Appendix I – Alternatives Analysis Technical Memorandum

Technical Memo

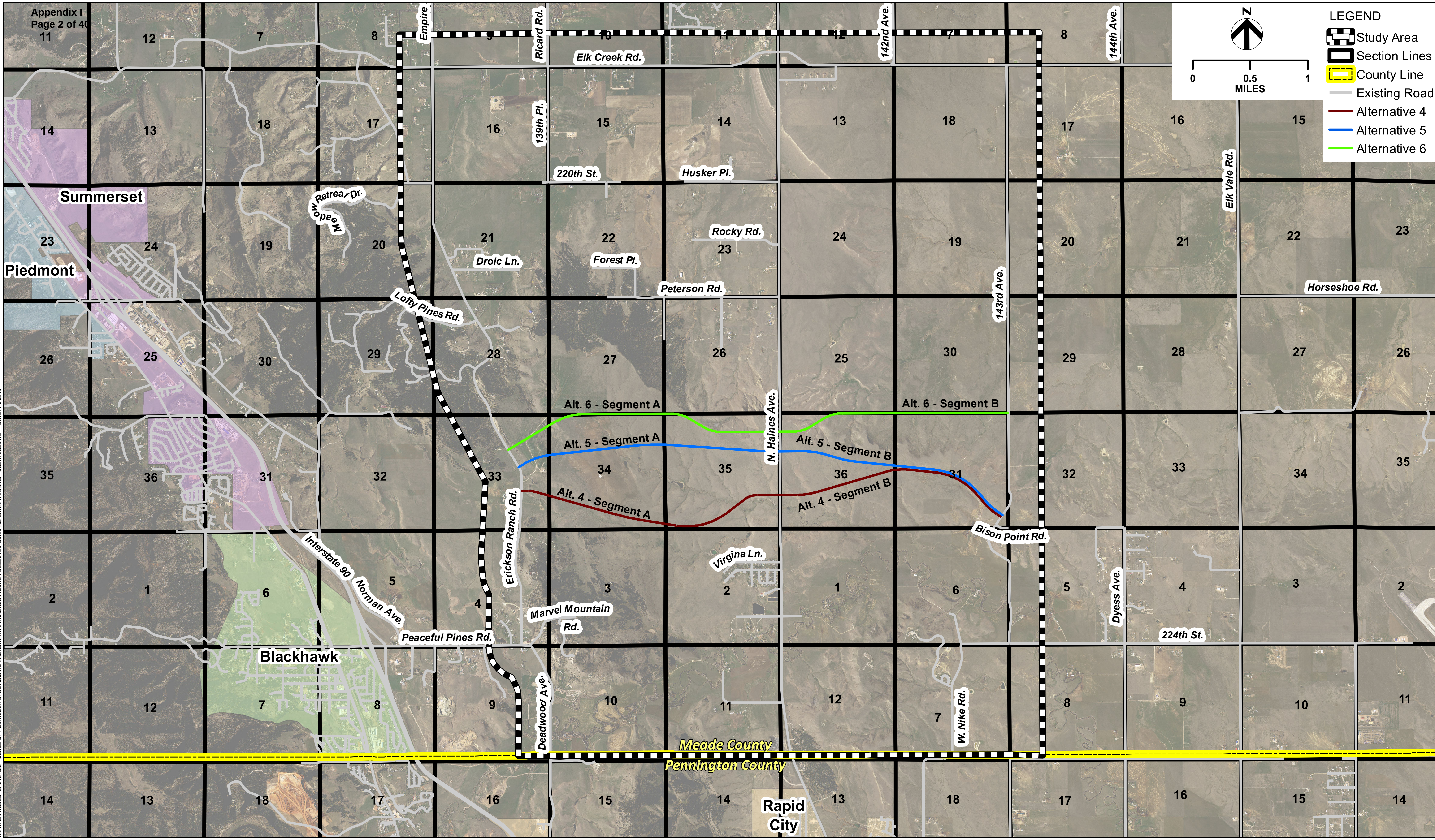
Date:	Tuesday, September 24, 2019
Project:	Southern Meade County Corridor Study
To:	Study Advisory Team
From:	HDR
Subject:	Alternatives Analysis

1.0 Background

A total of 12 build alternatives were considered during the preliminary alternatives screening process. Each of the 12 build alternatives were scored based on topography, earthwork, preliminary intersection geometrics, number of wetlands/drainage crossings, proximity to cultural/historic sites and structures/buildings, section line alignment, connectivity to existing development, east-west travel demand, utilities, and feasibility of future connectivity to I-90 to the west and Elk Vale Road to the east. During the screening process, the study alternatives were narrowed down to a total of three build alternatives, based upon the ranking of the scores associated with the above noted criteria. Refer to the alternatives development screening technical memo dated May 2019 for more details. The study advisory team (SAT) selected Alternatives 4, 5, and 6 to examine further, as illustrated in **Figure 1**.

Although outside of the study area of this corridor study, it is recognized that Elk Vale Road has significance to the regional transportation network. Elk Vale Road provides a direct north/south connection to I-90 (Exit 61) and the US-16 Bypass. The development screening technical memo dated May 2019 provided a cursory review to determine if the corresponding Segment A/B alignments could easily facilitate a future Segment C connection. Segment A corresponds to the section between Erickson Ranch Road and Haines Avenue. Segment B corresponds to the section between Haines Avenue and 143rd Avenue. Segment C corresponds to the section between 143rd Avenue and Elk Vale Road. Based on this cursory review, all three build alternatives selected to examine further within this document are expected to be able to provide a feasible connection to Elk Vale Road.

The future land use within the study area, shown in **Figure 2**, is projected for year 2040 and was procured from Meade County and the Rapid City Area Metropolitan Planning Organization (RCAMPO). The study area is primarily agricultural and rural residential with pockets of mixed use commercial.

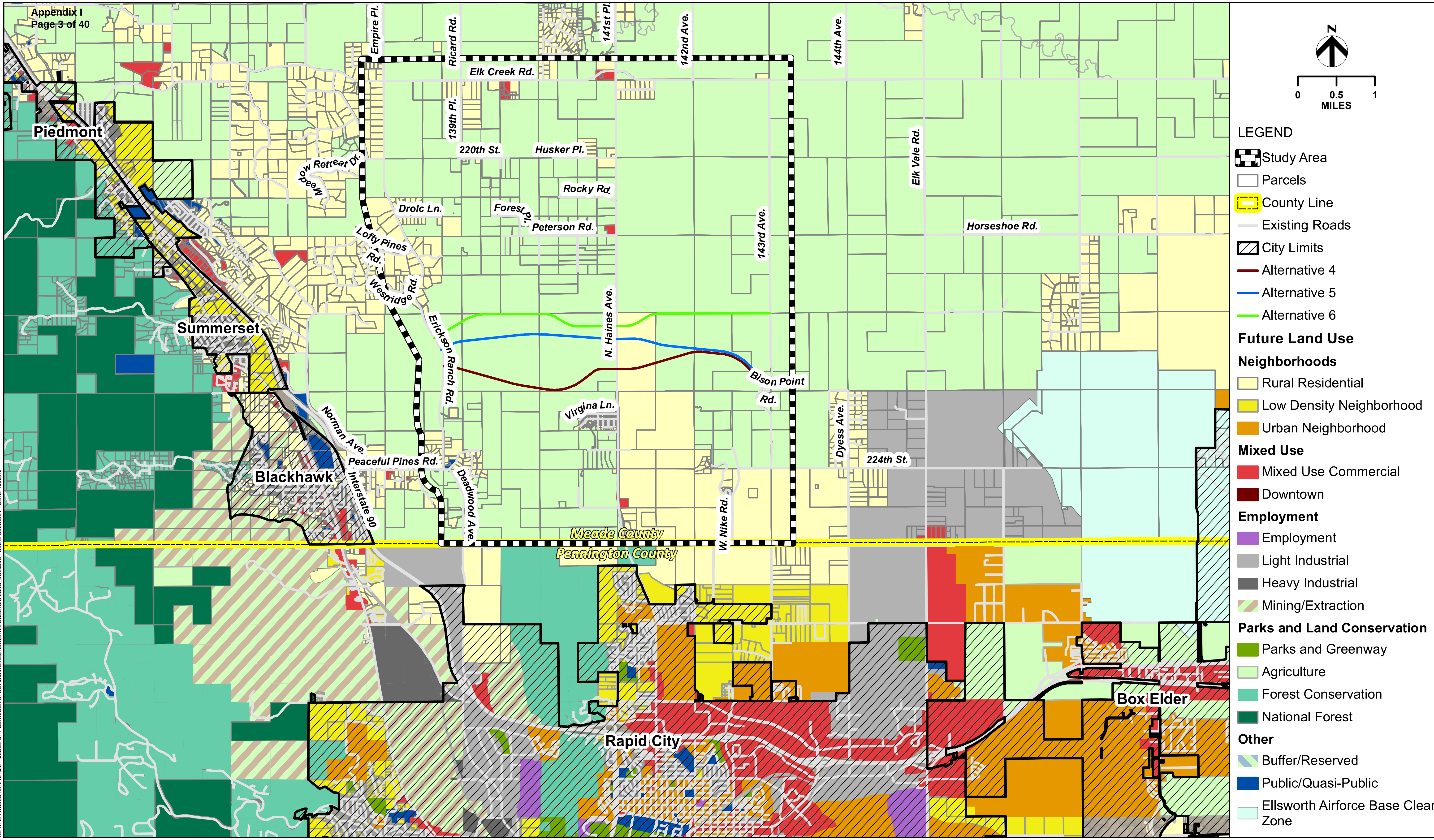


VICINITY MAP
SELECTED STUDY BUILD ALTERNATIVES

SOUTHERN MEADE COUNTY CORRIDOR STUDY

DATE
7/2/2019

FIGURE
FIGURE 1



HDR

FUTURE LAND USE

SOUTHERN MEADE COUNTY CORRIDOR STUDY

DATE
7/8/2019

FIGURE
FIGURE 2

1.1 Supplemental Alternative Screening

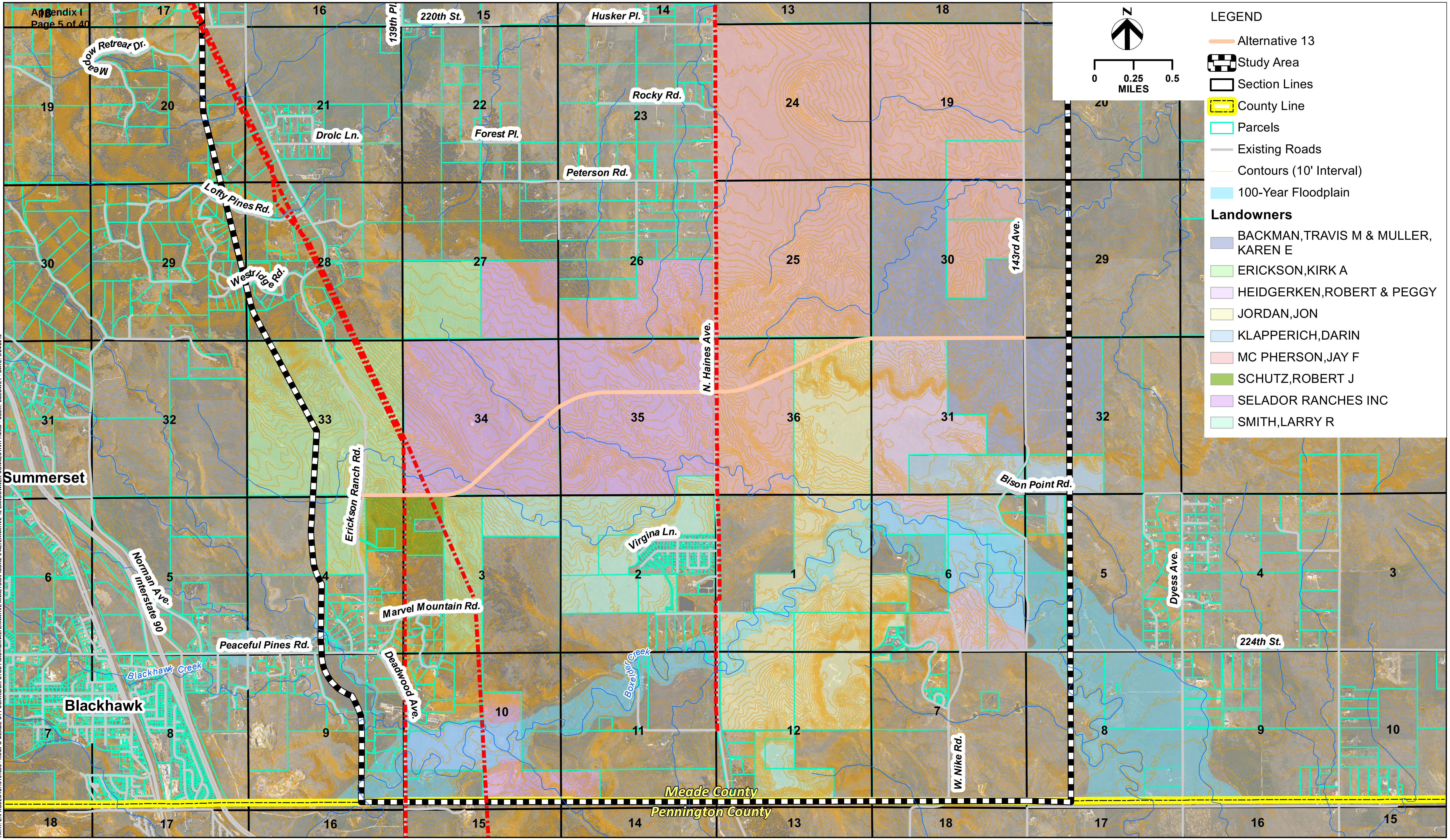
Following input received at the landowner and public meetings, Alternative 13 was investigated to determine whether it should be added as a fourth build alternative. This alternative is depicted in **Figure 3**. Alternative 13 is within the same township (Township 3) as the three selected build alternatives.

This option is likely to be the least impactful to the connectivity of landowner's contiguous parcels, but still splits several landowner's parcels in two, thereby impacting their current land operations. Alternative 13 follows two different the section lines for a portion of its alignment, which reduces the expected amount of right of way acquisition costs.

It was determined that this alternative would have poor intersection geometrics at the intersection of the proposed alternative and Erickson Ranch Road. A significant length of Erickson Ranch Road would need to be reconstructed in order to provide adequate sight distance due to the crest curve located to the south. The earthwork required is estimated to be around 600,000 cubic yards with some extensive cuts and fills required. The construction cost was estimated to be a little over 10 million.

Alternative 13 does not appear to impact a transmission line pole with its grading limits, and the 69 kV transmission line will likely not have a clearance issue with the proposed roadway. However, the alignment is in a 7' fill section for the 230 kV transmission line crossing. The 230 kV transmission line is expected to be impacted and require taller poles, for a total of 2 structures or $40,000 of BHE utility relocation costs.

Ultimately, Alternative 13 was determined to not be a competitor with the previously selected three build alternatives due to the safety issues at the Erickson Ranch Road intersection, utility impacts, large earthwork requirements, and high construction cost.



ALTERNATIVE 13

SOUTHERN MEADE COUNTY CORRIDOR STUDY

DATE
9/6/2019

FIGURE
FIGURE 3

2.0 Purpose and Need

A preliminary purpose and need statement has been developed to assist with screening alternatives for the project. Because the project is still within its preliminary phases, the purpose and need helps to frame the scope, goals and objectives for the corridor, which can be refined and further developed as needed in later phases of project development. The purpose and need is based on local and regional planning documents and input from the SAT on future development and goals for the area. Planned public input meetings may provide further input to define the purpose and need.

The purpose of the Southern Meade County Corridor Study is to identify a corridor that would accommodate the planned future land use as described in the Meade County Comprehensive Plan adopted January 2010, Meade Moving Forward 2040 Transportation Plan dated February 2016, Rapid City Comprehensive Plan adopted April 2014, and RapidTRIP 2040 Long Range Transportation Plan dated September 2015. The identified corridor would allow the preservation of a future route and ensure appropriate access management for any potential growth within the area.

As noted in the Meade Moving Forward Transportation Plan, this area is projected to have medium to high residential growth. Residential development is projected to increase along Elk Creek Road, Erickson Ranch Road and Haines Avenue. Rural residential development is occurring at a higher concentration near the northern half of the study area and more recently immediately north of the study area. The growth that is occurring is inconsistent with the goals and objectives of the Meade County Comprehensive Plan which seeks to encourage orderly, efficient land development within unincorporated areas of Meade County and is directly contributing to urban sprawl and premature fragmentation of agricultural land. An adequately spaced arterial grid-like network discourages scattered, non-farm residential developments and encourages the expansion of residential development near existing incorporated communities that is consistent with the Meade County Comprehensive Plan. Identifying a corridor before the area fully develops allows for preservation and access management thereby reducing future transportation construction and maintenance costs.

2.1 Additional Goals and Objectives

The Meade County Comprehensive Plan, Meade Moving Forward Transportation Plan, Rapid City Comprehensive Plan, and RapidTRIP 2040 Long Range Transportation Plan have specific goals for planning within Meade County and the RCMPO boundary to help further develop the objectives for the project. The goals that are most applicable to this corridor are listed as follows.

- To encourage orderly, efficient land development within the unincorporated areas of Meade County (Meade County Comprehensive Plan).
- To manage growth within the framework of the Meade County Comprehensive
- Land Use Plan and other municipal comprehensive plans (Meade County Comprehensive Plan).
- To maintain a distinction between rural areas and municipalities and preserve and enhance community identity (Meade County Comprehensive Plan).
- To provide a transportation system that promotes the safe and efficient movement of people, goods, and services (Meade County Comprehensive Plan).

- To preserve environmental, historical, and cultural resources (Meade County Comprehensive Plan).
- To maintain a viable agricultural economy and preserve the rural quality of life (Meade County Comprehensive Plan).
- Encourage the clustering of rural residential development to conserve natural features, limit impacts on the natural environment, and maximize infrastructure such as roads (Rapid City Comprehensive Plan).
- New East-West Connection recommended from Deadwood Ave/Erickson Ranch Road and Haines Avenue (Meade Moving Forward 2040 Transportation Plan, Rapid City Comprehensive Plan, and RapidTRIP 2040 Long Range Transportation Plan).

Other objectives and goals for the project may also be identified during the public scoping process.

2.2 No-Build Alternative

Development is expected to continue to occur within and surrounding the study area. All intersections and roadway segments within the study area during no-build 2045 conditions are expected to operate at acceptable levels of service (LOS C or better). Therefore, traffic operations will likely not drive the need for this east-west connector. Refer to the No-Build Future Conditions Traffic Operations memo dated May 2019 for further information.

The no-build alternative does not encourage orderly, efficient land development. Likewise, it does nothing to discourage sprawl or leapfrog development. While the no-build alternative preserves agricultural lands and the splitting of agricultural parcels in the short term, these farming and ranching lands will continue to be become more fragmented as disjointed neighborhood communities continue to develop in a scattered manner away from existing incorporated communities.

In the long term, the no-build alternative does not align with Meade County's goals listed previously and does not meet the purpose and need of this study.

2.3 Build Alternatives

The study originally evaluated 12 alternatives through the study area. These were further refined through analysis of existing roadways, alignment with section lines, topography and other environmental factors that would make the alternative impractical. Three practical build alternatives were selected based on this screening. All three alternatives were then evaluated based on the purpose and need. In the long term, the three build alternatives align with the purpose and need of the project and will meet all of Meade County's goals listed previously. Each alternative will provide a corridor that will accommodate planned growth that can be preserved for orderly and efficient development.

3.0 Build Alternatives Analysis

The three build alternatives were studied further to explore cultural/historic site impacts, floodplain encroachment, impacts to private property, connectivity to existing developments, wetland impacts, preliminary intersection geometrics, estimated construction costs, right of way acquisition costs, and impact to existing property operations. At the conclusion of this analysis, the main advantages and disadvantages of each alternative are listed and compared against one another.

3.1 Cultural and Historic Sites

No cultural sites were identified within the study corridors for any alternative. A record search of the State Historic Preservation Office (SHPO) directory was performed to determine the known potential cultural and historic sites within the study area. Visual observations from public right-of-way were also conducted to supplement the record search. No archaeological or historic architectural resources were noted during the windshield survey.

3.2 Floodplain Encroachment

None of the build alternatives are anticipated to encroach on a FEMA designated 1% annual chance floodplain. FEMA's National Flood Hazard Layer (NFHL) was utilized to review floodplain boundaries and potential impacts.

3.3 Private Property, Structures, and Buildings

Aerial imagery (2018) was used to determine potential impacts to any structures or buildings. Due to the importance to avoid impacts to private property, structures were avoided as much as possible during the process of developing the alignments. Based on aerial imagery (2018), none of the build alternatives are known to impact any existing structures or buildings.

3.4 Connectivity to Existing Developments

Many of the existing neighborhoods in the study area are fragmented and only provide one ingress/egress. It would be advantageous for the future corridor to provide connectivity to existing developments and provide the opportunity for the neighborhood to meet Meade County's egress codes. However, none of the top three ranking build alternatives selected during the preliminary alternative screening process to be studied further provides direct connectivity to existing development.

3.5 Wetland Impacts

A desktop wetland delineation was performed in order to determine the approximate quantity of wetland impacts that would be expected from the grading limits of each alternative. The boundaries of the desktop wetland delineation can be found in the plan view exhibits provided in **Appendix A**. The desktop delineation was completed using aerial photographs (2018), existing topography information, historic aerial photos and National Hydrography Dataset information and supplemented by visual observations in the field from existing public right-of-way. Most of the wetlands within the study boundary are likely to be palustrine emergent sloped wetlands and determined to be Waters of the U.S. These wetlands are subject to the Clean Water Act (CWA) Section 404 regulation based on their apparent continuous wetland connection to downstream waters. A road crossing that impacts in excess of 1/10 of an acre of a Water of the U.S. would likely require mitigation of the impact in order to secure a CWA 404 Permit from US Army Corps of Engineers. If federal funds are used, mitigation for impacts to naturally occurring wetlands of any size would be required to satisfy "Executive Order 11990 - Protection of Wetlands".

Table 1 summarizes the approximate total wetland impacts for each build alternative. To be conservative, it was assumed that all wetland impacts would need to be mitigated. Wetland mitigation can be in the form of purchasing wetland credits from a wetland mitigation bank or design/building a wetland mitigation site. At this time, there isn't a wetland mitigation bank west of the Missouri River in South Dakota. Designing/building a wetland mitigation site can widely vary depending on the complexity of site and how much the land costs. For the purposes of this study, it was estimated that the construction of the site would cost $25,000 per acre and the cost of the purchasing of the land was $3,500 per acre. In summary, the wetland mitigation costs per acre were estimated at $28,500 per acre.

Table 1. Approximate Wetland Impacts

Build Alternative	*Desktop Wetland Impacts (Acres)*	*Total Mitigation Cost Estimate*
Alternative 4	*0.21*	*$5,985*
Alternative 5	*0.18*	*$5,130*
Alternative 6	*1.05*	*$29,925*

3.6 Preliminary Intersection Geometrics

Three intersections per corridor alternative were reviewed to determine the preliminary intersection geometrics where the corridor would intersect Erickson Ranch Road, Haines Avenue, and 143rd Avenue. It is ideal in terms of having adequate sight distance for the intersections of the future corridor to be located on the horizontal and vertical tangent sections of the intersecting roadways.

Future intersecting roadways were assumed to be two-way stop controlled with the future corridor as the minor leg(s). Sight obstructions should not be present within the sight triangle of a stopped vehicle on the minor roadway leg, so a vehicle can safely perform a left turn, right turn, or through maneuver from the minor leg across or onto the major roadway. Sight obstructions can be caused by objects such as tall crops, walls, fences, bushes, trees, hedges, buildings, and the terrain itself.

Intersection sight distance was evaluated in the field based on visual observations. Potential intersection locations were determined using the best information available without field survey data to try and provide adequate sight distance based on where vertical crest curves approximately began and ended. Further investigation should be performed when preliminary and final design occurs. Some portions of Erickson Ranch Road, Haines Avenue, or 143rd Avenue may need to be reconstructed if adequate intersection sight distance cannot be provided solely by adjusting the intersection location.

As summarized in the **Table 2**, almost all of the build alternatives are expected to have adequate preliminary intersection geometrics. The intersection of Haines Avenue and Alternative 4 could not be located far enough away from a crest vertical curve that didn't impede the intersection sight distance due to topographical constraints and a large stream crossing. Therefore, a short length of Haines Avenue will likely need to be reconstructed to provide adequate intersection sight distance. This reconstruction length is included in the cost estimate for Alternative 4.

The intersection of Alternative 5 and Erickson Ranch Rd will be on the outside of a horizontal curve. However, it does not appear that there will be a horizontal sight obstruction issue based on the where it intersects the curve and since the sight lines are within the existing right of way. Alternatives 5 and 6 traverse a large hill that is spatially close to Erickson Ranch Road. It will be important during final design that the cut slopes near the intersection are laid back enough for adequate intersection sight distance.

Table 2. Expected Preliminary Intersection Geometrics

Build Alternative	*Erickson Ranch Rd Intersection*	*Haines Ave Intersection*	*143rd Ave Intersection*
Alternative 4	✓	✘	✓
Alternative 5	✓	✓	✓
Alternative 6	✓	✓	✓

✓= Intersection location is expected to have adequate intersection geometrics and will likely not require reconstruction of the intersecting existing roadway

✘= Due to frequent crest vertical curves along the intersecting existing roadway, the intersection could not be situated to provide adequate intersection geometrics and will likely require reconstruction of a certain length of existing roadway.

3.7 Conceptual Construction Cost Estimate Comparisons

A conceptual cost estimate was compiled to provide relative comparisons of the estimated construction costs between the different alternatives. Bid items that were able to be estimated at this conceptual level of design were quantified and listed in the estimate. Some bid items were not able to be quantified and the associated costs are assumed to be included in the 40% contingency. Due to the undefined nature of when this roadway will likely be constructed, construction costs were not escalated to a future construction year and are presented in 2019 dollars. The costs provided in **Table 3** are for the approximated construction costs of each build alternative. Based on forecasted traffic volumes, the segment between Erickson Ranch Rd and Haines Ave was assumed to be paved and the segment between Haines Ave and 143rd Ave was assumed to be gravel for the purposes of this cost estimate. Alternative 5 is estimated to have the lowest construction cost, and alternative 6 is estimated to have the highest construction cost. Alternative 4 is expected to have the second to lowest construction cost. A full conceptual cost estimate with itemized bid items can be found in **Appendix C** with a cost breakdown between Segment A (Erickson Ranch Road and Haines Avenue) and Segment B (Haines Avenue and 143rd Avenue).

Table 3. Total Conceptual Construction Cost Estimate

Build Alternative	*Construction Cost Estimate (2019$)*
Alternative 4	*$7.9 M*
Alternative 5	*$6.9 M*
Alternative 6	*$10.4 M*

It should be noted that this estimate does not include annual maintenance, engineering design fees, environmental permitting or right of way acquisition costs. Annual maintenance should be done on the roadway after being built such as crack sealing, asphalt patching, chip seal, etc. These costs were left out of the total due to the fact that each of the alternatives would have very similar maintenance costs and would likely not add to the discussion of comparing the alternatives to one another. Meade County currently does not keep track of their annual maintenance costs of asphalt or gravel roadways. For informational purposes only, in the 2018-2019 fiscal year, the SDDOT spent $5,483 per mile per year for non-interstate highways for routine maintenance, mowing roadsides, and plowing snow.

3.7.1 PROFILE OPTIMIZATION AND EARTHWORK

In order to generate an earthwork number, the build alternatives were designed utilizing a 55 mph design speed and modeled at a conceptual level to obtain approximate earthwork quantities and preliminary grading limits. An existing surface was generated from a USGS digital elevation model (dem). The profiles of each alternative were optimized to refine the earthwork volumes. Per AASHTO guidelines, a rural arterial roadway in rolling terrain would necessitate a maximum grade of 5%. However, a rural arterial roadway in mountainous terrain would necessitate a maximum of 6%. For the purposes of this modeling exercise, a maximum grade of 6% was used in select locations in order to reduce excessively large cuts and fills. Otherwise, a grade of 5% was typically used as the maximum grade. The typical sections used to conceptually model the alternatives are shown in **Figure 4**. Plan sheets showing the grading limits and right of way requirements can be found in **Appendix A**. Representative cross sections can be found in **Appendix B**.

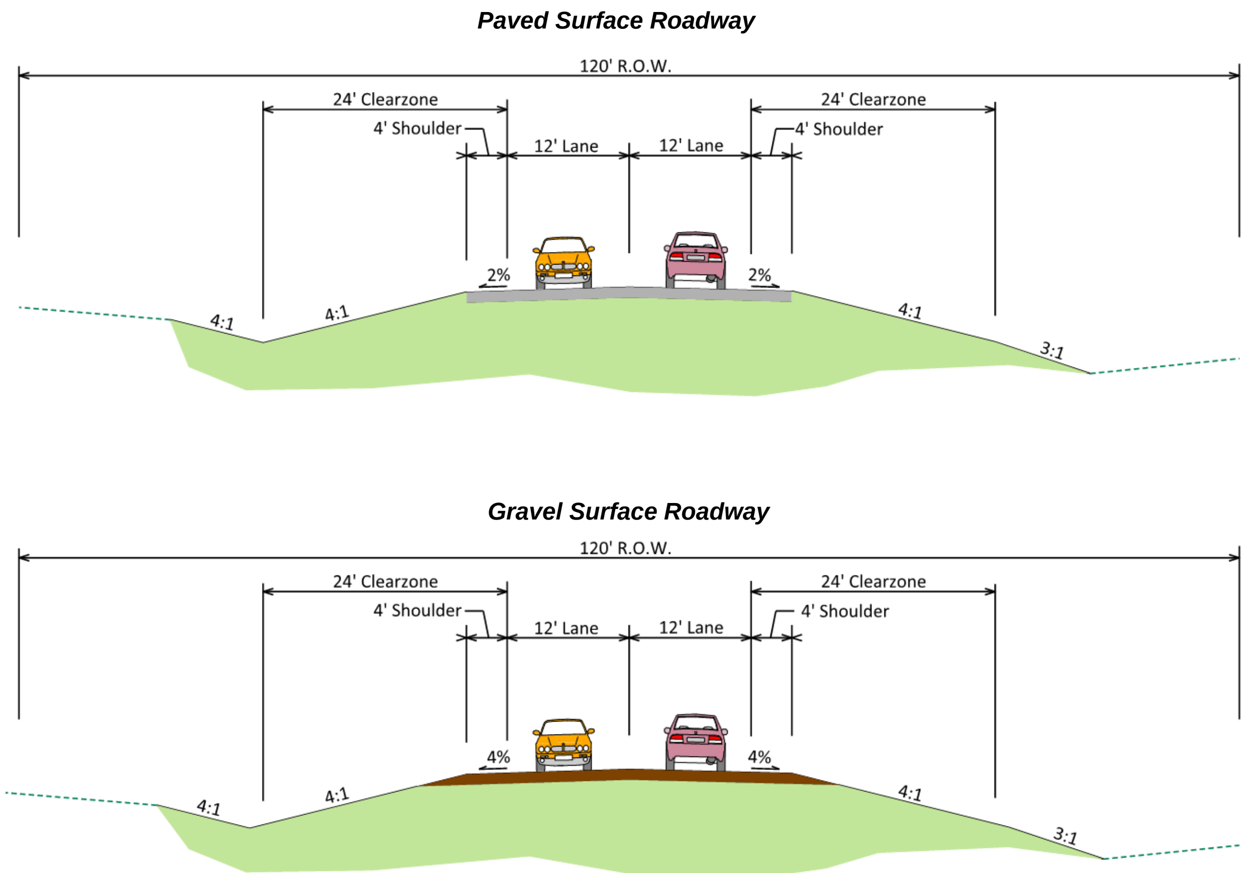


Figure 4. Typical Roadway Sections

The earthwork was balanced to the extent feasible in order to minimize earthwork transported across Haines Avenue. The earthwork values are preliminary in nature, because the topography used for the roadway modeling efforts is not of survey quality. A summary of the estimated unclassified excavation required by each alternative is summarized in **Table 4**.

Table 4. Estimated Grading Summary

Build Alternative	*Unclassified Excavation (CY)*
Alternative 4	*254,801*
Alternative 5	*300,376*
Alternative 6	*769,439*

3.7.2 HYDRAULICS

There are no known major stream or river crossings that would require a bridge or box culvert on any of the build alternatives. Likewise, there are no known houses or structures near the build alternatives that would cause concern for water backing up from the new road embankment. Since the floodplain is not being encroached upon, it is not anticipated to have floodplain permitting effort required for any of the alternatives.

Culverts would be installed at minor drainage crossings of the new roadway. For the purposes of the cost estimate, culvert locations and lengths were estimated using the existing ground contours, aerial imagery, and the approximate grading limits of each alternative. Without performing a full hydraulic analysis, the culverts could not be sized. However, what appears to be the largest stream crossing for the three build alternatives is shown highlighted in red in **Figure 5**. A preliminary calculation was performed for this stream crossing and it is likely that a 36" culvert should be able to accommodate a 25-year rainfall event. For the purposes of this study and to be conservative, it was assumed that a 36" reinforced concrete pipe (RCP) and two flared end sections would be used at each culvert crossing.

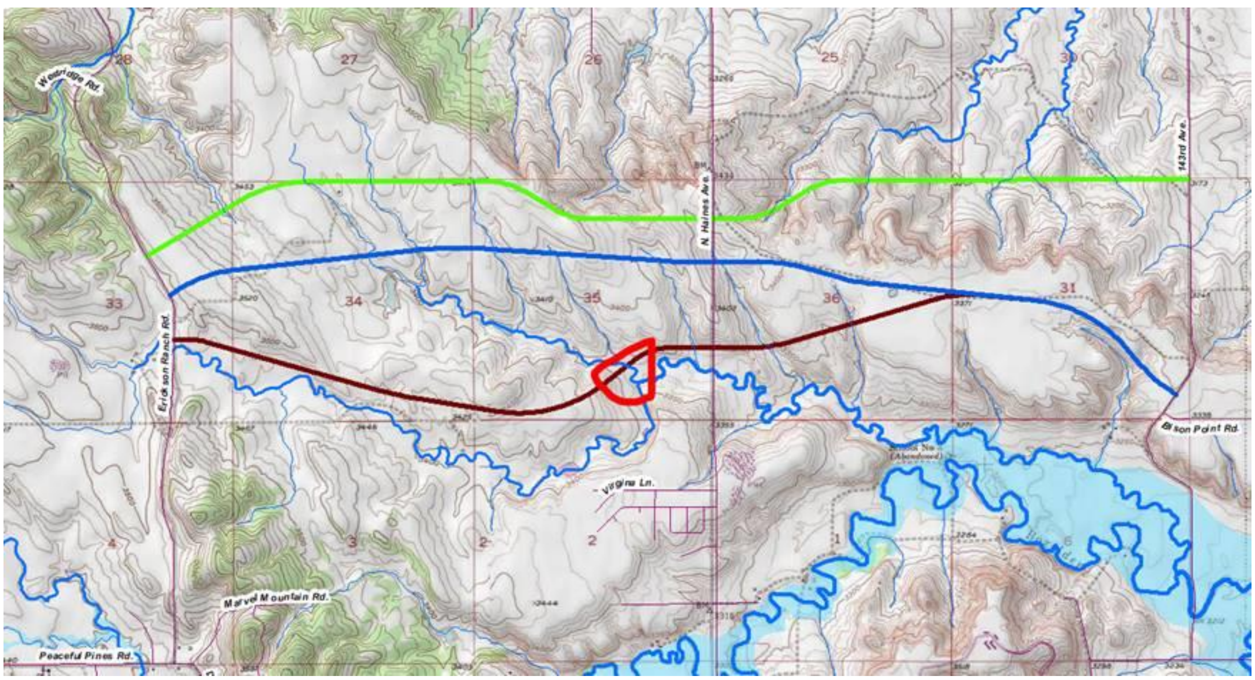


Figure 5. Largest Stream Crossing

3.8 Right of Way Acquisition and Temporary Construction Easement Estimate

As illustrated in the **Figure 4** Typical Roadway Sections, a right-of-way width of 120' was assumed for each of the alternatives. Additional right-of-way width was supplemented near drainage crossings for culvert maintenance access. Other than drainage crossings, grading limits that extended beyond the 120’ right of way were only included as temporary construction easement and not included in the right of way acquisition estimate.

Agricultural land sales within or near the study area from 2017 to 2018 were retrieved from the Meade County Equalization office. Recent sale prices were used to determine a fair market price for the right of way acquisition estimate. Prices were converted to 2019 dollars using three percent inflation. An average of the top three unit prices was used and rounded to the nearest 100 dollars. The average price per acre of the top three recent sales was calculated to be $3,500 per acre for right of way acquisition. Temporary construction easement costs were estimated at 3% per year of the appraised value for a total of two years. Based on the $3,500 approximate appraisal value used in the right of way acquisition calculations, the temporary construction easement would cost approximately $210 per acre.

It should be noted that the average price used for the purposes of this study is only a rough estimate and an appraisal would need to be done during the right of way acquisition process. Values did not include costs for the appraisal and acquisition process. **Table 5** summarizes the estimated right of way and easement requirements and costs for each alternative.

Table 5. Estimate of Right of Way/Easement Requirements and Costs

Build Alternative	*Right of Way Required (Ac)*	*Right of Way Acquisition Cost*	*Temporary Construction Easement Required (Ac)*	*Temporary Construction Easement Cost*
Alternative 4	*66.6*	*$233,100*	*5.9*	*$1,239*
Alternative 5	*66.2*	*$231,700*	*6.0*	*$1,260*
Alternative 6	*53.7*	*$187,950*	*14.8*	*$3,108*

3.9 Utilities

GIS datasets were used to locate known utilities. There is very little utility infrastructure or utility master plans within the study area. There are known natural gas pipelines and communication lines within the study area. However, the three build alternatives do not appear to impact known gas or communication lines. The only known utilities that cross paths with the build alternatives include two Black Hills Energy (BHE) transmission lines running north-south near Erickson Ranch Road and a West River Electric (WRE) north-south power distribution line near Haines Ave. Overhead electric line locations are illustrated in the exhibits provided in **Appendix A**. Anticipated impacts to each of these utilities is outlined in the paragraphs below and associated costs are summarized in **Table 6**.

3.9.1 BLACK HILLS ENERGY TRANSMISSION LINES

Transmission lines are particularly expensive to move, so coordination with Black Hills Energy occurred as part of this exercise. Out of the two BHE transmission lines, the western of the two is a 69 kV line and the eastern of the two is a 230 kV line. According to a BHE representative, the rough cost of the relocation of a transmission structure is about $30,000 per relocated structure and $20,000 for a structure that requires a taller pole without relocation. For a 69 KV line, BHE requires a minimum of 19.5 feet of clearance and generally constructs them with 26 feet of clearance. For a 230 kV line, BHE requires a minimum of 27 feet of clearance and generally constructs them with 29 feet of clearance. For the purposes of this study, anticipated impacts to poles and guy wires would require relocation of a structure and clearance issues would require two structures' poles to have height adjustments. Using the profile and grading limits, a preliminary evaluation of whether or not the alternative impacts the transmission poles or line was made.

Alternative 4 does not appear to impact a transmission line pole with its grading limits. However, the alignment is in a 6' fill section for the 69 KV transmission line crossing and a 2' fill section for the 230 kV transmission line crossing. Based on the general construction requirements and the actual field conditions, it is possible that there will be clearance issues with one or both transmission line crossings. The profile of the road most likely could not be lowered in order to maintain clearance over a drainage crossing nearby, but further investigation and coordination will be required during final design if alternative 4 is selected as the recommended alternative. For the purposes of this study, both transmission lines are expected to be impacted and require taller poles, for a total of 4 structures or $80,000 of BHE utility relocation costs.

Alternative 5's grading limits are not anticipated to impact a transmission line pole and clearance is likely not an issue because the alignment is in a cut section at both transmission line crossing locations. However, Alternative 5's grading limits are roughly 50 feet from a 69kV pole. If a guy wire is present at this transmission pole location, alternative 5's grading limits could impact a guy wire and require the relocation of the 69kV pole. Guy wires could not be seen on the nearby structures to alternative 5 from the public right of way. This is substantiated by the fact that the pole is a tangent structure and it has no indication of it being in an uplift condition since it is on top of a hill without large changes in elevation.

Alternative 6's grading limits impact a 69 kV transmission line pole for a total of 1 structure or $30,000 of BHE utility relocations costs. Clearance is likely not to be an issue with Alternative 6 because the alignment is in a cut section for both transmission line crossing locations.

3.9.2 WEST RIVER ELECTRIC POWER DISTRIBUTION LINES

According to a WRE representative, the rough cost of the relocation of a power distribution pole is $3,500 per structure. WRE requires a minimum of 27 feet of clearance between the highest point on the roadway to the nearest wire. It is assumed that all alternatives will likely require WRE power distribution line relocation/adjustment due to clearance issues and/or grading impacts to a pole. For the purposes of this study, approximately four power distribution poles will likely need to be adjusted per crossing to provide adequate clearance for a total of $14,000 in WRE utility relocations costs.

Table 6. Anticipated Utility Impacts

Build Alternative	*BHE Transmission Line Pole Relocation Costs (Near Erickson Ranch Rd)*	*WRE Power Distribution Pole Relocation Costs (Near Haines Ave)*
Alternative 4	*$80,000*	*$14,000*
Alternative 5	*-*	*$14,000*
Alternative 6	*$30,000*	*$14,000*

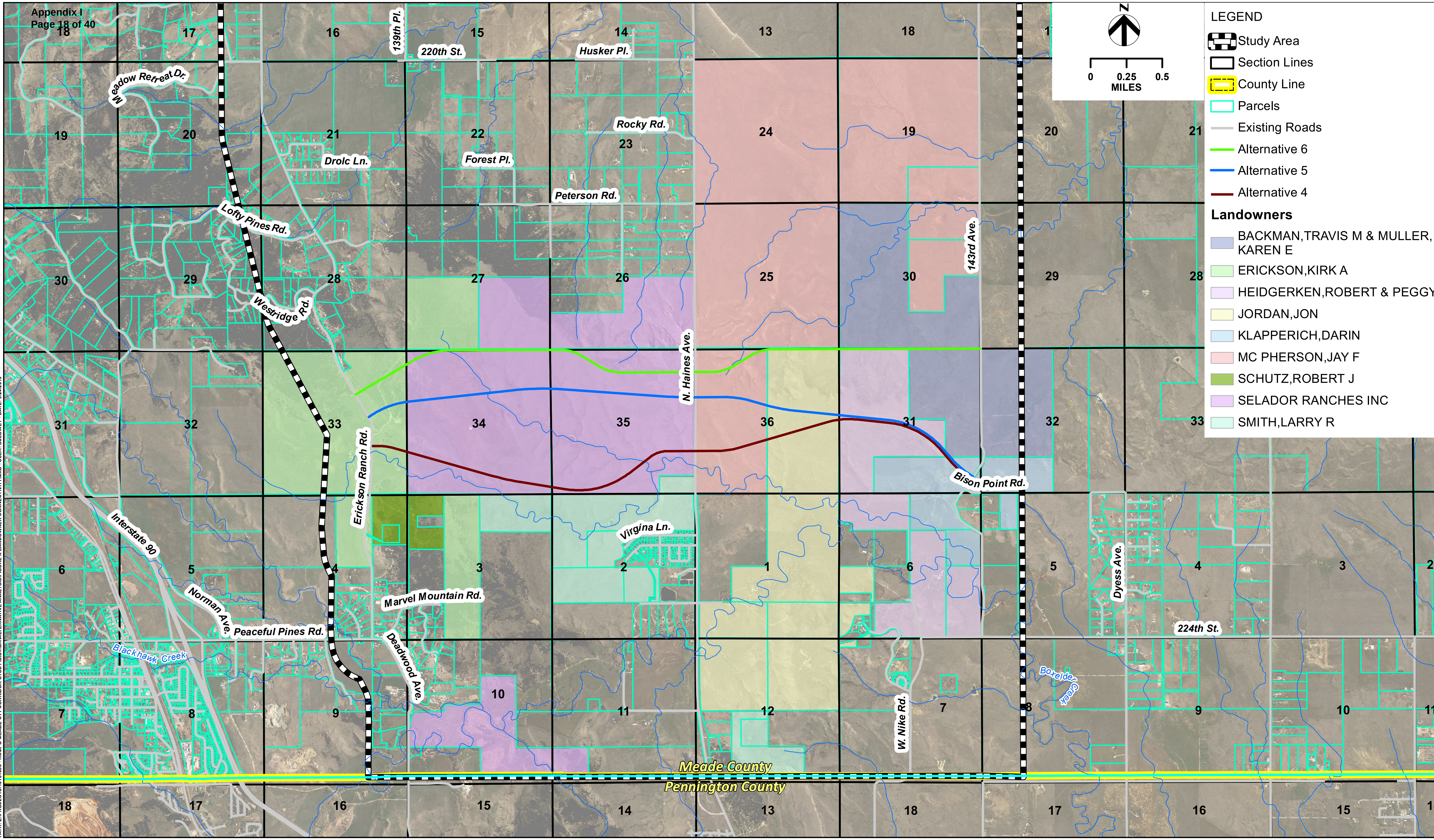
3.10 Impacts to Existing Property Operations

The proposed alternatives traverse lands that are primarily used for cattle ranching. It is expected for portions of the land within the study area to transition into residential land use within the next 20 years. It should be noted that if the proposed roadway is built during the time frame while the land is being utilized for agriculture, damages will likely be reviewed/assessed as part of a right-of-way acquisition process.

Landowner meetings were held on July 24th, 2019. During these meetings, landowners provided feedback of the proposed alternatives. The most common concern was the impacts the proposed roadway would impose on existing property operations. Many landowners own multiple parcels. **Figure 6** illustrates the connectivity of these landowner's parcels and how the different alternatives would cross with them. Some additional context and feedback received during the meetings is provided as follows.

- Kirk Erickson owns the majority of Section 33. He uses the land east of Erickson Ranch Road as summer pasture on the north end and bull pasture on the south end. Alternatives 4 would divide his bull pasture and Alternatives 5 and 6 would divide his summer pasture. Kirk Erickson prefers the no-build alternative.
- Selador Ranches did not have a strong preference on the different alternatives and has indicated that the land may be sold for development in the future. All three build alternatives divide this land but concerns were not identified at this time. Alternative 4 would have the least disruption to the current land operation.
- Jay McPherson indicated that all alternatives would have a negative effect on the current operation of his property. The majority of his land is located to the north of section 36, so all the alternatives divide his contiguous land. Alternative 4 leaves the most amount of land to the north of its alignment. He did indicate that he prefers an alternative that would traverse his land over flat ground to deter the public from dumping trash on his property or using it as a shooting range. Jay McPherson prefers the no-build alternative. However if he had to choose between the build alternatives, Alternative 5 would be his preference if a project were built, because it stays out of the rugged terrain.
- Robert Heidgerken's property operation is impacted the most by Alternative 4 and 5. The large draw that Alternative 4 and 5 cross on his property is not a good location for cattle to cross. His cattle use the draws on the north end of his property for shelter in adverse weather. Alternative 6 would have the least impact to his current property operation and would not divide his parcel into two.

- Darin Klapperich indicated that all the alternatives would have very little impact to the current operation of his property.
- Travis Backman (brother) and Karen Muller (sister) co-own their land near 143rd Avenue.
    - Travis and Judy Backman didn't believe that any of the alignments would significantly affect their current property operation. However, they prefer the no-build alternative. If they had to choose an alignment, alternative 4 and 5 would be prefered. They own land north and south of Alternative 6, so these roadway alignments would divide their two parcels.
    - Karen Muller does not believe the alignments significantly impact her land. However, she would prefer the no-build alternative. This undeveloped land has intrinsic value to her and her family. The house on the land can only be seen from the top of Bison Pass. Karen believes that the increased traffic near her land will make it feel less secluded.



CONNECTIVITY OF LANDOWNER PARCELS
SELECTED STUDY BUILD ALTERNATIVES

SOUTHERN MEADE COUNTY CORRIDOR STUDY

DATE
9/24/2019

FIGURE
FIGURE 6

4.0 Summary of Findings

4.1 Cost Estimate Comparisons

The overall costs for the alternatives is summarized in **Table 7**. Alternative 5 has the lowest overall cost, while alternative 6 has the highest overall cost. Although alternative 6 has the least amount of expected right of way acquisition requirements, the costs of acquiring the right of way is expected to be much less than the amount of earthwork required. It should be noted that Alternative 4 would be very cost comparative to alternative 5 if the reconstruction of Haines Avenue for increased sight distance was not a concern.

Table 7. Summary of Estimated Cost per Alternative

Alternative	*Wetland Mitigation*	*Construction*	*Right of Way Acquisition*	*Temporary Construction Easement*	*Utility Relocation*	*Total Estimated Costs*
No-Build Alternative	-	-	-	-	-	-
Build Alternative 4	*$5,985*	*$7,873,550*	*$233,100*	*$1,239*	*$94,000*	*$8,207,874*
Build Alternative 5	*$5,130*	*$6,911,303*	*$231,700*	*$1,260*	*$14,000*	*$7,163,393*
Build Alternative 6	*$29,925*	*$10,375,304*	*$187,950*	*$3,108*	*$44,000*	*$10,640,287*

4.2 Alternatives Advantages and Disadvantages

The advantages and disadvantages of the alternatives is summarized in **Table 8**.

Table 8. Summary of Alternatives' Advantages and Disadvantages

Alternative	*Advantages*	*Disadvantages*
No-Build	• *No cost* • *No impacts to existing property or parcels*	• *Does not meet the purpose and need for this study and thereby does not meet the overall land use goals of Meade County* • *Does not plan for future growth* • *In the long term, further fragmentation of agricultural land with scattered neighborhoods continue.*
Alternative 4	• *Low amount of anticipated wetland impacts* • *Least amount of earthwork* • *Meets the purpose and need of the corridor study*	• *Likely impacts to costly BHE transmission line, and possible service outages during construction* • *Impacts to WRE power distribution line* • *24% more right of way acquisition costs than Alternative 6* • *Total overall costs are expected to be over a million more than Alternative 5* • *Issues with preliminary intersection geometrics at Haines Ave. Adequate intersection sight distance likely to not be able to be provided under existing conditions. Likely will require a length of Haines Ave to be reconstructed to flatten a crest curve. The reconstruction on Haines will cause increased delay on busy existing roadway as new corridor is constructed* • *Impacts four landowners' current property operations (Kirk Erickson, Robert Heidgerken, Jon Jordan and Jay McPherson)*
Alternative 5	• *Expected to be the least expensive alternative* • *Least amount of anticipated wetland impacts* • *Limited delay during construction to existing North/South Corridors* • *No impacts to costly BHE transmission line, and thereby likely no service outages during construction* • *No known issues with preliminary intersection geometrics, adequate intersection sight distance expected* • *Meets the purpose and need of the corridor study*	• *Approximately 18% more earthwork required than Alternative 4* • *Impacts to WRE power distribution line* • *Approximately 23% more right of way acquisition costs than Alternative 6* • *Impacts four landowners' current property operations (Kirk Erickson, Robert Heidgerken, Jon Jordan and Jay McPherson)*
Alternative 6	• *Limited delay during construction to existing North/South Corridors* • *Lowest right of way acquisition costs because it follows the section line for a portion of its alignment. Additionally, this alternative causes the least number of parcels to be split into two.* • *Likely to have adequate preliminary intersection geometrics, however, the future intersection at Haines Ave might cause issues* • *Meets the purpose and need of the corridor study*	• *Extensive cuts and fills and large amount of total earthwork. Three times the amount of earthwork as compared to alternative 4.* • *Expected to be the most expensive alternative. Total overall costs are expected to be 3.5 million more than Alternative 5.* • *Impacts to BHE transmission line and WRE power distribution line* • *Largest amount of wetland impacts* • *Impacts two landowners' current property operations (Kirk Erickson and Jay McPherson)*

5.0 Recommendations

5.1 Recommended Alternative(s)

The study advisory team met on July 17th, 2019 to discuss the findings of this memo. The findings of this memo was also presented to the public and landowners on July 24th, 2019. Following the public and landowner meetings, the study advisory team reconvened on August 12th, 2019 to discuss the feedback received from these meetings and select the recommended alternative(s).

Although the county does not foresee the proposed connector road to be constructed in the near future unless financing outside of Meade County taxes becomes available, the county does not believe the No-Build alternative is a good option from a planning perspective. The county would like to put a plan in place rather than be reactive to development occurring in the future. Meade County has a long list of immediate roadway needs, and building a new road is not at the top of the immediate needs list. However, the county does see the importance of having a plan in place for the future connector road. During the years between concept and construction, this route gives future developers one more factor to consider in their planning decisions.

All three alternatives have impacts to landowners in different ways and since there wasn't a consensus or one alternative that was preferred by landowners, the recommended alternative came down to safety, constructability, and cost. The SAT recommended the following:

- Eliminating Alternative 6 because of poor constructability, high construction cost, and utility impacts.
- Eliminating Alternative 4 because of safety issues with the intersection at Haines Avenue. There were also concerns with the safety of the intersection location of Erickson Ranch Road and Alternative 4. Although it meets the minimum intersection sight distance requirements, drivers headed northbound can't see the intersection quite as well as they would with Alternative 5. Utility impacts with both the BHE transmission lines are anticipated as well.
- Alternative 5 is the recommended alternative. Alternative 5 has the most optimal intersection geometrics and is the least expensive of the other two alternatives. It also has the least amount of wetland and utility impacts.

5.2 Extended Roadway Network

Elk Vale Road provides a direct north/south connection to I-90 (Exit 61) and the US-16 Bypass. Due to the regional significance of Elk Vale Road, it is recommended that Meade County plan for a connection to be made between 143rd and Elk Vale Road. If a connection is not planned, 143rd Ave between the future roadway and 224th Ave should be upgraded to an arterial roadway typical section. The bridge over Box Elder Creek should be evaluated for the additional traffic volumes and the horizontal curve and longitudinal grades should be reconstructed to meet design criteria.

5.3 Access Management

As per access management guidelines found in Meade Moving Forward 2040 Transportation Plan and the Meade County Comprehensive Plan, accesses should be at least 500 feet from other existing or future accesses or intersections. Based on these guidelines, the following accesses are recommended to be relocated to connect with the future roadway, similarly to the example shown in **Figure 7**. Future developments that occur adjacent to the future corridor should follow these access management guidelines as well.

- An existing field access located less than 500’ south of where Alternative 5 would intersect with Haines Ave.
- An existing field access located less than 500’ north of where Alternative 6 would intersect with Haines Ave
- An existing commercial access off of Erickson Ranch Road (as shown in **Figure 7**)

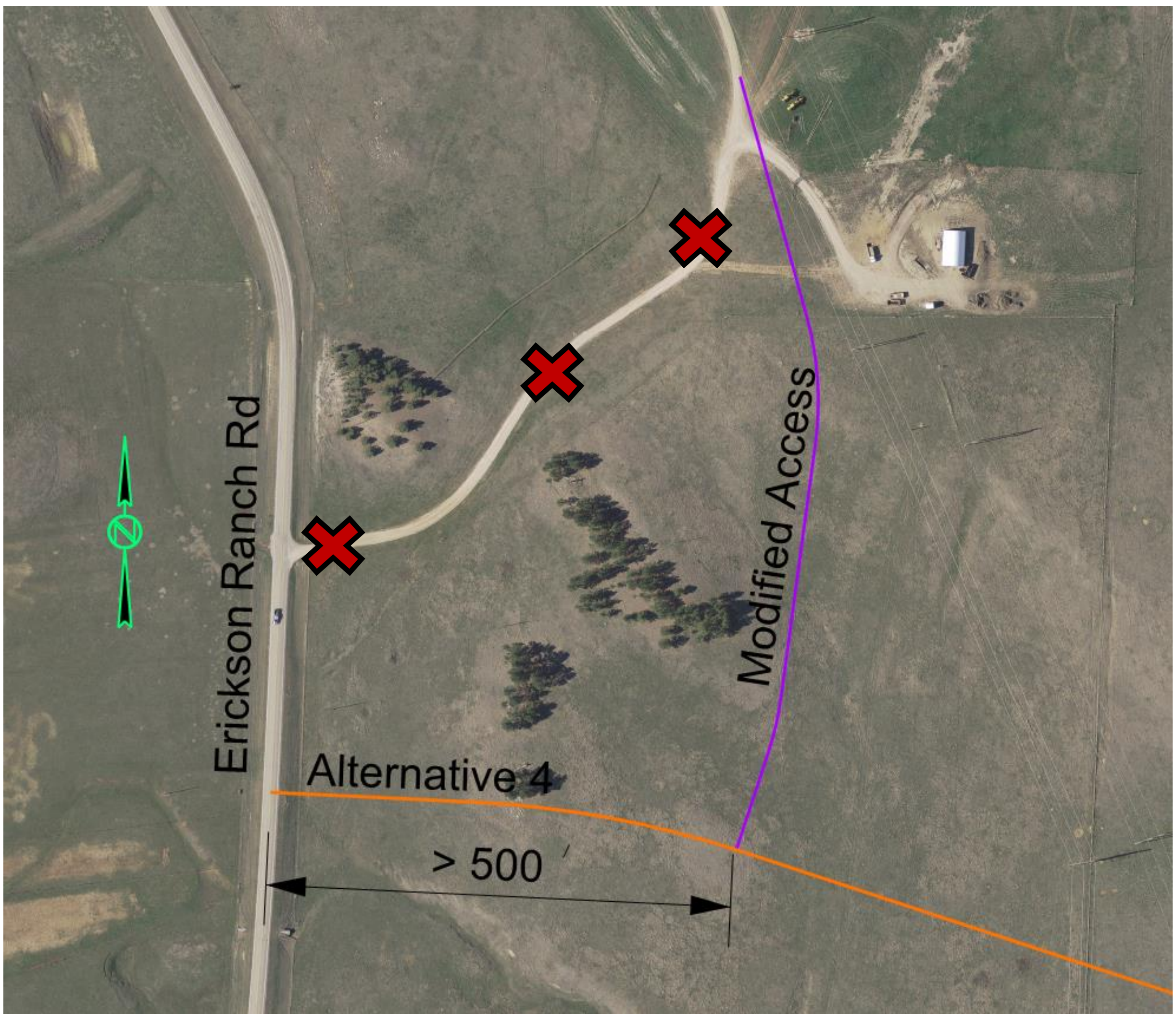
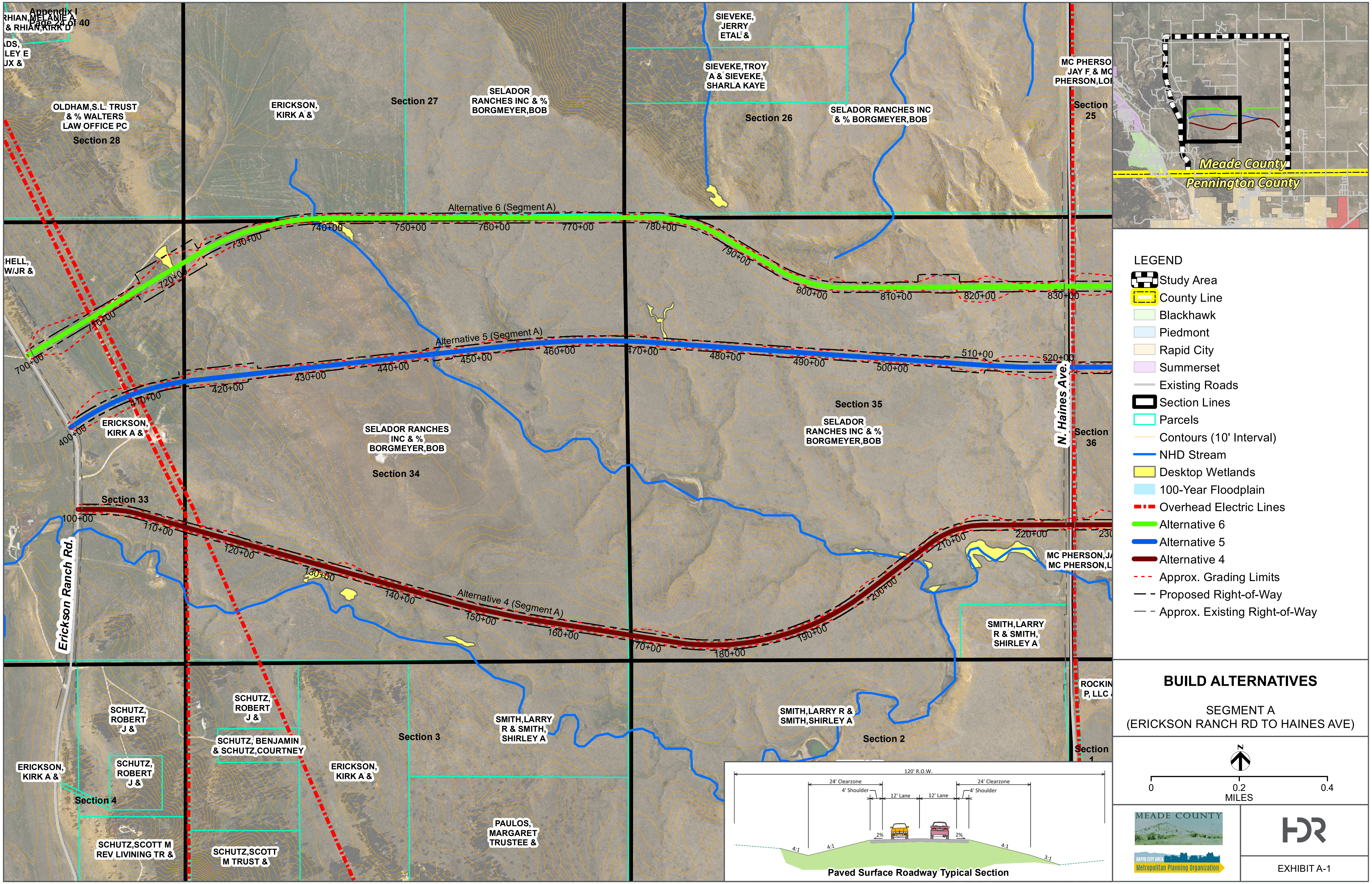


Figure 7. Example of Modified Access

Appendix A. Plan View Exhibits



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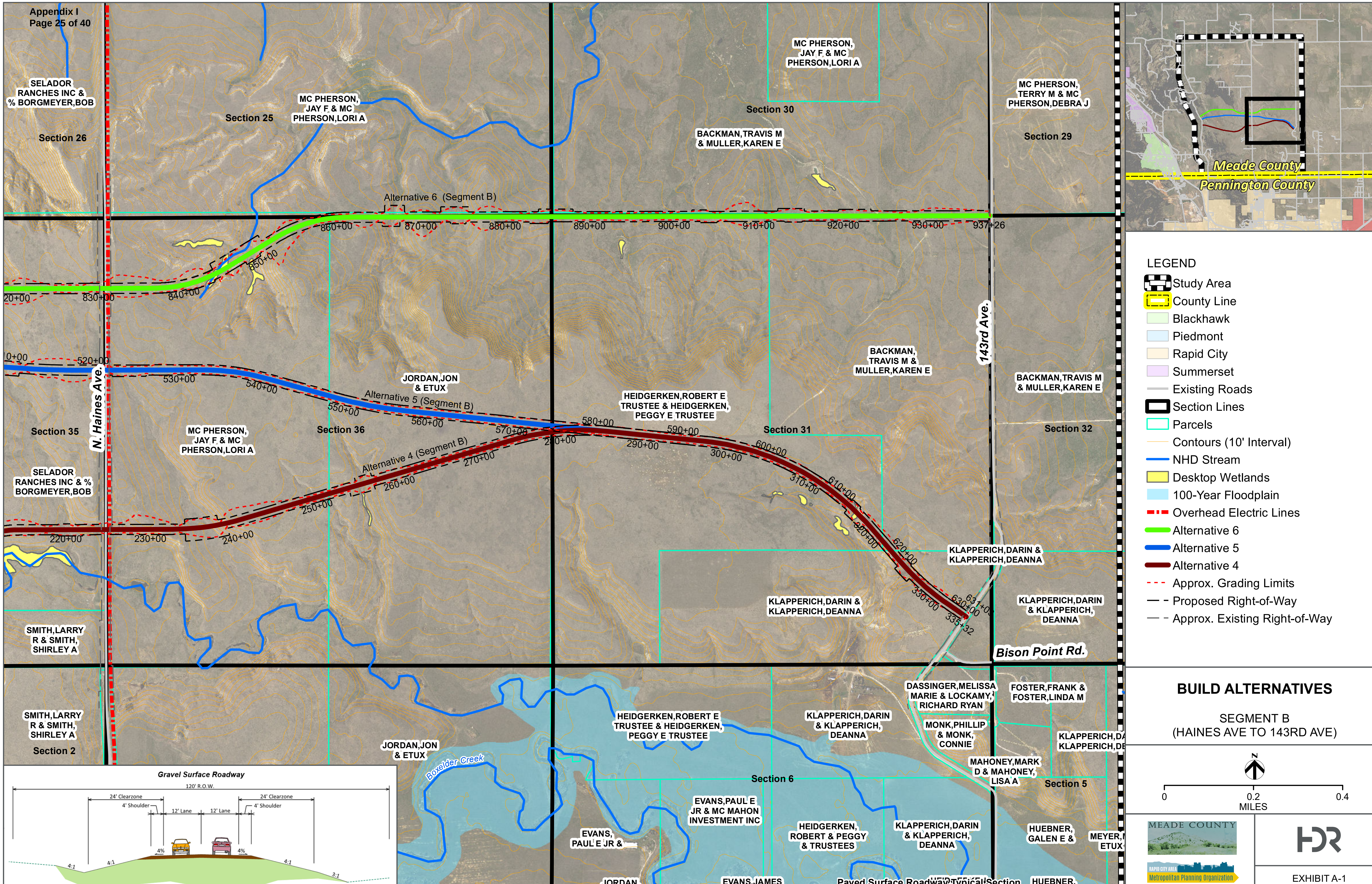

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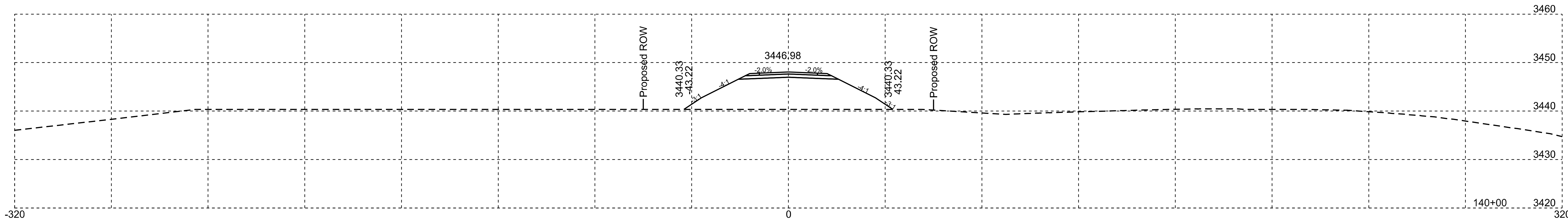
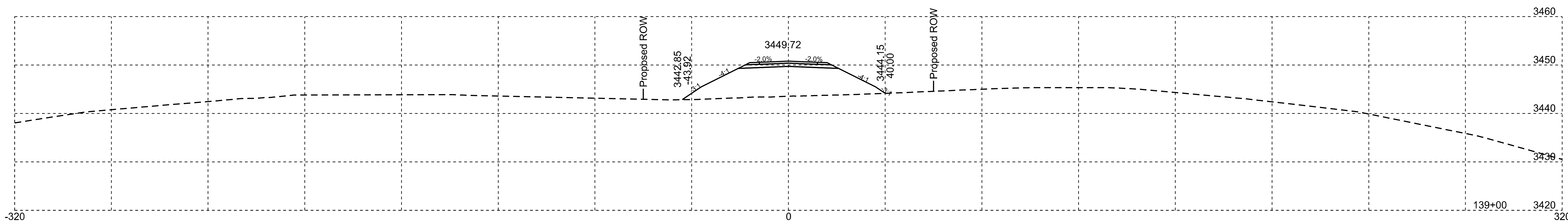
Appendix B. Representative Cross Sections

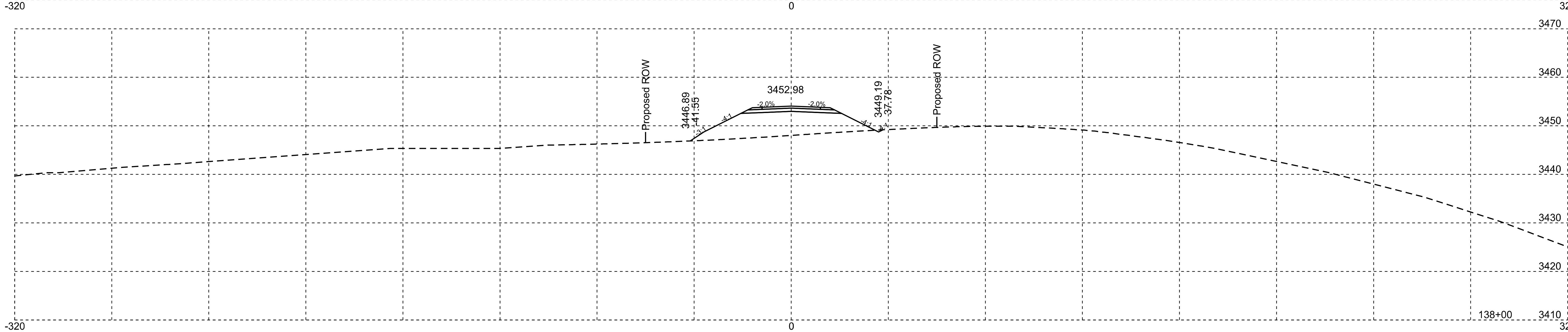
Alternative 4

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS



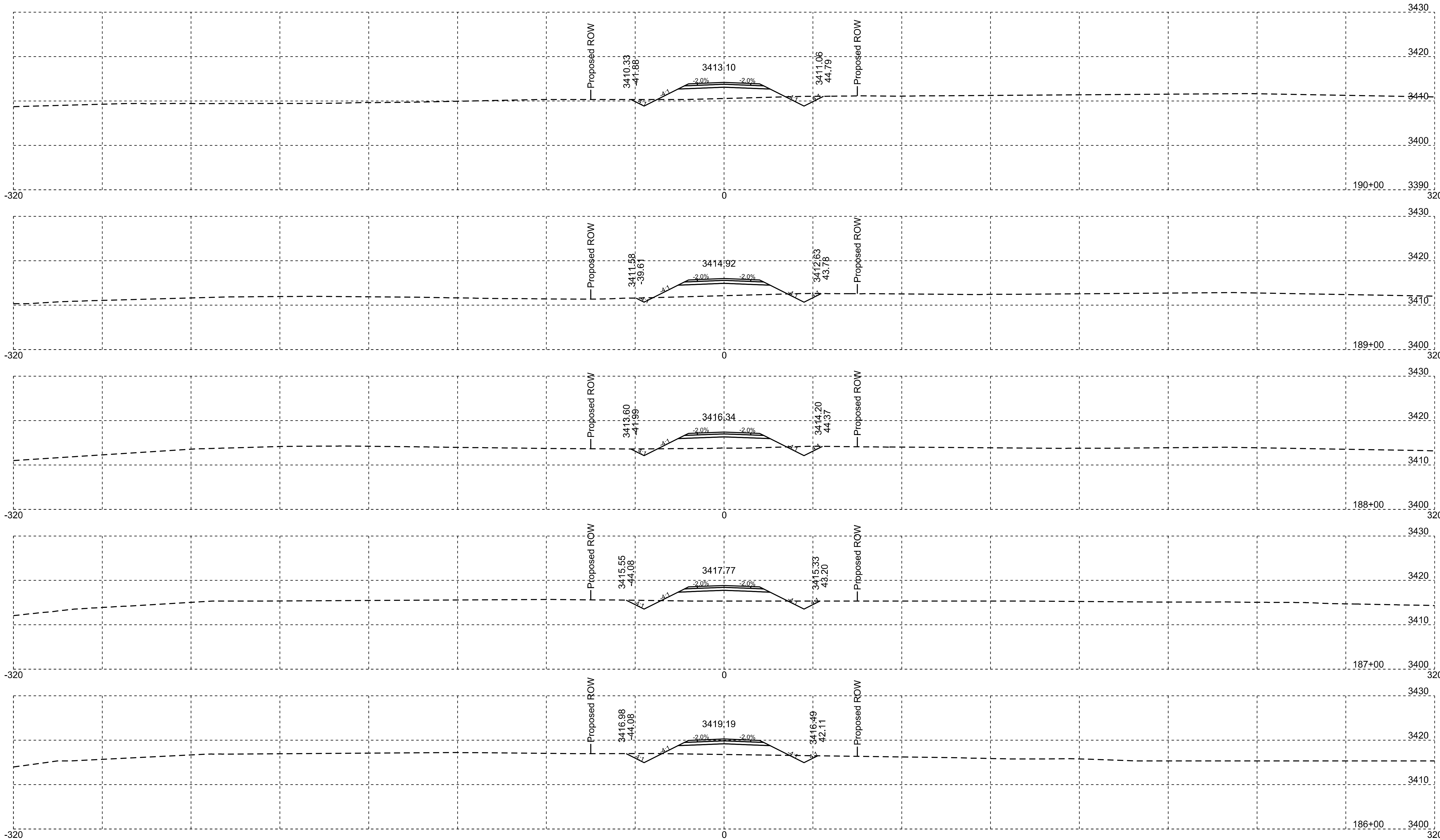




Alternative 4

Plotting Date: 6/25/2019

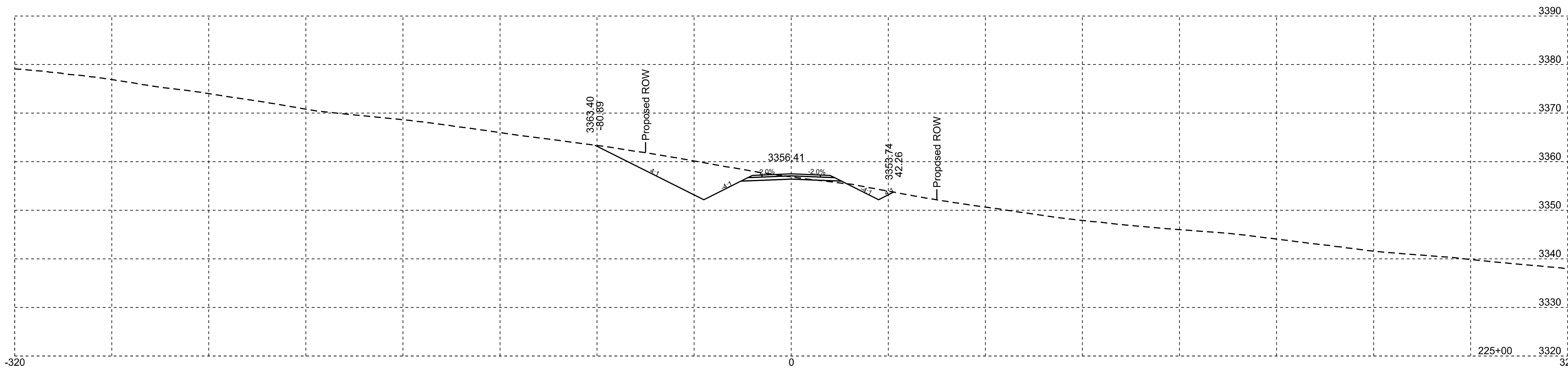
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

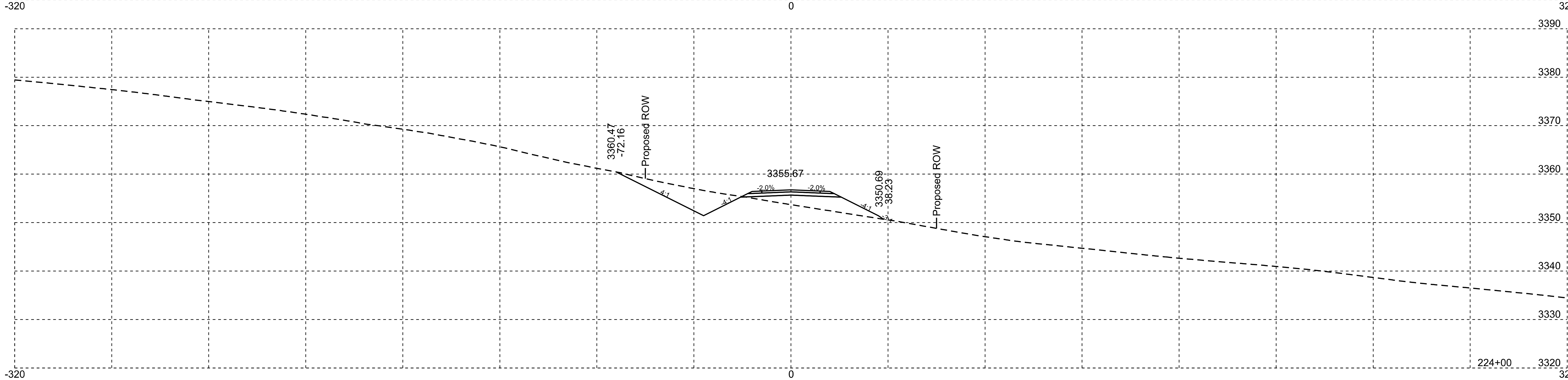


Alternative 4

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

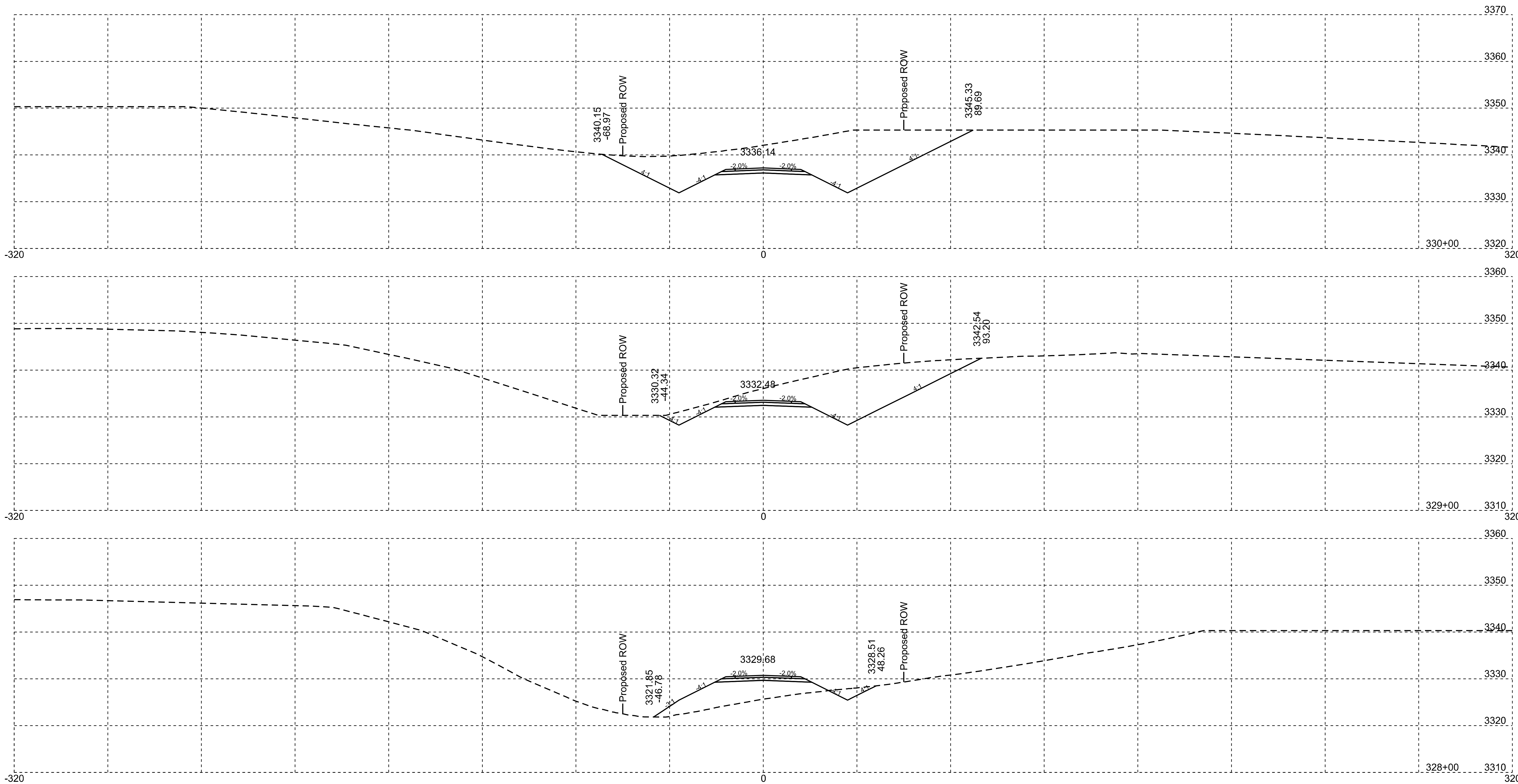




Alternative 4

Plotting Date: 6/25/2019

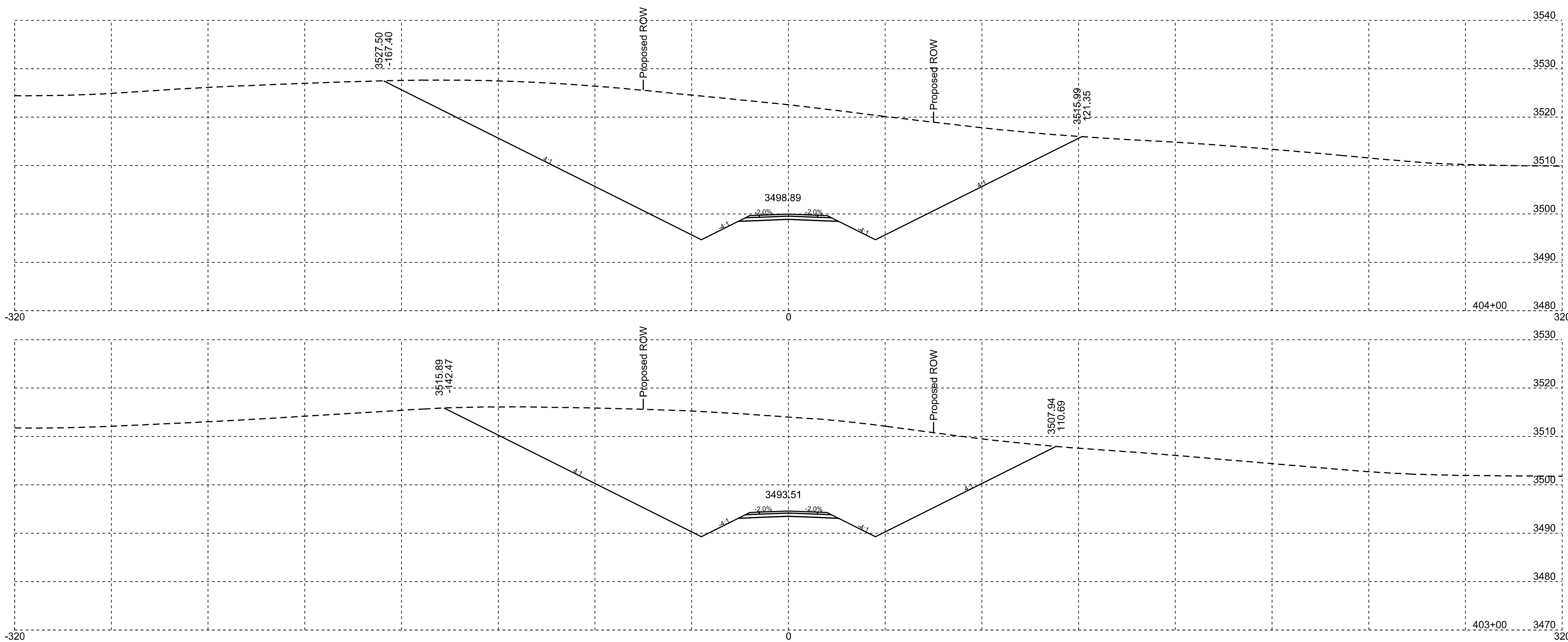
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS



Alternative 5

Plotting Date: 6/25/2019

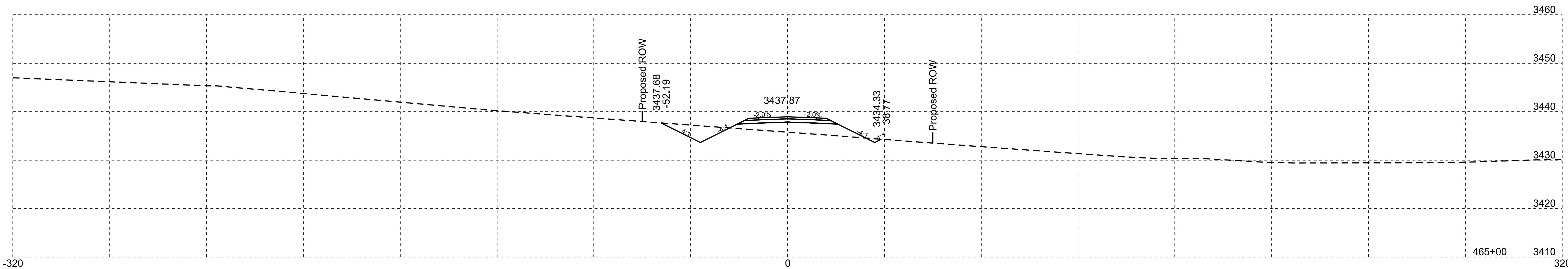
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

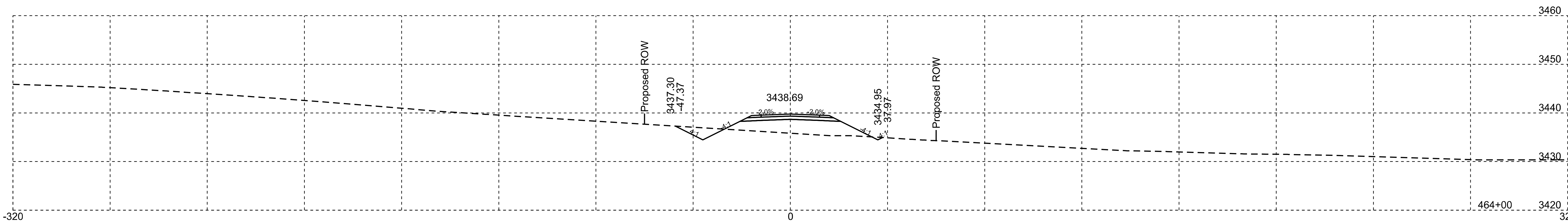


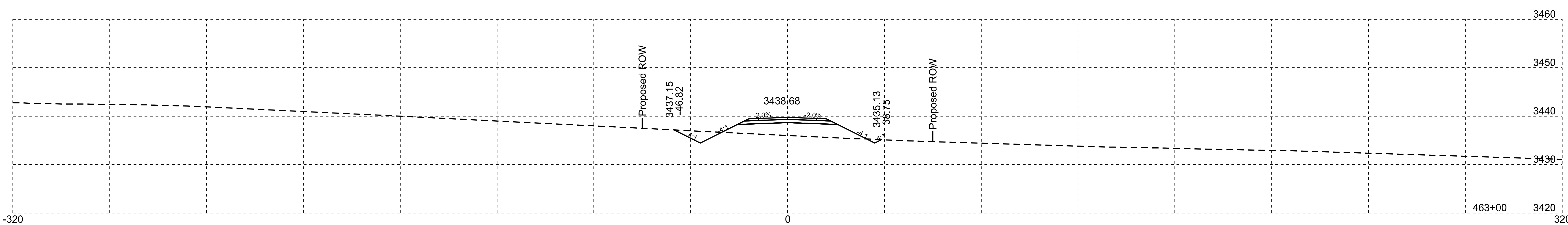
Alternative 5

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS



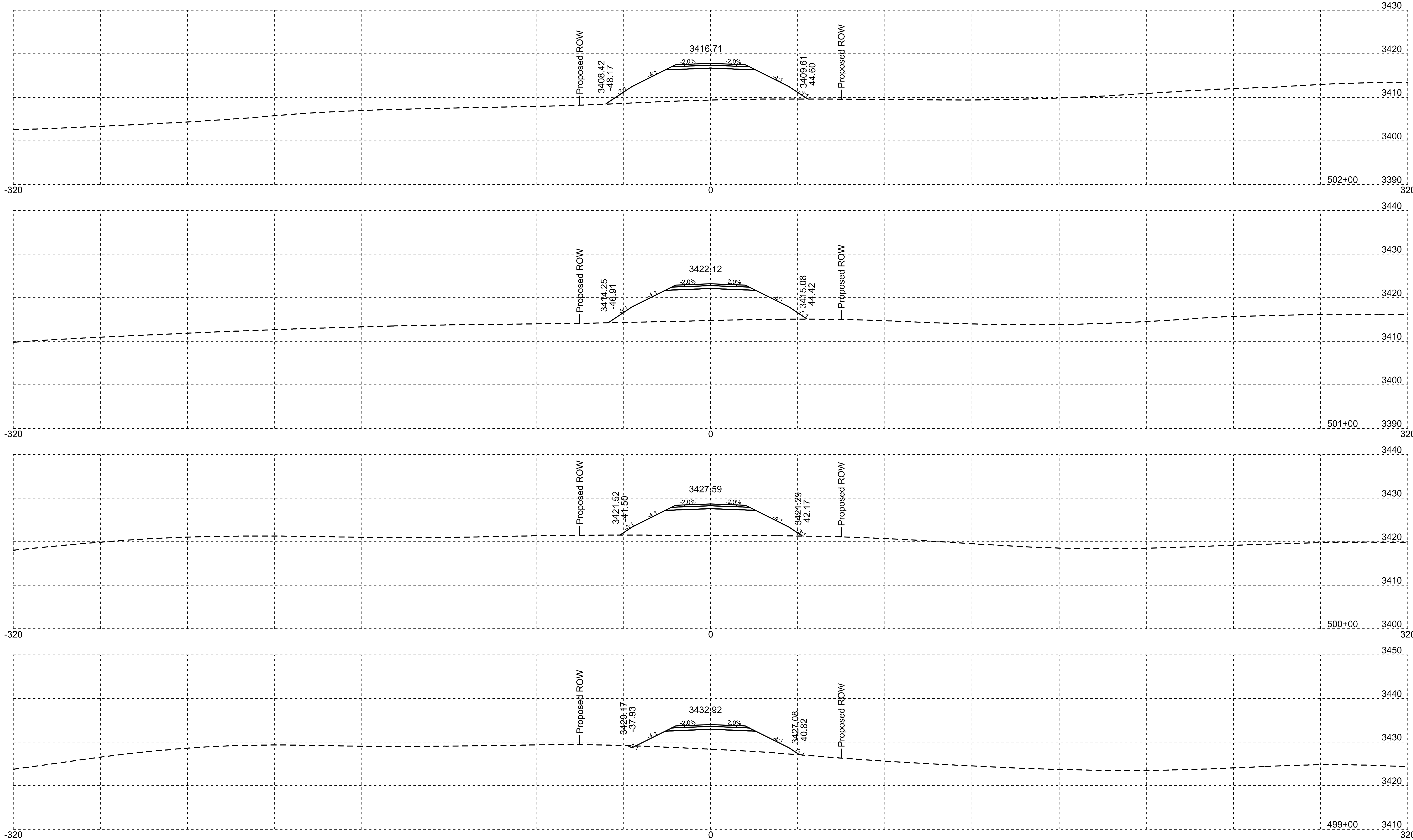




Alternative 5

Plotting Date: 6/25/2019

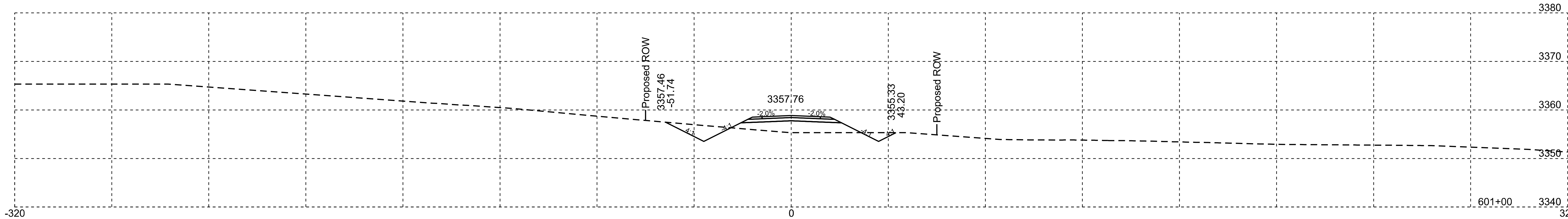
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

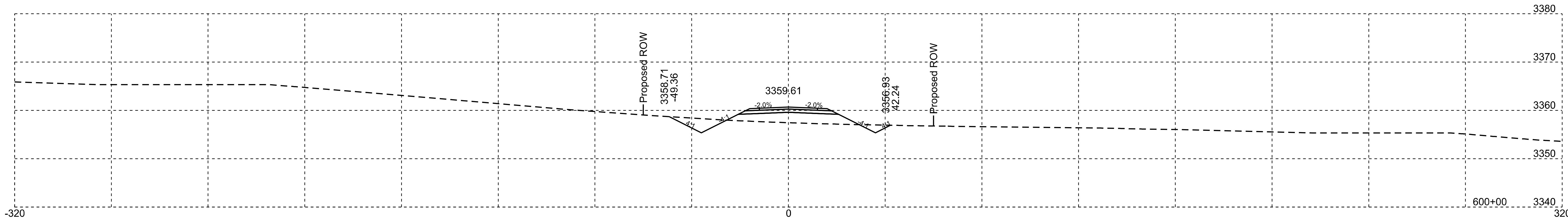


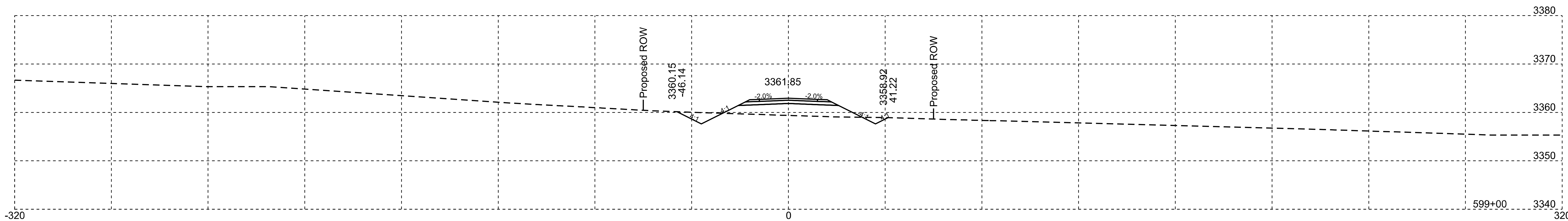
Alternative 5

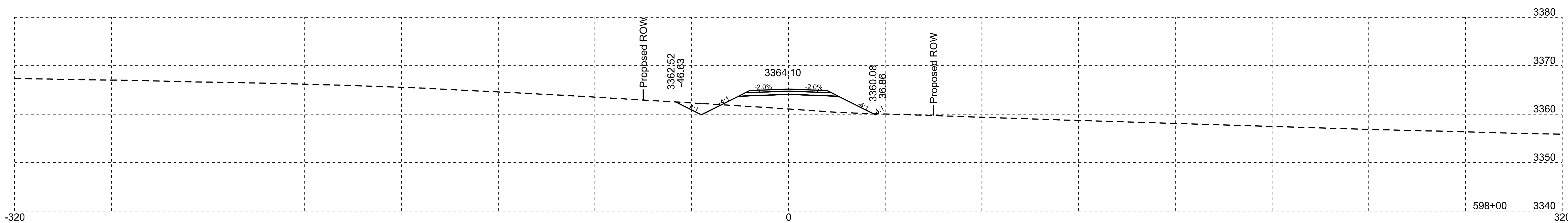
Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS





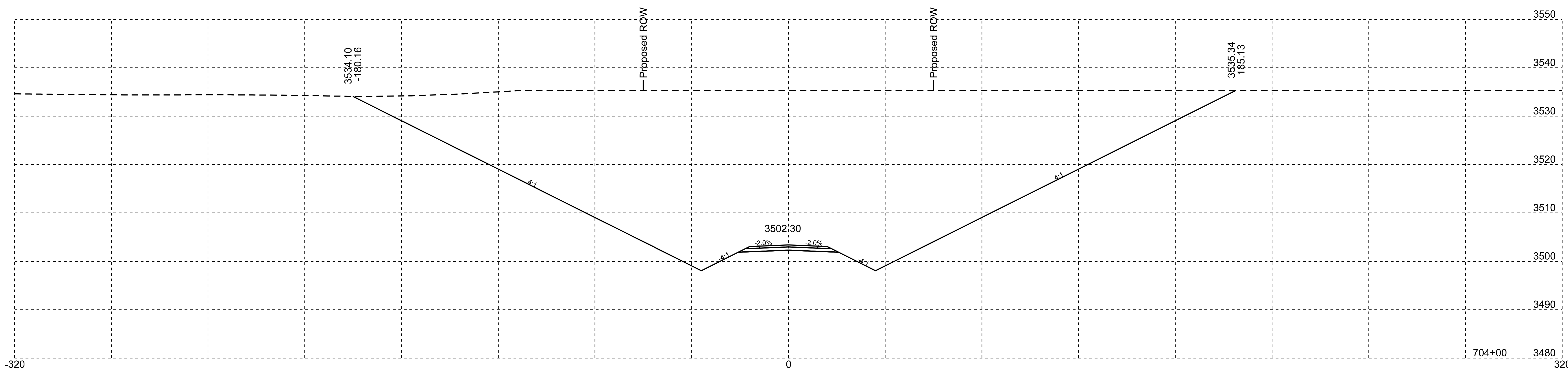


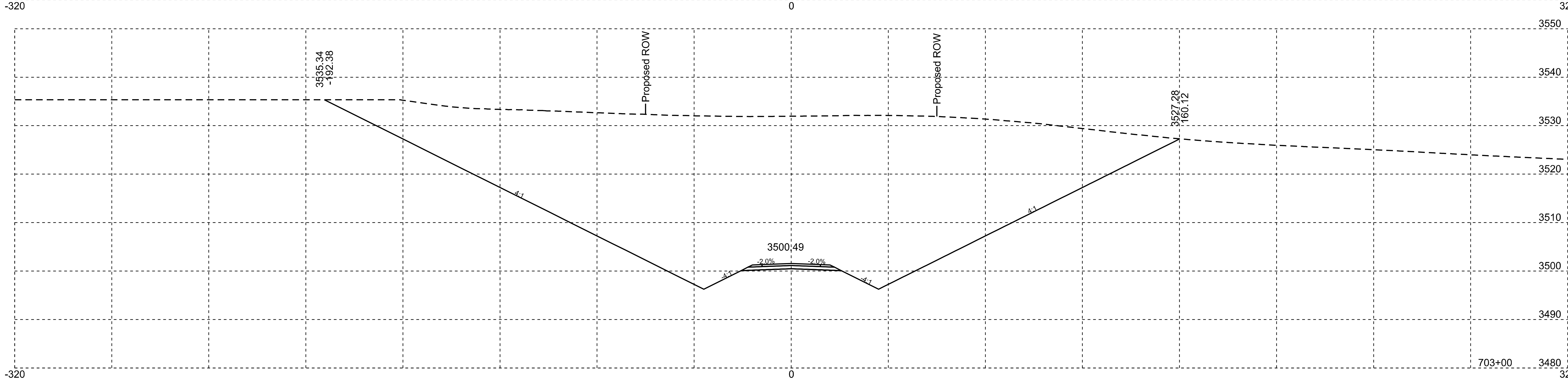


Alternative 6

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

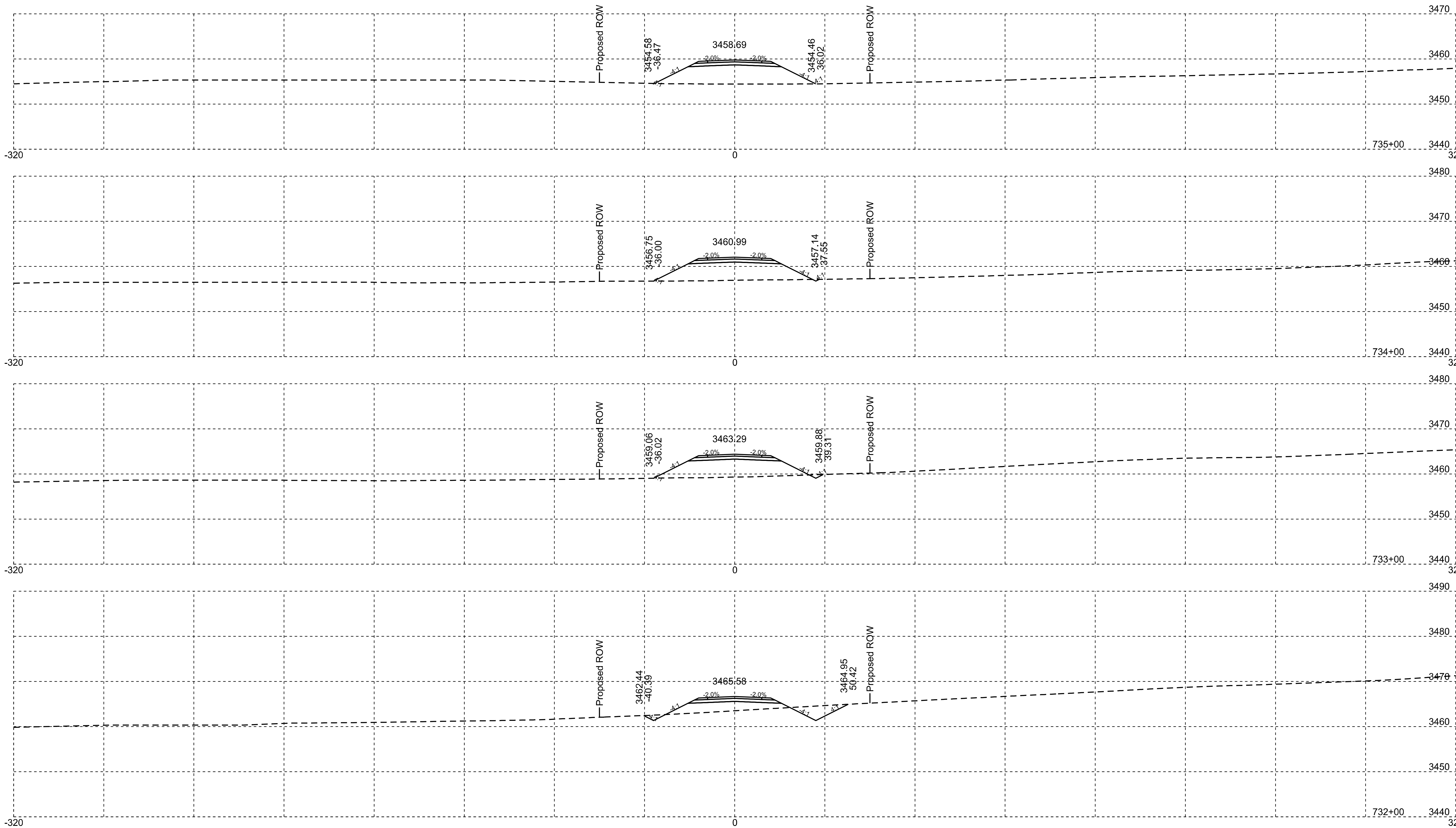




Alternative 6

Plotting Date: 6/25/2019

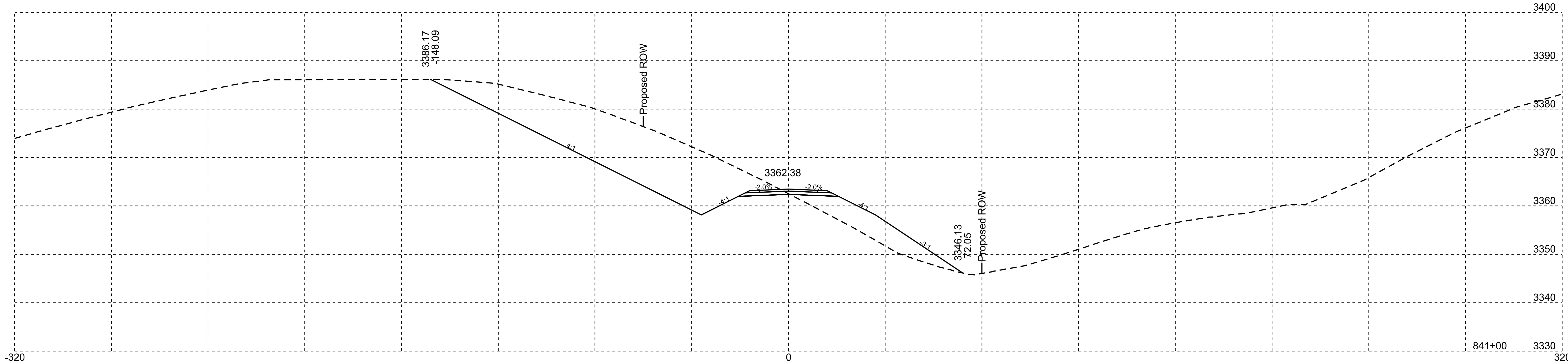
STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

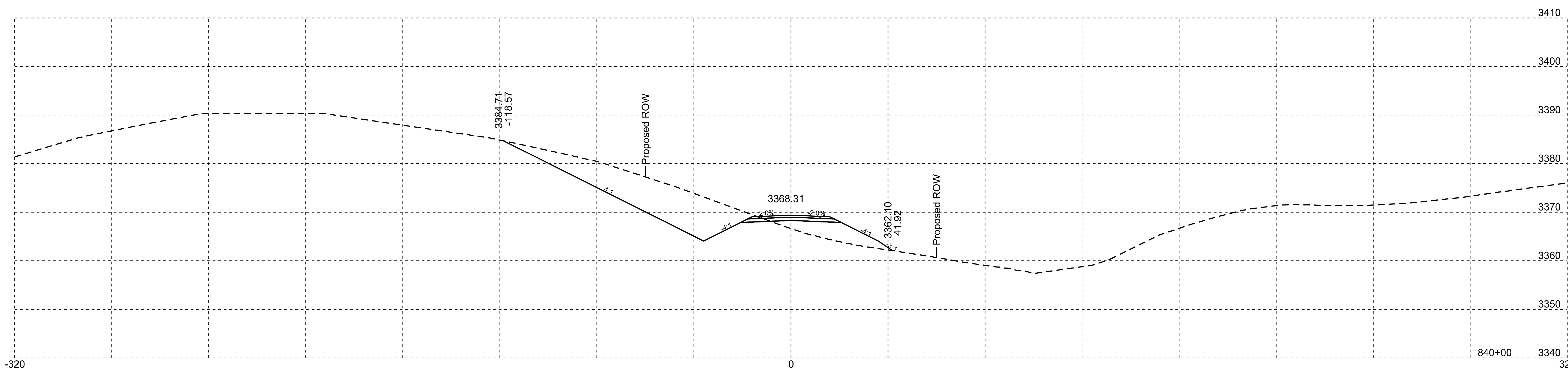


Alternative 6

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS

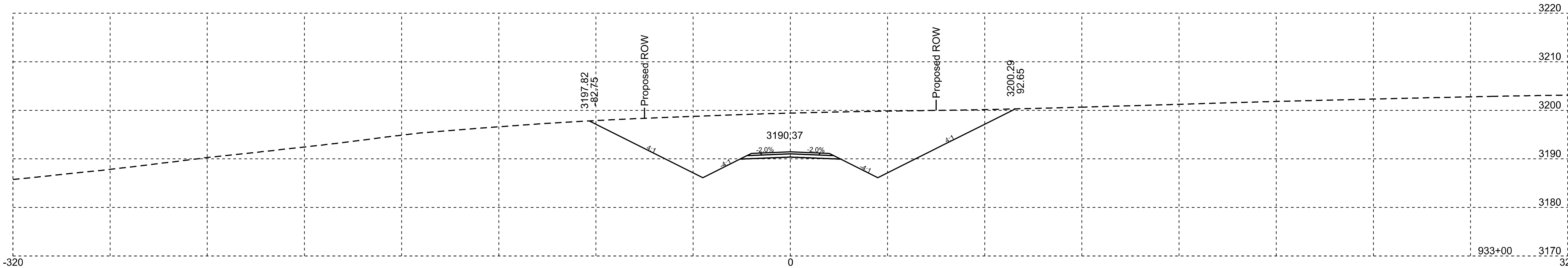


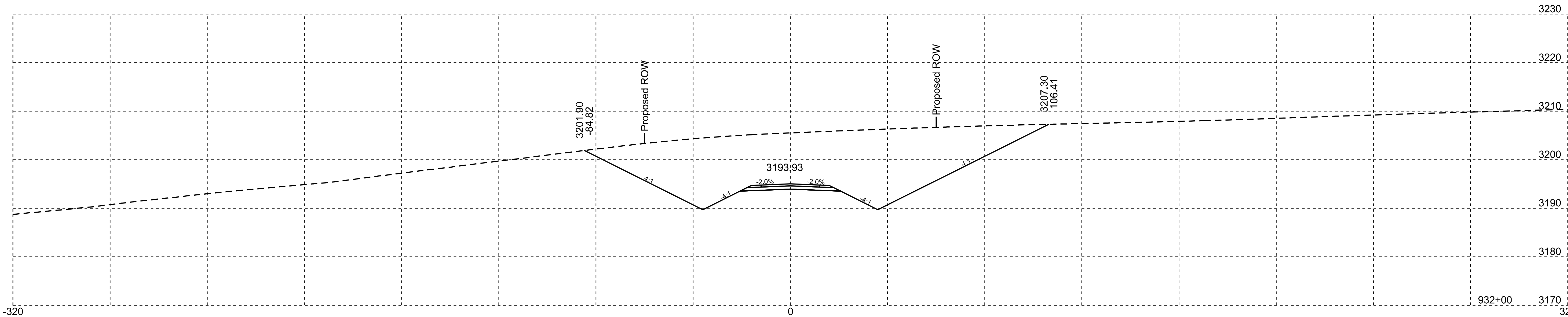


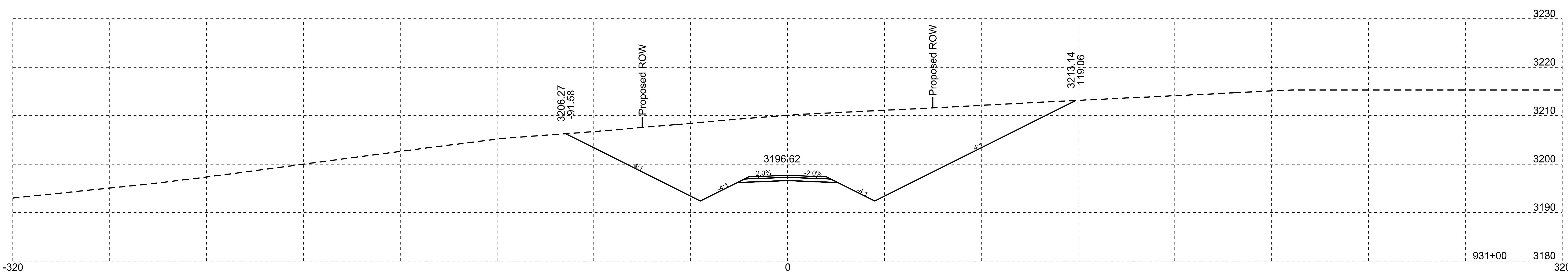
Alternative 6

Plotting Date: 6/25/2019

STATE OF SOUTH DAKOTA	PROJECT	SHEET	TOTAL SHEETS







Appendix C. Comparative Construction Cost Estimates

Comparitive Construction Cost Estimate

5-Aug-19

ALTERNATIVE 4

ITEM DESCRIPTION	UNIT	SEGMENT A EST QUANTITY	SEGMENT B EST QUANTITY	UNIT PRICE	SEGMENT A COST	SEGMENT B COST
Mobilization	LS	Lump Sum	Lump Sum	-	$ 500,000	$ 130,000
Clearing	LS	Lump Sum	Lump Sum	-	$ 20,000	$ 20,000
Construction Staking	LS	Lump Sum	Lump Sum	-	$ 15,000	$ 15,000
Remove Fence	Ft	491	1,634	$3.00	$ 1,473	$ 4,902
Placing Topsoil	CuYd	25009	24724	$2.50	$ 62,523	$ 61,810
Common Excavation	CuYd	201977	52824	$3.70	$ 747,313	$ 195,450
Water for Embankment	MGal	4040	1056	$20.00	$ 80,800	$ 21,120
Undercutting	CuYd	11528	10261	$4.00	$ 46,112	$ 41,044
Base Course	Ton	18444	0	$20.00	$ 368,888	$ -
Gravel Surfacing	Ton	0	13853	$21.00	$ -	$ 290,903
Magnesium Chloride	Mi	0	2.10	$8,000.00	$ -	$ 16,791
Asphalt Concrete Composite	Ton	13833	0	$110.00	$ 1,521,663	$ -
36" RCP Class 3, Furnish	Ft	850	1392	$60.00	$ 51,000	$ 83,520
36" RCP, Install	Ft	850	1392	$60.00	$ 51,000	$ 83,520
36" RCP Flared End, Furnish	Each	16	14	$700.00	$ 11,200	$ 9,800
36" RCP Flared End, Install	Each	16	14	$400.00	$ 6,400	$ 5,600
Right-of-Way Fence	Ft	24900	22164	$3.00	$ 74,700	$ 66,492
4"x4" Amber Delineator with 1.12 Lb/Ft Post	Each	125	111	$35.00	$ 4,375	$ 3,885
Type 2 Object Marker Back to Back	Each	16	14	$35.00	$ 560	$ 490
Flat Aluminum Sign, Nonremovable Copy High	SqFt	594	761	$14.50	$ 8,613	$ 11,035
2.0"x2.0" Perforated Tube Post	Ft	680	760	$12.00	$ 8,160	$ 9,120
Pavement Marking Paint, 4" Yellow	Ft	24900	0	$0.25	$ 6,225	$ -
Pavement Marking Paint, 4" White	Ft	24900	0	$0.30	$ 7,470	$ -
Class B Riprap	Ton	196	172	$40.00	$ 7,840	$ 6,880
Permanent Seed Mixture	Lb	568	585	$20.00	$ 11,360	$ 11,700
Fertilizing	Ton	1.1	1.2	$1,120.00	$ 1,232	$ 1,344
Mulching	Ton	32.8	33.8	$220.00	$ 7,216	$ 7,436
Erosion Control	LS	Lump Sum	Lump Sum	-	$ 60,000	$ 60,000
Temporary Traffic Control	LS	Lump Sum	Lump Sum	-	$ 25,000	$ 10,000
Reconstruction of Intersecting Roadway	Mi	0.34	0	$2,200,000.00	$ 750,000	$ -
				SUBTOTAL	$ 4,456,123	$ 1,167,841

ALTERNATIVE 5

ITEM DESCRIPTION	UNIT	SEGMENT A EST QUANTITY	SEGMENT B EST QUANTITY	UNIT PRICE	SEGMENT A COST	SEGMENT B COST
Mobilization	LS	Lump Sum	Lump Sum	-	$ 420,000	$ 130,000
Clearing	LS	Lump Sum	Lump Sum	-	$ 20,000	$ 20,000
Construction Staking	LS	Lump Sum	Lump Sum	-	$ 15,000	$ 15,000
Remove Fence	Ft	558	1,627	$3.00	$ 1,674	$ 4,881
Placing Topsoil	CuYd	28238	21494	$2.50	$ 70,595	$ 53,735
Common Excavation	CuYd	235773	64603	$3.70	$ 872,359	$ 239,031
Water for Embankment	MGal	4715	1292	$20.00	$ 94,300	$ 25,840
Undercutting	CuYd	11211	10181	$4.00	$ 44,844	$ 40,724
Base Course	Ton	17938	0	$20.00	$ 358,756	$ -
Gravel Surfacing	Ton	0	13,744	$21.00	$ -	$ 288,620
Magnesium Chloride	Mi	0	2.08	$8,000.00	$ -	$ 16,659
Asphalt Concrete Composite	Ton	13453	0	$110.00	$ 1,479,863	$ -
36" RCP Class 3, Furnish	Ft	1448	1038	$60.00	$ 86,880	$ 62,280
36" RCP, Install	Ft	1448	1038	$60.00	$ 86,880	$ 62,280
36" RCP Flared End, Furnish	Each	16	14	$700.00	$ 11,200	$ 9,800
36" RCP Flared End, Install	Each	16	14	$400.00	$ 6,400	$ 5,600
Right-of-Way Fence	Ft	24216	21990	$3.00	$ 72,648	$ 65,970
4"x4" Amber Delineator with 1.12 Lb/Ft Post	Each	122	110	$35.00	$ 4,270	$ 3,850
Type 2 Object Marker Back to Back	Each	16	14	$35.00	$ 560	$ 490
Flat Aluminum Sign, Nonremovable Copy High	SqFt	624	731	$14.50	$ 9,048	$ 10,600
2.0"x2.0" Perforated Tube Post	Ft	680	760	$12.00	$ 8,160	$ 9,120
Pavement Marking Paint, 4" Yellow	Ft	24216	0	$0.25	$ 6,054	$ -
Pavement Marking Paint, 4" White	Ft	24216	0	$0.30	$ 7,265	$ -
Class B Riprap	Ton	196	172	$40.00	$ 7,840	$ 6,880
Permanent Seed Mixture	Lb	679	483	$20.00	$ 13,580	$ 9,660
Fertilizing	Ton	1.4	1	$1,120.00	$ 1,568	$ 1,120
Mulching	Ton	39.2	27.9	$220.00	$ 8,624	$ 6,138
Erosion Control	LS	Lump Sum	Lump Sum	-	$ 60,000	$ 60,000
Temporary Traffic Control	LS	Lump Sum	Lump Sum	-	$ 10,000	$ 10,000
Reconstruction of Intersecting Roadway	Mi	0	0	$2,200,000.00	$ -	$ -
					$ 3,778,368	$ 1,158,277

ALTERNATIVE 6

ITEM DESCRIPTION	UNIT	SEGMENT A EST QUANTITY	SEGMENT B EST QUANTITY	UNIT PRICE	SEGMENT A COST	SEGMENT B COST
Mobilization	LS	Lump Sum	Lump Sum	-	$ 570,000	$ 260,000
Clearing	LS	Lump Sum	Lump Sum	-	$ 20,000	$ 20,000
Construction Staking	LS	Lump Sum	Lump Sum	-	$ 15,000	$ 15,000
Remove Fence	Ft	2456	5,767	$3.00	$ 7,368	$ 17,301
Placing Topsoil	CuYd	31893	29833	$2.50	$ 79,733	$ 74,583
Common Excavation	CuYd	498138	271301	$3.70	$ 1,843,109	$ 1,003,814
Water for Embankment	MGal	9963	5426	$20.00	$ 199,260	$ 108,520
Undercutting	CuYd	12090	9879	$4.00	$ 48,360	$ 39,516
Base Course	Ton	19344	0	$20.00	$ 386,874	$ -
Gravel Surfacing	Ton	0	13336	$21.00	$ -	$ 280,062
Magnesium Chloride	Mi	0	2.02	$8,000.00	$ -	$ 16,165
Asphalt Concrete Composite	Ton	14508	0	$110.00	$ 1,595,858	$ -
36" RCP Class 3, Furnish	Ft	1116	1944	$60.00	$ 66,960	$ 116,640
36" RCP, Install	Ft	1116	1944	$60.00	$ 66,960	$ 116,640
36" RCP Flared End, Furnish	Each	16	18	$700.00	$ 11,200	$ 12,600
36" RCP Flared End, Install	Each	16	18	$400.00	$ 6,400	$ 7,200
Right-of-Way Fence	Ft	26114	21338	$3.00	$ 78,342	$ 64,014
4"x4" Amber Delineator with 1.12 Lb/Ft Post	Each	131	107	$35.00	$ 4,585	$ 3,745
Type 2 Object Marker Back to Back	Each	16	18	$35.00	$ 560	$ 630
Flat Aluminum Sign, Nonremovable Copy High	SqFt	579	382	$14.50	$ 8,396	$ 5,539
2.0"x2.0" Perforated Tube Post	Ft	680	600	$12.00	$ 8,160	$ 7,200
Pavement Marking Paint, 4" Yellow	Ft	26114	0	$0.25	$ 6,529	$ -
Pavement Marking Paint, 4" White	Ft	26114	0	$0.30	$ 7,834	$ -
Class B Riprap	Ton	196	220	$40.00	$ 7,840	$ 8,800
Permanent Seed Mixture	Lb	779	758	$20.00	$ 15,580	$ 15,160
Fertilizing	Ton	1.5	1.5	$1,120.00	$ 1,680	$ 1,680
Mulching	Ton	45	43.8	$220.00	$ 9,900	$ 9,636
Erosion Control	LS	Lump Sum	Lump Sum	-	$ 60,000	$ 60,000
Temporary Traffic Control	LS	Lump Sum	Lump Sum	-	$ 10,000	$ 10,000
Reconstruction of Intersecting Roadway	Mi	0	0	$2,200,000.00	$ -	$ -
					$ 5,136,487	$ 2,274,445

	Alternative 4 Segment A	Alternative 4 Segment B	Alternative 5 Segment A	Alternative 5 Segment B	Alternative 6 Segment A	Alternative 6 Segment B
TOTAL	$ 4,456,122.66	$ 1,167,841.37	$ 3,778,367.64	$ 1,158,277.34	$ 5,136,486.75	$ 2,274,444.54
CONTINGENCY (40%)	$ 1,782,449.00	$ 467,137.00	$ 1,511,347.00	$ 463,311.00	$ 2,054,595.00	$ 909,778.00
2019 TOTAL CONSTRUCTION COST	$ 6,238,572	$ 1,634,978	$ 5,289,715	$ 1,621,588	$ 7,191,082	$ 3,184,223
2019 TOTAL CONSTRUCTION COST (A+B)	$ 7,873,550.04		$ 6,911,302.98		$ 10,375,304.29	