Final Evaluation of Designated Roads (Crowned Ridge Wind I Phase)

Prepared for:

Codington County Highway Department
Codington County, SD

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Prepared by:

BANNER
engineering a better community
Banner Associates, Inc. | 409 22nd Ave So | PO Box 298
Brookings, South Dakota 57006
Tel | 605.692.6342 Fax | 605.692.5714
Toll Free | 1.855.323.6342
www.bannerassociates.com

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Codington County Highway Department
Codington County, SD

Owner Information: Codington County, SD
Highway Department
1201 10th St NW
Watertown, SD 57201
(605) 882-6271

Prepared by: Waylon Blasius, PE
Reviewed by: Mark Junker, PE
Banner Associates Inc.
409 22nd Ave So
Brookings, SD 57006
Phone: (855)-323-6342 (Toll Free)

Certification:

Digitally signed by
Waylon Blasius, PE
Date: 2021.02.05
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I hereby certify that this Report was prepared by me or under my direct supervision.

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SECTION I: INTRODUCTION

NextEra Energy Resources LLC (Developer) has completed construction on the wind farm project referred to as Crowned Ridge Wind LLC. The construction was understood to be completed in two phases known as Crowned Ridge Wind I and Crowned Ridge Wind II, respectively, and each with preliminary transmission line phases. Portions of this wind farm project are located in Codington County, SD, where the Developer entered an agreement (Agreement for Road Use, Repair, and Improvements dated April 2nd, 2019) with the Codington County Highway Department (Owner) to utilize county roads as haul routes. The owner has consulted with Banner Associates, Inc. (Engineer) to perform two roadway evaluations of all proposed haul routes, once at a time prior to construction and once construction has ceased. The asphalt roadways used in this phase of the construction were presented to the Owner for post-construction evaluation on October 8, 2020. The gravel roadways used in this phase of construction were presented to the Owner for post-construction evaluation in November 2020. This report presents the Engineer's findings for the post-construction roadway evaluation of the Crowned Ridge Wind I Phase.

It is our understanding Crowned Ridge Wind I consisted of the construction of approximately 90 turbines and their connection to a substation in the northeast quadrant of Codington County, SD. More definitively, the project area is bound on the West by US Interstate 29, to the North by the Codington County line, to the East by the Codington County line, and to the South by Codington County Highway No 6. There were fourteen (14) miles of asphalt surfaced and ten (10) miles of gravel surfaced Codington County highway roads used as haul roads for the Crowned Ridge Wind I phase. The roads are identified in detail in Figure 1 below. Banner contacted the SDDOT regarding truck percentages of the ADT. The SDDOT stated that truck counts were not available for these two roads; however, the statewide average for Rural Collectors of this type is 13% of the ADT. The roads are in northeastern Codington County, near South Shore, SD. A project area map is provided in APPENDIX A.

A concrete batch plant as well as a material mining pit located within the footprint of this phase of the project. Both facilities were used for this phase and subsequent phases of the project. The concrete batch plant was located in Section 15 – Township 118 N – Range 51 W in Waverly Township, with access coming off of CCR No 3. The material mining pit is located in Section 16 – Township 118 N – Range 52 W in Rauville Township, with access coming off of CCR No 11. These facilities generated substantial traffic both in frequency and loading on some of the roads evaluated as part of this phase.

Figure 1 – Roadway Inventory

Roadway	Segment	Length (miles)	Surfacing	ADT	ADT-T
CCR No 3 – 462nd Avenue	165th St. – 164th St.	1	Asphalt	137	18
CCR No 3 – 464th Avenue	164th St. – 162nd St.	2	Asphalt	185	24
CCR No 4 – 161st Street	461st Ave. – 464th Ave.	3	Gravel	N/A	N/A
CCR No 6 – 164th Street	455th Ave. – 464th Ave.	9	Asphalt	337/218	44/28
CCR No 7 – 461st Avenue	164th St. – 157th St.	7	Gravel	N/A	N/A
CCR No 11 – 455th Avenue	162nd St. – 164th St.	2	Asphalt	1167	152
	Total Miles	24			

*CCR – Codington County Road *ADT – Average Daily Traffic *ADT-T – Average Daily Truck Traffic

SECTION II: ROADWAY EVALUATION PROCESS

Banner compiled input from internal transportation engineers, clients of previous roadway inspection projects, and the Owner's particular preferences in order to formulate an effective roadway evaluation process. Banner determined the most practical way to evaluate the roadway condition was to utilize three major categories of evaluation to include geotechnical investigation, manual roadway data collection, and visual inspection and observation. Further details are provided below.

Geotechnical Investigation

Banner obtained the professional services of GeoTek Engineering & Testing Services, Inc. in Sioux Falls, SD to perform standard penetration test (SPT) soil borings at a frequency of three per mile. The borings provide a representative sample of each segment of roadway in regard to the existing surfacing sections, as well as the type and condition of subgrade and underlying soils to a depth of six feet. These efforts were performed prior to the start of construction. The following paragraph and Figure 2 are excerpts from the pre-construction evaluation regarding the geotechnical exploration efforts.

GeoTek reported an asphalt pavement and clean gravel base course thickness for the asphalt surfaced haul roads, and a clean gravel surfacing thickness for the gravel surfaced haul roads. The average material thickness for each haul road is broken down in Figure 2 below. Banner particularly requested reporting of clean and contaminated base course material, as contamination can contribute to a weaker pavement section. All base course material was reported as clean.

Figure 2 – Average Surfacing Thicknesses

Road	Average Asphalt Pavement Thickness (in)	Average Gravel Base Thickness (in)	Average Gravel Surfacing Thickness (in)
CCR No 2 – 155th Street	N/A	N/A	4.6
CCR No 3 – 462nd Avenue	4.3	8.0	N/A
CCR No 3 – 464th Avenue (S)	4.9	7.5	N/A
CCR No 3 – 464th Avenue (N)	5.2	10.3	N/A
CCR No 4 – 161st Street	N/A	N/A	5.0
CCR No 6 – 164th Street	5.2	7.4	N/A
CCR No 7 – 461st Avenue	N/A	N/A	4.9
Overall – All Roads	5.1	8.2	4.9

Manual Roadway Data Collection

Banner performed manual field measurements of pavement widths and rut depths, as well as additional depth measurements to document any pavement deformations. These measurements were taken at a frequency of five per mile. The field measurements consisted of Banner staff using a magnesium screed to provide a straight edge plane from the crown of the roadway to the shoulder. Banner then determined offsets from centerline and measured depths departing from the straight edge to 1/16" precision. These measurements were taken at the same locations as the pre-construction manual field measurements to provide a better understanding of one aspect of potential roadway damages. Manual measurements were only taken on asphalt surfaced roadways, as the variability of gravel surfacing would make it too difficult to reproduce comparative results.

During post-construction evaluation efforts, Banner reported that on average the rutting within the wheel paths on CCR No 3 fell between 1/16” and 3/16” as a departure from the straight edge, with the deepest rut measuring 3/8". Banner reported that a majority of the rutting within the wheel paths on CCR No 6 fell between 0” and 1/8” as a departure from the straight edge, with the deepest rut measuring 3/16”. CCR No 3 was recently chip sealed prior to construction. CCR No 6 was recently overlaid with a 2” asphalt mat prior to construction. Both of those maintenance efforts were part of the Codington County Highway Departments preventative maintenance plan and had no relation to the project itself. The full data set for manual roadway measurements can be found in APPENDIX B.

Gravel Roadway Crown and Shoulder Topography

During the pre-construction evaluation, Banner used ATV mounted Trimble surveying equipment to collect horizontal and vertical data representing the crown and shoulder points of all Codington County gravel roadways proposed to be used as haul roads. This data was collected at 50-foot intervals. Understanding that general maintenance of gravel roadways will have an impact on the elevation and location of the crown and shoulder points, Banner feels the information collected is valuable in the assessment of the roadway drainage and crown slopes, as well as for comparison measures when assessing the roadways pre and post-construction status. Roadway crown and shoulder topographic data was collected during an abbreviated post-construction haul road evaluation, at which time it was determined that the crown slope of the roads was well outside of acceptable grades. The information was presented to the Developer and the Developer agreed to address the concerns. Banner did not perform a second post-construction topographic survey of the crown and shoulder points.

Visual Inspection and Observation

Banner collected video of each section of roadway from a vehicle mounted Go-Pro camera. Upon reviewing the video, Banner drove the roadway segments, making frequent stops to document and assess the frequency and severity of the different forms of distresses, defects, and deterioration related to both asphalt and gravel surfacing. Banner utilized notes from the inspection as well as pictures, video, and measurements to provide ratings for each roadway segment. Roadway rating criteria and results are provided in the Roadway Rating section of this report. During the pre-construction evaluation, Banner noted areas of additional observation that served as locations that Banner felt were most susceptible to damage from construction activities. Those same locations were observed during the post-construction evaluation, and a comparison to the pre-construction condition was noted. A map and comparison notes can be found in APPENDIX C.

Culvert Inspection

During the visual inspection, Banner also assessed all drainage pipes crossing beneath the highways. During the assessment, Banner took pictures of each end of the culverts, as well as any deficiencies noticed. Banner also recorded the shape, size, and material of each culvert, as well as the aforementioned deficiencies that were photographed. This work was completed during the pre-construction evaluation and then the culverts were re-assessed during the post-construction evaluation, with any changes noted. A map and detailed assessment notes can be found in APPENDIX D.

SECTION III: ASPHALT ROADWAY RATING

In an effort to give Codington County a basis for the condition of the prospective asphalt surfaced haul roads prior to construction, Banner has produced a rating for each one mile stretch of roadway evaluated. The rating system chosen by Banner is derived from the Pavement Surface Evaluation and Rating (PASER) Asphalt Roads Manual produced by the Transportation Information Center at the University of Wisconsin-Madison. The PASER Manual addresses four major categories of common asphalt pavement distress, to include: Surface defects, Surface deformation, Cracks, and Patches and potholes. Asphalt roadways are rated on a scale of 1 to 10; 1 - failed, 10 – excellent. The Distress Identification Manual for the Long-Term Pavement Performance Program produced by the Federal Highway Administration was also used as an additional resource for identifying severity levels of the pavement distress. An excerpt from the PASER Manual regarding a general description of each surface rating is provided in APPENDIX E.

The four major categories of distress can be broken down further to provide a more comprehensive evaluation tool. Surface defects are represented by raveling, flushing, and polishing. Surface deformation is represented by rutting, distortion, rippling and shoving, settling, and heaving. Cracks can be represented by transverse, reflective, longitudinal, block, alligator, and slippage. These distresses, along with patches and potholes present on the roadway, were evaluated by Banner Engineers as being of low, medium, or high severity. The severity and frequency of the distresses were taken into account when formulating an overall rating reflective of the entire mile stretch of roadway.

Banner utilized visual inspection and manual field measurements to determine severity levels of the pavement distress. What follows is a general synopsis of the information collected and used to determine the PASER ratings. The PASER rating for each one-mile segment of roadway is shown in Figure 3 on page 12.

Mile No. 8 - CCR No. 3 from 164th St. – 165th St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in mid-lane and along roadway edge. Transverse cracks feel pounded down into base material while driving.
- Moderate severity of block and alligator cracking present along outer 1/4 of lanes for approximately 20% of the segment length. Fair amount of cracking at North intersection causing roadway breakup.
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- Two maintenance patches replacing areas of break-up during construction
- Rutting measured between 1/16th and 3/8th of an inch.

Mile No. 9 - CCR No. 6 from 458th Ave. – 459th Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along shoulders and transverse cracks having been sealed prior to construction. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present along outer 1/4 of lanes, particularly in WB lane
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.

- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- One new maintenance patch was noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Shoulders of roadway appear to be pushing out.
- Rutting measured up to 1/16th of an inch.

Mile No. 10 - CCR No. 6 from 459th Ave. – 460th Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths and along shoulders and transverse cracks having been sealed prior to construction. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present along outer 1/4 of lanes, particularly in WB lane
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches observed
- Rutting measured up to 1/16th of an inch.

Mile No. 11 - CCR No. 6 from 460th Ave. – 461st Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths and along shoulders and transverse cracks having been sealed prior to construction. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present along outer 1/4 of lanes
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- One maintenance patch was noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Rutting measured between 1/16th and 1/8th of an inch.

Mile No. 12 - CCR No. 6 from 461st Ave. – 462nd Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths, along edge lines, and along the centerline. Transverse cracks feel pounded down into base material while driving.
- Moderate severity of block and alligator cracking present along outer 1/4 of lanes for approximately 30% of the segment length
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches observed
- Rutting measured between 1/16th and 3/16th of an inch.

Mile No. 13 - CCR No. 6 from 462nd Ave. – 463rd Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths and along the centerline. Transverse cracks feel pounded down into base material while driving.
- High severity of block and alligator cracking present along outer 1/3 of lanes for approximately 50% of the segment length, as well as some isolated areas along the centerline
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- Two maintenance patches were noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16th and 3/16th of an inch.

Mile No. 14 - CCR No. 6 from 463rd Ave. – 464th Ave

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths. Transverse cracks feel pounded down into base material while driving.
- High severity of block and alligator cracking present along outer 1/4 of lanes for approximately 75% of the segment length
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- One maintenance patch was noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Rutting measured between 1/16th and 3/16th of an inch.

Mile No. 15 - CCR No. 3 from 163rd St – 164th St

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths. Transverse cracks feel pounded down into base material while driving.
- Moderate severity of block and alligator cracking present along outer 1/4 of lanes for approximately 45% of the segment length
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- Four maintenance patches were noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16th and 3/16th of an inch.

Mile No. 16 - CCR No. 3 from 162nd St – 163rd St

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel paths and along roadway edges. Transverse cracks feel pounded down into base material while driving.
- High severity of block and alligator cracking present along outer 1/3 of lanes for approximately 70% of the segment length
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Some new scarring was noted on the pavement surface.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- Five maintenance patches were noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16th and 1/4th of an inch.

Mile No. 1A - CCR No. 11 from 163rd St. – 164th St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along centerline, mid-lane, and edge of roadway. Many cracks very open (1/2" wide or more).
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches observed.
- Rutting measured between 1/16th and 1/4th of an inch.

Mile No. 2A - CCR No. 11 from 162nd St. – 163rd St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along centerline, mid-lane, and edge of roadway. Some cracks very open (1/2" wide or more).
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings. It was also noted that there are areas of deep rutting. The asphalt movement and deep rutting has created a couple areas of dangerous travel, particularly on North end of segment.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches observed.
- Rutting measured between 1/16th and 9/16th of an inch.

Mile No. 3A - CCR No. 6 from 455th Ave. – 456th Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along shoulders and transverse cracks having been sealed prior to construction. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present in wheel paths
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.

- No new patches observed.
- Rutting measured up to 1/16th of an inch.

Mile No. 4A - CCR No. 6 from 456th Ave. – 457th Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along shoulders and transverse cracks having been sealed prior to construction. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present in wheel paths
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- Two maintenance patches were noted along this segment of roadway over top of the areas of minor block and alligator cracking
- Rutting measured between 1/16th and 5/16th of an inch.

Mile No. 5A - CCR No. 6 from 457th Ave. – 458th Ave.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent along shoulders and transverse cracks having been sealed prior to construction. Cracking more prevalent in Eastbound lane and beneath interstate overpass. Transverse cracks feel pounded down into base material while driving.
- Minor severity of block and alligator cracking present in wheel paths
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minor severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches observed
- Rutting measured between 1/16th and 7/16th of an inch.

Figure 3 – PASER Rating

Roadway	Segment	Mile Reference	PASER Rating
CCR No 3 - 462nd Ave	164th St – 165th St	8	5
CCR No 6 - 164th St	458th Ave – 459th Ave	9	6
CCR No 6 - 164th St	459th Ave – 460th Ave	10	6
CCR No 6 - 164th St	460th Ave – 461st Ave	11	7
CCR No 6 - 164th St	461st Ave – 462nd Ave	12	5
CCR No 6 - 164th St	462nd Ave – 463rd Ave	13	4
CCR No 6 - 164th St	463rd Ave – 464th Ave	14	4
CCR No 3 - 464th Ave	163rd St – 164th St	15	4
CCR No 3 - 464th Ave	162nd St – 163rd St	16	3
CCR No 6 - 164th St	457th Ave – 458th Ave	5A	7
CCR No 6 - 164th St	456th Ave – 457th Ave	4A	7
CCR No 6 - 164th St	455th Ave – 456th Ave	3A	8
CCR No 11 – 455th Ave	163rd St – 164th St	2A	7
CCR No 11 – 455th Ave	162nd St – 163rd St	1A	6

SECTION IV: GRAVEL ROADWAY RATING

In an effort to give Codington County a basis for the condition of the prospective gravel haul roads prior to construction, Banner produced a rating for each one mile stretch of roadway evaluated. The rating system chosen by Banner is derived from the Pavement Surface Evaluation and Rating (PASER) Gravel Roads Manual produced by the Transportation Information Center at the University of Wisconsin-Madison. The PASER Manual addresses five major conditions and defects common to gravel roadways, to include: Crown, Drainage, Gravel Layer, Surface deformation, and Surface defects. Gravel roadways are rated on a scale of 1 to 5; 1 - failed, 5 – excellent. An excerpt from the PASER Manual with a general description of each surface rating is provided in APPENDIX E. Banner performed a similar visual inspection during the post-construction roadway evaluation but did not produce a corresponding PASER rating for each segment of roadway, as by the time the roadways were turned over for evaluation, the ground was frozen and not all aspects of the evaluation could be completed.

The five major conditions and defects can be broken down further to provide a more comprehensive evaluation tool. Crown not only refers to the height and condition of the crown at the centerline of the roadway, but also the entire cross-slope of the roadway through the shoulders and to the ditch. Drainage assessment reflects the adequacy of the roadway corridor to convey water without having areas of standing water soaking into the roadway subgrade for long periods of time, through the use of roadside ditches and pass-through culverts. Gravel layer is a more tangible condition where the thickness and quality of the gravel can be measured and identified. Surface deformations are represented by conditions that create an unsafe roadway such as washboarding, potholes, and ruts. Surface defects are represented by dust and loose aggregate on the roadway. Banner evaluated the conditions and defects as being of low, medium, or high severity. The severity and frequency of the conditions were considered when formulating an overall rating reflecting the entire mile stretch of roadway. Something that must be understood is that many of the visual observations that are considered when rating these roadways can change significantly as a result of recent large weather events causing surface defects, or recent maintenance efforts repairing surface defects.

Banner utilized visual inspection to determine severity levels of the gravel conditions and defects to the extent possible with frozen ground. What follows is a general synopsis of the information collected for each stretch of gravel surfaced roadway.

CCR No 4 from 461st Ave. to 464th Ave.

- Visually the crown slopes appear to be fair, with some minor areas of curb and gutter on the roadway holding water on the roadway edge.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter effect on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Some areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline. These are likely soft areas that began to expose themselves but may have frozen before completely blowing out.

- Minimal other surface defects such as rutting, washboarding, or potholing were noted. This is likely due to recent maintenance efforts and frozen ground.

CCR No 7 from 157th St. to 164th St.

- Visually the crown slopes appear to be fair, with some minor areas of curb and gutter on the roadway holding water on the roadway edge.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter effect on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Some areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline. These are likely soft areas that began to expose themselves but became frozen before completely blowing out.
- Some areas noted where surface gravel appeared minimal in the wheel paths, or the surface gravel was contaminated making it appear that the section was minimal.
- Minimal other surface defects such as rutting, washboarding, or potholing were noted. This is likely due to recent maintenance efforts and frozen ground.

SECTION V: HAUL ROUTE MAINTENANCE

Representatives of Codington County and Banner Associates frequently traveled the haul routes to gauge the maintenance effort of the Developer during construction. The maintenance of the roads was the responsibility of the Developer for the duration of the construction period. Initial observations showed that the Developer did not take any pre-construction steps to improve the roadways and strengthen their ability to handle the proposed loadings anticipated with the project. Subsequent observations showed that the stretches of roadway evaluated in this phase of the project continued to deteriorate at a rapid pace, and some segments experienced excessive damages that at times created a compromised and unsafe roadway.

At times, the public traveling these roads contacted the Codington County Highway Department regarding potholes and roadway breakups creating safety concerns, particularly during night driving. The maintenance effort of the Developer to address these concerns was minimal throughout the duration of construction, particularly on the asphalt roadways, as it was noted that many areas of break-up were not maintained for a period of months. The developer did place temporary maintenance asphalt patches over areas of complete failure and break-up at the completion of construction. These patches are intended for short term maintenance relief only, and do not provide a long-term solution to the damages experienced. The Codington County Highway Department did not perform any routine maintenance on these stretches of roadway during the construction timeframe.

Maintenance efforts on the gravel roadways during construction consisted largely of the Developer digging out areas where their equipment could not pass and filling those areas with material in attempt to bridge the subgrade, as well as routine blading of the gravel surface. The Developer noted that the project did haul

additional gravel material to the haul routes as problem areas arose to facilitate the movement of construction vehicles throughout the course of the project. In addition to the gravel material provided for construction purposes, it appears that during construction gravel material was pulled from the outer ¼ of the roadway on each side, into the middle to provide a more stable single path for construction traffic. This assumption is made based on the condition of the gravel roads near the end of construction, as many of the gravel roadways showed crown slopes of 1.5 to 2.0 times as steep as pre-construction conditions. The steep crown slopes coupled with the roadway edges being dug down below the adjacent shoulder, created a curb and gutter appearance on the roadway which trapped water on the roadway and left little to no gravel surfacing on the roadway edges.

Banner was informed in August 2020 that the Developer had completed their use of the gravel haul roads associated with the wind farm construction. Banner performed an initial abbreviated evaluation of the gravel roads within this phase of the project. During this evaluation Banner identified many deficiencies with the gravel haul roads as presented by the Developer. These deficiencies placed the gravel haul roads in a far worse condition than that which was reported in the Pre-Construction Haul Road Report. Banner, the Owner, and the Developer met on site in September 2020 at which time Banner presented the unacceptable findings of the abbreviated evaluation. At that time, the Developer agreed to address all concerns as noted prior to returning the haul roads to the Owner for a post-construction evaluation to be administered. The items of concern noted during this meeting were also to be addressed on the gravel surfaced haul routes within all other phases of the project.

The Developer hired a contractor to perform some of the roadway restoration efforts noted in the aforementioned September 2020 site meeting. Representatives of Codington County and Banner Associates made site visits to assess the efforts and ensure care was being taken to restore the roadways appropriately. Both parties noted that substantial effort was made to dig out soft areas and clean up the roadway edges, as well as blade the existing gravel surfacing in a manner to more evenly distribute the surface material across the full width of the roadway creating a more consistent gravel surfacing depth and a more manageable crown slope. It was also noted that the center of the roadway had far thicker sections of gravel surfacing than the roadway edges prior to re-distribution efforts, likely being a direct result of the blading maintenance approach assumed earlier in this report. This substantial effort was consistent for approximately three (3) miles of the gravel surfaced roadway CCR No. 7 from 164th St. to 161st St. The remainder of the gravel surfaced haul routes in this phase of the project did not receive the same restoration efforts, as it appears that there were no more soft areas dug out and replaced on the remaining four (4) miles of CCR No. 7 or the three (3) miles of CCR No. 4. The Developer did continue the efforts of removing the curb and gutter effect and redistributing the gravel surfacing material for those seven miles. There was a snow storm in mid-October that impacted the project area and restoration efforts, and it is not known whether the impending winter weather and associated ground freeze played a factor in the decision to suspend the dig out operations.

SECTION VI: SUMMARY

Banner would consider the two-mile stretch of CCR No 3 from 162nd St. to 164th St. to be in poor condition overall. Manual roadway measurements show that the roadways have experienced minor to moderate rutting in the wheel paths. Visual observations have shown substantial damage and deficiencies across all aspects of pavement

evaluation, particularly related to cracking of all types at moderate to high severities, surface and wheel path wear, and the need for many temporary maintenance patches. An assessment of this two-mile segment of roadway using the PASER system provided ratings of three (3) and four (4), respectively.

Banner would consider the one-mile stretch of CCR No 3 from 164th St. to 165th St. to be in fair condition overall. Manual roadway measurements show that the roadway has experienced minor to moderate rutting in the wheel paths. Visual observations have shown moderate to high severity damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types at moderate to high severities, surface and wheel path wear, and the need for multiple temporary maintenance patches. An assessment of this one-mile segment of roadway using the PASER system provided a rating of five (5).

Banner has decided to break CCR No 6 into three separate segments for the purpose of summarizing their post-construction conditions. This is deemed appropriate as a portion of the roadway recently received an asphalt overlay and a portion of the roadway was an addition to the post-construction evaluation that was not part of the pre-construction evaluation. The same breakdown will be true for the comparison section of this report.

Banner would consider the three-mile stretch of CCR No 6 from 461st Ave. to 464th Ave. to be in poor to fair condition overall. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown substantial damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types at moderate to high severities, surface and wheel path wear, and the need for temporary maintenance patches. An assessment of this three-mile segment of roadway using the PASER system provided ratings of four (4), four (4), and five (5), respectively.

Banner would consider the three-mile stretch of CCR No 6 from 458th Ave. to 461st Ave. to be in good condition overall. This stretch of roadway received a mill and asphalt overlay effort in 2018, one year prior to the commencement of the wind farm project. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for temporary maintenance patches. It also was noted that the transverse cracks that may have reflected through the recent overlay have been pounded down to a point that the ride quality at highway speeds has been reduced. An assessment of this three-mile segment of roadway using the PASER system provided ratings of six (6), six (6), and seven (7), respectively.

Banner would consider the three-mile stretch of CCR No 6 from 455th Ave. to 458th Ave. to be in good condition overall. This stretch of roadway received a mill and asphalt overlay effort in 2018, one year prior to the commencement of the wind farm project. Manual roadway measurements show that the roadways have experienced minor to moderate rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for temporary maintenance patches. It also was noted that the transverse cracks that may have reflected through the recent overlay have been pounded down to a point that the ride quality at highway speeds has been reduced. An assessment of this three-mile segment of roadway using the PASER system provided ratings of eight (8), seven (7), and seven (7), respectively.

Banner would consider the two-mile stretch of CCR No 11 from 162nd St. to 164th St. to be in good condition overall. Manual roadway measurements show that the roadways have experienced minor to moderate rutting in the wheel paths. Visual observations have shown mostly minor to moderate damage and deficiencies across

all aspects of pavement evaluation, particularly related to cracking of all types as well as surface and wheel path wear, and some surfacing shifting. A few locations of higher severity deficiencies were present, particularly from 163rd St. to 164th St. and at the intersection of CCR No 11 and 164th St. An assessment of this two-mile segment of roadway using the PASER system provided ratings of six (6) and seven (7), respectively.

Banner would consider the three-mile stretch of CCR No 4 from 461st Ave. to 463rd Ave. to be in good condition overall. Crown slopes appeared adequate and the roadway was recently bladed to negate the appearance of much surface defects. A full post-construction evaluation was not able to be completed due to frozen ground conditions, and therefore Banner could not report on all aspects of the evaluation process and chose not to give the roadways a post-construction PASER rating. Having knowledge of the effort and process the Developer put forth for digging out soft areas on other stretches of gravel roadway but having suspended that effort prior to addressing this stretch of roadway, it is likely that there are soft areas that were exposed during construction that will show up again once the ground thaws. The number and size of these areas cannot be quantified at this time, and the only true way to find them will be to perform a follow-up inspection once ground conditions are favorable. Non-contaminated gravel surfacing depths were not investigated during the post-construction evaluation due to frozen ground conditions.

Banner would consider the seven-mile stretch of CCR No 7 from 157th St. to 164th St. to be in good condition overall. Crown slopes appeared adequate and the roadway was recently bladed to negate the appearance of much surface defects. A full post-construction evaluation was not able to be completed due to frozen ground conditions, and therefore Banner could not report on all aspects of the evaluation process and chose not to give the roadways a post-construction PASER rating. Site visits by Codington County and Banner Associates showed that the Developer provided adequate effort to repair soft areas exposed during construction for the three-mile stretch from 161st St. to 164th St. Understanding that same effort was not maintained for the remaining four-mile stretch from 161st St. to 157th St., it is likely that there are soft areas that were exposed during construction that will show up again once the ground thaws. The number and size of these areas cannot be quantified at this time, and the only true way to find them will be to perform a follow-up inspection once ground conditions are favorable. Non-contaminated gravel surfacing depths were not investigated during the post-construction evaluation due to frozen ground conditions.

The lack of pre-construction efforts to enhance the roadway carrying capabilities, as well as a lack of ongoing maintenance during construction has proved to be detrimental to the asphalt roadways in general. CCR No 3 and the three-mile stretch of CCR No 6 from 461st Ave. to 464th Ave. have been reduced to a state of partial to complete failure. Many locations have exhibited complete failure by means of excessive cracking, potholing, and complete break-up of the surface material. The six-mile stretch of CCR No 6 from 455th Ave. to 461st Ave., which received a mill and asphalt overlay effort in 2018, has experienced new cracking of various types, which can be distinguished because old cracks along this stretch of roadway had previously been sealed. The damage to the areas in this phase of the project that required full depth maintenance patching should be considered when assessing the roadway as a whole, as it is evidence that the entire roadway experienced a considerable amount of stress causing the weaker areas to fail and the stronger areas to move closure to failure. With the amount of damage that can be seen from the surface, it can be concluded that the remaining roadway section has been compromised as well.

As was noted in the pre-construction evaluation report, the Codington County Highway Department practices a preventative maintenance program for their roadways comprised largely of chip seals and overlays to ensure an extension of the roadway life cycle multiple times over before reaching a state of failure. This is a common

practice in this area, particularly on rural roadways where low ADT counts result in a substantial increase in the longevity of quality constructed and maintained roadways. What has transpired on CCR No 3 and the three-mile stretch of CCR No 6 from 461st Ave. to 464th Ave. would fall under the practice of reactive maintenance, in which the roadway is allowed to reach a point of failure and extensive restoration is necessary to return the roadway to a state in which future preventative maintenance can again be practiced. The damages experienced on the stretches of roadway that have been recently overlaid are more likely to be receptive to traditional preventative maintenance procedures such as an overlay.

With the roads having been in service for many years to this point and no significant damage noted on the pre-construction roadway evaluation, it is clear that the damages sustained by the haul routes from the construction activities are far beyond that in which typical traffic loadings over the course of sixteen months would have produced.

Restoration expectations for the haul routes were echoed at the South Dakota Public Utilities Commission meetings held on October 13th and again on October 28th, where commissioners made clear statements that the expectation for the roadway restoration efforts are for the roads to be returned in "perfect condition." The commission reaction was particular to a letter received from the project's public liaison, as well as comments made by the Codington County Highway Superintendent as well as photos that a local resident sent to the Public Utilities Commission. The damages were acknowledged by a representative of NextEra Energy and were quoted as being "typical" for a wind project site.

SECTION VII: EVALUATION COMPARISON

Banner has compared the pre-construction roadway evaluation data with the post-construction roadway evaluation data. This section summarizes our findings.

CCR No 3 from 162nd St. to 164th St. and CCR No 6 from 461st Ave. to 464th Ave.

This segment of roadway covers five (5) miles of asphalt surfaced haul route, totaling 25 manual roadway measurement locations. Of the 25 locations, seven (7) showed an increase in rut depth for at least one measurement at that location. The severity of the increased rut depths ranged from 1/16th of an inch to 1/8th of an inch. Another two (2) locations were temporarily patched due to damages sustained during construction and therefore a comparison could not be made. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was much more prevalent on the post-construction inspection, particularly longitudinal and block cracking along each outer quarter of the roadway. Flushing and polishing increased significantly, with it being very evident that oil had migrated to the surface of the asphalt in a large portion of the wheel paths. The aggregate in the wheel paths has been worn to a point where there is no angularity left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for twelve (12) temporary maintenance patches to be placed.

CCR No 3 from 164th St. to 165th St.

This segment of roadway covers one (1) mile of asphalt surfaced haul route, totaling 5 manual roadway measurement locations. Of the 5 locations, one (1) showed an increase in rut depth for at least one measurement at that locations. The severity of the increased rut depths ranged from 1/8th of an inch to 3/16th of an inch. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was much more prevalent on the post-construction inspection, particularly longitudinal and block cracking along each outer quarter of the roadway. Flushing and polishing increased significantly, with it being very evident that oil had migrated to the surface of the asphalt in the wheel paths. The aggregate in the wheel paths has been worn to a point where there is no angularity left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for two (2) temporary maintenance patches to be placed.

CCR No 6 from 458th Ave. to 461st Ave.

This segment of roadway covers three (3) miles of asphalt surfaced haul route, totaling 15 manual roadway measurement locations. Of the 15 locations, 1 showed an increase in rut depth for at least one measurement at that location. The severity of the increased rut depths ranged from 1/8th of an inch to 3/16ths of an inch. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was more prevalent on the post-construction inspection, particularly longitudinal cracking, and some block cracking along each outer quarter of the roadway. The transverse cracks that were present prior to construction feel to have been pushed into the base material causing an unsteady ride at highway speeds. Flushing and polishing increased, with it being evident that oil had migrated to the surface of the asphalt in a large portion of the wheel paths. The aggregate in the wheel paths has been worn to a point where minimal angularity is left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for two (2) temporary maintenance patches to be placed.

CCR No 6 from 455th Ave. to 458th Ave. and CCR No 11 from 162nd St. to 164th St.

There are no comparison notes for these stretches of roadway as there was no pre-construction roadway evaluation performed. These miles were not included in the original haul route map and the Developer did not notify Codington County that they would be using these segments. Codington County witnessed that these roadways were being utilized as haul roads, at which time they informed Banner. These roads had already been used for an unknown amount of time and the opportunity for pre-construction evaluations had passed.

CCR No 4 from 461st Ave. to 464th Ave. and CCR No 7 from 157th St. to 164th St.

The post construction visual inspection showed the roadway to be in good condition for the aspects that could be assessed with frozen conditions. Both the pre-construction and post-construction evaluations showed some areas of surface gravel contaminated with clay material, particularly along the centerline and in the wheel paths. One large change noted in the post-construction evaluation is a very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter effect on the roadway. Some of the areas of false edge have an abrupt change in cross-slope from the real edge

of roadway to the ditch foreslope. This may be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.

Banner completed a visual inspection and assigned a PASER roadway rating to each one mile stretch of asphalt surfaced designated haul route. Figure 3 below shows a comparison of PASER ratings for each mile stretch of asphalt surfaced roadway in this phase of the project.

Figure 3 – PASER Rating Comparison

Roadway	Segment	PASER Rating	
		Pre-Construction	Post-Construction
CCR No 3 - 462nd Ave	164th St – 165th St	6	5
CCR No 6 - 164th St	458th Ave – 459th Ave	8	6
CCR No 6 - 164th St	459th Ave – 460th Ave	8	6
CCR No 6 - 164th St	460th Ave – 461st Ave	8	7
CCR No 6 - 164th St	461st Ave – 462nd Ave	7	5
CCR No 6 - 164th St	462nd Ave – 463rd Ave	6	4
CCR No 6 - 164th St	463rd Ave – 464th Ave	7	4
CCR No 3 - 464th Ave	163rd St – 164th St	7	4
CCR No 3 - 464th Ave	162nd St – 163rd St	7	3
CCR No 6 - 164th St	457th Ave – 458th Ave	N/A	7
CCR No 6 - 164th St	456th Ave – 457th Ave	N/A	7
CCR No 6 - 164th St	455th Ave – 456th Ave	N/A	8
CCR No 11 – 455th Ave	163rd St – 164th St	N/A	7
CCR No 11 – 455th Ave	162nd St – 163rd St	N/A	6

During construction, many intersections were widened to accommodate construction traffic, which required the contractor to remove and temporarily place traffic signs at intersections. It was noted that the most common temporary placement effort was by placing the signposts in PVC standpipes that were anchored into the ground. During the post construction evaluation, it was noted that many signs remained in the temporary PVC standpipes and/or were reinstalled but incorrectly whether it be absent square placement to the corresponding intersection and roadways, at an inappropriate offset to the corresponding roadways, or on inappropriate mounting posts. The maintenance and reinstallation of these signs is of extreme importance.

Many areas of highway right of way that were vegetated prior to construction currently sit barren. The areas exhibiting a lack of vegetation were commonly observed in locations where existing intersections were widened for construction and the widening was removed at the conclusion of construction, and locations where turbine access roads are installed off of the county highway. The lack of vegetation in these areas creates a concern for erosion and sediment transfer.

Banner did not note any additional deficiencies during the post-construction evaluation of the culverts beneath the roadway.

APPENDIX G contains pre- and post-construction frozen frames from video of the haul routes collected by Banner. Each sheet shows a side-by-side comparison of the same location from each evaluation period. The damages shown are intended to depict the typical damage experienced by that segment of roadway. Please note that some haul routes were driven in opposite direction pre- and post-construction, so a red arrow is used to point out an identifier in each photo to verify it is the same location in both frozen frames. Banner has also included a sheet of photos taken during construction of areas of roadway that were completely compromised.

SECTION VIII: RESTORATION RECOMMENDATIONS

In accordance with Section 3.2 *Repair of Designated Roads* of the *Agreement for Road Use, Repair, and Improvements*, the Developer is responsible for the restoration of all Designated Roads as specified in this Final Evaluation of Designated Roads Report. Restoration may include, but is not limited to, to following: 1) services of civil, structural and geotechnical consultant(s), 2) Design, plans, bidding, staking, testing, observation, etc., 3) repair of damaged roadway areas, additional gravel, asphalt overlays, etc., 4) replacement of roadway base and surfacing, 5) repair and/or replacement of bridges and/or culverts. All costs associated with the restoration of the roadways, bridges, and culverts along the designated roads shall be paid for by the Developer. Banner provides the following recommendations for restoration of the haul routes, broken down into various segments of roadway each corresponding to a different restoration effort.

CCR No 3 from 162nd St. to 164th St. and CCR No 6 from 461st Ave. to 464th Ave.

Banner has determined that there is no feasible rehabilitation effort that could return these segments of roadway to pre-construction condition. The roads have experienced extensive damages that have compromised the structural integrity of the roadway section and its overall useful life. Therefore, Banner is recommending full reconstruction of the asphalt roadway surfacing section. Full reconstruction will include, but is not limited to, traffic control, shoulder preparation, reclamation of the in-place surfacing material, incorporation of virgin base course, roadway shaping, installation of 4” of asphalt concrete pavement surfacing, and restoring the shoulders of the roadway, and striping. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 3 from 164th St. to 165th St.

Banner has determined that the roadway has experienced damages in excess of what was observed during the pre-construction evaluation, including additional longitudinal and transverse cracking as well as some additional areas of block cracking. There were two temporary maintenance patches installed by the Developer within this one-mile segment after construction was complete. The damages sustained to require temporary maintenance patches provides a basis for the likely underlying damage sustained by the remainder of the roadway that has not yet reached a point of failure but is closer to failure than it was pre-construction. Banner is recommending that this segment of roadway be assessed for any specific locations where damages require a full dig out and patching effort, followed by milling 1.5” of the wearing course of asphalt and relaying a 2” wearing course. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 6 from 455th Ave. to 461st Ave.

Banner has determined that the asphalt overlay that was performed on the entire six-mile stretch of roadway in 2018 has experienced damages in excess of what was observed during the pre-construction evaluation, including additional longitudinal and transverse cracking as well as the start of some block cracking. There was a total of four (4) temporary maintenance patches installed by either Codington County or the Developer during or after construction within these six miles of roadway as well. These additional damages can be quantified for the three miles of roadway with a pre-construction evaluation, but not for the additional three miles that were used without notification to Codington County. Banner is recommending that this segment of roadway be assessed for any specific locations where damages require a full dig out and patching effort, followed by milling 1.5" of the wearing course of asphalt and relaying a 2" wearing course. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 11 from 162nd St. to 164th St.

Banner did not perform a pre-construction roadway evaluation on this two-mile stretch of roadway as it was not presented as part of the original haul route and Banner was not informed of its addition until well after it was being used for construction. The roadway certainly shows deficiencies, but it is difficult to ascertain how much the deficiencies were exaggerated due to construction traffic. The use of this stretch of roadway was similar to that of CCR No 6 from 455th Ave. to 458th Ave. and therefore, similar damages can be assumed. Banner is recommending milling 1.5" of the wearing course of asphalt and relaying a 2" wearing course for this segment of roadway.

CCR No 7 from 161st St. to 164th St.

Banner feels that the post construction restoration effort to repair soft areas that arose during construction as well as cleaning up the roadway edges and appropriately re-distributing the existing surfacing material are adequate. Banner recommends that the Developer seed the false roadway edges to provide a clear differentiation between the gravel roadway and the vegetated shoulders, for the safety of the travelling public. This will help reduce the chance that the now barren roadway shoulders would erode, causing future damage. In accordance with the *Agreement for Road Use, Repair, and Improvements*, now that construction is complete the Developer shall place 3" of SDDOT state spec. "gravel surface" material as defined in section 882 of the SDDOT specification book on gravel roads defined in the haul road agreement. It shall be noted that this effort has not yet been performed.

CCR No 7 from 157th St. to 161st St. and CCR No 4 from 461st Ave. to 464th Ave.

As was noted previously in this report, although the Developer continued to clean up the roadway edges and appropriately re-distribute the existing gravel surfacing material to create a more uniform surface and manageable crown, the same post-construction restoration effort to repair soft areas that arose during construction was not maintained for this segment of roadway. Banner does not feel it is reasonable to believe that this effort was abruptly determined to be no longer necessary by the Developer and therefore recommends that once the roadway is thawed in the Spring, the Developer perform the same assessment and digout effort that they felt was necessary for the initial three-mile stretch of full rehabilitation before frozen conditions set in. Due to the frozen conditions at the time of the post-construction evaluation, the extent of

the need as well as the cost for this effort is unknown and will likely vary across the remaining gravel roadway sections. Banner also recommends that the Developer seed the false roadway edges to provide a clear differentiation between the gravel roadway and the vegetated shoulders, for the safety of the travelling public. This will help reduce the chance that the now barren roadway shoulders would erode, causing future damage. Once repairs are made, in accordance with the *Agreement for Road Use, Repair, and Improvements*, the Developer shall place 3" of SDDOT state spec. "gravel surface" material as defined in section 882 of the SDDOT specification book on gravel roads defined in the haul road agreement. It shall be noted that this effort has not yet been performed.

Banner recommends that all intersections within the project footprint are to be evaluated and all signs are to be re-installed, as necessary, in accordance with the Codington County Highway Department standards for placement in relation to the corresponding roadway and on proper sign posts using Codington County Highway Department approved hardware. This effort is required to be coordinated with the Codington County Highway Department prior to commencement of the effort. Banner also recommends that all areas of highway right-of-way in need of vegetative restoration are to be cleared of all rock and gravel debris and seeded using a Codington County Highway Department approved seed mix and method.

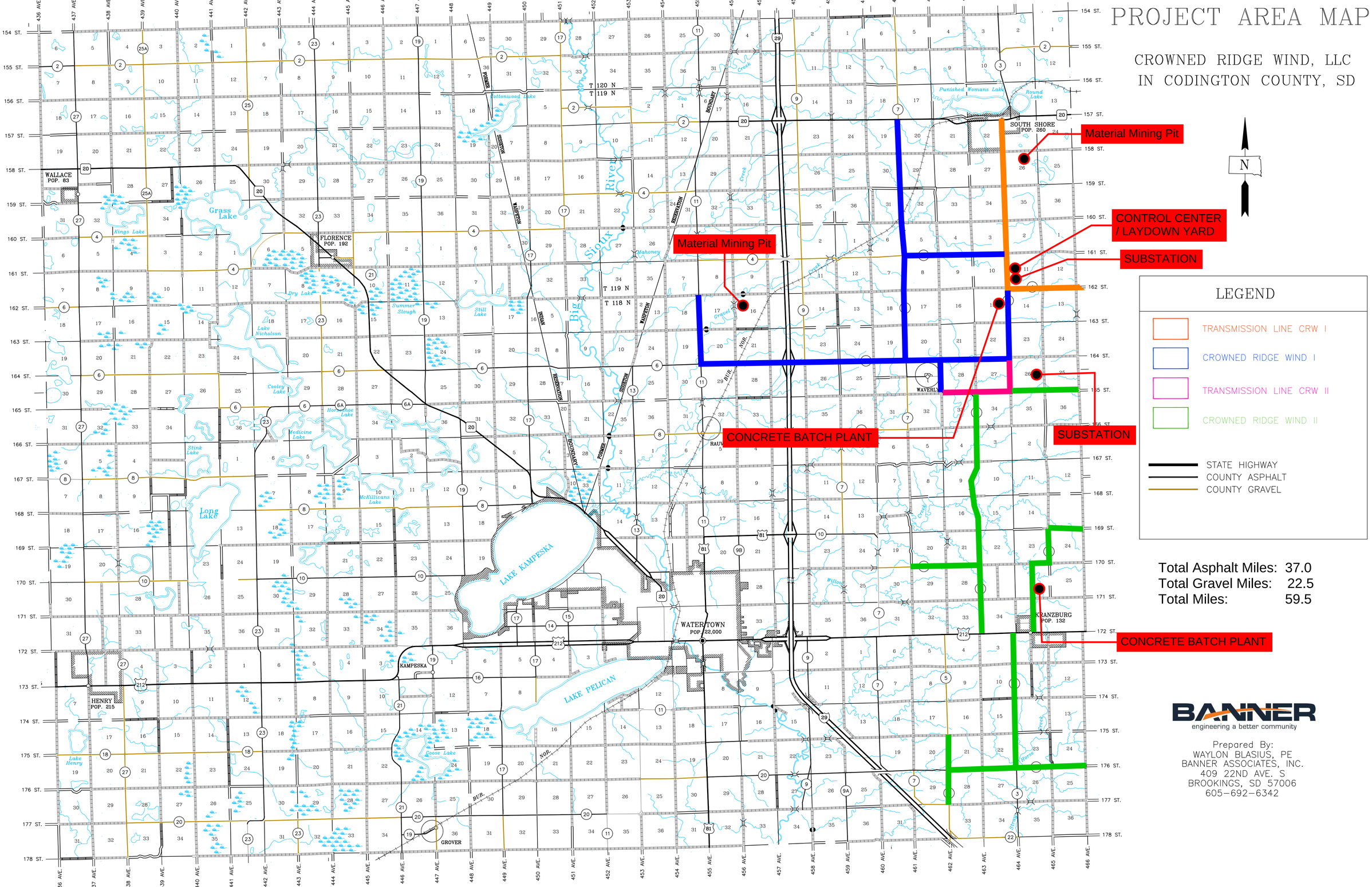
Banner recommends that a consultant be hired to produce construction documents and provide bidding and construction observation services appropriate for the effort necessary to complete the roadway restoration. All restoration plans and specifications are required to be approved by the Codington County Highway Department prior to any restoration efforts taking place. Banner also recommends that a testing agency be hired to complete quality control testing for the roadway restoration efforts.

An opinion of probable restoration cost can be found in Appendix F. Please note this cost estimate is meant for a ballpark cost for informational purposes only, the Developer is responsible for all actual costs incurred to completely satisfy the restoration recommendations. In accordance with Section 3.2 *Repair of Designated Roads* of the *Agreement for Road Use, Repair, and Improvements*, the restoration of the Designated Roads shall be completed within 12 months of the Final Evaluation of Designated Roads report being issued to the Developer.

APPENDIX A

PROJECT AREA MAP

PROJECT AREA MAP



BANNER
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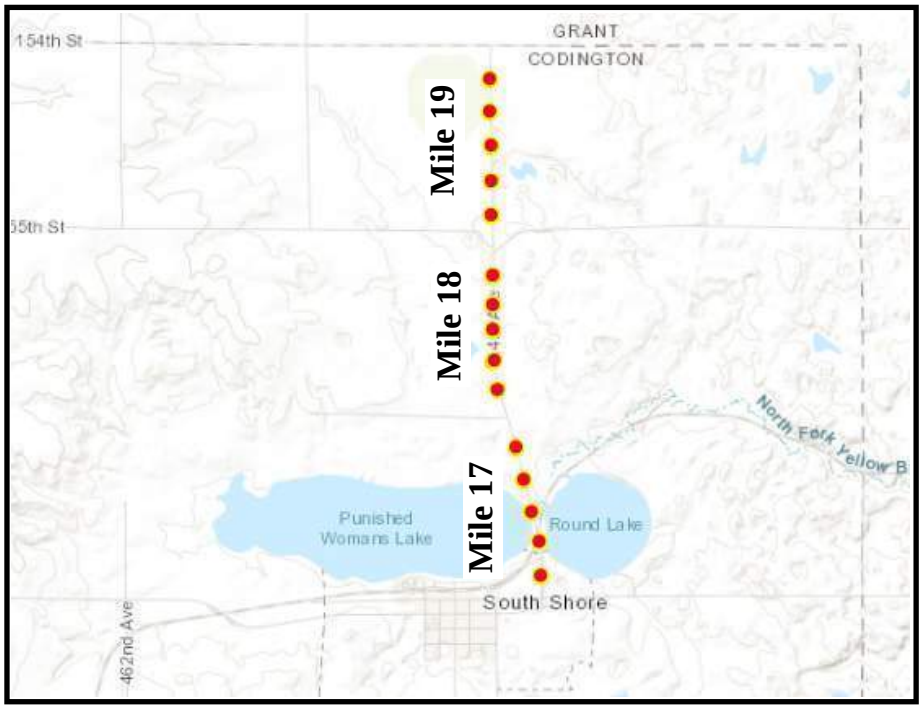
Prepared By:
WAYLON BLASIUS, PE
BANNER ASSOCIATES, INC.
409 22ND AVE. S
BROOKINGS, SD 57006
605-692-6342

APPENDIX B

MANUAL ROADWAY MEASUREMENTS



Roadway Measurements Map

Roadway Measurements Map

0 1 2
Miles

N

MILE 8

Location ID	Lane	Lane Width 1	Lane Width 2
M71	East	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
6	0	0	0
27	5/16	5/16	0
52	0	0	0
54	0	0	0
82	1/4	1/4	0
98	3/8	3/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M80	West	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
24	0	0	0
50	1/16	1/16	0
62	0	0	0
80	1/16	1/16	0
93	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M72	East	154	154
Offset	**Depth 1**	**Depth 2**	**Difference**
4	0	0	0
20	1/16	1/16	0
46	0	0	0
58	0	0	0
84	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M79	West	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
24	0	0	0
43	1/16	1/16	0
74	0	0	0
108	3/8	3/8	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M73	East	158	158
Offset	**Depth 1**	**Depth 2**	**Difference**
5	0	0	0
45	0	0	0
58	0	0	0
60	0	0	0
69	1/16	1/16	0
95	0	0	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M78	West	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
7	0	0	0
20	1/16	1/16	0
54	0	0	0
72	0	0	0
92	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M74	East	154	154
Offset	**Depth 1**	**Depth 2**	**Difference**
9	0	0	0
21	1/8	1/8	0
39	0	0	0
62	0	0	0
67	1/8	1/8	0
77	0	0	0
89	1/16	1/4	3/16

Location ID	Lane	Lane Width 1	Lane Width 2
M77	West	157	157
Offset	**Depth 1**	**Depth 2**	**Difference**
31	0	1/8	1/8
46	1/16	1/16	0
57	0	0	0
93	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M75	East	153	153
Offset	**Depth 1**	**Depth 2**	**Difference**
3	0	0	0
9	1/8	1/8	0
44	1/16	1/16	0
61	0	0	0
74	0	0	0
91	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M76	West	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
3	0	0	0
14	1/16	1/16	0
34	0	0	0
58	0	0	0
96	1/16	1/16	0
116	0	0	0

MILE 9

Location ID	Lane	Lane Width 1	Lane Width 2
M81	South	160 1/2	161

Offset	Depth 1	Depth 2	Difference
14 1/2	0	0	0
41 1/2	1/16	1/16	0
61 1/2	1/16	1/16	0
68 1/2	0	0	0
79 1/2	0	0	0
94 1/2	1/16	1/16	0
111 1/2	0	0	

Location ID	Lane	Lane Width 1	Lane Width 2
M140	North	158	158

Offset	Depth 1	Depth 2	Difference
9	0	0	0
31	1/16	1/16	0
57	0	0	0
70	0	0	0
94	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M82	South	159	159

Offset	Depth 1	Depth 2	Difference
16	0	0	0
38	1/16	1/16	0
67	0	0	0
72	0	0	0
89	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M139	North	162	162

Offset	Depth 1	Depth 2	Difference
12	0	0	0
30	0	0	0
55	0	0	0
76	0	0	0
95	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M83	South	167	167

Offset	Depth 1	Depth 2	Difference
11	0	0	0
30	1/16	1/16	0
62	0	0	0
74	0	0	0
96	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M138	North	162	162

Offset	Depth 1	Depth 2	Difference
18	0	0	0
38	1/16	1/16	0
64	0	0	0
72	0	0	0
95	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M84	South	157	157

Offset	Depth 1	Depth 2	Difference
10	0	0	0
39	1/16	1/16	0
67	0	0	0
70	0	0	0
97	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M137	North	165	165

Offset	Depth 1	Depth 2	Difference
16	0	0	0
32	0	0	0
43	1/16	1/16	0
64	0	0	0
72	0	0	0
91	1/16	1/16	0
112	0	0	

Location ID	Lane	Lane Width 1	Lane Width 2
M85	South	161	161

Offset	Depth 1	Depth 2	Difference
13	0	0	0
38	1/16	1/16	0
66	0	0	0
78	0	0	0
82	0	0	0
94	0	0	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M136	North	160	160

Offset	Depth 1	Depth 2	Difference
23	0	0	0
47	1/16	1/16	0
70	0	0	0
78	0	0	0
88	1/16	1/16	0
115	0	0	0

MILE 10

Location ID	Lane	Lane Width 1	Lane Width 2
M86	South	154	154

Offset	Depth 1	Depth 2	Difference
12	0	0	0
36	0	0	0
61	0	0	0
69	0	0	0
73	0	0	0
92	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M135	North	166	166

Offset	Depth 1	Depth 2	Difference
21	0	0	0
33	0	0	0
48	0	0	0
68	0	0	0
76	1/16	1/16	0
96	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M87	South	155	155

Offset	Depth 1	Depth 2	Difference
12	0	0	0
27	1/16	1/16	0
63	0	0	0
79	0	0	0
94	1/16	1/16	0
105	1/16	1/16	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M134	North	164	164

Offset	Depth 1	Depth 2	Difference
23	0	0	0
41	1/16	1/16	0
69	0	0	0
76	0	0	0
92	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M88	South	157	157

Offset	Depth 1	Depth 2	Difference
13	0	0	0
38	0	0	0
53	1/16	1/16	0
67	0	0	0
76	0	0	0
90	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M133	North	167	167

Offset	Depth 1	Depth 2	Difference
18	0	0	0
46	1/16	1/16	0
67	0	0	0
74	0	0	0
91	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M89	South	160	160

Offset	Depth 1	Depth 2	Difference
17	0	0	0
42	1/16	1/16	0
65	0	0	0
72	0	0	0
87	1/16	1/16	0
109	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M132	North	160	160

Offset	Depth 1	Depth 2	Difference
10	0	0	0
40	0	0	0
46	1/16	1/16	0
57	0	0	0
71	0	0	0
89	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M90	South	162	162

Offset	Depth 1	Depth 2	Difference
12	0	0	0
37	1/16	1/16	0
64	0	0	0
75	0	0	0
96	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M131	North	160	160

Offset	Depth 1	Depth 2	Difference
10	0	0	0
31	0	0	0
46	1/16	1/16	0
67	0	0	0
72	0	0	0
90	1/16	1/16	0
111	0	0	0

MILE 11

Location ID	Lane	Lane Width 1	Lane Width 2
M91	South	161	161
Offset	**Depth 1**	**Depth 2**	**Difference**
10	0	0	0
44	1/16	1/16	0
64	0	0	0
72	0	0	0
101	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M130	North	162	162
Offset	**Depth 1**	**Depth 2**	**Difference**
12	0	0	0
37	1/16	1/16	0
55	0	0	0
68	0	0	0
88	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M92	South	165	165
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
42	1/16	1/16	0
66	0	0	0
78	0	0	0
102	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M129	North	162	162
Offset	**Depth 1**	**Depth 2**	**Difference**
12	0	0	0
40	1/16	1/16	0
64	0	0	0
76	0	0	0
98	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M93	South	163	163
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
35	1/16	1/16	0
64	0	0	0
69	0	0	0
98	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M128	North	157	157
Offset	**Depth 1**	**Depth 2**	**Difference**
12	0	0	0
42	1/16	1/16	0
50	0	0	0
64	0	0	0
98	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M94	South	161	161
Offset	**Depth 1**	**Depth 2**	**Difference**
9	0	0	0
40	1/16	1/16	0
65	0	0	0
76	0	0	0
96	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M127	North	164	164
Offset	**Depth 1**	**Depth 2**	**Difference**
17	0	0	0
42	1/16	1/16	0
60	0	0	0
76	0	0	0
101	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M95	South	164	164
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
42	1/16	1/16	0
66	0	0	0
72	0	0	0
104	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M126	North	159	159
Offset	**Depth 1**	**Depth 2**	**Difference**
9	0	0	0
35	1/16	1/16	0
58	0	0	0
62	0	0	0
86	1/8	1/8	0
96	1/16	1/16	0
117	0	0	0

MILE 12

Location ID	Lane	Lane Width 1	Lane Width 2
M96	South	156	156

Offset	Depth 1	Depth 2	Difference
16	0	0	0
40	0	0	0
59	0	0	0
65	0	0	0
90	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M125	North	153	153

Offset	Depth 1	Depth 2	Difference
1	0	0	0
8	1/8	3/16	1/16
24	0	1/8	1/8
42	1/16	1/16	0
68	0	0	0
72	0	0	0
88	1/8	1/8	0

Location ID	Lane	Lane Width 1	Lane Width 2
M97	South	153	153

Offset	Depth 1	Depth 2	Difference
9	0	0	0
40	1/16	1/16	0
67	0	0	0
74	0	0	0
94	1/16	1/16	0
105	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M124	North	156	157

Offset	Depth 1	Depth 2	Difference
13	0	0	0
43	1/16	1/16	0
71	1/16	1/16	0
80	0	0	0
86	0	0	0
101	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M98	South	151	151

Offset	Depth 1	Depth 2	Difference
15	0	0	0
43	1/16	1/16	0
60	0	0	0
70	0	0	0
90	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M123	North	161	161

Offset	Depth 1	Depth 2	Difference
11	0	0	0
42	1/16	1/16	0
54	0	0	0
80	0	0	0
96	3/16	3/16	0
107	1/8	1/8	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M99	South	153	153

Offset	Depth 1	Depth 2	Difference
10	0	0	0
38	1/8	1/8	0
62	0	0	0
80	0	0	0
98	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M122	North	159	159

Offset	Depth 1	Depth 2	Difference
26	0	0	0
40	1/16	1/16	0
60	1/16	1/16	0
71	0	0	0
90	1/8	1/8	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M100	South	155	155

Offset	Depth 1	Depth 2	Difference
16	0	0	0
45	1/8	1/8	0
65	0	0	0
73	0	0	0
96	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M121	North	155	155

Offset	Depth 1	Depth 2	Difference
3	0	0	0
16	1/8	1/8	0
41	0	0	0
64	0	0	0
91	1/8	1/8	0
111	0	0	0

MILE 13

Location ID	Lane	Lane Width 1	Lane Width 2
M101	South	152	152

Offset	Depth 1	Depth 2	Difference
7	0	0	0
12	3/16	3/16	0
27	1/16	1/16	0
50	1/8	1/8	0
61	0	0	0
92	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M120	North	152	154

Offset	Depth 1	Depth 2	Difference
10	0	0	0
20	1/16	1/16	0
48	0	0	0
62	1/16	1/16	0
84	1/16	1/16	0
104	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M102	South	151	151

Offset	Depth 1	Depth 2	Difference
18	0	0	0
40	1/16	1/16	0
64	0	0	0
75	0	0	0
98	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M119	North	155	155

Offset	Depth 1	Depth 2	Difference
9	0	0	0
28	1/8	1/8	0
55	0	0	0
70	0	0	0
98	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M103	South	143	143

Offset	Depth 1	Depth 2	Difference
16	0	0	0
42	0	0	0
66	0	0	0
78	0	0	0
96	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M118	North	156	156

Offset	Depth 1	Depth 2	Difference
10	0	0	0
36	1/16	1/16	0
59	0	0	0
68	0	0	0
92	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M104	South	146	146

Offset	Depth 1	Depth 2	Difference
16	0	0	0
40	1/16	1/16	0
60	0	0	0
76	0	0	0
100	1/8	3/16	1/16
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M117	North	157	157

Offset	Depth 1	Depth 2	Difference
16	0	0	0
51	1/16	1/16	0
68	0	0	0
80	0	0	0
96	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M105	South	146	146

Offset	Depth 1	Depth 2	Difference
14	0	0	0
36	0	0	0
60	0	0	0
78	0	0	0
104	0	1/16	1/16
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M116	North	156	156

Offset	Depth 1	Depth 2	Difference
10	0	0	0
27	1/16	1/16	0
45	1/16	1/16	0
54	0	0	0
72	0	0	0
98	1/8	1/8	0
114	0	0	0

MILE 14

Location ID	Lane	Lane Width 1	Lane Width 2
M106	South	141	141
Offset	**Depth 1**	**Depth 2**	**Difference**
10	0	0	0
36	1/8	3/16	1/16
59	0	0	0
75	0	0	0
89	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M115	North	163	163
Offset	**Depth 1**	**Depth 2**	**Difference**
12	0	0	0
36	1/16	1/16	0
55	0	0	0
78	1/16	1/16	0
104	3/16	3/16	0
115	1/8	1/8	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M107	South	149	149
Offset	**Depth 1**	**Depth 2**	**Difference**
22	0	1/8	1/8
38	1/8	3/16	1/16
58	0	0	0
79	0	0	0
102	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M114	North	152	152
Offset	**Depth 1**	**Depth 2**	**Difference**
14	0	0	0
43	0	0	0
61	1/16	1/16	0
71	0	0	0
98	3/16	1/4	1/16
115	1/16	1/16	0

Location ID	Lane	Lane Width 1	Lane Width 2
M108	South	163	163
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
37	1/16	1/16	0
62	0	0	0
82	0	0	0
105	0	0	0
113	1/16	1/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M113	North	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
9	0	0	0
29	1/16	1/16	0
71	1/16	1/16	0
102	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M109	South	154	154
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
34	1/16	1/16	0
57	0	0	0
81	0	0	0
101	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M112	North	155	155
Offset	**Depth 1**	**Depth 2**	**Difference**
0	1/8	1/8	0
20	1/8	1/8	0
33	0	0	0
70	1/16	1/16	0
105	3/16	3/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M110	South	142	142
Offset	**Depth 1**	**Depth 2**	**Difference**
16	0	0	0
45	1/16	1/16	0
64	0	0	0
72	0	0	0
96	0	0	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M111	North	156	156
Offset	**Depth 1**	**Depth 2**	**Difference**
10	0	0	0
50	1/16	1/16	0
67	1/8	1/8	0
78	0	0	0
108	3/16	3/16	0
118	0	0	0

MILE 15

Location ID	Lane	Lane Width 1	Lane Width 2
M141	East	147	147

Offset	Depth 1	Depth 2	Difference
4	0	0	0
12	1/16	1/16	0
26	0	0	0
46	1/16	1/16	0
71	0	0	0
89	1/8	1/8	0
107	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M142	East	150	150

Offset	Depth 1	Depth 2	Difference
9	0	0	0
18	1/16	1/16	0
24	0	0	0
36	1/16	1/16	0
55	0	0	0
87	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M143	East	169	169

Offset	Depth 1	Depth 2	Difference
3	0	N/A	
6	1/8	N/A	
28	0	N/A	
44	1/16	N/A	
62	0	N/A	
70	0	N/A	
93	1/8	N/A	

Location ID	Lane	Lane Width 1	Lane Width 2
M144	East	147	147

Offset	Depth 1	Depth 2	Difference
3	0	0	0
9	1/8	1/8	0
21	0	0	0
30	1/8	1/8	0
65	0	0	0
76	0	0	0
89	1/16	1/16	0

Location ID	Lane	Lane Width 1	Lane Width 2
M145	East	144	144

Offset	Depth 1	Depth 2	Difference
3	0	0	0
35	3/16	3/16	0
58	0	0	0
69	0	0	0
86	1/16	1/16	0
106	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M190	West	149	149

Offset	Depth 1	Depth 2	Difference
3	0	0	0
25	1/16	1/16	0
55	0	0	0
76	0	0	0
98	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M189	West	145	145

Offset	Depth 1	Depth 2	Difference
2	0	0	0
20	1/8	1/8	0
64	0	0	0
69	0	0	0
88	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M188	West	150	150

Offset	Depth 1	Depth 2	Difference
3	0	N/A	
18	1/4	N/A	
35	1/8	N/A	
58	0	N/A	
67	0	N/A	
98	5/16	N/A	
118	0	N/A	

Location ID	Lane	Lane Width 1	Lane Width 2
M187	West	151	152

Offset	Depth 1	Depth 2	Difference
4	0	0	0
22	3/16	3/16	0
48	0	0	0
60	0	0	0
97	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M186	West	153	153

Offset	Depth 1	Depth 2	Difference
6	0	0	0
23	3/16	3/16	0
46	0	0	0
59	0	0	0
90	3/16	3/16	0
115	0	0	0

MILE 16

Location ID	Lane	Lane Width 1	Lane Width 2
M146	East	142	142

Offset	Depth 1	Depth 2	Difference
5	0	0	0
33	1/8	1/8	0
64	0	0	0
78	0	0	0
92	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M147	East	146	146

Offset	Depth 1	Depth 2	Difference
13	0	0	0
37	1/16	1/16	0
67	0	0	0
74	0	0	0
88	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M148	East	141	141

Offset	Depth 1	Depth 2	Difference
14	0	0	0
30	1/16	1/16	0
55	0	0	0
58	0	0	0
80	1/8	1/8	0
101	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M149	East	143	

Offset	Depth 1	Depth 2	Difference
5	0	N/A	N/A
25	1/16	N/A	N/A
62	0	N/A	N/A
64	0	N/A	N/A
88	1/4	N/A	N/A
114	0	N/A	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M150	East	149	149

Offset	Depth 1	Depth 2	Difference
6	0	0	0
14	1/8	1/8	0
30	0	0	0
53	1/16	1/16	0
64	0	0	0
89	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M185	West	160	160

Offset	Depth 1	Depth 2	Difference
10	0	0	0
28	1/8	1/8	0
56	0	0	0
64	0	0	0
96	3/16	3/16	0
113	0	1/8	1/8

Location ID	Lane	Lane Width 1	Lane Width 2
M184	West	161	161

Offset	Depth 1	Depth 2	Difference
9	0	0	0
35	0	0	0
63	0	0	0
70	0	0	0
96	3/16	3/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M183	West	161	161

Offset	Depth 1	Depth 2	Difference
15	0	0	0
29	1/16	1/16	0
49	0	0	0
60	0	1/8	1/8
64	0	1/8	1/8
92	3/16	3/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M182	West	161	161

Offset	Depth 1	Depth 2	Difference
16	0	0	0
43	1/16	1/16	0
69	0	0	0
80	0	0	0
104	1/4	1/4	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M181	West	151	151

Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	3/16	3/16	0
38	1/16	1/16	0
50	0	0	0
70	0	0	0
92	1/8	1/8	0
113	0	0	0

MILE 17

Location ID	Lane	Lane Width 1	Lane Width 2
M151	East	144	144

Offset	Depth 1	Depth 2	Difference
5	0	0	0
20	1/16	1/16	0
61	0	0	0
80	0	0	0
99	1/16	1/4	3/16
110	0	3/16	3/16

Location ID	Lane	Lane Width 1	Lane Width 2
M152	East	140	140

Offset	Depth 1	Depth 2	Difference
7	0	0	0
16	1/16	1/16	0
43	0	0	0
70	0	0	0
93	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M153	East	149	149

Offset	Depth 1	Depth 2	Difference
6	0	0	0
18	1/16	1/16	0
46	1/16	1/16	0
55	0	0	0
72	0	0	0
95	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M154	East	151	151

Offset	Depth 1	Depth 2	Difference
13	0	0	0
25	1/16	1/16	0
44	0	0	0
73	0	0	0
101	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M155	East	146	146

Offset	Depth 1	Depth 2	Difference
8	0	0	0
22	1/8	1/8	0
48	0	0	0
64	0	0	0
96	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M180	West	154	154

Offset	Depth 1	Depth 2	Difference
18	0	0	0
27	1/16	1/16	0
53	0	0	0
71	0	0	0
98	1/8	1/8	0
109	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M179	West	150	150

Offset	Depth 1	Depth 2	Difference
6	0	0	0
22	1/8	1/8	0
50	0	0	0
70	0	0	0
99	1/16	1/16	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M178	West	162	162

Offset	Depth 1	Depth 2	Difference
6	0	0	0
19	1/8	1/8	0
44	0	0	0
48	0	0	0
63	1/16	1/16	0
80	0	0	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M177	West	150	150

Offset	Depth 1	Depth 2	Difference
8	0	0	0
19	1/16	1/16	0
42	0	0	0
56	0	0	0
92	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M176	West	148	149

Offset	Depth 1	Depth 2	Difference
6	0	0	0
16	1/16	1/16	0
48	0	0	0
77	0	0	0
100	1/8	1/8	0
115	0	0	0

MILE 18

Location ID	Lane	Lane Width 1	Lane Width 2
M156	East	145	145

Offset	Depth 1	Depth 2	Difference
10	0	0	0
36	1/16	1/16	0
42	0	0	0
55	1/16	1/16	0
69	0	0	0
105	1/8	1/8	0
119	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M157	East	158	158

Offset	Depth 1	Depth 2	Difference
10	0	0	0
35	1/16	1/16	0
56	0	0	0
66	0	0	0
84	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M158	East	152	152

Offset	Depth 1	Depth 2	Difference
6	0	0	0
25	1/16	1/16	0
54	0	0	0
74	0	0	0
94	1/16	1/16	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M159	East	149	149

Offset	Depth 1	Depth 2	Difference
6	0	0	0
32	1/16	1/16	0
59	0	0	0
71	0	0	0
108	1/8	1/8	0
119	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M160	East	150	150

Offset	Depth 1	Depth 2	Difference
18	0	0	0
32	1/16	1/16	0
64	0	0	0
77	0	0	0
96	1/16	1/16	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M175	West	155	155

Offset	Depth 1	Depth 2	Difference
25	0	0	0
59	1/16	1/8	1/16
77	0	0	0
89	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M174	West	150	150

Offset	Depth 1	Depth 2	Difference
6	0	0	0
32	1/16	1/16	0
50	0	0	0
68	0	0	0
88	1/16	1/8	1/16
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M173	West	155	

Offset	Depth 1	Depth 2	Difference
6	0		
34	1/16		
59	0		
70	0		
93	1/16		
116	0		

Location ID	Lane	Lane Width 1	Lane Width 2
M172	West	157	157

Offset	Depth 1	Depth 2	Difference
11	0	0	0
28	1/16	1/16	0
48	0	0	0
54	0	0	0
64	1/8	1/8	0
86	0	0	0
102	1/16	1/16	0

Location ID	Lane	Lane Width 1	Lane Width 2
M171	West	152	

Offset	Depth 1	Depth 2	Difference
9	0		
26	1/16		
57	0		
71	0		
96	1/8		
116	0		

MILE 19

Location ID	Lane	Lane Width 1	Lane Width 2
M161	East	150	150

Offset	Depth 1	Depth 2	Difference
12	0	0	0
34	1/16	1/16	0
63	0	0	0
78	0	0	0
101	1/16	1/16	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M170	West	154	154

Offset	Depth 1	Depth 2	Difference
18	0	0	0
34	1/16	1/16	0
48	0	0	0
51	1/16	1/16	0
69	0	0	0
94	1/16	1/16	0
107	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M162	East	151	151

Offset	Depth 1	Depth 2	Difference
7	1/8	1/8	0
15	0	0	0
20	0	0	0
41	1/16	1/16	0
58	0	0	0
78	0	0	0
97	1/8	1/8	0

Location ID	Lane	Lane Width 1	Lane Width 2
M169	West	150	150

Offset	Depth 1	Depth 2	Difference
10	0	0	0
28	1/16	1/16	0
50	0	0	0
69	0	0	0
90	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M163	East	146	146

Offset	Depth 1	Depth 2	Difference
3	0	0	0
35	1/16	1/16	0
61	0	0	0
70	0	0	0
98	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M168	West	155	158

Offset	Depth 1	Depth 2	Difference
11	0	0	0
33	0	0	0
40	0	0	0
51	0	0	0
60	1/16	1/16	0
73	0	0	0
98	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M164	East	146	146

Offset	Depth 1	Depth 2	Difference
8	0	0	0
21	1/16	1/16	0
35	0	0	0
53	1/16	1/16	0
69	0	0	0
81	0	0	0
104	1/8	1/8	0

Location ID	Lane	Lane Width 1	Lane Width 2
M167	West	150	150

Offset	Depth 1	Depth 2	Difference
6	0	0	0
16	1/16	1/16	0
25	0	0	0
38	1/16	1/16	0
50	0	0	0
67	0	0	0
93	1/8	1/8	0

Location ID	Lane	Lane Width 1	Lane Width 2
M165	East	144	144

Offset	Depth 1	Depth 2	Difference
5	0	0	0
25	1/16	1/16	0
46	1/16	1/16	0
61	0	0	0
72	0	0	0
96	1/16	1/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M166	West	148	148

Offset	Depth 1	Depth 2	Difference
22	0	0	0
34	1/16	1/16	0
52	0	0	0
68	0	0	0
88	1/8	3/16	1/16
117	0	0	0

MILE 1A

Location ID	Lane	Lane Width 1	Lane Width 2
M1A	East	150	

Offset	Depth 1	Depth 2	Difference
12	0	0	N/A
26	0	1/16	N/A
46	0	0	N/A
76	0	0	N/A
94	0	1/8	N/A
114	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M2A	West	162	

Offset	Depth 1	Depth 2	Difference
15	0	0	N/A
26	0	1/4	N/A
52	0	0	N/A
77	0	0	N/A
107	0	5/16	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M3A	East	142	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
22	0	1/16	N/A
44	0	0	N/A
70	0	0	N/A
92	0	1/8	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M4A	West	159	

Offset	Depth 1	Depth 2	Difference
18	0	0	N/A
30	0	1/8	N/A
58	0	0	N/A
80	0	0	N/A
107	0	1/16	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M5A	East	150	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
19	0	1/16	N/A
38	0	0	N/A
74	0	0	N/A
90	0	1/16	N/A
110	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M6A	West	160	

Offset	Depth 1	Depth 2	Difference
20	0	0	N/A
33	0	9/16	N/A
60	0	0	N/A
78	0	0	N/A
105	0	3/16	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M7A	East	146	

Offset	Depth 1	Depth 2	Difference
6	0	0	N/A
16	0	1/4	N/A
36	0	0	N/A
70	0	0	N/A
93	0	3/16	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M8A	West		

Offset	Depth 1	Depth 2	Difference
17	0	0	N/A
26	0	9/16	N/A
60	0	0	N/A
80	0	0	N/A
101	0	1/4	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M9A	East	143	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
24	0	1/16	N/A
40	0	0	N/A
76	0	0	N/A
90	0	1/4	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M10A	West	164	

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
34	0	1/8	N/A
63	0	0	N/A
80	0	0	N/A
106	0	1/8	N/A
120	0	0	N/A

MILE 2A

Location ID	Lane	Lane Width 1	Lane Width 2
M11A	East	155	

Offset	Depth 1	Depth 2	Difference
12	0	0	N/A
30	0	1/4	N/A
46	0	0	N/A
76	0	0	N/A
96	0	0	N/A
114	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M12A	West	148	

Offset	Depth 1	Depth 2	Difference
15	0	0	N/A
30	0	3/16	N/A
52	0	0	N/A
77	0	0	N/A
96	0	3/8	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M13A	East	156	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
22	0	0	N/A
45	0	0	N/A
70	0	0	N/A
104	0	0	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M14A	West	163	

Offset	Depth 1	Depth 2	Difference
18	0	0	N/A
30	0	0	N/A
45	0	1/8	N/A
80	0	0	N/A
104	0	1/4	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M15A	East	148	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
19	0	0	N/A
30	0	1/16	N/A
74	0	0	N/A
100	0	0	N/A
110	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M16A	West	156	

Offset	Depth 1	Depth 2	Difference
20	0	0	N/A
33	0	1/16	N/A
60	0	0	N/A
78	0	0	N/A
100	0	1/16	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M17A	East	146	

Offset	Depth 1	Depth 2	Difference
6	0	0	N/A
16	0	0	N/A
36	0	1/4	N/A
70	0	0	N/A
93	0	0	N/A
115	0	3/16	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M18A	West	160	

Offset	Depth 1	Depth 2	Difference
17	0	0	N/A
30	0	1/4	N/A
60	0	0	N/A
80	0	0	N/A
101	0	0	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M19A	East	146	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
29	0	1/16	N/A
40	0	0	N/A
76	0	0	N/A
95	0	1/16	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M20A	West	154	

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
36	0	1/4	N/A
63	0	0	N/A
80	0	0	N/A
106	0	0	N/A
120	0	0	N/A

MILE 3A

Location ID	Lane	Lane Width 1	Lane Width 2
M21A	North		

Offset	Depth 1	Depth 2	Difference
15	0	0	N/A
26	0	1/16	N/A
52	0	0	N/A
78	0	0	N/A
102	0	1/16	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M22A	South		

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
30	0	1/16	N/A
50	0	0	N/A
80	0	0	N/A
100	0	1/16	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M23A	North	157	

Offset	Depth 1	Depth 2	Difference
10	0	0	N/A
28	0	1/16	N/A
48	0	0	N/A
76	0	0	N/A
98	0	1/16	N/A
118	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M24A	South	167	

Offset	Depth 1	Depth 2	Difference
14	0	0	N/A
30	0	1/16	N/A
50	0	0	N/A
75	0	0	N/A
105	0	1/16	N/A
120	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M25A	North		

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
35	0	1/16	N/A
58	0	0	N/A
70	0	0	N/A
98	0	1/16	N/A
118	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M26A	South	160	

Offset	Depth 1	Depth 2	Difference
13	0	0	N/A
35	0	0	N/A
60	0	0	N/A
80	0	0	N/A
104	0	1/16	N/A
120	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M27A	North	160	

Offset	Depth 1	Depth 2	Difference
10	0	0	N/A
30	0	1/16	N/A
50	0	1/16	N/A
80	0	0	N/A
100	0	1/16	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M28A	South	160	

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
36	0	1/16	N/A
60	0	0	N/A
84	0	0	N/A
108	0	1/16	N/A
120	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M29A	North		

Offset	Depth 1	Depth 2	Difference
12	0	0	N/A
38	0	1/16	N/A
50	0	0	N/A
72	0	0	N/A
100	0	1/16	N/A
115	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M30A	South		

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
36	0	1/16	N/A
58	0	0	N/A
80	0	0	N/A
106	0	1/16	N/A
120	0	0	N/A

MILE 4A

Location ID	Lane	Lane Width 1	Lane Width 2
M31A	North	156	

Offset	Depth 1	Depth 2	Difference
12	0	0	N/A
36	0	1/16	N/A
46	0	0	N/A
76	0	0	N/A
108	8	1/8	N/A
114	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M32A	South	156	

Offset	Depth 1	Depth 2	Difference
15	0	0	N/A
25	0	1/8	N/A
52	0	0	N/A
77	0	0	N/A
90	0	1/8	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M33A	North	159	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
33	0	1/16	N/A
44	0	0	N/A
70	0	0	N/A
100	0	1/2	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M34A	South	156	

Offset	Depth 1	Depth 2	Difference
18	0	0	N/A
27	0	1/8	N/A
58	0	0	N/A
80	0	0	N/A
110	0	1/16	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M35A	North	156	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
19	0	0	N/A
48	0	1/4	N/A
74	0	0	N/A
90	0	0	N/A
110	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M36A	South	162	

Offset	Depth 1	Depth 2	Difference
20	0	0	N/A
30	0	1/8	N/A
60	0	0	N/A
78	0	0	N/A
105	0	0	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M37A	North	158	

Offset	Depth 1	Depth 2	Difference
6	0	0	N/A
16	0	0	N/A
31	0	1/16	N/A
70	0	0	N/A
110	0	3/8	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M38A	South	157	

Offset	Depth 1	Depth 2	Difference
17	0	0	N/A
29	0	1/8	N/A
60	0	0	N/A
80	0	0	N/A
103	0	3/8	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M39A	North	158	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
31	0	1/8	N/A
40	0	0	N/A
76	0	0	N/A
97	0	5/16	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M40A	South	156	

Offset	Depth 1	Depth 2	Difference
16	0	0	N/A
26	0	3/16	N/A
63	0	0	N/A
80	0	0	N/A
107	0	3/8	N/A
120	0	0	N/A

MILE 5A

Location ID	Lane	Lane Width 1	Lane Width 2
M41A	North	158	

Offset	Depth 1	Depth 2	Difference
12	0	0	N/A
36	0	1/16	N/A
46	0	0	N/A
76	0	0	N/A
107	8	7/16	N/A
114	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M42A	South	158	

Offset	Depth 1	Depth 2	Difference
15	0	0	N/A
31	0	1/8	N/A
52	0	0	N/A
77	0	0	N/A
97	0	7/16	N/A
128	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M43A	North	169	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
33	0	0	N/A
44	0	0	N/A
70	0	0	N/A
108	0	1/4	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M44A	South	156	

Offset	Depth 1	Depth 2	Difference
18	0	0	N/A
44	0	1/4	N/A
58	0	0	N/A
80	0	0	N/A
100	0	5/16	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M45A	North	186	

Offset	Depth 1	Depth 2	Difference
8	0	0	N/A
19	0	0	N/A
45	0	3/16	N/A
74	0	0	N/A
101	0	1/8	N/A
110	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M46A	South	171	

Offset	Depth 1	Depth 2	Difference
20	0	0	N/A
42	0	1/8	N/A
60	0	0	N/A
78	0	0	N/A
104	0	3/8	N/A
130	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M47A	North	160	

Offset	Depth 1	Depth 2	Difference
6	0	0	N/A
16	0	0	N/A
37	0	1/8	N/A
70	0	0	N/A
108	0	1/4	N/A
112	0	0	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M48A	South	159	

Offset	Depth 1	Depth 2	Difference
17	0	0	N/A
29	0	0	N/A
60	0	0	N/A
80	0	0	N/A
103	0	0	N/A
128	0	0	N/A

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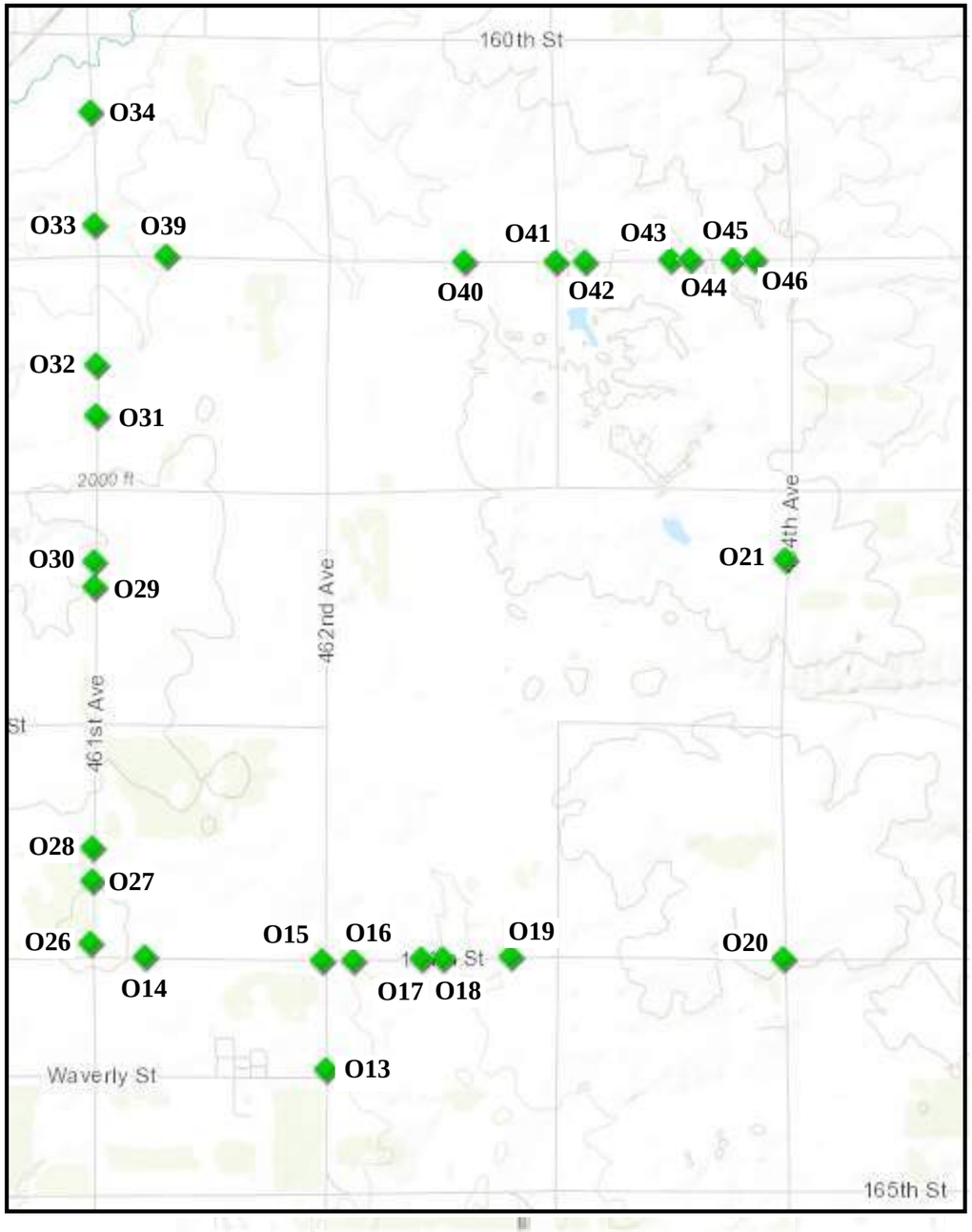
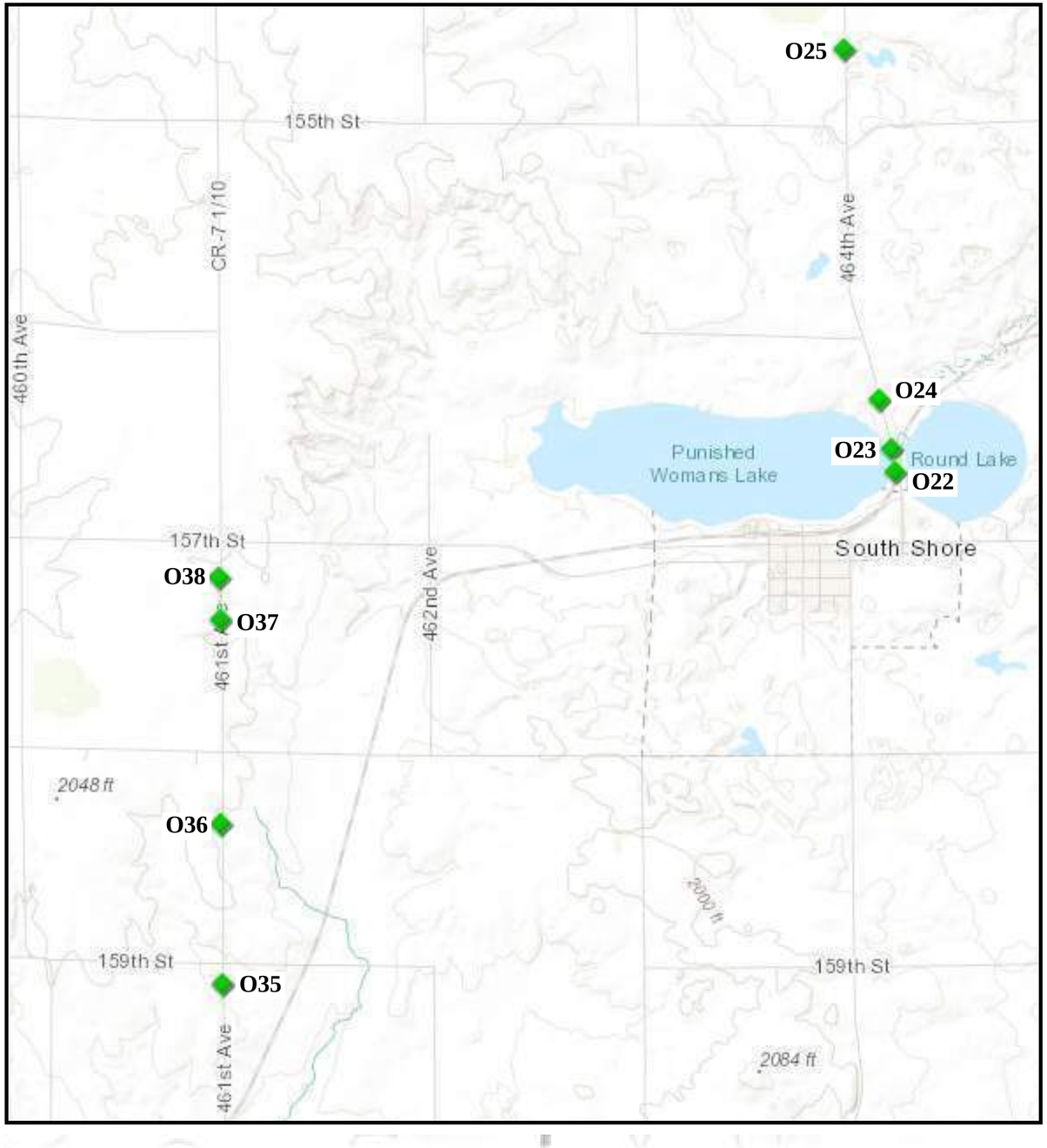
APPENDIX C

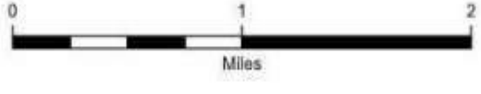
ADDITIONAL AREAS OF OBSERVATION





Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu...

Additional Areas of Observation Map



ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Pre-Construction Comments	Post-Construction Comparison
O13	462nd Ave.	Mid-lane Longitudinal Cracking	longitudinal cracking down the center of the east lane starting to show up, approximately 1/4" wide or more, approximaley 125' long	Similar condition
O14	164th St.	Patch	6'x75' patch in north lane, potential past issues, area to keep eye on for potential future failures	Similar condition
O15	164th St.	Intersection Cracking	additional wear at intersection from stopping, going, and turning	Additional block cracking and some roadway breakup starting, new pothole present
O16	164th St.	Settlement Above Culvert	roadway settlement above culverts, up to 3/4" at fog lines and 1/4" at cemterline	Simlar condition with additional wear noted
O17	164th St.	Excessive Rutting	excessive rutting coupled with center of lane heave, depth of 1" outside wheelpath and 1-1/4" inside wheel path, mainly north lane with lesser amount in south lane	Temporary patch due to breakup during construction
O18	164th St.	Patch	new asphalt patch above culverts, area to keep an eye on	Existing patch intact, some settlement
O19	164th St.	Settlement Above Culvert	roadway settlement and cracking above culvert, 1/2" at fog lines and 1/4" at centerline	Similar condition
O20	164th St.	Intersection Deterioration	some rutting and cracking in intersection, area to keep an eye on	Temporary patch due to breakup during construction
O21	464th Ave.	Excessive Rutting	excessive rutting coupled with mid-lane heaving, ruts of 1-1/2" at inside wheel path of west lane, 3/4" at outside wheel path of west land and both wheel paths in east lane	No post-construction comparison, road not used
O22	464th Ave.	Railroad Crossing	some rutting, some cracking, area to keep an eye on	No post-construction comparison, road not used
O23	464th Ave.	Asphalt Deformation Above Culverts	asphalt settlement above culverts, mainly east lane, 1" at fog line	No post-construction comparison, road not used

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ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Pre-Construction Comments	Post Construction Comparison
O24	464th Ave.	Cracking and Scarring	additonal cracking, scarring, and pavement deterioration	No post-construction comparison, road not used
O25	464th Ave.	Mid-lane Longitudinal Cracking	longitudinal cracking in east lane intermittently throughout entire mile, low severity	No post-construction comparison, road not used
O26	462nd Ave.	Washboarding	approximately 500' long washboarding	No post-construction comparison due to gravel road variability and frozen conditions
O27	462nd Ave.	Soft Area	soft area, rutting, missing aggregate, approximately 200' long	No post-construction comparison due to gravel road variability and frozen conditions
O28	462nd Ave.	Soft Area	approximately 200' long	No post-construction comparison due to gravel road variability and frozen conditions
O29	462nd Ave.	Soft Area	soft spots, potholes, rutting, approximately 200' long	No post-construction comparison due to gravel road variability and frozen conditions
O30	462nd Ave.	Soft Area	approximately 100' long	No post-construction comparison due to gravel road variability and frozen conditions
O31	462nd Ave.	Soft Area	soft area, rutting, missing aggregate, approximately 400' long	No post-construction comparison due to gravel road variability and frozen conditions
O32	462nd Ave.	Soft Area	rutting, missing aggregate, soft area, approximately 200' long	No post-construction comparison due to gravel road variability and frozen conditions
O33	462nd Ave.	Potential Soft Area	aggregate washed off of roadway, low lying ground, soft edges	No post-construction comparison due to gravel road variability and frozen conditions
O34	462nd Ave.	Potential Soft Area	some aggregate missing, potential for rutting	No post-construction comparison due to gravel road variability and frozen conditions
O35	462nd Ave.	Potential Soft Area	lower lying ground, aggregate washed into ditch	No post-construction comparison due to gravel road variability and frozen conditions

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ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Pre-Construction Comments	Post Construction Comparison
O36	462nd Ave.	Potential Soft Area	lower lying ground, some rutting present, some aggregate washed off of roadway	No post-construction comparison due to gravel road variability and frozen conditions
O37	462nd Ave.	Potential Soft Area	aggregate washed off of wheel paths to edges of road, potential soft area from being lower lying ground	No post-construction comparison due to gravel road variability and frozen conditions
O38	462nd Ave.	Potential Soft Area	aggregate washed into ditches, soft edges, missing aggregate in wheel paths	No post-construction comparison due to gravel road variability and frozen conditions
O39	161st St.	Soft Area	soft spot rutting, approximately 100' long	No post-construction comparison due to gravel road variability and frozen conditions
O40	161st St.	Soft Area	rutting and soft area	No post-construction comparison due to gravel road variability and frozen conditions
O41	161st St.	Soft Area	rutting and soft area	No post-construction comparison due to gravel road variability and frozen conditions
O42	161st St.	Soft Area	rutting and soft area	No post-construction comparison due to gravel road variability and frozen conditions
O43	161st St.	Soft Area	soft area and rutting	No post-construction comparison due to gravel road variability and frozen conditions
O44	161st St.	Soft Area	soft area and rutting	No post-construction comparison due to gravel road variability and frozen conditions
O45	161st St.	Soft Area	rutting and soft area	No post-construction comparison due to gravel road variability and frozen conditions
O46	161st St.	Soft Area	north half of roadway rutting and soft spots, approximately 100' long	No post-construction comparison due to gravel road variability and frozen conditions

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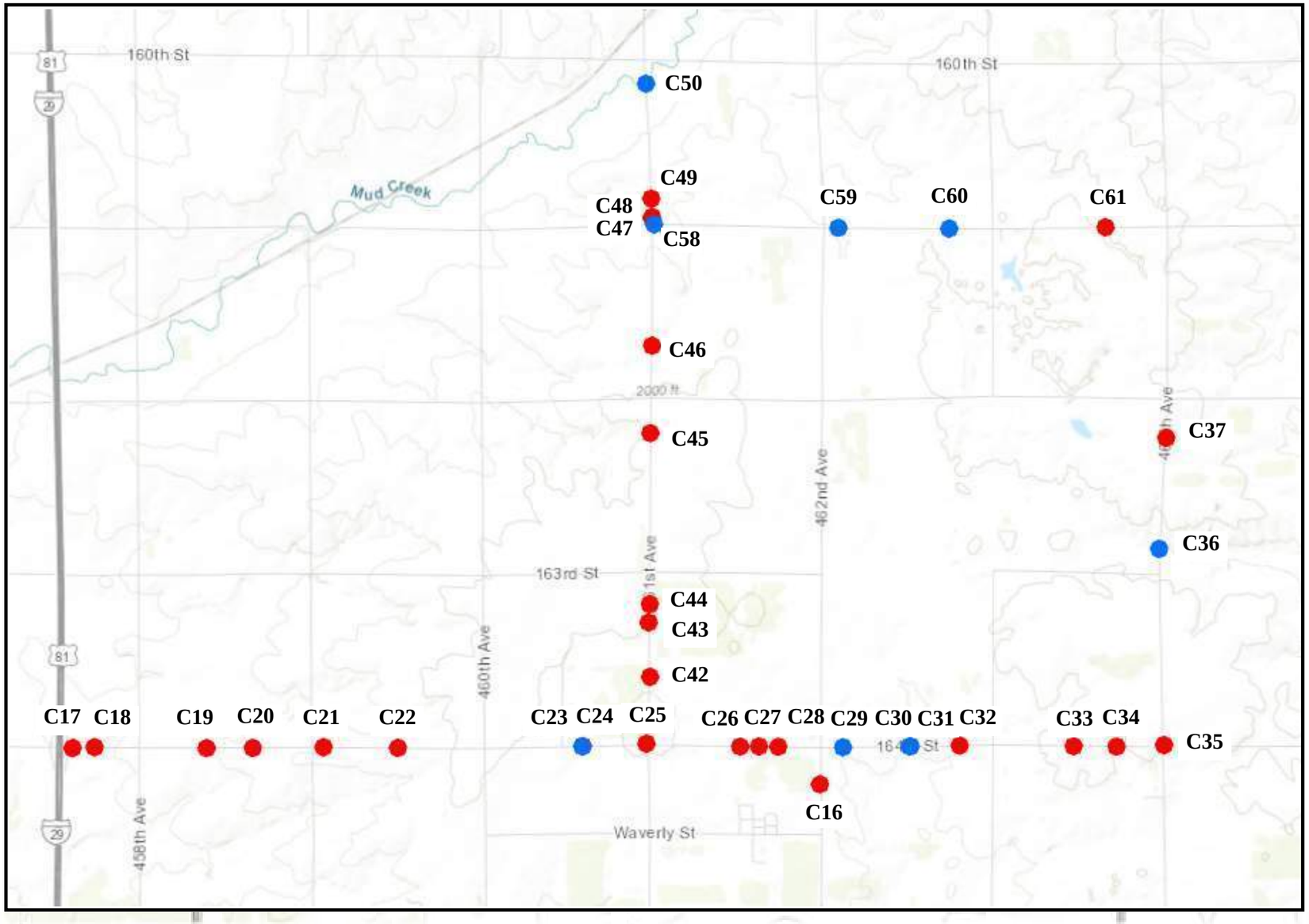
APPENDIX D

CULVERT INSPECTIONS



Legend:

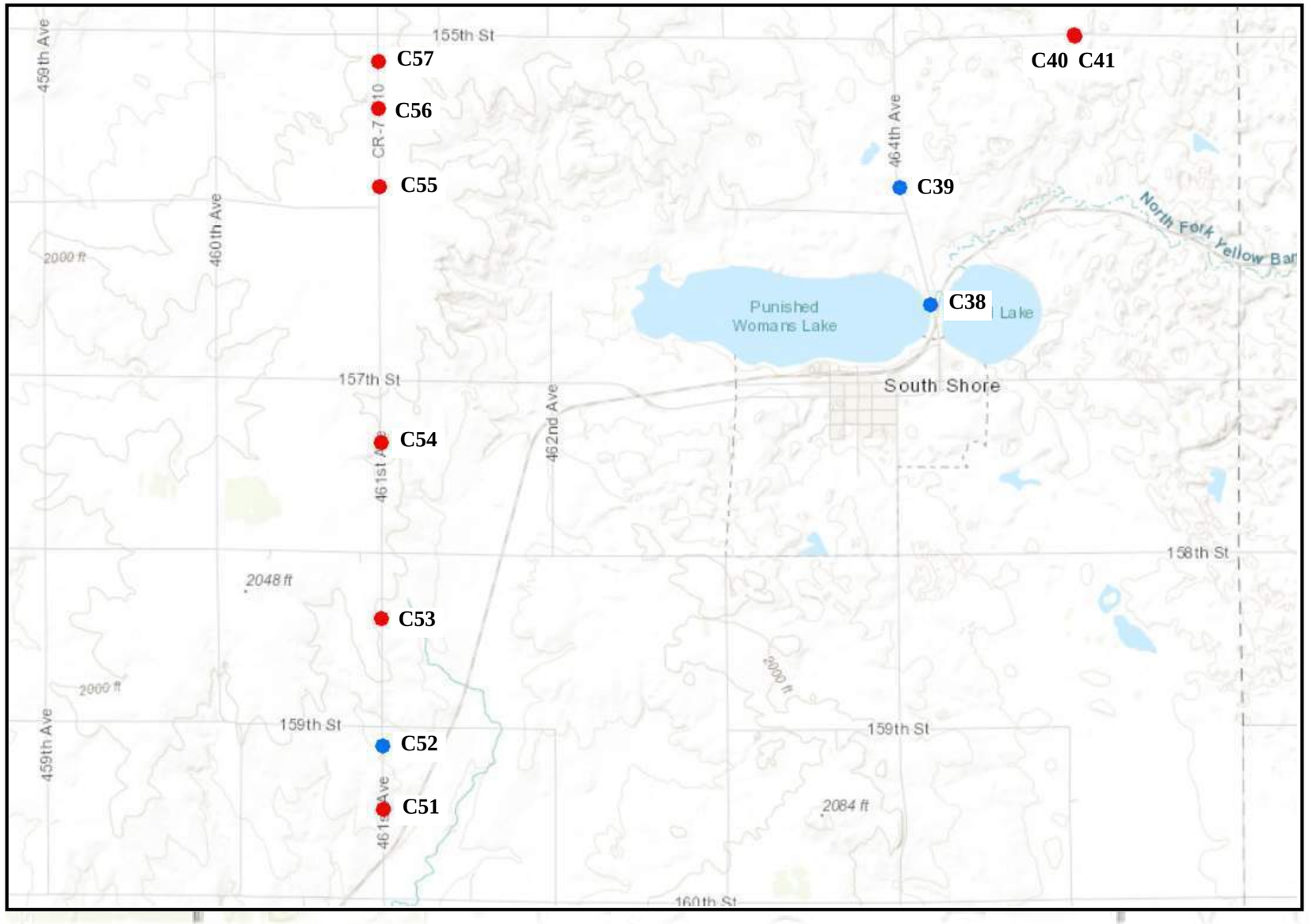
- Culverts Under 48" Diameter
- Culverts of 48" Diameter and Larger

Culvert Map

0 1 2

Miles

N



Legend:

- Culverts Under 48" Diameter
- Culverts of 48" Diameter and Larger

Culvert Map

0 1 2
Miles

N

PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C16	Round	24"	RCP	West	Good condition	East	end section separated at joint, debris in end section due to separation
C17	Round	24"	RCP	North	good condition, ends are tied off with tie bolts, rock debris	South	good condition, ends sections are tied with tie bolts
C18	Round	24"	RCP	North	Two culverts, 7' center-to-center, end section separated 2" at end joint	South	good condition
C19	Round	18"	RCP	North	End section is 1/3 full of mud and debris, end section is deteriorating	South	end section separated from first joint, debris in pipe, end section detiorating
C20	Round	18"	RCP	North	2/3 full of mud and debris	South	no end section, pipe portruded out of embankment and broke
C21	Round	24"	RCP	North	Separated 1-1/2" at the first joint, concrete starting to spall off on the end section	South	End section is separated 2-1/2" from the end joint, debris is collecting due to separation
C22	Round	24"	RCP	North	Gravel and depris in end section, no notable joint seperation	South	End section separated 2" at first joint, filled with joint sealant
C23	Round	60"	RCP	North	Joints are tied with tie bolts, joint separated 2-1/2", pile of gravel debris in pipe	South	end section is tied with tie bolts
C24	Round	60"	RCP	North	Joints are tied, joint separated 2" at bottom	South	joints are tied
C25	Round	16"	RCP	North	rebar visible on the end section	South	good condition
C26	Round	36"	RCP	North	End section separated 10" from first joint, embankment above first joint has washed down into section of first joint	South	end section separated 3-1/2" at first joint
C27	Round	30"	RCP	North	end sections in good condition, half full of debris	South	end sections in good condition, debris fills bottom 5"
C28	Round	18"	RCP	North	first joint is separated enough for embankment to fall through	South	assume first joint is separated due to hole in embankment above first joint, debris is falling through joint
C29	Round	60"	RCP	North	two culverts, 9' center-to-center, top is completely separated 6" on the west culvert, all embankment has fallen through	South	end section is tied for both culverts, west culvert first joint is separated 4"
C30	Round	72"	RCP	North	Two culverts, 11' center-to-center, west joints tied, second joint is separated 4" on bottom, east end section is completely off of the last joint and has settled down	South	end sections are tied with tie bars, west joints are good, east top is separated 4-1/2"

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POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C16	Round	24"	RCP	West	No Change Noted	East	No Change Noted
C17	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C18	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C19	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C20	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C21	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C22	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C23	Round	60"	RCP	North	No Change Noted	South	No Change Noted
C24	Round	60"	RCP	North	No Change Noted	South	No Change Noted
C25	Round	16"	RCP	North	No Change Noted	South	No Change Noted
C26	Round	36"	RCP	North	No Change Noted	South	No Change Noted
C27	Round	30"	RCP	North	No Change Noted	South	No Change Noted
C28	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C29	Round	60"	RCP	North	No Change Noted	South	No Change Noted
C30	Round	72"	RCP	North	No Change Noted	South	No Change Noted

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PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C31	Round	60"	RCP	North	good condition	South	End section is separated 5-1/2" at first joint
C32	Round	36"	CMP	North	two culverts, 8' center-to-center, no noticeable deformations	South	metal flared end attached, no noticeable deformation
C33	Round	18"	RCP	North	bottom of the first joint is separated and there is debris building up	South	end section looks visibly separated
C34	Round	30"	RCP	North	end joint is separated off the first joint and has settled	South	first joint is separated, embankment is washing though it
C35	Round	24"	RCP	West	end section is cracking	East	no noticeable defects
C36	Round	72"	RCP	West	end section tied with tie bolts, 2" separation at the first joint, steel pipe travels along top of culvert throughout	East	end section tied with tie bolts, 3" separation at first joint, spalling occurring at first joint and rebar is visible
C37	Round	24"	RCP	West	no noticeable defects	East	no noticeable defects
C38	Round	60"	RCP	West	two pipe, 2" seperation at the first joint on the south pipe, end section tied at first joint on both pipes, north pipe joints are sealed	East	End section is tied at first joint on both pipes, joints are sealed on both pipes, north pipe end section is deteriorating at flared end and rebar is exposed
C39	Arch	60"x48"	RCP	West	no noticeable defects, odd shape, vertical walls with round top	East	no noticeable defects, odd shape, vertical walls with round top
C40	Round	24"	CMP	North	could not locate, possibly buried	South	good condition
C41	Round	24"	RCP	North	First joint completely separated, can't see much else	South	First and second joints are separated completely
C42	Round	25"	CMP	West	good condition, no deformation	East	Slightly bent rim, good condition
C43	Round	30"	CMP	West	Slightly bent rim, good condition	East	Slightly bent rim, good condition
C44	Round	30"	CMP	West	Slightly bent rim, some debris	East	Slightly bent rim
C45	Round	30"	CMP	West	Good condition	East	good condition

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POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C31	Round	60"	RCP	North	No Change Noted	South	No Change Noted
C32	Round	36"	CMP	North	No Change Noted	South	No Change Noted
C33	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C34	Round	30"	RCP	North	No Change Noted	South	No Change Noted
C35	Round	24"	RCP	West	No Change Noted	East	No Change Noted
C36	Round	72"	RCP	West	No Change Noted	East	No Change Noted
C37	Round	24"	RCP	West	No Change Noted	East	No Change Noted
C38	Round	60"	RCP	West	No Change Noted	East	No Change Noted
C39	Arch	60"x48"	RCP	West	No Change Noted	East	No Change Noted
C40	Round	24"	CMP	North	No Change Noted	South	No Change Noted
C41	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C42	Round	25"	CMP	West	No Change Noted	East	No Change Noted
C43	Round	30"	CMP	West	No Change Noted	East	No Change Noted
C44	Round	30"	CMP	West	No Change Noted	East	No Change Noted
C45	Round	30"	CMP	West	No Change Noted	East	No Change Noted

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PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C46	Round	25"	CMP	West	Good condition, no noticeable deformation	East	rim is slightly bent
C47	Round	42"	RCP	West	End sections tied on, good condition all around	East	End sections tied on, good condition all around
C48	Round	42"	RCP	West	End sections tied on, good condition all around	East	End sections tied on, good condition all around
C49	Round	25"	CMP	West	Pipe could not be found, probably filled with water	East	Very deformed, filled with debris
C50	Box	144"x64"	RCBC	West	Double 12'x5'4" box	East	Crack in the north wall under the east shoulder
C51	Round	28"	CMP	West	Deformed downwards, some debris, top is split	East	Deformed downwards, half filled with debris
C52	Round	48"	RCP	West	Flared end, end section cracking and off of the first joint completely, tied with cable and anchor bolts	East	No flared end, no end section, joints look good
C53	Round	24"	CMP	West	Slightly bent rim, deformed downwards	East	Slightly bent rim
C54	Round	38"	CMP	West	Rim bent, no deformation in pipe	East	Good condition
C55	Round	28"	CMP	West	Good condition	East	Slightly bent rim
C56	Round	24"	RCP	West	Rock debris, end section is spalling	East	End section is spalling with visible rebar
C57	Round	24"	RCP	West	Good condition	East	Pipe is tilted
C58	Box	48"x60"	RCBC	North	Good Condition	South	Good Condition
C59	Box	48"x60"	RCBC	North	Good condition, no deficiencies to report	South	Good condition, no deficiencies to report
C60	Box	48"x60"	RCBC	North	Good condition	South	Good condition
C61	Round	32"	RCP	North	End section spalling	South	Full of water

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POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C46	Round	25"	CMP	West	No Change Noted	East	No Change Noted
C47	Round	42"	RCP	West	No Change Noted	East	No Change Noted
C48	Round	42"	RCP	West	No Change Noted	East	Grout missing on first joint
C49	Round	25"	CMP	West	No Change Noted	East	No Change Noted
C50	Box	144"x64"	RCBC	West	No Change Noted	East	No Change Noted
C51	Round	28"	CMP	West	No Change Noted	East	No Change Noted
C52	Round	48"	RCP	West	No Change Noted	East	No Change Noted
C53	Round	24"	CMP	West	No Change Noted	East	No Change Noted
C54	Round	38"	CMP	West	No Change Noted	East	No Change Noted
C55	Round	28"	CMP	West	No Change Noted	East	No Change Noted
C56	Round	24"	RCP	West	No Change Noted	East	No Change Noted
C57	Round	24"	RCP	West	No Change Noted	East	No Change Noted
C58	Box	48"x60"	RCBC	North	No Change Noted	South	No Change Noted
C59	Box	48"x60"	RCBC	North	No Change Noted	South	No Change Noted
C60	Box	48"x60"	RCBC	North	No Change Noted	South	No Change Noted
C61	Round	32"	RCP	North	No Change Noted	South	No Change Noted

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APPENDIX E

PASER MANUAL RATING SHEETS

Rating system

Surface rating	*Visible distress**	*General condition/ treatment measures*
10 Excellent	None.	New construction.
9 Excellent	None.	Recent overlay. Like new.
8 Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40′ or greater). All cracks sealed or tight (open less than ¼″).	Recent sealcoat or new cold mix. Little or no maintenance required.
7 Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open ¼″) due to reflection or paving joints. Transverse cracks (open ¼″) spaced 10′ or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.	First signs of aging. Maintain with routine crack filling.
6 Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open ¼″–½″). Transverse cracks (open ¼″–½″), some spaced less than 10′. First sign of block cracking. Sight to moderate flushing or polishing. Occasional patching in good condition.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat.
5 Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open ½″ or more) show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.	Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2″)
4 Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½″ deep or less).	Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2″ or more).
3 Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (greater than ½″ but less than 2" deep). Occasional potholes.	Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
2 Very Poor	Alligator cracking (over 25% of surface). Severe rutting or distortions (2″ or more deep). Extensive patching in poor condition. Potholes.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective.
1 Failed	Severe distress with extensive loss of surface integrity.	Failed. Needs total reconstruction.

** Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.*

Rating road surface condition

A simplified rating system has been developed to help manage gravel roads. It uses a scale of 1 to 5—**5** is **excellent** condition and **1** is **failed**. In a normal progression the road will start out in excellent condition and gradually deteriorate under the effects of traffic and weather. Routine grading and minor patching may be sufficient to restore the road to excellent condition. As conditions worsen, more extensive maintenance may be required; complete rebuilding may eventually be necessary.

To select a rating first assess the crown, drainage, and gravel layer. Then review the individual defects and select the type of maintenance or rehabilitation necessary. The rating should reflect the condition and type of maintenance or repairs required. Look at the photographs in this section to become more familiar with the ratings and conditions.

Ratings are related to needed maintenance or repair

Rating 5 Newly constructed road. Excellent crown and drainage. No maintenance required.

Rating 4 Good crown and drainage. Routine maintenance.

Rating 3 Roadway shows traffic effects. Needs regrading, minor ditch maintenance, and spot gravel application.

Rating 2 Road needs additional aggregate layer, major drainage improvements.

Rating 1 Travel is difficult. Complete rebuilding required.

Surface rating	*Visible distress**	*General condition/ treatment measures*
5 Excellent	No distress. Dust controlled. Excellent surface condition and ride.	New construction—or total reconstruction. Excellent drainage. Little or no maintenance needed.
4 Good	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	Recently regraded. Good crown and drainage throughout. Adequate gravel for traffic. Routine grading and dust control may be needed.
3 Fair	Good crown (3"-6"). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate but additional aggregate may be needed in some locations to correct washboarding or isolated potholes and ruts. Some culvert cleaning needed. Moderate washboarding (1"-2" deep) over 10%-25% of the area. Moderate dust, partial obstruction of vision. None or slight rutting (less than 1" deep). An occasional small pothole (less than 2" deep). Some loose aggregate (2" deep).	Shows traffic effects. Regrading (reworking) necessary to maintain. Needs some ditch improvement and culvert maintenance. Some areas may need additional gravel.
2 Poor	Little or no roadway crown (less than 3"). Adequate ditches on less than 50% of roadway. Portions of the ditches may be filled, overgrown and/or show erosion. Some areas (25%) with little or no aggregate. Culverts partially full of debris. Moderate to severe washboarding (over 3" deep) over 25% of area. Moderate rutting (1"-3"), over 10%-25% of area. Moderate potholes (2"-4") over 10%-25% of area. Severe loose aggregate (over 4").	Travel at slow speeds (less than 25 mph) is required. Needs additional new aggregate. Major ditch construction and culvert maintenance also required.
1 Failed	No roadway crown or road is bowl shaped with extensive ponding. Little if any ditching. Filled or damaged culverts. Severe rutting (over 3" deep), over 25% of the area. Severe potholes (over 4" deep), over 25% of area. Many areas (over 25%) with little or no aggregate.	Travel is difficult and road may be closed at times. Needs complete rebuilding and/or new culverts.

** Individual road sections will not have all of the types of distress listed for any particular rating. They may have only one or two types.*

APPENDIX F

OPINION OF PROBABLE RESTORATION COSTS

Banner Associates, Inc.
409 22nd Avenue South
Brookings, SD 57006
Tel 605.692.6342
Toll Free 855.323.6342
www.bannerassociates.com

OPINION OF PROBABLE RESTORATION COST

24 Miles of CCR No. 3, CCR No. 4, CCR No. 6, CCR No. 7, & CCR No. 11

PROJECT Crowned Ridge Wind I Phase **BAI NO 22913.00**

LOCATION Codington County, SD

DATE February 1, 2021

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Traffic Control and Detour signing	24	Mile	$1,500.00	$36,000.00
2	Preparation of Roadway - Shoulder Removal	5	Mile	$2,500.00	$12,500.00
3	Reclamation of Existing Surfacing Section	5	Mile	$20,000.00	$100,000.00
4	Installation of Virgin Base Course and Roadway Shaping	5	Mile	$35,000.00	$175,000.00
5	Installation of Asphalt Surfacing Material (4" Thick)	5	Mile	$290,000.00	$1,450,000.00
6	Shoulder Restoration	5	Mile	$2,500.00	$12,500.00
7	Digouts (Reclaim, Remove 2", and Compact)	7	Mile	$10,000.00	$70,000.00
8	Patching Digout areas (2" Asphalt)	7	Mile	$17,500.00	$122,500.00
9	Milling 1.5" Wearing Course	9	Mile	$12,000.00	$108,000.00
10	2" Wearing Course Asphalt Surfacing Overlay	9	Mile	$145,000.00	$1,305,000.00
11	Roadway Striping	14	Mile	$7,500.00	$105,000.00
G1	Gravel Roadway Soft Area Repairs	7	Mile	$13,000.00	$91,000.00
G2	3" Gravel Surfacing Installation	10	Mile	$50,000.00	$500,000.00
G3	Sign Restoration	1	Lump Sum	$12,000.00	$12,000.00
G4	Seeding Restoration	1	Lump Sum	$48,000.00	$48,000.00
				Asphalt Roadway Restoration Subtotal =	$3,496,500
				Gravel Roadway Restoration Subtotal =	$651,000
				Construction Contingencies (10%) =	$414,750
				Opinion of Probable Construction Costs =	**$4,562,250**
				Design, Bidding and Construction Services =	$96,000
				Quality Control Testing Services =	$24,000
				Opinion of Probable Restoration Cost =	**$4,682,250**

APPENDIX G

HAUL ROUTE COMPARISON PICTURES

Pre CCR 3 from 163rd St. to 164th St. 1:11 video time

Post CCR 3 from 163rd St. to 164th St. 1:27 video time

Pre CCR 3 from 162nd St. to 163rd St. 2:09 video time

Post CCR 3 from 162nd St. to 163rd St. 2:29 video time

Pre CCR NO 6 from 458th to 459th 0:18 video time

Post CCR NO 6 from 458th to 459th 0:40 video time

Pre CCR NO 6 from 459th to 460th 1:57 video time

Post CCR NO 6 from 459th to 460th 1:22 video time

Pre CCR NO 6 from 460th to 461st 4:59 video time

Post CCR NO 6 from 460th to 461st 4:40 video time

Pre CCR NO 6 from 461st to 462nd 6:14 video time

Post CCR NO 6 461st to 462nd 7:25 video time

Pre CCR NO 6 from 462nd to 463rd XXX video time

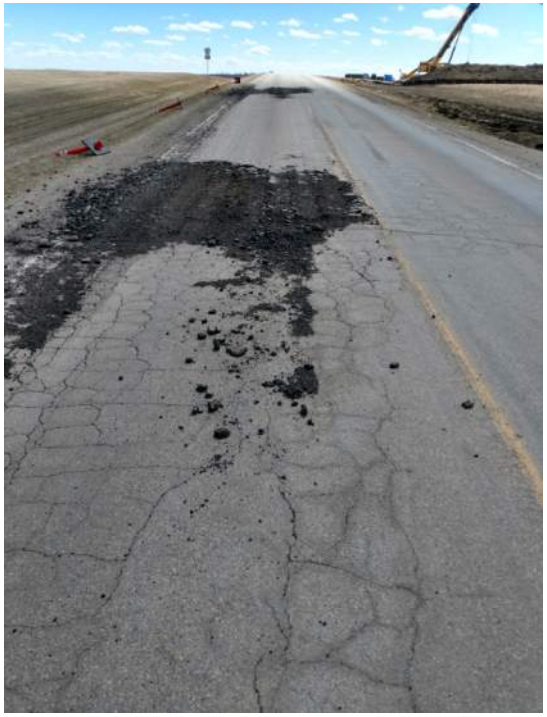
Post CCR NO 6 from 462nd to 463rd 0:54 video time

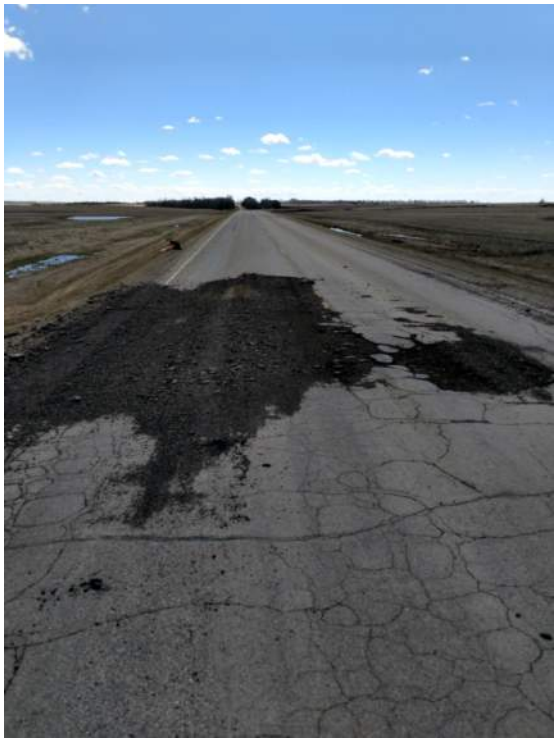
Pre CCR NO 6 from 463rd to 464th 10:06 video time

Post CCR NO 6 from 463rd to 464th 3:15 video time

Pre CCR NO 3 from 164th to 165th 1:39 video time

Post CCR NO 3 from 164th to 165th 1:41 video time





CROWNED RIDGE WIND I PHASE MID-CONSTRUCTION PHOTOS