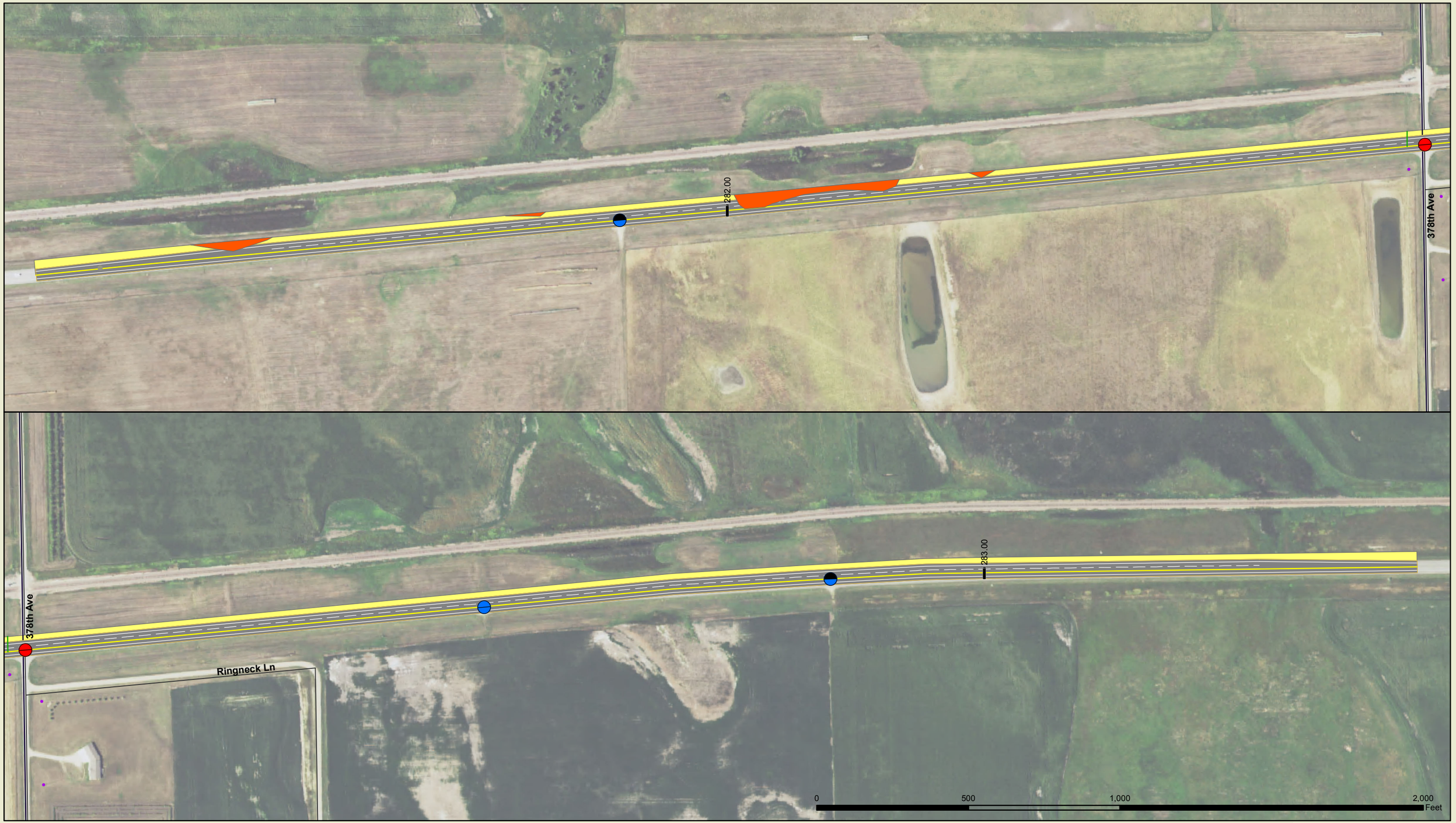
Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 E
3-Lane Westbound Passing Lane

Figure V-13

KLJ





US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

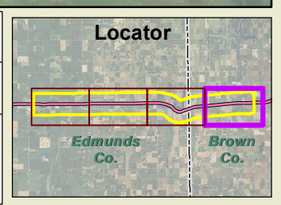
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 F
3-Lane Westbound Passing Lane

Figure V-14

KLJ



US 12 Corridor Study

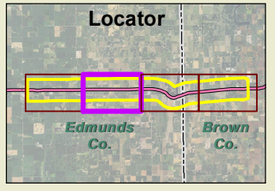
- Existing US 12 ROW
- Passing Lane 2 Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 G
4-Lane Passing Lane

Figure V-15

KLJ



US 12 Corridor Study

- Existing US 12 ROW
- Passing Lane 2 Impact Area
- Impacted Wetlands
- Railroad ROW
- Railroad
- Streams/Rivers
- Lake
- US Highway
- State Highway
- Roads
- MRMs
- City
- Township
- Project Boundary
- County Boundary
- SD Parks and Rec Areas
- Impacted Mains
- Pump
- Water Misc
- Valve
- Blowoff Assembly
- No Access
- Private Drive
- Field Approach
- Commercial/Industrial
- Public Roadway

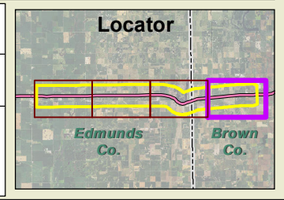
N W E S

Orthophoto Source: NAIP
Date of Photography: 2014

Alternative 2 H
4-Lane Passing Lane

Figure V-16

KLJ



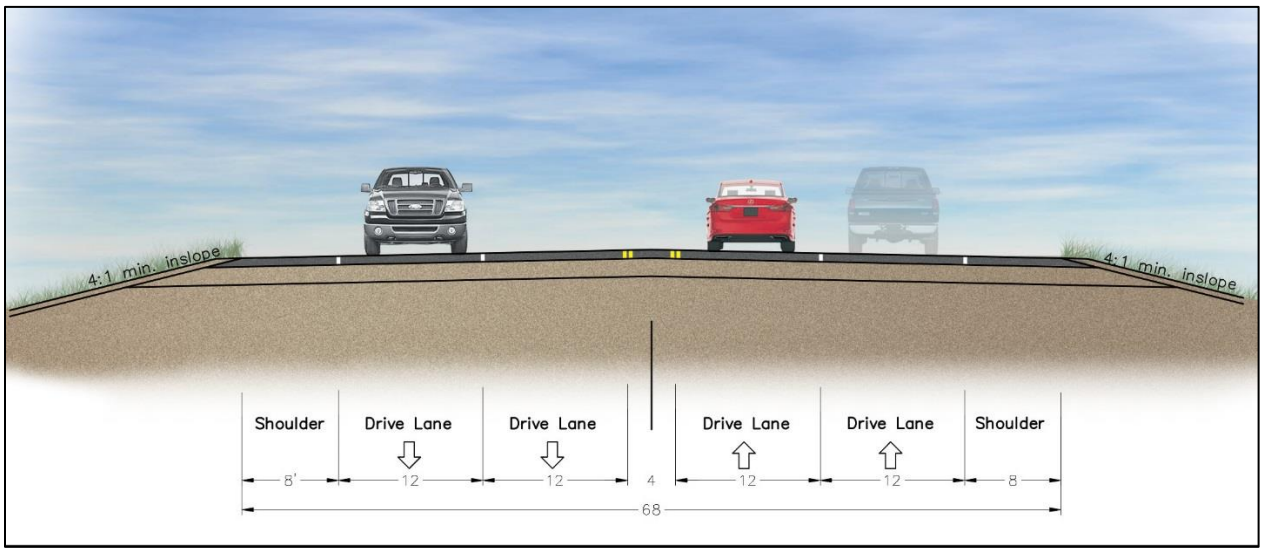
ALTERNATIVE 3: FOUR-LANE UNDIVIDED SECTION

Alternative 3 consists of a four-lane undivided section with a four-foot painted median. A four-foot median was selected to provide some separation between the eastbound and westbound lanes, but still be considered an undivided section. See Figure V-17 for the proposed typical four-lane undivided section. The four-lane undivided section would maintain the existing centerline and add an additional outside lane in both the westbound and eastbound directions. This configuration would lie within existing ROW. Costs for Alternative 3 were generated by SDDOT, and assume contingency for structural widening and engineering costs, however don't account for potential right of way impacts.

Analysis for the four-lane undivided section is split between the three distinct sections of the US 12 corridor:

- Ipswich to County Road 17
- County Road 17 to County Road 2 (Mina)
- County Road 2 to Aberdeen

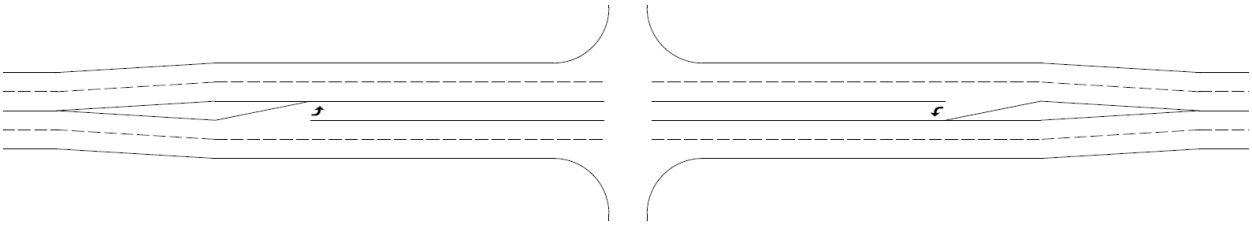
Figure V-17: Four-Lane Undivided Typical Section



INTERSECTION IMPROVEMENTS

For the four-lane undivided section, Figure V-18 shows the assumed geometry for key intersections along the corridor. Due to the roadway volumes, it was anticipated that most left-turn lanes would continue to be installed, but the right-turn lanes would likely not be necessary.

Figure V-18: Four-Lane Undivided Typical Intersection



Alternative 3 also assumed a westbound left-turn and eastbound right-turn lane are constructed at the Sytle Farms westernmost access and a consolidation of the Sun Terminal access and 361st Avenue.

Summary of Alternative 3

Table V-9 below shows the cost estimate for Alternative 3. These costs do not reflect any applicable property acquisition

Table V-9: Alternative 3 Cost Estimate

Segment	Alternative Description	Miles	Cost/Mile	Cost
Ipswich to CR 17	Four-Lane Undivided	12.440	$1,553,584	$19,327,096
			Subtotal	$19,327,096
CR 17 to CR 2	Four-Lane Undivided	3.306	$1,553,584	$5,136,686
			Subtotal	$5,136,686
CR 2 to Aberdeen	Four-Lane Undivided	5.506	$1,553,584	$8,554,363
			Subtotal	*$8,554,363*
			Total	$33,018,145

Note: *Alternative 3 cost estimates include contingency for engineering and incidental structural impacts*

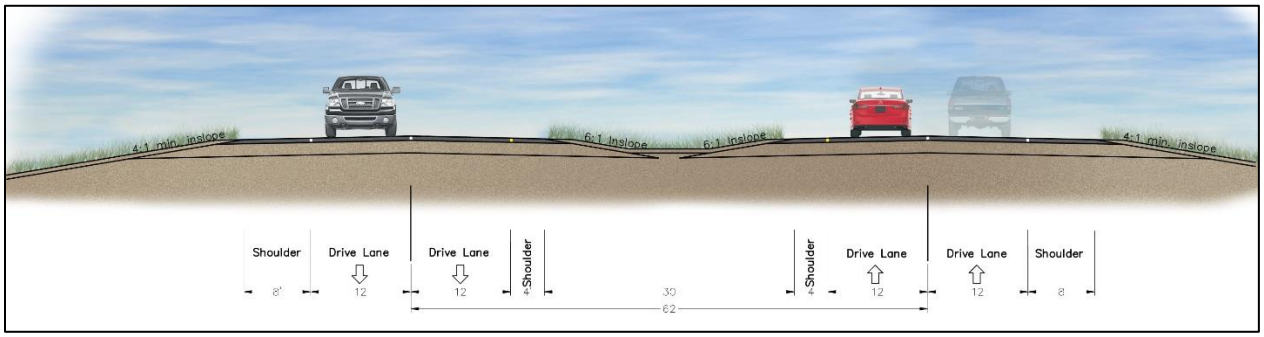
ALTERNATIVE 4: FOUR-LANE DIVIDED SECTION

Alternative 4 consists of a four-lane divided section with a depressed 30-foot median. Figure V-19 shows the proposed typical section for this alternative. Costs for Alternative 4 were generated by SDDOT, and assume contingency for structural widening and engineering costs, however don't account for potential right of way impacts.

Analysis for each of the sub-alternatives was split between the three distinct sections of the US 12 corridor:

- Ipswich to County Road 17
- County Road 17 to County Road 2 (Mina)
- County Road 2 to Aberdeen

Figure V-19: Divided Four-Lane Typical Section



Two sub-alternatives have been identified for the four-lane divided section.

Sub-Alternative 4A: Additional Lanes to the North

This sub-alternative would turn the existing roadway into the eastbound lanes and construct two new westbound lanes north of the existing roadway. A transition would occur near Ipswich and Aberdeen to shift the roadway alignments to tie in with the existing three-lane or four-lane section.

Based on these assumptions, it was conservatively estimated that that the typical grading limits would extend 50 feet to the south and 115 feet to the north of the existing centerline.

The benefits of this sub-alternative include reduced construction cost, since minimal construction would need to occur on the existing roadway. This sub-alternative would require shifting all right-of-way and environmental impacts to the north side of the roadway.

Sub-Alternative 4B: Additional Lanes to the South

This sub-alternative would turn the existing roadway into the westbound lanes and construct two new eastbound lanes south of the existing roadway. A transition would occur near Ipswich and Aberdeen to shift the roadway alignments to tie in with the existing three-lane or four-lane section.

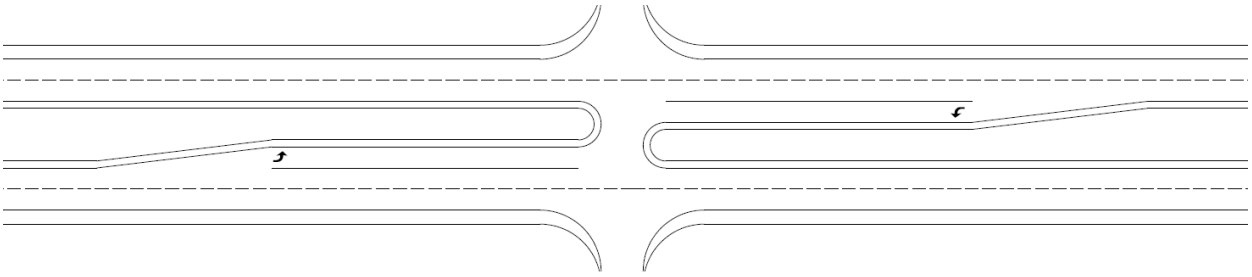
Based on the assumptions, it was conservatively estimated that that the typical grading limits would extend 115 feet to the south and 50 feet to the north of the existing centerline.

The benefits of this sub-alternative include reduced construction cost, since minimal construction would need to occur on the existing roadway. This sub-alternative would require shifting all right-of-way and environmental impacts to the south side of the roadway.

Intersection Improvements

For the four-lane divided section sub-alternatives, Figure V-20 shows the assumed geometry for key intersections along the corridor. Due to the roadway volumes, it was anticipated that most left-turn lanes would continue to be installed, but the right-turn lanes would likely not be necessary.

Figure V-20: Four-Lane Divided Typical Intersection



Alternative 4 also assumed a westbound left-turn and eastbound right-turn lane are constructed at the Sytle Farms westernmost access and a consolidation of the Sun Terminal access and 361st Avenue.

Summary of Alternative 4

Table V-10 below shows the cost estimate for Alternative 4, which does not include right of way costs.

Table V-10: Alternative 4 Cost Estimate

Segment	Alternative Description	Miles	Cost/Mile	Cost
Ipswich to CR 17	Four-Lane Divided	12.440	$2,243,537	$27,910,338
			Subtotal	$27,910,338
CR 17 to CR 2	Four-Lane Divided	3.306	$2,243,537	$7,417,910
			Subtotal	$7,417,910
CR 2 to Aberdeen	Four-Lane Divided	5.506	$2,243,537	$12,353,390
			Subtotal	$12,353,390
			Total	**$47,681,698**

Note: *Alternative 4 cost estimates include contingency for engineering and incidental structural impacts*

VI. ALTERNATIVES EVALUATION

Following guidance of 23 Code of Federal Regulation (CFR) 450, Appendix A, planning products were developed so various project alternatives can move directly into project development, and a likely National Environmental Policy Act (NEPA) phase, following the completion of the US 12 Corridor Study. To assist with linking the planning and NEPA phase a project purpose and need was developed based on information developed through the corridor study for future potential improvements.

Alternative evaluation and screening can be done both against the project purpose and need as well as against technical evaluation criteria to assist with screening out corridor level planning products prior to moving into NEPA. The technical evaluation includes both environmental and property impacts, as well as quantitative analysis related to traffic, safety and benefit-cost analysis.

While alternatives were not prioritized, or screened out (eliminated) as part of the US 12 Corridor Study, the development of a project purpose and need as well as a technical screening process which met the intent of 23 CFR 450, Appendix A was deemed appropriate. The technical basis for easier dismal during the NEPA phase was established through the planning process.

PURPOSE & NEED

A project purpose and need statement was developed pursuant to the conditions and needs identified through the US 12 Corridor Study. The planning level purpose and need is more simplified than what may be expected within NEPA document, however forms the foundational building block for later versions.

PURPOSE

The purpose of the project is to improve safety and both intersection and corridor level capacity along the US 12 corridor.

NEED

The need for this project is driven by the increased agricultural related truck traffic along the corridor, which has caused platooning and capacity concerns for local and regional traffic along US 12. Three fatal crashes which occurred within a 16-month period increased concern for the safety of the roadway.

PURPOSE & NEED SCREENING

The No Build Alternative would technically not meet the purpose and need, but would be carried forward to serve as a baseline for other alternatives in a future NEPA document.

All four of the build alternatives developed as part of the US 12 Corridor Study appear to meet the project purpose and need established as part of the planning process.

ENVIRONMENTAL & PROPERTY IMPACTS

The technical and environmental screening process serve to evaluate each project alternative based on anticipated impacts and benefits. The following data sets were collected and used to identify impacts of the proposed alternatives along the US 12 corridor:

- Cultural Impacts – Cultural and historical data for the study corridor was provided by the South Dakota Archaeological Research Center (SARC). Significant sites and structures within the project impact area were identified. The existing data set also identifies areas of previously completed cultural surveys. Impacts measured by total sites or structures.
- Wetlands – National Wetlands Inventory (NWI) data was acquired for the study area. NWI data were clipped to the project impact area for each project impact area. Impacts measured in acres.
- Bridges – No alternative impacted any bridge or culvert other than the four which currently carry US 12.
- Right-of-way – Existing right-of-way was assumed to match the right of way shown in the SDDOT plans along US 12. Typically, there is approximately 200 feet, however it varies in several locations. The right-of-way impact was based on the amount of project impact area located outside of the existing right-of-way. Impacts measured in acres.
- Walworth, Edmunds and Brown (WEB) Water - Water mains in lineal feet and counts of various water valves and assemblies.

Project impacts have been calculated based on the following assumptions:

- Alternative 1: Intersection & Spot Improvements – Assumes 50 feet of impact offset from the current centerline related to additional or modified turn lanes.
- Alternative 2: Passing Lanes – Assumes 50 feet of new impact offset from the centerline for the addition of new passing lanes.
- Alternative 3: Four-Lane Undivided Section – Assumes 100 feet offset from the centerline for development of a four-lane divided section (50 feet on either side of the centerline).
- Alternative 4: Four-Lane Divided Section – Assumes 165 feet of impact variable by sub-alternative. Assumed impact for each four-lane divided section sub-alternative is as follows:
  - North Alignment: 115 feet north and 50 feet south of current centerline.
  - South Alignment: 115 feet south and 50 feet north of current centerline.

Alternative 1: Intersection Improvements

Table VI-1 shows the potential impacts by adding in intersection improvements within the US 12 Corridor at the identified study area intersections. No structural impacts are anticipated within Alternative 1 improvements.

Table VI-1: Alternative 1 Environmental & Property Impacts

	Right Of Way	Cultural	Wetlands (Acres)	WEB Water				
				Mains (LF)	Beehive Water Pumps	Beehive Water Miscellaneous	Beehive Valve	Beehive Blowoff Assembly
Alt 1-1A: Designate Sylte Accesses	0	0	0	156	0	0	1	0
Alt 1-1B: Remove East Sylte Access	0	0	0	0	0	0	0	0
Alt 1-1C: Relocate Sylte and Sun Terminal Access to 360th Avenue	10.9	0	0.31	303	0	0	0	0
Alt 1-1D: Maintain Existing Sun Terminal Access	0	0	0	0	0	0	0	0
Alt 1-1E: Relocate Sun Terminal Access to 361st Avenue	3.3	0	0	200	0	0	0	0
Alt 1-1F: Dynamic Message Sign	No Cultural/Environmental Impacts							
Alt 1-2G: US 12 and SD 45 Turn Lane Additions/Modifications	0	0	0.04	200	0	0	0	0
Alt 1-3I: US 12 and CR 15 Turn Lane Additions/Modifications	0	0	0.05	173	0	0	0	0
Alt 1-4K: US 12 and CR 17 Turn Lane Additions/Modifications	0	0	0.09	100	0	0	0	0
Alt 1-5L: Eastbound Left-Turn Lane at Nesbitt Drive	No Cultural/Environmental Impacts							
Alt 1-6M: Dynamic Message Signs	No Cultural/Environmental Impacts							
Alt 1-6N: Intersection Lighting	No Cultural/Environmental Impacts							

Alternative 2: Passing Lanes

A summary of the environmental and property impacts for this alternative is shown below in Table VI-2. The environmental impacts from Alternative 1 would be carried forward into Alternative 2. Additional environmental impacts would potentially occur at the locations of the proposed passing lanes. The environmental impacts are broken down by passing lane. Alternative 2 was developed to avoid impacts to existing structures along the US 12 corridor.

Table VI-2: Alternative 2 Environmental & Property Impacts

Alternative	Segment	Right Of Way (Acres)	Cultural	Wetlands (Acres)	WEB Water				
					Mains (LF)	Beehive Water Pumps	Beehive Water Miscellaneous	Beehive Valve	Beehive Blowoff Assembly
2-1A – 361st Avenue to SD 45 (Eastbound)	Ipswich to Mina	0	0	0.02	50	0	0	0	0
2-1B – 361st Avenue to Lane drop at SD 45 (Eastbound)				0.02	50				
2-1C – 365th Avenue to 367th Avenue (Eastbound)				0.10	0				
2-1D – 375th Avenue to 377th Avenue (Eastbound)	Mina to Aberdeen	0	0	0	0	0	0	0	0
2-2E – 369th Avenue to 367th Avenue (Westbound)	Ipswich to Mina	0	0	0.07	50	0	0	0	0
2-2F – CR12WA to 377th Avenue (Westbound)	Mina to Aberdeen	0	0	0.53	50	0	0	0	0
2-3G – 366th Avenue to 368th Avenue (4-lane)	Ipswich to Mina	0	0	0.15	100	0	0	0	0
2-3H – 376th Avenue – 378th Avenue (4-lane)	Mina to Aberdeen	0	0	0.55	100	0	0	0	0

Alternative 3: Four-Lane Undivided Section

The environmental impacts for the four-lane undivided section are shown in Table VI-3.

Table VI-3: Alternative 3 Environmental & Property Impacts

Segment	Right Of Way (Acres)	Cultural	Wetlands (Acres)	WEB Water				
				Mains (LF)	Beehive Water Pumps	Beehive Water Miscellaneous	Beehive Valve	Beehive Blowoff Assembly
Ipswich to Mina	6.5	0	1.43	1,552	0	0	1	0
Mina	0	0	0.05	103	0	0	0	0
Mina to Aberdeen	0	0	0.87	390	0	0	0	0

There is typically 100 feet of right-of-way on either side of the existing centerline. With the additional lanes, it was anticipated that most impacts would be kept within 50 feet of the existing centerline. For Alternative 3, there would be no anticipated additional right-of-way necessary to build a four-lane undivided section.

Four structures would be impacted, three bridges and one box culvert. One is the bridge over the BNSF railroad at Mina, the bridge over the Snake Creek and two structures over Preachers Run.

For wetlands, there was a total of 2.4 acres of impacts. For the WEB Water utilities, there was approximately 2,045 lineal feet of main impacts.

Alternative 4: Four-Lane Divided Section

The environmental impacts for the four-lane divided section are shown in Table VI-4.

Table VI-4: Alternative 4 Environmental & Property Impacts

	Segment	Right Of Way (Acres)	Cultural	Wetlands (Acres)	WEB Water				
					Mains (LF)	Beehive Water Pumps	Beehive Water Miscellaneous	Beehive Valve	Beehive Blowoff Assembly
Alternative 4A: North Alignment	Ipswich to Mina	22.4	0	9.1	8,758	0	0	10	0
	Mina	5.1	1	0.7	170	0	0	0	0
	Mina to Aberdeen	9.2	1	6.5	585	0	0	1	0
	Total	36.7	2	16.3	9,513	0	0	11	0
Alternative 4B: South Alignment	Ipswich to Mina	22.6	0	9.7	62,754	1	27	50	9
	Mina	5.1	1	0.2	2,559	0	0	0	0
	Mina to Aberdeen	9.2	1	1.9	10,930	0	0	5	0
	Total	36.9	2	11.8	76,243	1	27	55	9

For both sub-alternatives, the four existing structures along US 12 would be impacted. There would also be the expense of widening these structures to fit the four-lane sections. Four cultural sites would be impacted by widening to a four-lane section.

Sub-Alternative A: Additional Lanes North

There is 16.3 acres of wetland impacts. WEB water impacts included approximately 9,500 lineal feet of main impacts and 11 WEB water structures that would be impacted.

Sub-Alternative B: Additional Lanes South

There is 11.8 acres of wetland impacts. WEB water impacts include approximately 76,200 lineal feet of main impacts and 92 WEB water structures that would be impacted.

Alternative 4 Summary

There are limited cultural impacts of the proposed four-lane divided sections. Both sub alternatives would impact four structures along the US 12 Corridor.

The wetland impacts are also similar between the two sub-alternatives, with Sub-alternative 4B having 4.5 acres fewer impacts.

The WEB water impacts varied greatly between the two sub-alternatives, since the majority of the main is located south of the existing US 12 alignment. Sub-alternative 4B has approximately 66,700 more lineal feet of impact and 81 more structures impacted compared to Sub-alternative 4A.

SAFETY EVALUATION

The Interactive Highway Safety Design Model (IHSDM) is a decision-support tool that estimates the expected safety and operational performance of existing and proposed highway designs against the Highway Safety Manual (HSM). There are six evaluation modules that can be run within the IHSDM, however, for the US 12 Aberdeen to Ipswich Corridor Study, only the Crash Prediction module was used.

Factors that were incorporated into the base model include, but are not limited to:

- Mainline and minor approach ADT
- Crash history
- Roadway typical section (lane widths, intersection geometry, shoulder widths, etc.)
- Horizontal and vertical alignments
- Safety features such as intersection lighting and centerline and shoulder rumblestrips

This base model was then updated for each alternative and the Crash Prediction module run to see how the proposed alternatives would impact the amount of crashes in the corridor, and each alternative was compared. Each alternative compared five year crash results from 2016 to 2021.

The following eight models were developed and analyzed as part of safety improvements along the US 12 corridor. A summary of the crash outputs for each model is shown in Table VI-5 below. For additional information, the full IHSDM report summaries are located in **Appendix A5**.

» No Build – Existing Conditions

» Alternative 1: Intersection Improvements – Assumes intersection improvements only. Alternative 1 primarily consisted of turn lane improvements, access relocations/closures, and the addition of DMS and intersection lighting. For simplifying the number of models that would need to be run, it was assumed that Sub-alternative A and E would be carried forward from the Sylte Terminal to 361st Avenue. This would involve installing turn lanes at the west access into the Sylte Terminal and relocating the Sun Terminal Access to 361st Avenue and adding turn lanes to 361st Avenue.

» Alternative 2: Passing Lanes (three-lane) – Assumes three-lane passing lanes only. Alternative 2 (three-lane) did not include any of the improvements from Alternative 1. The base model remained the same with the addition of a passing lane at the locations listed for Alternative 2, Sub-alternatives A-F.

» Alternative 2: Passing Lanes (four-lane) – Assumes four-lane passing lanes only. Similarly, for the Alternative 2 (four-lane) model, the base model was modified to include concurrent passing lanes at the locations listed for Alternative 2, Sub-alternatives G-H.

» Alternative 2+1: Passing Lanes (three-lane) – Assumes intersection improvements and three-lane passing sections. For this model, Alternative 1 improvements were combined with the passing lanes listed for Alternative 2, Sub-alternatives A-F.

» Alternative 2+1: Passing Lanes (four-lane) – Assumes intersection improvements and four-lane passing sections. For this model, Alternative 1 improvements were combined with the passing lanes listed for Alternative 2, Sub-alternatives G-H.

» Alternative 3: Four-Lane Undivided Section – Assumes four-lane undivided section with left-turn lanes at key intersections. For Alternative 3, all right-turn lanes were removed from the corridor. Left-turn lanes remained in all locations that were existing or part of Alternative 1 improvements. An additional through lane was added in each direction and a 4' traversable median was added.

» Alternative 4: Four-Lane Divided Section – Assumes four-lane divided section with left-turn lanes at key intersections. For Alternative 4, there were two sub-alternatives. One would be to add the new lanes to the north and one to add the new lanes to the south. Since the traffic would be anticipated to operate the same either way within the IHSDM Crash Prediction Module, only one IHSDM scenario was run for Alternative 4.

  Similar to Alternative 3, all right-turn lanes were removed from the corridor. Left-turn lanes were maintained at all existing locations or if they were recommended as part of Alternative 1 improvements. An additional through lane was added in each direction and a 30' median was added.

SUMMARY AND ANALYSIS OF MODEL OUTPUT

After running all the models, safety benefits are realized for each of the build alternatives. The following tables demonstrates various features of the model runs.

Table VI-5: IHSDM Summary

	Total Crashes	Fatal and Injury Crashes	Fatal and Serious Injury Crashes	Property Damage Only Crashes
Base	135.71	48.35	26.00	87.36
Alternative 1	130.04	45.95	24.73	84.09
Alternative 2 (3-lane)	129.37	46.31	24.89	83.05
Alternative 2 (4-lane)	132.29	47.25	25.40	85.04
Alternative 2+1 (3-lane)	124.03	44.06	23.69	79.97
Alternative 2+1 (4-lane)	126.62	44.85	24.13	81.76
Alternative 3	105.71	55.58	40.07	50.13
Alternative 4	105.25	55.73	39.94	49.52

There were three intersections from the existing conditions crash analysis that exceeded the statewide average crash rate: 361st Avenue, SD 45 and CR 15. The actual crash rate (based on the past five years of crashes) is very similar to the crash rate projected from the IHSDM module. Table VI-6 below shows how the crash rate per MEV varies between each of the alternatives. With the Alternative 1 intersection improvements there is a drop in the crash rates at each of the intersections.

Table VI-6: IHSDM Key Intersection Analysis

Intersection		IHSDM Crash Rate/MEV							
	Observed Crash Rate	Base	Alt 1	Alt 2 (3-lane)	Alt 2 (4-lane)	Alt 2 (3-lane) +1	Alt 2 (4-lane) +1	Alt 3	Alt 4
361st Avenue	0.30	0.34	0.21	0.34	0.34	0.21	0.21	0.20	0.20
SD 45	0.28	0.30	0.26	0.30	0.30	0.30	0.26	0.24	0.24
CR 15	0.37	0.38	0.33	0.38	0.33	0.38	0.33	0.28	0.28

The segment and intersection crash frequency were compared between the different models.

- The four-lane alternatives had the lowest segment and intersection crash rates
- The four-lane alternatives had the highest severe crash rate.
- The three-lane sub-alternatives of Alternative 2 had the lowest segment crash rate.
- The four-lane sub-alternatives of Alternative 2 had the lowest intersection crash rate.
- The four-lane sub-alternative of Alternative 2 and Alternative 1 had the lowest total crash rate.

Table VI-7 summarizes the model output and comparison between the Existing Condition (Base) and each alternative related intersection versus segment crashes.

Table VI-7: IHSDM Segment and Intersection Analysis

Location	Actual	Base	Alt 1	Alt 2 (3-Lane)	Alt 2 (4-Lane)	Alt 2+1 (3-Lane)	Alt 2+1 (4-Lane)	Alt 3	Alt 4
Segment	x	90.59	90.76	84.25	87.17	84.42	87.34	71.75	71.29
Intersection	x	45.03	39.22	45.03	36.86	39.56	39.22	33.94	33.94
Total	x	135.62	129.98	129.28	124.03	123.98	126.56	105.69	105.23

Table VI-8 summarizes the model output and comparison between the Existing Condition (Base) and each alternatives related to serious injury crashes.

Table VI-8: Serious Injury Crashes by Model Run

	Intersection	Segment	Total
Base	19.27	29.14	48.41
Alt 1	16.82	29.19	46.01
Alt 2 (3-lane)	19.27	27.1	46.37
Alt 2 (4-lane)	19.27	28.04	47.31
Alt 2 (3-lane) +1	16.96	27.15	44.11
Alt 2 (4-lane) +1	16.82	28.09	44.91
Alt 3	14.62	40.97	55.59
Alt 4	14.62	41.12	55.74

Table VI-9 summarizes the model output and comparison between the Existing Condition (Base) and each alternatives related to property damage only (PDO) crashes.

Table VI-9: Property Damage Only (PDO) Crashes by Model Run

	Intersection	Segment	Total
Base	25.85	61.51	87.36
Alt 1	22.46	61.62	84.08
Alt 2 (3-lane)	25.85	57.2	83.05
Alt 2 (4-lane)	25.85	59.19	85.04
Alt 2 (3-lane) +1	22.65	57.32	79.97
Alt 2 (4-lane) +1	22.46	59.3	81.76
Alt 3	19.35	30.77	50.12
Alt 4	19.35	30.17	49.52

TRAFFIC EVALUATION

The level of service of both the mainline and each primary study intersection was analyzed. The No Build Alternative with existing and projected traffic forecasts were used to provide a baseline comparison for each Build Alternative.

INTERSECTION CAPACITY BUILD ANALYSIS

Level of service (LOS) analyses were conducted for each alternative at each study intersection. LOS thresholds can be found in Table II-5.

Table VI-8 shows the intersection LOS for each alternative for 2016, 2021 and 2045 counts for the Sylte and Sun Terminals. The LOS for the Sylte Terminal West Access, Sylte Terminal East Access, and Sun Terminal are LOS B or better for 2016, 2021, and 2045 AM and PM peak hour conditions. Generally, sub-alternative C has a higher delay in seconds compared to the sub-alternatives with the traffic generator volumes remaining separated (Sub-alternative 1A, 1B, 1D, and 1E). Table VI-9 below shows the intersection LOS for the remaining study intersections.

Table VI-10: Study Intersections Level of Service with Improvement Alternatives

Intersection	Alternative	Peak Period	2016 Level of Service Delay (seconds)					2021 Level of Service Delay (seconds)					2045 Level of Service/ Delay (seconds)				
			Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB
US 12 & Sylte Farms Terminal-West Driveway	No Build	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.7	10.5	-	-	-	7.8	11.0	-	-	-	7.9	12.0	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.4	10.7	-	-	-	8.5	11.3	-	-	-	8.8	12.6	-
	Alt 1 (Sub Alt A) & Alt 2	A.M.	-	-	A	-	-	-	-	A	-	-	-	-	A	-	-
			-	-	7.7	-	-	-	-	7.8	-	-	-	-	7.9	-	-
		P.M.	-	-	A	-	-	-	-	A	-	-	-	-	A	-	-
			-	-	8.4	-	-	-	-	8.5	-	-	-	-	7.9	-	-
	Alt 1 (Sub Alt B) & Alt 2	A.M.	-	-	A	A	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.7	9.9	-	-	-	7.8	10.2	-	-	-	7.9	10.9	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.4	10.7	-	-	-	8.5	11.2	-	-	-	8.8	12.6	-
	Alt 3 & Alt 4	A.M.	-	-	A	-	-	-	-	A	-	-	-	-	A	-	-
			-	-	7.7	-	-	-	-	7.8	-	-	-	-	8.0	-	-
		P.M.	-	-	A	-	-	-	-	A	-	-	-	-	A	-	-
			-	-	8.6	-	-	-	-	8.8	-	-	-	-	9.1	-	-
US 12 & Sylte Farms Terminal - East Driveway	No Build	A.M.	-	-	A	A	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.2	10.0	-	-	-	8.3	10.2	-	-	-	8.5	10.7	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.4	10.5	-	-	-	8.5	11.0	-	-	-	8.8	12.2	-
	Alt 1 (Sub Alt A) & Alt 2	A.M.	-	-	A	A	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.2	10.0	-	-	-	8.3	10.3	-	-	-	8.5	10.9	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.4	10.7	-	-	-	8.5	11.2	-	-	-	8.8	12.4	-
	Alt 3 & Alt 4	A.M.	-	-	A	A	-	-	-	A	A	-	-	-	A	B	-
			-	-	8.4	9.7	-	-	-	8.5	9.9	-	-	-	8.8	10.3	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	8.6	10.4	-	-	-	8.8	10.8	-	-	-	9.1	11.7	-
US 12 & 360th Ave	Alt 1 (Sub Alt C) & Alt 2	A.M.	-	A	A	B	A	-	A	A	B	B	-	A	A	B	B
			-	7.6	7.7	10.6	9.7	-	7.7	7.8	11.1	10	-	7.8	8.0	12.5	10.8
		P.M.	-	A	A	B	A	-	A	A	B	B	-	A	A	B	B
			-	7.7	8.4	10.9	9.9	-	7.8	8.6	11.4	10.3	-	7.9	8.8	12.9	11.2
US 12 & North Central Farmers Sun Terminal	No Build	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.8	10.5	-	-	-	7.9	11.1	-	-	-	8.1	12.3	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.7	10.1	-	-	-	7.8	10.4	-	-	-	7.9	11.1	-
	Alt 1 (Sub Alt D) & Alt 2	A.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.8	10.5	-	-	-	7.9	11.0	-	-	-	8.1	12.2	-
		P.M.	-	-	A	B	-	-	-	A	B	-	-	-	A	B	-
			-	-	7.7	10.1	-	-	-	7.8	10.4	-	-	-	7.9	11.1	-
US 12 & 361st Ave	Alt 1 (Sub Alt E) & Alt 2	A.M.	-	A	A	B	A	-	A	A	B	B	-	A	A	B	B
			-	7.5	7.8	10.7	9.8	-	7.6	7.9	11.4	10.1	-	7.7	8.1	12.8	11
		P.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	B
			-	7.5	7.7	10.3	9.6	-	7.6	7.8	10.5	9.9	-	7.7	7.9	11.3	10.5
	Alt 3 & Alt 4	A.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	B
			-	7.6	7.9	10.4	9.4	-	7.6	8	11.0	9.6	-	7.8	8.2	12.1	10.2
		P.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	A
			-	7.5	7.8	10.0	9.2	-	7.6	7.8	10.2	9.4	-	7.7	8.0	10.7	9.9

Table VI-11: Study Intersections Level of Service with Improvement Alternatives

Intersection	Alternative	Peak Period	2016 Level of Service/ Delay (seconds)					2021 Level of Service/ Delay (seconds)					2045 Level of Service/ Delay (seconds)				
			Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB	Overall	EB	WB	NB	SB
US 12 & SD 45	No Build	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.6	7.7	10.6	10.5	-	7.6	7.8	11.1	11	-	7.8	7.9	12.1	12.2
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.7	7.7	10.9	11.2	-	7.8	7.8	11.4	12	-	8	7.9	13.0	14
	Alt 1 (Sub Alt G) & Alt 2	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.6	7.7	10.6	10.5	-	7.6	7.8	11.1	11	-	7.8	7.9	12.1	12.1
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.7	7.7	10.8	11.2	-	7.8	7.8	11.4	12	-	8	7.9	12.9	14
	Alt 3 & Alt 4	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.6	7.8	10.4	10.2	-	7.7	7.8	10.9	10.7	-	7.8	8.0	11.8	11.5
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.7	7.8	10.6	10.9	-	7.8	7.8	11.1	11.6	-	8	8.0	12.4	13.2
US 12 & CR 15	No Build	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.7	8.3	10.6	10.7	-	7.8	8.4	11.0	11.4	-	7.9	8.7	12.1	13.1
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.8	8.5	11.4	10.9	-	7.8	8.6	12.1	11.7	-	8	8.9	14.0	13.4
	Alt 1 (Sub Alt I) & Alt 2	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.7	8.3	10.6	10.7	-	7.8	8.4	11.0	11.3	-	7.9	8.7	12.1	13
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.8	8.5	11.4	10.9	-	7.8	8.6	12.1	11.7	-	8	8.9	14.0	13.4
	Alt 3 & Alt 4	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.8	8.5	10.4	10.3	-	7.8	8.6	10.7	10.9	-	8	8.9	11.8	12.3
		P.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	7.8	8.7	11.2	10.5	-	7.9	8.9	11.8	11.2	-	8.1	9.2	13.4	12.5
US 12 & CR 17	No Build, Alt 1, & Alt 2	A.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	B
			-	7.5	7.4	10.5	9.4	-	7.5	7.4	10.9	9.6	-	7.6	7.5	11.9	10.2
		P.M.	-	A	A	B	A	-	A	A	B	B	-	A	A	B	B
			-	7.5	7.5	10.5	9.6	-	7.5	7.5	11.1	10	-	7.7	7.7	12.5	10.7
	Alt 3 & Alt 4	A.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	A
			-	7.5	7.4	10.3	9.0	-	7.5	7.4.	10.6	9.2	-	7.6	7.5	11.7	9.6
		P.M.	-	A	A	B	A	-	A	A	B	A	-	A	A	B	B
			-	7.5	7.5	10.2	9.3	-	7.5	7.5	10.6	9.7	-	7.7	7.7	11.6	10.2
US 12 & Nesbitt Dr	No Build	A.M.	-	A	-	-	A	-	A	-	-	B	-	A	-	-	B
			-	7.6	-	-	9.9	-	7.7	-	-	10.3	-	7.9	-	-	11.2
		P.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
			-	7.7	-	-	10.0	-	7.8	-	-	10.4	-	8.0	-	-	11.4
	Alt 1 (Sub Alt L) & Alt 2	A.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
			-	7.6	-	-	10.2	-	7.7	-	-	10.7	-	7.8	-	-	11.8
		P.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
			-	7.7	-	-	10.3	-	7.8	-	-	10.8	-	8.0	-	-	12.0
	Alt 3 & Alt 4	A.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
			-	7.6	-	-	10.0	-	7.7	-	-	10.4	-	7.9	-	-	11.3
		P.M.	-	A	-	-	B	-	A	-	-	B	-	A	-	-	B
			-	7.7	-	-	10.0	-	7.8	-	-	10.4	-	8.0	-	-	11.5
US 12 & CR 12WA	No Build, Alt 1, & Alt 2	A.M.	-	A	A	B	B	-	A	A	B	B	-	A	A	B	B
			-	8.1	7.6	10.3	10.8	-	8.2	7.7	10.8	11.3	-	8.4	7.8	11.9	12.7
		P.M.	-	A	A	A	B	-	A	A	A	B	-	A	A	A	B
			-	8.3	7.8	9.0	11.1	-	8.4	7.8	9.1	11.9	-	8.7	8.0	9.5	13.6
	Alt 3 & Alt 4	A.M.	-	A	A	A	B	-	A	A	A	B	-	A	A	B	B
			-	8.2	7.7	9.7	10.8	-	8.3	7.7	10.0	11.3	-	8.6	7.8	10.6	12.8
		P.M.	-	A	A	A	B	-	A	A	A	B	-	A	A	A	B
			-	8.5	7.8	8.6	10.8	-	8.6	7.9	8.7	11.4	-	8.9	8.1	8.8	12.8

In general, the intersection LOS remained the same or slightly improved between the No Build Alternative and improvements included in Alternative 1 and Alternative 2. When intersections had higher volumes using right-turn lanes (ex. CR 12WA, CR 15) there was typically a slight increase in delay for Alternative 3 and Alternative 4.

Corridor Capacity Analysis

LOS analyses were conducted for the entire US 12 corridor for each alternative. The capacity analysis utilized lane width, access density, directional hourly volume (DHV), percent no passing zones, and other factors to determine how each segment operates. HCS 2010, a software that implements the Highway Capacity Manual, was used to calculate segment LOS.

Table II-7 shows the indicators for LOS for each corridor segment. A more thorough explanation of corridor LOS concepts is included in Chapter II. Table VI-10 shows the corridor LOS for each build alternative for 2016, 2021, and 2045.

Table VI-12: 2016, 2021 and 2045 Corridor LOS Summary

2016 Peak Hour	LOS	Average Travel Speed	% Time Spent Following	% No Passing
No Build	B	63.1	37.9	20%
Alternative 1	B	63.0	38.6	22%
Alternative 2 (3-Lane + Alt 1)	A	63.8	31.5	22%
Alternative 2 (4-Lane + Alt 1)	A	63.8	31.5	22%
Alternative 3	A	60.0*	x	0%
Alternative 4	A	60.0*	x	0%

2021 Peak Hour	LOS	Average Travel Speed	% Time Spent Following	% No Passing
No Build	B	62.7	41.4	20%
Alternative 1	B	62.6	42.1	22%
Alternative 2 (3-Lane + Alt 1)	A	63.5	34.4	22%
Alternative 2 (4-Lane + Alt 1)	A	63.5	34.4	22%
Alternative 3	A	60.0*	x	0%
Alternative 4	A	60.0*	x	0%

2045 Peak Hour	LOS	Average Travel Speed	% Time Spent Following	% No Passing
No Build	B	61.3	48.8	20%
Alternative 1	B	61.3	49.3	22%
Alternative 2 (3-Lane + Alt 1)	B	62.3	40.9	22%
Alternative 2 (4-Lane + Alt 1)	B	62.3	40.9	22%
Alternative 3	A	60.0*	x	0%
Alternative 4	A	60.0*	x	0%

*The multilane highway equations in the HCM do not allow for speeds greater than 60 mph. These segments could not be treated as freeway segments in the HCM as the level of access anticipated on US 12 could not be replicated.

Alternative 1 typically increased the percent time spent following (PTSF) and decreased the average travel speed (ATS). This is due to the fact that wherever there is a turn lane, there is no passing allowed for the opposing travel lane. Adding and extending turn lanes at the various intersections increases the amount of striped no passing zones.

Alternative 2, under both the three-lane and four-lane sub-alternatives, improves the LOS from LOS B in 2016 and 2021 to LOS A. The PTSF decreases significantly by adding in passing lanes, typically decreasing by six to nine percent.

Alternative 3 and Alternative 4 would not have any no passing zones, since each direction would be able to pass throughout the entire study corridor. The ATS is not directly comparable to the two-lane alternatives, since the multilane highway equations in the HCM do not allow for ATS greater than 60 miles per hour.

BENEFIT COST ANALYSIS

The South Dakota Department of Transportation (SDDOT) US 12 Corridor Study has several alternatives to consider, each offering varying costs and benefits. Table VII-13 lists the alternatives that were included in the benefit-cost analysis.

Table VI-13: Benefit Cost Analysis Alternatives

Alternative	Description
Base	No build, as-is conditions
Alternative 1	Intersection and spot improvements
Alternative 2a	Three-lane with passing lanes, plus improvements from Alternative 1
Alternative 2b	Four-lane undivided with passing lanes, plus improvements from Alternative 1
Alternative 3	Four lane undivided
Alternative 4	Four lane divided

METHODOLOGY

The alternatives were evaluated using the "Challenger-Defender Method," also known as an incremental benefit-cost ratio. This is a standard benefit-cost model used for transportation projects where there are two or more alternatives to compare. The analysis is completed by calculating all discounted costs and quantifiable benefits for each alternative (for this analysis, a standard three percent discount rate was used). The base scenario begins as the defender and the alternative with the lowest cost serves as the challenger. The incremental benefit-cost ratio is then calculated as noted below:

$$\frac{\text{(Benefits of defender - benefits of challenger)}}{\text{(Costs of the defender – costs of the challenger)}}$$

If the incremental benefit-cost ratio is greater than one, the challenger becomes the defender. If it is less than one, the defender remains. This analysis is repeated until all alternatives have been considered. The surviving defender is the economically preferred alternative.

INPUTS AND ASSUMPTIONS

In a BCA, it is critical to ensure alternatives are compared using consistent measures and timelines. For analysis purposes, the construction year was set at 2025. Benefits were measured starting in 2027 (the assumed year 1, post construction) and extended out over the 40-year anticipated life of the project. Costs and benefits related to travel time and intersection delay were not considered in the BCA.

COSTS

All costs utilized in this analysis were pulled directly from the engineer's preliminary opinion of cost. Operation and maintenance costs were calculated in to this analysis as well. The detailed cost/benefit analysis is included in Appendix A8.

BENEFITS

Safety related benefits were calculated using the Interactive Highway System Design Model (IHSDM) analysis that was run for each alternative. The IHSDM model accounts for current conditions (no build) and incorporates safety benefits recognized from the countermeasures designed into each alternative. The analysis was run on a five-year model; for BCA calculation purposes, the five-year calculation was then broken down into an annual average. Per SDDOT guidance, fatal and injury crashes were valued at $374,800 per incident, and property damage only crashes were valued at $17,600. Annual benefits were applied over each year of the project life and discounted accordingly.

RESULTS

Following the Challenger-Defender methodology, the chart below highlights the outcomes of the analysis and the ranking of each alternative. As shown in Table VII-14, from an incremental benefit-cost analysis perspective, Alternative 1 is the preferred alternative with Challenger-Defender ratio of 2.83:1.

Table VI-14: Incremental Benefit/Cost Analysis

Alternative Countermeasure	Discounted Value of Benefits	Discounted Value of Costs	Challenger/Defender BC ratio	Challenger/ Defender Ranking
No Build	$ -	$ -	-	6
1	$3,292,244	$1,163,915	2.83	1
2A	$5,978,416	$9,548,514	0.32	2
2B	$4,851,515	$8,559,836	0.21	3
3	$(7,067,492)	$25,305,659	-0.43	5
4	$(7,223,953)	$36,544,005	-0.30	4

A standard net-present value benefit-cost ratio was also calculated for each alternative. As noted in Table VI-15 below, Alternative one is the most economically viable option, with a net-present benefit-cost ratio of 2.83:1.

Table VI-15: Net Present Value

Alternative Countermeasure	Discounted Value of Benefits	Discounted Value of Costs	Net Present Value	Independent BC Ratio
No Build	$ -	$ -	$ -	-
1	$3,292,244	$1,163,915	$2,128,329	2.83
2A	$5,978,416	$9,548,514	$(3,570,098)	0.63
2B	$4,851,515	$8,559,836	$(3,708,322)	0.57
3	$(7,067,492)	$25,305,659	$(32,373,151)	-0.28
4	$(7,223,953)	$36,544,005	$(43,767,959)	-0.20

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VII. RECOMMENDATIONS & IMPLEMENTATION

SUMMARY

The US 12 Corridor Study developed a broad range of alternatives to improve identified needs along the 20-mile study US 12 corridor from east of the Ipswich city limits to Brown County Road 12W. The following alternatives were developed, analyzed and refined based on input from the public and focus group participants:

- No Build – A do nothing alternative in which no improvements are made to the existing condition.
- Alternative 1 – Strategic intersection level improvements in the form of lighting, turn lane additions/modifications and other operational or safety improvements.
- Alternative 2 – Development of a series of either three- or four-lane passing sections along the US 12 Corridor.
- Alternative 3 – Development of a four-lane undivided section.
- Alternative 4 – Development of a four-lane divided section.

As discussed throughout the US 12 Corridor Study, significant public and local agency concerns surfaced based on a series of fatal and serious injury accidents along US 12. Recent increases in heavy truck traffic associated with agricultural related industry along the US 12 have also raised concerns from the public. Alternatives analysis focused on comparing each of the above alternatives against the No Build condition to determine the relative benefit of each set of improvements.

Existing (2016) and projected conditions (2021 & 2045) analysis determined very few of the proposed alternatives would be warranted based on current SDDOT Standards. Future conditions analysis indicated that all future warranted turn lanes are currently in place at three locations along US 12:

- SD 45
- Edmunds County CR 15
- Edmunds Country Road 17

This element of the US 12 Corridor Study serves to outline the path forward for some of the less expensive and more cost-effective improvements identified through the US 12 Corridor study. As well, this element of the Corridor Study provides a few additional considerations for future improvements not initially evaluated by the technical or public process which support the US 12 Corridor Study. Additionally, it is important to take note of efforts which were initiated even before the onset of the US 12 Corridor Study.

RECENT IMPROVEMENTS

Several recent improvements have been made along US 12. Even before SDDOT initiated the US 12 Corridor Study several improvements were completed or were in the process of being completed to address safety and traffic concerns along the corridor.

Incremental intersection improvements at strategic locations throughout the corridor have been made by SDDOT over the past several years. In late 2015, SDDOT completed a detailed safety review of the corridor which outlined a series of potential small scale safety improvements. Starting in 2016, the South Dakota Highway Patrol (SDHP) increased enforcement along the US 12 Corridor in response to incidents and crashes along the corridor. Centerline rumble strips were added in late 2016. The SDDOT current practice is to deploy temporary dynamic message signs (DMS) during peak

traffic conditions to advise motorist to conditions. While small scale in nature, these improvements have made a difference by improving driver awareness to conditions along the corridor.

Crash Analysis & Safety Considerations

Based on data collected by SDDOT at the end of the US 12 Corridor Study, it appears recent improvements are making a difference. Between the years 2011-2015 crash data along the corridor indicated an average of 10 crashes per year. This five-year data set was the base data used to develop and evaluate alternatives along US 12. However, in 2016, total crashes were reduced to 8. Between October 2016 and the end of February (since implementation of the centerline rumble strips), total crashes were down to an annual average of 7.2. Although the initial results are promising, additional time must pass to fully determine the benefit of recent proactive improvements and strategies.

Table VII-1: Crash Analysis Since 2016

Year	Total	Per Year	Fatal	Injury	PDO
2011-2015	50	10	5	15	30
2016	8	8	1	4	3
Oct 16 - Feb 17	3	7.2*	1	1	1

* Prorated to full year

Based on existing conditions along the US 12 Corridor no intersections exceed a critical crash rate of 1.0 crashes per Million Enter Vehicles (MEV). This measure is typically used to determine a critical crash rate which in many cases will trigger consideration of counter measures. The statewide average for similar rural principal arterials in South Dakota is 0.27 crashes per MEV. The SAT determine that .27/MEV should be used as a trigger to evaluate (not trigger) potential future improvements as part of the US 12 Corridor Study. A total of three 3 intersections along US 12 exceeded the statewide average:

- 361st Avenue;
- SD 45/Craven Corner;
- Edmunds County 15.

Proactive improvements are identified for SD 45 and CR 15. Small scale improvements were identified and evaluated at several other intersections throughout the US 12 Corridor. These improvements were clarified through the development of Alternative 1.

The US 12 Corridor Study made use of the Crash Prediction Module of the Highway Safety Manual (HSM). The results of that analysis were summarized in detail in the report, however in general the following was concluded:

- All Alternatives are predicted to reduce total number of crashes.
- Alternative 1 and 2 were predicted to have no effect on the total number of crashes on the corridor segments.
- Alternative 3 and 4 predicted to have more severe injury and fatal crashes then the other alternatives, however they did reduce the property damage only (PDO) crashes.

These somewhat mixed and at first glance contradictory results are partially based on the number of crashes which SDDOT, SDHP and the consulting team feel are related to “driver behavior” as opposed to geometric conditions of the

corridor. This does not offset the negative consequences of crashes. Concerns with driver behavior along the US 12 corridor were a common theme voiced by the public. Increased public awareness of safe driving habits and increased enforcement from SDHP are targeting this issue.

Additional Improvement Considerations Developed Following Technical Analysis & Public Input

Following Public Input Meeting #2 and in consultation with the Study Advisory Team, additional improvements or modifications to developed alternatives were discussed. These improvements could be considered for potential additional evaluation as SDDOT moves various alternatives further in the project development phase.

- Conditions through Mina – Several concerns were expressed throughout the study regarding the stretch of corridor through Mina. The following should be considered following completion of the US 12 Corridor Study.
    - Consider reducing speeds through Mina to 55 mph.
    - Continue to monitor the access into the M-Station convenience store off of US 12 and the intersection of Nesbitt Drive.
- Intersection Lighting – Alternative 1 considered intersection lighting at locations which met current SDDOT warrants. Only the intersection of CR 12 met warrants. SDDOT is currently reviewing lighting warrants. Substantial public input was reviewed regarding the need for additional lighting at several intersections along the US 12 Corridor. These would include intersections with existing truck generators and Nesbit Drive (near the M-Station).
- Rural Intersection Conflict Warning Systems (RICWS) – SDDOT should continue to monitor conditions at all key intersections to determine if future conditions warrant development of RICWS systems along the corridor. Special attention should be given to the following:
    - Brown County CR 15
    - SD 45/Craven Corner
- Passing Lanes – In consultation with the SAT, it was determined the following additional considerations should be evaluated related to the adding passing lanes along US 12:
    - The preliminary recommendation is the three-lane sections are more appropriate to address the concerns and issues along US 12, as opposed to the two four-lane sections proposed.
    - The addition of the three-lane eastbound passing lane east of 361st should be considered in tandem with the suggested eastbound right-turn lane at SD 45/Craven Corner.
    - In place of the proposed westbound passing lane (Alternative 2f) proposed between Brown County 12W and 377th, it is suggested the continuation of two 2 westbound lanes from the four-lane to two-lane taper to 377th be evaluated.
- Four Lane – The overall development of a four-lane section along the entire corridor doesn't meet requirements of SDDOT. Two specific potential considerations were developed by the SAT for additional future consideration related to the four-lane alternative.

- Extend the current four-lane section from MRM 284 (east of Brown County 12W) to Edmunds CR 2 (east of MRM 278). This would negate the need to consider passing lanes in this stretch. Cost estimates for this improvement ranges from $8.5 (undivided) to $12.3 million (divided).

  An independent BC analysis was not run for this improvement, however it would likely be less than 1.0. However, when coupled with other improvements discussed in Alterative 1 and 2, this may be perceived positively from public and key stakeholders.

Intersection Level of Service & Turn Lanes

The US 12 Corridor Study identified a series of intersection level turn lane improvements. These improvements were aimed at addressing concerns related to the movement of trucks and to address potential spot issues along the US 12 Corridor.

With or without turn lane improvements, intersection level of service (LOS) along US 12 remains at or above LOS B through the year 2045. The percentage of truck traffic along US 12 is above 20 percent (and potentially higher during peak harvest and spring planting). To address this concern the US 12 Corridor Study suggests improving all existing and any new future turn lanes should be long enough to accommodate anticipated vehicle lengths and queues by designing turn lanes to meet or exceed the SDDOT warranted minimums.

Corridor Level of Service

The US 12 Corridor Study identified a series of passing lane options to address concerns identified along the US 12 Corridor. Additionally, two four-lane alternatives were evaluated. Each set of improvements for corridor level improvements were modeled using the Highway Capacity Manual (HCM) to determine improvements to both existing (2016) and projected year 2021 and 2045 traffic conditions along the corridor. A summary of those results showed the following:

- Intersection LOS remains A or B with or without proposed improvements
- Average travel speeds (ATS) remain between 61 to 63 MPH with or without improvements
- Percent of Time Following (PTSF) slightly reduced with the addition of passing lanes
- Corridor LOS goes from B to A with Alternatives 2, 3 and 4

The current SDDOT standard for adding capacity to corridors in rural South Dakota is LOS C. Because of this, no capacity improvements are technically warranted for 2016 conditions. Nonetheless, the US 12 Corridor study identified nearly cost effective solutions to address concerns with slower moving traffic and driver frustration through the development of Alternative 2, which outlined a series of passing lanes at strategic locations along US 12. These improvements will continue to be evaluated for inclusion in the State Transportation Improvement Program (STIP) following the completion of the US 12 Corridor Study.

There has been longstanding public support for a four-lane section along US 12. That sentiment was reinforced during the public input process for the US 12 Corridor Study. As is shown here, and is further discussed below, other potential improvements appear to address identified intersection and corridor level issues in a more cost-effective manner.

Project Selection & Programming

Following completion of the US 12 Corridor Study, the SDDOT will integrate the findings into the development of future State Transportation Improvement Programs (STIP). Prior to projects entering the STIP, SDDOT will use the analysis completed in the US 12 Corridor Study to compare the benefit/cost of the recommended alternatives against other state highway needs throughout South Dakota.

As summarized in detail in preceding sections, the benefit cost (B/C) analysis of the identified improvements show only Alternative 1 having a B/C ratio above 1.0. A B/C ratio greater than 1 suggests and improvements benefits outweigh its costs. Alternative 2 has as B/C ratio of less than 1.0 and Alternatives 3 and 4 in effect have a B/C ratio of less than 0. The B/C ratio of a project is a significant factor used by SDDOT in programming projects in the STIP.

Table VII-2: Benefit Cost Analysis

Alternative Countermeasure	Discounted Value of Benefits	Discounted Value of Costs	Net Present Value	Independent BC Ratio
No Build	$ -	$ -	$ -	-
1	$3,292,244	$1,163,915	$2,128,329	2.83
2A	$5,978,416	$9,548,514	$(3,570,098)	0.63
2B	$4,851,515	$8,559,836	$(3,708,322)	0.57
3	$(7,067,492)	$25,305,659	$(32,373,151)	-0.28
4	$(7,223,953)	$36,544,005	$(43,767,959)	-0.20

SDDOT intends to continue to evaluate and consider the technical analysis and public input developed as part of the US 12 Corridor Study. SDDOT will consider presenting improvements along US 12 to the SDDOT Transportation Commission this spring for consideration with the next STIP process. Considering the current STIP covers the years 2017-2020, it would be likely that any new project would not appear until 2021, the next new year in the STIP for which funds will be programmed.

SDDOT does prepare the proactive Development element of the STIP which covers the four years beyond the last year in the STIP. In this case it would cover years 2022-2025. For more significant investments in US 12, it is likely a project may appear in the Development element of the next STIP.

The STIP development process includes public information meetings throughout the state. The SDDOT will highlight and discuss the programming of improvements to the US 12 Corridor at the Aberdeen meeting planned for July, 2017.