Appendix I
Wildlife Crossings
Analysis and Recommendations

STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA

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ABBREVIATIONS AND ACRONYMS

Borough	Kenai Peninsula Borough
DOT&PF	Alaska Department of Transportation and Public Facilities
Draft SEIS	Draft Supplementary Environmental Impact Statement
EIS	Environmental Impact Statement
Final EIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
Forest Service	Forest Service, U.S. Department of Agriculture
MP	Milepost or mile point
ROD	Record of Decision
SMU	State Management Unit
USFWS	U.S. Fish and Wildlife Service

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1 Introduction and Summary of Recommendations

In the Sterling Highway Milepost (MP) 45–60 Draft Supplemental Environmental Impact Statement (Draft SEIS; March 2015), the Alaska Department of Transportation and Public Facilities (DOT&PF) and the Federal Highway Administration (FHWA) committed to providing wildlife crossing structures as mitigation for wildlife impacts. The Draft SEIS committed to providing further information regarding wildlife crossings in the Final Environmental Impact Statement (Final EIS). The focus of this document is to identify proposed crossing structure locations based on the modeling results of the wildlife mitigation study as well as other relevant information (see Section 3).

This document identifies likely wildlife movement corridors and potential locations of wildlife crossing structures for the project's four "build" alternatives. Maps 1 through 11, at the end of this document, illustrate primary habitat use and movement corridors for six focal species as well as wildlife-vehicle collision data. Based on this information, the results of a camera trap study (Map 12), and expert knowledge, a number of potential wildlife crossing structures were identified for the Cooper Creek, G South, Juneau Creek, and Juneau Creek Variant Alternatives (Map 13). This document provides an assessment of each potential wildlife crossing structure and recommends a subset for further consideration.

summarizes the recommended wildlife crossing structures (with location numbers keyed to the maps) and provides an overall cost estimate for wildlife mitigation based on these crossings (note that the recommended structures for the two Juneau Creek alternatives are the same and are listed in a single column).

The following sections address the process used to arrive at these recommendations. Section 3 summarizes the methodology used to assess wildlife habitat use and movement that led to the selection of potential crossing locations. Section 4 summarizes the information available for each of the six focal species and references the report, *Habitat Use and Movement Patterns of Focal Species on the Kenai Peninsula, Alaska, USA* (Suring et al. 2017). Section 5 discusses the design criteria and estimated costs for the crossing structures. Sections 6, 7, and 8 address the crossing structures and other recommended wildlife mitigation measures in detail, including their estimated costs. Preliminary design drawings for some of the structures are provided in Appendix A.

Table 1. Summary of recommended wildlife crossing structures by alternative

	Cooper Creek	G South	Juneau Creek (both alternatives)
Dedicated Wildlife Crossings (location numbers)	6, 7, 22, 24	13, 22, 24	9, 20, 22, 24
Bridges with Wildlife Crossings (location names/numbers)	4, 5, 14, 15, and Cooper Cr. Bridge	11, 12, 14, 15, and Juneau Cr. Bridge (Lower)	Juneau Cr. Bridge (Upper)
Cost Range[a]	\$2.1–\$5.8 million	\$2.1–\$5.4 million	\$4.0–\$7.3 million
25% Set-aside for Additional Wildlife Mitigation[c]	\$520,000–\$4.5 million	\$535,000–\$1.4 million	\$1.0–\$1.8 million
Post-construction Monitoring	\$200,000	\$200,000	\$200,000
Grand Total for Recommended Wildlife Mitigation	**\$722,000–\$7.5 million**	**\$2.7–\$5.9 million**	**\$5.6 –\$9.7 million**

[a] Cost range is based on the range of structure types examined for dedicated wildlife crossings. Included in the cost shown is the estimated cost for the extension of Schooner Bend Bridge (Crossings #14 and #15; Cooper Creek and G South Alternatives only), which was not expressed as a range. Earthwork required at some locations also is included. See Section 7.2 for detailed costs for each recommended crossing for each alternative.

[b] Average cost is based on an average of the lowest and highest cost structure options examined at each crossing site noted, plus any substantial earthwork required (e.g., to raise the road surface).

[c] The set-aside is a reasonable estimate of other costs, such as additional smaller dry culverts for smaller animals, revegetation/cover for animals at structure entrances, diversions, signs, and other mitigation efforts that may be recommended but are not based on any quantities or formal proposal or estimates at this time.

2 Background

The purpose of this document is to explain the process used to identify locations for grade-separated wildlife crossings, and to make recommendations regarding which structures to include as mitigation.

A wildlife mitigation study (*Habitat Use and Movement Patterns of Focal Species on the Kenai Peninsula, Alaska, USA*; Suring et al. 2017) was completed to model potential locations for suitable crossings in the project area based on wildlife habitats and movement corridors. Originally, DOT&PF and FHWA had intended to complete the modeling study during the design phase after the Final EIS and Record of Decision (ROD). As part of project mitigation, the schedule has been advanced based on agency input to incorporate the study results into the mitigation discussion of the Final EIS and ROD.

The focus of this document is to identify proposed crossing structure locations based on the modeling results of the wildlife mitigation study. The modeling results were used along with various other geospatial data, camera trap study results, and various other information sources to identify recommended crossings for each of the alternatives. Wildlife crossing structures are intended to maintain connectivity of wildlife habitat and minimize wildlife-vehicle collisions.

The aim for the Final EIS is to identify the scope, types, and locations of potential wildlife mitigation and to include cost estimates so that all parties can see the financial and physical commitments before FHWA issues a ROD. The locations and types of crossings identified are preliminary. Particularly the structure type and exact location are anticipated to be modified or refined during project design.

3 Methodology

The identification of potential wildlife crossing structures and mitigation locations relied on several sources of information, including geospatial datasets, empirical wildlife field studies, expert knowledge, and highway engineering. Some of the primary data sources used are briefly described in the following paragraphs.

Wildlife habitat and movement modeling was conducted by Suring et al. (2017) based on a study plan developed in concert with biologists from ADF&G, Forest Service, and USFWS. This peer-reviewed study was intended to identify wildlife habitat associations and movement patterns in the project area as a means of identifying potential mitigation locations. The resulting datasets calculated the probability of wildlife movement and habitat use for six focal species: brown bear, black bear, moose, Canada lynx, Dall sheep, and wolverine. Potential limitations for use of the data are the broad scale at which the data are presented and the inability to predict changes in wildlife movement as a result of different build alternatives. Suring et al. (2017) recommended broad areas of the project area for wildlife mitigation on a scale of 1 to 4 miles wide, but the data are not refined enough to identify specific locations on the landscape for crossing structures.

A **wildlife camera trap study** was completed in conjunction with the wildlife habitat and movement modeling, and provided for model calibration and an empirical verification of the model outputs. A total of 43 remote wildlife cameras were distributed throughout the project area (Map 12) between October 2015 and November 2016. Of the six focal species, brown bear, black bear, moose, and Canada lynx were captured at the camera traps. The results of the camera trap study were used to support crossing structure locations at a more refined scale than is possible with the completed wildlife modeling on its own. The results are limited, however, to confirmed locations of high wildlife activity and should not be relied upon to identify locations of low wildlife activity (see Chapter 12 of Suring et al. 2017). Furthermore, the distribution of camera traps was intended to calibrate the model for the focal species, and the camera traps were located near the existing highway for convenience. As such, they were not intended to provide coverage of the new-build portions of the alternatives.

Wildlife-vehicle collision data were provided by DOT&PF. The dataset represents locations of vehicular accidents involving wildlife that were reported by Alaska State Troopers between 2000 and 2009. This information provides relatively fine scale crossing information, but it is important to note that attributes of the highway and drivers also influence collisions and that collision locations may not represent the areas where wildlife safely cross the highway most often. In addition, this dataset is limited to the existing highway.

Other geospatial datasets such as (but not limited to) topography, vegetation, buildings, roads, trails, and land ownership were considered during identification and evaluation of potential crossing locations.

Expert knowledge included comments by U.S. Fish and Wildlife Service (USFWS) and Forest Service, U.S. Department of Agriculture (Forest Service), wildlife biologists on the Preliminary Final EIS. In addition, the HDR field biologists who conducted the wildlife camera trap study provided insights based on their field experiences.

Highway engineers provided valuable information on the applicability of potential crossing locations and the design of potential crossing structures.

In Section 6, each potential crossing structure location is evaluated in the context of these different data sources, where applicable.

4 Wildlife Habitat Use and Movement

The wildlife modeling examined habitat suitability and habitat connectivity based on a variety of empirical and theoretical model inputs (Suring et al. 2017). Habitat suitability is based largely on available telemetry data and known habitat preferences. Other model inputs include landscape features such as slope, aspect, and elevation. Anthropogenic features, such as existing roads, trails, and buildings, were also included in most models. Connectivity analyses examined "least cost corridors" where the combination of distance, habitat type, low human development, and other landscape features best connected areas of core habitat. Similarly, using a model analogous to electric current, the "pinch point" maps determined connectivity through areas of "high circuit current" where resistance to wildlife movement is lowest. Pinch points are locations where relatively high densities of wildlife may be expected due to restrictions in movement between core habitats. The model outputs for wildlife habitat and movement are not always cohesive with one another. Habitat suitability and connectivity maps for each focal species are provided in Suring et al. (2017). For the purposes of evaluating potential wildlife crossing and mitigation locations, HDR focused on least cost corridor and pinch point models overlain with other geospatial datasets and considered in conjunction with other information described in Section 3.

For most species, movement throughout the project area is widespread and random, and generally occurs on a gradient. The corridors shown in Maps 1 through 11 and in Suring et al. (2017) are displayed in a way that highlights the areas of highest probability for wildlife habitat use and movement. However, the probability for occurrence is not normally distributed across the landscape, and areas shown in lighter colors may not actually be significantly different than the observed centers of corridors. In addition, any number of small-scale landscape features, such as minor drainages, forest openings, or old logging roads, may disproportionately affect wildlife movement and distribution.

This analysis focuses on ways to maintain permeability by providing grade-separated wildlife crossing opportunities. The emphasis is on identifying crossings in the best possible locations for the greatest use by wildlife because each crossing could cost between half a million and several million dollars. Therefore, the focus is on the clearest crossing locations indicated in the data. Ideally, crossing locations would benefit the greatest number of individuals of multiple species. However, multi-species movement corridors are difficult to design due to the divergent behavioral characteristics and habitat preferences of some species (Suring et al. 2017).

Of the six focal species for which modeling was conducted, model confidence is highest for brown bear and black bear. Although the model confidence for moose was not high, additional data from the camera trap study and moose-collision data have been used to supplement the model, and provide a good understanding of moose habitat use and movement in the project area. Brown bear, black bear, and moose were the most commonly observed wildlife at camera traps in the project area. Furthermore, these three species pose the greatest risk of wildlife-vehicle collisions. As such, the modeling for these three species was given higher priority during selection of potential crossing locations than Canada lynx, Dall sheep, and wolverine, although these species were also considered at each crossing location. Lynx, sheep, and wolverine are less abundant in the project area and less likely to cross the highway on a regular basis. Conversely, impacts to core habitat and habitat connectivity may result in disproportionately greater effects to these species due to their limited population size.

The following subsections describe habitat use and movement corridors for each of the six focal species. Section 6 concentrates the analysis on 12 segments associated with the project's alternative alignments and identifies potential crossing locations within each segment.

4.1 Brown Bear

Brown bear foraging habitat in the project area is closely associated with anadromous fish (salmon) streams and lakes. Least cost travel corridors and pinch points are generally adjacent to or connecting these waterbodies within riparian vegetation (Chapter 3 of Suring et al. 2017). The only exception is brown bears with cubs in the summer, which are more widely distributed to avoid conflicts with adult bears near salmon-bearing streams. Although brown bear presence is highly seasonal, the project area streams represent an abundant and important food source from mid-summer through autumn, which attracts high densities of brown bears.

Brown bear least cost corridors generally follow the Kenai River and its tributaries, including Jean Creek, Russian River, Juneau Creek, and Cooper Creek (Map 1). Based on a 2016 Monitoring Project Report, prepared for Chugach Electric by the Forest Service (dated March 24, 2017), while the number of fish entering Cooper Creek and moving upstream varies each year, Chinook, sockeye, coho, Dolly varden, rainbow trout, a few pink salmon, and even whitefish occur in Cooper Creek; however, no bears were observed in this drainage during the camera trap study (Camera S05; see Map 12). All other modeled corridors were strongly supported by the results of the camera trap study. Brown bears were observed in high densities along the Kenai River, Juneau Creek, and Russian River from mid-July through September. Another brown bear corridor extends from the Juneau Creek and Bean Creek area to the Quartz Creek area and provides a connection between these two important salmon-bearing streams (Map 1). Camera traps (N13 and N01; see Map 12) did not record significant brown bear travel along this corridor, but the locations of the camera traps may have been insufficient to capture activity in this widely dispersed travel corridor.

Brown bear pinch points, or areas of concentrated density during movement, are generally co-located with least cost corridors. Map 2 shows the combined highest value pinch point areas for brown bears in the summer with and without cubs, and spring with and without cubs. Figures detailing each season are provided in Suring et al. (2017).

4.2 Black Bear

Black bears generally avoid salmon-bearing streams, because brown bears easily out-compete them for resources. Therefore, core habitat in the project area maintains a minimum distance from anadromous fish streams and is confined to forested areas on mountain slopes and valleys. Black bear core habitat and least cost travel corridors are relatively well dispersed throughout the mid-elevations of the project area (Map 3). As a result, pinch points are less common than for other species and generally occur between core areas (Map 4). The camera trap study found that black bears were well dispersed throughout the project area. Cameras that recorded the highest number of brown bears, such as those immediately adjacent to anadromous fish streams, generally recorded the fewest black bears. Few cameras were located within modeled black bear pinch points and core habitat.

4.3 Moose

Moose habitat use and movement were modeled separately for all four seasons (Suring et al. 2017), and the model outputs vary greatly depending on season. Moose were observed at almost every one of the cameras during the camera trap study. However, the model outputs for moose were inconclusive when compared to the camera trap data; the camera trap data did not support or contradict the models. Based on camera trap data, there is a weak, but apparent, inverse relationship between the presence of brown bear and wolves (wolves generally occur along the Kenai River in the western half of the project area) and the presence of moose. Moose collisions are concentrated throughout the west half of the study area, but may be related as much to the nature of sight-lines on the existing highway as to actual moose distribution. To facilitate the identification of potential crossing locations, HDR combined model outputs for all seasons in Maps 5 and 6. Moose movement corridors generally link core habitat areas north and south of the existing highway and are influenced by pockets of high-quality moose habitat in the Kenai River valley.

In winter, a widely dispersed moose corridor exists between MP 55 and 58, as well as in the vicinity of MP 52. Winter pinch points generally approximate these corridors. In spring, there are well-defined moose movement corridors at MP 56 and 52. Pinch points are non-existent in spring. Summer moose movement corridors are centered on MP 56 and are well dispersed between MP 48 and MP 52. Pinch points in summer are generally present near MP 55 and 56, as well as the community of Cooper Landing. Autumn moose movement corridors are well defined at MP 56 and 48. Autumn pinch points are present between MP 47 and 50. Considering these seasonal movement corridors cumulatively, MP 56 stands out as a year-round high-use area for moose movement. As shown on Map 5, the moose-vehicle collision data do not match movement corridors exactly. The camera traps suggested widely dispersed use of the project area by moose. However, one camera that was tied for recording the most moose was located near MP 54, which does not show up strongly in the models.

4.4 Canada Lynx

The project area generally consists of high-quality habitat for Canada lynx (see Chapter 8 in Suring et al. 2017). Habitat use and movement is fairly homogenous throughout the area. The camera trap study recorded only 36 observations of lynx and did not identify any areas with high abundance compared to other areas. In general, Canada lynx were observed west of Cooper Landing and outside of areas with relatively high human presence. While they shift depending on sex and season, Canada lynx core habitats are located throughout the project area in the Kenai River valley and Juneau Creek valley. Pinch points were also generally wide, but varied by season (Chapter 9 in Suring et al. 2017). The combined least cost corridors for all seasons generally encompass the entire project area (Map 7).

4.5 Dall Sheep

Dall sheep core habitat generally consists of alpine meadows, tundra, and scree slopes. Least cost corridors (Map 8) and pinch points (Map 9) connect these core habitats. In winter, Dall sheep may descend into coniferous forests with dense canopies where there is less snow and browse is easier to access. Dall sheep, along with mountain goats, may on occasion cross low valleys to migrate between alpine core areas. No Dall sheep were observed during the camera trap study. This suggests that Dall sheep would rarely cross the existing highway or the four alternatives. However, the cameras were generally located outside of Dall sheep habitat. In addition, the winter of 2015–2016 was one of the warmest and driest on record, so it is unlikely that many sheep left their high-elevation habitat over the duration of the study. It may be relevant to note that mountain goats were observed at a camera trap near MP 45 in July 2016. Least cost movement corridors between core habitats were generally identified between MP 53 and 57 as well as between MP 47 and 50 (Map 8). Pinch points are generally located along the same portions of the project area (Map 9).

4.6 Wolverine

Wolverine core habitat consists of alpine tundra and was mapped both north and south of the project area. However, as carnivores, wolverines are habitat generalists that will pursue prey in most habitat types. The greatest limiting factor to wolverine habitat use is human presence, and they will tend to avoid roads, heavily used trails, and residential areas. Least cost corridors for wolverine were mapped by Suring et al. (2017) throughout most of the project area. Kenai Lake was the only significant obstruction to movement between core habitats (Map 10). Similarly, pinch points were inconclusive and suggest that wolverines could occur throughout the project area (Map 11). No wolverines were observed during the camera trap study.

5 Crossing Structure Design Criteria and Costs

This section describes the general design criteria and costs of wildlife crossing structures. This sets the stage for Section 6, which assesses each crossing location for its specific potential to accommodate a wildlife crossing structure that would meet the criteria. Appendix A includes preliminary engineering designs for a subset of the potential crossing locations identified in this document, and Appendix B provides cost estimates for a range of structure types at most potential crossing locations.

All alternatives would require similar types of highway crossings—either wildlife underpasses or overpasses—that would provide openings or surface dimensions sufficient for wildlife use. In the 2011 *Wildlife Crossing Structure Handbook*, FHWA provided guidance for basic structural dimensions of wildlife overpasses and underpasses that would be appropriate for brown bear and moose crossings (FHWA 2011):

- Wildlife overpass width: minimum 130–165 feet; recommended 165–230 feet[1]
- Wildlife underpass:
  - Horizontal opening (width): minimum 23 feet, recommended >32 feet
  - Vertical opening (height): minimum 13 feet, recommended >13 feet

The FHWA minimums were used as a starting point for this project and were expanded for Alaska conditions. For example, the USFWS recommended 18 feet for underpasses that would accommodate moose and the maximum reasonable width for all underpasses. Thus, for this effort, structure designs and cost estimates are based on:

- Wildlife overpass: minimum width 130 feet
- Wildlife underpass:
  - Minimum opening width 23 feet (as close to 32 feet as possible, depending on the limits of final structure type selected)
  - Minimum opening height >15 feet (ideally 18 feet for crossings intended for moose)

Wildlife crossings typically are structures involving walls, bridges, and arches, and such structures as retaining walls, bridges, and culverts tend to be expensive parts of transportation projects—much more expensive than a basic road embankment built on classified fill. Cost estimates for large mammal underpasses for this project are based on a range of possible solutions for wildlife passage beneath the highway, including deck bulb-T concrete highway bridge, steel box culvert, round steel pipe (to be partially filled to create a walking surface for animals), and pre-cast concrete arch concepts. Except for bridges, these structure types involve burying a wildlife crossing structure in the road embankment. Because of the side slopes of the embankment, structures would need to be much longer than the width of the highway pavement, or headwalls and wing walls would be necessary to provide a shorter passageway for wildlife and a more open entry/exit. However, headwalls and wing walls add considerably to the cost. Cost estimates in Appendix B show these differences, including illustrations of the cross-sections of the various structure types.

[1] Note that an overpass of this width for use by wildlife means a tunnel of this length for the highway.

It is likely that any buried structure would be built with headwalls and wing walls to shorten the passage for wildlife.

A steel arch running through the width of the fill footprint (and supported on a concrete pedestal wall foundation to gain height) appears to be the least costly option based on preliminary engineering, but such a structure would be quite long unless headwalls and wing walls were used at the openings. With a headwall and wing walls, a steel box, steel arch, or round steel pipe (the pipe partially filled to provide a natural base) would have similar costs, but the walls typically would add approximately $200,000 to a crossing, despite the shorter length of the passage. Round steel pipe can be a sort of compromise between full-length structures that need no walls and short-passage structures that use a headwall and wing-walls. This is because the round pipe can be cut to match the angle of the road embankment. A concrete "collar" would reinforce this cut area at approximately the same cost as a vertical headwall, and there would be no wing walls. The result would be an entry/exit area that was open overhead and partially closed on the sides. A bridge typically would provide the most open entry/exit, and the bridge options typically would cost the most. However, for horizontal opening widths approaching and exceeding the 32-foot width, the other options become more difficult or impossible, and the bridge option is likely to be best.

The cost estimates in Appendix B do not include fencing or other means of directing wildlife to structures or away from the highway, any plantings or other efforts to create habitat or cover at the crossings, or other mitigation measures (see also Section 8, Related Mitigation Measures). However, cost estimates in Section 7.2 have included contingency budgets to cover these associated features. For purposes of initial examination, and based on the dimensions above, the following structure costs (rounded) are estimated:

- Wildlife overpass 130 feet wide: $2.6 million (accommodates 3–4 lanes)
- Wildlife underpass (clearance 23–32 feet wide, 18 feet high):
    - Range of cost: $400,000–$1.8 million per dedicated crossing
    - Average of all of the lowest and highest costs at all of the crossing locations: $916,000 per crossing

The cost for the same structure type at two different crossing sites may vary widely depending on the number of lanes on the highway, depth of fill/width of the highway footprint, and other site-specific variables. See Appendix B for more detailed preliminary cost estimates.

6 Wildlife Crossing Structures

The wildlife corridors discussed in Section 4 were used to identify potential wildlife crossing locations. All portions of the build alternatives were divided into a total of 12 segments based on geographic location and similar wildlife characteristics (Map 13). The following subsections discuss each of these segments in detail. Where possible, potential crossing locations were identified within each segment. Crossings that were located within modeled wildlife movement corridors or pinch points were carried forward for further analysis and evaluation which included an assessment of collision data, camera trap data, topography, land ownership, and more. The available information discussed in Section 3 was used to qualitatively assess each potential crossing location. The potential crossings are numbered roughly from east to west as #1 through #26, and are indicated on Map 13.

6.1 Segment 1 (MP 44–45)

General Description. This segment is located between MP 44 and 45 on the east end of the project area. This segment includes all proposed build alternatives and the existing Sterling Highway in the vicinity of Quartz Creek and the junction with Quartz Creek Road. Suring et al. (2017) mapped Brown bear core habitat within the Quartz Creek drainage from approximately MP 44 eastward. The models suggest that brown bears would cross this segment of highway to access core habitat in Quartz Creek. The brown bear corridor crosses the hillside north of Cooper Landing to access Juneau Creek and the Kenai River. However, cameras near this segment north of the highway captured very few brown bears and did not support the modeled movement corridor running east-west between Juneau Creek and Quartz Creek. Moose may cross this segment during summer, but the models don't show moose movement in this area for other seasons. Numerous moose were observed along Quartz Creek, but relatively few were captured by cameras north of the highway. In addition, wildlife-vehicle collision data indicate only one moose collision in this segment, near MP 45. This segment also shows up strongly for Dall sheep movement between Langille Mountain and Right Mountain, although this species was not observed at any camera traps. It is important to note that mountain goats, a species that shares a similar ecological niche with Dall sheep, were observed on several occasions in July 2016 at camera traps on the north side of the highway near this segment (at approximately MP 45). None of the other focal species show strong regular use of this area.

Engineering. There is not a reasonable potential for a wildlife underpass within this segment. A wildlife overpass (Crossing #1) is possible within the MP 44.3 to 44.8 area (see preliminary design drawings on Sheet 1 of Appendix A). This could serve brown bear movement and possibly seasonal moose movement. Because of human development in this general area, including Sunrise Inn, homes, and a State airstrip, the MP 44.3 area has been identified as having the best potential for placement of a Large Mammal Overpass. This overpass would be 130 to 150 feet wide, providing a tunnel of the same length for the highway (note: the highway in this location has three lanes today, and it may be prudent to provide tunnel width for a future four lanes). However, this location is complicated by a trash/garbage transfer station (potential bear attractant) and the airport. Kenai Peninsula Borough (Borough) land associated with the solid waste transfer station is potentially available on the south side of the highway in this area. However, placing the highway in a short tunnel (with an earth ramp for wildlife leading onto Borough land) would place the tunnel portal too close to the transfer station's driveway intersection and an intersection for Russian Gap Road on the north side of the highway. Therefore, use of this area likely would require acquisition of a private parcel (2016 assessed value $249,500) that lies adjacent to the transfer station parcel to the west. State land south of the highway and beyond the airport (along Quartz Creek) is likely to be reasonably protected as wildlife habitat. The Borough owns land on the north side of the highway and this area may not have as much protection in the future.

While this area appears important for bears and moose according to modeled data, the crossing location is outside the project area, and camera trap information and collision data did not support the modeled data. Sites west of MP 44.3 would conflict with human development south of the highway and direct wildlife toward the airstrip, which is another conflict. It is not advisable to funnel wildlife to cross into an area with conflicting land uses (i.e. an airport and a garbage transfer station). Other options further east may be more promising and more effective as brown bear crossings and could be considered in the future. Given the high costs of a wildlife overpass and the complexities of land uses in the area, the costs and benefits of a crossing at this location do not suggest it would be worthwhile and therefore this wildlife overpass is not recommended.

6.2 Segment 2 (MP 45–46.5)

General Description. This segment of highway (all build alternatives) skirts the edge of Kenai Lake at the base of a relatively steep slope, therefore wildlife movement across the highway is expected to be minimal. Very low numbers of wildlife were recorded in this area during the camera trap study, and there were no reported wildlife-vehicle collisions in this segment between 2000 and 2009. As such, no wildlife crossing structures were considered for this segment.

6.3 Segment 3 (Cooper Landing North)

General Description. This segment begins where the G South and Juneau Creek Alternatives diverge from the existing highway and from the Cooper Creek Alternative. This segment follows the G South and Juneau Creek Alternatives as they contour north of Cooper landing. The west end of this segment is located where the G South and the Juneau Creek Alternatives diverge. The modeling suggests weak summer and strong autumn movement of moose in a north-south direction across this segment. Brown bear and black bear corridors generally parallel or overlap this segment in an east-west direction between Juneau Creek and Quartz Creek. A narrow black bear corridor crosses the approximate center of this segment just north of Cooper Landing. However, as noted by USFWS and Forest Service biologists, north-south movement across this segment would funnel wildlife into the urbanizing environment of Cooper Landing, which could result in increased human-wildlife conflict and increased wildlife mortality. Conversely, a crossing structure could provide northward escape for wildlife moving through the Cooper Landing community from habitat south of the existing highway. However, given the presence of Kenai River and Kenai Lake as well as residential areas, northward movement is expected to be relatively low. The camera trap study did not provide sufficient coverage of this segment (Map 12).

Engineering. Two potential crossing locations were identified within this segment.

Space exists for a wildlife underpass (Crossing #2) near the end of Langille Road, north of a large-lot rural residential area that is already partially built out. The project is planning to provide an underpass for the Slaughter Gulch Trail near Slaughter Creek, approximately 1,700 feet to the east. This wildlife underpass could support moose movement during summer and fall (Map 5) as it could be designed to be 18 feet in height. Black bear and Dall sheep may also use the crossing according to the least cost corridor models. A drawback to this location is that people may attempt to use it to reconnect an informal trail that connects Birch Ridge with the Slaughter Gulch Trail. The depth of fill shown in the preliminary highway design in this location is nearly 40 feet. It is likely the finished profile grade to provide a wildlife crossing would be reduced by at least 17 feet. The highway at this location would be three lanes, requiring an underpass at least 56 feet long. Preliminary design drawings are provided on Sheet 2 of Appendix A. There are existing developed residential buildings immediately south of this proposed crossing which may reduce its effectiveness and DOT&PF would not exert eminent domain to purchase multiple private properties and relocate residents. Given the position of this potential crossing adjacent to Cooper Landing, existing land uses, the additional requirements needed to reduce potential conflict and improve its potential for success, this crossing is not recommended.

A wildlife underpass (Crossing #3) could be located in the general Birch Ridge area, north of Cooper Landing, to support summer moose movement through Cooper Landing (see Map 5 and Sheet 3 of Appendix A). This location is less optimal than Crossing #2 because it does not show up strongly in the modeling for any species except Dall sheep. This crossing could also potentially direct wildlife in to the Cooper Landing community, and for this reason is not recommended.

6.4 Segment 4 (MP 46.5–48)

General Description. This segment applies to the Cooper Creek Alternative and follows the existing highway through the community of Cooper Landing from MP 46.5 to 48. Due to the density of human habitation along this segment, wildlife use is likely to be lower than all other segments. However, modeling does suggest that black bear and moose could cross the Kenai River in the vicinity of the existing Cooper Landing Bridge at MP 47.9. Camera traps did not identify high levels of use north or south of this area, but cameras were not fixed at the bridge to identify crossing at this particular location. It is probable that the corridors running north-south here are a phantom product of the modeling that erroneously links least cost corridors at the narrowest points across surfaces with low permeability (such as water bodies). Moose collisions near MP 48, on the south side of the bridge, are relatively high and likely result from moose choosing to cross the highway rather than the river at his point as they move in an east-west direction.

Engineering. The project would replace the Cooper Landing Bridge and move the northern abutment back. Without modification to the proposed bridge structure, the bridge could be designed to allow for wildlife underpass at both ends (Crossings #4 and #5) in the area beside the river (in excess of 100 feet on each side) by ensuring the south side was adequately excavated to provide vertical (>15 feet) and horizontal clearance (see preliminary design drawings on Sheet 4 of Appendix A). The underside of the bridge would consist of retaining walls and bridge pillars that would need to be modified with rocks and vegetation to improve the natural appearance of the crossing. These modifications would facilitate east-west movements, which are perpendicular to movement indicated in the modeling and would direct wildlife from one urbanized area to another. Despite this, the modification could prevent wildlife from crossing the highway at grade, which may reduce wildlife-vehicle collision potential. These modifications (Crossings #4 and #5) to the planned bridge are recommended for the Cooper Creek Alternative.

6.5 Segment 5 (Cooper Creek)

General Description. This segment includes the portion of the Cooper Creek Alternative that is separate from the existing highway. It starts at approximately MP 48, climbs south of Cooper Landing, and rejoins the highway at approximately MP 51, which is just west of Cooper Creek.

The eastern half of this segment traverses through and above residential areas that are part of the community of Cooper Landing. The western half is largely undeveloped. Moose are the species most likely to occur in this area. The summer least cost corridor model for moose identifies a wide corridor that crosses the center of this segment. Other seasons do not show as strongly for moose. Camera traps recorded high levels of moose compared to other species in this area. The black bear corridor model suggests black bear may cross the middle of this segment as they come and go from core habitat located just uphill from this area. Brown bear are less likely to occur in this area. The models suggest brown bear may occur in Cooper Creek, but that is not likely until salmon return to this water body (stream enhancement projects currently underway are intended to improve salmon habitat). Lynx core habitat is present on the west side of this segment in the vicinity of Cooper Creek, as are wolverine movement corridors. The modeling suggests sheep may cross this segment on its east end, near Cooper Landing, but this is not likely to be a common occurrence.

Engineering. There are three potential wildlife underpass locations, including a large highway bridge, within this segment. A potential wildlife underpass (Crossing #6) is located approximately 1,700 feet east of Cooper Lake Dam Road and south of the Cooper Landing community. The project would also provide a grade-separated underpass for Cooper Lake Dam Road. The underpasses would be provided individually in an effort to separate human and wildlife uses, although this road is not heavily used and could also provide opportunities for wildlife movement. The potential wildlife underpass (Crossing #6) is recommended for the Cooper Creek alternative and would be most beneficial for moose. A minimum height of 18 feet is possible at this crossing location. A preliminary design drawing of this underpass is provided on Sheet 5 of Appendix A. A substantial drawback to this location is that the highway would be four lanes wide, which would require an underpass in excess of 65 feet in length. Nonetheless, this section of the highway would be located in high quality moose habitat and a crossing is recommended. Because of the underpass length, final design for this alternative should seek to maximize the opening height and create as much width as reasonably possible.

The Cooper Creek Alternative would also include an 800-foot-long bridge approximately 100 feet above Cooper Creek (see preliminary design on Sheet 6 of Appendix A). This would provide a broad opportunity for wildlife crossing north-south in movement corridors along Cooper Creek. No modification of the proposed bridge would be necessary. According to camera trap S08 (see Map 12), few wildlife move through the Cooper Creek valley, but there is a potential that brown bear would return to this drainage in the future.

There is also potential for a wildlife underpass (Crossing #7) of the Cooper Creek alternative where it completes a descent from Cooper Creek Bridge, near MP 51.1 of the existing highway (but east of the point the new alignment would merge with the existing alignment). This could be accomplished without substantial alteration of the highway design. In this location the highway would be three lanes wide, requiring an underpass at least 56 feet in length. Wildlife would still have to cross the “old” Sterling Highway in this location at-grade, but the traffic volume would be approximately 30 percent of current total volume. This would appear to be the best location for moose coming off the hillside south of the highway or moose going to and from high quality habitat west of the highway and south of the existing highway (Map 5). A below grade crossing here would be beneficial to reduce potential for moose-vehicle collision as vehicles descend from the Cooper Creek bridge or turn to climb towards the bridge. For this reason, this crossing is recommended.

6.6 Segment 6 (Bean Creek South)

General Description. This segment starts where the G South and Juneau Creek alternatives diverge and extends approximately one mile to the edge of the Juneau Creek Canyon and only applies to the G South Alternative. This segment is located on a bluff above the Kenai River and Juneau Creek. This bluff area shows up as a weak moose movement corridor during summer and autumn. Black bear use of this segment could be considered moderate to high. Brown bear are less likely to occur here, but may use Bean Creek as a travel corridor and thus may intersect this segment. Lynx core habitat is present throughout the entire segment and wolverine movement corridors are also present. Cameras were not positioned sufficiently close to this segment during the camera trap study. This segment crosses an area that is currently undeveloped and located on the western edge of the community of Cooper Landing.

Engineering. A potential crossing location was identified where this segment crosses Bean Creek (Crossing #8). Bean Creek is a small anadromous fish stream that will be crossed by the alternative, and therefore is a logical place to provide a crossing for black bears (and brown bears to a lesser extent) as they may make north-south movements in this area. The project could replace a planned standard fish-passage stream culvert with a wildlife underpass or provide a bridge to accommodate bears and moose. This likely would require a horizontal opening wider than 32 feet and would require raising the highway grade on fill by about 15 feet, and expanding the road footprint (see preliminary design drawings on Sheet 8 of Appendix A). In this location, the highway would be three lanes wide, requiring an underpass approximately 52 feet in length. Although it is not recommended specifically to encourage bears to cross to the south side of the highway into the settled part of the community it may be prudent to provide a crossing opportunity to allow bears in the developed area to more readily exit the area.

The Bean Creek Trail is located nearby. The grade-separated underpass for the extension of a Forest Service logging road off the end of Slaughter Ridge Road/Cecil Road, which currently serves as the beginning of the Bean Creek Trail and had been proposed in the Draft SEIS, would be relocated farther to the east. If a wildlife underpass were located at the creek, there would be approximately 600 feet of separation between the two structures. Also, the trail north of the highway would be rerouted to cross the creek farther north than previously proposed to provide greater separation between wildlife and human traffic (approximately 1,000 feet of separation). Despite these measures, there remains increased potential for human-wildlife conflict due to the positioning of this underpass near a well-used trail and on the edge of residential development. For this reason, this crossing is not recommended. However, where Bean Creek crosses the G South Alternative, the culvert could be designed to be large enough to allow small to medium sized mammals (e.g., lynx, wolverine, wolves, black bear) to pass under the highway. Human use from the adjacent private property could develop if this culvert were large enough.

6.7 Segment 7 (Bean Creek North)

General Description. This segment applies to the Juneau Creek alternatives and is located in the vicinity of Bean Creek Trail. This segment extends from where the G South and Juneau Creek alternatives diverge and extends to the edge of the Juneau Creek valley. Black bear core habitat is located just north of this segment, and black bear would be the species most likely to cross this segment. The models suggest moose may cross this segment in the summer, but they are less likely to be present during other seasons. The segment is located in Canada lynx core habitat and is crossed by a least cost corridor for wolverine. Brown bear are more likely to avoid this segment and remain within the Juneau Creek valley. The camera trap study did not include this segment.

Engineering. Two wildlife underpasses are possible without substantial modification of the highway design. Crossing #9 is possible where the Juneau Creek alternatives alignment curves to the northwest (see preliminary design drawings on Sheet 9 in Appendix A). This would be located east of Bean Creek and just west of the point that the G South and Juneau Creek alignments split (see Map 13). One drawback to this location is that the highway is currently designed to be three lanes wide at this location. This underpass could provide an important opportunity for brown and black bears that are north of the new highway to continue in an east-west direction rather than crossing southward into Cooper Landing. This crossing is recommended for the Juneau Creek alternatives.

Crossing #10 is possible near the western edge of Segment 7 near the headwaters of Bean Creek (Map 13). Preliminary design drawings are provided on Sheet 10 of Appendix A. This crossing would be located at an existing small ravine and could accommodate a structure with 23 feet of width and 18 feet of height. This crossing is also in a portion of the highway designed to be three lanes wide. This crossing could provide a connection between the Kenai River valley and upper Juneau Creek for black bear and moose. However, this crossing is relatively close to the upper Juneau Creek Bridge and may be redundant as that bridge provides crossings for these species above the canyon rims. Given the proximity to a planned bridge, the required length of the crossing to span three lanes, and the relatively weak modeled movement corridors in this area, this crossing is not recommended.

6.8 Segment 8 (Upper Juneau Creek)

General Description. This is a short segment that encompasses the proposed long-span bridge over Juneau Creek Canyon and is associated with the Juneau Creek alternatives. Juneau Creek is a major corridor for brown bear as it provides access to salmon streams and is itself an isolated salmon stream not heavily fished by humans. Brown bear will move through this valley seasonally to access high quality habitat and nightly to fish during summer and fall. The camera trap along Juneau Creek had the highest number of brown bears, but did not record any other focal species. The models indicate that the only other species likely to occur in Juneau Creek Canyon are Canada lynx, as this segment is located in core habitat for lynx. Along the canyon rims, black bear and moose may occur. Animal trails are common along the rim of the canyon and are likely used by a number of species.

Engineering. The project would construct an 825-foot-long bridge across Juneau Creek Canyon (the canyon is approximately 425 feet wide) as well as a substantial portion of the canyon rims—approximately 200 feet on each side would provide wildlife passage without modifications to the planned bridge (see preliminary drawings on Sheets 11 and 12 of Appendix A). The bridge would be located more than 200 feet above Juneau Creek. The Resurrection Pass Trail would be located on the west side and the Bean Creek Trail on the east side, both under the bridge along the rim of the canyon. With these trails present under the bridge, moose and black bear would be less likely to use these areas, but 200 feet of space on each side may be sufficient to allow use for both humans and wildlife.

6.9 Segment 9 (Lower Juneau Creek)

General Description. This segment extends from the eastern side of Juneau Creek Canyon, spans Juneau Creek valley, and joins the existing highway and Cooper Creek alternative after crossing the Kenai River at approximately MP 51.5 of the current highway. Important brown bear corridors associated with Juneau Creek to the east and Kenai River to the west cross this segment at each end. The middle of the segment provides movement corridors for black bear and moose. Lynx and wolverine are also expected to occur throughout this segment, but Dall sheep are unlikely.

Engineering. Where the G South Alternative crosses Juneau Creek, a long and high bridge is proposed—1,320 feet long and approximately 170 feet above the creek (see preliminary design drawings on Sheets 13 and 14 of Appendix A). In terms of separation of traffic from the ground and stream below, this would be analogous to the Canyon Creek Bridge on the Seward Highway (near the Hope Highway junction). This bridge would provide a wide area beneath which animals could move freely. This is one of the most important bear movement corridors in the project area. One of the primary concerns in this area is new public access on the construction road that would be needed to build the bridge piers. To keep the construction access from becoming a new public access route, some combination of the following is recommended:

1. Removing the bridge construction access road and making the route unattractive for people on foot (e.g., by removing any embankment, and by placing boulders and root wads)
2. Retaining a tree buffer during construction and revegetating all disturbed areas, including planting native trees
3. Posting No Parking signs in the Juneau Creek area (from the Juneau Creek Bridge to the Kenai River Bridge)
4. Working with Alaska Department of Fish and Game, Sport Fish and Habitat divisions, to ensure fishing regulations would not encourage bear-human encounters on lower Juneau Creek and Kenai River in this area
5. Fencing all, or portions of, the highway in this area to direct wildlife under the Juneau Creek and Kenai River bridges and to protect people and bears from the probable human-bear encounters
6. Posting educational signs about bears and bear habitat

The new Kenai River Bridge proposed for the G South Alternative provides an opportunity for wildlife passage along both banks, but the bridge would need to be raised approximately 10 feet to provide clearance for moose on the south bank. The bridge would provide approximately 50 feet of horizontal space and 15 feet of vertical clearance for wildlife on the south side of the river (Crossing #11) and at least as much width with higher vertical clearance on the northeast side (Crossing #12; see preliminary design on Sheet 16 of Appendix A). Because of the bear concentration in the Juneau Creek valley and the impediment of existing human development in Cooper Landing to the east, providing for wildlife access to the west and along the north side of the river is an important east-west connection to maintain. For this reason, Crossing #11 and #12 are recommended for the G South Alternative.

In addition, for the G South Alternative, the realignment of the “old” highway to intersect the new highway provides an opportunity to create a wildlife underpass (Crossing #13) on the “old” highway to serve north-south wildlife movements. A north-south underpass would require raising the “old” highway alignment to match the raised approach to the Kenai River Bridge, creating a small vertical curve at the approach to the intersection. The crossing could be placed 300 to 350 feet east of the intersection and could be designed to be 23 feet wide and 15 feet high (see preliminary design drawings on Sheet 17 of Appendix A). All, or parts, of the intersection area could be fenced or could use walls or rock to help keep animals off the roads and people out of the wildlife crossings. Crossing #13 is also recommended for the G South Alternative.

6.10 Segment 10 (MP 51.5–55)

General Description. This segment applies to the Cooper Creek and G South Alternatives and extends from MP 51.5 to 55 of the existing highway. This segment parallels the Kenai River and important brown bear habitat. It crosses the Kenai River at approximately MP 53.1, known as the Schooner Bend Bridge. The brown bear movement corridor that follows the Kenai River at MP 53.1 is one of the most important areas to maintain brown bear passage as it is a pinch point that concentrates movement between Juneau Creek and Russian River. Much of the brown bear movement in north-south and east-west directions in and across the project area passes through this area. The west end of this segment is located near the Russian River confluence, which is a popular fishing location for both humans and bears. A well-defined moose least cost corridor crosses this segment at MP 52 during all seasons except autumn. This is strongly supported by a camera trap (S08, see Map 12) near MP 51.5 that recorded high numbers of moose, and there were relatively high levels of moose-vehicle collisions between MP 51 and 53 (Maps 5 and 6). Although the modeling does not indicate a moose corridor between MP 53.5 and 55, camera traps and moose-vehicle collision data suggest moose cross the existing highway at relatively high rates in this area. In fact, the two cameras that recorded the most moose during the camera trap study were located south (S08) and north (N10) of this segment (see Map 12). Black bear use is fairly consistent throughout this segment. Core habitat is located on both sides of the segment and movement between these areas could occur regularly. A camera located near MP 52.5 recorded relatively high numbers of black bear. Wolverine and lynx may also occur throughout this segment, and a Dall sheep movement corridor is shown between MP 53.5 and MP 55 (Map 8).

Engineering. The replacement of Schooner Bend Bridge at MP 53.1 provides an opportunity for enhanced passage of brown bear. The proposed bridge deck extends adequately on the east end of the bridge (Crossing #14) and has height to allow for wildlife passage. The bridge deck could be extended approximately 17 feet on the west end (Crossing #15), the western abutment could be made into a retaining wall, and a bench area could be excavated from the river bluff to provide approximately 40 feet of space adjacent to the Kenai River for wildlife passage. The existing ground surface would be lowered, contoured, and planted to allow for wildlife passage. In sum, this bridge would allow space (40+ feet wide and 18 feet high) for passage along both banks (see preliminary design drawings on Sheet 18 in Appendix A).

The topography near MP 54 is not conducive to an underpass or overpass, and there are two driveways for two residential properties at and east of MP 54. The highway could be raised approximately 14 feet to create clearance for an underpass (Crossing #16) in the space between the two driveways, but this would create a much larger fill footprint (see preliminary design drawings on Sheet 19 of Appendix A). There is only a narrow habitat strip between the river and the highway in this area, and both sides of the highway have a number of archaeological sites, mostly grouped as the Beginnings Heritage Site. This area was previously used for formal interpretation of Dena'ina culture and is important to the Kenaitze Indian Tribe. Directing wildlife passage between two residential properties may not provide sufficient separation from human activity. For all these reasons, this site is not recommended for a wildlife crossing.

At MP 54.6 a potential wildlife overpass (Crossing #17) is possible where the existing highway passes through a cut in the hillside. The design of this overpass would be similar to that on Sheet 20 of Appendix A, but would likely require less fill material. An overpass in this location could be designed to be at least 130 feet in width and could generally continue the existing slope from the north side of the highway at approximately a 3:1 slope. The highway in this section is currently designed to be three lanes wide – the crossing is located at the start of an eastbound passing lane. A camera trap (N12, see Map 12) on the north side of the highway near this potential crossing location recorded high numbers of brown bear in mid-summer. Another nearby camera (N10) recorded more moose than any other camera except one. A drawback to this crossing would be that the south side is a relatively small parcel of land that would require wildlife to cross the river or move back on to the highway if they chose to move east or west and avoid the river. This crossing is located 0.4 mile east of Sportsman's Landing, which sees high levels of human activity seasonally and may alter the effectiveness of the overpass. On the south side of the river there is substantial high quality moose habitat. Due to less than optimal habitat on the south side of the highway, this crossing is not recommended.

6.11 Segment 11 (Parcel 395)

General Description. This segment, on the Juneau Creek alternatives, runs from the west side of Juneau Creek Canyon to the intersection of the Juneau Creek alternatives with the existing Sterling Highway near Sportsman's Landing (Russian and Kenai River confluence). This segment traverses a relatively low-angle slope and crosses State Management Unit (SMU) 395 north of the Resurrection Trail. The segment is located in high quality moose habitat mapped by ADF&G as important rutting and winter range. Much of the habitat in this area consists of alders, birch saplings, and early successional forests, which provide quality moose browse. The models by Suring et al. (2017) did not indicate particularly high value moose movement for this area, but it is well understood to be high quality moose habitat. Camera traps (N09 and N10; see Map 12) near this segment recorded relatively high numbers of moose. The cameras (N12 and S08; see Map 12) and moose-vehicle collision data also indicated high use areas near MP 54 and MP 51.5 of the existing highway from which moose may move northward across this segment to core habitat east of Round Mountain (Maps 5 and 6). The segment also overlaps black bear core habitat and increased prevalence of least cost corridors and pinch points as the segment approaches the Kenai River. Black bear were recorded in moderate to high numbers at cameras south of this segment. Brown bear would be rare throughout most of this segment, but abundance would increase as the alignment approached the Kenai River.

Engineering. The project includes a dedicated underpass for Juneau Creek Road, a Forest Service logging road through SMU 395 (a Forest Service road easement through the State lands). The road is little used but preserves access rights for the Forest Service for administrative use and public access to nearby Forest lands. If SMU 395 were developed for residential lots by Kenai Peninsula Borough (Borough), as is expected, there is potential that Juneau Creek Road and the grade-separated crossing could be incorporated as a public road alignment serving the rural residential subdivision. For this reason, the underpass had been conceived as wide enough for a public road (30+ feet wide, with up to 16 feet of vertical clearance) and was considered for conversion to dedicated wildlife use. However, it was decided to keep the road crossing and wildlife crossing separate.

A potential wildlife underpass (Crossing #18) is located just outside the northern boundary of SMU 395, where the highway elevation can be increased by approximately 14 feet to create space for wildlife clearance (approximately 18 feet; see preliminary design drawing on Sheet 21 of Appendix A). At this location the highway is planned for east-bound and west-bound passing lanes and would be four lanes wide (64 feet). Raising the highway would increase the project footprint in a large wetland complex just east of the crossing location; the wetland impact could be mitigated at greater expense by use of retaining walls. Walls have not been assumed in cost estimates in Appendix C. This underpass may conflict slightly with future ramps that could be built by the Borough to access SMU 395, which should be considered during final design. If this part of SMU 395 were developed with roads and housing, the underpass may have poor utility in the long run. Due to the planned width of the road and impacts to wetlands, this crossing is not recommended.

Two additional crossing locations are possible just to the west of the SMU 395. Crossing #19 is a potential underpass and Crossing #20 is a potential overpass. Preliminary design drawings are shown for both structures on Sheet 22 of Appendix A. They are possible on both the Juneau Creek and Juneau Creek Variant Alternatives in different locations, but within a similar general area. Given their proximity, they are redundant to one another, and only one should be selected. These crossings may conflict slightly with future ramps that could be built by the Borough to access SMU 395, which should be considered during final design. Crossing #20 is located at a point where the proposed Juneau Creek Alternative would cut through the hillside and an approximately 50 foot tall retaining wall is currently planned. This would be sufficient to design an overpass that maintains the existing slope over the highway and does away with the retaining wall. The highway would be three lanes wide in this area; a passing lane would be located on the eastbound lane. Both crossings would be most beneficial to moose accessing habitat in SMU 395 on both sides of the Juneau Creek alternatives or movement between core habitat on Round Mountain and lower elevation foraging habitat in the valley bottom. Black bear would also benefit from below or above grade connectivity to core habitat on either side of the Juneau Creek alternatives. The distribution of camera traps was insufficient to support crossings at this location. Crossing #20 is recommended for the Juneau Creek alternatives because an overpass is generally more effective for moose, particularly given that Crossing #19 would need to span three lanes.

6.12 Segment 12 (MP 55–58)

General Description. This segment encompasses all four alternatives from MP 55 to MP 58 of the existing highway. MP 58 is the dividing point between this project and the adjacent Sterling Highway MP 58–79 project (a separate DOT&PF project currently under construction that includes its own wildlife mitigation and crossing structures). Suring et al. (2017) identified Segment 12 as a hot spot for multiple species. Brown bear are very strongly associated with the Kenai River located immediately south of this segment. Least cost corridors and pinch points run coincident with the river corridor and abut the southern edge of the highway. Several camera traps supported the brown bear modeling in this area, with high numbers of brown bear fishing along this stretch of the river. The cameras also indicated a strong cycle of nocturnal bear activity opposite diurnal human activity. In general, brown bears are not present in high numbers during the day. Some bears may remain in the area resting during daylight hours, while most bears likely move away from areas of elevated human use which may cause them to cross this segment of the highway.

The combined least cost corridor for moose stretches from MP 55.5 to 57. This area exhibits high quality wetland habitat along the river south of the highway. Moose-vehicle collisions have occurred throughout this segment. Although black bears are less likely to congregate along the Kenai River, they will move across this segment to reach high quality core habitat on each side of the valley. One particularly important location for black bear is in the vicinity of Fuller Creek. A camera trap (N14; see Map 12) located near Fuller Creek captured the highest number of black bear of any camera, and a well-defined movement corridor runs north-south across the highway in this location (approximately MP 57.1). Other black bear movement corridors appear near MP 55 and 55.5.

Crossing locations for all species may be random or dependent on numerous dynamic factors, but some topographic features may suggest locations with higher crossing rates. For example, between MP 55.5 and 57, there is lowland/riparian habitat suitable for both moose and brown bear. At each of these mileposts, the Kenai River and the existing highway (including all alternatives) meet, creating a constriction where animals would need to choose between crossing the river or the highway. Elevated numbers of wildlife-vehicle collisions occur at both of these mileposts. A camera trap (N11; see Map 12) located at MP 55.5, on the north side of the highway, captured relatively high numbers of moose, black bear, and brown bear moving to and from the existing highway. As mentioned above, black bear are known to use the Fuller Creek drainage regularly, which funnels those animals to the highway segment near MP 57.

Engineering. A total of six potential crossing locations were identified within this segment (Map 13): two potential overpasses (Crossings #21 and #23) and four potential underpasses (Crossings #22 and #24–26). This segment is unique in that all alternatives are located on a common alignment with no alternative route available for oversize loads. Due to concerns about restrictions on over-height loads, the potential wildlife overpasses within this segment are not recommended and only wildlife underpasses are proposed.

Crossing #21 is a potential overpass located at MP 55.6. This overpass is possible for all alternatives except the Juneau Creek Alternative. This overpass would be located where a cut-slope approximately 30 feet tall is present along the uphill edge of the existing highway. The overpass could be at least 130 feet wide, and the highway would be two lanes wide at this point. Preliminary design drawings are shown on Sheet 24 in Appendix A. Crossing #12 is located near a constriction between the river and highway, as discussed above. There is an old logging road on the north side of the highway, which according to camera trap data (N11; see Map 12), is used by moose, brown bear, black bear, and lynx at relatively high rates. If constructed, some kind of diversion would be necessary to direct wildlife away from their normal movement path and onto the crossing structure. Given the existing cut slope, it is anticipated that the existing slope of the hillside could be maintained across the highway to the river's floodplain. The USFWS had previously requested that a pullout for parking and river access at this approximate location be maintained; however, if an overpass were built here, this feature should be relocated. This overpass is not recommended, as described above, due to concerns about restrictions on over-height loads with no alternate route available.

Crossing #22 is a potential wildlife underpass at MP 56.3 that would work for all alternatives. This crossing would not require substantial modification of the highway design. The location would accommodate an underpass at least 23 feet wide and 18 feet tall to allow for moose and other mammals (see preliminary design on Sheet 25 of Appendix A). The uphill end of this wildlife crossing is at the base of a steep hillside, which may create a cave-like appearance to the crossing without major modifications to the terrain beyond the current highway footprint. The proposed road would be three lanes wide at this location, which may reduce effectiveness, but if the width and height can be increased, the overall effectiveness would be improved. Because the overpass at Crossing #23 is not recommended due to concerns about height restrictions, Crossing #22 is recommended. It may also be possible in design to make the width of the undercrossing greater than the standard 23–32 feet or to install two 23-foot-wide crossings in this general area to maximize the effectiveness.

Crossing #23 is a potential wildlife overpass at MP 56.6. At this location the new highway would cut through a small ridge. This location would accommodate an overpass of at least 130 feet with a vertical clearance of 17.5 feet for vehicles and 5 feet of top thickness above an arch tunnel. At this location the highway is planned to be approximately 52 feet wide. An alternative location may be available at MP 56.4 where a slightly taller cut exists and there is an existing pullout for parking and river access. At both mileposts, the highway is currently designed as three lanes (see preliminary design drawings on Sheet 26 of Appendix A). A crossing in this area would be beneficial for brown bear and possibly moose. Camera N15 (Map 12), located at this location, recorded relatively high numbers of brown bear, but few moose. However, the camera was located in a position such that moose, being taller than bears, would be less common due to vegetation near the camera. The least cost corridor for moose passes directly through this area. A relatively high number of moose collisions have occurred near this location. This overpass is not recommended, as described above, due to concerns about restrictions on over-height loads with no alternate route available.

Crossing #24 is a potential underpass at MP 57.2 where Fuller Creek crosses under the existing highway. A crossing here inside an enlarged culvert was recommended by the USFWS to not only permit wildlife passage, but also better accommodate periods of high water volume in the creek. It is possible to create an underpass by raising the level of the roadway to accommodate an underpass with at least 15 feet of clearance. This would add roughly 15 to 20 feet on each side of the alignment both east and west of the creek crossing; this width could be accommodated within the current right-of-way. In addition, a crossing here would require minor alterations of the entrance to the existing Fuller Creek trailhead parking area to accommodate the higher roadbed. At the crossing location, the highway would be two lanes wide, but just to the east the highway would begin to widen to three lanes to accommodate a turning lane for eastbound traffic to access the Fuller Creek trailhead (see preliminary design drawings on Sheet 27 of Appendix A). This crossing would be most beneficial to black bear and brown bear that follow the Fuller Creek drainage to and from the Kenai River. As mentioned above, high numbers of black bears were observed in the Fuller Creek area during the camera trap study. This crossing location is recommended for all alternatives. Between Crossing #23 and #24, the existing highway and river come close together at approximately MP 57.1. To maintain connectivity between habitat patches south of the highway but north of the Kenai River, it is recommended that a patch of wooded habitat between the highway and river be retained, if possible, during final design.

It is possible to provide for a wildlife underpass at MP 57.7 (Crossing #25), between the trailhead for Fuller Creek Trail and the Kenai National Wildlife Refuge Visitor Contact Station (see preliminary design drawings on Sheet 28 of Appendix A). Due to its proximity to the Sterling MP 58–79 project and wildlife underpasses associated with that project, this crossing is not recommended.

A wildlife underpass was determined possible in the western portion of this corridor near MP 58 (Crossing #26; see preliminary design drawings on Sheet 29 of Appendix A). DOT&PF has committed to providing a wildlife underpass in this approximate location as part of the adjacent Sterling MP 58–79 project; therefore, this crossing is not recommended for this project.

7 Conceptual Wildlife Crossings for Each Highway Alternative

7.1 Recommended Crossings

Table 2 summarizes all potential crossings and includes initial recommendations. These recommended crossings are mapped for each alternative: Cooper Creek Alternative (Map 14), G South Alternative (Map 15), and the two Juneau Creek alternatives (Map 16). Section 7.2 provides details on the costs associated with each potential crossing. The following are pre-design recommendations. Final crossing locations will be decided upon after on-site visits with wildlife agency staff as well as final engineering assessments during the design phase.

Table 2. Potential crossings by segment, with recommendations

Segment	Crossing	Alternative(s)	Crossing Description	Potential Species
1	1	All	Overpass possible at MP 44.3. *Not recommended.*	Brown Bear, Summer Moose, Dall Sheep
2	NA	All	No crossings recommended	NA
3	2	G South, Juneau Creek Alternatives	Possible to create underpass. *Not recommended.*	Black Bear, Autumn Moose
	3		Possible to create underpass. *Not recommended.*	Brown and Black Bear, Autumn Moose
4	4 and 5	Cooper Creek	Replacement bridge over Kenai River at Cooper Landing would be longer than existing with space for wildlife passage on both sides of river. *Provided.*[a] Possible to excavate material for wildlife clearance. *Recommended*.	Moose
5	6	Cooper Creek	Possible to create wildlife underpass east of Cooper Lake Dam Road underpass. *Recommended*	Moose, Black Bear, Lynx, Wolverine
	Cooper Cr. Bridge		High 800-foot-long bridge at Cooper Creek leaves valley bottom for wildlife. *Provided*[a]	Lynx, Wolverine, Potential Future Brown Bear
	7		Underpass possible near MP 51. *Recommended*	Black Bear, Moose, Brown Bear
6	8	G South	Possible to dedicate Bean Creek stream crossing for wildlife. *Not Recommended.*	Moose, Black Bear, Brown Bear, Lynx
7	9	Juneau Creek Alternatives	Possible to provide underpass. *Recommended.*	Moose, Black Bear, Brown Bear, Lynx
	10		Possible to create underpass. *Not Recommended.*	Black Bear, Moose, Lynx
8	Upper Juneau Cr Bridge	Juneau Creek Alternatives	High 825-foot-long bridge at Juneau Creek Canyon leaves canyon for wildlife & canyon rims (200 feet each side) for wildlife & trails. *Provided*[a]	Brown Bear, Lynx, Wolverine

Segment	Crossing	Alternative(s)	Crossing Description	Potential Species
9	Lower Juneau Cr Bridge	G South	High 1,320-foot-long bridge at Juneau Creek leaves valley bottom for wildlife. *Provided*[a]	Brown Bear, Lynx, Wolverine
	11, 12, and 13		Possible to raise Kenai River Bridge at MP 51.3 for wildlife passage (*Recommended*), plus underpass of old highway possible near junction. *Recommended*	Brown Bear
10	14 and 15	G South, Cooper Creek	Possible to extend Schooner Bend Bridge for wildlife, both sides. *Recommended*	Brown Bear
	16		Possible to raise highway near MP 54 for underpass. *Not recommended.*	Moose
	17		Possible to create overpass at MP 54.6. *Not recommended*.	Moose, Brown Bear
11	18	Juneau Creek Alternatives	Possible to raise highway grade to provide underpass for wildlife. Possible to preserve eastern end of SMU 395 as non-development corridor for wildlife. *Not Recommended.*	Moose, Black Bear, Lynx, Wolverine
	19		Possible to create underpass just west of SMU 395 and preserve western portions of SMU 395 as non-development corridor for wildlife. *Not Recommended.*	
	20		Possible to create overpass just west of SMU 395 and preserve western portions of SMU 395 as non-development corridor for wildlife. *Recommended*.	
12	21	All Alternatives (except Juneau Creek)	Overpass possible at MP 55.6. *Not recommended.*	Moose, Black Bear, Brown Bear, Lynx, Wolverine
	22	All Alternatives	Underpass possible at MP 56.3. *Recommended*	Black Bear, Lynx, Wolverine, Moose, Brown Bear
	23		Overpass possible at MP 56.6 or 56.4. *Not recommended* for the Juneau Creek alternatives.	Brown Bear, Black Bear, Moose, Lynx, Wolverine
	24		The culvert for Fuller Creek could be enlarged to create an underpass at MP 57.2. *Recommended.*	Black Bear, Brown Bear, Lynx, Wolverine
	25		Underpass possible at MP 57.5. *Not recommended.*	Br. Bear, Bl. Bear, Lynx, Wolverine
	26		Underpass possible at MP 58. *Not recommended.*	Bl. Bear, Lynx, Wolverine

NA=Not Applicable
[a] Bridges would be provided regardless of wildlife study and mitigation discussions, but modifications may be suggested as noted.

7.2 Crossing Details for Each Alternative

The numbered subsections in Section 6, above, indicate conceptually how wildlife crossings could be treated under each alternative. As noted in Section 6, most crossing locations would accommodate a wildlife underpass, and engineers have used the opening dimensions described above: 23 feet wide and 15 feet high (18 feet for crossings that would accommodate moose). In some cases, changes to the highway profile were noted as necessary. The tables that follow provide greater detail for each of the alternatives. Engineering concepts for each crossing location are shown in Appendix A.

For purposes of estimating costs for each recommended crossing structure, an average cost for each location was used. Specifically, estimates use an average of the crossing type with lowest cost and the crossing type with highest cost for a given specific location (from Appendix B). These costs for each recommended location are then added together. Other costs, such as wildlife-specific revegetation and diversions, have not been calculated. A contingency amount (estimated at 25% of total costs for wildlife structures) to account for all other wildlife mitigation costs, including those just listed, underpasses for smaller animals, and other items that may be selected are also included.

Cooper Creek Alternative. The crossing locations associated with the Cooper Creek Alternative are shown on Map 14. Table 3 summarizes recommended wildlife crossings for the Cooper Creek Alternative and their costs.

G South Alternative. The crossing locations associated with the G South Alternative are shown on Map 15. Table 4 summarizes the recommended wildlife crossings for the G South Alternative and their costs.

Juneau Creek Alternative and Juneau Creek Variant Alternative. The crossing locations associated with the two Juneau Creek alternatives are shown on Map 16. Table 5 summarizes recommended wildlife crossings for the Juneau Creek alternatives and their costs.

Table 3. Cooper Creek Alternative proposed wildlife crossings and cost estimates

Segment	Crossing	Best For	Description	Cost Range (in thousands)	Earth Work (in thousands)	Cost Based on Average + Earthwork
4	4 and 5	Moose	Replace **bridge** and, with earthwork, provide space on both sides for wildlife with adequate clearances.		--	
5	6	Moose	**Underpass** east of Cooper Lake Dam Road.	$440–$1,351	--	$895,718
	Cooper Cr Bridge	Br. Bear, Bl. Bear, Lynx	High **bridge** 800-ft-long at Cooper Creek leaves valley bottom for wildlife.[a]			
	7	Moose, Br. Bear	**Underpass** near MP 51 where new highway descends to Kenai River.	$348–$935	--	$641,707
10	14 and 15	Br. Bear	Extend Schooner Bend **Bridge** for wildlife, both sides.	$491	--	$490,644

Segment	Crossing	Best For	Description	Cost Range (in thousands)	Earth Work (in thousands)	Cost Based on Average + Earthwork
12	22	Moose	Underpass at MP 56.3	$427–$1,272	--	$849,850
	24	Bear	Underpass at MP 57.2 (Fuller Cr.)	$375–$1,764	--	$1,070,011
Total structure costs for recommended crossings			Four dedicated wildlife underpasses, two modified bridges, one long bridge (not modified)	$2,081–$5,813	--	$3,947,930
25% set-aside for related wildlife mitigation *(e.g., revegetation, diversions, smaller size animal crossings, signs)*				$520–$1,453	--	$986,982
Post-construction Monitoring				$200		$200,000
Total (rounded)				$722–$7,466		$5,135,000

Cost Range is based on the range of structure types examined (Appendix B). *Cost Based on Average* is derived from an average of the lowest and highest cost structure options examined at each crossing site noted.

[a] Bridge would be provided regardless of wildlife study and mitigation discussions; no modification of bridge structure necessary.

Table 4. G South Alternative proposed wildlife crossings and cost estimates

Segment	Crossing	Best For	Description	Cost Range (in thousands)	Earth Work (in thousands)	Cost Based on Average + Earthwork
9	Juneau Cr. Bridge (Lower)	Br. Bear	High bridge, 1,320 feet long at Juneau Creek, leaves valley bottom for wildlife [a]			
	11 and 12	Br. Bear	Raise Kenai River Bridge at MP 51.3 for wildlife passage on both sides of river[b]	$500–$1,000	$435	$435,146
	13	Moose	Underpass of old highway near junction with new highway	$348–$935	--	$641,707
10	14 and 15	Br. Bear	Extend Schooner Bend Bridge for wildlife, both sides.	$491	--	$490,644
12	22	Moose	Underpass at MP 56.3	$427–$1,272	--	$849,850
	24	Bl. Bear, Br. Bear	Underpass at MP 57.2 (Fuller Cr.)	$375–$1,764		$1,070,011
Total structure costs for recommended crossings			Three dedicated wildlife underpasses, two modified bridges, one long bridge (not modified)	$2,141–$5,462	--	$3,487,358
25% set-aside for related wildlife mitigation *(e.g., revegetation, diversions, smaller size animal crossings, signs)*				$535–$1,366	--	$871,840
Post-construction Monitoring				$200		$200,000
Total (rounded)				$2,676–$6,838		$4,559,000

Cost Range is based on the range of structure types examined (Appendix B). *Cost Based on Average* is derived from an average of the lowest and highest cost structure options examined at each crossing site noted.

[a] Bridge would be provided regardless of wildlife study and mitigation discussions; no modification of bridge structure necessary.

[b] Bridge would be provided regardless of wildlife study and mitigation discussions; however raising the bridge increases superstructure costs, and retaining walls to support wildlife crossings.

Table 5. Juneau Creek and Juneau Creek Variant Alternatives proposed wildlife crossings and cost estimates

Segment	Crossing	Best For	Description	Cost Range (in thousands)	Earth Work (in thousands)	Cost Based on Average + Earthwork
7	9	Bl. Bear, Br. Bear	Underpass	$480–$1,536	--	$1,007,793
8	Juneau Cr. Bridge (Upper)	Br. Bear	High bridge, 825 feet long at Juneau Creek Canyon, leaves canyon for wildlife & canyon rims (200 feet each side) for wildlife & trails[a]	--	--	--
11	20	Moose, Bl. Bear	Overpass near the west edge of SMU 395.	$2,759	$300	$3,058,960
12	22	Moose	Underpass at MP 56.3[b]	$427–$1,272	--	$849,850
	24	Bl. Bear, Br. Bear	Underpass at MP 57.2 (Fuller Cr.)	$375–$1,764		$1,070,011
Total structure costs for recommended crossings			Three dedicated wildlife underpasses, one dedicated wildlife overpasses, and one long bridge (not modified)	$4,041–$7,331	-	$6,286,614
25% set-aside for related wildlife mitigation *(e.g., revegetation, diversions, smaller size animal crossings, signs)*				$1,010–$1,833	--	$1,496,654
Post-construction Monitoring				$200		$200,000
Total (rounded)				$5,551–$9,664		$7,983,268

Cost Range is based on the range of structure types examined (Appendix B). *Cost Based on Average* is derived from an average of the lowest and highest cost structure options examined at each crossing site noted.

[a] Bridge would be provided regardless of wildlife study and mitigation discussions; no modification of bridge structure necessary.

8 Related Mitigation Measures

8.1 Constructed Mitigation

In some cases, mitigation concepts have been included in the descriptions above in Section 6. Other mitigation measures that could be considered are the following:

1. Fencing often is provided in conjunction with wildlife crossings. In this project area, public access to the Kenai River and to recreational trails and lands is highly valued, so fencing may be limited and must be carefully considered. Fencing was discouraged by the USFWS and Forest Service. Further discussion during final design is needed with land managers and wildlife agencies to refine fencing or other diversion locations to maintain access to important recreational sites, while also promoting effectiveness of the crossings.
2. "Cattle guard" style impediments, electric fencing, or other means of keeping animals from going around the ends of fences into the highway corridor could be included as part of fencing or other diversions.
3. The project could use earthen escape ramps for animals trapped on the highway side of fencing. "Jump-outs" where wildlife can escape through one-way gates from the highway corridor might be needed in some areas to prevent wildlife-vehicle collisions. Jump-outs were included on the adjacent MP 58–79 project, and it is possible their effectiveness will be evident before this project is fully constructed.
4. Any culvert or underside of bridge could include texturing to reduce sound and echoing. Lined culverts and use of uneven surfaces (natural stone or brick) for retaining walls could help reduce noise levels and improve wildlife acceptability to promote use of the crossings. Some planned stream and drainage culverts could be designed slightly larger than necessary to potentially allow smaller mammals to pass under the new alignments.
5. At the time of final pavement design, DOT&PF could consider noise abatement through the use of rubberized asphalt throughout the project area, if testing that has been ongoing in recent years shows it is durable and if DOT&PF approves it for use (currently it is in testing and not approved for use).

The EIS indicates several other potential mitigation measures related to wildlife that will be considered during final design:

- Vegetation planting or clearing to help direct wildlife movement, and additional clearing at curves where vegetation may screen wildlife around a bend.
- Standard wildlife warning signs for drivers.
- Movement-activated electronic warning signs for drivers.

In addition, the wildlife study consultant Northern Ecologic suggested that DOT&PF and FHWA could consider financial and administrative support for the following:

- Management of Human Behavior
  - Management of attractants. The single most important action for controlling brown bear-human conflict is keeping human-generated attractants unavailable to brown bears.
  - Bear resistant infrastructure. Bear-resistant food containers and trash containers.
  - Information and education. A clear, concise, consistent, and motivating message regarding food storage regulations and proper human behavior is the most important aspect of management of brown bears and humans.

- Management of Human Uses
    - Distribution of anglers
    - Disposal of fish waste
- Facilitate coexistence of humans and brown bears.
- Management of facilities and habitats.

Table 2, Table 3, and Table 4, all in Section 7.2, indicate a set-aside dollar amount that could be applied to any of these additional mitigation measures.

8.2 Monitoring

A key component to any wildlife mitigation will be a monitoring plan to assess effectiveness and to guide adaptive management measures by the wildlife agencies that may improve effectiveness. DOT&PF and the USFWS agreed that DOT&PF would fund two years of post-construction monitoring for the adjacent MP 58–79 project, including costs of personnel, equipment, and production of a report. This project includes a similar scale of wildlife crossings in a shorter distance. Construction would take place over a longer period, in phases. Therefore, a similar amount of funding for monitoring is proposed for this project as was proposed for the longer adjacent project. During the design phase, a Memorandum of Understanding will be developed between DOT&PF and the USFWS/Forest Service to document agreements on monitoring study design and methodology.

References

Interagency Working Group. February 2009. Wildlife Mitigation and Human Safety for Sterling Highway MP 58–79 Project: Progress Report (phase I). Submitted by U.S. Fish & Wildlife Service, Alaska Department of Fish & Game, Alaska Department of Transportation & Public Facilities, Federal Highway Administration, Alaska Moose Federation, and Alaska State Troopers. Submitted to Alaska Department of Transportation & Public Facilities and Federal Highway Administration.

Federal Highway Administration. March 2011. *Wildlife Crossing Structure Handbook: Design and Evaluation in North America.* Central Federal Lands Highway Division. Bozeman, MT/Washington, DC.

Suring, L. H., W. L. Gaines, and J. S. Begley. 2017. Habitat use and movement patterns of focal species on the Kenai Peninsula, Alaska, USA. Northern Ecologic L.L.C. Technical Bulletin 2017–1. Prepared for Alaska Department of Transportation and Public Facilities. Anchorage.

Maps

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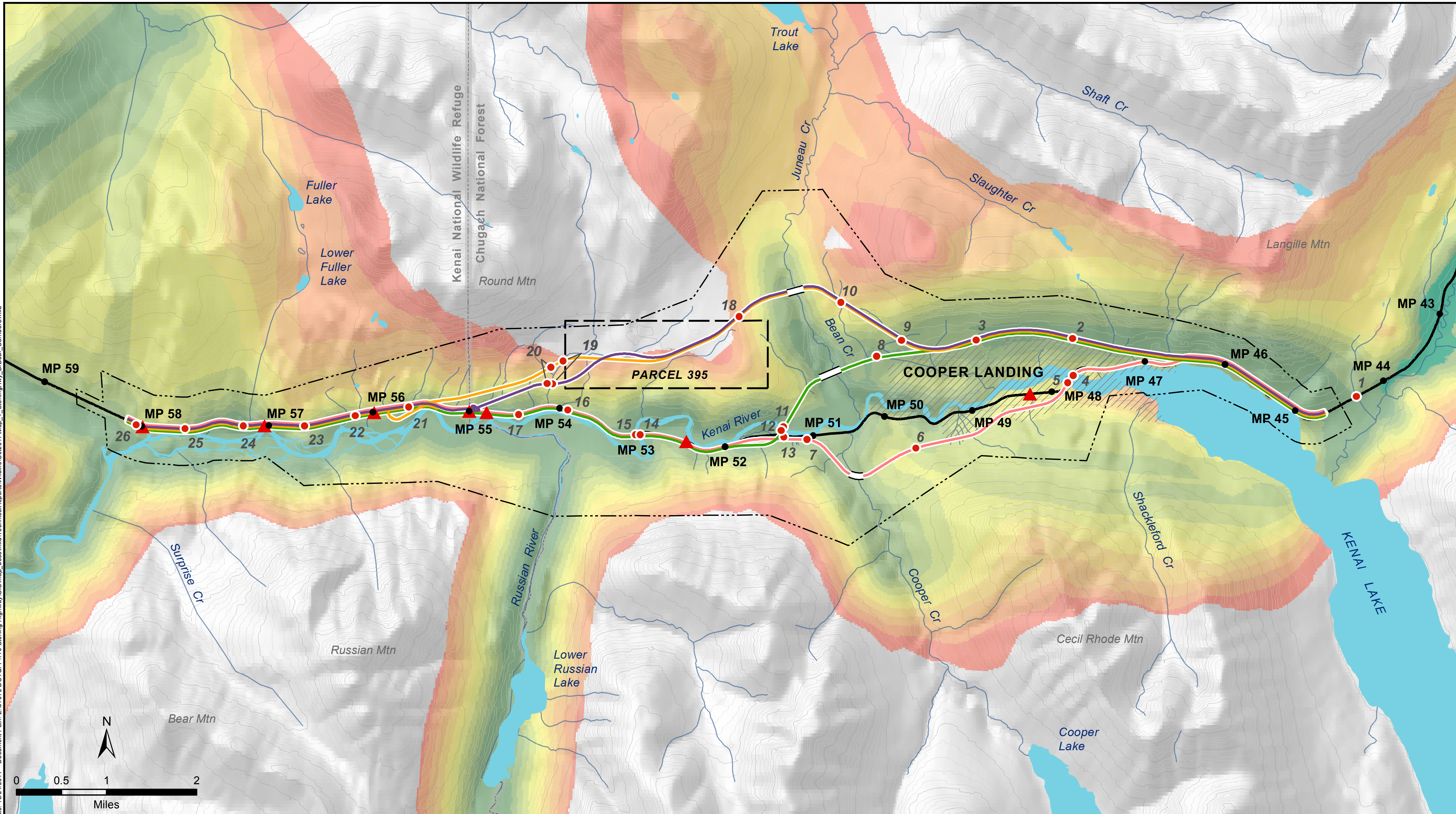

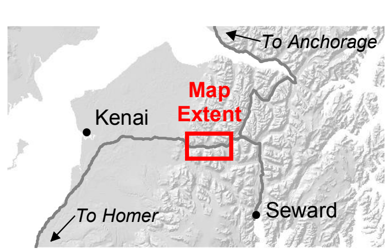

STERLING HIGHWAY MILE POST 45 TO 60 ALASKA

Legend

- Existing Highway

Project Alternatives

- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Brown Bear Least Cost Corridor

- Higher Use
- Lower Use
- Core Habitat

- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)
- Bridge
- Developed Area, Cooper Landing Community
- Parcel 395
- Project Area

MAP 1

LEAST COST CORRIDORS BROWN BEAR

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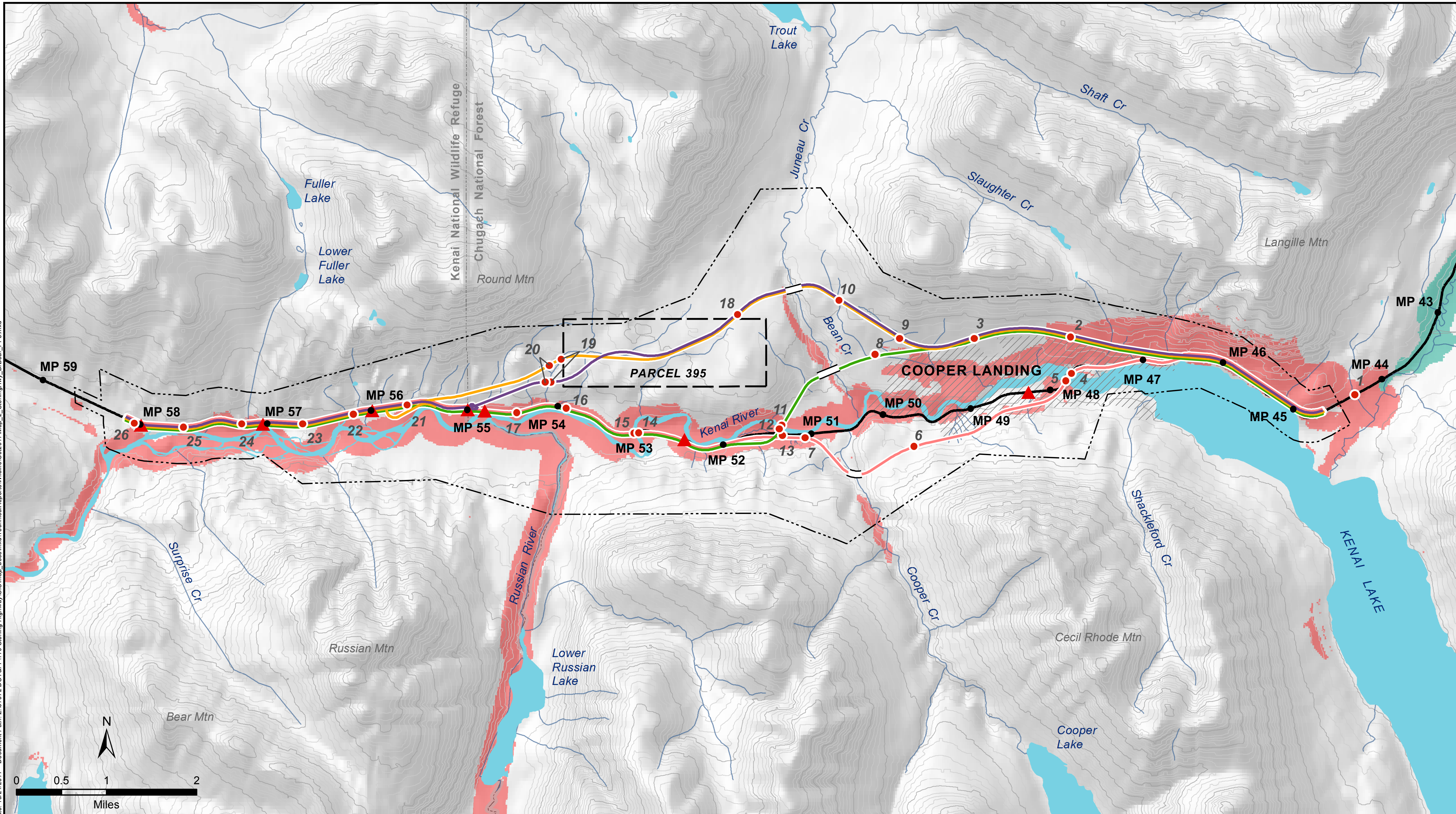

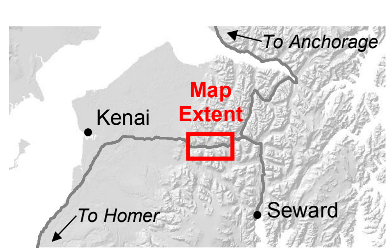

STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA

Legend

- Existing Highway
- **Project Alternatives**
  - Cooper Creek
  - G South
  - Juneau Creek
  - Juneau Creek Variant
- Brown Bear Pinch Points - All Seasons
- Core Habitat
- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 2

PINCH POINTS BROWN BEAR

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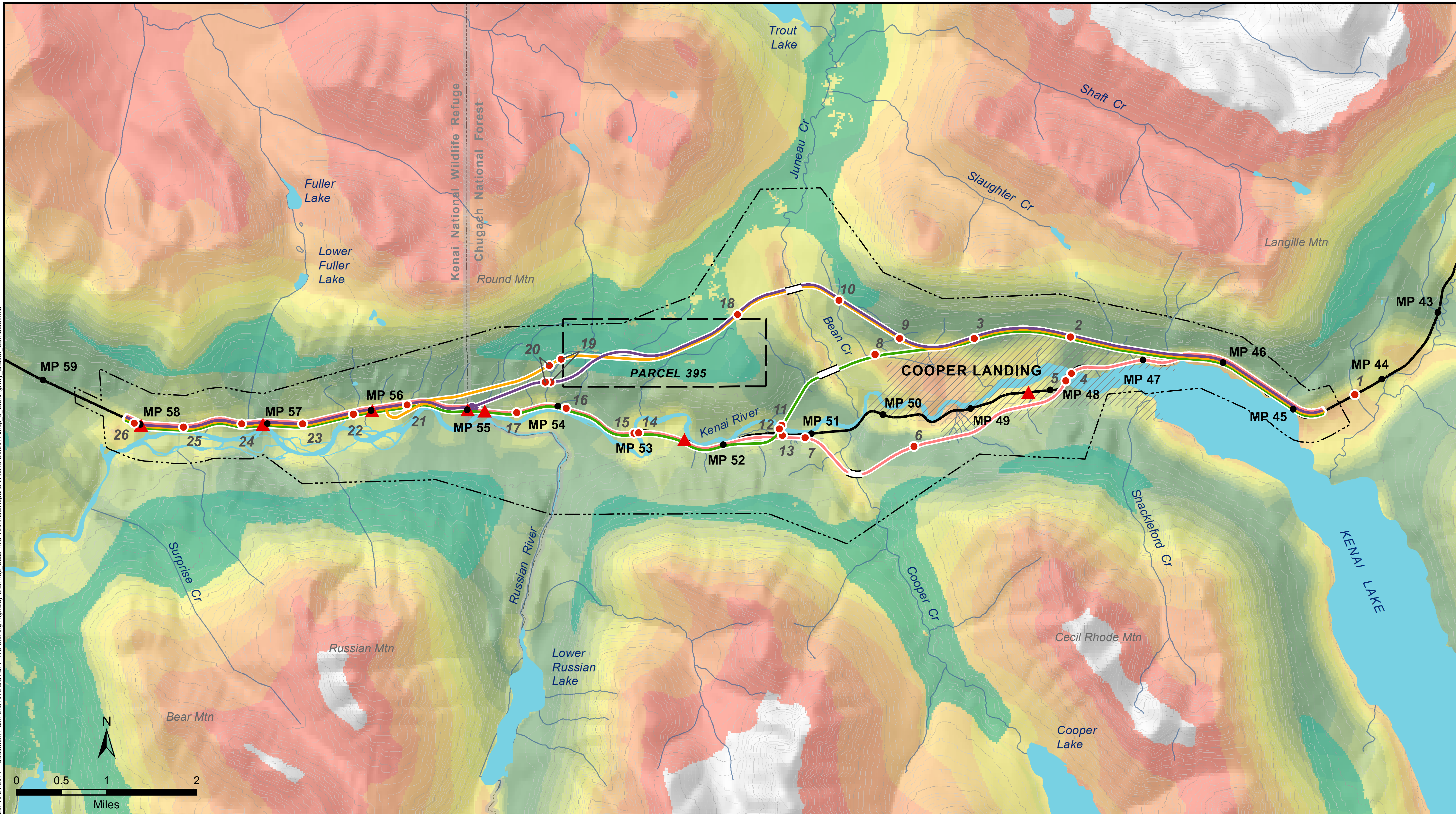
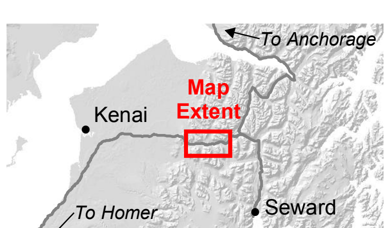


STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA



Legend

- Existing Highway

Project Alternatives

- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Black Bear Least Cost Corridor

- Higher Use
- Lower Use
- Core Habitat

- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 3

LEAST COST CORRIDORS BLACK BEAR

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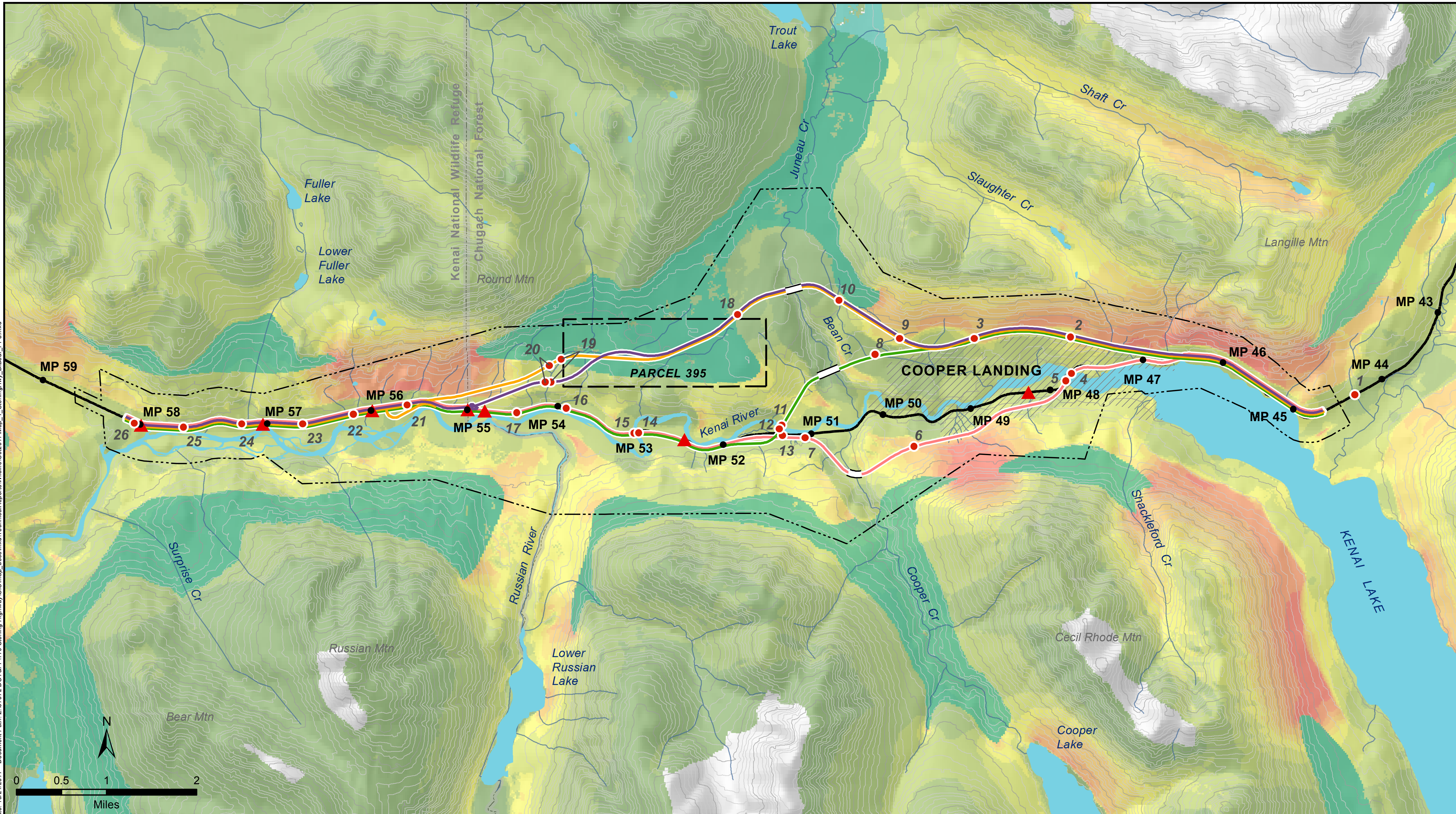

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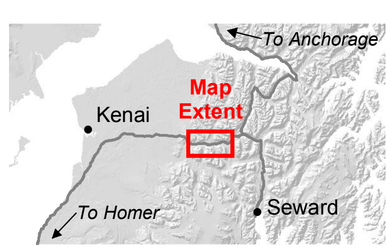
STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA



Legend

Existing Highway

Project Alternatives
- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Black Bear Pinch Points
- Lower Use
- Higher Use
- Core Habitat

- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 4

PINCH POINTS BLACK BEAR

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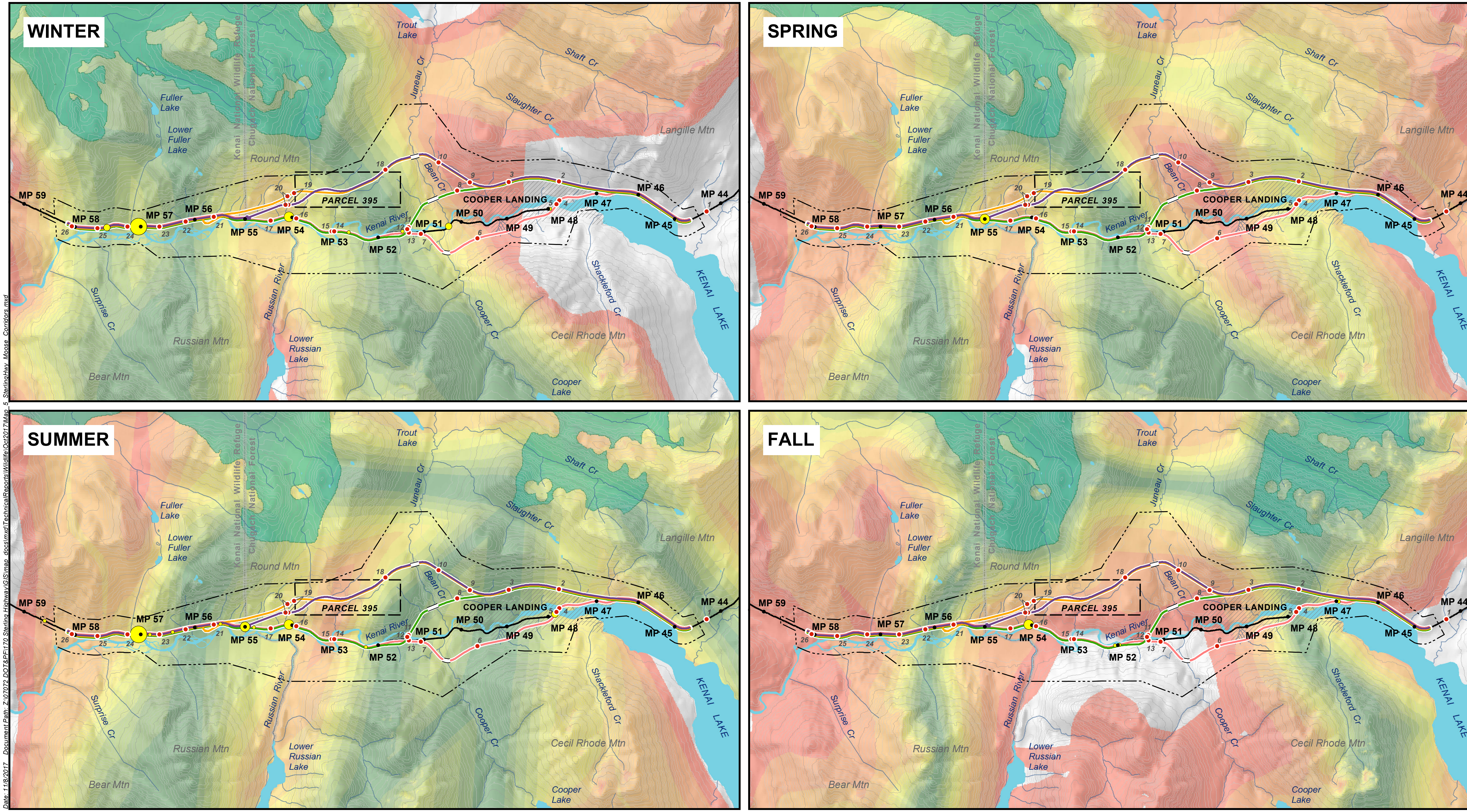
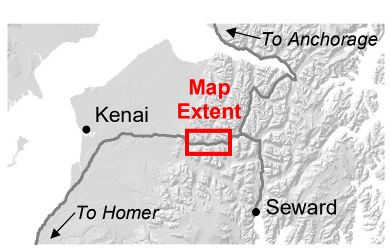


STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA



Legend

Existing Highway

Project Alternatives
- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Moose Least Cost Corridor
- Higher Use
- Lower Use
- Core Habitat

Moose Accidents 2000-2009
- 1
- 2
- 3-4
- >4

- Potential Dedicated Wildlife Crossing
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

N

0 0.5 1 2
Miles

MAP 5

LEAST COST CORRIDORS MOOSE

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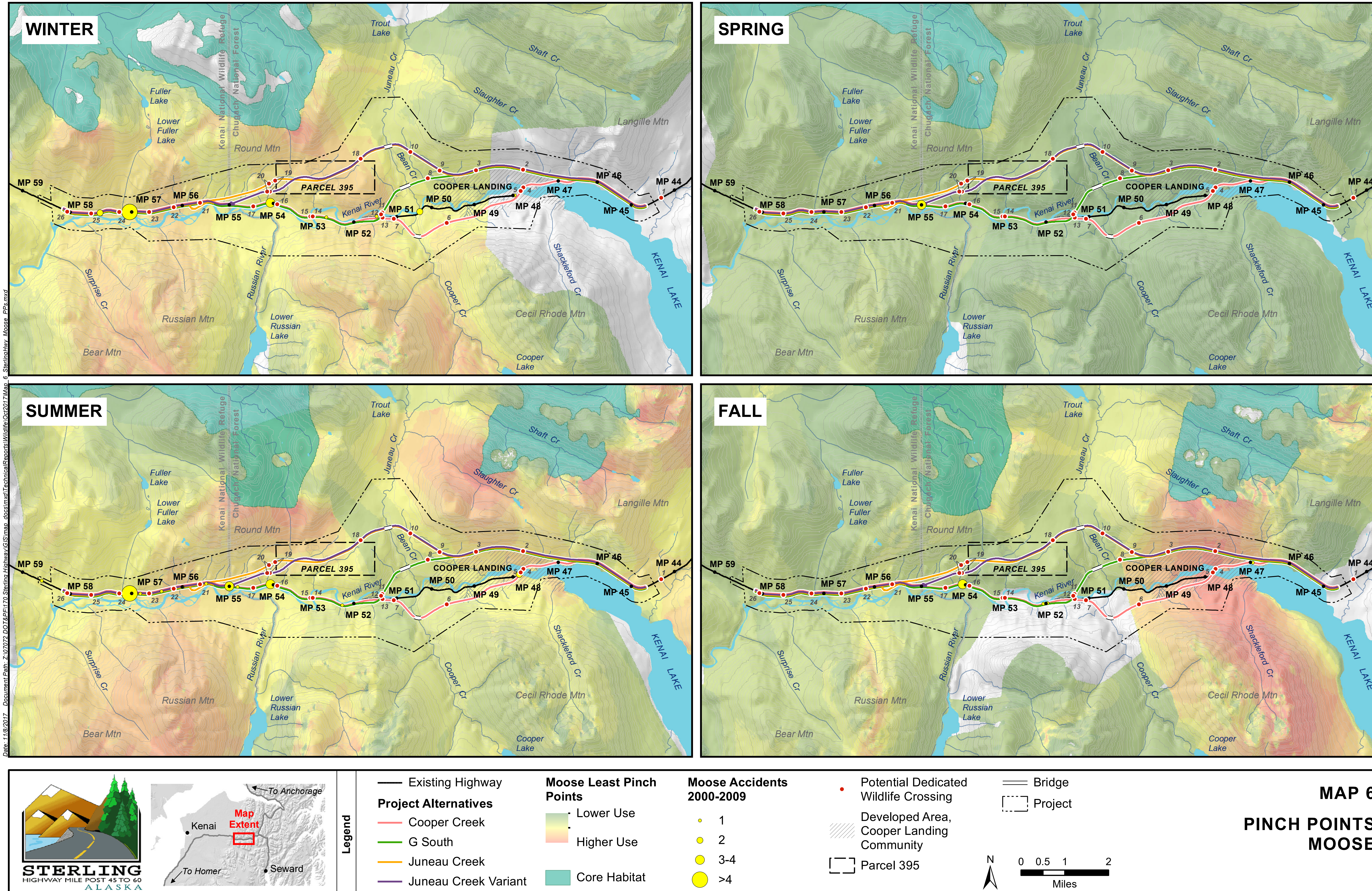
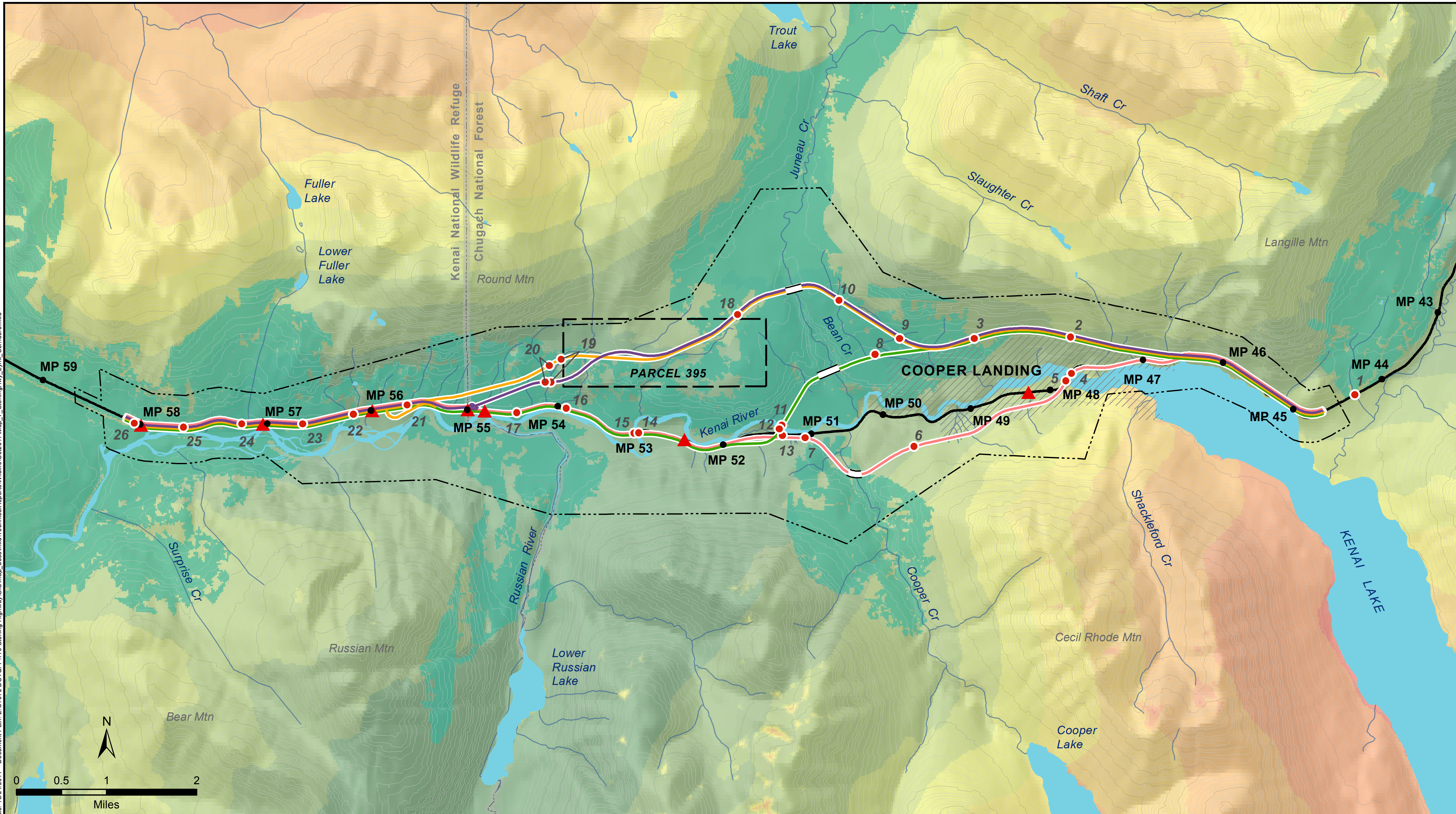
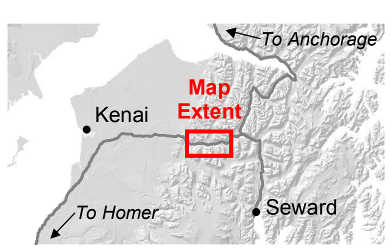


MAP 6

PINCH POINTS MOOSE





STERLING HIGHWAY MILE POST 45 TO 60 ALASKA

Legend

- Existing Highway

Project Alternatives

- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Lynx Least Cost Corridor

- Higher Use
- Lower Use
- Core Habitat

- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 7

LEAST COST CORRIDORS LYNX

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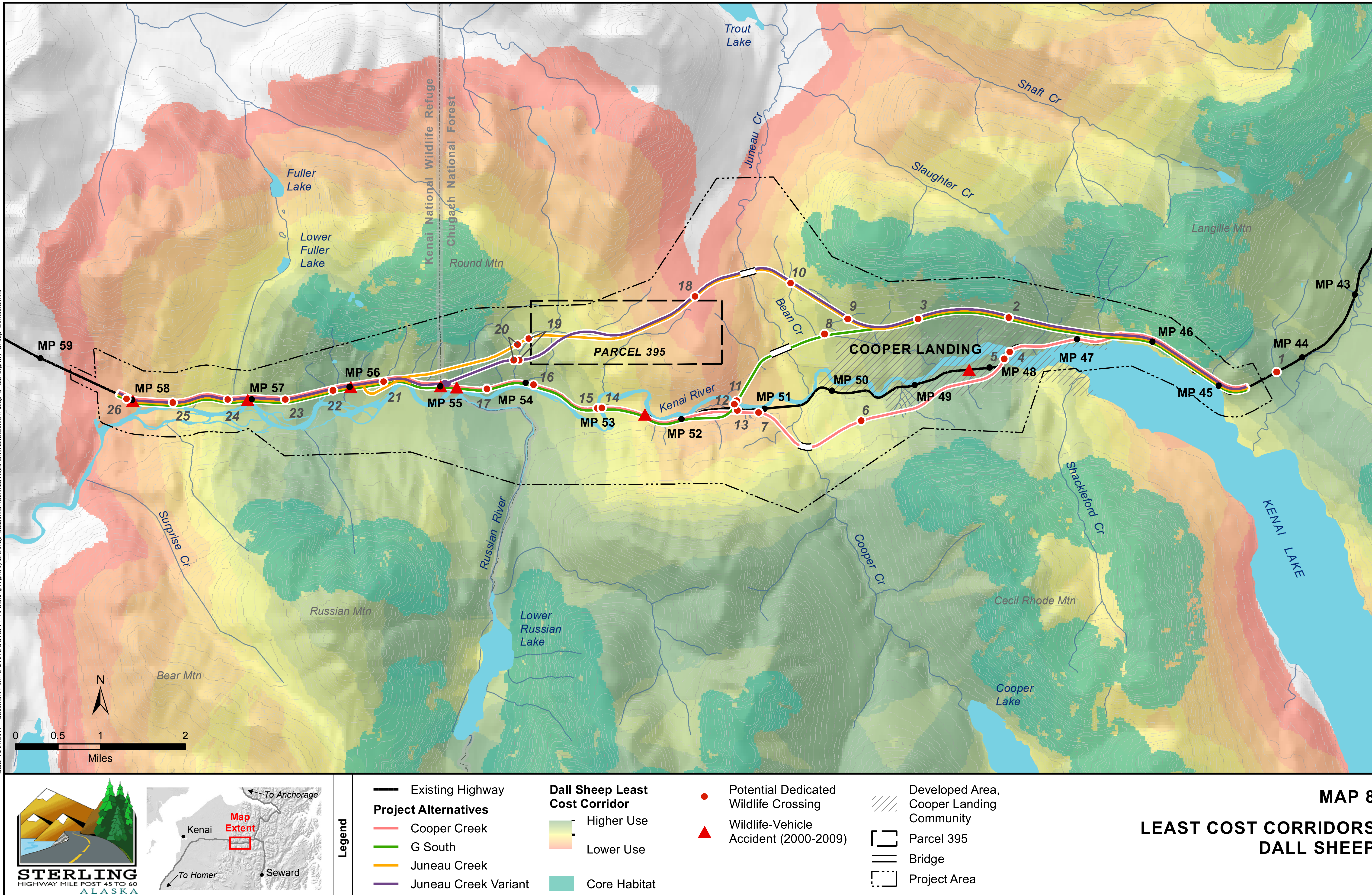

MAP 8

LEAST COST CORRIDORS
DALL SHEEP

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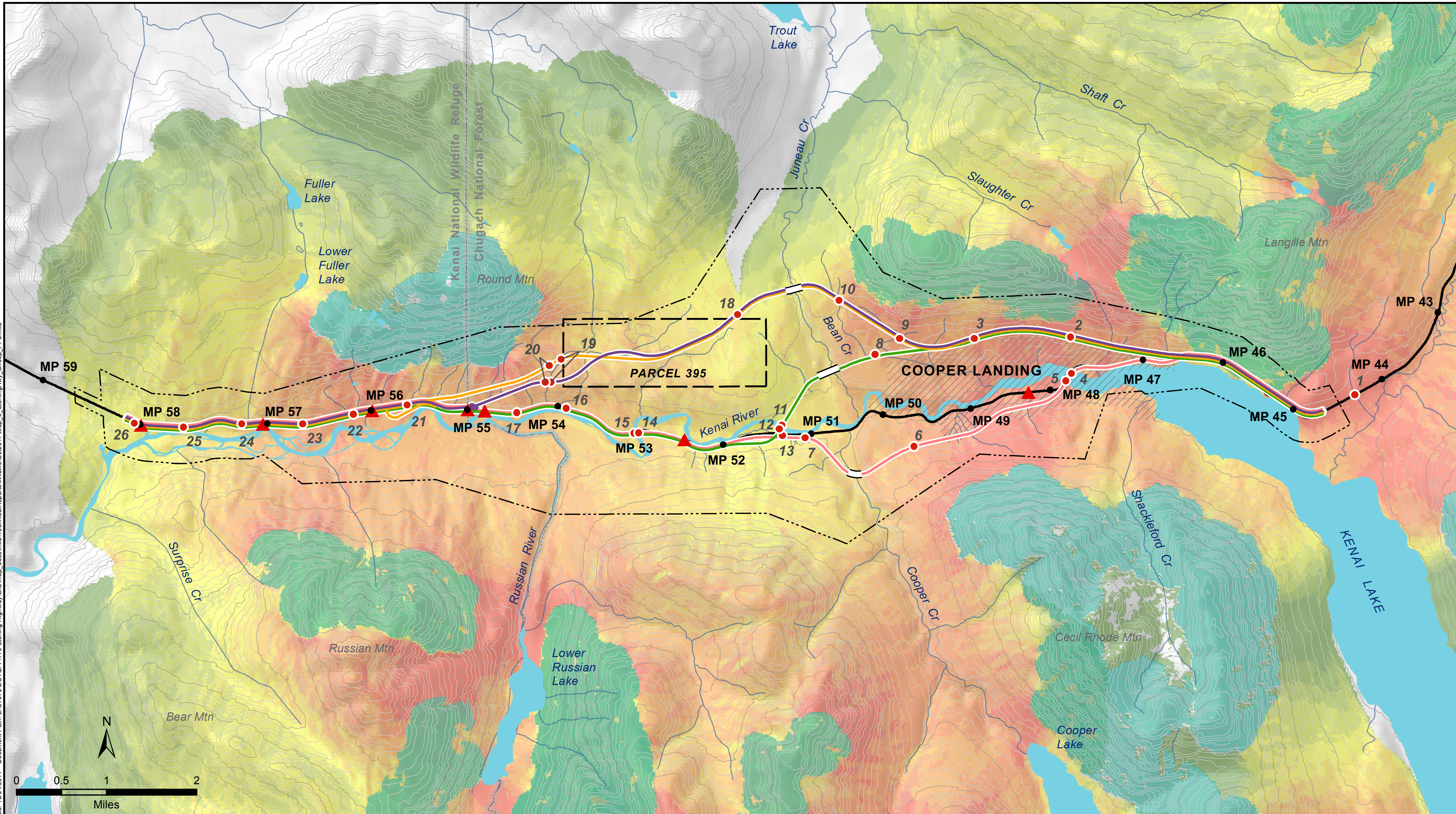

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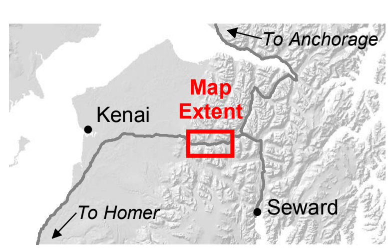
STERLING HIGHWAY MILE POST 45 TO 60 ALASKA



Legend

- Existing Highway

Project Alternatives

- Cooper Creek
- G South
- Juneau Creek
- Juneau Creek Variant

Sheep Pinch Points

- Higher Use
- Lower Use
- Core Habitat

- Potential Dedicated Wildlife Crossing
- Wildlife-Vehicle Accident (2000-2009)

- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 9

PINCH POINTS DALL SHEEP

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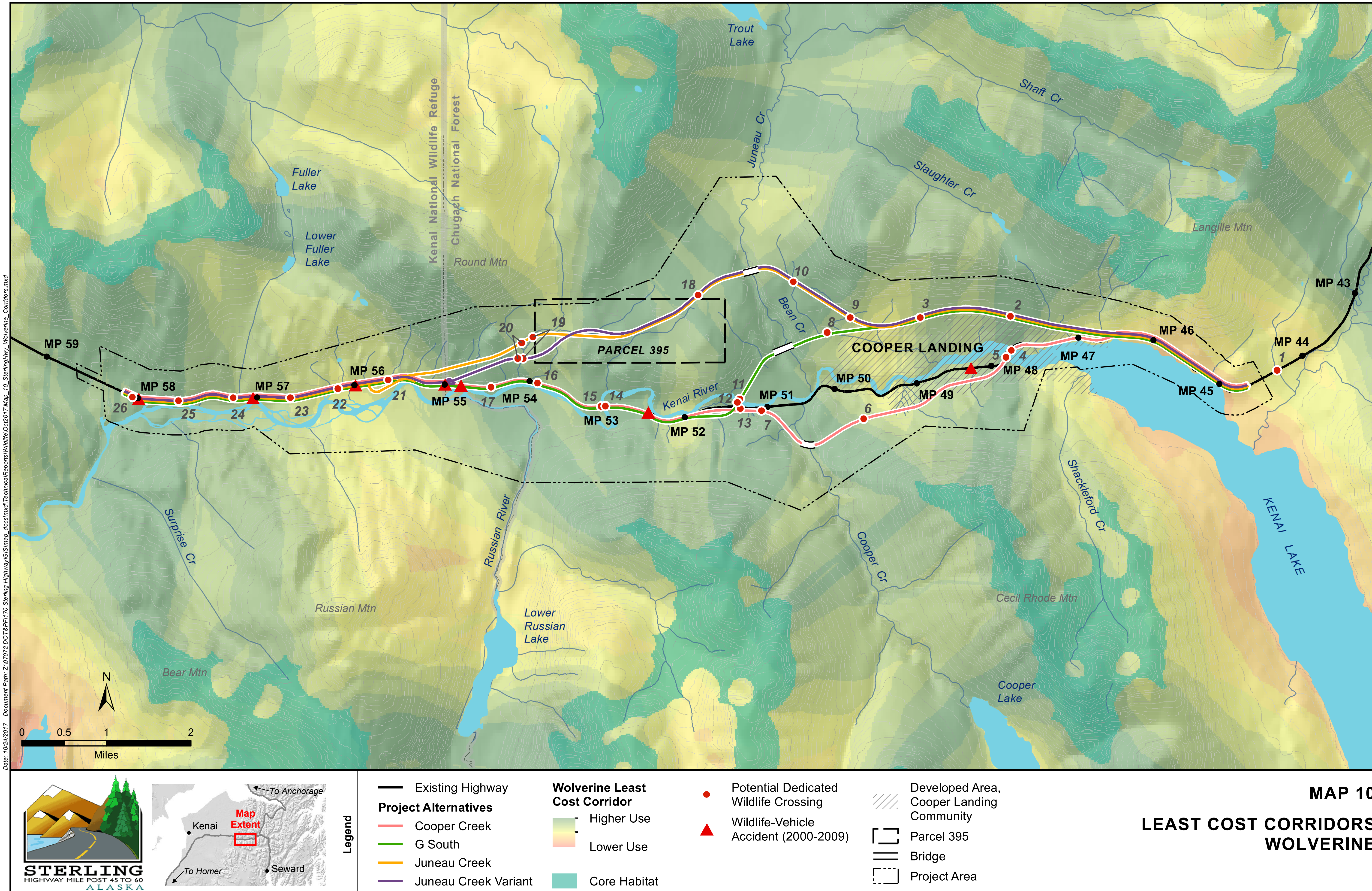

MAP 10

LEAST COST CORRIDORS WOLVERINE

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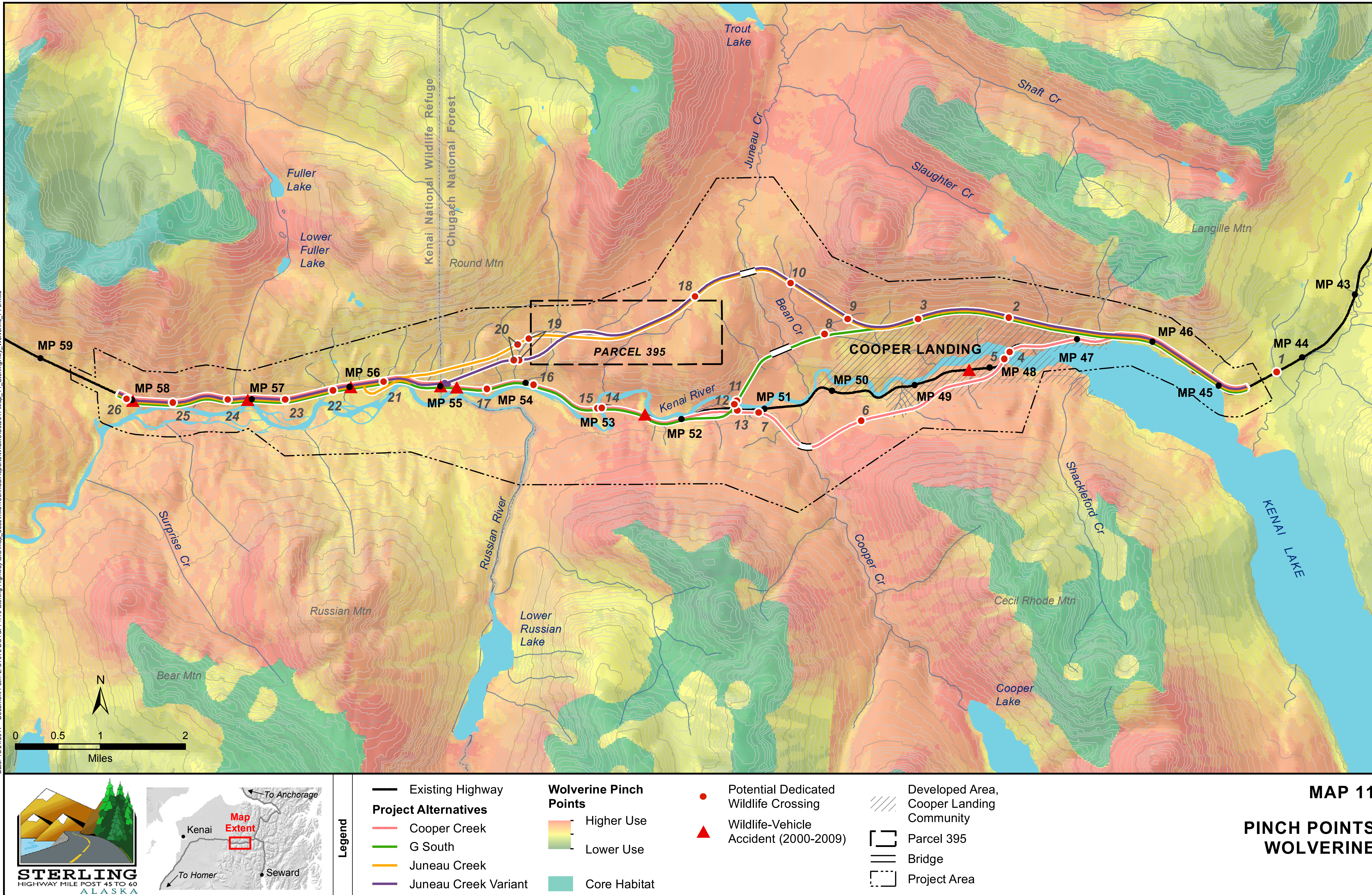
MAP 11
PINCH POINTS
WOLVERINE
Legend
Existing Highway
Project Alternatives
Cooper Creek
G South
Juneau Creek
Juneau Creek Variant
Wolverine Pinch Points
Higher Use
Lower Use
Core Habitat
Potential Dedicated Wildlife Crossing
Wildlife-Vehicle Accident (2000-2009)
Developed Area, Cooper Landing Community
Parcel 395
Bridge
Project Area
STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA
To Anchorage
Kenai
Map Extent
To Homer
Seward
COOPER LANDING
PARCEL 395
Kenai National Wildlife Refuge
Chugach National Forest
Trout Lake
Fuller Lake
Lower Fuller Lake
Round Mtn
Juneau Cr
Shaft Cr
Slaughter Cr
Langille Mtn
Bean Cr
Kenai River
Russian River
Surprise Cr
Russian Mtn
Lower Russian Lake
Bear Mtn
Cooper Cr
Shackleford Cr
Cecil Rhode Mtn
Cooper Lake
KENAI LAKE
MP 43
MP 44
MP 45
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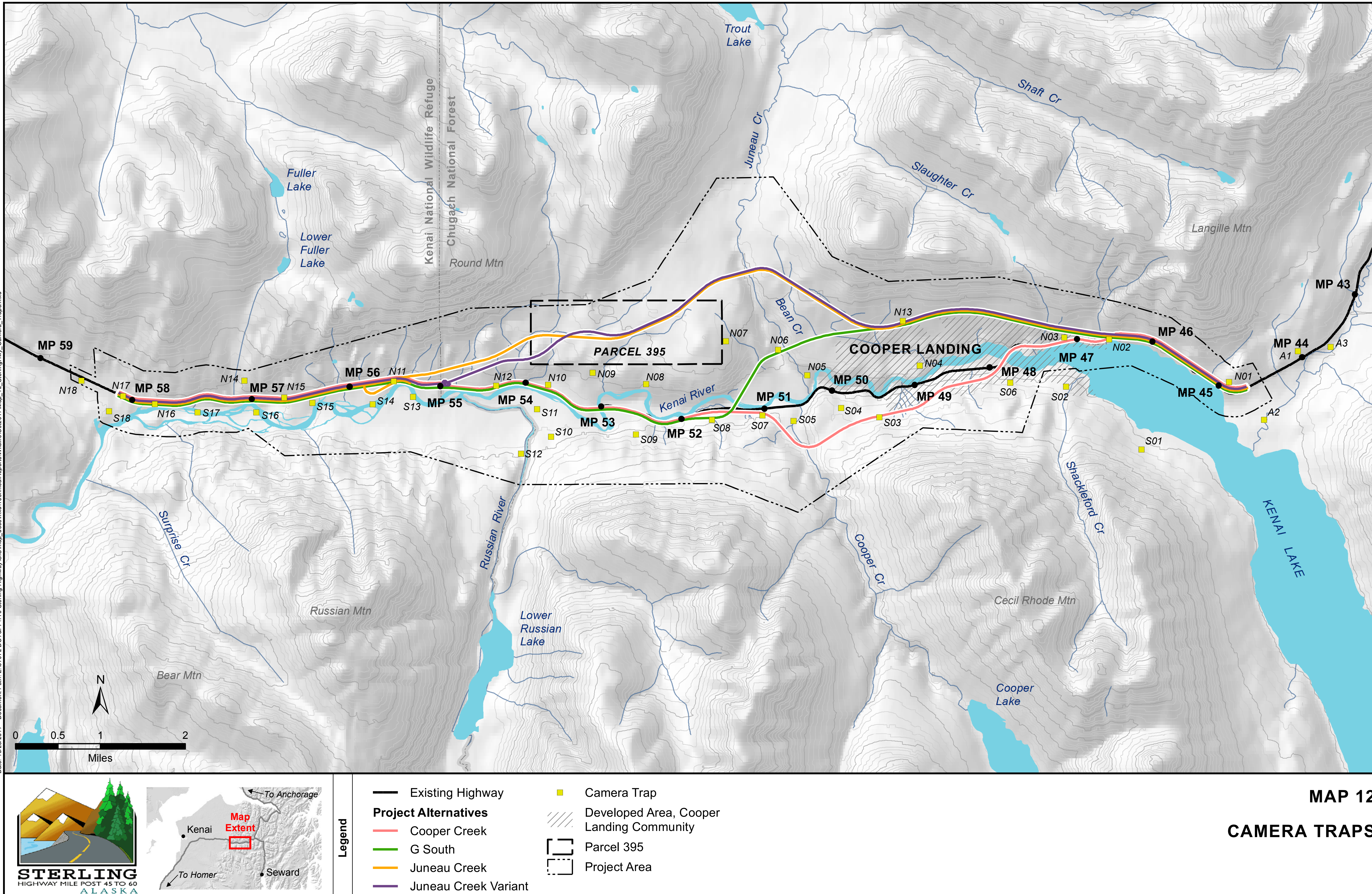

Legend

- Existing Highway
- **Project Alternatives**
  - Cooper Creek
  - G South
  - Juneau Creek
  - Juneau Creek Variant
- Camera Trap
- Developed Area, Cooper Landing Community
- Parcel 395
- Project Area

MAP 12

CAMERA TRAPS

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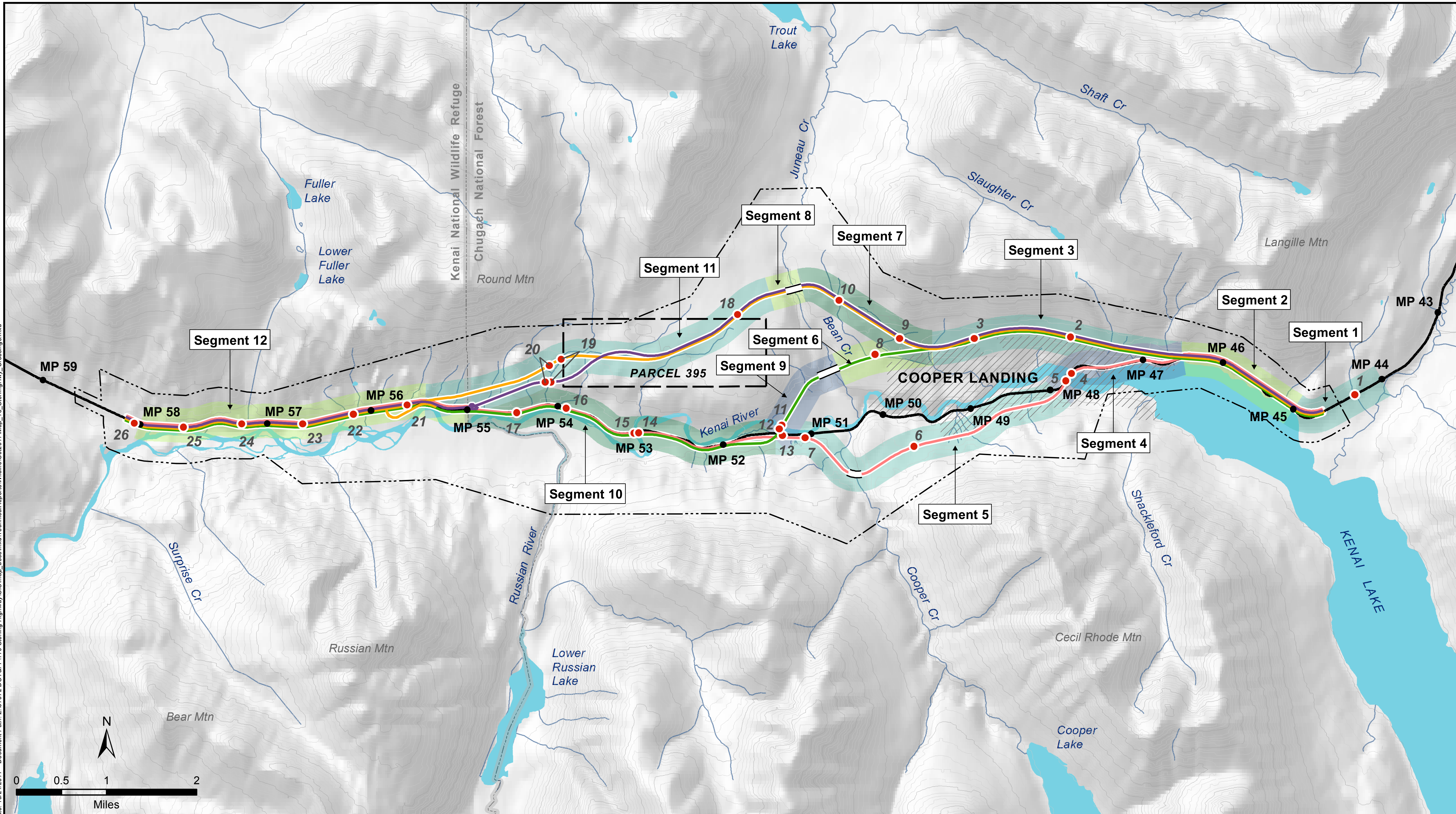

STERLING HIGHWAY MILE POST 45 TO 60 ALASKA

To Anchorage
Kenai
Map Extent
To Homer
Seward

Legend

- Existing Highway
- **Project Alternatives**
  - Cooper Creek
  - G South
  - Juneau Creek
  - Juneau Creek Variant
- Potential Dedicated Wildlife Crossing
- Developed Area, Cooper Landing Community
- Parcel 395
- Bridge
- Project Area

MAP 13

POTENTIAL CROSSING LOCATIONS

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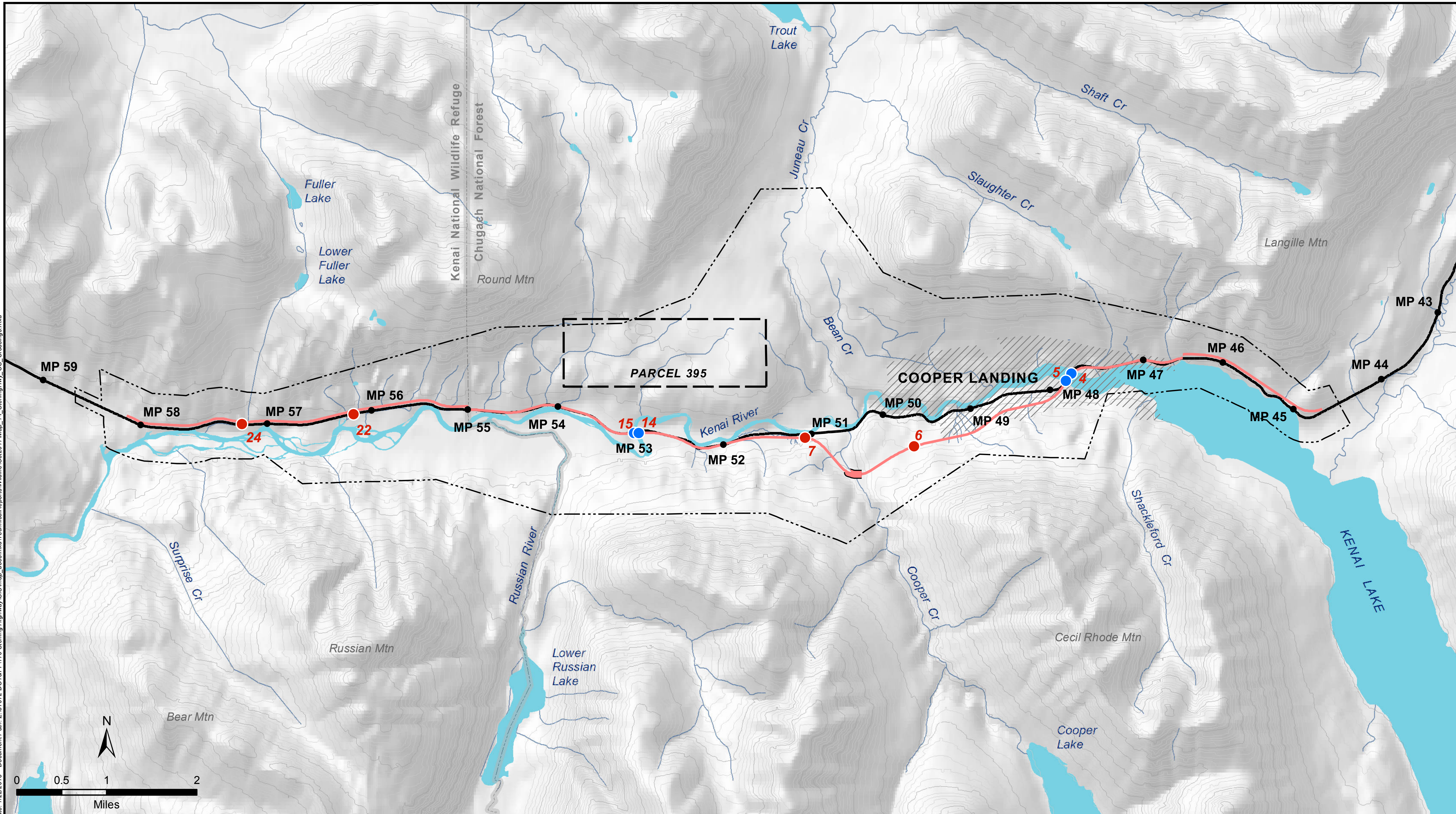

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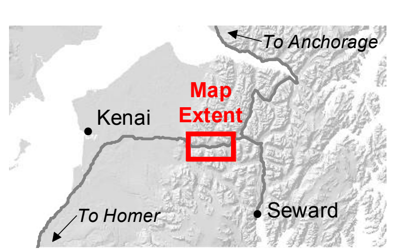
STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA



Legend

Recommended Wildlife Crossing
- Bridge
- Overpass
- Underpass

- Existing Highway
- Cooper Creek Alternative
- Cooper Creek Bridge
- Developed Area, Cooper Landing Community
- Parcel 395
- Project Area

MAP 14

RECOMMENDED CROSSING LOCATIONS
COOPER CREEK ALTERNATIVE

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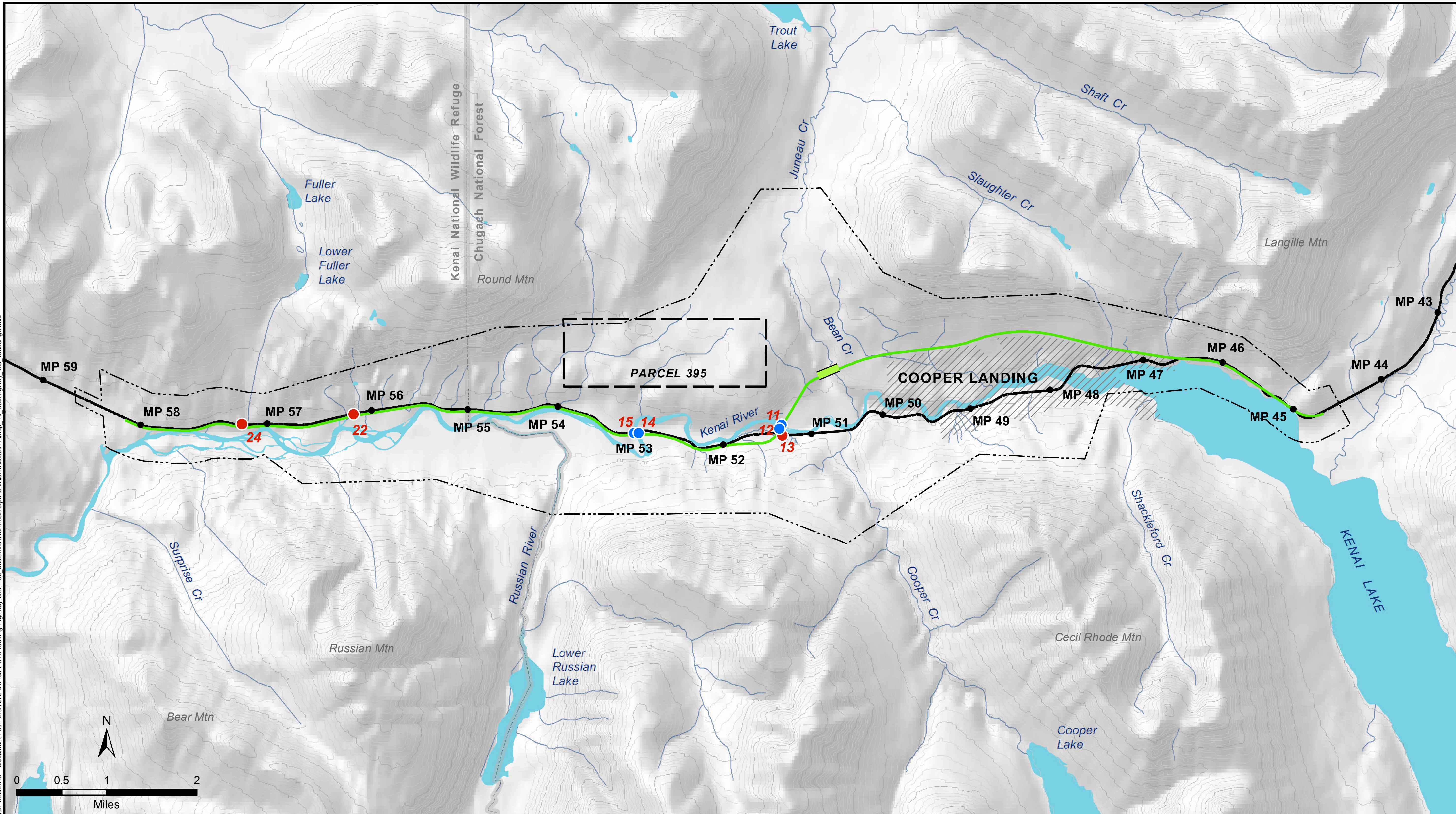

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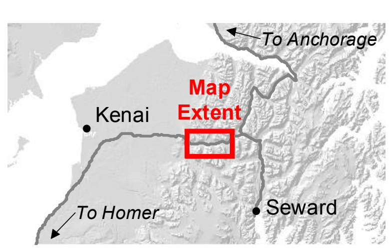
STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA



Legend

Recommended Wildlife Crossing
- Bridge
- Overpass
- Underpass

- Existing Highway
- G South Alternative
- Lower Juneau Creek Bridge

- Developed Area, Cooper Landing Community
- Parcel 395
- Project Area

MAP 15

RECOMMENDED CROSSING LOCATIONS G SOUTH ALTERNATIVE

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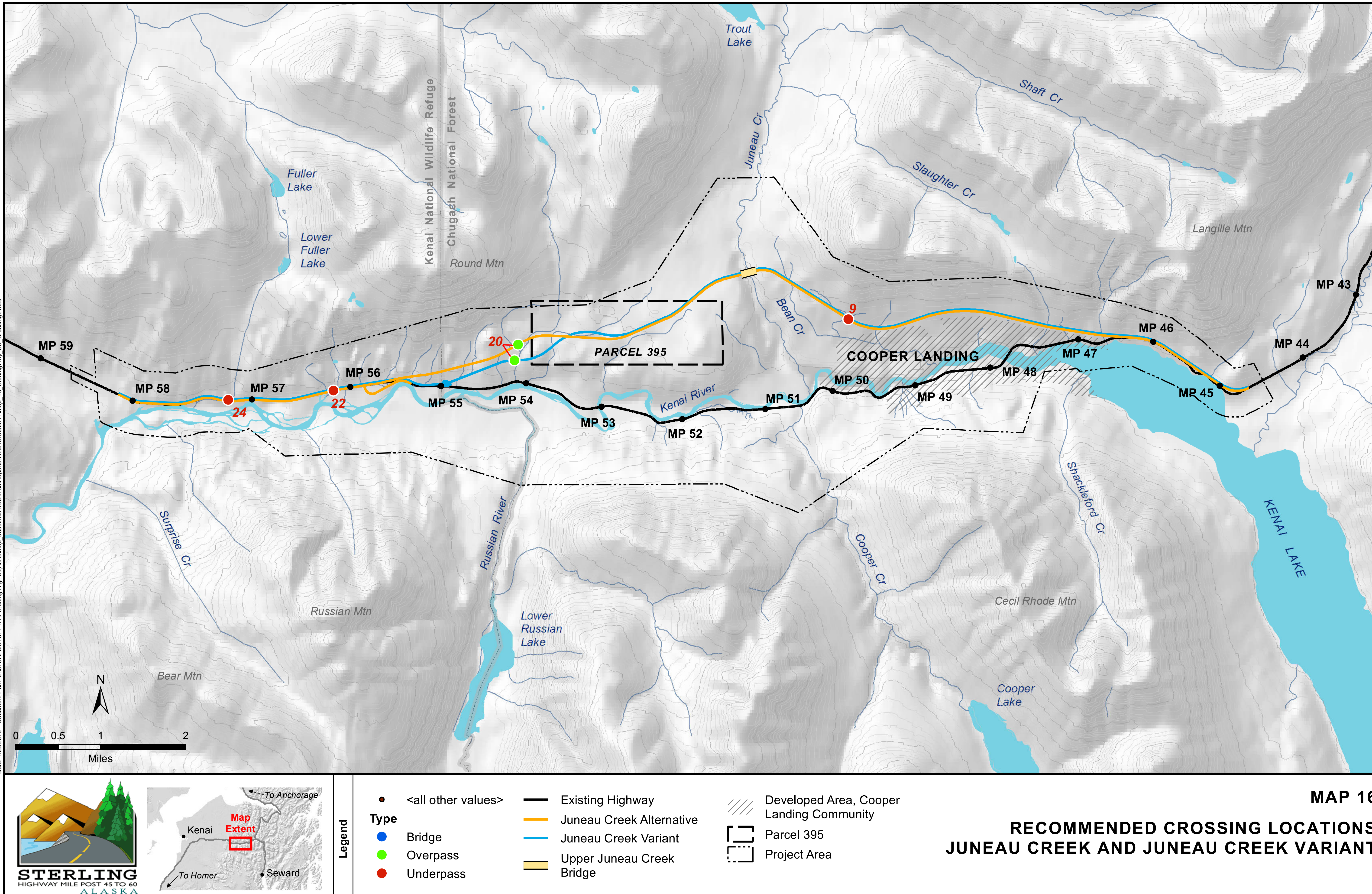

MAP 16

RECOMMENDED CROSSING LOCATIONS JUNEAU CREEK AND JUNEAU CREEK VARIANT

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Appendix A

Conceptual Engineering for Wildlife Crossings

The attached plan sheets indicate initial concepts for wildlife crossing structures at a subset of the 26 locations noted on Map 13. In some cases, there are different concepts for two different project alternatives (alignments) at a given location number. In other cases, the highway alignment and wildlife crossing concept is identical for two or more alternatives at a given location; in such cases, the concepts shown are based on the G South Alternative or Juneau Creek Alternative but would apply to other alternatives as noted on each sheet.

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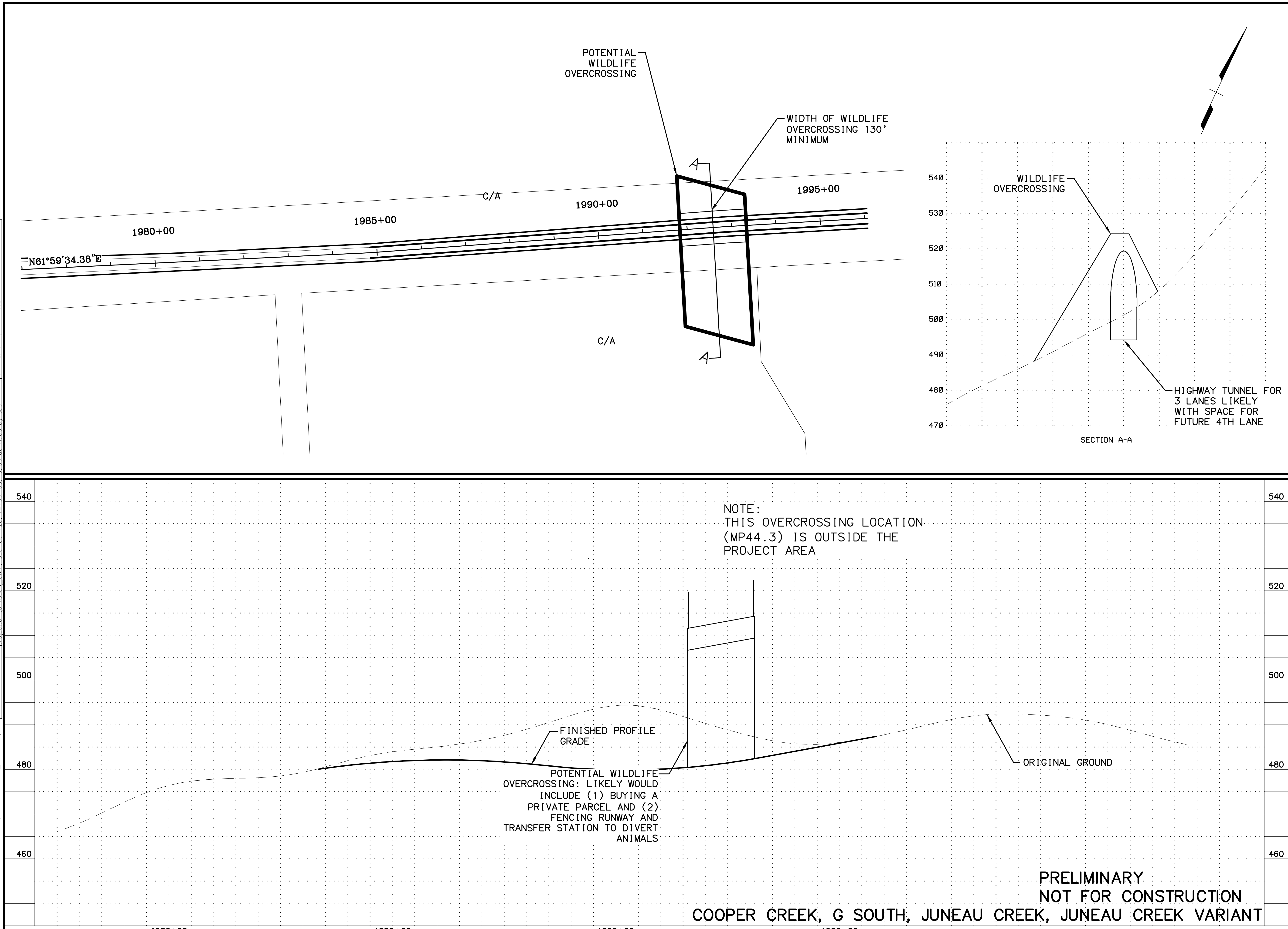

SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

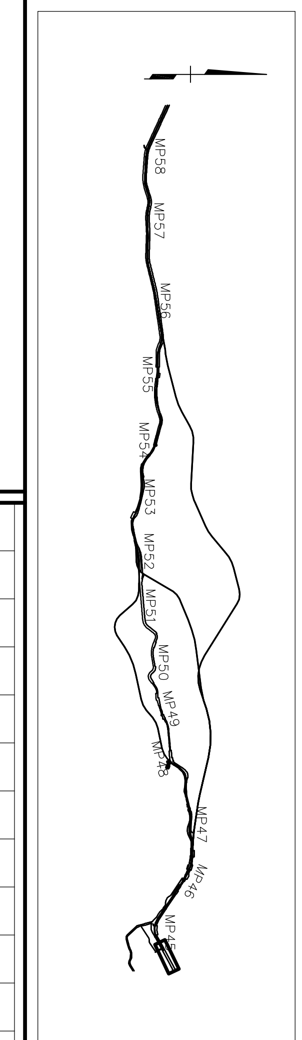
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



1

SEGMENT 1

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1806+00 TO 1832+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB
SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION

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SHEET NO.	TOTAL SHEETS
2	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

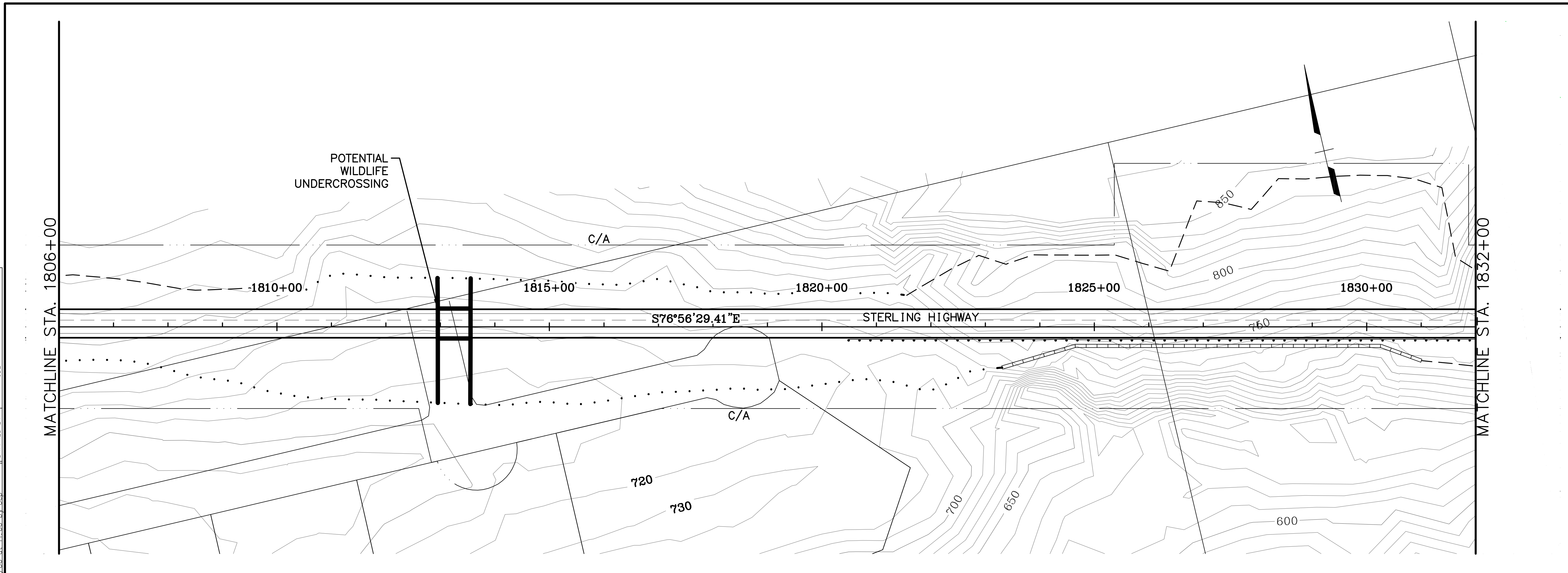
F-021-2(15)/53014

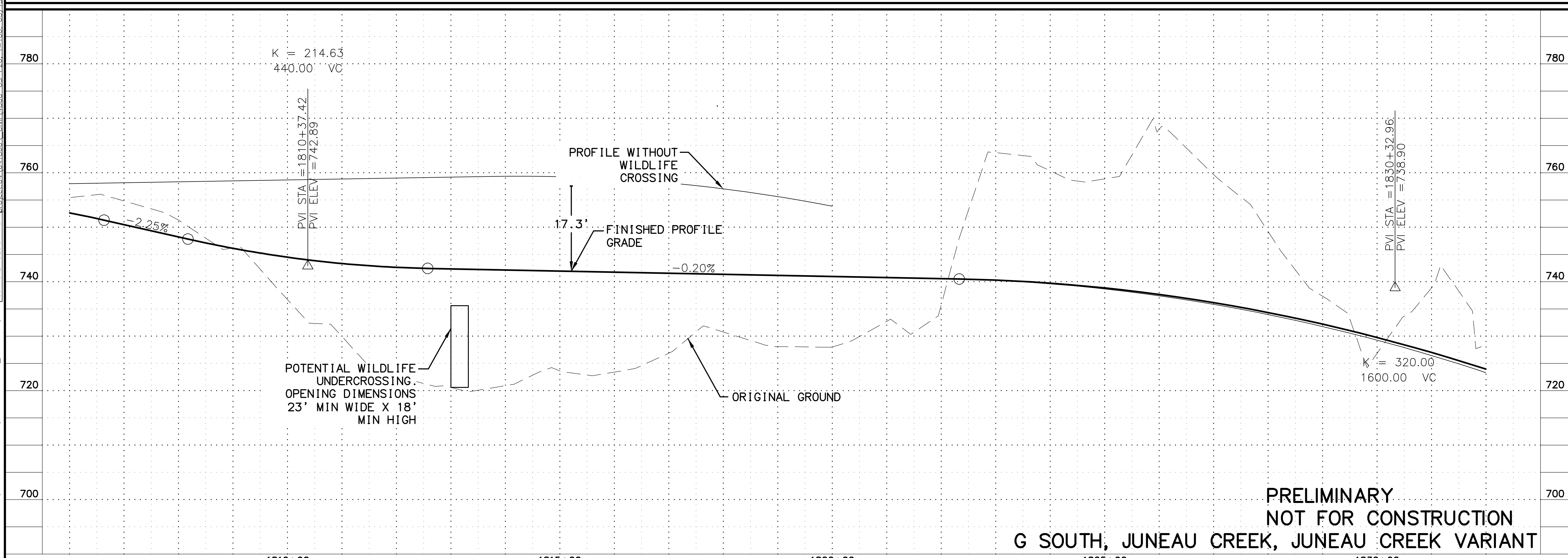
ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION





2

SEGMENT 3

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

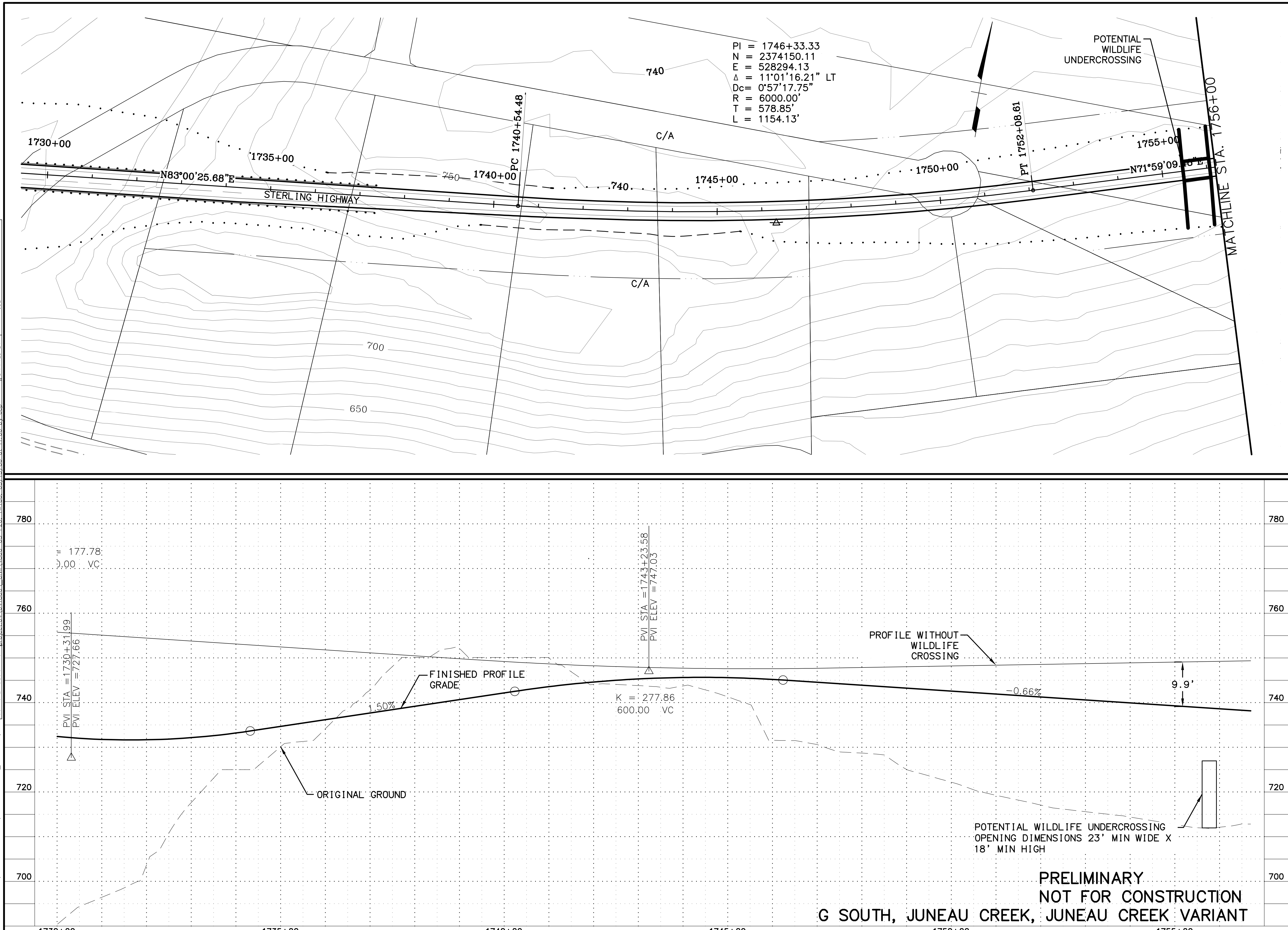
STERLING HIGHWAY
M.P. 45–60

STA 1806+00 TO 1832+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION

VIEW: GS-F25_F_D0755, GS-F25_F_D1055, GS-F25_H_L5000
XREF: 4800-BD02, 4800-DESIGN-01, 4800-SURVEY_A-02-PP, ROW



SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

3

SEGMENT 3

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1730+00 TO 1756+00

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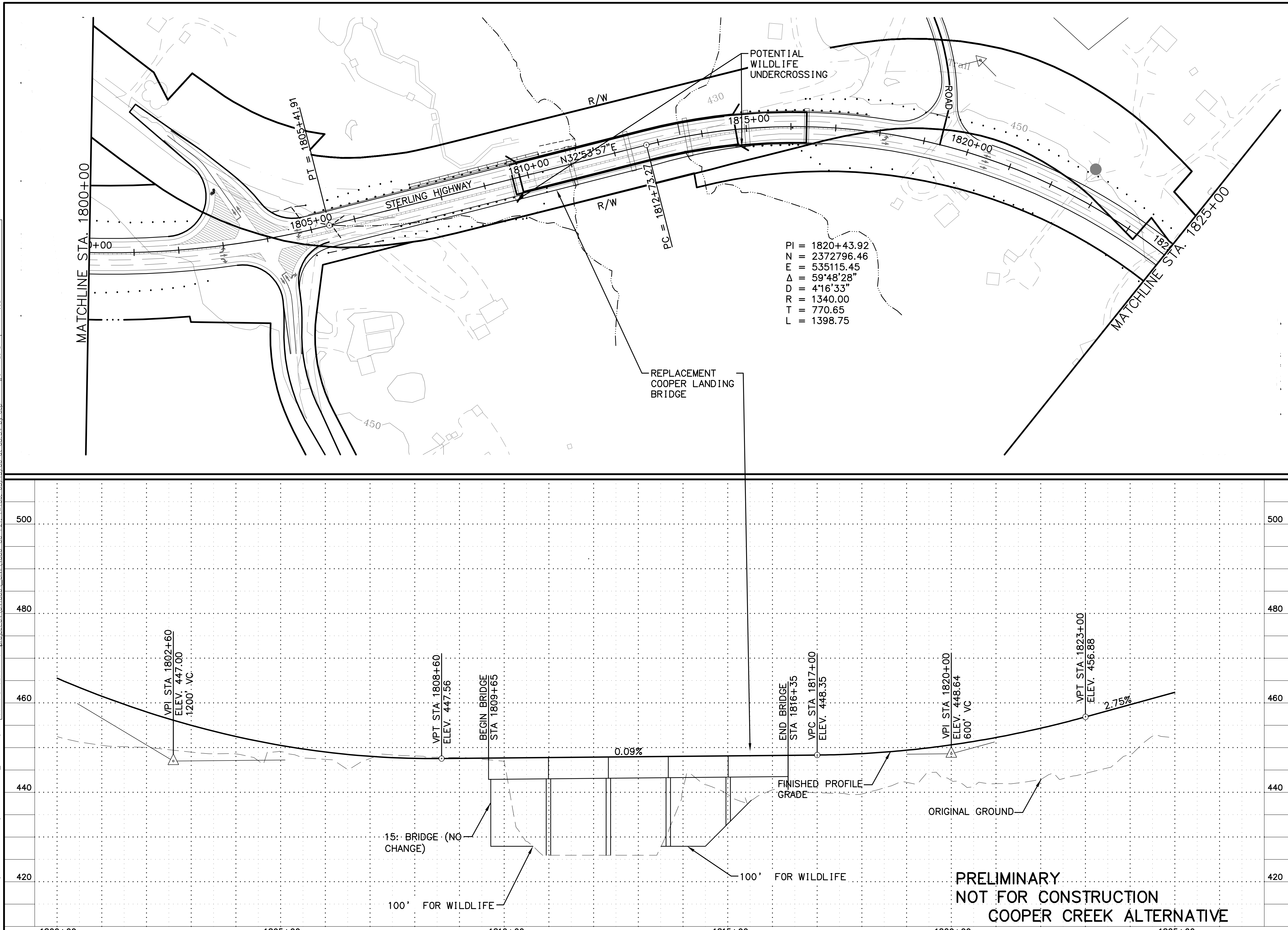


SHEET NO.	TOTAL SHEETS
4	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

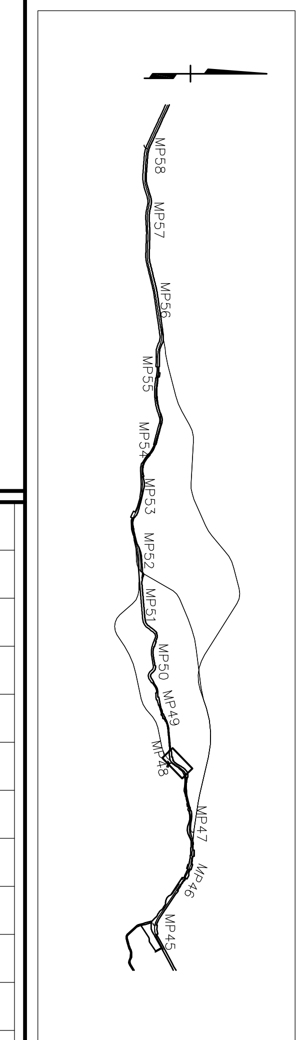
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



4&5

SEGMENT 4

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

COOPER CREEK ALT.
PLAN AND PROFILE
STA 1800+00 TO 1825+00

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SHEET NO.	TOTAL SHEETS
5	29
STATE	YEAR
ALASKA	2016

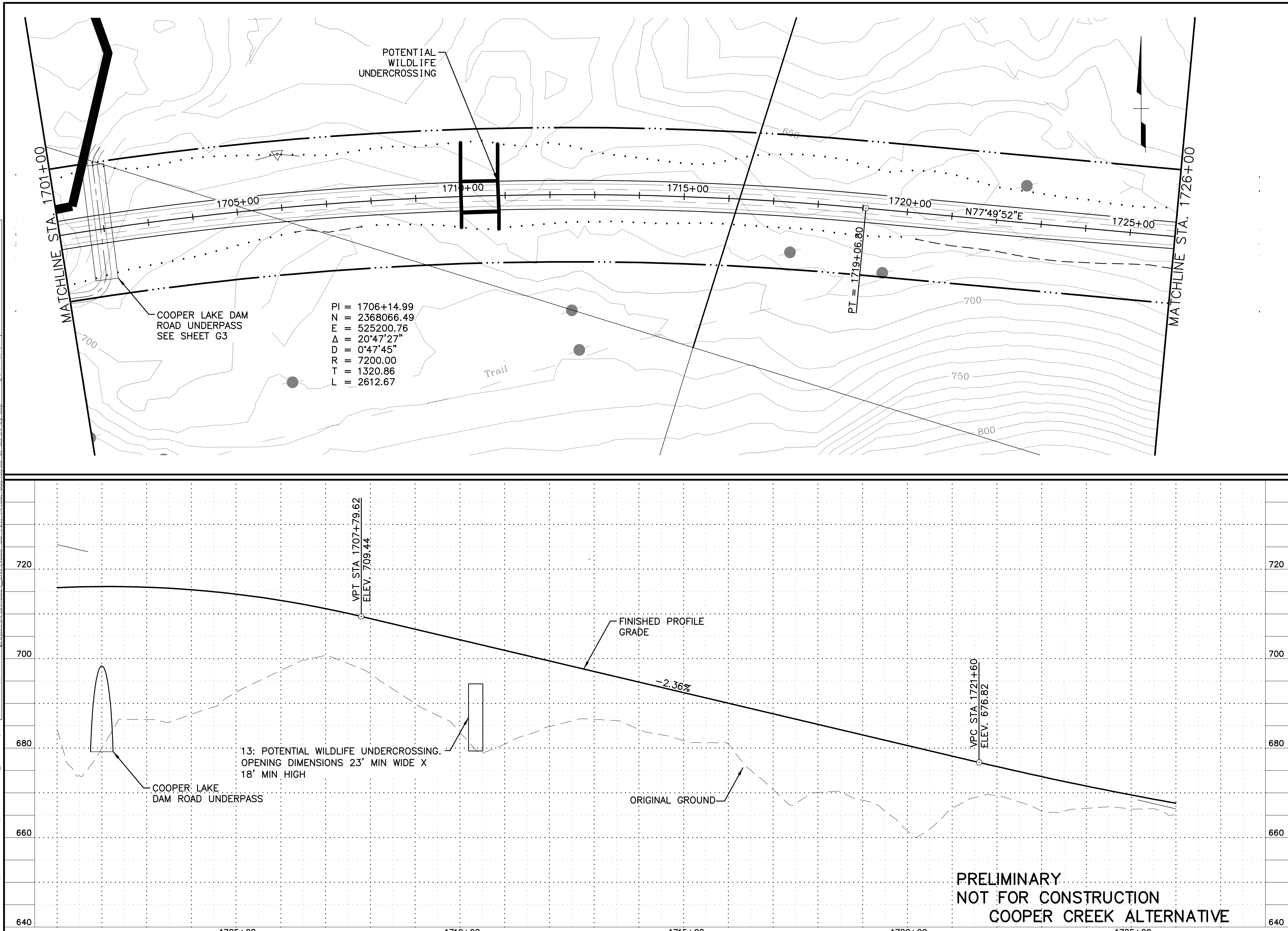
PROJECT DESIGNATION: F-021-2(15)/53014

ADDENDUM NO.

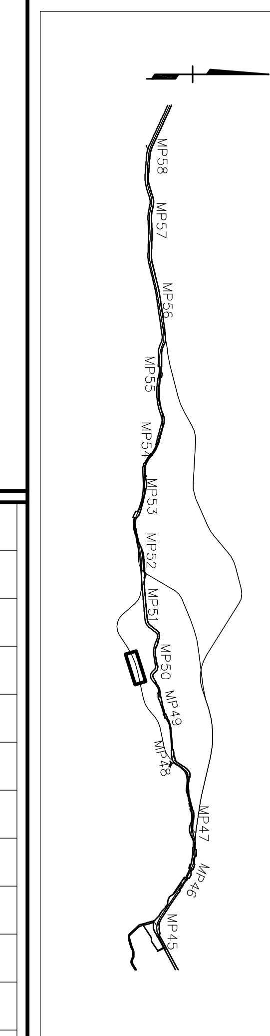
ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



PRELIMINARY
NOT FOR CONSTRUCTION
COOPER CREEK ALTERNATIVE



SEGMENT 5

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1701+00 TO 1726+00

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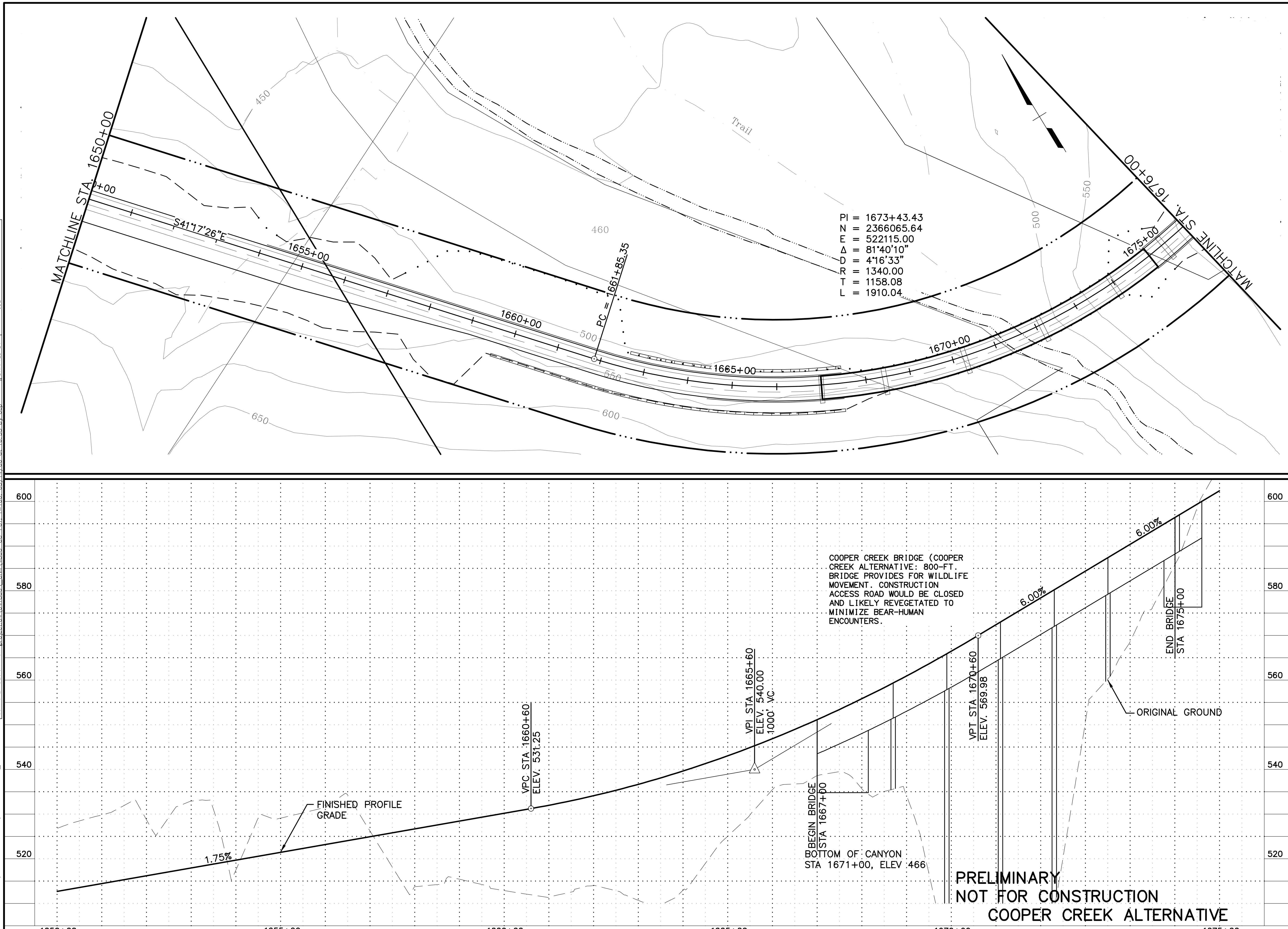

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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

COOPER CREEK BRIDGE

SEGMENT 5

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1650+00 TO 1676+00

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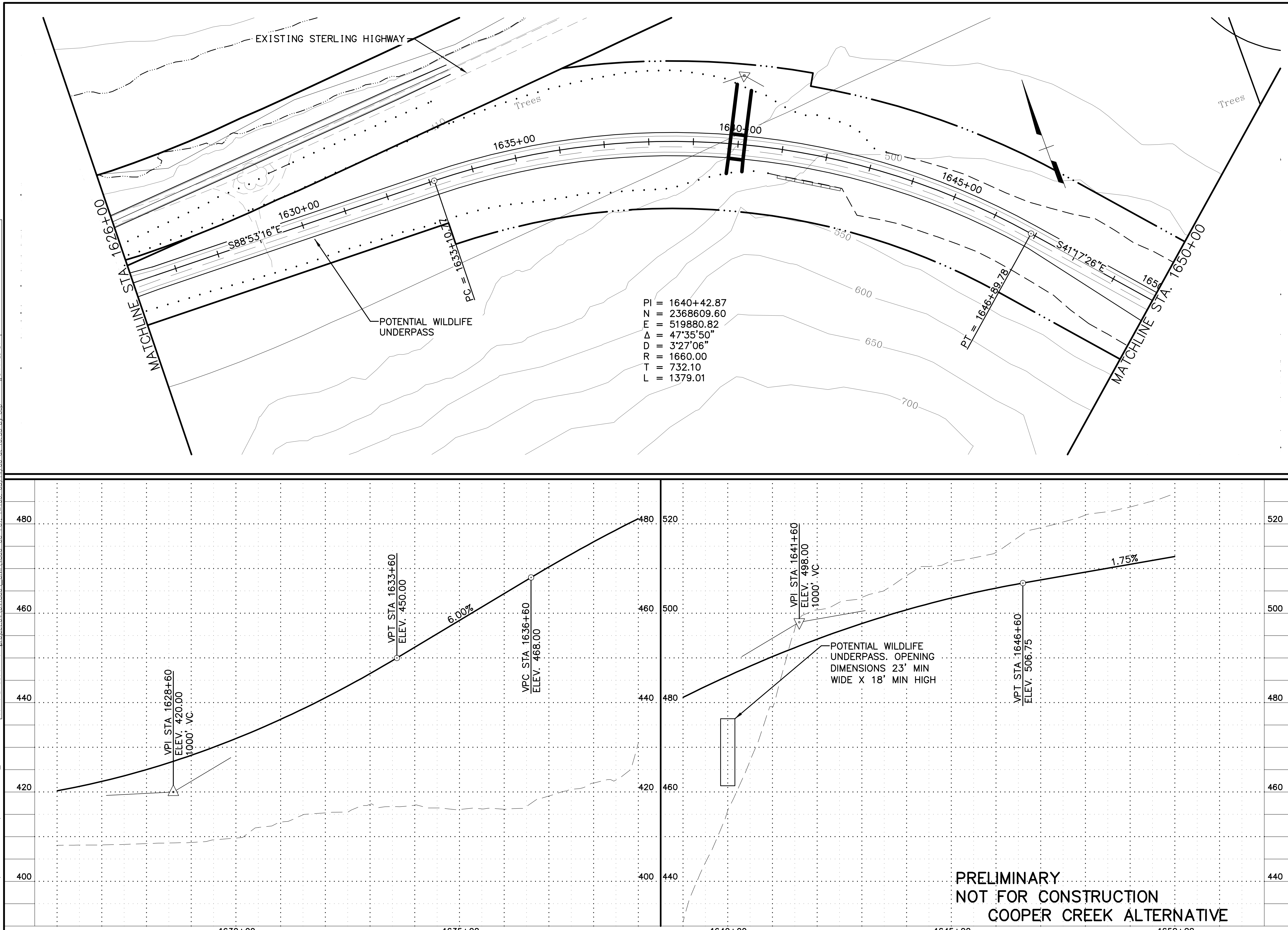

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STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

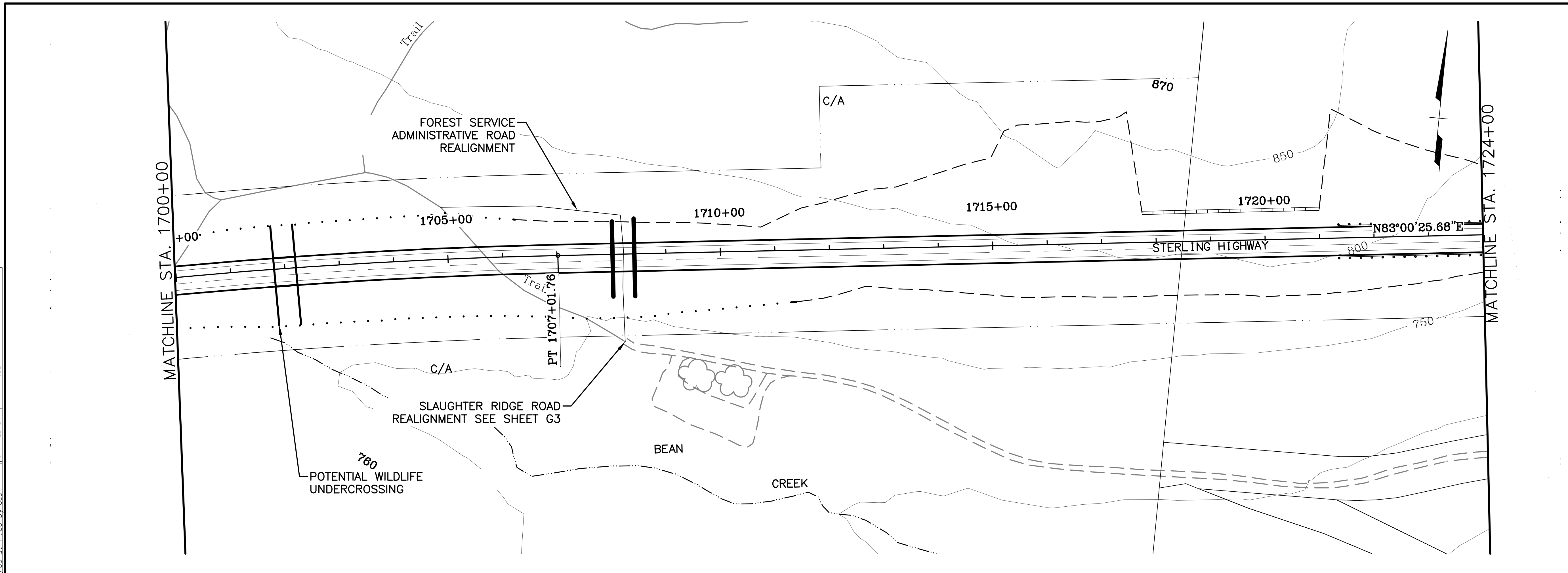
SEGMENT 5

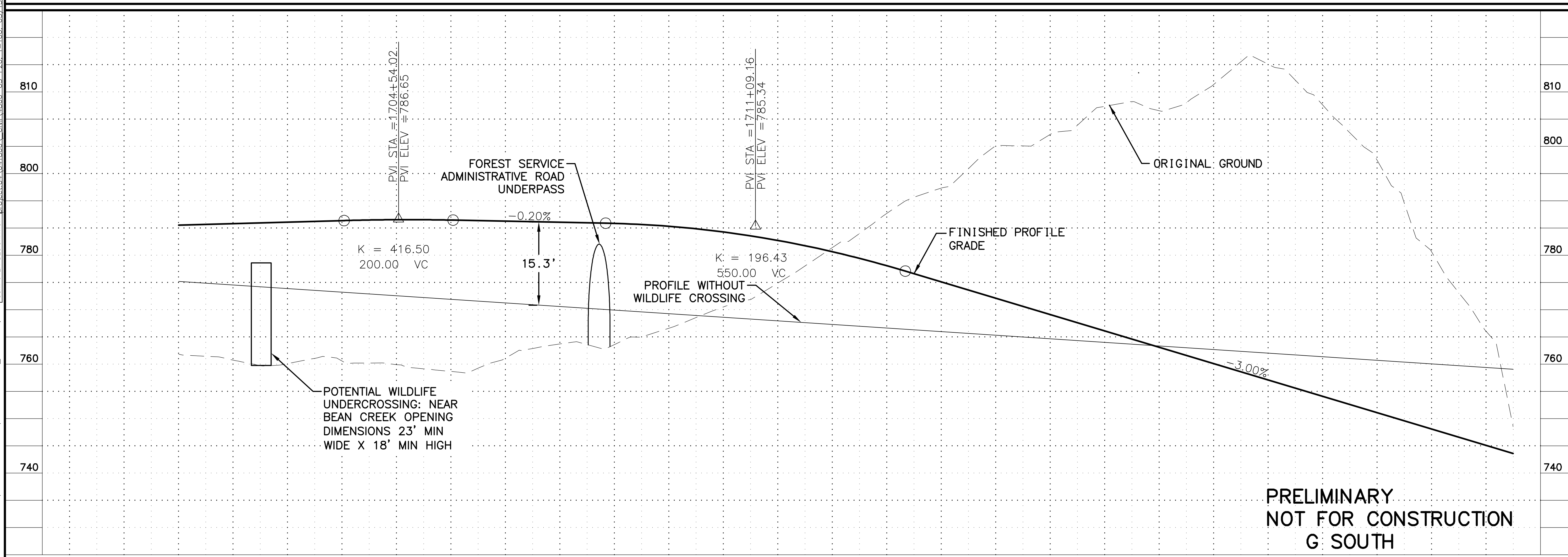
STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1601+00 TO 1628+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB
SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION





PRELIMINARY
NOT FOR CONSTRUCTION
G SOUTH

SHEET NO.	TOTAL SHEETS
8	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

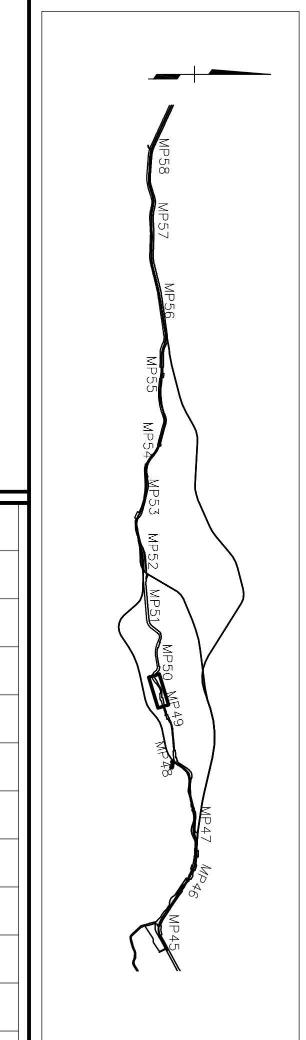
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



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SEGMENT 6

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1700+00 TO 1724+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

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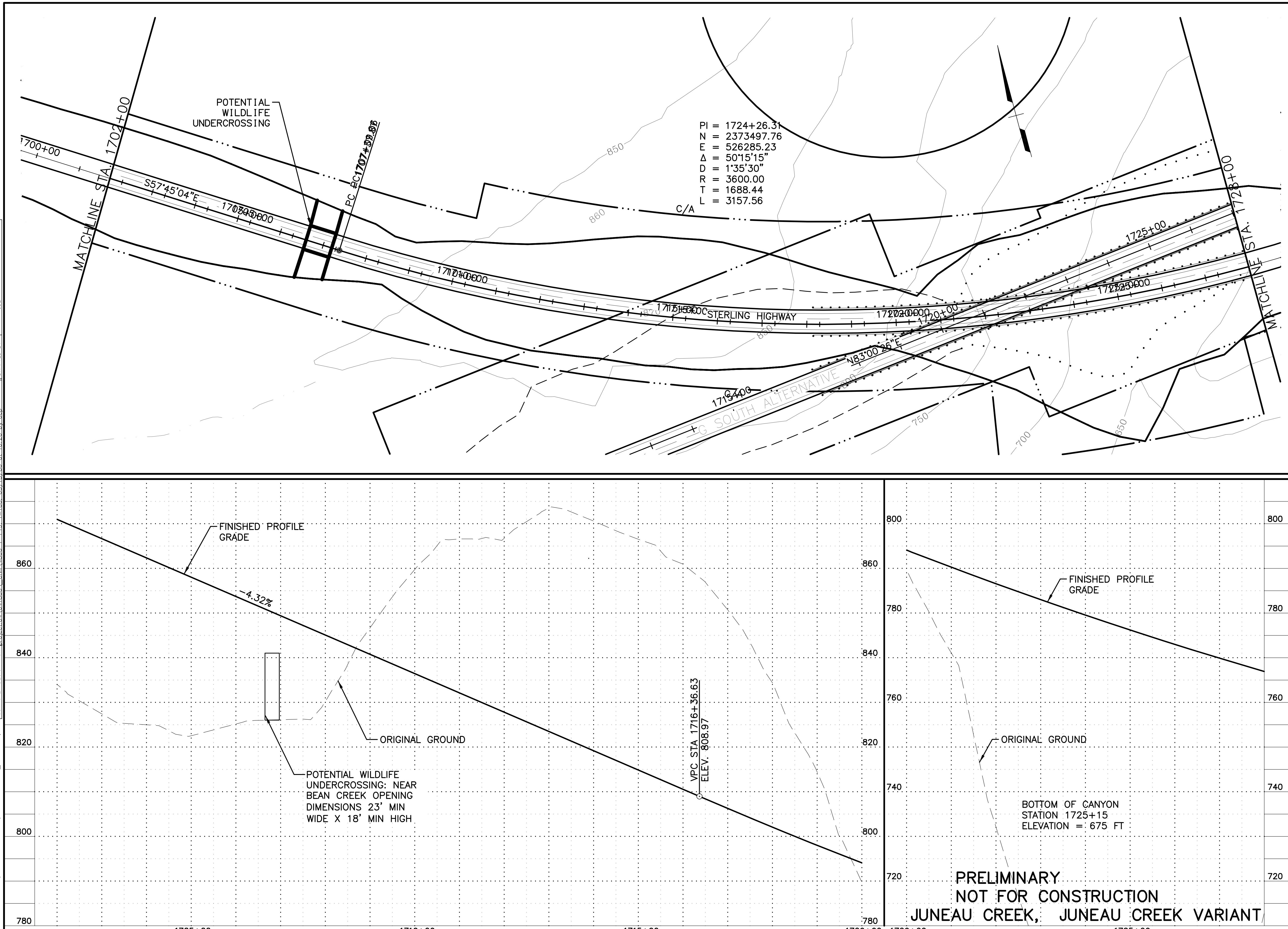

PRELIMINARY
NOT FOR CONSTRUCTION
JUNEAU CREEK, JUNEAU CREEK VARIANT

SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION: F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

9

SEGMENT 7

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1702+00 TO 1728+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

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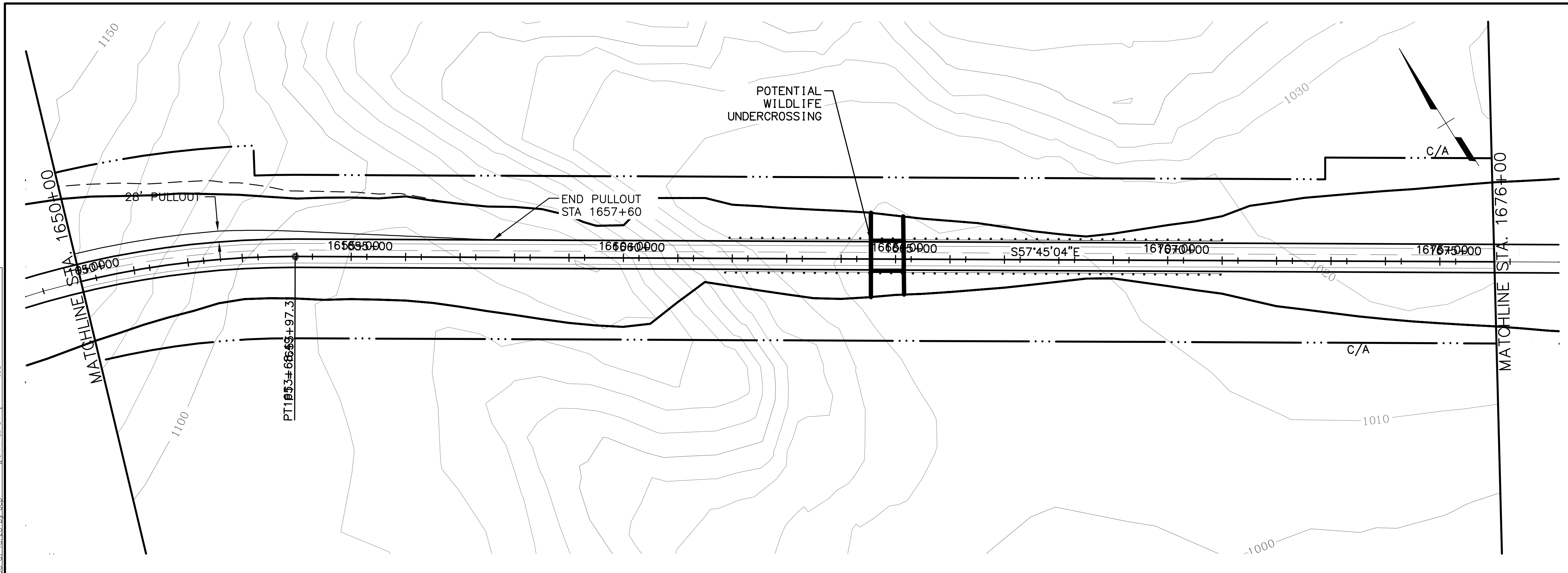

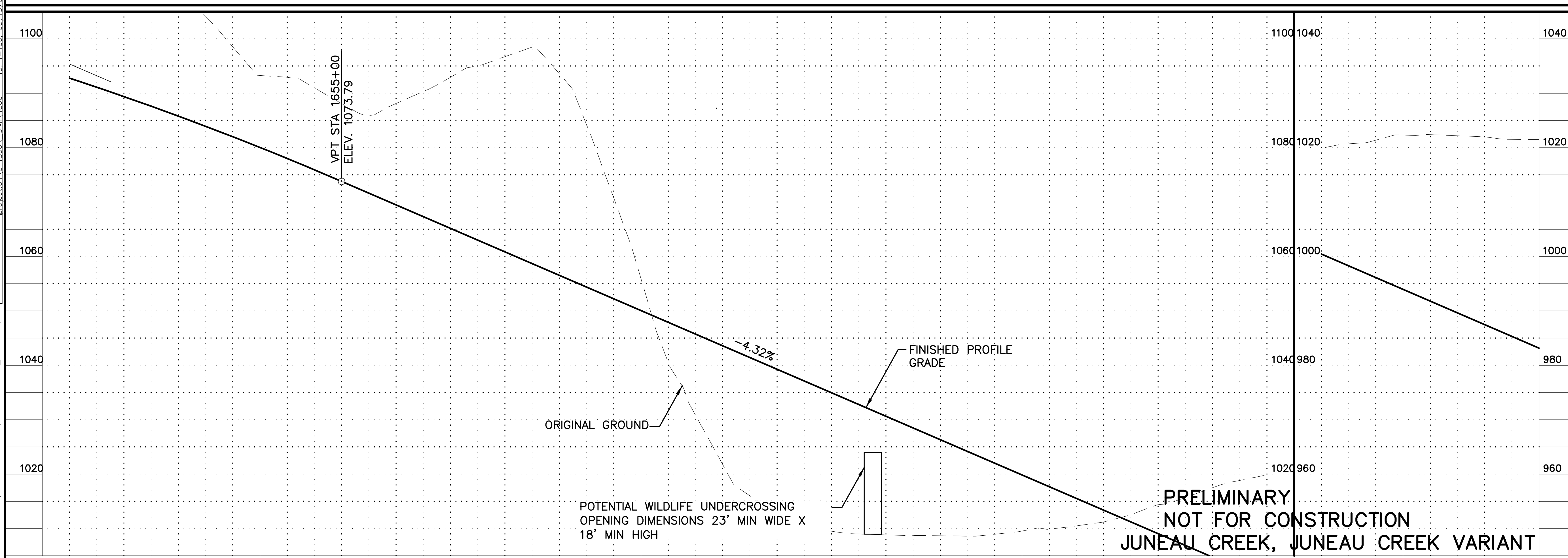

PRELIMINARY
NOT FOR CONSTRUCTION
JUNEAU CREEK, JUNEAU CREEK VARIANT

SHEET NO.	TOTAL SHEETS
10	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

10

SEGMENT 7

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1650+00 TO 1676+00

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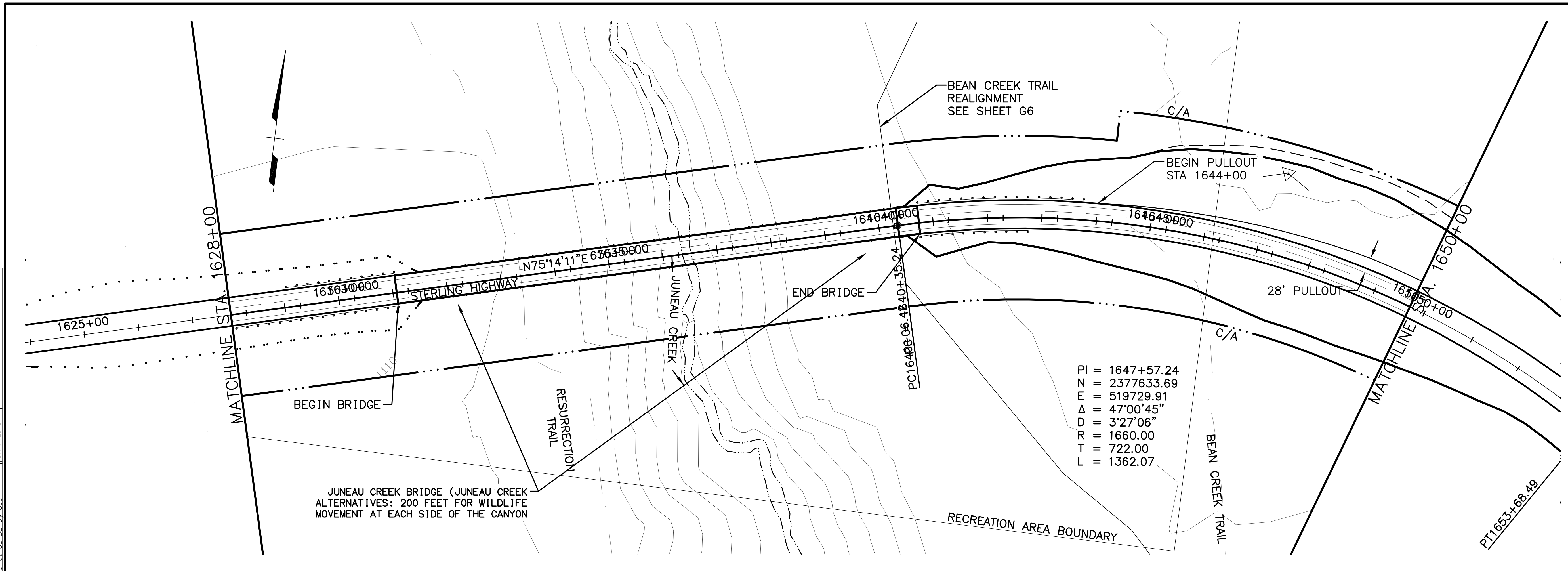

SEE SHEET 11 FOR PROFILE

PRELIMINARY
NOT FOR CONSTRUCTION
JUNEAU CREEK, JUNEAU CREEK VARIANT

SHEET NO.	TOTAL SHEETS
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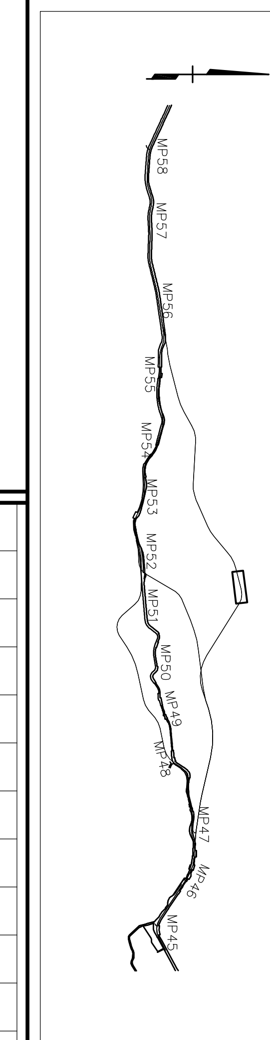
STATE	YEAR
ALASKA	2016
PROJECT DESIGNATION	
F-021-2(15)/53014	
ADDENDUM NO.	
ATTACHMENT NO.	

REVISIONS

NO.	DATE	DESCRIPTION



UPPER JUNEAU CREEK BRIDGE

SEGMENT 8

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1628+00 TO 1650+00

DESIGNED BY
CHECKED BY
DRAFTED BY
SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION

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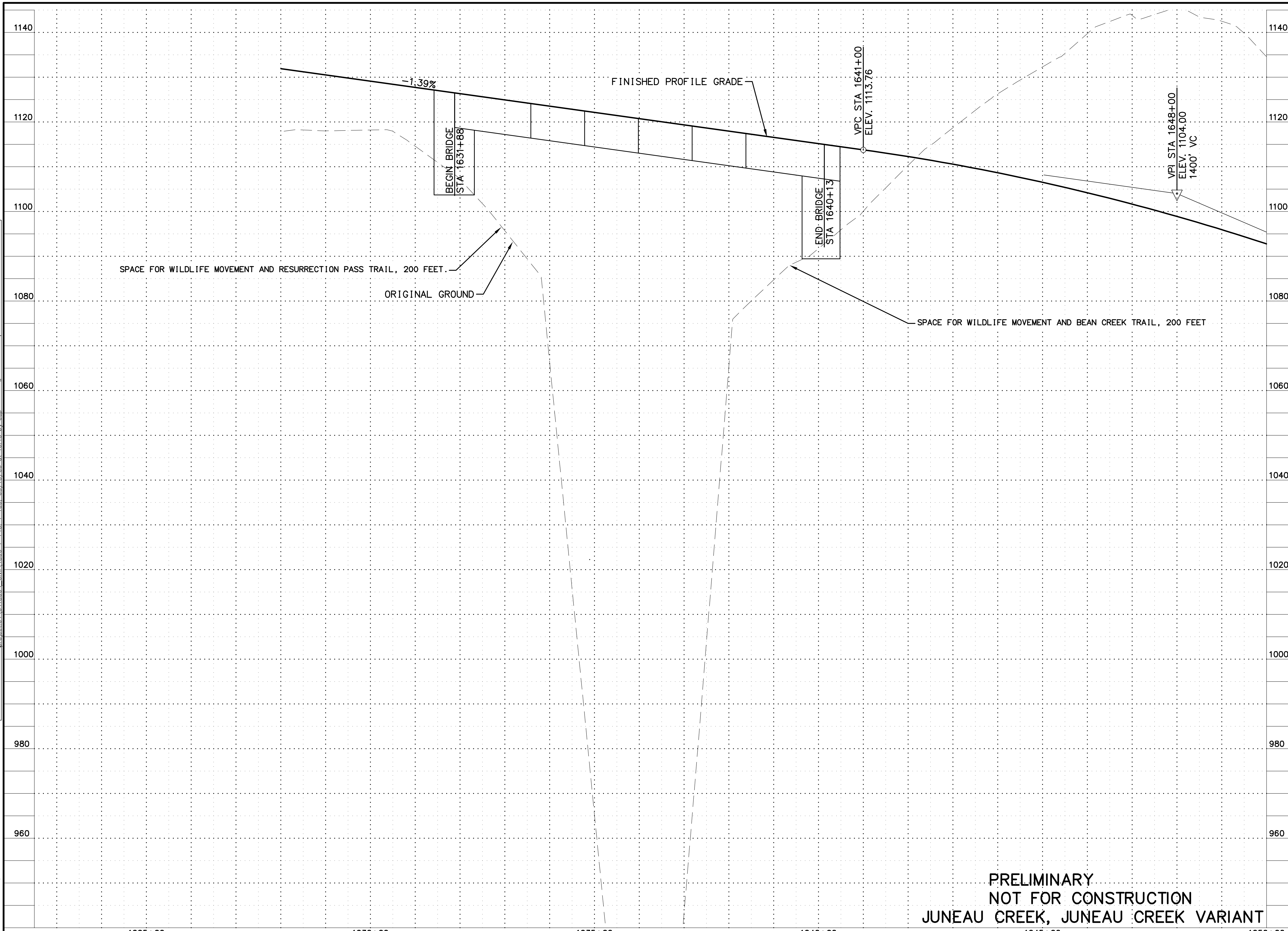

SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

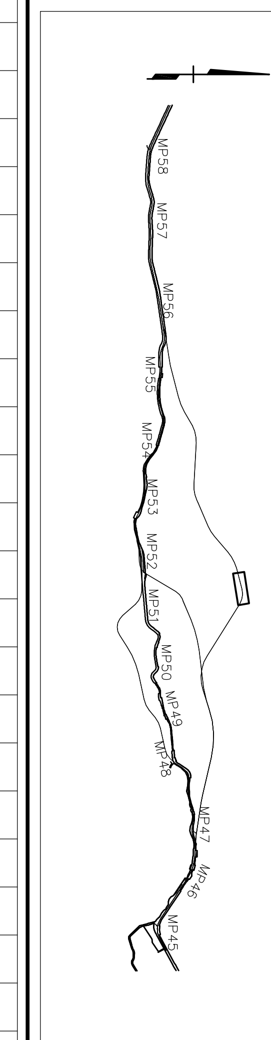
F−021−2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



UPPER JUNEAU CREEK BRIDGE

SEGMENT 8

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45−60

STA 1628+00 TO 1650+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-F-F18_1=100, 03/15/06 at 10:15 by cep

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XREF: 4800-BD02, 4800-DESIGN-01

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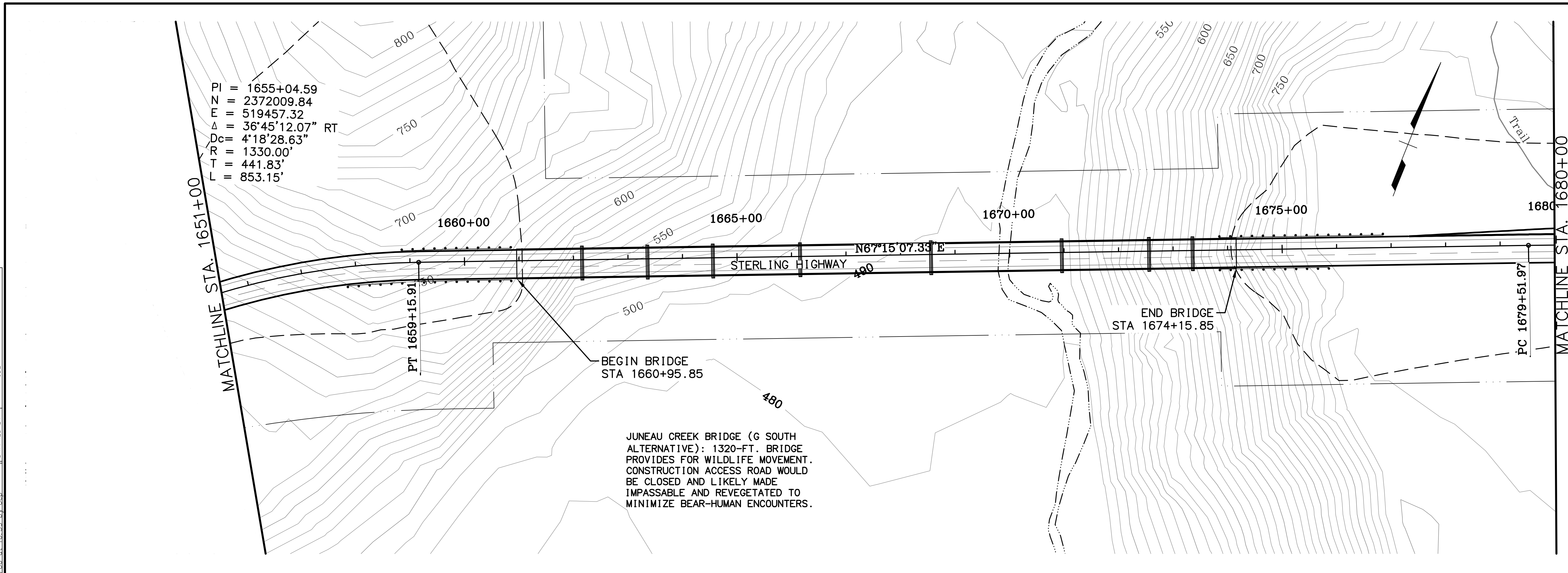


SEE SHEET 13 FOR PROFILE

PRELIMINARY
NOT FOR CONSTRUCTION
G SOUTH

SHEET NO.	TOTAL SHEETS
13	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION: F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

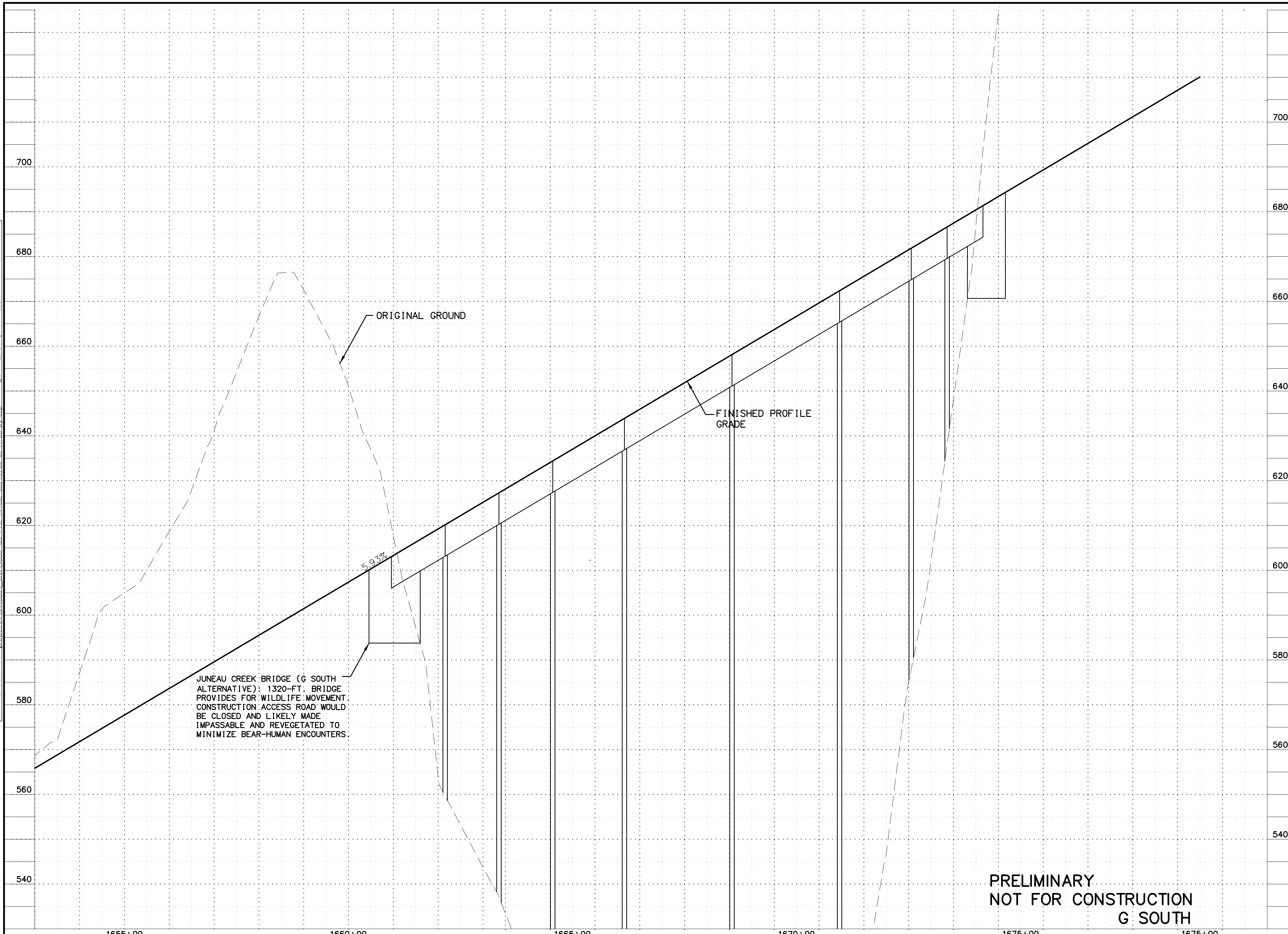
LOWER JUNEAU CREEK BRIDGE

SEGMENT 9

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1653+00 TO 1680+00



SHEET NO.	TOTAL SHEETS
14	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

LOWER JUNEAU CREEK BRIDGE

SEGMENT 9

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1653+00 TO 1675+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CRB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION

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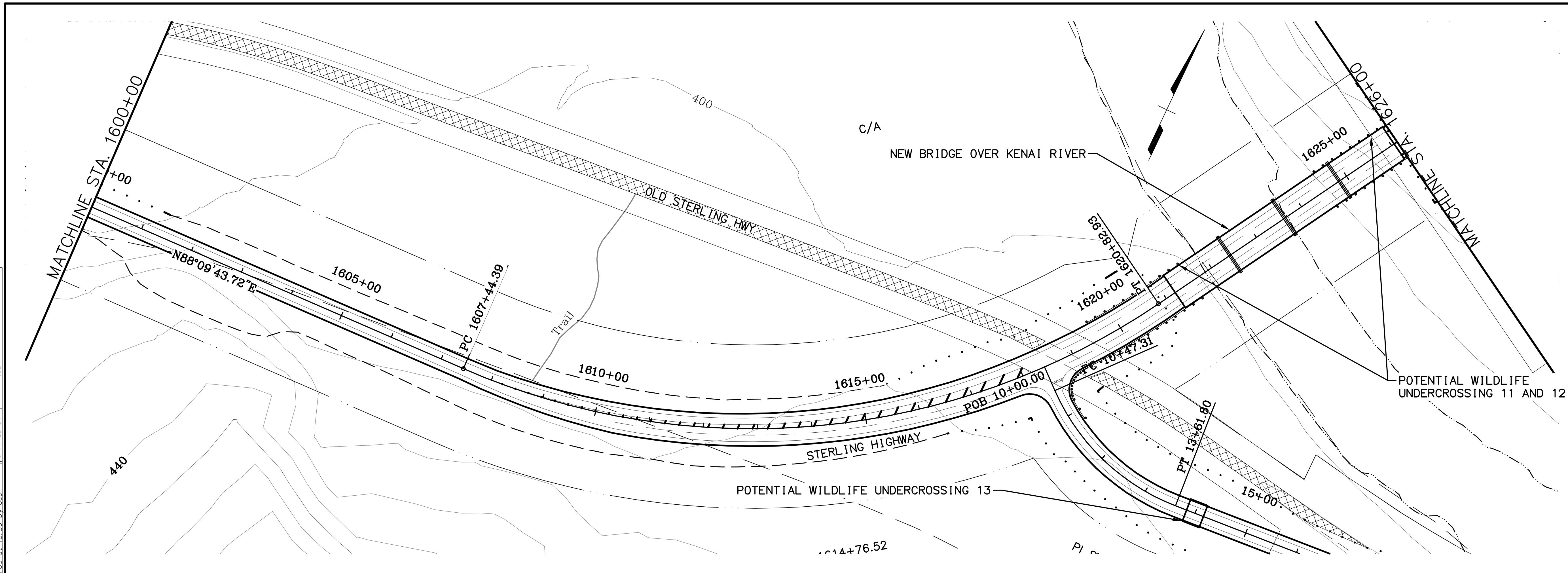

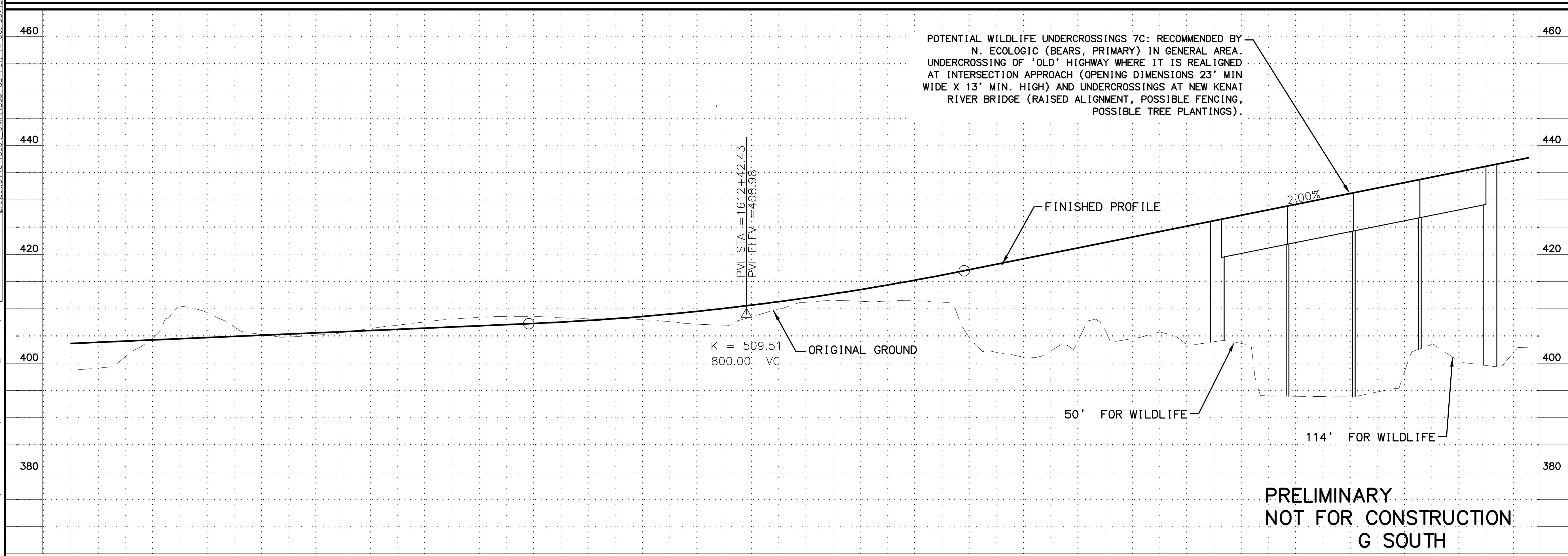

PRELIMINARY
NOT FOR CONSTRUCTION
G SOUTH

SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

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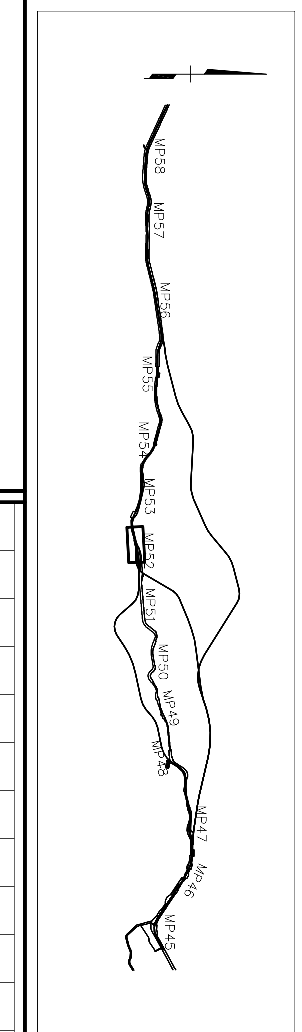

11-12

SEGMENT 9

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1600+00 TO 1626+00

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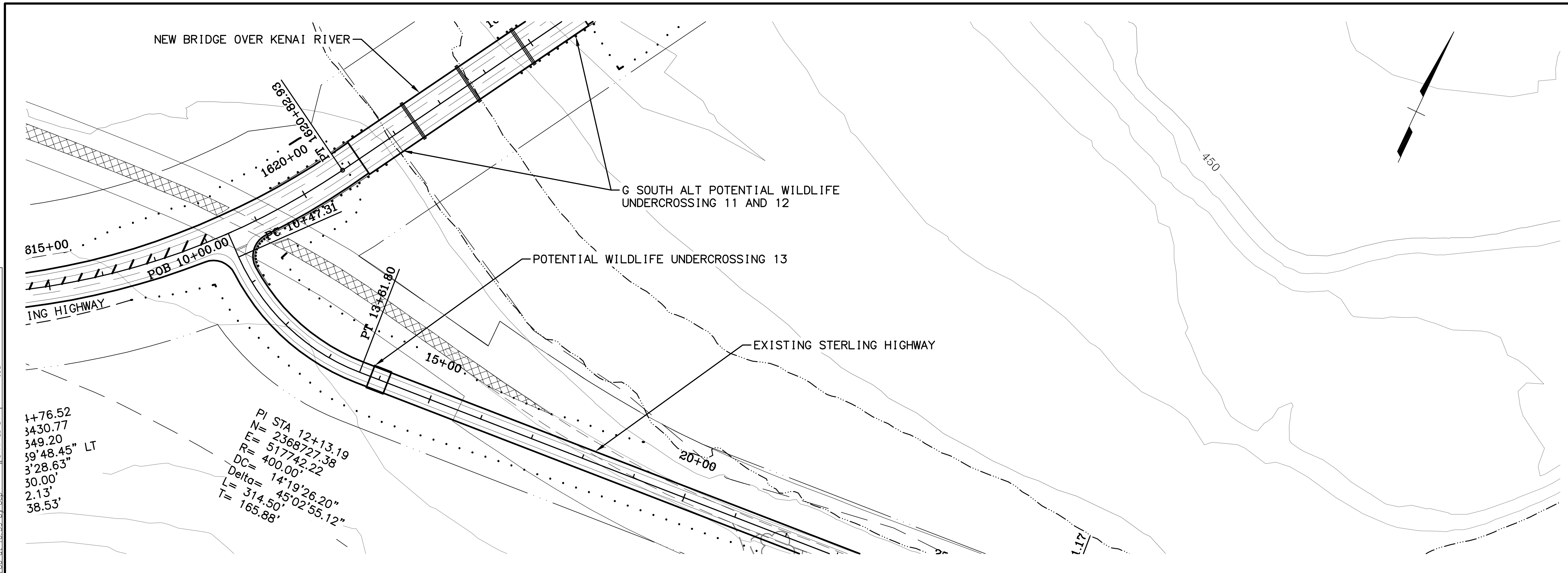

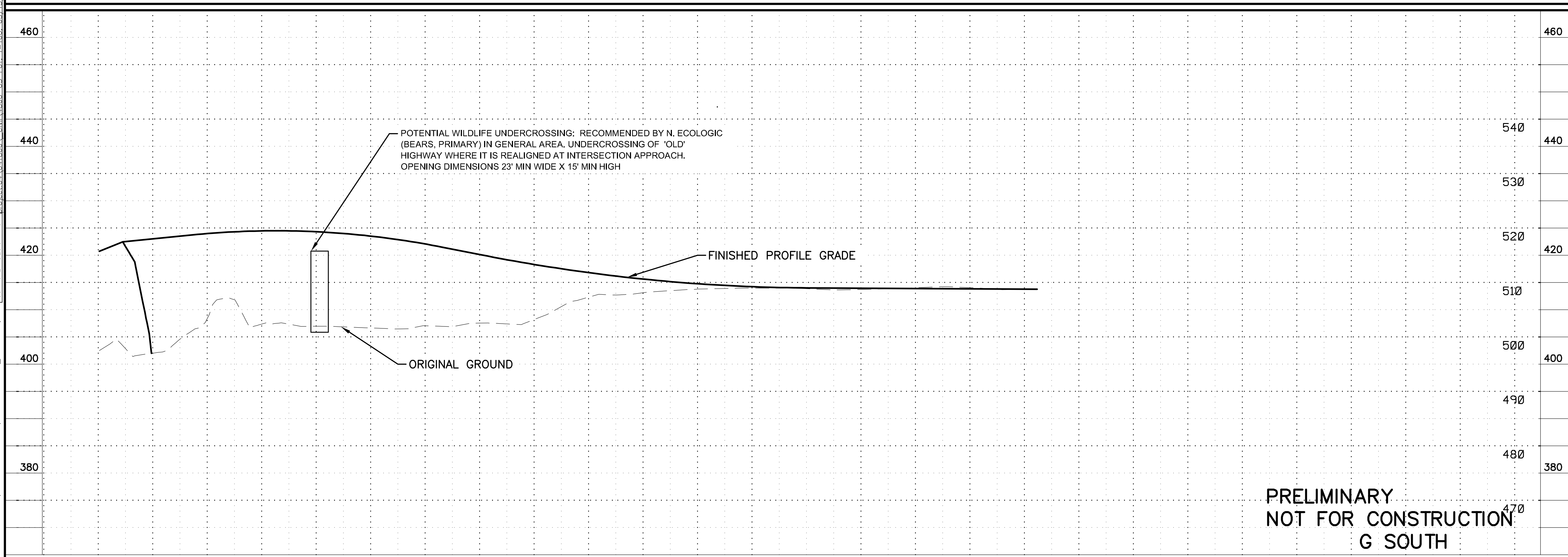

PRELIMINARY
NOT FOR CONSTRUCTION
G SOUTH

SHEET NO.	TOTAL SHEETS
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STATE	YEAR
ALASKA	2016

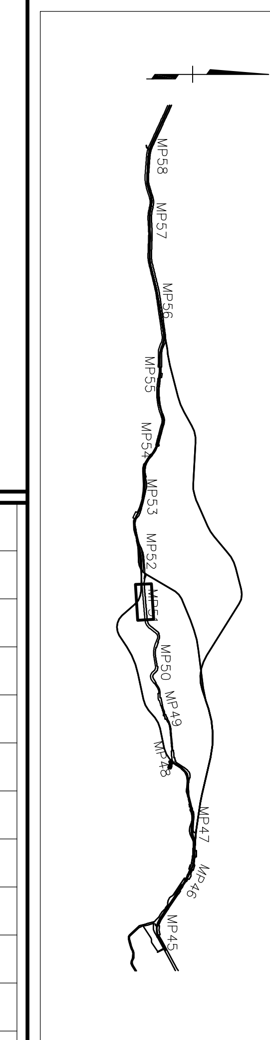
PROJECT DESIGNATION: F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



13

SEGMENT 9

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1600+00 TO 1626+00

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SHEET NO.	TOTAL SHEETS
18	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

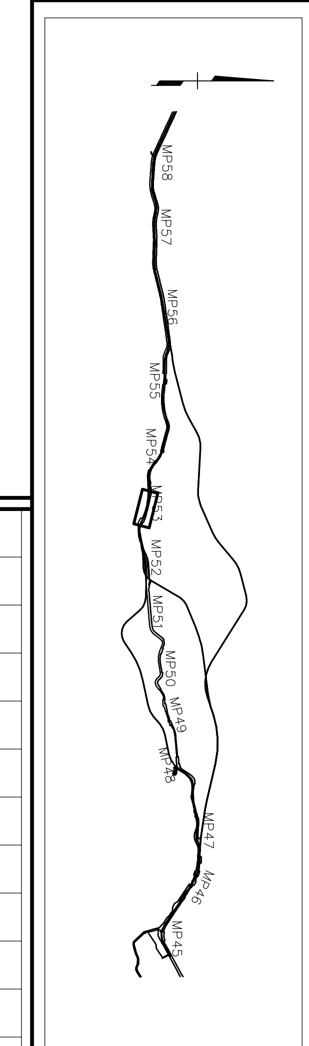
F-021-2(15)/53014

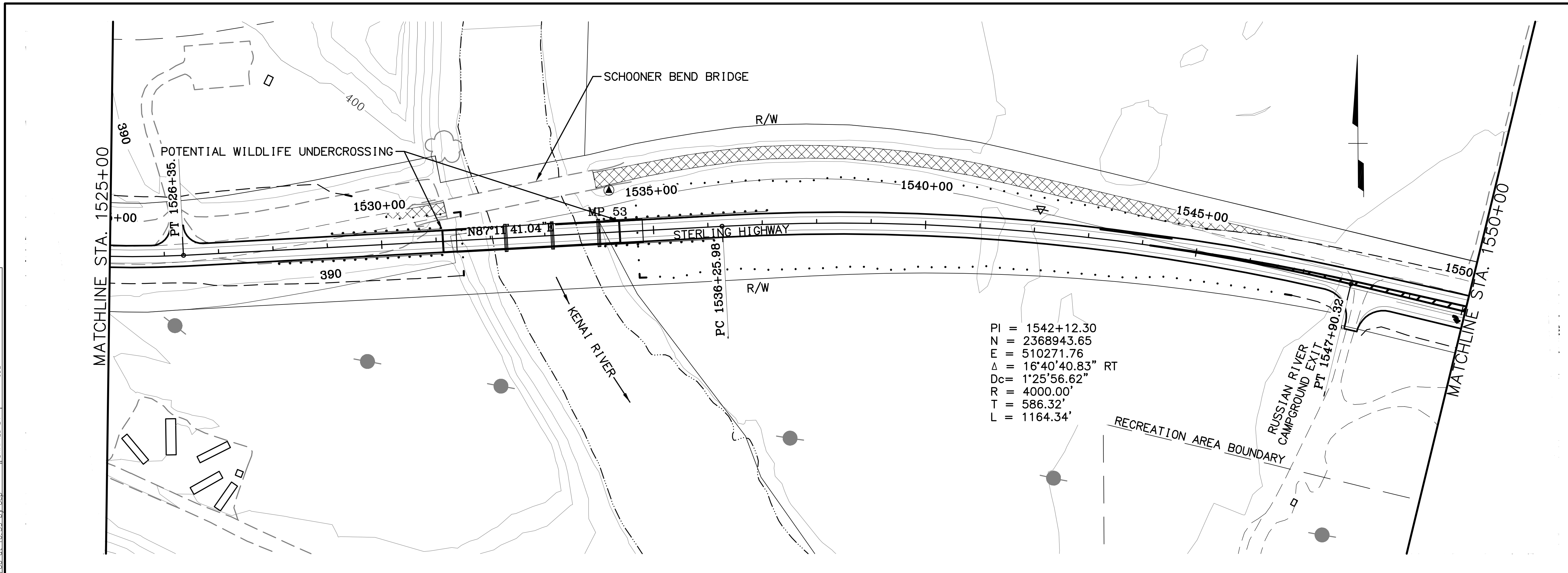
ADDENDUM NO.

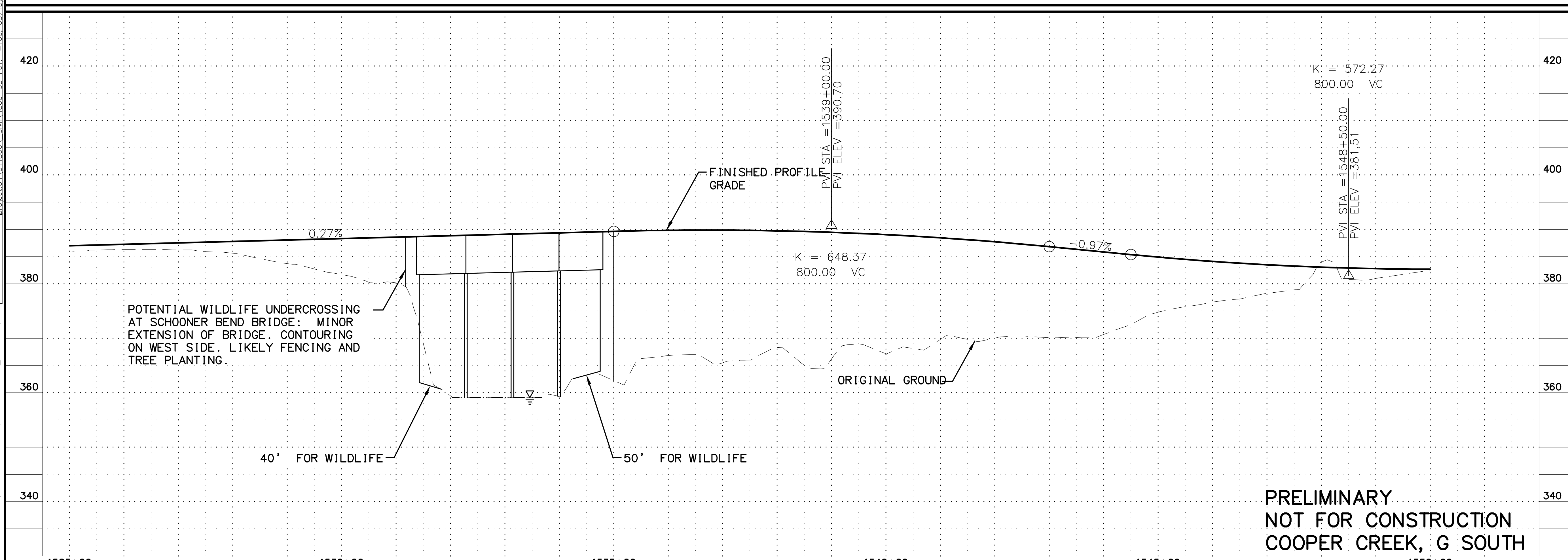
ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION







PRELIMINARY
NOT FOR CONSTRUCTION
COOPER CREEK, G SOUTH

14-15

SEGMENT 10

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1525+00 TO 1550+00

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SHEET NO.	TOTAL SHEETS
19	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

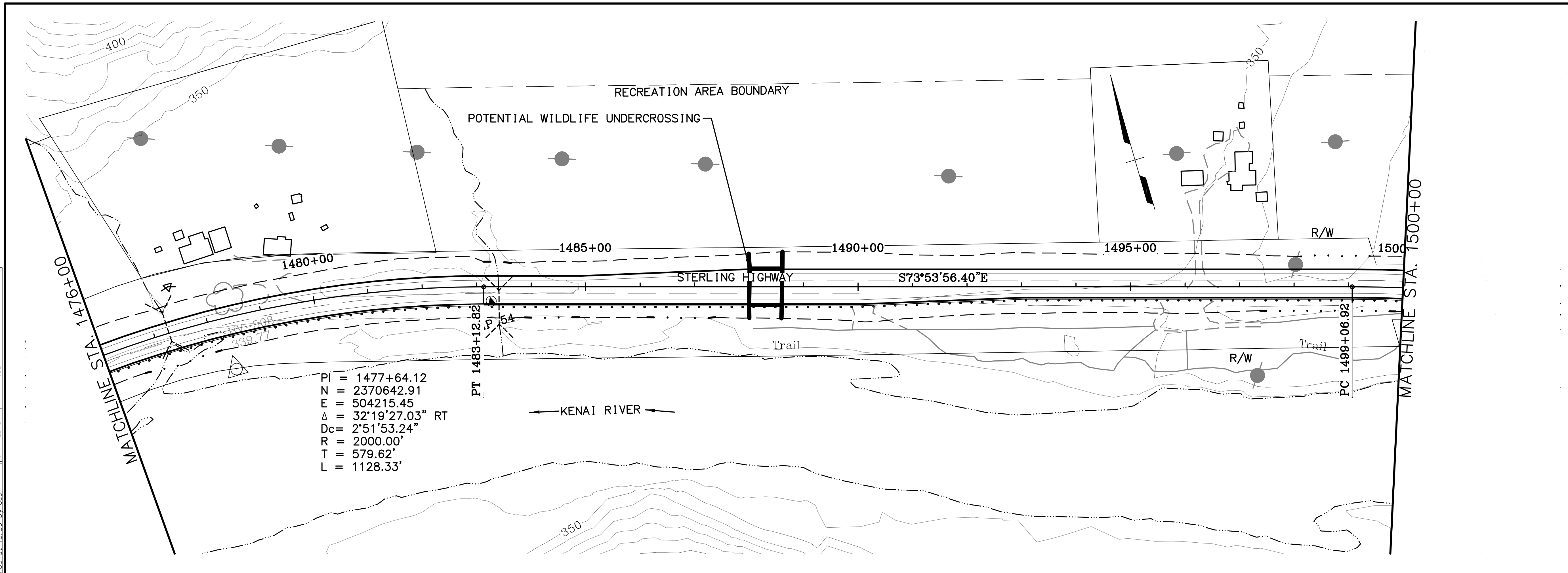
F-021-2(15)/53014

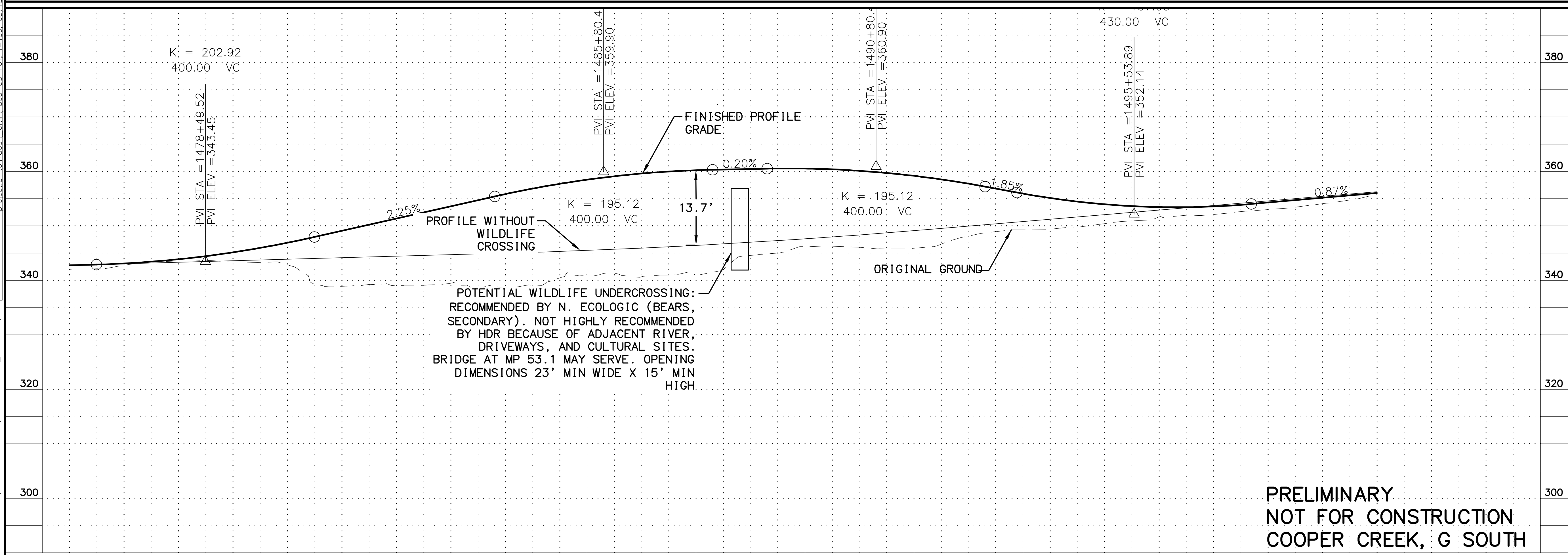
ADDENDUM NO.

ATTACHMENT NO.

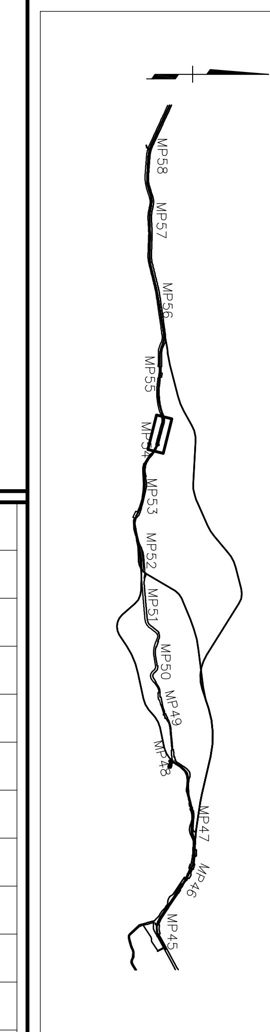
REVISIONS

NO.	DATE	DESCRIPTION





PRELIMINARY
NOT FOR CONSTRUCTION
COOPER CREEK, G SOUTH



16

SEGMENT 10

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1476+00 TO 1500+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION

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SHEET NO.	TOTAL SHEETS
20	29
STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION

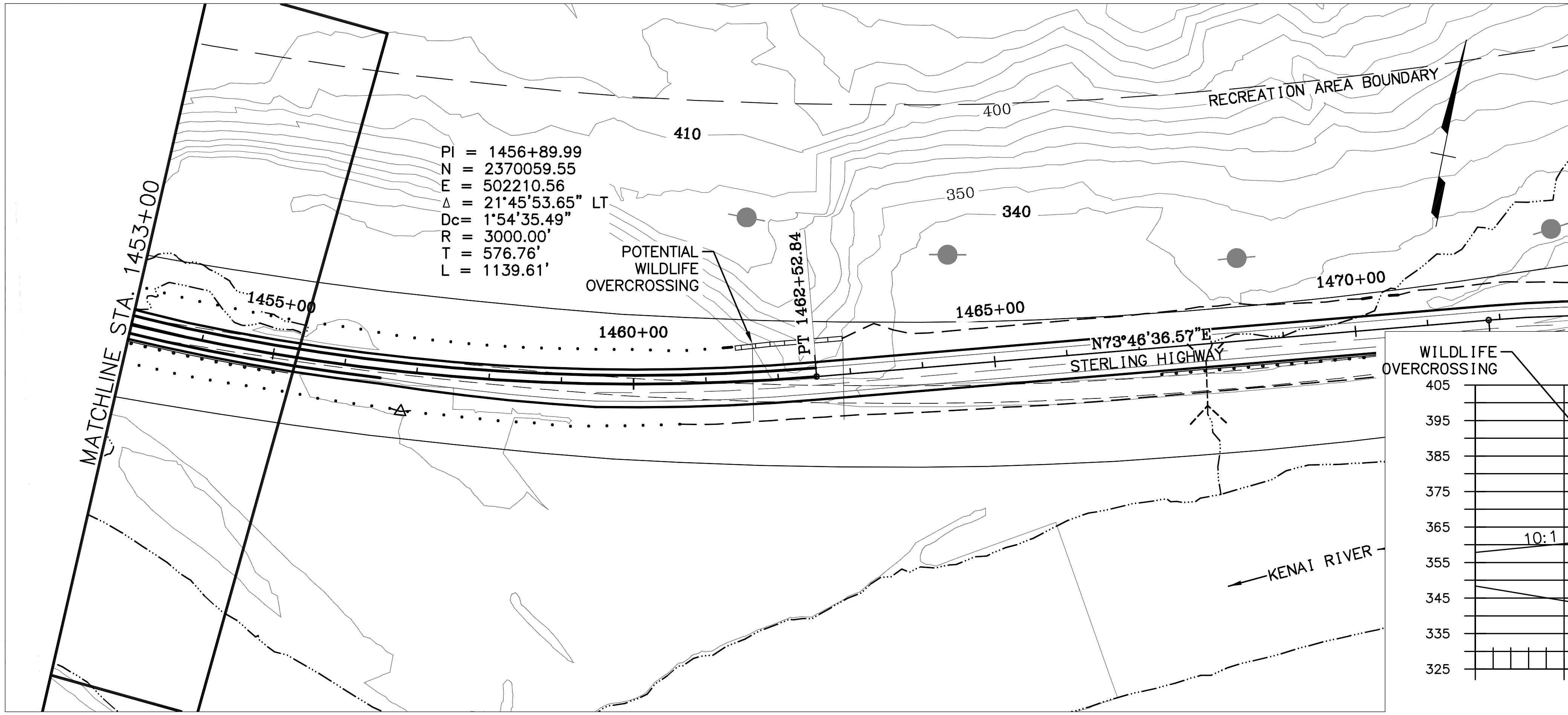
F-021-2(15)/53014

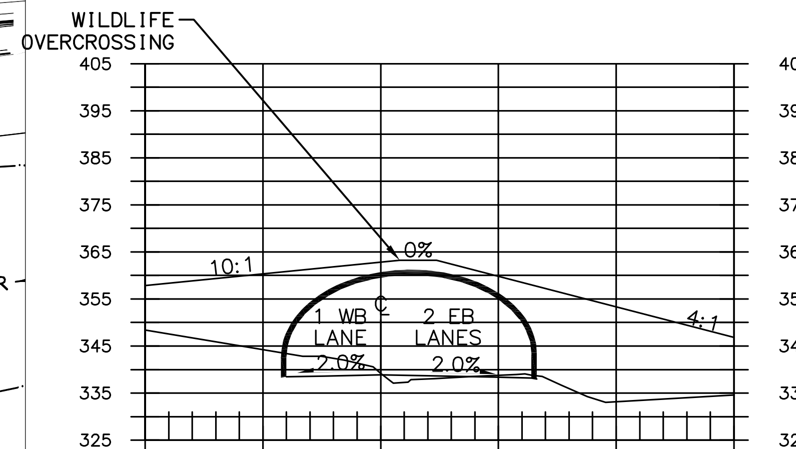
ADDENDUM NO.

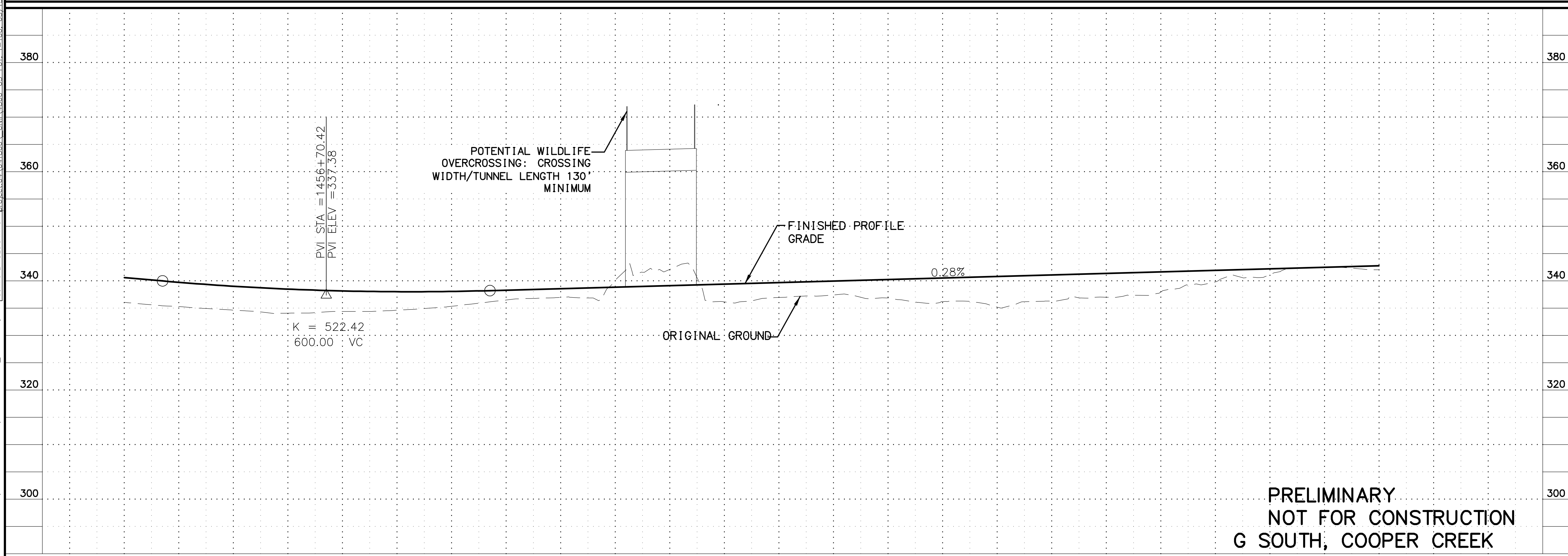
ATTACHMENT NO.

REVISIONS

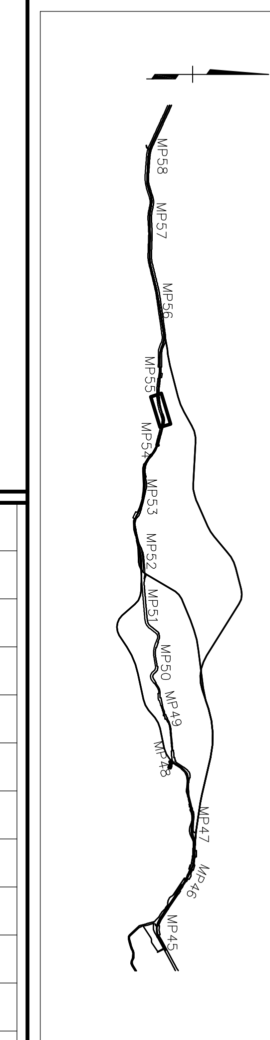
NO.	DATE	DESCRIPTION







PRELIMINARY
NOT FOR CONSTRUCTION
G SOUTH, COOPER CREEK



17

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

G SOUTH
PLAN AND PROFILE
STA 1458+00 TO 1476+00

DESIGNED BY	EPL
CHECKED BY	EPL
DRAFTED BY	CBB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-GS-F01 1=100 03/15/06 at 10:39 by gep

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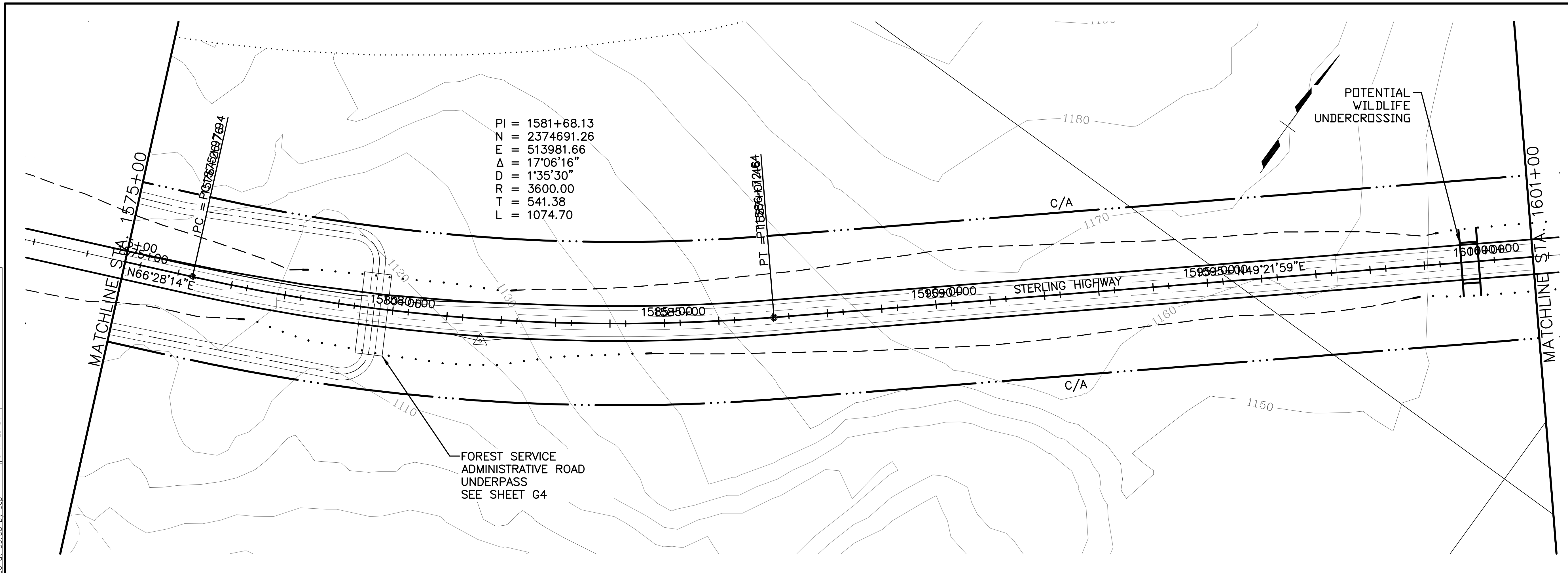
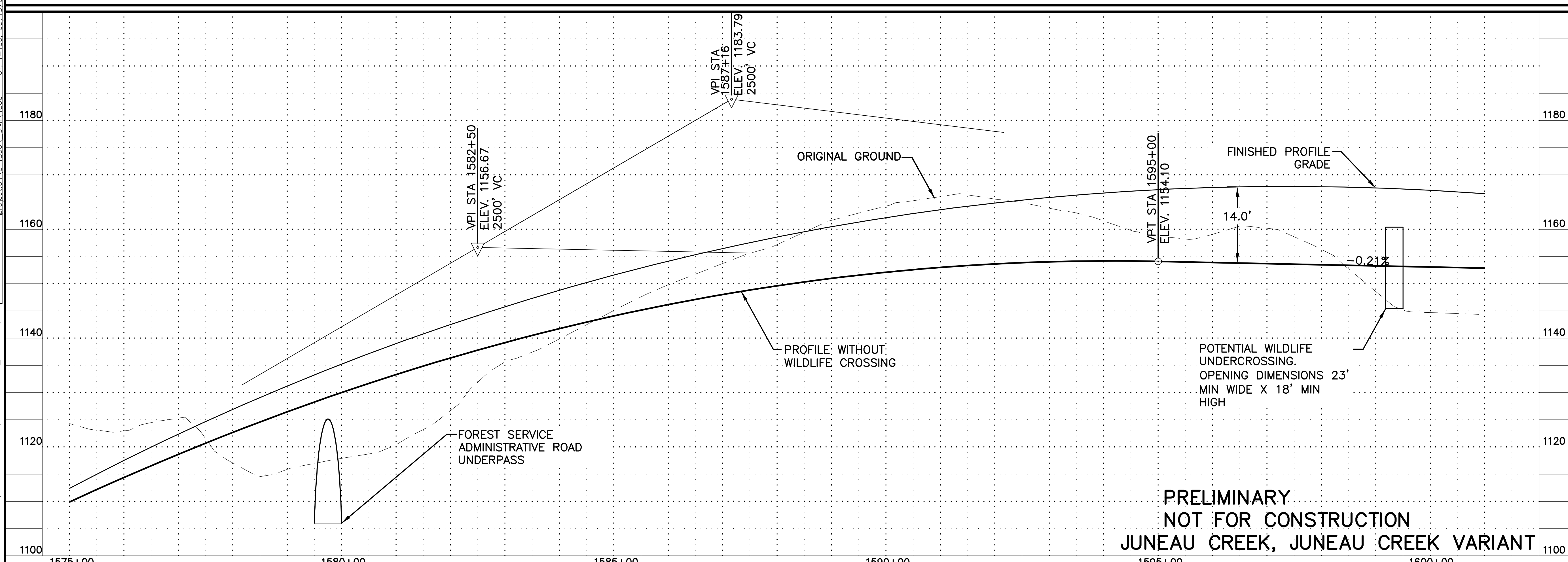




PRELIMINARY
NOT FOR CONSTRUCTION
JUNEAU CREEK, JUNEAU CREEK VARIANT

SHEET NO.	TOTAL SHEETS
21	29
STATE	YEAR
ALASKA	2014

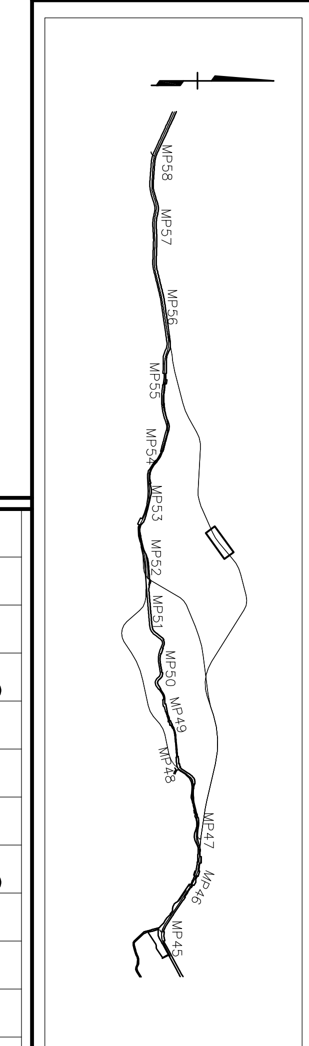
PROJECT DESIGNATION
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



18

"SEGMENT 11"

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1601+00 TO 1628+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-F-F01 1=100 03/15/06 at 09:58 by cep

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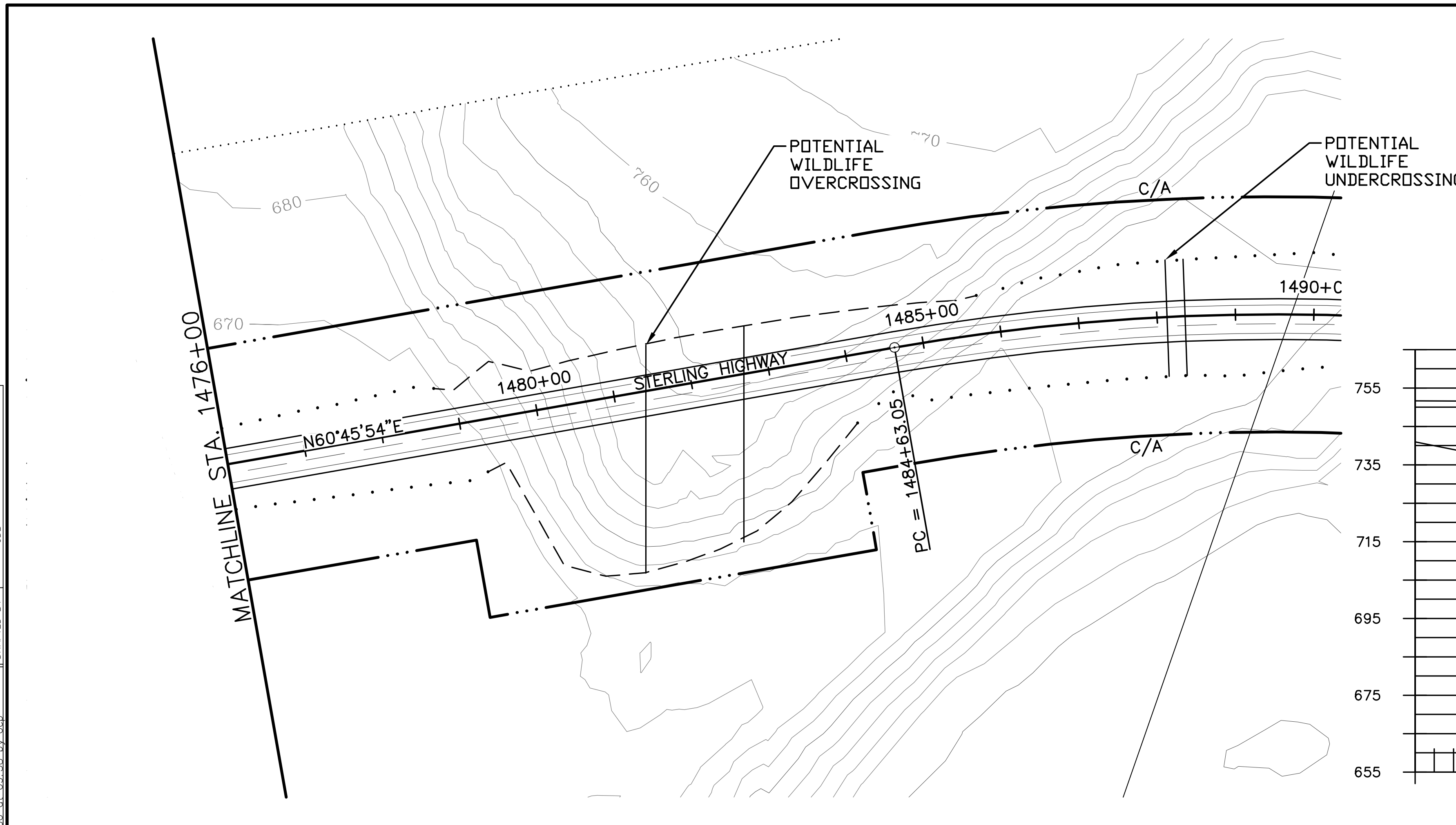
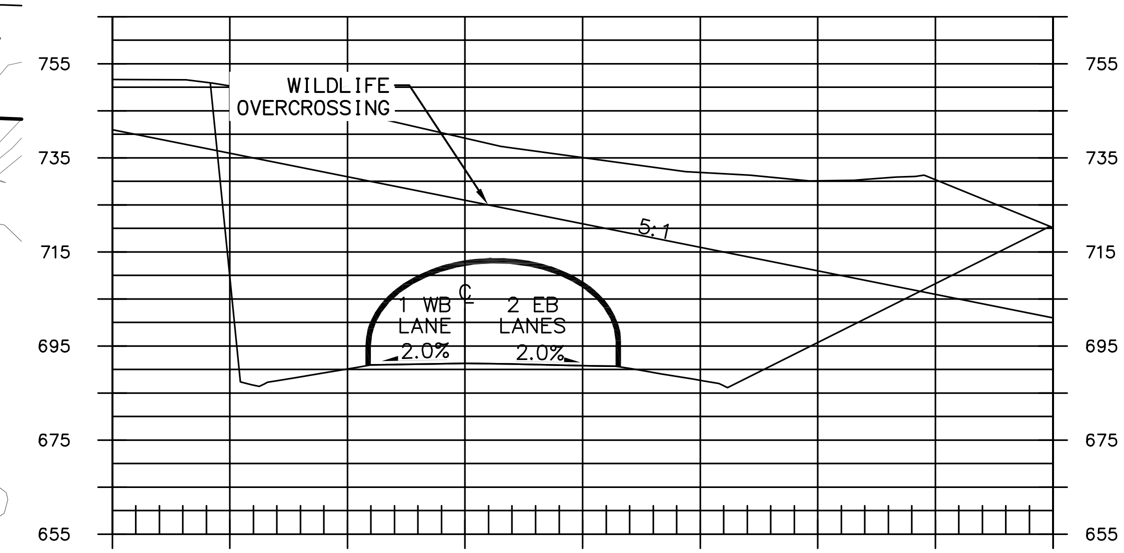
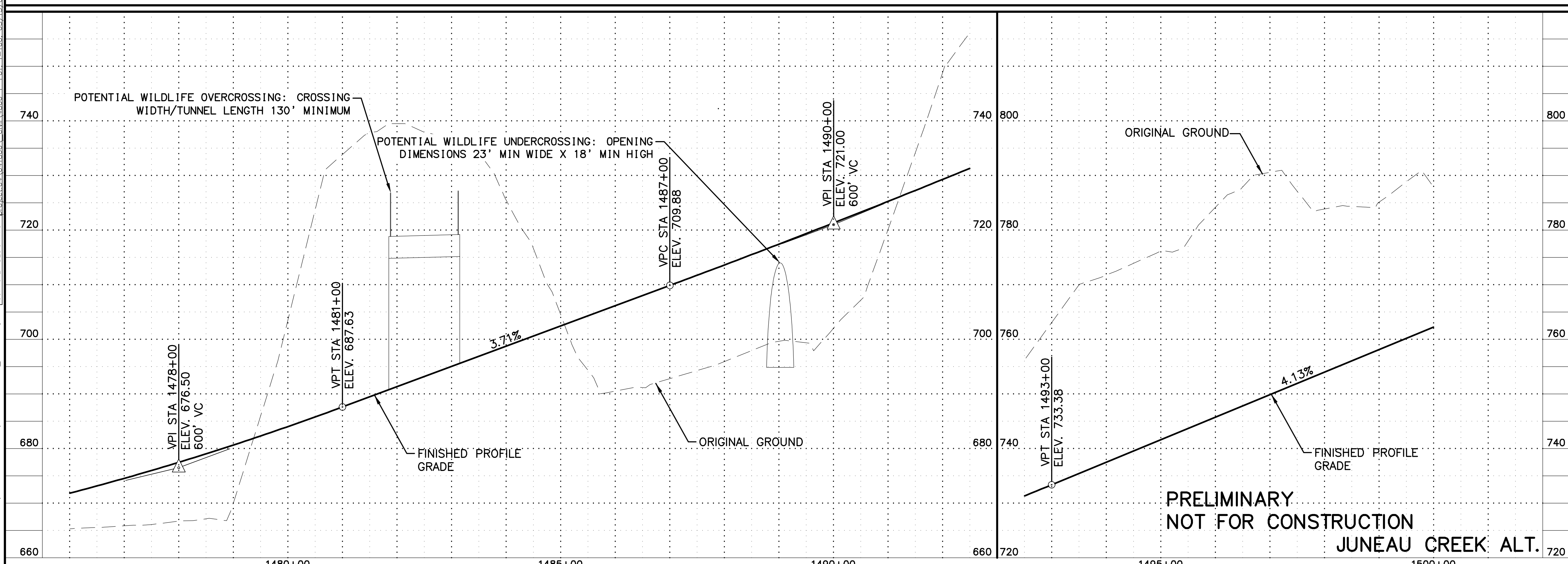






PRELIMINARY
NOT FOR CONSTRUCTION

JUNEAU CREEK ALT.

SHEET NO.	TOTAL SHEETS
22	29
STATE	YEAR
ALASKA	2014

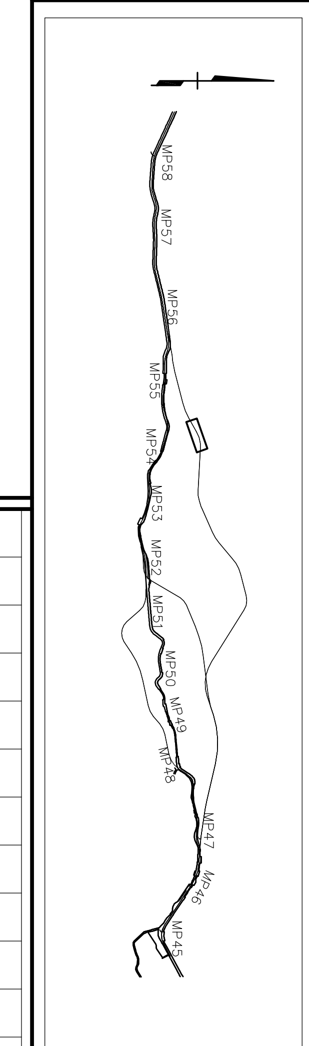
PROJECT DESIGNATION
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



19–20

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

JUNEAU CREEK ALT.
PLAN AND PROFILE
STA 1476+00 TO 1500+00

DESIGNED BY	EPL
CHECKED BY	EPL
DRAFTED BY	CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-F-F01 1=100 03/15/06 at 09:58 by cep

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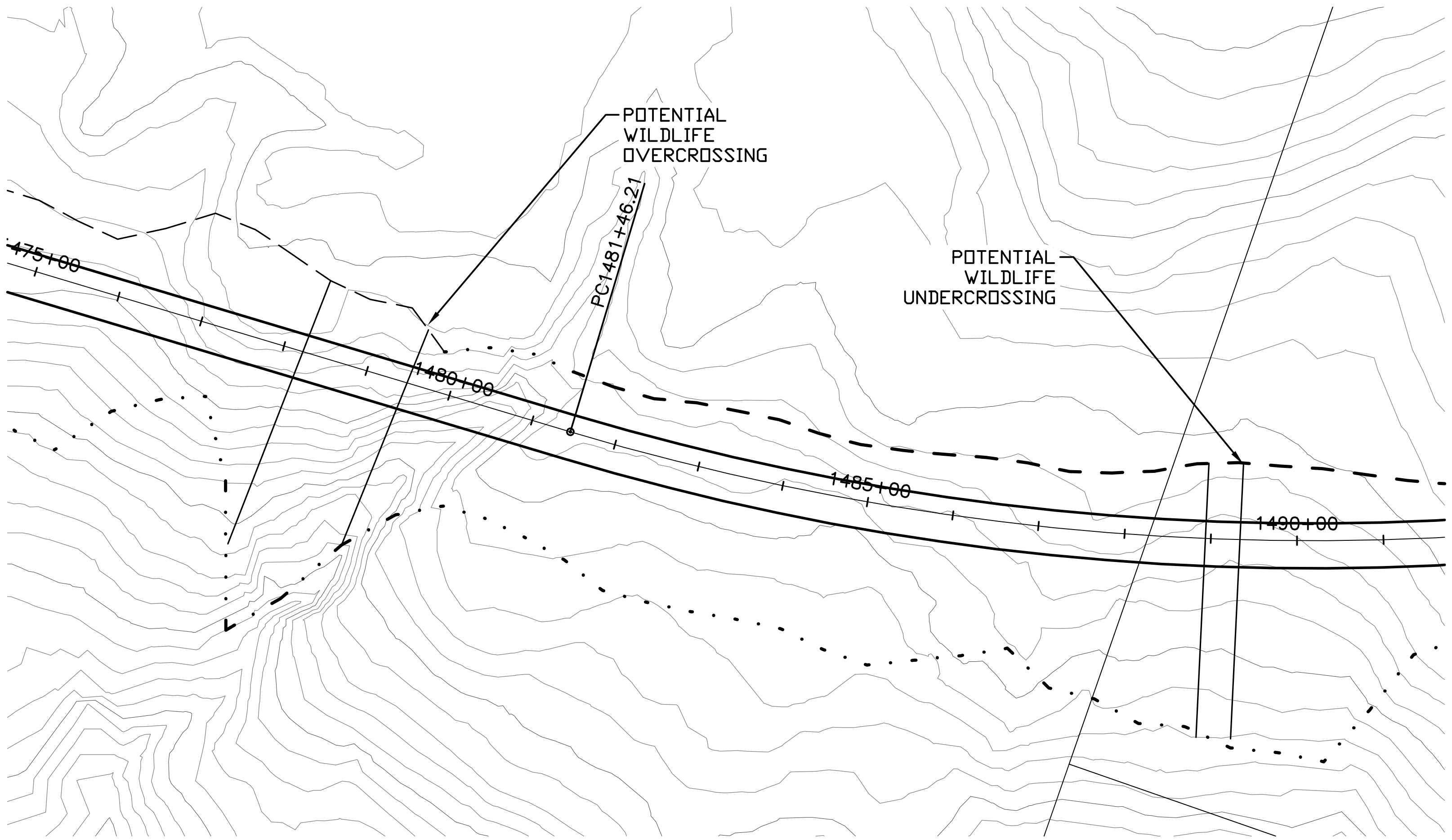
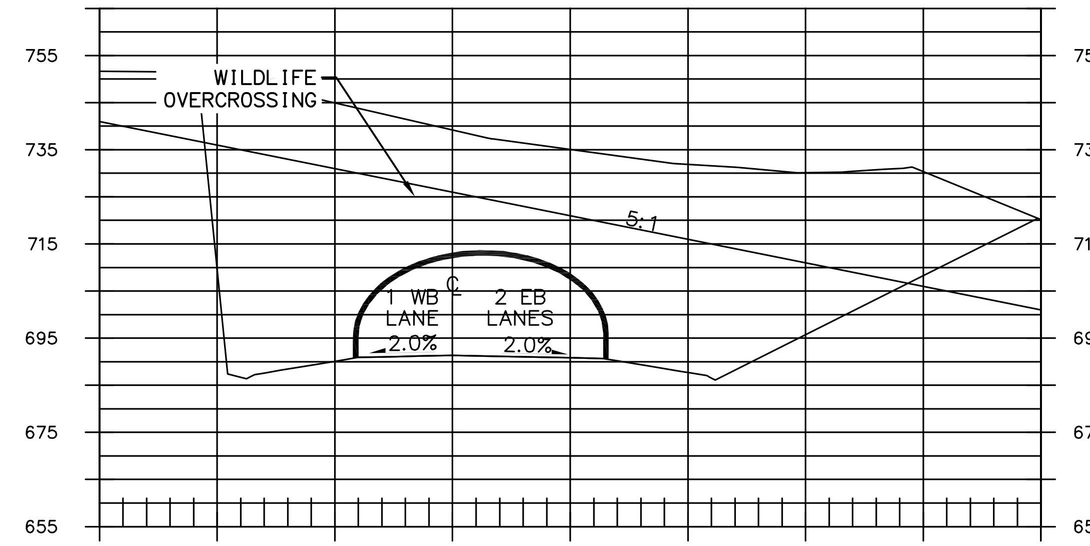
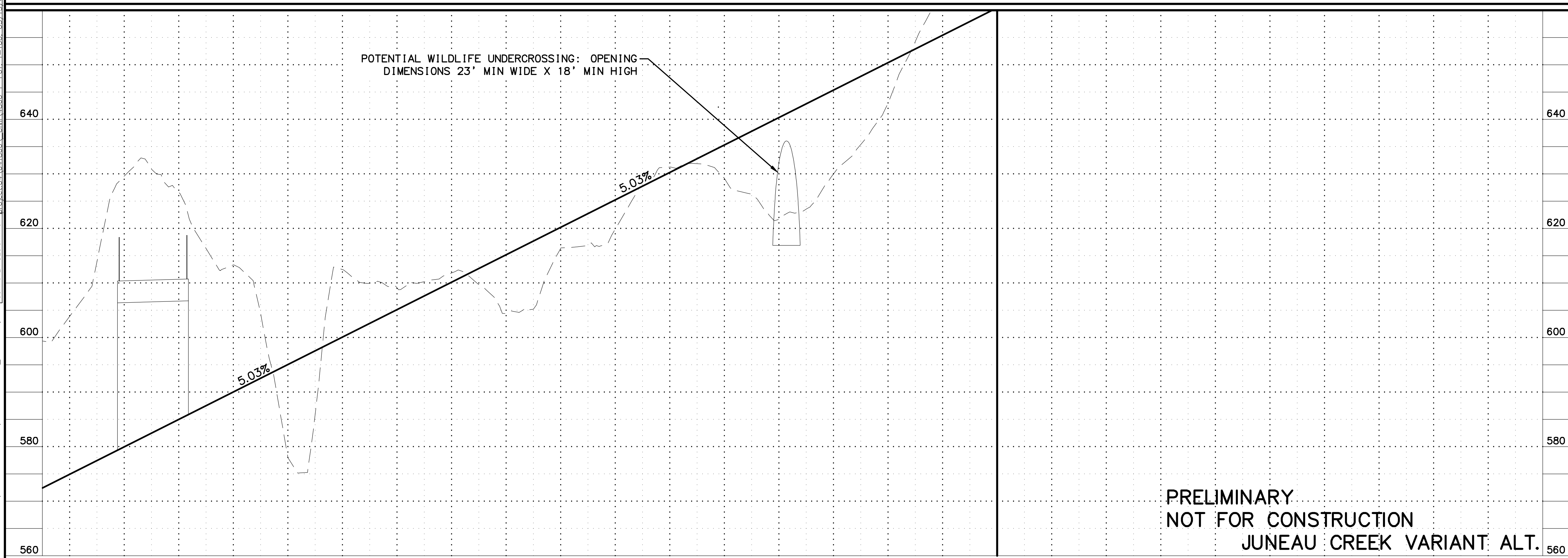






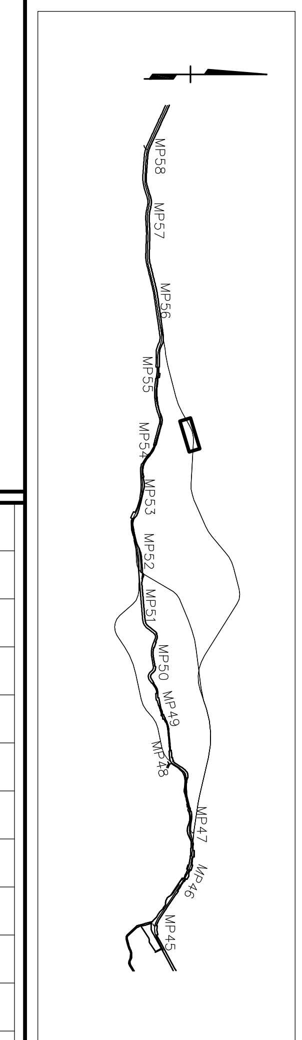
PRELIMINARY
NOT FOR CONSTRUCTION
JUNEAU CREEK VARIANT ALT.

SHEET NO.	TOTAL SHEETS
23	29
STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION
F-021-2(15)/53014
ADDENDUM NO.
ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



19–20

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

JUNEAU CREEK ALT.
PLAN AND PROFILE
STA 1476+00 TO 1500+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CDB
SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-F-F01 1=100 03/15/06 at 09:58 by cep
VIEW: F-F11_F-D0755, F-F11_F-D1055, F-F11_H=5000
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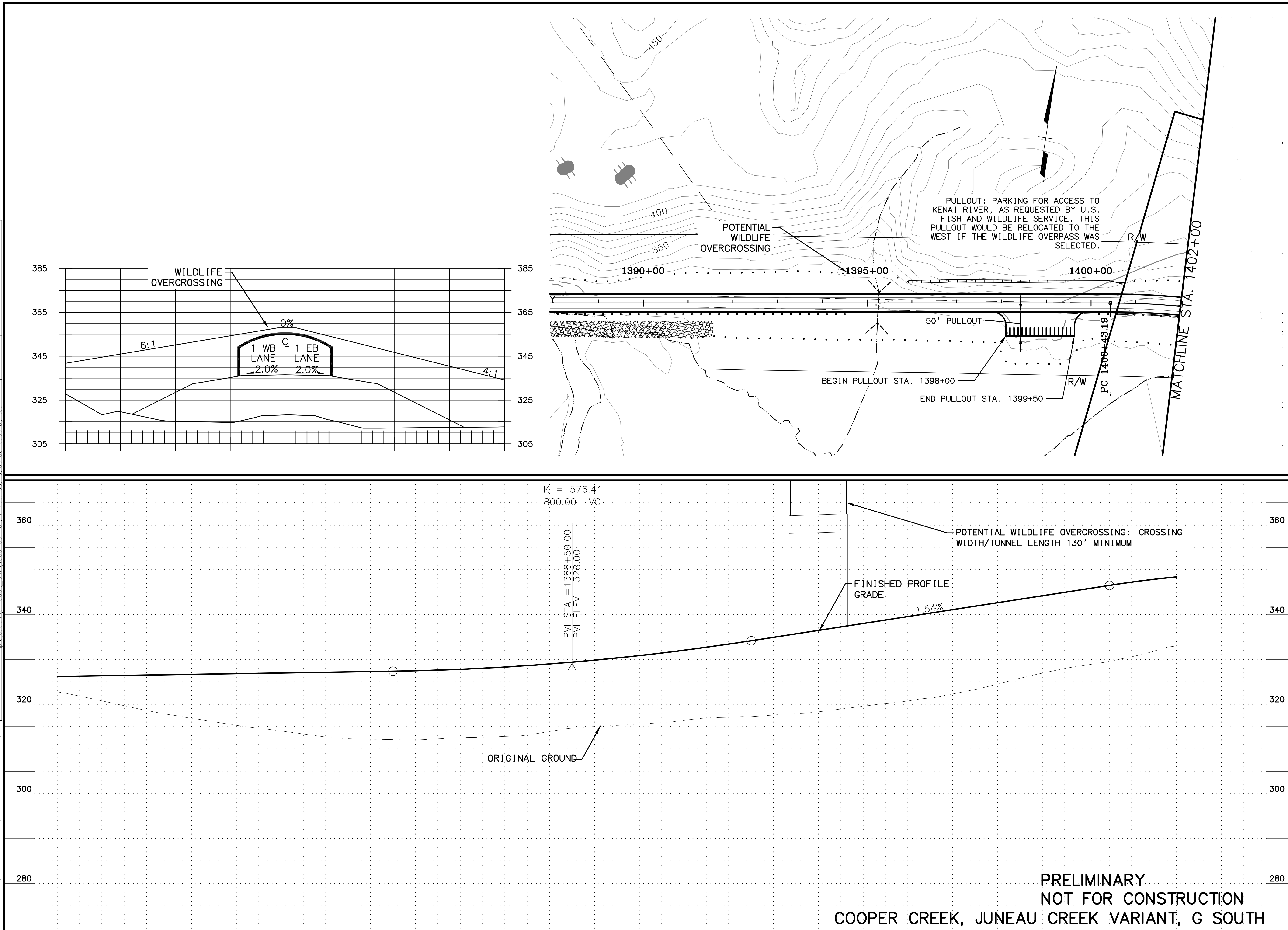

PRELIMINARY
NOT FOR CONSTRUCTION

COOPER CREEK, JUNEAU CREEK VARIANT, G SOUTH

SHEET NO.	TOTAL SHEETS
24	29
STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

21

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

G SOUTH
PLAN AND PROFILE
STA 1377+00 TO 1402+00

DESIGNED BY	EPL
CHECKED BY	EPL
DRAFTED BY	OEB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-GS-F01 1=100 03/15/06 at 10:39 by oep
VIEW: GS-F07_F_D0755, GS-F07_F_D1055, GS-F07_H_L5000
XREF: 4800-BD02, 4800-DESIGN-01, 4800-SURVEY_A-02-PP, ROW-RGB

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SHEET NO.	TOTAL SHEETS
25	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

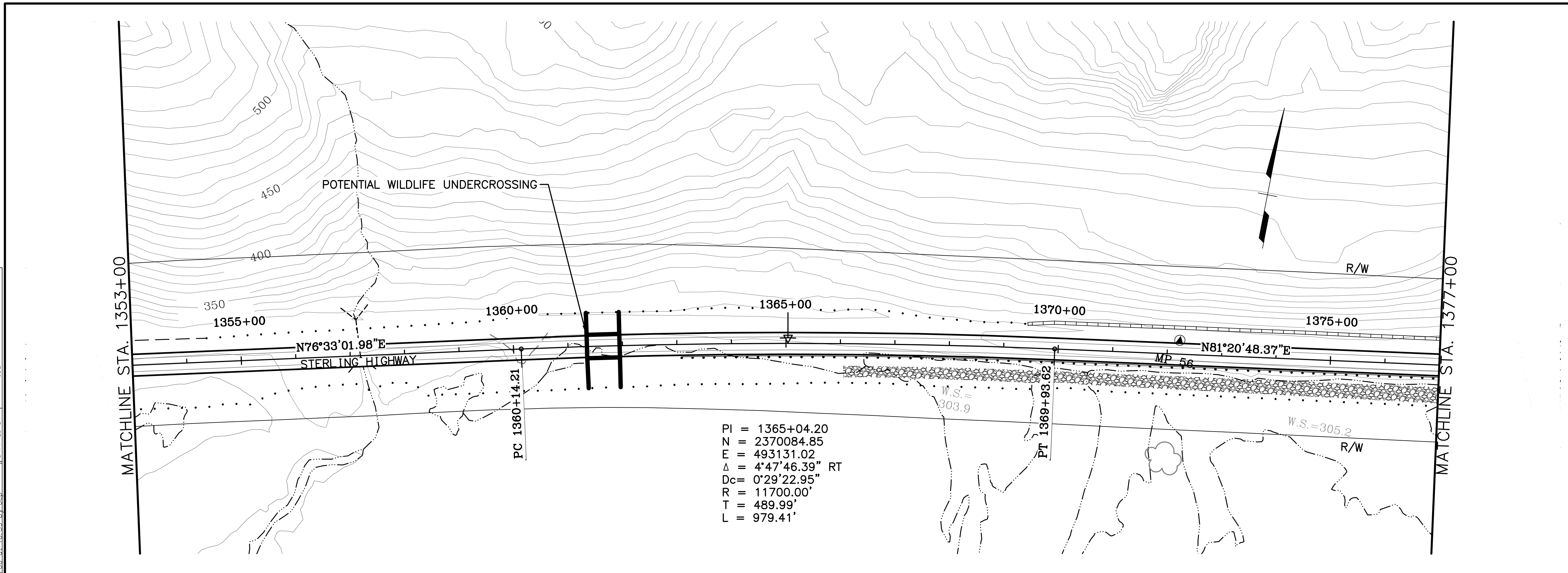
F-021-2(15)/53014

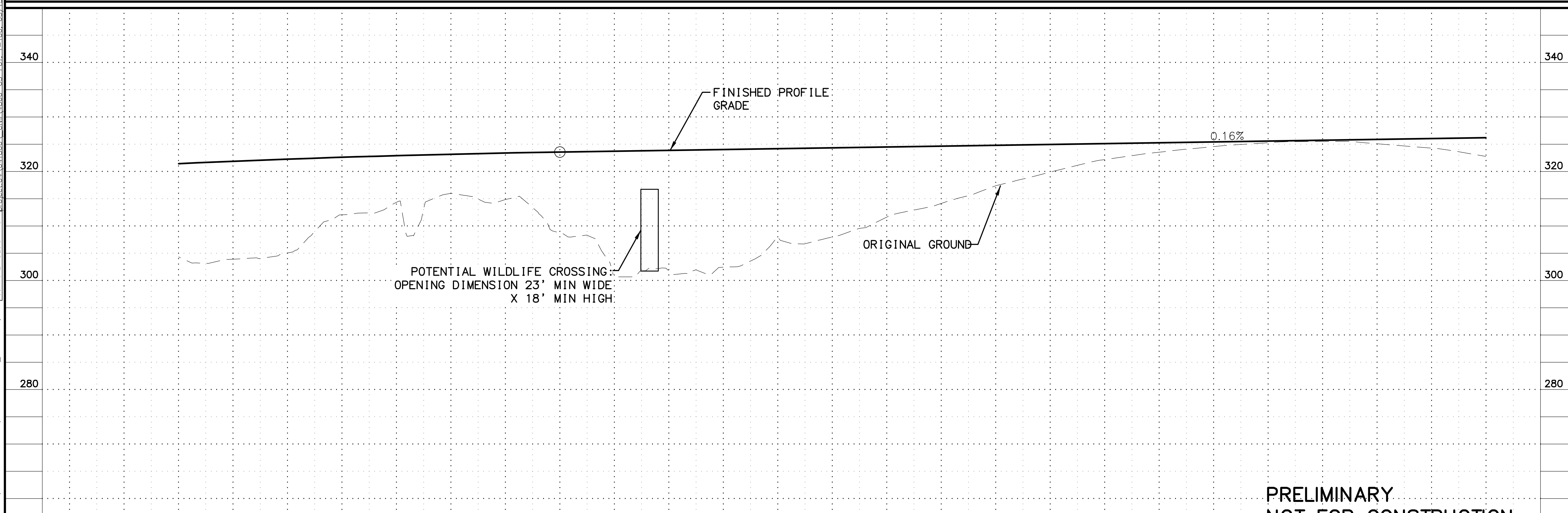
ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

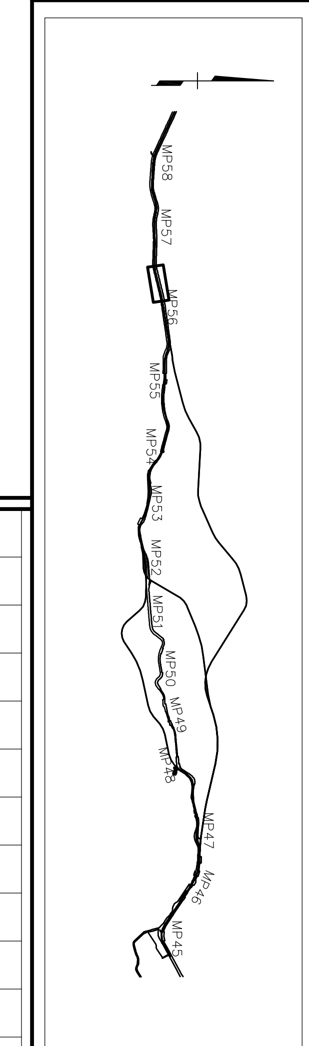
NO.	DATE	DESCRIPTION





PRELIMINARY
NOT FOR CONSTRUCTION

COOPER CREEK, G SOUTH, JUNEAU CREEK, JUNEAU CREEK VARIANT



22

"SEGMENT 12"

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1353+00 TO 1377+00

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SHEET NO.	TOTAL SHEETS
26	29
STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION

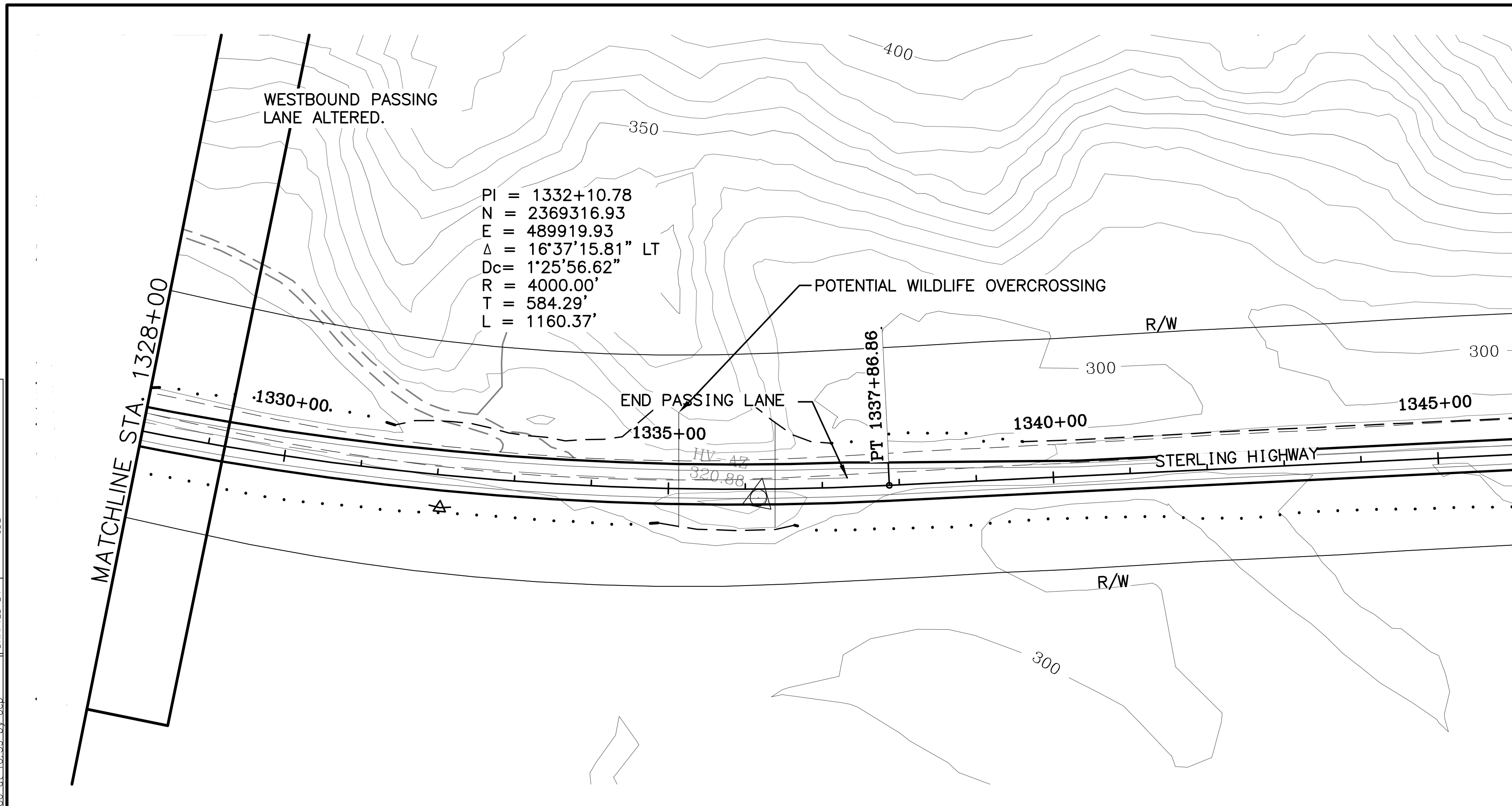
F-021-2(15)/53014

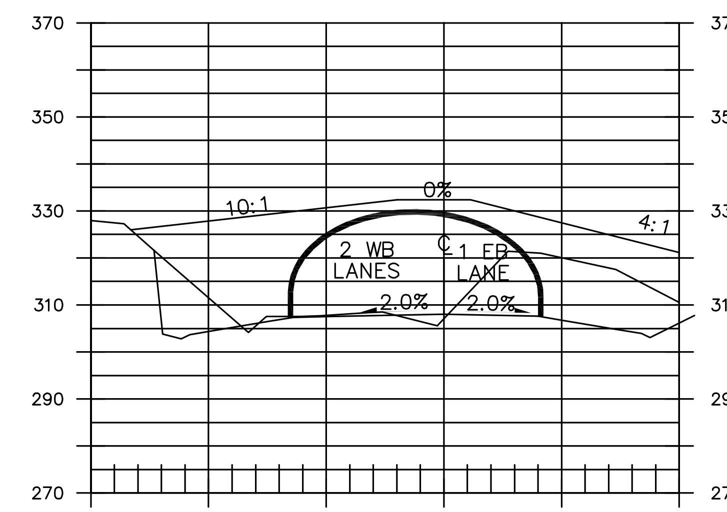
ADDENDUM NO.

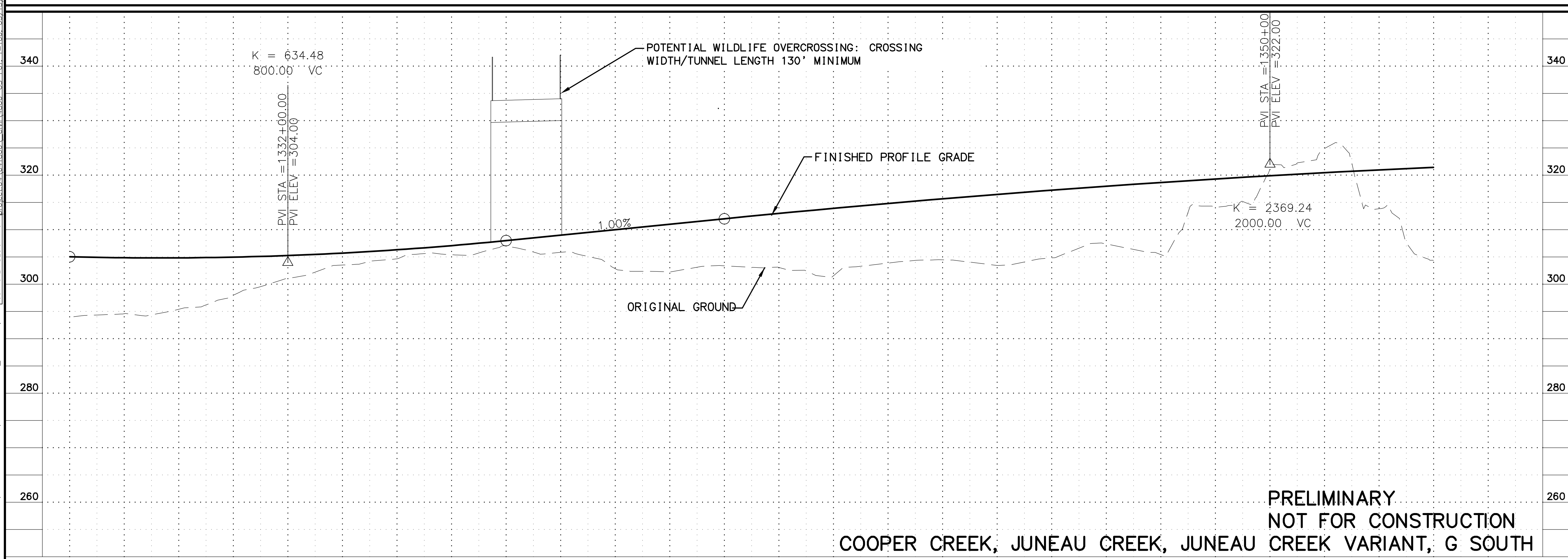
ATTACHMENT NO.

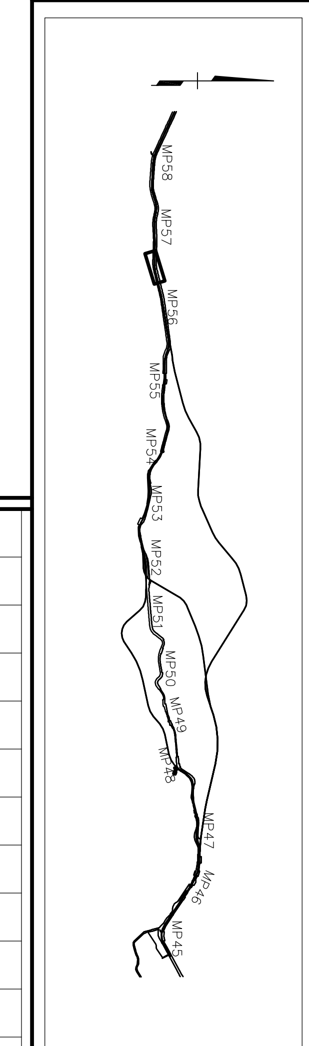
REVISIONS

NO.	DATE	DESCRIPTION









23

PRELIMINARY
NOT FOR CONSTRUCTION

COOPER CREEK, JUNEAU CREEK, JUNEAU CREEK VARIANT, G SOUTH

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

G SOUTH
PLAN AND PROFILE
STA 1328+00 TO 1353+00

DESIGNED BY	EPL
CHECKED BY	EPL
DRAFTED BY	CDB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-GS-F01, 1=100, 03/15/06 at 10:39 by oep

VIEW: GS-F05_F_D0755, GS-F05_F_D1055, GS-F05_H_L5000
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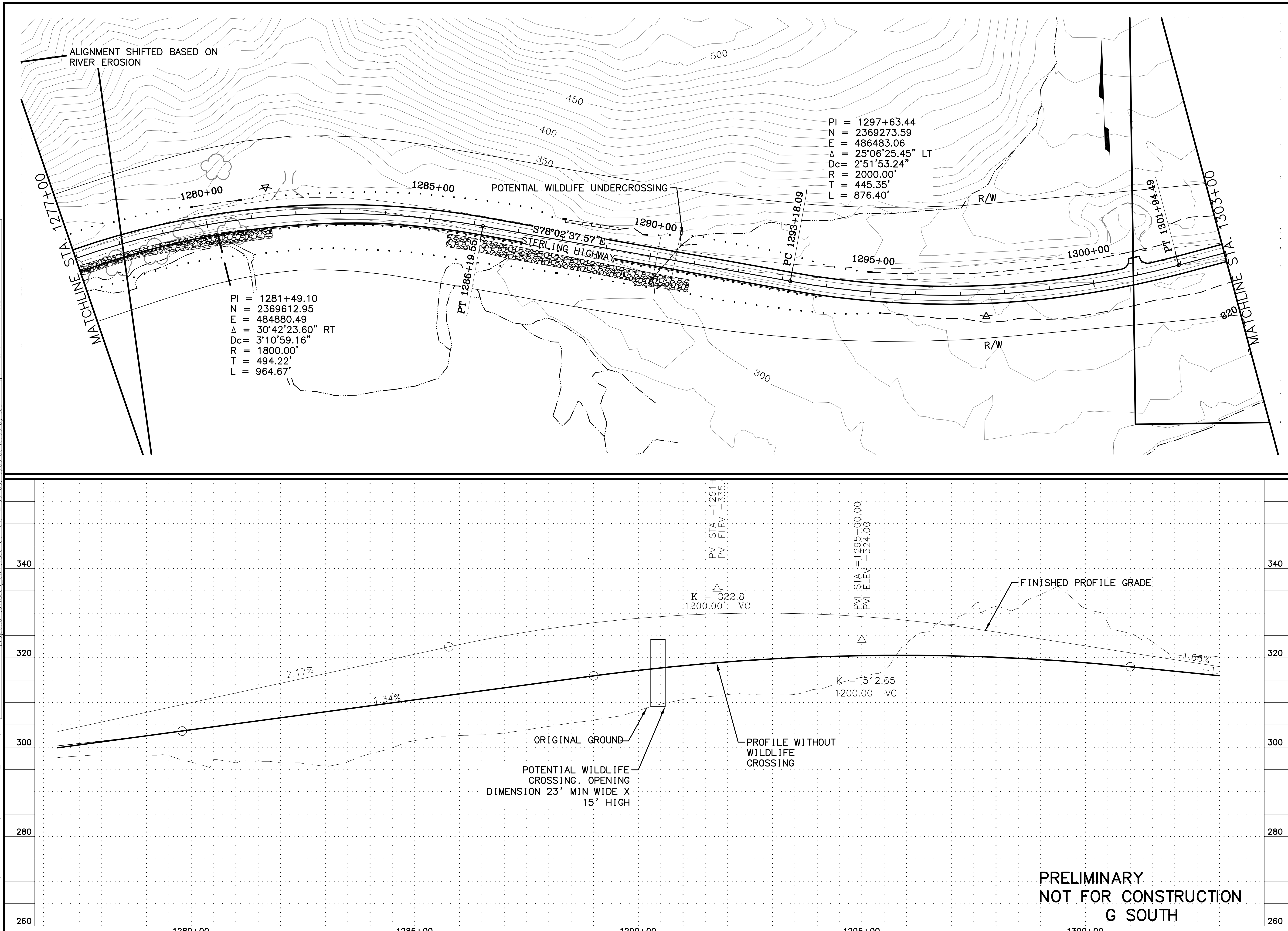

SHEET NO.	TOTAL SHEETS
27	29
STATE	YEAR
ALASKA	2014

PROJECT DESIGNATION

F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION

24

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

G SOUTH
PLAN AND PROFILE
STA 1277+00 TO 1303+00

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SHEET NO.	TOTAL SHEETS
28	29
STATE	YEAR
ALASKA	2016

PROJECT DESIGNATION

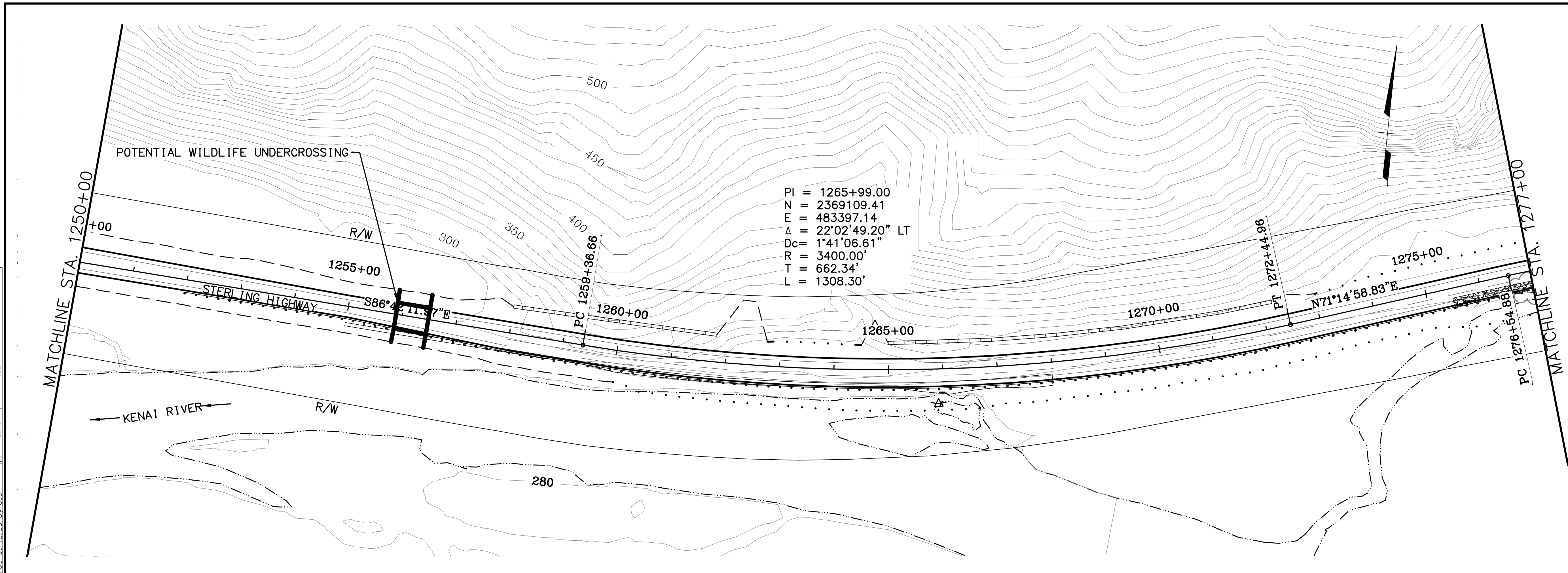
F-021-2(15)/53014

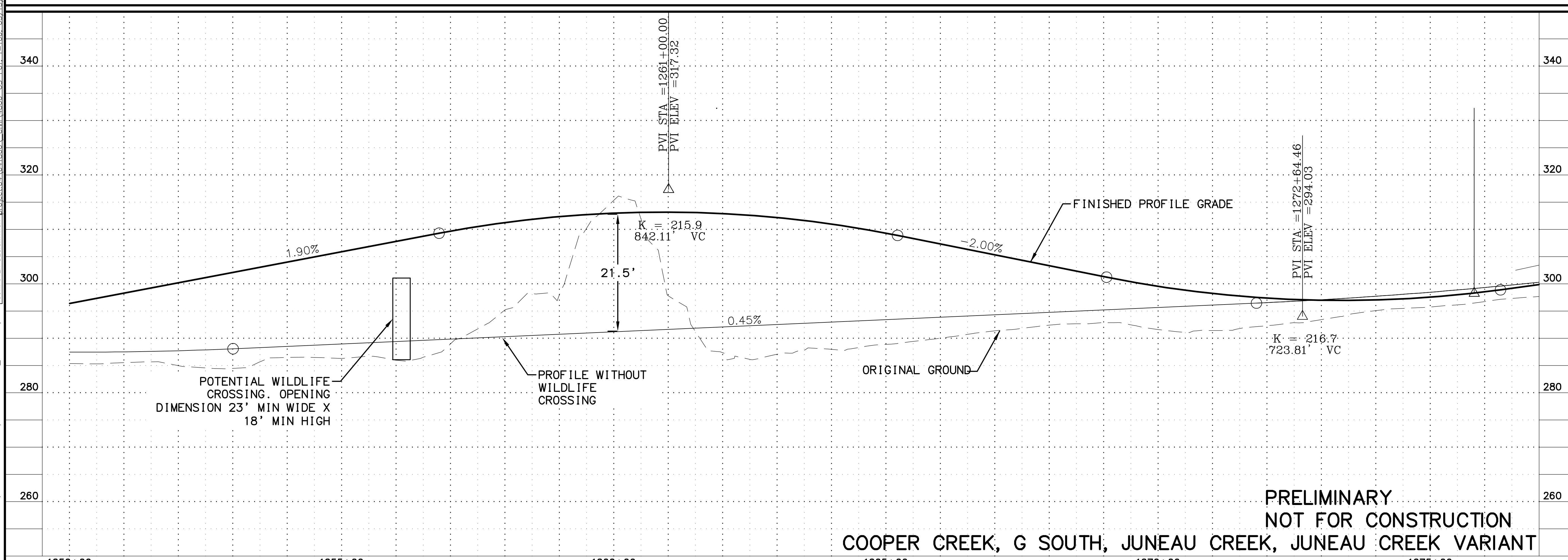
ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

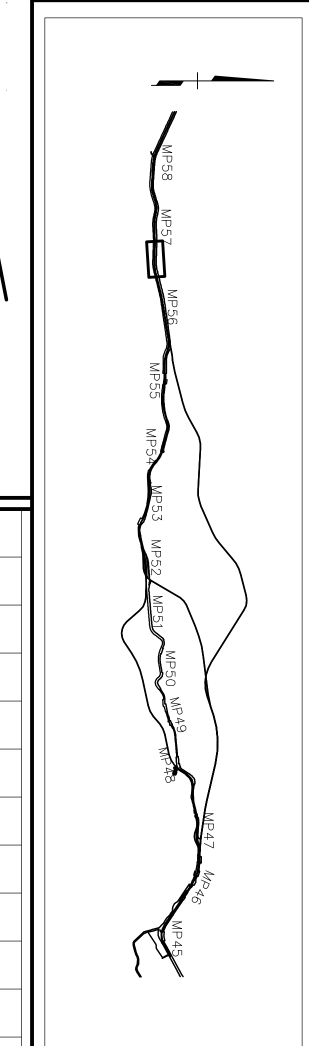
NO.	DATE	DESCRIPTION





PRELIMINARY
NOT FOR CONSTRUCTION

COOPER CREEK, G SOUTH, JUNEAU CREEK, JUNEAU CREEK VARIANT



25

SEGMENT 12

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45-60

STA 1250+00 TO 1277+00

DESIGNED BY EPL
CHECKED BY EPL
DRAFTED BY CBB

SPECIFICATIONS
STANDARDS
COMPUTER DESIGNATION project\04\041800_Civil\4800-GS-F01 1=100 03/15/06 at 10:39 by oep
VIEW: GS-F02_F_D0755, GS-F02_F_D1055, GS-F02_H_L5000
XREF: 4800-BD02, 4800-DESIGN-01, 4800-SURVEY_A-02-PP, ROW

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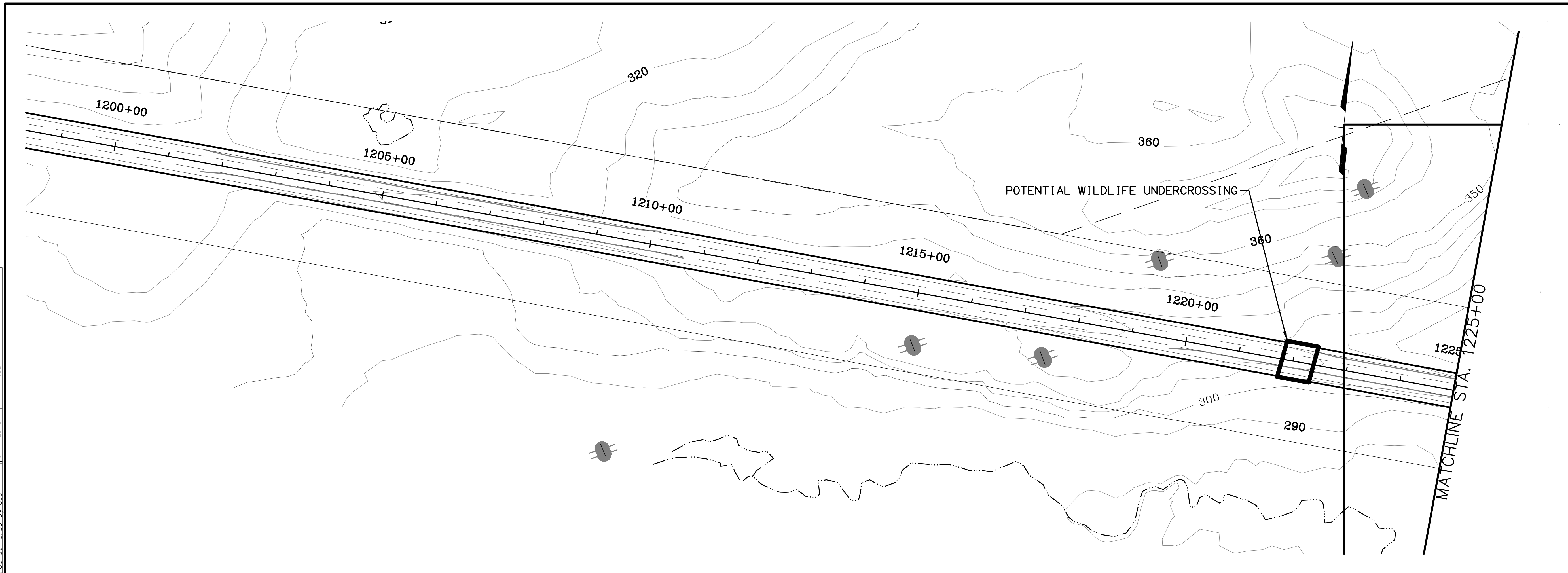
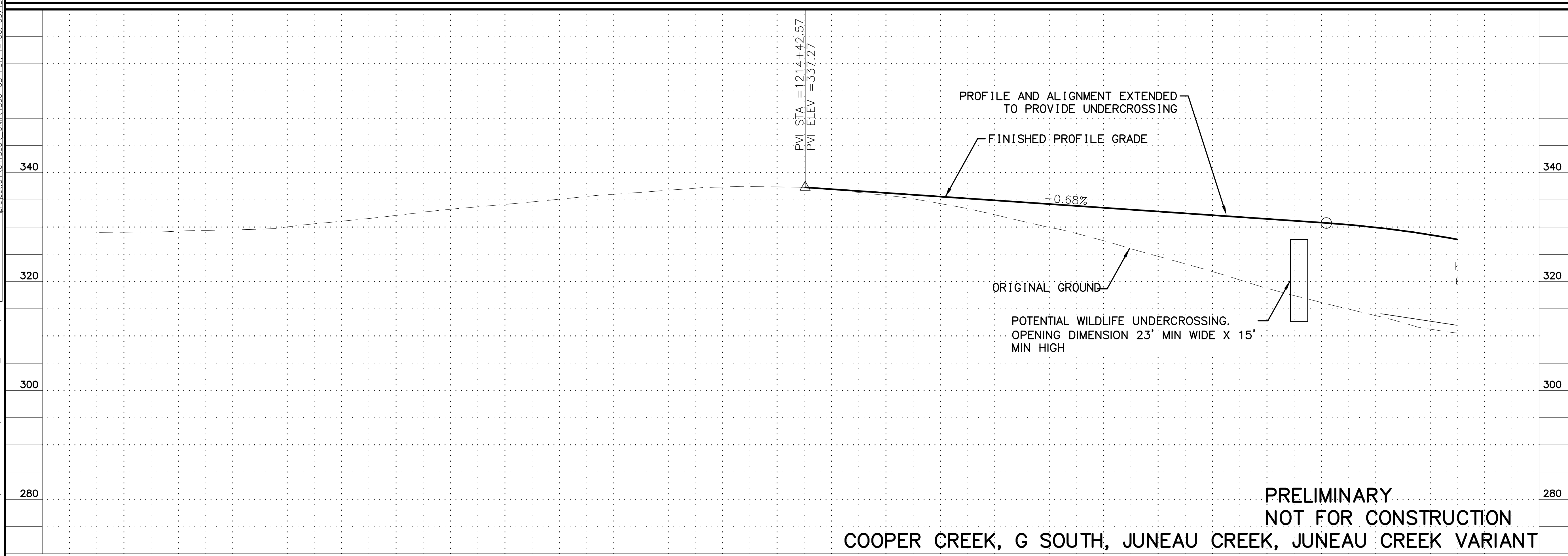




PRELIMINARY
NOT FOR CONSTRUCTION

COOPER CREEK, G SOUTH, JUNEAU CREEK, JUNEAU CREEK VARIANT

SHEET NO.	TOTAL SHEETS
29	29
STATE	YEAR
ALASKA	2016

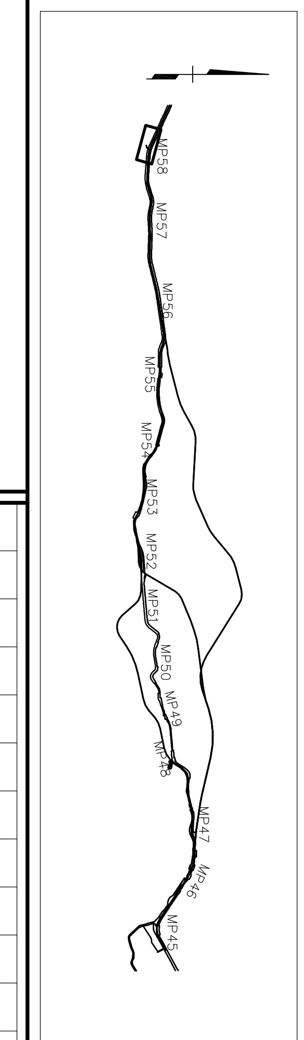
PROJECT DESIGNATION
F-021-2(15)/53014

ADDENDUM NO.

ATTACHMENT NO.

REVISIONS

NO.	DATE	DESCRIPTION



26
SEGMENT 12

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

STERLING HIGHWAY
M.P. 45–60

STA 1200+00 TO 1225+00

Appendix B

Preliminary Costs for Various Wildlife Crossing Structure Types

Cost estimates for wildlife underpasses or wildlife overpass shown in the attached table typically address only the structure costs. Where substantial earthwork would be required to raise the height of a road surface at such a crossing, or at a bridge, earthwork costs were calculated separately and are presented in the body of the report. Similarly, the table accounts for costs of structure work to extend bridges where necessary, but costs for excavation beneath the bridges is not included. Fencing and guardrails at each wildlife crossing are expected to be similar for any crossing and would be additional. The structure costs are considered to be the largest cost component.

Cross sections illustrate the structure types.

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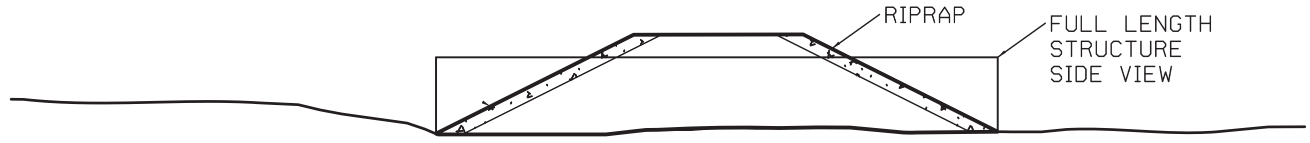
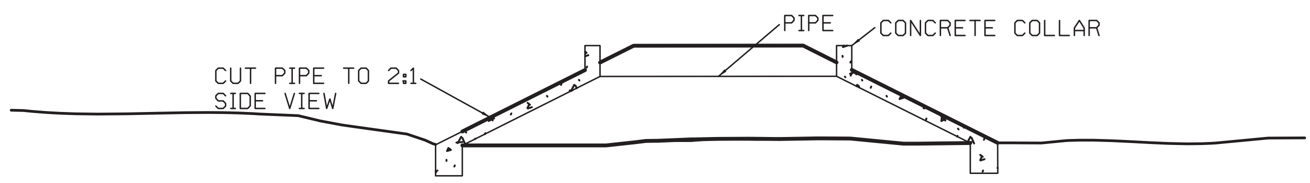
WILDLIFE CROSSING
STRUCTURE TYPES

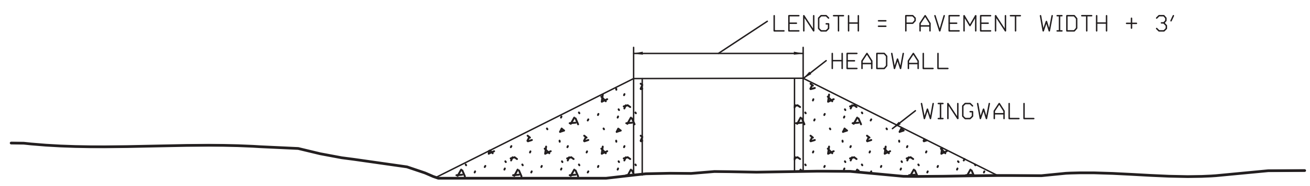
BOX, ARCH, & PRECAST FULL SLOPE LENGTH, NO HEADWALL/WINGWALL (Cross Section View)



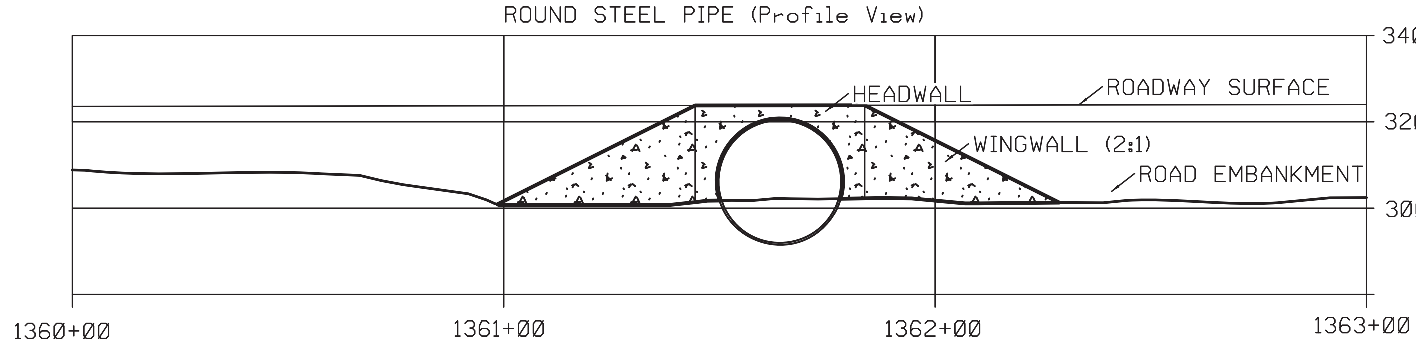
ROUND PIPE FULL SLOPE LENGTH, NO WINGWALL (Cross Section View)



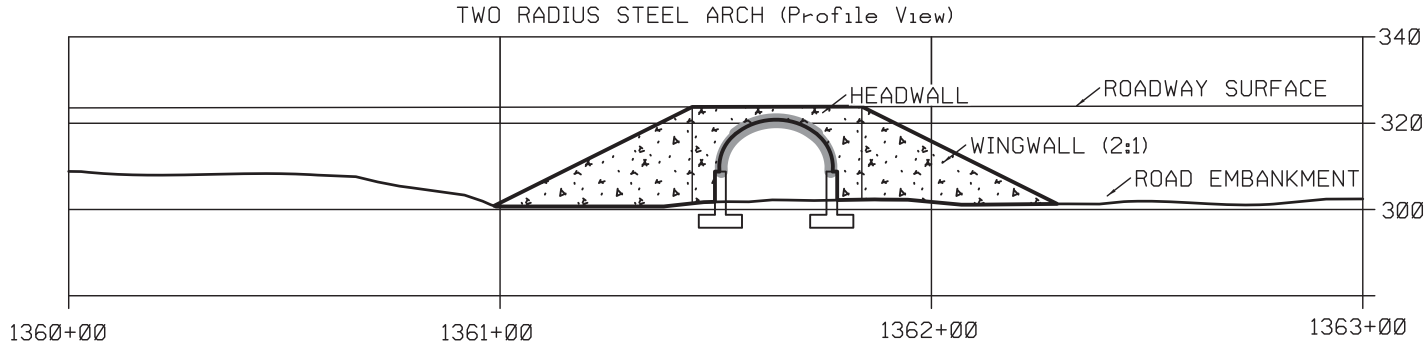
MINIMUM LENGTH STRUCTURE WITH HEADWALL/WINGWALL (Cross Section View)



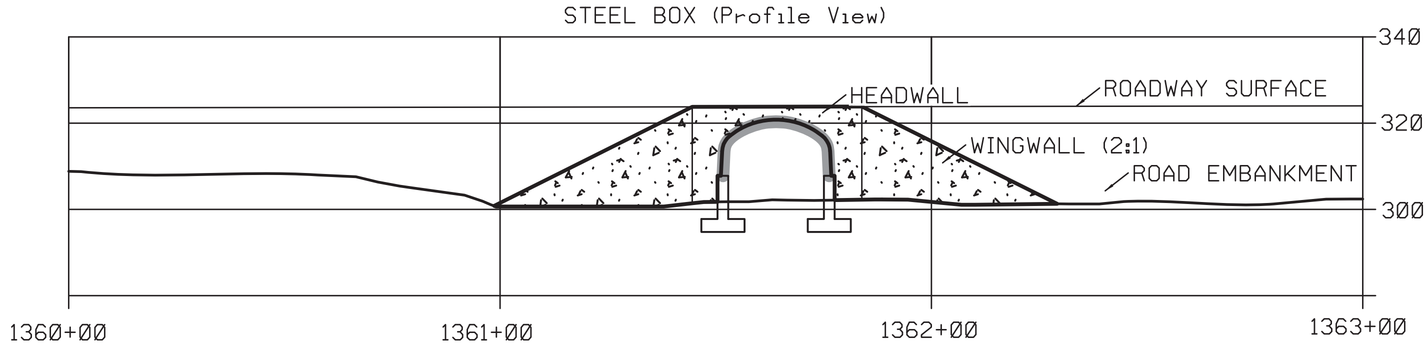
ROUND STEEL PIPE (Profile View)



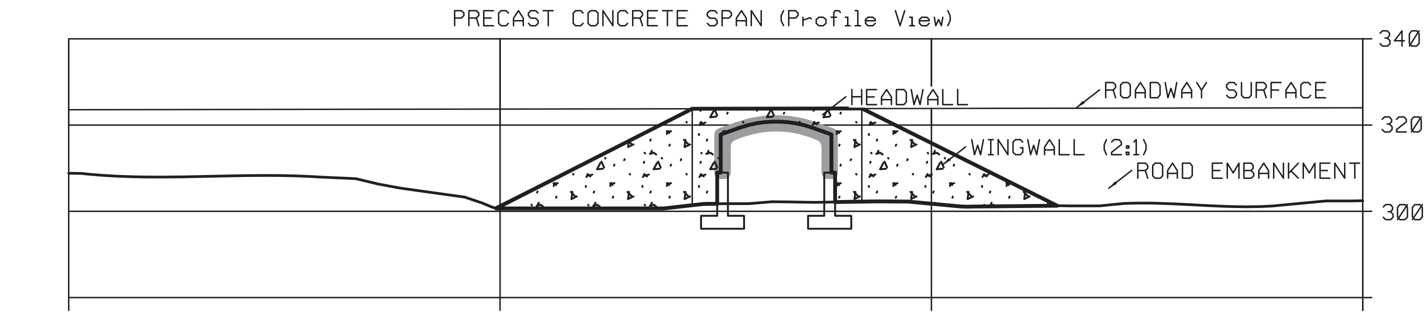
TWO RADIUS STEEL ARCH (Profile View)



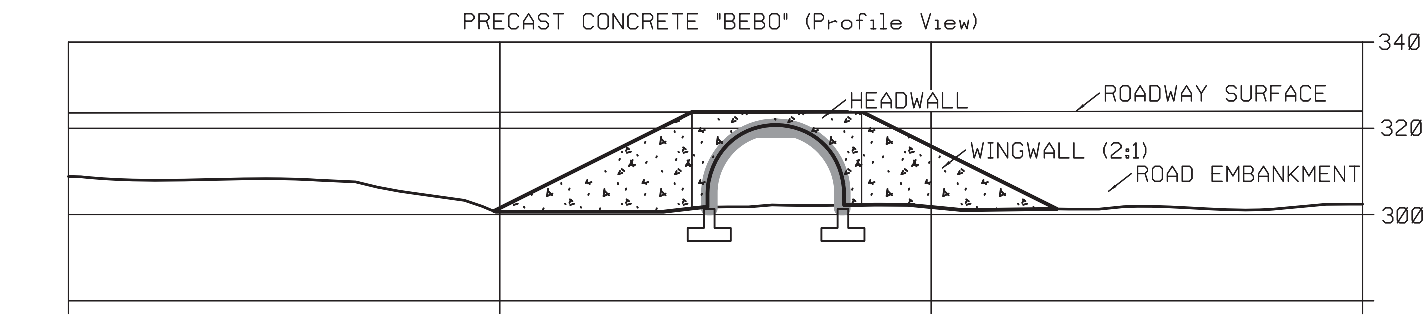
STEEL BOX (Profile View)



PRECAST CONCRETE SPAN (Profile View)



PRECAST CONCRETE "BEBO" (Profile View)



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PRELIMINARY COSTS FOR VARIOUS WILDLIFE CROSSING STRUCTURE TYPES

DECK BULB TEE BRIDGE (23' HORIZONTAL CLEARANCE)

23' HORIZONTAL CLEARANCE

Crossing Number/Name	Alternatives Effected	Description	MIN VERTICAL CLEARANCE	Bridge Deck: Bridge Deck SF	Bridge Deck: Cost/SF	MSE Retaing Wall (Per Side): Retaining Wall SF	MSE Retaing Wall (Per Side): Ret. Wall Cost/SF	Wingwalls (Per Side): Wingwall SF	Wingwalls (Per Side): Wingwall Cost/SF	Total Cost
1	All	Overpass at MP 44.3								
2	JC, JCV, GS	Underpass north of Cooper Landing	15	1815	$250	1,223.8	$65.0	990.1	$240	**$1,088,098**
3	JC, JCV, GS	Underpass north of Cooper Landing	18	1419	$250	1,214.8	$65.0	1,596.1	$240	**$1,278,808**
4/5	CC	Underpass at MP 48	18							
6	CC	Underpass south of Cooper Landing	18	2211	$250	1,323.3	$65.0	780.1	$240	**$1,099,233**
Cooper Cr.	CC	Cooper Creek Bridge								
8/9	JC, JCV, GS	Underpasses northwest of Cooper Landing	18	1815	$250	1,388.8	$65.0	1,275.1	$240	**$1,246,348**
10	JC, JCV	Underpass northwest of Cooper Landing	18	1815	$250	1,333.8	$65.0	1,176.1	$240	**$1,191,678**
Juneau Cr.	JC, JCV	Upper Juneau Creek Bridge	18							
Juneau Cr.	GS	Lower Juneau Creek Bridge	18					`		
13	GS, CC	Underpass of "old' highway at MP 52	18	1419	$250	763.3	$65.0	630.1	$240	**$756,433**
14/15	GS, CC	Schooner Bend Bridge	18							
16	GS, CC	Underpass at MP 54	15	2211	$250	1,820.0	$65.0	1,352.0	$240	**$1,438,310**
18	JC, JCV	Underpass east of SMU 395	18							
22	All	Underpass at MP 56.2	18	1419	$250	1,021.3	$65.0	1,128.1	$240	**$1,029,013**
25	All	Underpass at MP 57.5	15	1584	$250	1,104.0	$65.0	1,058.0	$240	**$1,047,360**
26	All	Underpass at MP 58.1	15	2211	$250	1,256.3	$65.0	703.1	$240	**$1,053,563**

ROUND STEEL PIPE 28'-6", BURIED 15' MINIMUM CLEARANCE

MINIMUM LENGTH

Wingwall/Headwall = $240/SF

Crossing Number/Name	Length	Cost/LF	Wingwall Cost	Total Cost
1				
2	55	$1,675	$734,402	**$826,527**
3	43	$1,675	$1,136,450	**$1,208,475**
4/5				
6	67	$1,675	$587,282	**$699,507**
Cooper Cr.				
8/9	55	$1,675	$926,786	**$1,018,911**
10	55	$1,675	$860,738	**$952,863**
Juneau Cr.				
Juneau Cr.				
13	43	$1,675	$478,226	**$550,251**
14/15				
16	70	$1,675	$977,582	**$1,094,832**
18	67	$1,675	$601,454	**$713,679**
22	43	$1,675	$828,434	**$900,459**
25	48	$1,675	$780,878	**$861,278**
26	67	$1,675	$531,794	**$644,019**

TWO RADIUS STEEL ARCH 25'-5" H x 11'-7" V 15' MINIMUM CLEARANCE

MINIMUM LENGTH

Wingwall/Headwall = $240/SF

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Wingwall Cost	Pedestal Wall Cost	Total Cost
1					
2	55	$725	$694,560	$73,370	**$807,805**
3	43	$725	$1,087,680	$57,362	**$1,176,217**
4/5					
6	67	$725	$551,160	$89,378	**$689,113**
Cooper Cr.					
8/9	55	$725	$882,480	$73,370	**$995,725**
10	55	$725	$817,920	$73,370	**$931,165**
Juneau Cr.					
Juneau Cr.					
13	43	$725	$445,080	$57,362	**$533,617**
14/15					
16	70	$725	$932,160	$93,380	**$1,076,290**
18	67	$725	$564,960	$89,378	**$702,913**
22	43	$725	$786,360	$57,362	**$874,897**
25	48	$725	$739,920	$64,032	**$838,752**
26	67	$725	$497,160	$89,378	**$635,113**

STEEL BOX 24'-8" H x 12'-7" V 15' MINIMUM CLEARANCE

MINIMUM LENGTH

Wingwall/Headwall = $240/SF

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Wingwall Cost	Pedestal Wall Cost	Total Cost
1					
2	55	$770	$685,216	$73,370	**$800,936**
3	43	$770	$1,075,945	$57,362	**$1,166,417**
4/5					
6	67	$770	$542,812	$89,378	**$683,780**
Cooper Cr.					
8/9	55	$770	$871,940	$73,370	**$987,660**
10	55	$770	$807,779	$73,370	**$923,499**
Juneau Cr.					
Juneau Cr.					
13	43	$770	$437,528	$57,362	**$528,000**
14/15					
16	70	$770	$921,322	$93,380	**$1,068,602**
18	67	$770	$556,512	$89,378	**$697,480**
22	43	$770	$776,418	$57,362	**$866,890**
25	48	$770	$730,277	$64,032	**$831,269**
26	67	$770	$489,210	$89,378	**$630,178**

PRECAST CONCRETE SPAN 24' H x 11' V 15' MINIMUM CLEARANCE

MINIMUM LENGTH

Wingwall/Headwall = $240/SF

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Wingwall Cost	Pedestal Wall Cost	Total Cost
1					
2	55	$2,050	$674,296	$73,370	**$860,416**
3	43	$2,050	$1,067,905	$57,362	**$1,213,417**
4/5					
6	67	$2,050	$530,692	$89,378	**$757,420**
Cooper Cr.					
8/9	55	$2,050	$862,460	$73,370	**$1,048,580**
10	55	$2,050	$797,819	$73,370	**$983,939**
Juneau Cr.					
Juneau Cr.					
13	43	$2,050	$424,448	$57,362	**$569,960**
14/15					
16	70	$2,050	$912,202	$93,380	**$1,149,082**
18	67	$2,050	$544,512	$89,378	**$771,240**
22	43	$2,050	$766,218	$57,362	**$911,730**
25	48	$2,050	$719,717	$64,032	**$882,149**
26	67	$2,050	$476,610	$89,378	**$703,338**

PRECAST CONCRETE 'BEBO' 30' H x 18' V

MINIMUM LENGTH

Wingwall/Headwall = $240/SF

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Wingwall Cost	Pedestal Wall Cost	Total Cost
1	260	$2,700	$1,536,960	$520,000	**$2,758,960**
2	55	$2,700	$675,496	$73,370	**$897,366**
3	43	$2,700	$1,086,385	$57,362	**$1,259,847**
4/5					
6	67	$2,700	$524,692	$89,378	**$794,970**
Cooper Cr.					
8/9	55	$2,700	$872,300	$73,370	**$1,094,170**
10	55	$2,700	$804,779	$73,370	**$1,026,649**
Juneau Cr.					
Juneau Cr.					
13	43	$2,700	$412,688	$57,362	**$586,150**
14/15					
16	70	$2,700	$924,202	$93,380	**$1,206,582**
18	67	$2,700	$539,232	$89,378	**$809,510**
22	43	$2,700	$771,738	$57,362	**$945,200**
25	48	$2,700	$723,077	$64,032	**$916,709**
26	67	$2,700	$467,730	$89,378	**$738,008**

DECK BULB TEE BRIDGE (32' HORIZONTAL CLEARANCE)

Crossing Number/Name	Alternatives Effected	Description	MIN VERTICAL CLEARANCE	Bridge Deck: Bridge Deck SF	Bridge Deck: Cost/SF	MSE Retaing Wall (Per Side): Retaining Wall SF	MSE Retaing Wall (Per Side): Ret. Wall Cost/SF	Wingwalls (Per Side): Wingwall SF	Wingwalls (Per Side): Wingwall Cost/SF	Total Cost
1	All	Overpass at MP 44.3								
2	JC, JCV, GS	Underpass north of Cooper Landing	15	2310	$250	2,213.9	$65.0	990.1	$240	**$1,340,564**
3	JC, JCV, GS	Underpass north of Cooper Landing	18	1806	$250	2,810.9	$65.0	1,596.1	$240	**$1,583,054**
4/5	CC	Underpass at MP 48	18							
6	CC	Underpass south of Cooper Landing	18	2814	$250	2,103.4	$65.0	780.1	$240	**$1,351,399**
Cooper Cr.	CC	Cooper Creek Bridge								
8/9	JC, JCV, GS	Underpasses northwest of Cooper Landing	18	2310	$250	2,663.9	$65.0	1,275.1	$240	**$1,535,864**
10	JC, JCV	Underpass northwest of Cooper Landing	18	2310	$250	2,509.9	$65.0	1,176.1	$240	**$1,468,324**
Juneau Cr.	JC, JCV	Upper Juneau Creek Bridge	18							
Juneau Cr.	GS	Lower Juneau Creek Bridge	18							
13	GS, CC	Underpass of "old' highway at MP 52	18	1806	$250	1,393.4	$65.0	630.1	$240	**$935,099**
14/15	GS, CC	Schooner Bend Bridge	18							
16	GS, CC	Underpass at MP 54	15	2814	$250	3,172.0	$65.0	1,352.0	$240	**$1,764,820**
18	JC, JCV	Underpass east of SMU 395	18							
22	All	Underpass at MP 56.2	18	1806	$250	2,149.4	$65.0	1,128.1	$240	**$1,272,419**
25	All	Underpass at MP 57.5	15	2016	$250	2,162.0	$65.0	1,058.0	$240	**$1,292,900**
26	All	Underpass at MP 58.1	15	2814	$250	1,959.4	$65.0	703.1	$240	**$1,295,719**

ROUND STEEL PIPE 28'-6", BURIED

FULL TOE TO TOE LENGTH, COLLAR/NO WINGWALLS

Collar = $240/SF

Crossing Number/Name	Length	Cost/LF	Collar	Total Cost
1				
2	144	$1,675	$261,648	**$502,848**
3	156	$1,675	$261,648	**$522,948**
4/5				
6	146	$1,675	$261,648	**$506,198**
Cooper Cr.				
8/9	156	$1,675	$261,648	**$522,948**
10	152	$1,675	$261,648	**$516,248**
Juneau Cr.				
Juneau Cr.				
13	114	$1,675	$261,648	**$452,598**
14/15				
16	174	$1,675	$261,648	**$553,098**
18	122	$1,675	$261,648	**$465,998**
22	138	$1,675	$261,648	**$492,798**
25	140	$1,675	$261,648	**$496,148**
26	142	$1,675	$261,648	**$499,498**

TWO RADIUS STEEL ARCH 25'-5" H x 11'-7" V

FULL TOE TO TOE LENGTH, NO HEADWALL/WINGWALLS

Class I RipRap Slope Protection = $100/CY

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Class I Riprap	Pedestal Wall Cost	Total Cost
1					
2	144	$725	$47,839	$288,000	**$440,239**
3	156	$725	$61,404	$312,000	**$486,504**
4/5					
6	146	$725	$42,186	$292,000	**$440,036**
Cooper Cr.					
8/9	156	$725	$54,621	$312,000	**$479,721**
10	152	$725	$52,360	$304,000	**$466,560**
Juneau Cr.					
Juneau Cr.					
13	114	$725	$37,665	$228,000	**$348,315**
14/15					
16	174	$725	$56,317	$348,000	**$530,467**
18	122	$725	$42,752	$244,000	**$375,202**
22	138	$725	$51,230	$276,000	**$427,280**
25	140	$725	$49,534	$280,000	**$431,034**
26	142	$725	$39,925	$284,000	**$426,875**

STEEL BOX 24'-8" H x 12'-7" V

FULL TOE TO TOE LENGTH, NO HEADWALL/WINGWALLS

Class I RipRap Slope Protection = $100/CY

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Class I Riprap	Pedestal Wall Cost	Total Cost
1					
2	144	$770	$46,914	$288,000	**$445,794**
3	156	$770	$60,232	$312,000	**$492,352**
4/5					
6	146	$770	$41,364	$292,000	**$445,784**
Cooper Cr.					
8/9	156	$770	$53,573	$312,000	**$485,693**
10	152	$770	$51,353	$304,000	**$472,393**
Juneau Cr.					
Juneau Cr.					
13	114	$770	$36,925	$228,000	**$352,705**
14/15					
16	174	$770	$55,237	$348,000	**$537,217**
18	122	$770	$41,919	$244,000	**$379,859**
22	138	$770	$50,243	$276,000	**$432,503**
25	140	$770	$48,578	$280,000	**$436,378**
26	142	$770	$39,145	$284,000	**$432,485**

PRECAST CONCRETE SPAN 24' H x 11' V

FULL TOE TO TOE LENGTH, NO HEADWALL/WINGWALLS

Class I RipRap Slope Protection = $100/CY

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Class I Riprap	Pedestal Wall Cost	Total Cost
1					
2	144	$2,050	$47,686	$288,000	**$630,886**
3	156	$2,050	$61,302	$312,000	**$693,102**
4/5					
6	146	$2,050	$42,012	$292,000	**$633,312**
Cooper Cr.					
8/9	156	$2,050	$54,494	$312,000	**$686,294**
10	152	$2,050	$52,225	$304,000	**$667,825**
Juneau Cr.					
Juneau Cr.					
13	114	$2,050	$37,474	$228,000	**$499,174**
14/15					
16	174	$2,050	$56,196	$348,000	**$760,896**
18	122	$2,050	$42,580	$244,000	**$536,680**
22	138	$2,050	$51,090	$276,000	**$609,990**
25	140	$2,050	$49,388	$280,000	**$616,388**
26	142	$2,050	$39,743	$284,000	**$614,843**

PRECAST CONCRETE 'BEBO' 30' H x 18' V

FULL TOE TO TOE LENGTH, NO HEADWALL/WINGWALLS

Class I RipRap Slope Protection = $100/CY

Pedestal Wall = $667/LF

Crossing Number/Name	Length	Cost/LF	Class I Riprap	Pedestal Wall Cost	Total Cost
1					
2	144	$2,700	$53,349	$288,000	**$730,149**
3	156	$2,700	$68,754	$312,000	**$801,954**
4/5					
6	146	$2,700	$46,930	$292,000	**$733,130**
Cooper Cr.					
8/9	156	$2,700	$61,052	$312,000	**$794,252**
10	152	$2,700	$58,484	$304,000	**$772,884**
Juneau Cr.					
Juneau Cr.					
13	114	$2,700	$41,795	$228,000	**$577,595**
14/15					
16	174	$2,700	$62,977	$348,000	**$880,777**
18	122	$2,700	$47,572	$244,000	**$620,972**
22	138	$2,700	$57,200	$276,000	**$705,800**
25	140	$2,700	$55,275	$280,000	**$713,275**
26	142	$2,700	$44,363	$284,000	**$711,763**

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