US14A/US85
Deadwood Box Corridor Study
Initial Analysis of Concepts

Lawrence County, South Dakota
October 18, 2021

DEADWOOD 1876 SOUTH DAKOTA

SD DOT

U.S. Department of Transportation
Federal Highway Administration

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1.0 Introduction

The South Dakota Department of Transportation (SDDOT) in conjunction with the City of Deadwood (the City) and Federal Highway Administration (FHWA) is conducting a corridor planning study for a portion of the US Highway 14 Alternate (US14A) / US Highway 85 (US85) / Pioneer Way corridor in the City of Deadwood, South Dakota. This study will identify potential alignment and design options, structure types, construction phasing, and detour considerations for the structure (Structure Number 41-161-156) over Whitewood Creek, referred to as the "Deadwood Box". It is a 2,063 foot-long structure that crosses US85 / Pine Street and carries the US14A / US85 / Pioneer Way corridor on a good portion of its deck.

The purpose of this memo is to present and evaluate preliminary concepts developed to address transportation issues and needs along the US14A/US85 corridor and potential replacement of the Deadwood Box. Based on this initial evaluation, recommendations are presented for concepts to be carried forward as Build Options for further refinement and evaluation.

The main criteria used to evaluate the preliminary concepts includes (not necessarily in order of importance):

- Whether a concept meets project purpose and need
- Hydraulic impacts
- Constructability
- Right of way needs and private property impacts
- Comparative construction costs
- Potential environmental impacts
- Comparative safety
- Geologic impacts
- Multi-modal considerations
- Social acceptability and community context
- Utility impacts

An evaluation matrix is provided at the end of the memo.

The US14A/US85 Deadwood Box corridor concepts were reviewed by the Study Advisory Team (SAT) at a meeting held on December 18, 2020. The concepts were then presented to the public at Public Information Meeting No. 2 from January 8, 2021 to February 8, 2021. The SAT reconvened on March 5, 2021 to review the public input of the concepts. Preliminary recommendations of concepts to be carried forward as Build Options included:

- Option 1A
- Option 1C

This memo documents concept layouts and evaluation measures reflective of this study phase. Further refinement and evaluation of the Build Options carried forward will be presented and documented in subsequent study memos and reports.

1.1 Project Location

Deadwood is located within Lawrence County, South Dakota. The City lies within a narrow canyon in the northern Black Hills and is known for its rich history and as a popular tourist destination. The Deadwood Box carries US14A/US85/Pioneer Way for approximately 1,768 feet near Deadwood's historic Main Street and conveys Whitewood Creek from approximately Pine Street to Railroad Avenue (See Figure 1).

The commercial district exists along the main roadway corridors: Main Street, US14A, US85, and Sherman Street. Residential neighborhoods begin roughly one to two blocks from the main roadways and are built up into the hillsides and gulches of Deadwood.

Development within the City is challenging due to little developable land and the surrounding steep and forested terrain. In addition, United States Forest Service (USFS) and Bureau of Land Management (BLM) manage lands surrounding the city limits. The physical and land-ownership constraints restrict traditional outward growth and have led to inward, upward, and discontinuous outward growth patterns.

1.2 Project Limits

The study area includes the following roadway segments (See Figure 1):

- US14A / Pioneer Way from Upper Main Street to the northern junction with US85,
- Main Street from the northern intersection of US14A / Pioneer Way to the southern intersection of US14A / Pioneer Way,
- US85 / Sherman Street from Cemetery Street to Pine Street.
- US85 / Pine Street from Main Street to Sherman Street, and
- Sherman Street from Pine Street/US85 to US14A/Pioneer Way.

The study area encompasses the potential relocation of the Deadwood Box, Whitewood Creek and roadway corridor, the possible construction detour routes, and the surrounding major intersections that may be indirectly impacted by the build concepts brought forward during the concept development process.

This study area represents an area of analysis that would encompass effects that are reasonably foreseeable and are related to the Project, including improvements associated with the Deadwood Box and other potential related improvements along US14A/US85, intersections, parking areas, and pedestrian facilities.

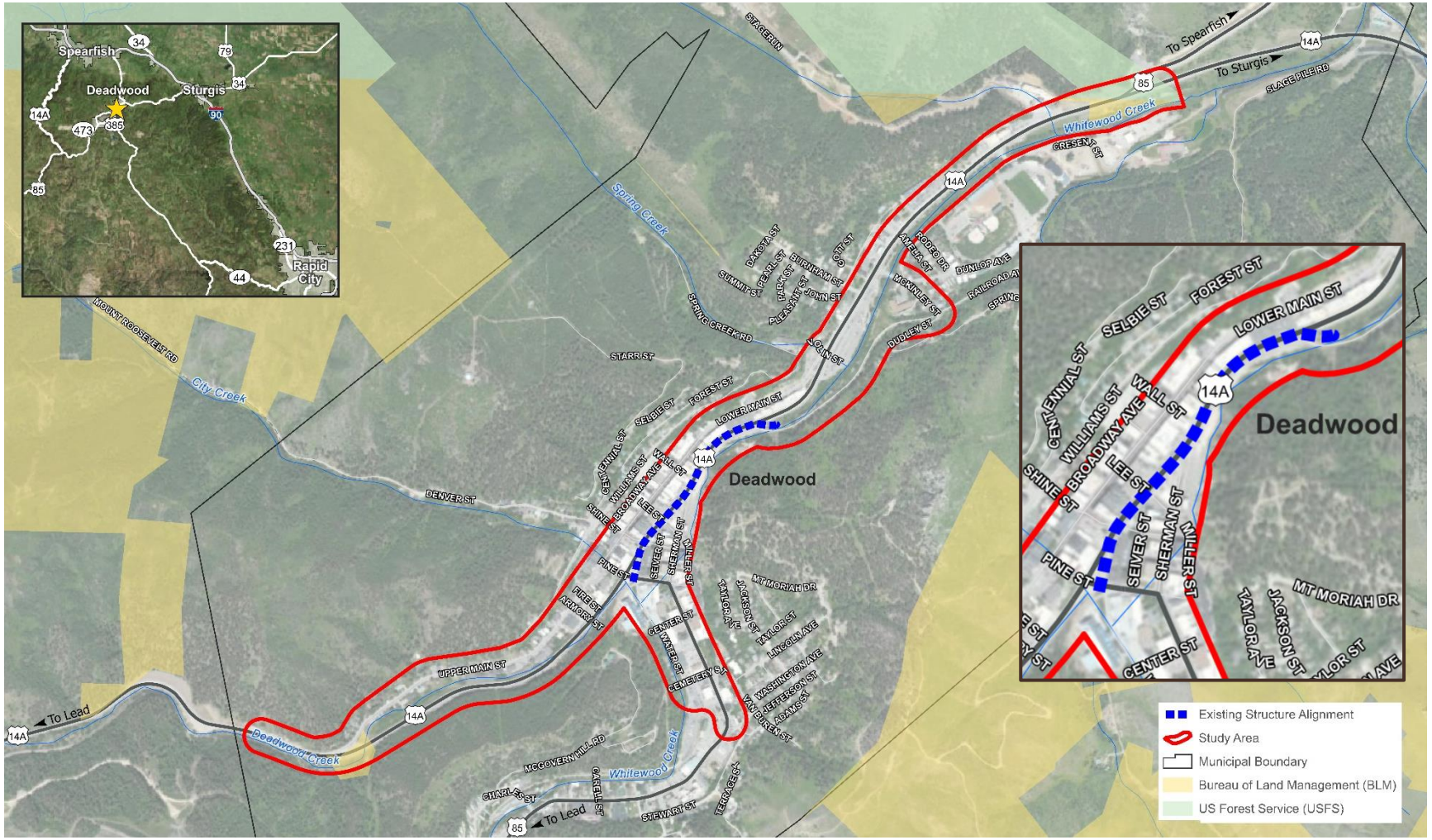


Figure 1. Project Location and Study Area

Regionally, US14A and US85 are the primary arteries between Deadwood and Interstate 90 (I-90), which brings many travelers into the Black Hills for recreation and other tourism activities. West of Deadwood, US14A serves as the truck route to the nearby town of Lead. US85 connects the eastern part of Spearfish located on I-90 to Deadwood and eastern Wyoming. US85 also connects to US Highway 385 (US385) south of the study area which is the main north-south route through the Black Hills. Highway 14A also serves as a recreational route through Spearfish Canyon.

Along with motor travel, bicycle and pedestrian use is important within Deadwood to support the tourism industry and recreational and healthy lifestyles. Existing and future multi-use paths and trails are shown in Figure 2.

1.3 Background

The Deadwood Box (Structure Number 41-161-156) was constructed in 1967 and underwent major rehabilitation in 1989. Other repairs have occurred during the life of the structure such as epoxy chip seal, patching of spalled concrete, and repair of delamination areas. Successive inspection reports note additional areas of exposed rebar, spalling has expanded, and the structure deck, concrete floor, and deck joints are continuing to degrade.

Even with rehabilitation and minor repairs, the structure is reaching the end of its serviceable life. The SDDOT Major Bridge Investment Study[1] noted the structure was rated "Structurally Deficient[2]", from the 2012 and 2014 inspections, citing that the substructure has significant condition issues. It should be noted that based on new definitions for condition ratings, the structure is no longer considered structurally deficient and currently has a "fair condition" rating.

The City of Deadwood Comprehensive Plan[3] also recognized US14A as an area for improvement, citing that pedestrian safety, particularly at crossings, was a concern of the City. The 2008 Deadwood Pedestrian Circulation and Enhancement Study[4] noted that several crossings have had numerous complaints over the years regarding difficulty in crossing the roads. However, few instances of pedestrian-vehicle crashes have been reported within the study area[5]. Pedestrian facilities through town include curbside sidewalks of varying widths, and multi-use trails. Crosswalks also exist at signalized and unsignalized intersections, as shown in Figure 2.

[1] FHU and Benesch. (2016). Report for the South Dakota Department of Transportation Major Bridge Investment Study.

[2] The term "Structurally Deficient" is no longer used when referring to the classification condition of a structure. Under the programs established by MAP-21 federal legislation, "structurally deficient" has been redefined as Poor in a Good/Fair/Poor condition classification system.

[3] City of Deadwood. (2018). *Deadwood Comprehensive Plan.* Found online at: https://www.cityofdeadwood.com/vertical/sites/%7BECDE07BE-19F7-4F11-A017-CFDAD3EEEE69%7D/uploads/DeadwoodCompPlan_Draft_November2018.pdf

[4] RPM Transportation Consulting and NJS Engineering. 2008. City of Deadwood Pedestrian Circulation and Enhancement Study.

[5] HDR. (2020) DRAFT Technical Memo: Crash History Review.

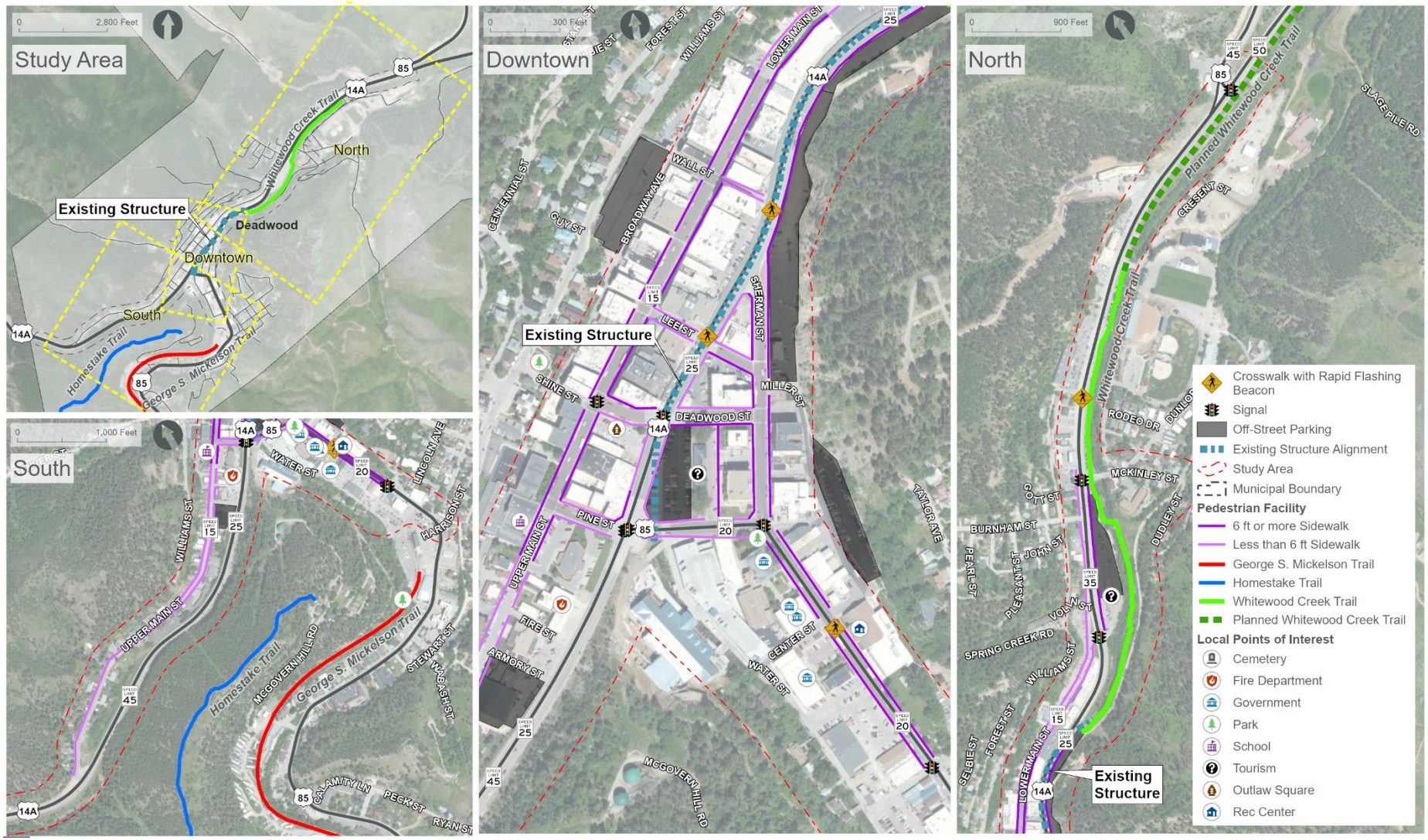


Figure 2. Pedestrian Facilities within the Study Area

City of Deadwood Historic Status

In addition to the planning studies described previously, the City also has issued design guidelines for the Historic District to remain in compliance with and enhance their standing with the National Historic Landmark designation. The guidelines were developed to help evaluate the appropriateness of alterations to the Historic District.

One guideline pertinent to this study is the importance of not creating any additional disturbance to the rock cut faces. Another is the use of brick pavers for pavement surfacing. Any impacts to these pavers will need to be replaced in kind. The limits of brick paving can be found in Figure 3.

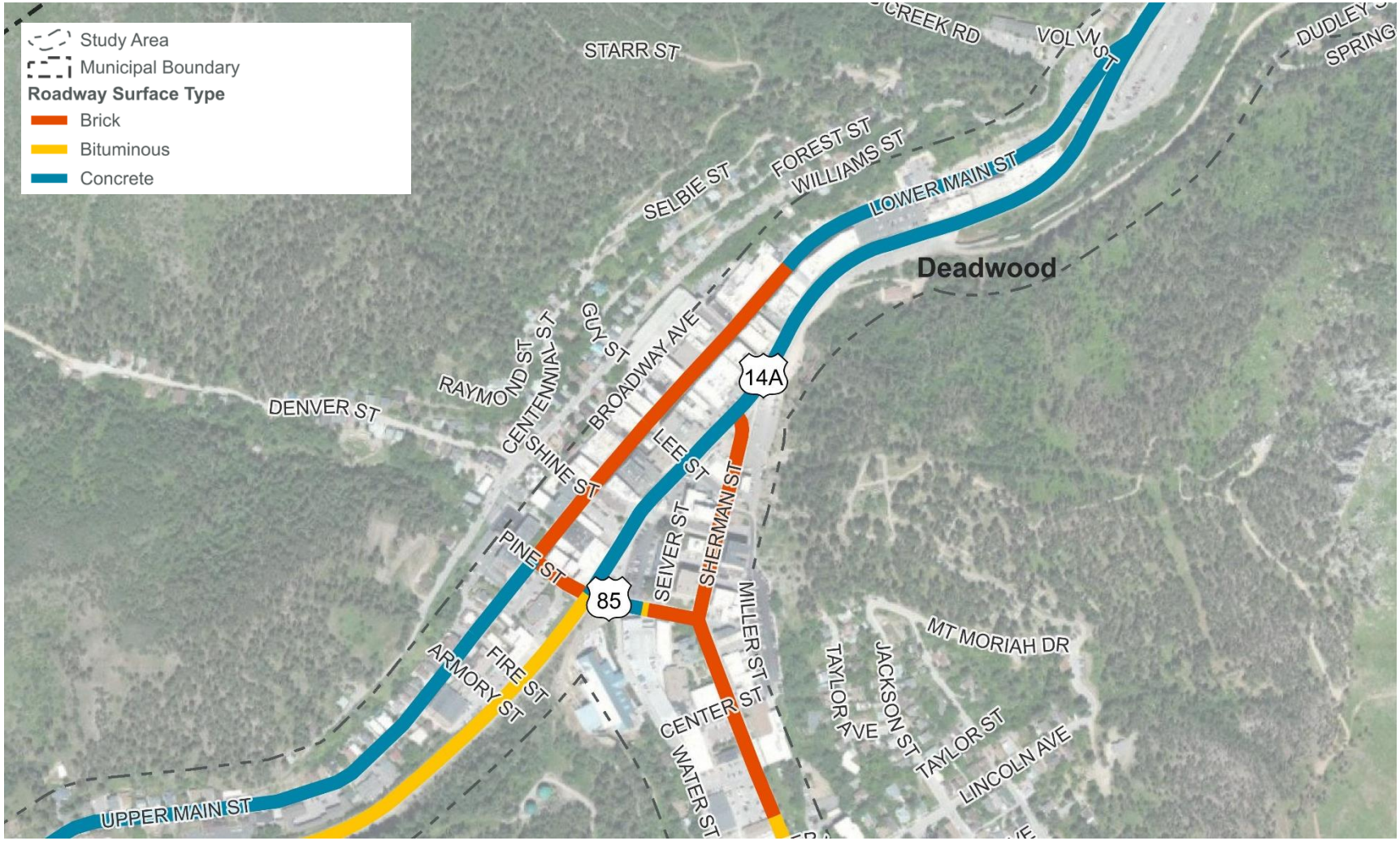


Figure 3. Limits of Brick Paving within the Study Area

2.0 Purpose and Need Summary

The draft purpose and need statement for the US14A/US85 Deadwood Box Corridor Project is as follows (as of November 2, 2020):

The purpose of this Project is to address the deteriorating structure to provide a durable structure and reduce long-term maintenance costs of the Deadwood Box. The project is needed because of the continuing deterioration of the Deadwood Box resulting in low sufficiency and condition ratings. Additionally, the project needs to address the increasing costs of maintaining the structure at a “Fair” or better condition.

During Project scoping, goals were discussed and considered for inclusion in the Project. Project goals are not part of the alternative screening process; however, these goals are incorporated into the concepts, where possible, to meet the concerns of the stakeholders and public. Failure to meet a Project goal would not necessarily eliminate an alternative from consideration. Goals for the project include improving bicycle and pedestrian circulation within the corridor through trail and sidewalk enhancements and by improving connectivity between the parking areas and the core downtown area.

Refer to the latest version of the US14A/US85 Deadwood Box Corridor Project purpose and need document for additional information.

3.0 Concepts

Concepts developed for the US14A/US85 Deadwood Box Corridor are listed in Table 1.

The concepts can be differentiated based on:

(1) **Route:** The through U.S. highway route movement

- The main reason for changing the through U.S. highway route movement between US14 and US85 is to explore the impact to traffic operations by streamlining turning movements at five key intersections and potentially eliminate the need for the US14A/Sherman Street intersection that sits at a high skew.

(2) **Deadwood Box Construction:** Location/type of drainage structure

- The build concepts explore the feasibility of rebuilding the structure within the existing alignment or whether a partial new alignment aids in constructability. The concepts also explore conditions where the box is a closed cell box culvert or if the channel can be partially opened for a stretch of Whitewood Creek.

(3) **Location of Transportation Facilities:** The location of parking areas in relation to US14A/US85

- The build concepts explore the feasibility of moving the parking to the historic main street side of US14A/US85 (western side) and the highway to the rock-slope side (eastern side), thereby reducing potential conflicts between pedestrians and vehicles.

Table 1. Summary of US14A/US85 Deadwood Box Corridor Concepts

Concept No.	Route		Deadwood Box Construction			Location of Transportation Facilities	
			Closed Cell Box Culvert		Partial Open Channel		
	Through Movement	Via	Within Existing	Partial New Alignment	Within Existing	Parking Side	Highway Side
NB	US14A	Pioneer Way	-	-	-	East	West
MR	US14A	Pioneer Way	-	-	-	East	West
1a	US14A	Pioneer Way	x			East	West
1b	US14A	Pioneer Way	x	x		East	West
1c	US14A	Pioneer Way	x			West	East
1d	US14A	Pioneer Way		x		West	East
2a	US85	Sherman St./ Pioneer Way	x			East	West
2b	US85	Sherman St./ Pioneer Way	x			West	East
2c	US85	Sherman St./ Pioneer Way		x		West	East
2d	US85	Miller St./ Pioneer Way	x			West	East
3a	US14A	Pioneer Way	x			West/East	East
4a	US14A	Tunnel	x		x	West/East	N/A
5a	US14A	Upper Main St./ Williams St.	x		x	East	N/A

4.1 Description of Concepts

The No-Build and Major Rehabilitation options are the two baseline concepts that explore the impacts if the Deadwood Box was not replaced in its entirety. The Build Concepts can be divided into five main groupings, with sub-options provided in the first two groupings. A more detailed description of the concept groupings goals is described in the sections that follow. All initial concept layout exhibits can be found in Appendix A.

No-Build (NB)

The no-build option consists of minor repairs typical for any highway or bridge. However, no major rehabilitation is done to the existing structure to extend its life span. This condition allows the box to continue to deteriorate until US14A will require load restrictions. With this scenario, the drainage structure will still need to be replaced in the near future.

Major Rehabilitation (MR)

The major rehabilitation option consists of completing extensive rehabilitation to try to extend the box's life span. This option will require significant up-front maintenance and long-term maintenance moving forward. With this scenario, the drainage structure will still need to be replaced in the near future.

Concept 1: US14A as Through Movement with US85 Junction

The Concept 1 grouping retains similar traffic movement characteristics to the existing corridor, most notably retaining US14A as the through movement with a US85 junction via Pine Street / Sherman Street. This allows for a through movement that does not require trucks to turn in order to take US14A to avoid the narrow, steep, and curvy ascent into Lead, SD via US85. Four options were developed as preliminary concepts that retain US14A as the through movement:

- Concept 1a: Parking to East, Highway to West, Deadwood Box Rebuilt within Existing
- Concept 1b: Parking to East, Highway to West, Deadwood Box Rebuilt Partially within Existing and Partially New Alignment
- Concept 1c: Parking to West, Highway to East, Deadwood Box Rebuilt within Existing
- Concept 1d: Parking to West, Highway to East, Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

Concept 2: US85 as Through Movement with US14A Junction

Concepts 2a, 2b, and 2c reroute US14A/US85 down Sherman Street and Concept 2d reroutes the US14A/US85 down Miller Street. US85 would be the through movement with a US14A junction via Pine Street and Deadwood Street. This will require trucks to make a turn in order to take US14A to avoid the narrow, steep, and curvy ascent into Lead, SD via US85. These concepts combine the main turning movements from the five intersections of US14A & US85/Pine Street, US14A & Deadwood Street, US14A & Lee Street, US14A & Sherman Street, and US85/Pine Street & Sherman Street into two intersections at Sherman Street/US85 & US14A/Pine Street and Sherman Street/US85 & US14A/Deadwood Street.

Four options were developed as preliminary concepts that change the through movement to US85:

- Concept 2a: Parking to East, Highway to West and Along Sherman St, Deadwood Box Rebuilt within Existing
- Concept 2b: Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt within Existing
- Concept 2c: Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

- Concept 2d: Parking to West, Highway to East and Along Miller Street, Deadwood Box Rebuilt within Existing

Concept 3: US14A Overpass

Concept 3 introduces an overpass between Deadwood Street and Lower Main Street. The main goal of raising the grade on US14A and providing this overpass is to provide connectivity between the parking areas and historic Main Street, thereby reducing the potential conflict between highway traffic and pedestrians.

One option was developed as a preliminary concept with a US14A Overpass:

- Concept 3a: Parking Below, Highway Overpass Between Deadwood Street and Lower Main Street, Deadwood Box Rebuilt within Existing

Concept 4: Tunnel System

Concept 4 introduces two tunnels that would allow traffic to cross over Whitewood Creek twice and completely bypass the Deadwood Box. The tunnel would provide a bypass with access to US14A/US85 via the intersections of US14A & Lower Main Street and US14A & US85/Sherman Street and US14A & Upper Main Street.

One option was developed as a preliminary concept with a US14A Tunnel System:

- Concept 4a: Parking Area Between Lee Street and Lower Main Street, Highway Tunnel System Between Lower Main Street to US85/Sherman Street and US85/Sherman Street to Upper Main Street and Lower Main Street, Deadwood Box Rebuilt within Existing, Partial Open Channel between Inlet at Pine Street and Wall Street

Concept 5: Highway Rerouted on Local Roadway

Concept 5 reroutes US14A/US85 onto Williams Street and Upper Main Street. The focus of this concept was to determine a way to allow for as much open channel as possible.

One option was developed as a preliminary concept with US14A/US85 rerouted on a local roadway:

- Concept 5a: Highway rerouted onto Williams Street and Upper Main Street, Deadwood Box Rebuilt within Existing, Partial Open Channel between Deadwood Street and the existing outlet

4.2 Debris Catcher

The existing debris catcher is secured to the Deadwood Box Inlet near Pine Street, as shown in Figure 4. There is poor accessibility to the debris catcher at this location. The debris removal equipment either must block traffic on Pine Street or block traffic on a private entrance to the Deadwood Mountain Grand.

Figure 4. Existing Debris Catcher Secured to Box Inlet Adjacent to Pine Street

One possible solution is to place one or two debris catchers upstream of the box's inlet. The first proposed location is adjacent to Center Street and the second supplementary location could be adjacent to Cemetery Street. There are minimal trees between Center Street and the box's inlet, therefore locating the debris catcher upstream to inlet should not be an issue. This solution would be applicable to all of the preliminary build concepts. Note that the City of Deadwood is installing an upstream debris catcher near the intersection of US85 & US385, approximately 1.9 miles upstream of the existing box inlet.

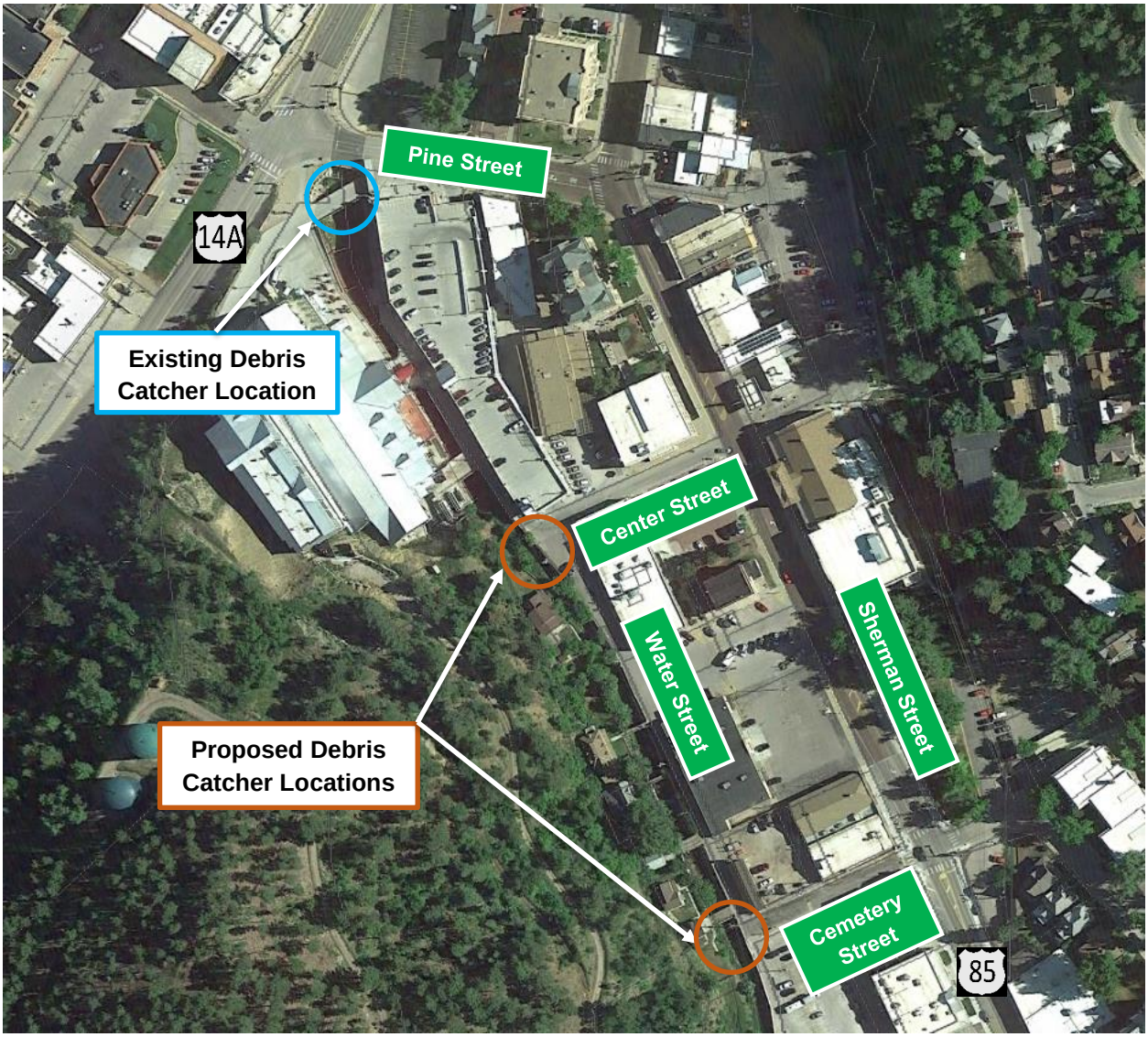


Figure 5. Location of Proposed Debris Catcher Locations

A couple examples of debris catchers are shown in Figure 6 and Figure 7.

Source: (Tindle Newspapers Ltd., 2020)[6], A debris catcher designed to prevent trees, branches and other vegetation from causing flooding issues in Laxey River, Isle of Man

Figure 6. Example #1 of an Upstream Debris Catcher

Source: (NRCS, 2002)[7] Designed by NRCS to catch large debris such as large rocks and trees from water erosion after the Los Alamos, New Mexico fires.

Figure 7. Example #2 of an Upstream Debris Catcher

[6] Tindle Newspapers Ltd. (2020, November 24). Debris catcher installed over a year after flood. Retrieved from IOM Today: http://www.iomtoday.co.im/article.cfm?id=59222&headline=Debris%20catcher%20installed%20over%20a%20year%20after%20flood&sectionIs=News&searchyear=2020

[7] NRCS. (2002). *Photo Gallery, Photo NRCSNM02052.* Retrieved from Natural Resources Conservation Service: https://photogallery.sc.egov.usda.gov/photogallery/#/

5.0 Evaluation Methodology

The following methodology was used to compare concepts and determine the feasibility, benefits, and drawbacks of each.

5.1 Evaluation Categories

A brief description of each evaluation category is provided in the sections that follow.

MEETS PURPOSE AND NEED

The concept was evaluated on whether it meets the US14A/US85 Deadwood Box Corridor Project purpose and need.

HYDRAULIC IMPACTS

The main hydraulic differences between the concepts are discussed, including whether the proposed box structure has no upstream base flood elevation impacts and therefore, results in a no-rise condition or if the concept has a high likelihood of a Conditional Letter of Map Revision (CLOMR) and remapping.

CONSTRUCTABILITY

Preliminary construction phasing and detours have been developed for each initial concept. The constructability is based on the number of phases required, how much of the construction can occur "offline" without disturbing local or regional traffic, and whether the maintenance of traffic (MOT) requires a detour down historic Main Street or through a neighborhood.

ROW NEEDS AND PRIVATE PROPERTY IMPACTS

Right of way (ROW) needs were generated using the preliminary concept layouts. The number of private buildings that were impacted are noted on the figures and tables.

COMPARATIVE COSTS

Preliminary concept costs included:

- Construction cost
- Contingency
- ROW acquisition costs
- Total cost

POTENTIAL ENVIRONMENTAL IMPACTS

Several resource categories were used to qualitatively evaluate potential impacts of the concepts. Key resource categories considered include visual, Section 4(f) and Section 6(f) properties, and waters of the US.

SAFETY

Safety was evaluated qualitatively and comparatively between concepts. This includes a comparison of pedestrian safety, roadway geometrics, access spacing, and elimination of intersections and thereby the number of total conflict points along the corridor. A predictive safety analysis using the Interactive Highway Safety Design Model (IHSDM) was not performed at this level of the concept development, but a more in-depth predictive safety analysis will be completed after the concepts have been narrowed down to a maximum of three build concepts.

GEOLOGIC IMPACTS

Three sources of geologic impacts were considered including:

- Excavation required for Deadwood Box Structure
- Excavation of the previously undisturbed/vegetated portions of a rock cut backslope.
- Excavation of the previously disturbed/unvegetated portions of a rock cut backslope.

MULTI-MODAL CONSIDERATIONS

Several improvements or impacts were considered in this category including:

- Reduction in pedestrian crossing locations between parking areas and historic Main Street
- Widening of the eastern shared use path between Sherman Street and Whitewood Creek Trailhead
- Addition of sidewalk on west side of corridor where it is currently missing

SOCIAL ACCEPTABILITY AND COMMUNITY CONTEXT

Impacts included in this category included:

- Permanent impacts to parking
- Impacts to a neighborhood
- Aesthetics of a build concept
- Removal of community buildings

UTILITY IMPACTS

A high-level review of impacts to existing utilities and the feasibility of future utility improvements, a comparative level of utility impacts, and any other red flags for each build concept.

5.2 Scoring Methodology

The following table summarizes the highest score each evaluation category could receive. All categories that have a high significance or will be the driving force behind the concept feasibility are given a score out of 20. All categories that are a project goal and less of a feasibility issue are given a score out of 10.

A high score in the category signifies the concept is the least impactful in terms of that category or exhibits the greatest feasibility and likelihood of meeting the goals of that category. The evaluation category scoring for each concept will be summarized in an overall evaluation matrix at the end of this report. This scoring will provide an overall picture of the most feasible concepts.

Table 2. Evaluation Category Scoring

Evaluation Category	**Highest Scoring Possible**
Meets Purpose and Need	N/A
Hydraulic Impacts	20
Constructability	20
ROW Needs and Private Property Impacts	20
Comparative Costs	20
Potential Environmental Impacts	20
Safety	10
Geologic Impacts	10
Multi-modal Considerations	10
Social Acceptability and Community Impacts	10
Utility Impacts	10
Total	**150**

6.0 Evaluation

The following presents US14A/US85 Deadwood Box Corridor concept options, evaluation findings, and recommendations. A graphical layout, description, summary of benefits and drawbacks, and recommendation is provided for each concept.

Supporting technical information and analysis is provided in the Appendices:

- Preliminary Concept Layouts (Appendix A)
- Hydraulics & Hydrology (H&H) Analysis Technical Memo (Appendix B)
- Preliminary Phasing of Concepts (Appendix C)
- Preliminary Utility Coordination Technical Memo (Appendix D)

The overall concept evaluation matrix is provided in Table 14 at the end of this section.

6.1 Meets Purpose and Need

The No-Build and Major Rehabilitation conditions do not:

- Meet project purpose and need.
- Address other project goals including:
  - Goals for the project include improving bicycle and pedestrian circulation within the corridor through trail and sidewalk enhancements and by improving connectivity between the parking areas and the core downtown area via traffic calming measures (i.e. road diet) and moving parking areas to the other side of the roadway.

All other build concepts provide a durable structure and reduce long-term maintenance costs of the Deadwood Box. Thus, Concepts 1 through 5 meet the purpose and need of the Study. The No-Build condition will be carried forward as a baseline comparison for the concepts.

6.2 Hydraulic Impacts

As described in the H&H Analysis Technical Memo included in Appendix B, a closed cell drainage structure with an equivalent span of 36 feet was found to be sufficient for the box replacement. Some of the options propose opening the existing box and replacing with an open channel. Details summarizing the advantages, drawbacks, and scoring regarding the hydraulic impact category is in this section.

Cast in Place Concrete or Precast Structure

Cast in place concrete box culvert and precast box culvert construction both have their benefits. Cast in place box culvert benefits include structure durability, lack of recurring required maintenance and efficient hydraulic structures making them a desirable structure type. Cast in place box culverts are labor intensive and require extensive labor hours and concrete cure time to form and pour the sections. If an expedited construction schedule is required, a cast in place box culvert would not be the first choice for construction.

Precast box culverts include the same benefits as the cast in place box culverts. The precast box culvert can be installed on site relatively quickly with minimal wait time between placing sections. The precast box does require many more joints since the sections are limited to lengths that can be delivered to the construction site and construction equipment can easily lift and place. For this project the joint connections would be an additional benefit to match the meandering alignment of Whitewood Creek. Cast in place and precast box culvert construction are viable options for any of the concepts.

Summary of Hydraulics Considerations and Scoring

For options 1 through 3, the proposed box structure has no upstream base flood elevation impacts if proposed entrance size matches existing entrance size. Therefore, it creates a no-rise condition. The system 100-year flow is confined/contained within the box. The floodplain administrator could require CLOMR and remapping on the upstream end to clean up the poor existing mapping which has the floodway halfway into Pine Street. It is unknown if this will happen, but the potential exists. Any remapping required upstream will be problematic due to poor existing mapping and the difficulty of finding proper tie-in points that meet FEMA requirements.

In contrast, concepts 4 and 5 will require CLOMR and remapping. Any remapping will be difficult upstream to find proper tie in points according to FEMA requirements. In addition, there are potential upstream base flood elevation impacts. Any impacts that create a rise in the base flood elevation will not be approved by FEMA because the increase will impact structures and those impacts would need to be mitigated. The model is very sensitive to deviations from a culvert and causes some upstream locations to show a rise.

The advantages, drawbacks, and associated scoring of each concept in terms of hydraulic impacts is summarized in Table 3. The reasoning of the scoring can be found in the bullet below.

- Since the advantage of a no-rise condition and the disadvantage of a high likelihood of a CLOMR/remapping are inverses of each other, 20 points were given to concepts that resulted in a no-rise condition.

Table 3. Hydraulics Considerations

Concept No.	Advantage	Drawback	Hydraulics Score
	No-Rise Condition	*CLOMR and Remapping Required*	
NB	x		20
MR	x		20
1a	x		20
1b	x		20
1c	x		20
1d	x		20
2a	x		20
2b	x		20
2c	x		20
2d	x		20
3a	x		20
4a		x	0
5a		x	0

6.3 Constructability

Constructability will be one of the key factors in determining which conceptual options can be feasibly built given the constrained space within the US14A corridor and the limited availability of detours. This section is meant to be a high-level review to identify any major red flags with each concept.

Overview of Concept Construction

Concepts 1a,1c, 2a, 2b and 2d keep the channel on its original alignment for construction of the new structure. This allows the new culvert to be built within the existing one. The existing structure can remain in place where needed to serve as shoring for adjacent buildings during construction, thereby limiting the need for building additional construction shoring. The new structure would be built one half at a time to maintain Whitewood Creek flow through construction.

Concepts 1b, 1d and 2c move the north end of the channel east of the existing location. These options would require extensive excavation to create the new channel. While constructing the new channel, shoring of the existing structure or adjacent buildings would be required in some areas due to the destabilization of the existing box. These options may require a long traffic closure along the existing route for construction of the crossover point between the existing and new channel.

Concept 3 keeps the channel on its original alignment for construction of the new structure, allowing the new culvert to be built within the existing one. It also raises the roadway over a portion of the parking area. The box culvert sections can be built as described for Concepts 1 and 2 with modifications in the area where the south bridge abutment meets the box culvert. The impact of the substantial grade raise over the box culvert can be reduced by using Expanded Polystyrene (EPS) foam fill. Using this material would reduce the overall load on the box and shorten the construction time. The EPS foam could be enclosed using precast concrete panels. This construction method reduces the required heavy equipment and vibration normally associated with large grade raises. The bridge would use frame abutments and bents to reduce the overall height of the structure, reduce the roadway grades coming up to the bridge, and to allow for parking beneath. The girder system would potentially be steel girders (such as I or tub) due to the curve in the superstructure and to reduce the number of spans.

Concept 4 introduces a tunnel system through the hillside which virtually removes all impacts to the traveling public during construction. The tunnel would be constructed using predominantly the drill and blast method with some rock excavation at the portals. The portals would be stabilized using rock bolts and shotcrete with the interior of the tunnels using rock bolts and a cast in place reinforced concrete tunnel liner. The relatively short tunnel lengths do not require an extensive ventilation system. A simple flow through system can be used. Five bridges would need to be constructed to span various locations along Whitewood Creek. The bridges would most likely be single span prestressed structures with various widths depending on the required configuration at each location. A portion of Whitewood Creek would remain as an open channel within a concrete canal tying into a box culvert at the north end. The concrete canal would serve as a type of retaining wall to support the adjacent buildings and allow for free flow of Whitewood Creek. The box culvert would be constructed as described for Concepts 1 and 2.

Concept 5 moves US14A/US85 to the west along the existing Williams Street. Williams Street would be widened using various retaining wall types such as MSE, cantilever, moment slab and large block walls depending on the design parameters. A bridge connection can be made to the existing parking ramp giving direct access from US14A/US85. The southern end of the of the existing box culvert would be replaced as described for Concepts 1 and 2. An open channel would be constructed in the location of the existing box culvert through the remainder of the project. The channel would be constructed of reinforced concrete to serve as a retaining wall for adjacent buildings. Two bridges would be required to cross

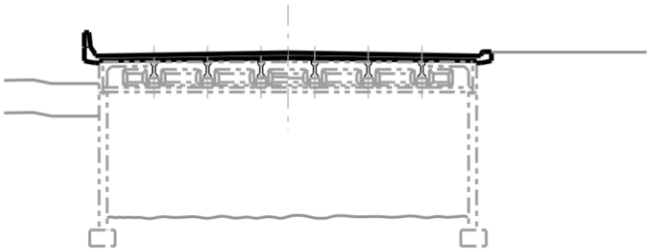
Whitewood Creek. The bridges would most likely be single span prestress structures with various widths depending on the required configuration at each location.

Overview of Box Construction Phasing

The following figures provide a representation of how the proposed drainage structure could be constructed within the existing box's walls while still carrying traffic on half of its superstructure. Constructing the box in this way will minimize temporary impacts to parking during Phase A because it would allow the eastern half of the box to constructed while the western half of the existing box/superstructure could be utilized to maintain traffic. Cast in place (CIP) and precast barrels are both viable options for structure replacement and are shown in the figures below for completeness.

ORIGINAL STRUCTURE

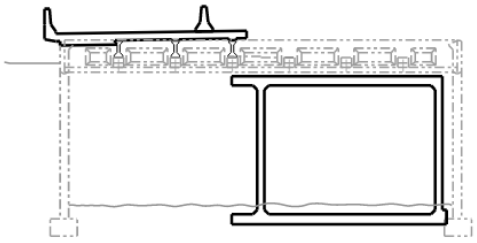
The following is a representation of the original structure. The existing span ranges from 36 feet for the first few hundred feet of the box and then widens to 45 feet+/- for the remainder of its length. The superstructure consists of longitudinal stringers/girders with an average spacing of 6 feet and 8 inches that rest on transverse floor beams with an average spacing of 20 feet. These beams are supported by abutments that can stay in place during the duration of the construction.



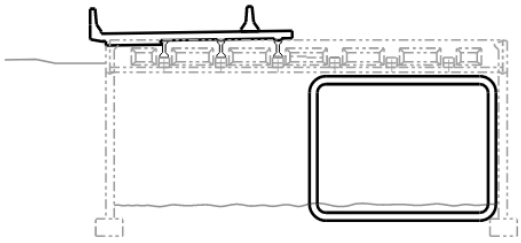
Existing Structure

PHASE A

One half of the existing superstructure can be removed, and traffic is carried on the remaining half of the superstructure. One half of the new structure is built beneath the existing. The flow of Whitewood Creek will be maintained throughout construction by the use of a port-a-dam system and portions of the completed box culvert. It is assumed that the Creek can be diverted around the potion of the structure being built, and once that section is constructed, the Creek can be directed through the completed portion of the structure while the remaining portion is constructed.



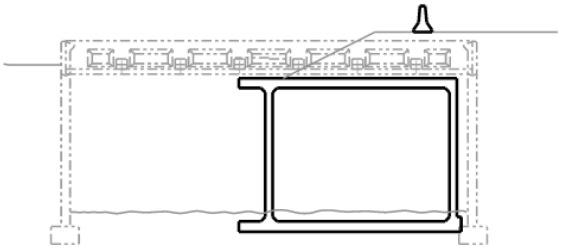
Cast in Place



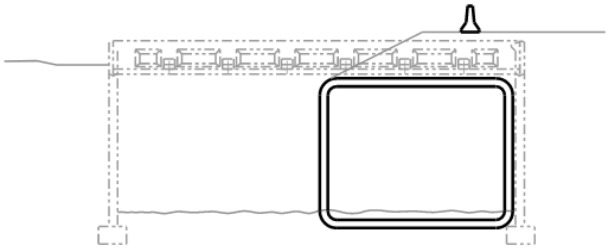
Precast

PHASE B

The second half of the existing superstructure is removed. Traffic is carried on fill placed on the new box section (existing girders between abutments stay in place).



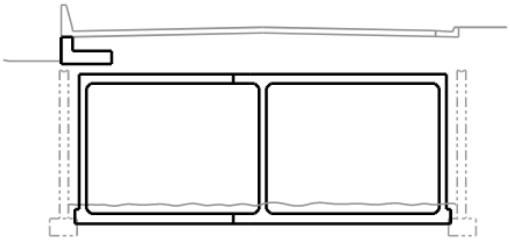
Cast in Place



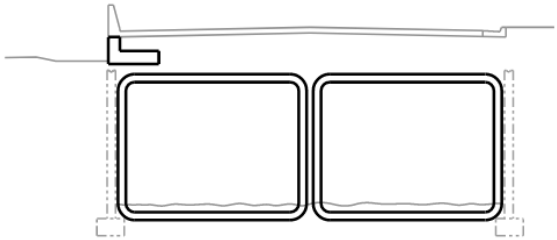
Precast

PHASE C

Existing girders are removed, fill is placed on the new box section, retaining walls are built (if necessary), and surfacing is placed.



Cast in Place



Precast

Preliminary Construction Phasing

Preliminary construction phasing is described in the following sections and shown in Appendix C. Many phases will have sub-phases and will be subject to the discretion of the contractor, the City, and SDDOT at the time of construction. These concepts are provided for illustrative purposes only and not meant to describe every intricacy.

PHASE 0 (PURPLE)

Phase 0 applies to Concepts 2, 4, and 5 and reflects improvements that can be completed offline of US14A.

- For Concepts 2a through 2d, this phase involves any construction that needs to occur on Sherman Street, existing eastern parking areas, Deadwood Street and/or Miller Street. Traffic would be detoured to Pine Street to access the junction with US85.
- For Concept 4a, this phase would involve constructing the two tunnels and four portals. This phase will have minimal impact on traffic and does not require any detours.
- For Concept 5a, this phase would involve widening the roadway and constructing a significant length of retaining walls along Williams Street. This phase will have significant impact on local traffic. This phase does not require any detours on US14A/US85.

PHASE 1 (ORANGE)

- For Concepts 1, 2, and 3, this phase entails removing and constructing the first 200 feet of the box. This requires the US85 crossing at Pine Street to be closed and traffic to be rerouted via Deadwood Street and Sherman Street. Temporary paving and a temporary easement will likely be required to maintain large trucks around Deadwood Street's turning radii. Three vehicular and pedestrian crossings can be accommodated at Deadwood Street, Lee Street and Wall Street. Note that Wall Street can only accommodate one-way traffic but can be used for emergency services.
- For Concepts 4 and 5, traffic can be rerouted onto the new highway facilities through the tunnel or Williams Street, respectively. Two vehicle and pedestrian crossings remain open at Deadwood Street and Lee Street, but much of the box and supporting roadway components can be constructed all at once.

PHASE 2 (GREEN)

- For Concepts 1, 2, and 3, this phase entails constructing the next 600 feet of the box between Pine Street and Sherman Street. The structure deck will be removed, and a double barrel box can be constructed within the existing box walls. This requires US14A to be closed between Pine Street and Sherman Street and traffic to be rerouted via Pine Street and Sherman Street. Temporary paving and temporary easement will likely be required in order to get trucks around the turning radii at the intersection of US85/Pine Street & US85/Sherman Street. Two vehicular and pedestrian crossings can be accommodated at Wall Street and Pine Street. Note that Wall Street can only accommodate one-way traffic but can be used for emergency services. Preparations of temporary paving and other improvements required to the parking areas for the detour during Phase 3 will occur in Phase 2. The temporary displacement of approximately 171 parking spaces is required for the rest of the duration of construction at the Miller Street, Bullock Hotel/Holiday Inn, and Whitewood Creek parking areas. Preparations during this phase include a temporary structure extension of approximately 90 feet at the box outlet adjacent to Railroad Avenue.
- For Concepts 4 and 5, traffic can remain on the new highway facilities through the tunnel or Williams Street, respectively. This phase entails construction of the remaining roadway or bridge features on Deadwood Street, Lee Street, and Sherman Street. For concept 4, two vehicle and pedestrian crossings remain open at Pine Street and Wall Street. For concept 5, three vehicle and pedestrian crossings remain open at Pine Street, Deadwood Street, and Wall Street.

PHASE 3 (YELLOW)

Phase 3 applies to Concepts 1, 2, and 3.

- Concepts 1a, 1c, 2a, 2b, 2d, and 3a construct the last 1200 feet of proposed drainage structure within the walls of the existing box. For all these concepts, Phase 3 is much more simplified and does not require a full closure of the corridor and therefore, does not require a detour of traffic down historic Main Street. Traffic can be detoured onto the temporary box outlet extension, the existing eastern parking areas and then rerouted using Sherman Street and Pine Street. Two vehicular and pedestrian crossings can be accommodated at Pine Street, Deadwood Street, and Lee Street.
- Concepts 1b, 1d, and 2c construct the last 1200 feet of the proposed drainage structure outside of the walls of the existing box. This gives these concepts a significant disadvantage in terms of being able to maintain traffic on the corridor. An open trench will require either benching, sloping, or shoring of the trench sides. Approximately ten feet of open space will be necessary on either side of the box. If sloping was used, a trench back slope of +/- 2H:1V to catch up to the above

ground elevation would be necessary depending on the soils present. This amounts to about 50 feet of space required on either side of the box. Due to the width of the drainage structure, trench boxes will not be able to be utilized, but other methods of trench shoring could be utilized. Due to space limitations of the corridor, a full closure of the corridor is assumed to be required and therefore, a detour of traffic down historic Main Street is necessary.

PHASE 4/5 (BLUE/MAGENTA)

Phase 4 and 5 apply to Concepts 1, 2, and 3.

- For Concepts 1 and 2, this phase includes completing the final roadway components, as necessary.
- For Concept 3, this phase includes completing the elevated roadway, bridge, and retaining walls on the north end of the project.

PHASE 6 (CYAN)

Phase 6 applies to 3 only.

- For Concept 3, this phase includes detouring US14A traffic on the nearly constructed overpass and completing the remaining work on the parking areas below the underpass. This phase would also include any necessary improvements needed on Deadwood Street and Lee Street, one at a time, in order to maintain at least 2 vehicle and pedestrian crossings. Pine Street would provide the second vehicle and pedestrian crossing.

General Tunnel Construction Considerations

Concept 4 includes constructing two separate tunnels. Figure 8 illustrates excavation profiles in hard ground (rock) and soft ground (soil). Deadwood tunnels would be excavated in rock by the drill and blast method. The noise will impact local residents. Road-header mechanical excavation could be less disruptive, subject to rock strength analysis.

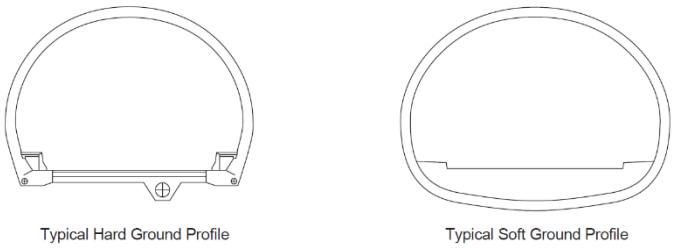


Figure 8. Excavation profiles in hard ground (rock) and soft ground (soil).

Verges provide walkways for road users during emergencies, tunnel maintenance and operations. Drains, fire mains, and fireproof cable ducts for communications/lighting are typically constructed under walkways. Verge width must facilitate services and driver visibility. Walkways with low curb height facilitate nearside opening of car doors to avoid people exiting into moving traffic.

Verge Dimensions in Tunnel Section

- A - Walkway Headroom = 8 ft minimum (emergency only, no public access)
- C - Total Verge Width = 5 ft minimum
- Lane Width in Tunnel = 12 feet (each direction)

Longitudinal ventilation is the simplest form of tunnel ventilation with low capital and operating cost. Longitudinal mechanical ventilation can be provided with:

- Jet fans in the tunnel roof to create a longitudinal flow of air along the length of the tunnel.
- Injectors directing fresh air into the tunnel to induce secondary flow and enhance longitudinal flow.
- Push-pull arrangements of axial type jet fans.

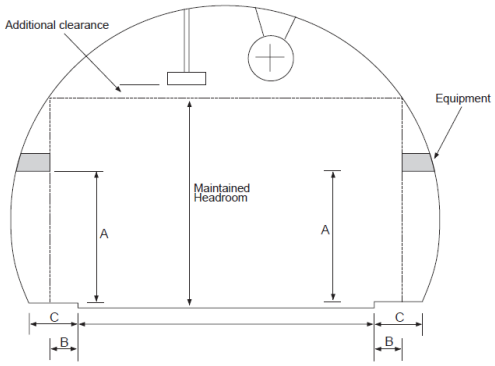


Figure 9. Tunnel Ventilation Schematic

Figure 10 provides an example of the progression for a drill and blast highway tunnel excavation and support. Initial support during excavation is typically grouted rockbolts and fiber reinforced shotcrete. Final support is typically steel reinforced cast-in-place concrete (see the bottom two photos).

Figure 16. Tunnel excavation with rock condition from fair to good. Steel fiber shotcrete and rock bolts are shown as primary support.

Figure 17. Mechanical excavation of the tunnel bench after blasting. Excavator and hydraulic hammer were used for scaling and rock breaking.

Figure 18. Tunnel lining operations by Brisamar Portal. Steel form is ready for the first concrete pouring as steel rebar reinforcement is installed.

Figure 19. Picture appreciating the Progress of tunnel final lining and the steel form along tunnel alignment

Figure 10. Tunnel Construction Progression[8]

[8] Canseco Aragon, H., & Banuet Rodriguez, M. (2017). *Construction of the Longest Road Tunnel in Mexico.* Acapulco City.

Summary of Constructability Considerations and Scoring

The advantages, drawbacks, and associated scoring of each concept in terms of constructability is summarized in Table 4. The reasoning of the scoring can be found in the bullets below.

- For concepts where the box would be constructed within the existing box's footprint (Concepts 1a, 1c, 2a, 2b, 2d, 3, 4, 5), a total of 15 points were added to the score. Reconstructing the box within the walls of the existing drainage structure will likely be quicker because additional trenching would not be required. As described in Phase 3, an open trench will require either benching, sloping, or shoring of the trench sides. This will take additional time and require a detour provided on historic Main Street since there would not be enough room within the corridor to maintain traffic. Furthermore, as described in the "General Box Phasing Options" section, minimal impacts to parking would occur for Phase A because it would allow half of the box to constructed while the other half of the existing box/deck could be utilized for maintenance of traffic. These concepts give the contractor the greatest amount of flexibility.
- All concept phasing accommodated two crossings of Whitewood Creek/US14A for vehicles and pedestrians, and a total of 5 points was added to score for meeting this requirement.
- Since the drawback of a detour on historic main was the inverse of the advantage of the box being constructed entirely within the existing box, this was noted in the table but did not change the scoring.
- If the concept had significant impacts to local access, 15 points were removed from the score.
- If the concept required frequent rehabilitation, a long construction timeline, and significant delay to roadway users over the lifespan of the structure, 15 points were removed from the score.

Table 4. Constructability Considerations

Concept No.	Advantage		Drawback			Constructability Score
	Box Constructed Entirely within Existing	*Two Crossings Accommodated for Veh./Ped. Traffic*	*Extensive excavation for New Channel and Detour on Historic Main Street*	*Significant Impacts to Local Access*	*Significant Delay to Roadway Users Over Lifespan*	
NB	N/A	N/A			x	5
MR	x	x			x	5
1a	x	x				20
1b		x	x			5
1c	x	x				20
1d		x	x			5
2a	x	x				20
2b	x	x				20
2c		x	x			5
2d	x	x				20
3a	x	x				20
4a	x	x				20
5a	x	x		x		5

6.4 ROW Needs and Private Property Impacts

ROW needs and private property impacts were based on the preliminary concept layouts provided in Appendix A. ROW impacts include row acquisition, permanent easement and temporary easement in the total area. ROW acquisition costs were based on market value averages of commercial and residential properties in the area. If a concept impacted a building, the entire property was assumed to be acquired and included in the ROW acquisition cost.

Summary of ROW Needs and Private Property Impacts and Scoring

The associated ROW impacts, commercial buildings impacted, residential buildings impacted, and total ROW costs are summarized for each concept in Table 5. The reasoning of the scoring can be found in the bullet below.

- The concepts were given a score based on the total ROW costs. The score was calculated using the ratio between concept's individual ROW costs and the highest ROW cost of all the concepts.

Table 5. ROW Needs and Private Property Impacts

Concept No.	ROW Impacts (Acres)	Commercial Buildings Impacted (#)	Residential Buildings Impacted (#)	Total ROW Costs ($)	ROW Score
NB	-	-	-	-	20
MR	-	-	-	-	20
1a	0.34	-	-	$0.6 M	19
1b	0.34	-	-	$0.6 M	19
1c	1.56	-	-	$2.6 M	17
1d	1.56	-	-	$2.6 M	17
2a	1.04	-	-	$1.7 M	18
2b	2.46	-	-	$4.1 M	15
2c	2.46	-	-	$4.1 M	15
2d	4.18	4	-	$16.9 M	0
3a	2.53	-	-	$4.2 M	15
4a	5.62	3	4	$9.8 M	8
5a	3.91	2	39	$12.7 M	5

6.5 Comparative Costs

A comparative cost estimate was developed for each concept. This included items such as surfacing, roadway obliteration, structure removal, box replacement within existing/partial new alignment, channel paving, box inlet/outlet replacement, bridges, retaining walls, soil nail reinforcement, maintenance, and traffic signals.

Maintenance costs were calculated differently for the no-build, major rehabilitation, and build options.

- *No Build:* The no build option included 30 years of the routine minor structure maintenance for the existing box.
- *Major Rehabilitation:* The major rehabilitation option included the rehabilitation cost, 30 years of the routine minor structure maintenance for the rehabilitated box, and 30 years of the major less frequent structure maintenance. The rehabilitation cost included modifying the girder ends, replacing the expansion devices, replacing the deck, and abutment wall repairs. Major structure maintenance included replacing the expansion devices (20 year cycle) and an overlay. The overlay was assumed to be either epoxy (10 year cycle) or low-slump dense concrete (LSDC) (20 year cycle).
- *Build Options:* For all the build options, the box maintenance was assumed to be negligible for 30 years after the box was constructed. The only maintenance costs included for the build options were roadway and bridge maintenance (as applicable).

Summary of Comparative Costs and Scoring

The associated construction costs, contingency, row costs, and total costs were aggregated and summarized in Table 6. The reasoning of the scoring can be found in the bullets below.

- The concepts were given a score based on the total costs. The score was calculated using the ratio between the concept's individual costs and the highest cost of all the concepts.
- Major rehabilitation of the box structure includes the rehabilitation cost. Major rehabilitation would still require box replacement in the future. It is estimated that this cost would take place 30 years in the future and would be around $59.5 M (same as Option1a) in today's dollars. This replacement cost is not included in the total cost but this replacement cost plus the rehabilitation cost was factored into this concept's score.

Table 6. Comparative Costs

Concept No.	Construction Cost	Maintenance Costs	ROW Costs	Total Cost	Cost Score
NB	-	$0.6 M	-	$0.6 M	20
MR	$22.2 M	$3.3 M	-	$25.5 M	9
1a	$57.7 M	$1.2 M	$0.6 M	$59.5 M	12
1b	$58.8 M	$1.2 M	$0.6 M	$60.6 M	12
1c	$62.4 M	$1.2 M	$2.6 M	$66.2 M	11
1d	$63.4 M	$1.2 M	$2.6 M	$67.2 M	11
2a	$62.0 M	$1.6 M	$1.7 M	$65.3 M	12
2b	$68.6 M	$1.6 M	$4.1 M	$74.3 M	10
2c	$69.7 M	$1.6 M	$4.1 M	$75.4 M	10
2d	$77.1 M	$2.2 M	$16.9 M	$96.2 M	8
3a	$73.6 M	$3.7 M	$4.2 M	$81.5 M	9
4a	$140.3 M	$3.7 M	$9.8 M	$153.8 M	0
5a	$93.7 M	$3.3 M	$12.7 M	$109.7 M	6

6.6 Environmental Constraints

Environmental constraints are discussed in much greater detail within the Environmental Scan. A few of the more pertinent environmental impacts were selected to be highlighted in this report.

Summary of Environmental Impacts and Scoring

The main environmental constraints of each concept are summarized in Table 7. The reasoning of the scoring can be found in the bullet below.

- The concepts all started with a score of 20. Two points was added per advantage and two points was subtracted per drawback. A score could not go above 20 or below zero.

Table 7. Environmental Constraints

	Advantage			Drawback								
Concept No.	*Temporary or No Impact to Flood-plain*	*Potential for Expansion of Outlaw Square*	*Improved Visual Appeal and Habitat of Open Channel*	*Permanent Impact to Floodplain*	*Stream Relocation*	*Potential Impacts to Northern Long Eared Bat or Mountain Suckers Habitat*	*Potential Adverse Visual Impact to Historic District*	*Known Historic Buildings Impacted*	*Known Archeological Sites Impacted**	*Conversion of 4(f) or 6(f) Recreational Properties*	*Potential Hazardous Material Site Impacts*	**Environmental Score**
NB	x											20
MR	x											20
1a	x					x					2	16
1b				x	x	x					2	10
1c	x					x	x		1		2	12
1d				x	x	x	x		1		2	6
2a	x	x				x			1		4	12
2b	x	x				x	x		1		4	10
2c		x		x	x	x	x		1		4	4
2d	x	x				x	x		1	1	5	6
3a	x					x	x		1		1	14
4a			x	x		x	x	4	1		4	0
5a			x	x		x	x	25		1	4	0

*Impacts to eligible historic sites would also be considered a 4(f) impact. Those are not scored within this table.

6.7 Comparative Safety

Summary of Comparative Safety and Scoring

A comparison of the main safety improvements and the main safety drawbacks for each concept are compared in Table 8. The reasoning of the scoring can be found in the bullets below.

- A concept with an improvement to pedestrian safety, specifically a significant reduction in potential pedestrian-vehicle conflicts, a total of 4 points was added to the score. Concepts where parking areas were located adjacent to historic Main Street and the US14A was moved to the east provided greater safety benefit due to fewer pedestrians needing to cross US14A/US85. This was noted as a significant issue in the Pedestrian Circulation and Enhancement Study and thus was weighted more heavily than the other two advantages. However, if a concept placed US14A/US85 thru traffic onto a high pedestrian corridor, such as Sherman Street (Option 2a, 2b, 2c), this would increase the number of pedestrians needing to cross mainline US14A/US85 traffic. The reduction in potential pedestrian-vehicle conflicts at Wall Street would likely be a wash with the increased potential pedestrian-vehicle conflicts along Sherman Street. In this case, no points were given for pedestrian improvements to Option 2b and 2c.
- Access can have a direct impact on the safety and traffic flow of a corridor. SDDOT has spacing requirements for intersections and driveways based on a highway's access classification. US14A/US85 through Deadwood is classified as 'Urban Developed'. The existing access spacing on US14A ranges from 12 to 18 accesses per mile, while Sherman Street has 46 accesses per mile. As the highway functions today, the primary access to US14A between Pine Street and Lower Main Street comes from the intersections with the main cross streets. Private access to businesses are provided on the cross streets. Access spacing requirements and an inventory of compliant/non-compliant existing accesses can be found in the *Existing Conditions Memo*.
    - Some of the proposed concepts introduce and/or eliminate access to the US14A/US85 mainline corridor.
        - Options 2a, 2b, and 2c places US14A traffic onto Sherman Street, where seven accesses/intersections, primarily to parking areas, but also to Lee Street, do not comply with the access spacing. These accesses would either need to be closed or there would likely be safety/traffic operation consequences.
        - Concept 5 has a drawback of an increased number of residential driveways and access points along US14A.
    - The total number of major intersections were tallied on US14A (Pine Street to Lower Main Street), US85 (Pine Street to US14A/Sherman Street), and Sherman Street (Pine Street to US14A) and compared against the no-build option. For each intersection reduction, a point was added to the concept's score.
    - The total number of non-compliant accesses were tallied on the proposed concept's US14A/US85 mainline corridor. For each non-compliant access, a half of a point was removed from its score.
- If the concept included the addition of a center turn lane, a total of 3 points was added to the score. The three-lane section is expected to have a safety improvement by separating left turn traffic from through traffic compared to the four-lane section. For signalized intersections, adding a left turn lane provides an easier opportunity to separate a protected left turn phase and the conflicting pedestrian phase. In addition, it provides a flashing yellow arrow (FYA) as another 'yield' reminder for left turners to double-check the crosswalk. It also allows left turn vehicles to store in a left turn lane while there are conflicts in the crosswalk.
    - A traffic operations analysis was performed to determine the corridor's lane requirements. It was found that the three-lane section between Pine Street and Sherman Street is expected to operate at an acceptable level of service in the future 2027 and 2050 build

conditions. More information on this analysis can be found in the *Future Build Conditions Traffic Operations Memo*.

- Any concepts with drawbacks that included steep grades, increased roadway curvature, and a significant increase in guardrail were docked by 1 point per drawback.

Table 8. Comparative Safety

Concept No.	Advantage			Drawback				Safety Score
	Pedestrian Safety Improvement	*Addition of Center Turn Lane*	*Reduction of Major Intersections*	*Steep Grades*	*Increased Roadway Curvature*	*Significant Increase in Guardrail*	*Non-Compliant Accesses*	
NB								0
MR								0
1a		x						3
1b		x						3
1c	x	x	1		x			7
1d	x	x	1		x			7
2a		x	2		x		8	2
2b		x	2		x		8	2
2c		x	2		x		8	2
2d	x	x	6					10
3a	x	x	4	x		x		9
4a	x	x	8					10
5a	x	x	8	x	x	x	86	0

6.8 Geologic Impacts

Many of the hillsides adjacent to the corridor have exposed unvegetated man-made rock-cut faces. The disturbed rock-cut area on Sherman Street between Deadwood Street and US14A/Pioneer Way and US14A between Sherman Street and Wall Street is highlighted in Figure 11. However, there are areas to the northeast that may have been previously disturbed but are now vegetated. Some of the options, particularly the ones where US14A/US85 is directly adjacent to the steep slopes, may require additional exposed rock-cut. There are several unknowns regarding what would be necessary at the rock backslope face. Missing information includes rock types, if fractures are present, and height of the cut.

A rockfall area adjacent to the backslope may or may not be required between the edge of traveled way and the start of the backslope. There are too many unknowns at this point to determine if this rockfall area is necessary. Disturbance to the hillside many require additional survey and evaluation work before the full extent of environmental impacts are known. These concepts could be revised to avoid or minimize the impacts, but it will take away a significant number of parking spaces and reduce the continuity of the parking area. This would require more access points along the corridor to accommodate discontinuous parking areas and reduce the traffic flow and safety benefits gained by consolidating access and parking areas.

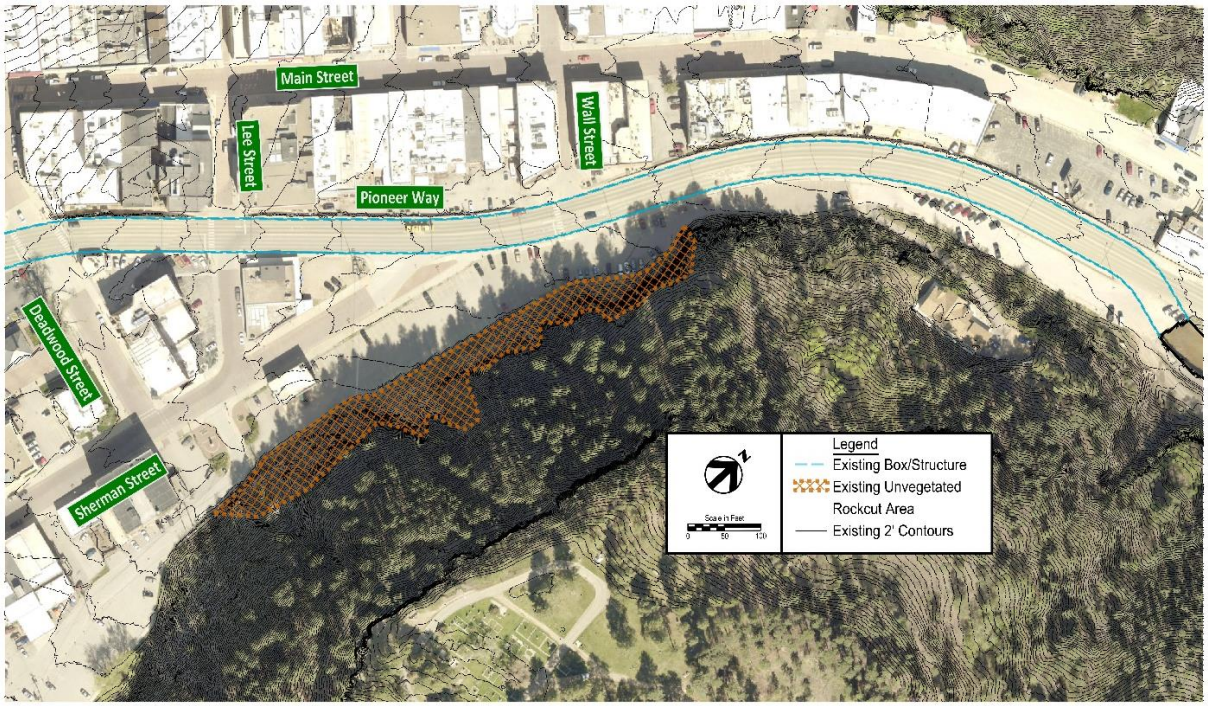


Figure 11. Existing Unvegetated Man-made Rock-cut Face

Table 9 provides a summary of the concepts' disturbance to the surrounding geology.

- When the Deadwood Box is outside of its existing footprint (concepts 1b, 1d, 2c), there is a possibility of encountering rock. Concepts that likely require rock excavation for the Box's trench were docked one point.
- For every 400 feet of previously disturbed backslope excavation, another point was removed.
- For every 200 feet of previously undisturbed backslope excavation, another point was removed. Impacting previously undisturbed/vegetated backslope was considered more impactful since it likely requires additional environmental evaluation and potential impacts. Minimizing the addition of any new disturbed rock facing is also an important guideline for keeping the City of Deadwood's historic landmark status.

Table 9. Summary of Geologic Impacts

Concept No.	Box Trench Length within Possible Rock Excavation (Ft)	Length of Backslope Excavation/Disturbance (Ft)			Geologic Impacts Score
		Previously Disturbed Backslope	*Previously Undisturbed Backslope*	*Rounded Total Length*	
NB	-	-	-	-	10
MR	-	-	-	-	10
1a	-	-	-	-	10
1b	1,131	-	-	-	9
1c	-	200	600	800	7
1d	1,131	200	600	800	6
2a	-	-	-	-	10
2b	-	610	600	1210	5
2c	1,131	610	600	1210	4
2d	-	610	1525	2135	1
3a	-	40	600	640	7
4a	-	50	150	200	9
5a	-	-	13000	13000	0

6.9 Multi-modal Considerations

Summary of Multi-modal Considerations and Scoring

A comparison of the main multi-modal advantages and disadvantages for each concept are compared in Table 10. The reasoning of the scoring can be found in the bullets below.

- Sidewalk improvements were weighted at a 4 because of the importance to have pedestrian facilities on both sides of US14A/US85.
- Shared use path improvements were weighted at a 3. An important goal of the City is for the Michelson Trail and Whitewood Creek Trail to connect via a path wide enough to accommodate both bicycles and pedestrians.
- Reduction in Potential for Pedestrian-Vehicle Conflicts was weighted as a 3.
- There is an increased amount of traffic diverted to a local residential neighborhood or pedestrian heavy roadway lined with business storefronts with Options 2a, 2b, 2c, and 5. Three points were taken away for this drawback.
    - Options 2a, 2b, and 2c move US14A traffic to Sherman Street and would significantly increase the traffic in that area. Much like Main Street, Sherman Street is highly used by pedestrians. In order to accommodate the through traffic numbers, lanes will need to be added and sidewalks will need to be narrowed. Traffic, including trucks, would be directly adjacent to the sidewalks with little to no buffer. Business entrance accesses are primarily facing Sherman Street. Those entering or leaving businesses would need to walk along Sherman Street.

Table 10. Summary of Multi-modal Considerations

Concept No.	Advantage			Drawbacks	Multi-modal Considerations Score
	Sidewalk Improvements	*Shared Use Path Improvements*	*Reduction in Potential for Pedestrian-Vehicle Conflicts*	*Permanent Diversion of Traffic in Pedestrian Heavy Area*	
NB					0
MR					0
1a	x	x			7
1b	x	x			7
1c	x	x	x		10
1d	x	x	x		10
2a	x	x		x	4
2b	x	x		x	4
2c	x	x		x	4
2d	x	x	x		10
3a	x	x	x		10
4a	x	x	x		10
5a	x	x		x	4

6.10 Social Acceptability and Community Context

This category encompasses the different aspects of the corridor that are important to the community including the number of parking spaces displaced by the different concepts, the removal of community buildings, the removal of parcel access, the economic vitality of Deadwood's businesses, and the aesthetics, such as retaining walls and additional disturbance to rock cuts,.

Permanent impacts to parking and private property impacts are summarized in Table 11. Parking impacts included on-street and parking area impacts. On-street parking is very important and scarce in the City of Deadwood. Removing on-street parking would exacerbate the current parking issues in Deadwood. The businesses rely on tourist "impulse" visits and removing the ability to park near their business would likely reduce those impulse visits.

Table 11. Permanent Parking and Private Property Impacts

Concept No.	Private Property Impacts			Parking Impacts		
	Commercial Buildings Impacted	*Residential Buildings Impacted*	*Access Closures*	*Parking Spaces Eliminated*	*Parking Spaces Added*	*Net Parking Spaces Lost(-) /Gained(+)*
NB				0	0	0
MR				0	0	0
1a				9	0	-9
1b				9	0	-9
1c				74	52	-22
1d				74	52	-22
2a			8	23	26	3
2b			8	191	148	-43
2c			8	191	148	-43
2d	4			238	175	-63
3a				238	252	14
4a	3	4		171	338	167
5a	2	39	86	0	0	0

Option 2a, 2b, and 2c moves US14A traffic to Sherman Street and would significantly increase the traffic in that area. Currently, Hwy 14A has 11,600 VPD while Sherman is about 6,500 VPD. In order to accommodate the through traffic numbers, three lanes would be required with a short segment east of Deadwood Street requiring four lanes. This will require the removal of all on-street parking and narrowing of sidewalks. Business entrance accesses are primarily facing Sherman Street. As discussed in the comparative safety section, potentially eight business or parking access points would need to be closed as a result of access management requirements. Parking and pedestrian activity are both factors to the economic vitality of Deadwood's businesses.

Summary of Social Acceptability and Community Context and Scoring

A comparison of the social acceptability and community context advantages and disadvantages for each concept are compared in Table 12.

The reasoning of the scoring can be found in the bullets below.

- Scoring started with 10 and dropped by 2 points for each drawback.
- If a building was removed, the scoring automatically dropped to zero. Removal of buildings for roadway and drainage improvements would likely be seen as unacceptable by the community.
- If a concept included permanent impacts to businesses due to reduced load limits from a deteriorating structure, this immediately reduced the score to 0.

Table 12. Summary of Social Acceptability and Community Context

Concept No.	Advantage	Drawback						Score
	Net Increase in Parking	*Buildings Removed*	*Access Closures*	*Net Decrease in Parking*	*On-Street Parking Removal*	*Poor Aesthetics from Bridge, Retaining Walls, Hillside Cut*	*Businesses permanently impacted by reduced load limits from deteriorating structure.*	
NB							x	0
MR							x	0
1a				x				8
1b				x				8
1c				x		x		6
1d				x		x		6
2a	x		x		x			6
2b			x	x	x	x		2
2c			x	x	x	x		2
2d		x		x		x		0
3a	x					x		8
4a	x	x						0
5a		x	x			x		0

6.11 Utility Coordination

A memo titled “Initial Concept Analysis – Preliminary Utility Coordination” is provided in Appendix D and was prepared to document the existing and planned future improvements to the City of Deadwood’s water and wastewater utilities. The memo also identifies utilities within the project area and identifies relevant facilities that are critical to daily utility operations.

Summary of Comparative Costs and Scoring

A comparison of the level of utility impacts for each concept are compared in Table 13. The reasoning of the scoring can be found in the bullets below.

- Scoring was based on the low-medium-high system of comparative level of impact between the other build alternatives.

Table 13. Summary of Utility Impacts

Concept No.	Water Main Crossings (#)	Sanitary Sewer Main Crossings (#)	Potential Parallel Utility Impacts (ft)	Likely Parallel Utility Relocation (ft)	Impacts to Surface Features (ft)	Comparative Level of Impact	Score
NB	-	-	-	-	-	-	10
MR	-	-	-	-	-	-	10
1a	3	1	1500			Low	10
1b	3	1	800	700		Medium	6
1c	3	1	1500			Low	10
1d	3	1	800	700		Medium	6
2a	3	1	1500			Low	10
2b	3	1	1500			Medium-Low	8
2c	3	1	800	700	2300	Medium-High	2
2d	3	1	800	*	2300	Medium-High	2
3a	3	1	1500	1400	*	Medium-High	2
4a	3	1	1500	*		Medium	6
5a	3	1	*	*	*	High	0

**Additional investigation or additional survey required*

6.12 Evaluation Matrix

Table 14. US14A/US85 Deadwood Box Concept Evaluation Matrix

Concept No.	Description	Meets Purpose and Need	Hydraulic Impacts	Constructability	ROW Needs and Private Property	Comparative Costs	Environmental Constraints	Comparative Safety	Geologic Impacts	Multi-modal Impacts	Social Acceptability and Community Context	Utility Impacts	Total Score
	Scored Out of	**N/A**	**20**	**20**	**20**	**20**	**20**	**10**	**10**	**10**	**10**	**10**	**150**
NB	No-Build Option	No	20	5	20	20	20	0	10	0	0	10	105
MR	Major Rehab	No	20	5	20	9	20	0	10	0	0	10	94
1a	US14A as Thru Movement, Parking to East, Highway to West, Deadwood Box Rebuilt within Existing	Yes	20	20	19	12	16	3	10	7	8	10	**125**
1b	US14A as Thru Movement, Parking to East, Highway to West, Deadwood Box Partially New Alignment	Yes	20	5	19	12	10	3	9	7	8	6	99
1c	US14A as Thru Movement, Parking to West, Highway to East, Deadwood Box Rebuilt within Existing	Yes	20	20	17	11	12	7	7	10	6	10	**120**
1d	US14A as Thru Movement, Parking to West, Highway to East, Deadwood Box Rebuilt Partially New Alignment	Yes	20	5	17	11	6	7	6	10	6	6	94
2a	US85 as Thru Movement, Parking to East, Highway to West and Along Sherman St, Deadwood Box Rebuilt within Existing	Yes	20	20	18	12	12	2	10	7	6	10	114
2b	US85 as Thru Movement, Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt within Existing	Yes	20	20	15	10	10	2	5	7	2	8	96
2c	US85 as Thru Movement, Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt Partially New Alignment	Yes	20	5	15	10	4	2	4	7	2	2	**68**
2d	US85 as Thru Movement, Parking to West, Highway to East and Along Miller Street, Deadwood Box Rebuilt within Existing	Yes	20	20	0	8	6	10	1	10	0	2	**77**
3a	US14A Overpass	Yes	20	20	15	10	14	9	7	10	8	2	115
4	Tunnel System	Yes	0	20	8	0	0	10	9	10	0	6	**63**
5	Highway Rerouted on Local Roadway	Yes	0	5	5	6	0	0	0	4	0	0	**20**

7.0 Conclusion

The following tables summarize concepts that are being carried forward as Build Options and concepts that are not being carried forward as Build Options, respectively. The next step for the Build Options being carried forward includes further design refinement and evaluation.

A separate memo was prepared to document the discussions that occurred during the SAT meeting #3 including additional concept ideas and concepts eliminated from further analysis. The memo titled Initial Concept Elimination from SAT Meeting #3 has been included in Appendix E.

One to two debris catchers are recommended upstream of the box's inlet. The first proposed location is adjacent to Center Street and the second supplementary location could be adjacent to Cemetery Street. This solution would be applicable to all build options carried forward.

Table 15. Concepts to be Carried Forward as Build Options

Concept No.	Description	Main Reason (s) for Carrying Forward
1a	US14A as Thru Movement, Parking to East, Highway to West, Deadwood Box Rebuilt within Existing	• Least expensive build option. • Minimal ROW acquisition would be required. • Minimal impacts to the rock backslope and utilities. • Reconstructing the box within the walls of the existing drainage structure will expedite the construction schedule. • Construction detours will likely be able to remain within the proximity of the US14A corridor and off Main Street.
1c	US14A as Thru Movement, Parking to West, Highway to East, Deadwood Box Rebuilt within Existing	• Minimal impacts to utilities. • Fourth least expensive build option. • Increased connectivity between parking near Wall Street and historic Main Street, reducing the potential for pedestrian-vehicle conflicts. • Reconstructing the box within the walls of the existing drainage structure will expedite the construction schedule. • Construction detours will likely be able to remain within the proximity of the US14A corridor and off Main Street.

Table 16. Concepts Not Carried Forward as Build Options

Concept No.	Description	Main Reason (s) for Not Carrying Forward
MR	Major Rehab	• Does not meet the purpose and need of the study • Requires significant up-front maintenance and long-term maintenance moving forward. • The drainage structure will still need to be replaced in the near future.
1b	US14A as Thru Movement, Parking to East, Highway to West, Deadwood Box Partially New Alignment	• During certain phases of construction, a traffic closure on US14A would be required with a traffic detour on Main Street. The shift of the box alignment would also result in significant excavation, utility impacts, and the potential to disturb an archeological/cultural significant area.
1d	US14A as Thru Movement, Parking to West, Highway to East, Deadwood Box Rebuilt Partially New Alignment	• During certain phases of construction, a traffic closure on US14A would be required with a traffic detour on Main Street. The shift of the box alignment would also result in significant excavation, utility impacts, and the potential to disturb an archeological/cultural significant area.
2a	US85 as Thru Movement, Parking to East, Highway to West and Along Sherman St, Deadwood Box Rebuilt within Existing	• Main traffic would be placed onto Sherman Street/US85. To accommodate traffic, lanes would have to be expanded, therefore eliminating on-street parking and narrowing sidewalks. • Traffic would go from 6,500 VPD to 11, 600 VPD on an area highly used by pedestrians. • To accommodate truck turns, ROW impacts would occur to properties on Deadwood and Pine Street. • Trucks that fail to turn to merge back with US14A would continue on US85, a steep and curvy route that will put them in downtown Lead, another pedestrian heavy area. • One public and six private accesses would require closure to meet access spacing requirements.
2b	US85 as Thru Movement, Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt within Existing	• Main traffic would be placed onto Sherman Street/US85. To accommodate traffic, lanes would have to be expanded, therefore eliminating on-street parking and narrowing sidewalks. • Traffic would go from 6,500 VPD to 11, 600 VPD on an area highly used by pedestrians. To accommodate truck turns, ROW impacts would occur to properties on Deadwood and Pine Street. • Trucks that fail to turn to merge back with US14A would continue on US85, a steep and curvy route that will put them in downtown Lead, another pedestrian heavy area. • One public and six private accesses would require closure to meet access spacing requirements.
2c	US85 as Thru Movement, Parking to West, Highway to East and Along Sherman St, Deadwood Box Rebuilt Partially New Alignment	• During certain phases of construction, a traffic closure on US14A would be required with a traffic detour on Main Street. • The shift of the box alignment would also result in significant excavation, utility impacts, and the potential to disturb an archeological/cultural significant area. • Main traffic would be placed onto Sherman Street/US85. To accommodate traffic, lanes would have to be expanded, therefore eliminating on-street parking and narrowing sidewalks. • Traffic would go from 6,500 VPD to 11, 600 VPD on an area highly used by pedestrians. • To accommodate truck turns, ROW impacts would occur to properties on Deadwood and Pine Street.

Concept No.	Description	Main Reason (s) for Not Carrying Forward
		• Trucks that fail to turn to merge back with US14A would continue on US85, a steep and curvy route that will put them in downtown Lead, another pedestrian heavy area. • One public and six private accesses would require closure to meet access spacing requirements.
2d	US85 as Thru Movement, Parking to West, Highway to East and Along Miller Street, Deadwood Box Rebuilt within Existing	• Option would require the removal of four commercial buildings. • Trucks that fail to turn to merge back with US14A would continue on US85, a steep and curvy route that will put them in downtown Lead, another pedestrian heavy area.
3a	US14A Overpass	• The cost of Option 3 is almost $13 million more than Option 1c. • This option has a large amount of retaining walls, which would be a large sight obstruction and block the view of the surrounding environment between the east and west. It would also cut off some street access. • It may be difficult to design a structure where the footings of the bridge avoid the Box location. • The bridge and retaining wall structures of the overpass would be an obstruction to the view shed and possibly impact the City's historic designation.
4	Tunnel System	*Previously eliminated. See Appendix E - Initial Concept Elimination from SAT Meeting #3 Memo dated January 2021*
5	Highway Rerouted on Local Roadway	*Previously eliminated. See Appendix E - Initial Concept Elimination from SAT Meeting #3 Memo dated January 2021*

Appendix A. Preliminary Concept Layouts

Preliminary Concepts

(Proposed Deadwood Box Shown)

Broadway Parking Ramp

Main Street

Lee Street

Wall Street

Pine Street

Outlaw Square

Pioneer Way

Lower Main Street

Whitewood Creek Parking

Private Parking

Deadwood Street

Railroad Ave

Vistor Info

Sherman Street

Miller Street Parking

STOP

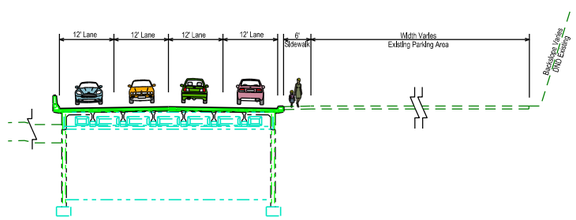
85

14A

A

Scale in Feet
0 75 150

Existing Roadway Typical Section



SECTION A-A :EXISTING ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

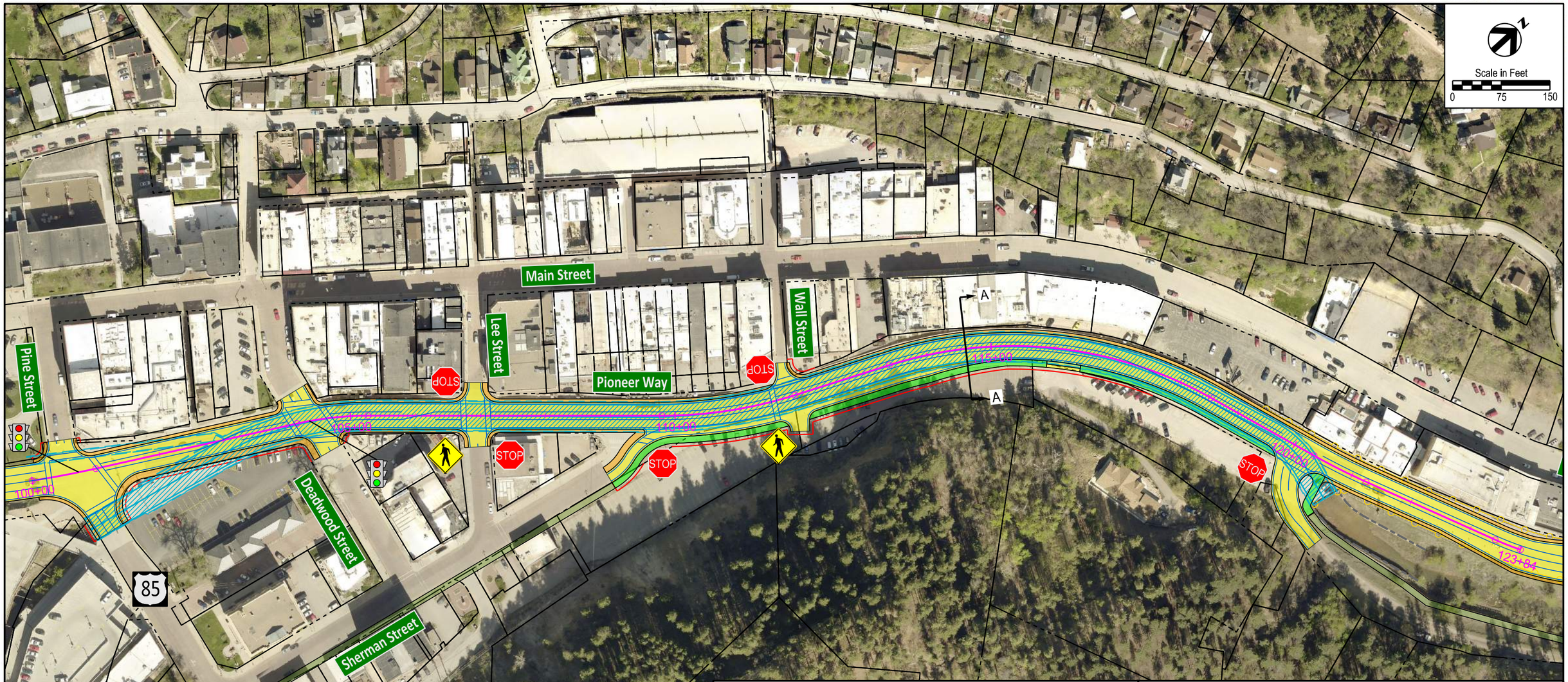
No-Build

US14A / US85 Deadwood Box Corridor Study

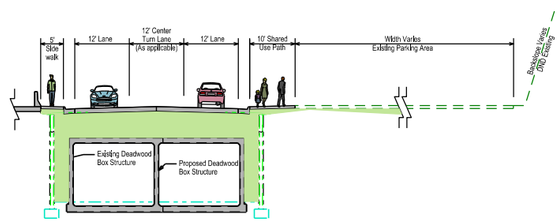
Deadwood, SD

Concept #

NB



Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

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Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

US14A as Thru Movement with US85 Junction - Parking to East, Highway to West
Deadwood Box Rebuilt within Existing

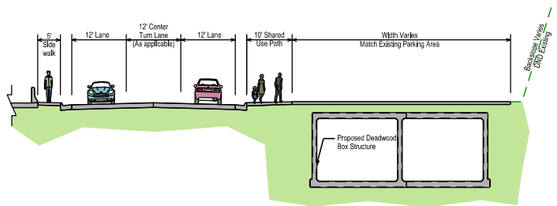
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1a

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Pioneer Way
Wall Street
Deadwood Street
Sherman Street
85
85
STOP
STOP
STOP
STOP
STOP
A
A
100+00
110+00
115+00
120+00
123+84

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

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Date: 10/23/2020
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US14A as Thru Movement with US85 Junction - Parking to East, Highway to West
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

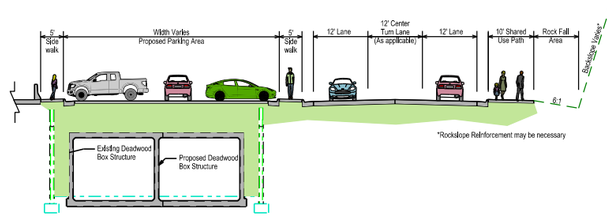
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1b

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Wall Street
Pioneer Way
Deadwood Street
Sherman Street
85
STOP
A
100+00
105+00
110+00
115+00
120+00
123+76

Proposed Roadway Typical Section



SECTION A-A ; PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

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US14A = US85 DEADWOOD BOX

US14A as Thru Movement with US85 Juction - Parking to West, Highway to East
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

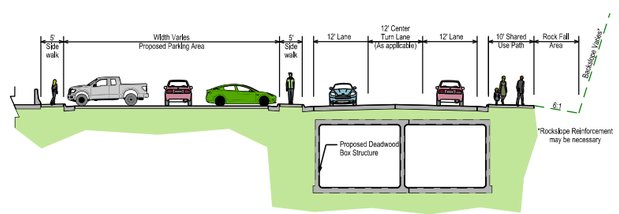
Deadwood, SD

Concept #
1c

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Wall Street
Pioneer Way
Deadwood Street
Sherman Street
85
STOP
A
100+00
110+00
120+00
123+76

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

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US14A = US85 DEADWOOD BOX

US14A as Thru Movement with US85 Junction - Parking to West, Highway to East
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

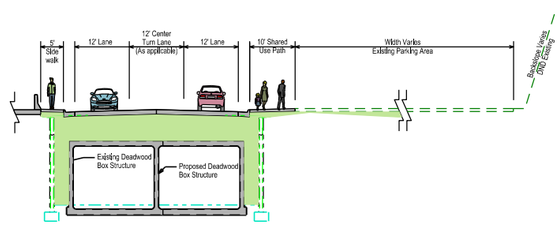
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1d

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
14A
85
STOP
A
A
222+93

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to East, Highway to West
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

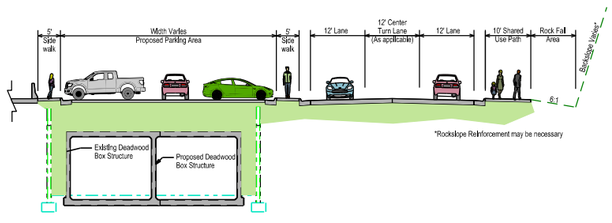
Deadwood, SD

Concept #
2a

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
14A
85
STOP
A
A
210+00
215+00
220+00
222+50

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
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Drawn By: K.Wieler
Date: 10/23/2020
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Revision:

US14A • US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to West, Highway to East
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

Concept #
2b

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
14A
85
STOP
A
X
210+00
220+00
222+60
Proposed Roadway Typical Section
Width Varies Proposed Parking Area
6' Side walk
12' Lane
12' Center Turn Lane (As applicable)
10' Shared Use Path
Rock Fall Area
Bedrock Slope*
6:1
Proposed Deadwood Box Structure
*Rockslope Reinforcement may be necessary
SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTHEAST
Legend
Existing Box/Structure
Proposed Box/Open Channel
Proposed Roadway
Raised Median
Existing/Proposed Path
Proposed Sidewalk
Bridge Construction
Proposed Parking Area
Remove Roadway
Tunnel
Existing ROW / Property Line
ROW/Easement Acquisition
Existing Retaining Wall
Proposed Retaining Wall
Rockslope Reinforcement
Existing Guardrail
Proposed Guardrail
Access Management
Building Impacts
Signalized Intersection
Stop Condition Intersection
Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

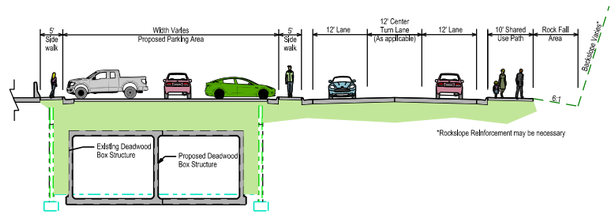
US85 as Thru Movement with US14A Junction - Parking to West, Highway to East
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 2c

Main Street
Lee Street
Wall Street
Pine Street
Deadwood Street
Sherman Street
Pioneer Way
14A
85
STOP
A
A
225+00
229+00
232+37
Scale in Feet
0 75 150

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to West, Highway to East and Along Miller St
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

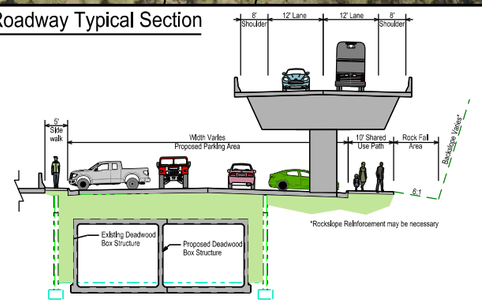
Concept # 2d

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
85
STOP
A
X

Overpass Elevation = 4547.0'
Driveway Elevation = 4534.0'
Clearance = 13.0'

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

Elevate Lanes on Bridge, Parking on Bottom Level
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

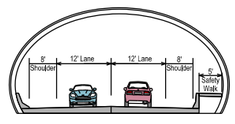
Deadwood, SD

Concept #
3a

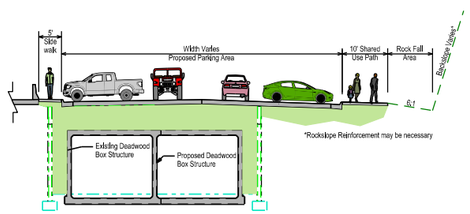
Scale in Feet
0 150 300

Main Street
Lee Street
Pine Street
Wall Street
Deadwood Street
Sherman Street
Lower Main Street
14A
85
STOP
End Open Channel Paving
Begin Closed Box
Begin Open Channel Paving
End Closed Box
A
B

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTH



SECTION B-B : PROPOSED DEADWOOD BOX
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By:
Date:
Chked By:
Date:
Revision:

US14A * US85 DEADWOOD BOX

Tunnel Through the Hillside Sheet 1 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 4a

Main Street

Pine Street

Lee Street

Wall Street

Deadwood Street

Sherman Street

Lower Main Street

Begin Open Channel Paving

End Open Channel Paving

Begin Closed Box

End Closed Box

STOP

B

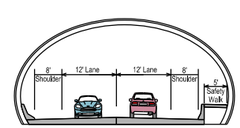
A

14A

85

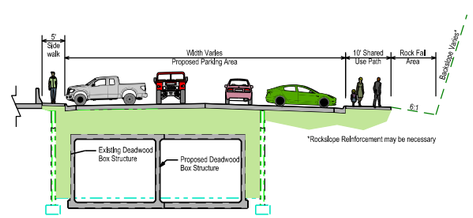
Scale in Feet
0 75 150

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTH



SECTION B-B : PROPOSED DEADWOOD BOX

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

Tunnel Through the Hillside Sheet 2 of 2

Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

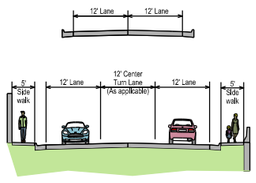
Concept # 4a

Scale in Feet
0 225 450

N

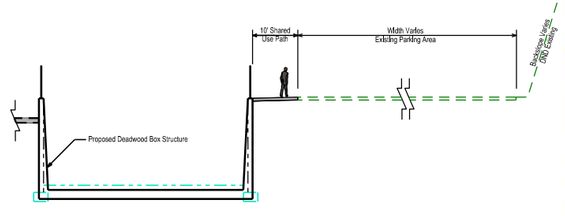
14A
85
Pine Street
Lee Street
Main Street
Wall Street
Lower Main Street
Deadwood Street
Sherman Street
STOP
A
B
End Closed Box
Begin Open
Channel Paving
Begin
Closed
Box
End Open
Channel Paving

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST



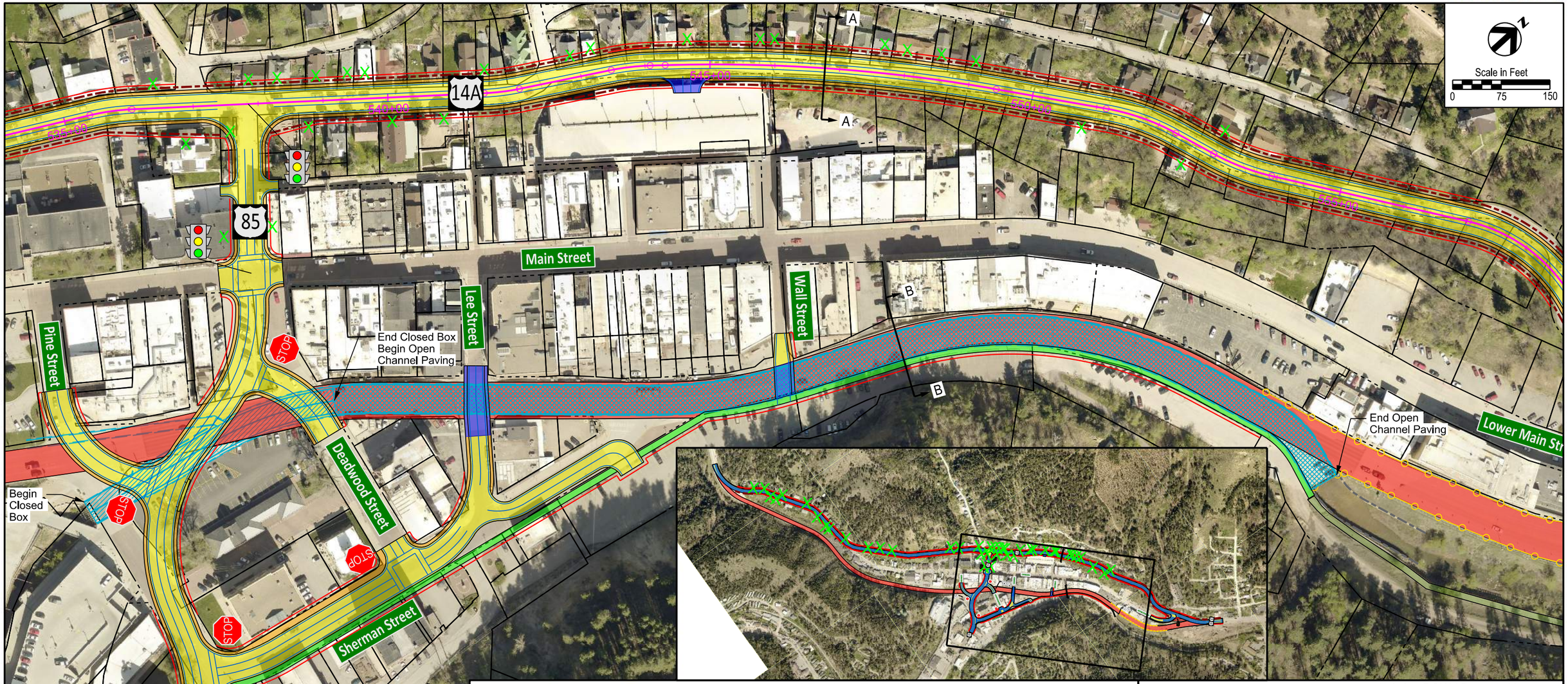
SECTION B-B : PROPOSED DEADWOOD BOX

LOOKING NORTHEAST

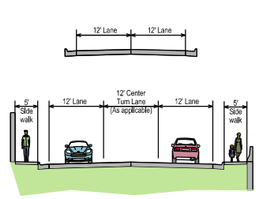
Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

	Drawn By: Date: Chked By: Date: Revision:	US14A • US85 DEADWOOD BOX	Reroute Highway on Local Network Sheet 1 of 2 Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St US14A / US85 Deadwood Box Corridor Study — Deadwood, SD	Concept # 5a

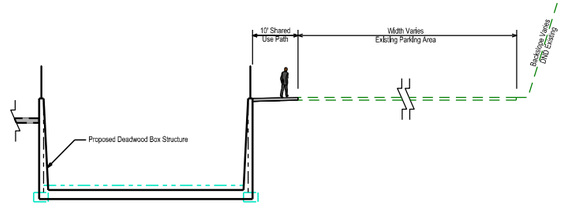


Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST



SECTION B-B : PROPOSED DEADWOOD BOX

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

Reroute Highway on Local Network Sheet 2 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Deadwood St and Outlet

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 5a

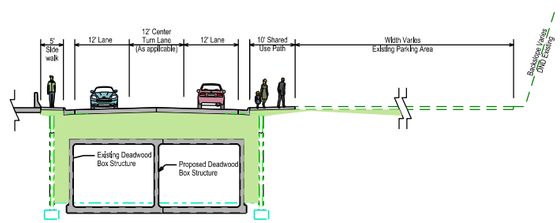
Preliminary Concepts

(Only Roadway Surface Features Shown)

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Pioneer Way
Wall Street
Deadwood Street
Sherman Street
85
85
STOP
STOP
STOP
STOP
STOP
A
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

US14A as Thru Movement with US85 Junction - Parking to East, Highway to West
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

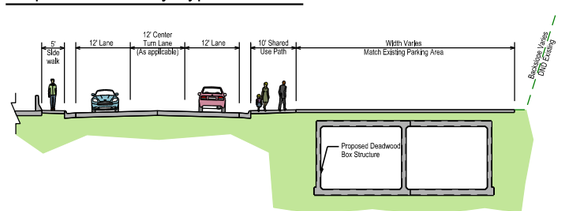
Deadwood, SD

Concept #
1a

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Pioneer Way
Wall Street
Deadwood Street
Sherman Street
85
85
STOP
STOP
STOP
STOP
STOP
A
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A as Thru Movement with US85 Junction - Parking to East, Highway to West
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

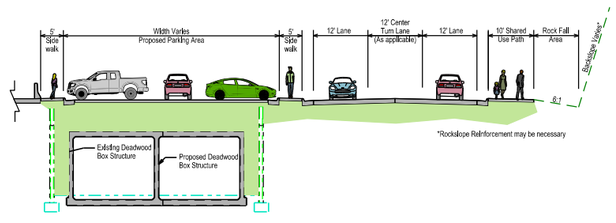
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1b

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Wall Street
Pioneer Way
Deadwood Street
Sherman Street
85
STOP
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

US14A as Thru Movement with US85 Juction - Parking to West, Highway to East
Deadwood Box Rebuilt within Existing

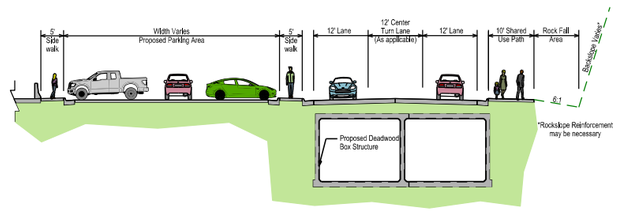
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1c

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Wall Street
Pioneer Way
Deadwood Street
Sherman Street
85
STOP
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

US14A as Thru Movement with US85 Junction - Parking to West, Highway to East
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

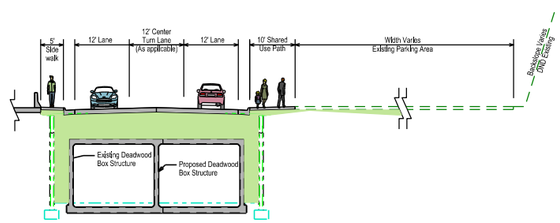
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1d

Scale in Feet
0 75 150

Main Street
Pine Street
Lee Street
Pioneer Way
Wall Street
14A
Deadwood Street
Sherman Street
85
STOP
A
X

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to East, Highway to West
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

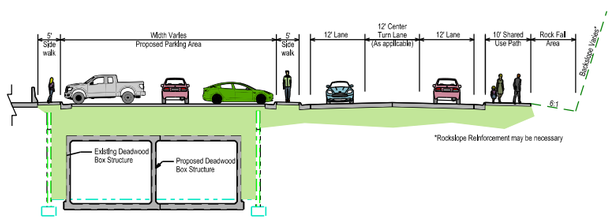
Deadwood, SD

Concept #
2a

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
14A
85
STOP
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to West, Highway to East
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

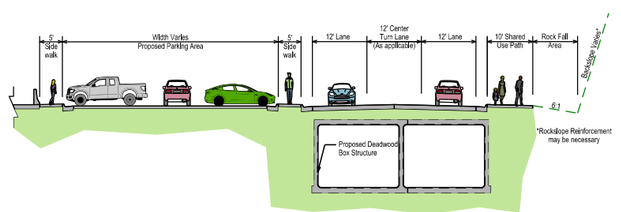
Deadwood, SD

Concept #
2b

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
14A
85
STOP
A

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

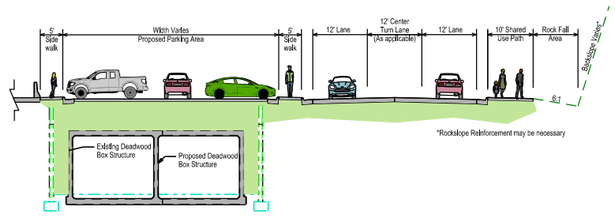
US85 as Thru Movement with US14A Junction - Parking to West, Highway to East
Deadwood Box Rebuilt Partially within Existing and Partially New Alignment

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 2c

Main Street
Lee Street
Wall Street
Pine Street
Deadwood Street
Sherman Street
Pioneer Way
14A
85
STOP
A
A
Scale in Feet
0 75 150

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

US85 as Thru Movement with US14A Junction - Parking to West, Highway to East and Along Miller St
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

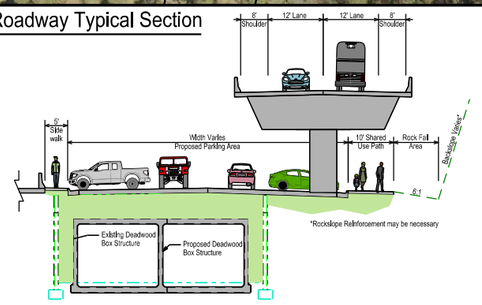
Concept #
2d

Scale in Feet
0 75 150

Main Street
Lee Street
Wall Street
Pine Street
Pioneer Way
Deadwood Street
Sherman Street
STOP
85
A
X

Overpass Elevation = 4547.0'
Driveway Elevation = 4534.0'
Clearance = 13.0'

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

Elevate Lanes on Bridge, Parking on Bottom Level
Deadwood Box Rebuilt within Existing

US14A / US85 Deadwood Box Corridor Study

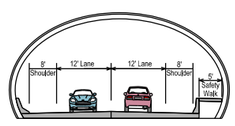
Deadwood, SD

Concept #
3a

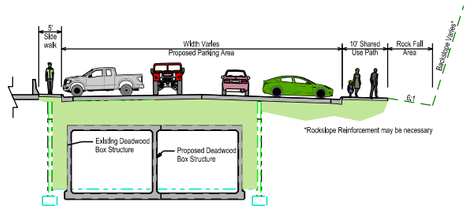
Scale in Feet
0 150 300

Pine Street
Main Street
Lee Street
Wall Street
Deadwood Street
Sherman Street
Lower Main Street
14A
85
STOP
Begin Open Channel Paving
End Open Channel Paving Begin Closed Box
End Closed Box
A
B

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTH



SECTION B-B : PROPOSED DEADWOOD BOX
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By:
Date:
Chked By:
Date:
Revision:

US14A * US85 DEADWOOD BOX

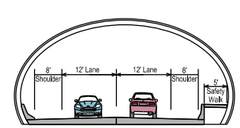
Tunnel Through the Hillside Sheet 1 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

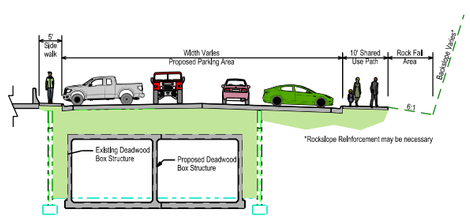
Concept # 4a

Main Street
Pine Street
Lee Street
Wall Street
Deadwood Street
Sherman Street
Lower Main Street
Begin Open Channel Paving
End Open Channel Paving
Begin Closed Box
End Closed Box
STOP
A
B
14A
85
Scale in Feet
0 75 150

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85
LOOKING NORTH



SECTION B-B : PROPOSED DEADWOOD BOX
LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

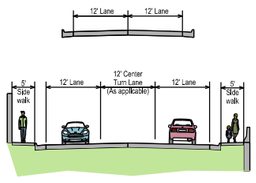
Tunnel Through the Hillside Sheet 2 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St
US14A / US85 Deadwood Box Corridor Study
Deadwood, SD

Concept #
4a

Scale in Feet
0 225 450

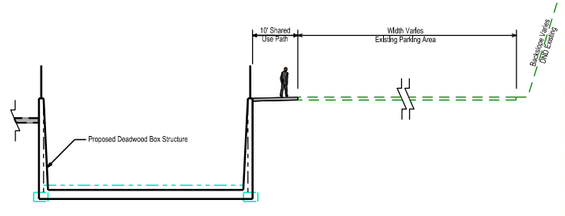
14A
85
Pine Street
Lee Street
Main Street
Wall Street
Lower Main Street
Deadwood Street
Sherman Street
STOP
A
B
End Closed Box
Begin Open
Channel Paving
Begin
Closed
Box
End Open
Channel Paving

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST



SECTION B-B : PROPOSED DEADWOOD BOX

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By:
Date:
Chked By:
Date:
Revision:

US14A • US85 DEADWOOD BOX

Reroute Highway on Local Network Sheet 1 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Pine St and Wall St

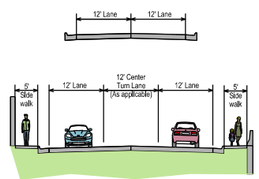
US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept #
5a

Scale in Feet
0 75 150

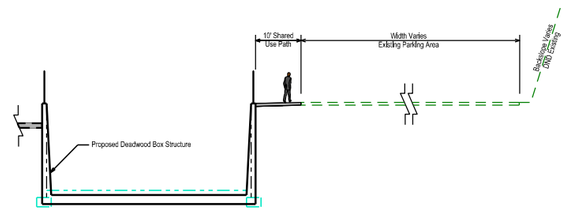
14A
85
Main Street
Lee Street
Wall Street
Pine Street
Deadwood Street
Sherman Street
Lower Main Str
STOP
A
B
End Closed Box
Begin Open Channel Paving
End Open Channel Paving
Begin Closed Box

Proposed Roadway Typical Section



SECTION A-A : PROPOSED ROADWAY US14A / US85

LOOKING NORTHEAST



SECTION B-B : PROPOSED DEADWOOD BOX

LOOKING NORTHEAST

Legend

- Existing Box/Structure
- Proposed Box/Open Channel
- Proposed Roadway
- Raised Median
- Existing/Proposed Path
- Proposed Sidewalk
- Bridge Construction
- Proposed Parking Area
- Remove Roadway
- Tunnel
- Existing ROW / Property Line
- ROW/Easement Acquisition
- Existing Retaining Wall
- Proposed Retaining Wall
- Rockslope Reinforcement
- Existing Guardrail
- Proposed Guardrail
- Access Management
- Building Impacts
- Signalized Intersection
- Stop Condition Intersection
- Pedestrian Crossings

Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A * US85 DEADWOOD BOX

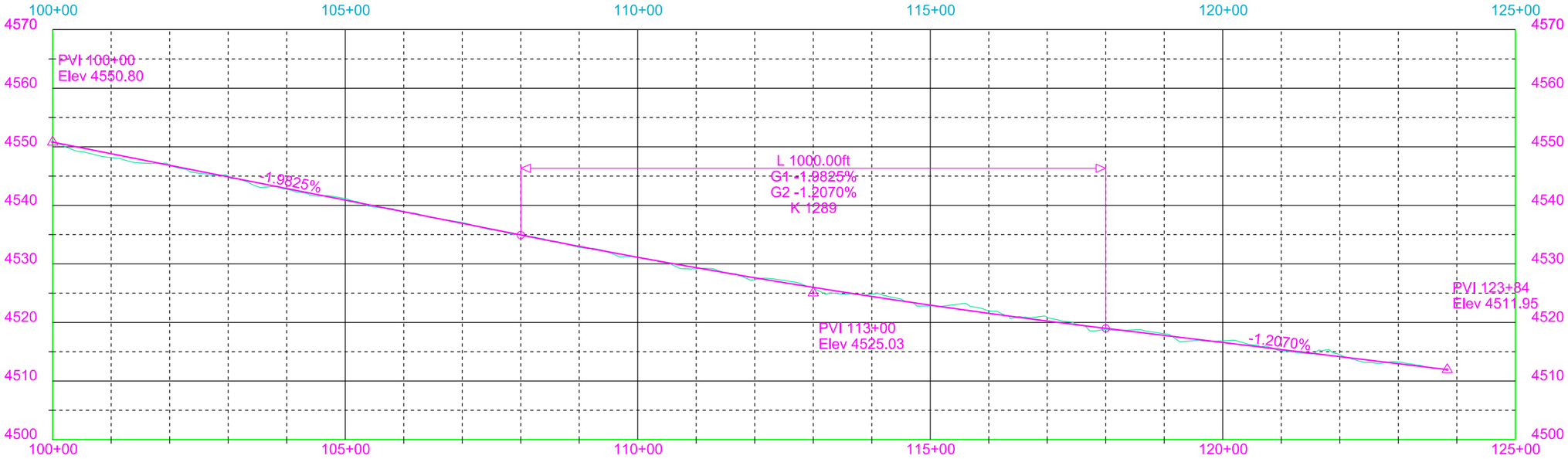
Reroute Highway on Local Network Sheet 2 of 2
Deadwood Box Rebuilt within Existing, Partial Open Channel Between Deadwood St and Outlet

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

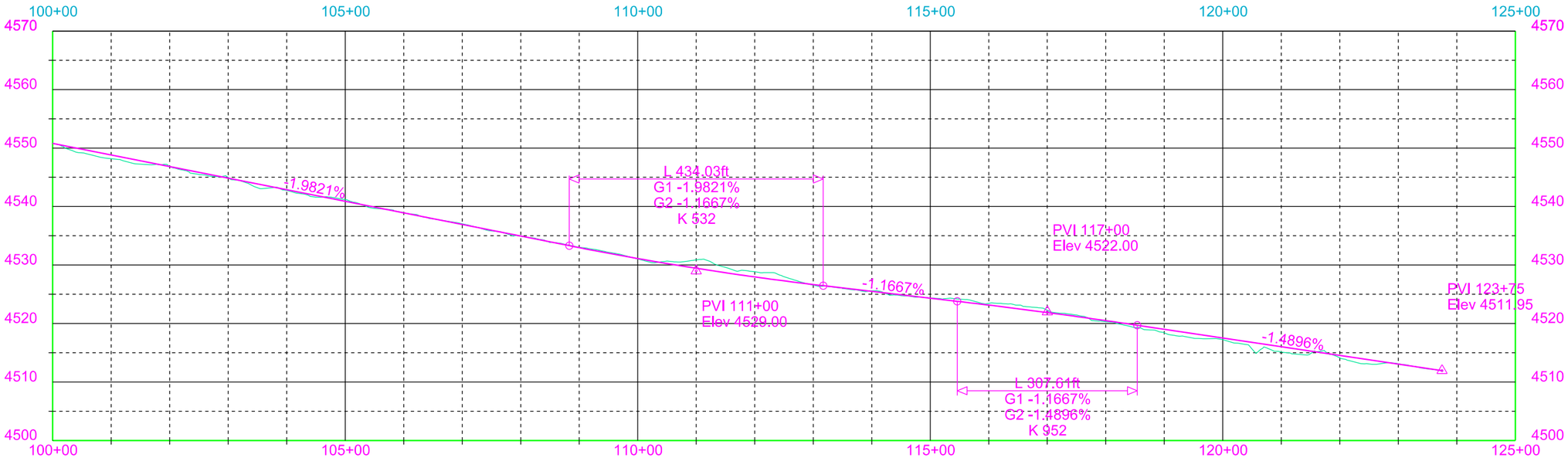
Concept # 5a

Preliminary Concept Profiles

CONCEPT 1A & 1B

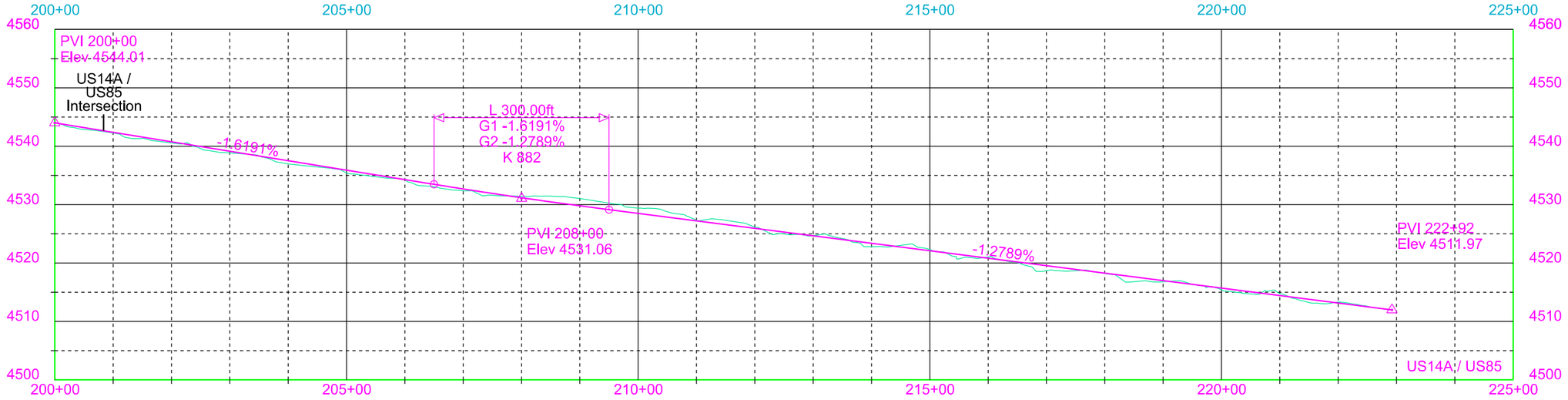


CONCEPT 1C & 1D

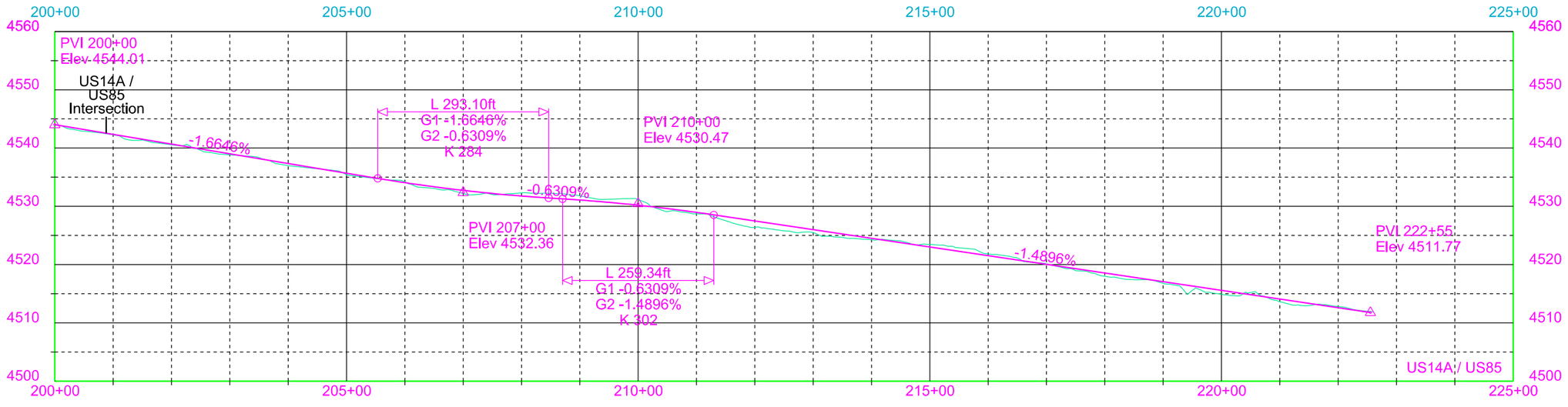


	Drawn By: Date: Chked By: Date: Revision:		Vertical Alignment - Concepts 1a through 1d US14A / US85 Deadwood Box Corridor Study	Concept # 1a-1d Deadwood, SD

CONCEPT 2A

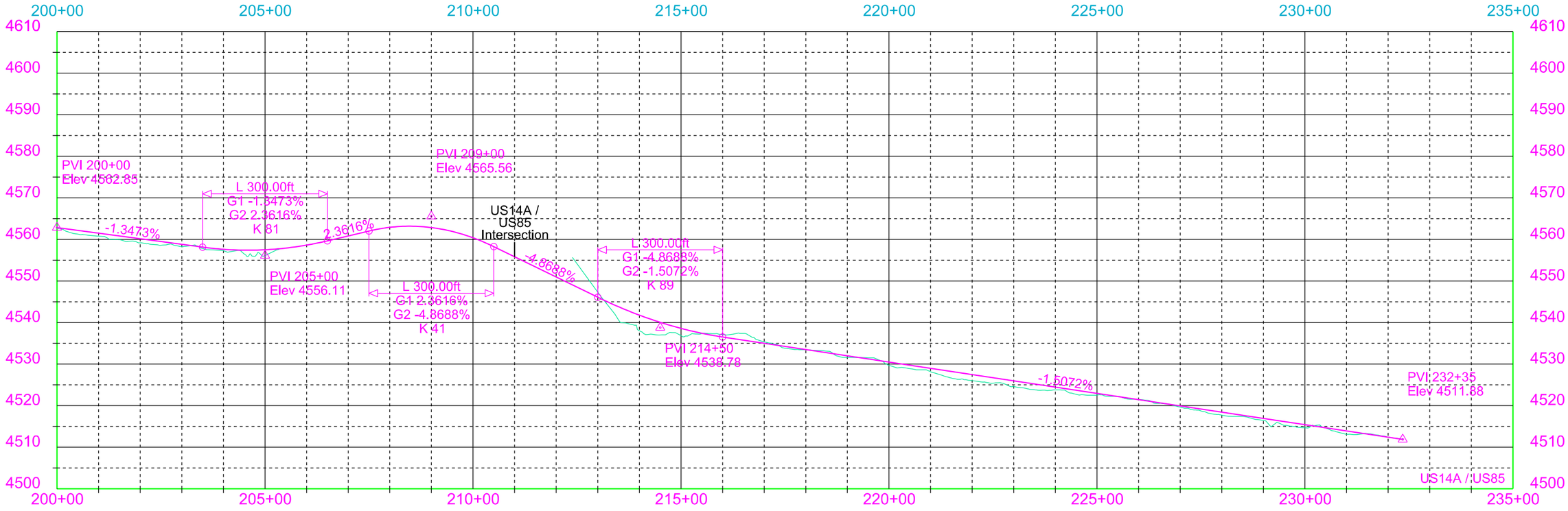


CONCEPT 2B & 2C



Drawn By: Date: Chked By: Date: Revision:		Vertical Alignment - Concepts 2a, 2b, 2c US14A / US85 Deadwood Box Corridor Study	Deadwood, SD	Concept # 2a-2c

CONCEPT 2D



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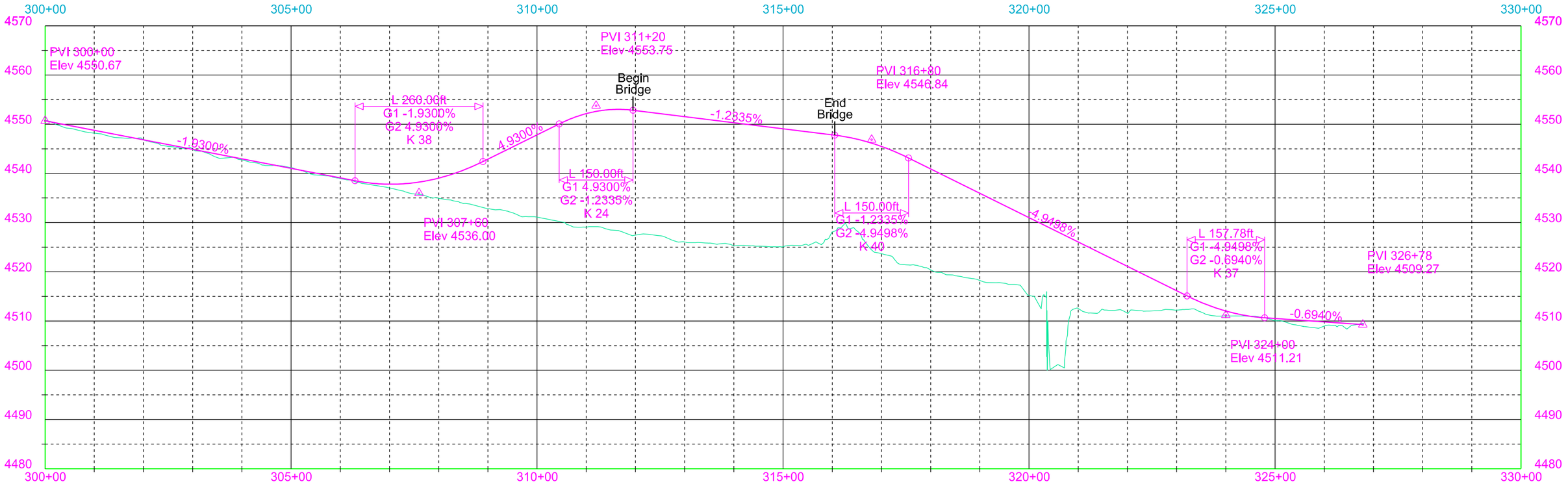
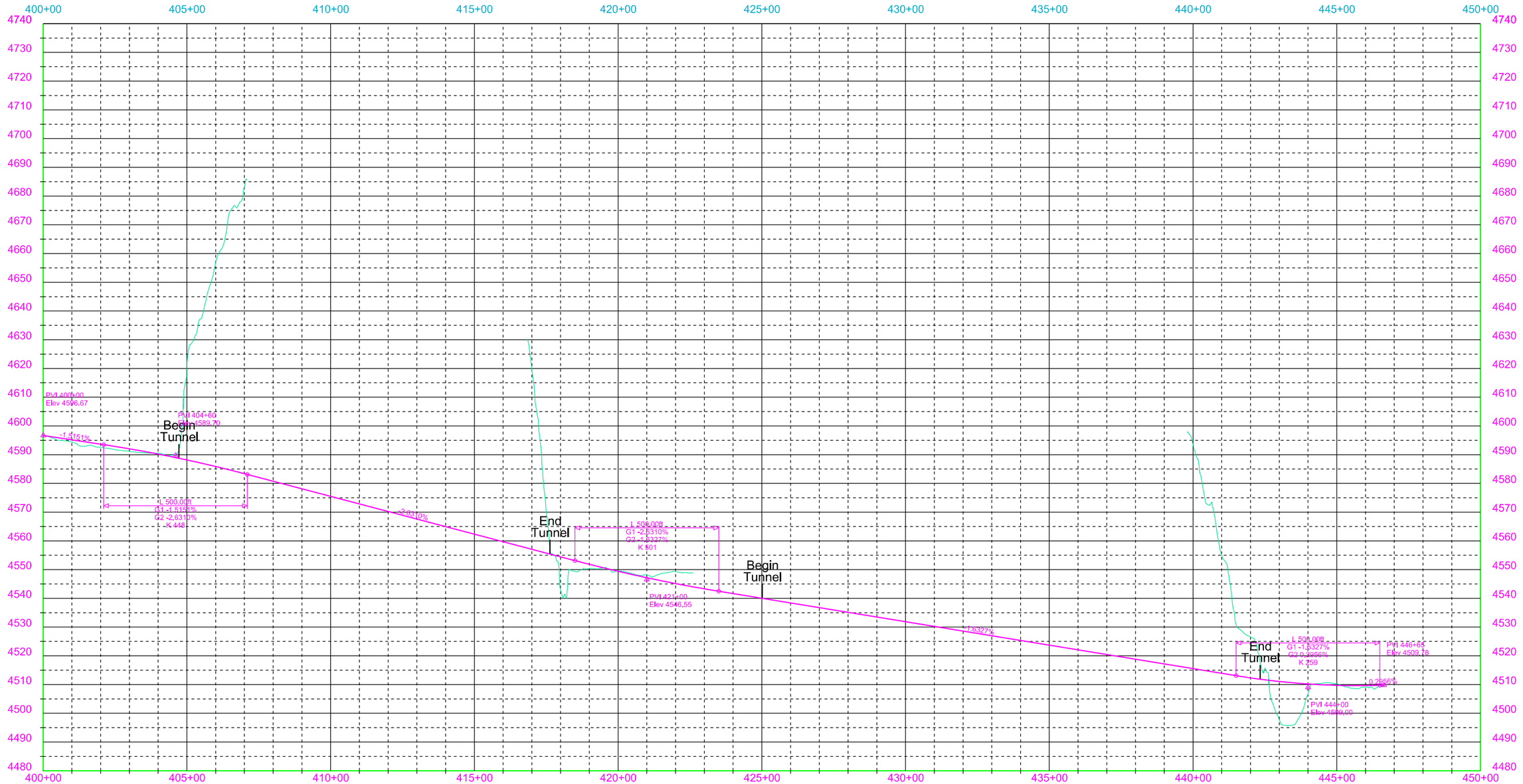
CONCEPT 3



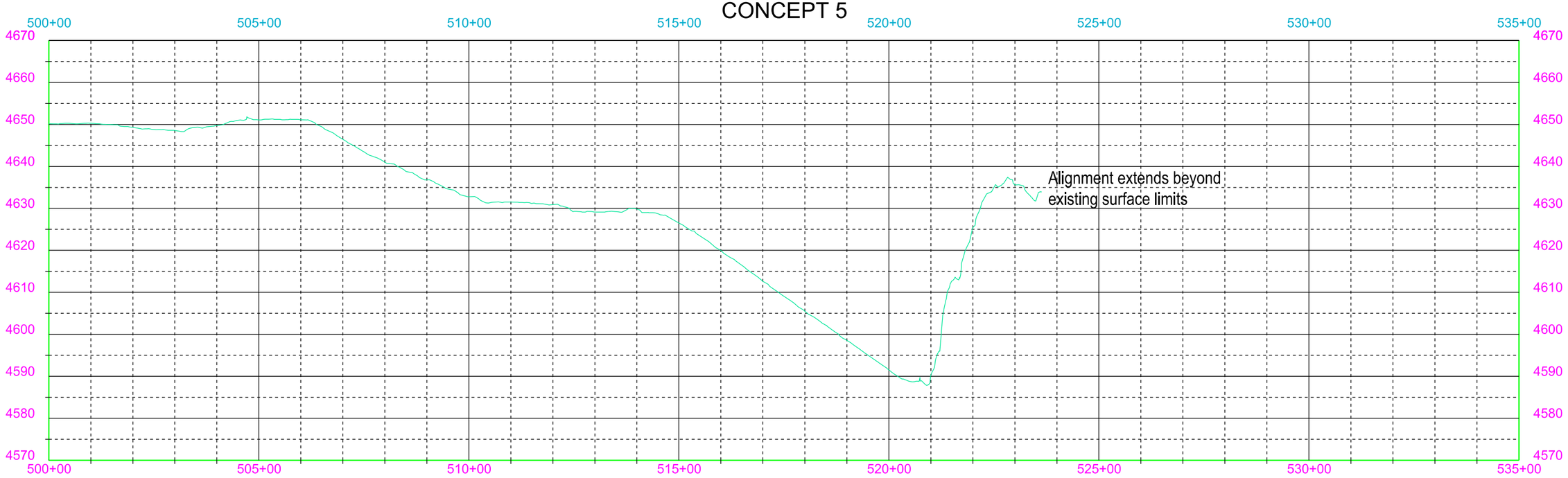
	Drawn By: Date: Chked By: Date: Revision:		Vertical Alignment - Concept 3a US14A / US85 Deadwood Box Corridor Study	Concept # 3a Deadwood, SD

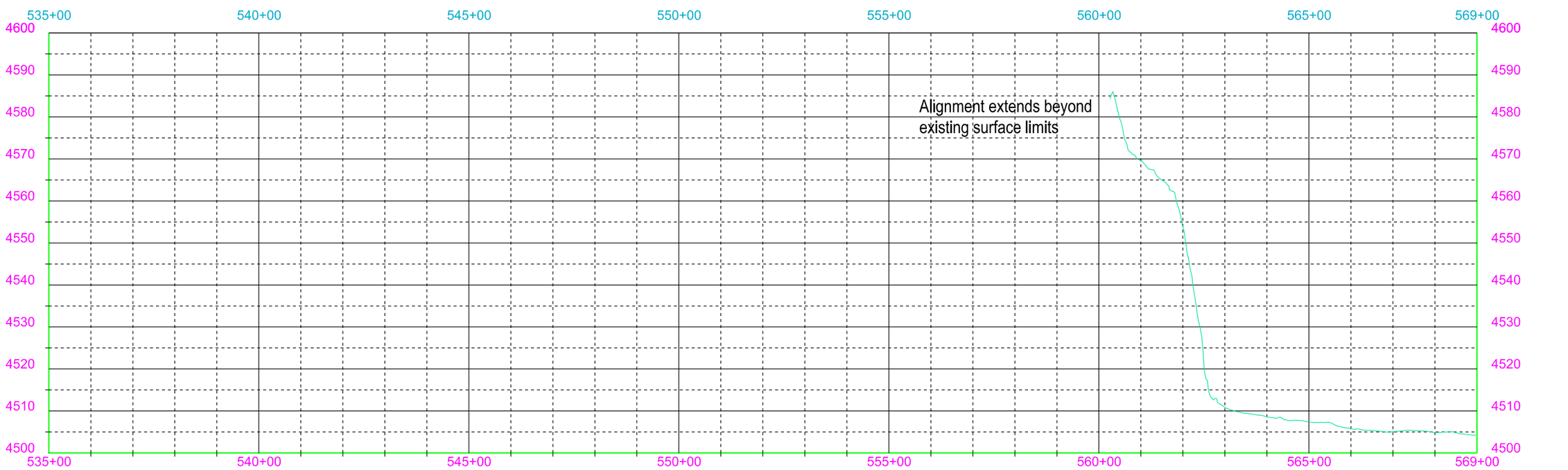
CONCEPT 4



	Drawn By: Date: Chked By: Date: Revision:		Vertical Alignment - Concept 4a US14A / US85 Deadwood Box Corridor Study	Concept # 4a Deadwood, SD

CONCEPT 5

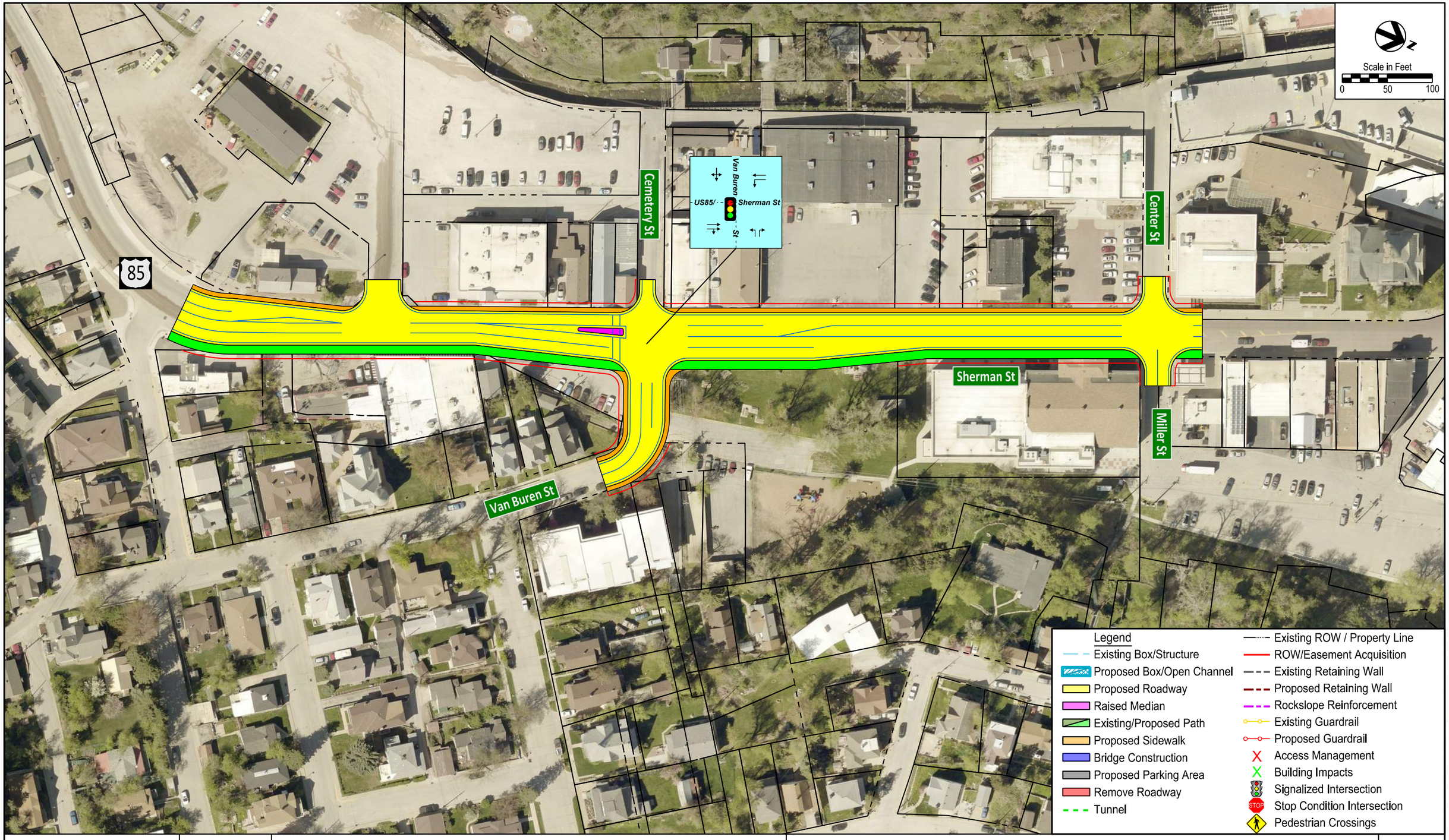




	Drawn By: Date: Chked By: Date: Revision:		Vertical Alignment - Concept 5a US14A / US85 Deadwood Box Corridor Study	Concept # 5a Deadwood, SD

Corridor Improvements Outside of Box Area

(Applicable to All Concepts)



Drawn By:
Date:
Chked By:
Date:
Revision:

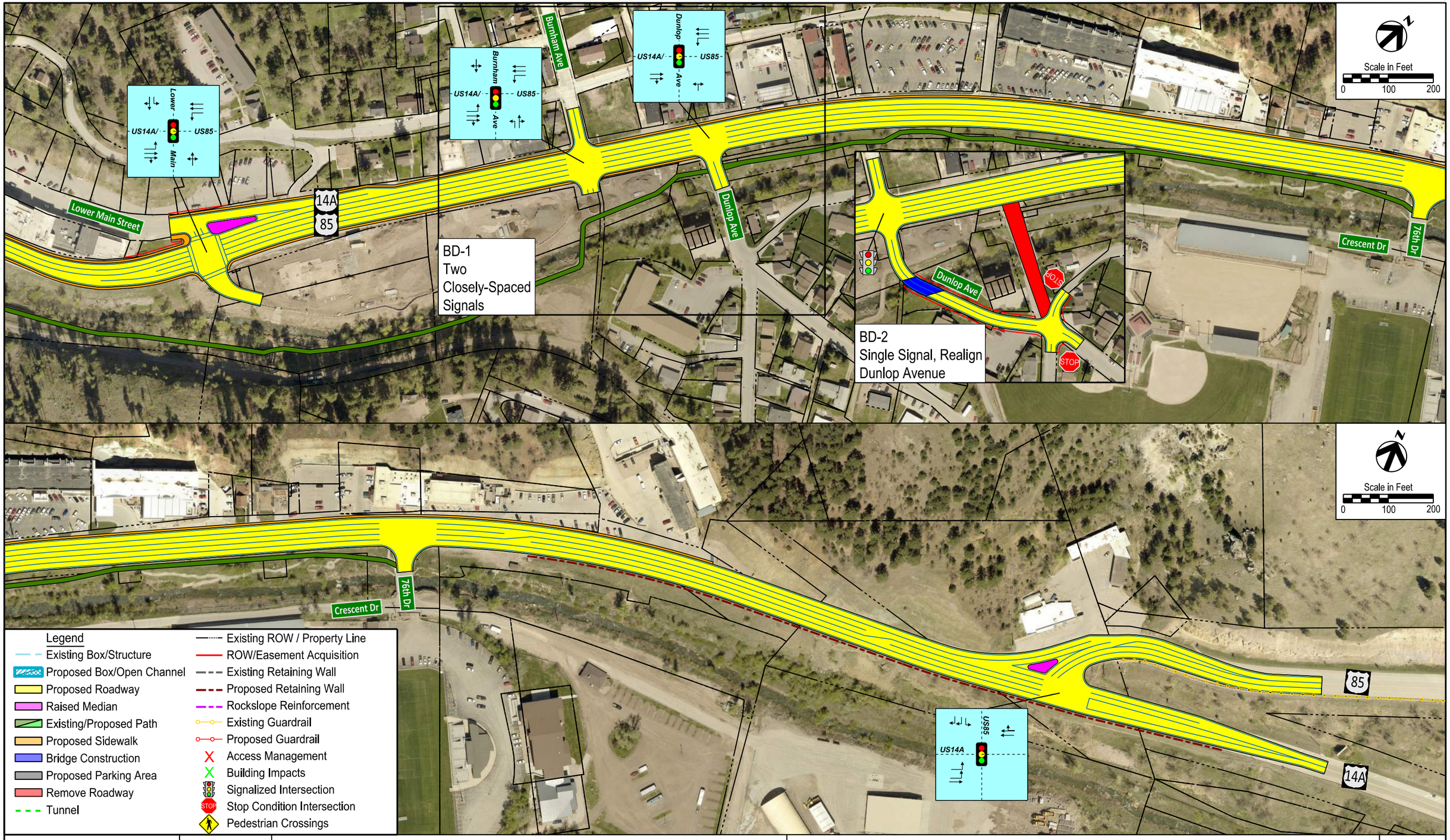
US14A • US85 DEADWOOD BOX

Improvements Outside of the Box
US85/Sherman St & Van Buren St

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

Concept #



Drawn By: K.Wieler
Date: 10/23/2020
Chked By: S.Slowey
Date: 10/23/2020
Revision:

US14A • US85 DEADWOOD BOX

Improvements Outside of the Box
US85 & US14A

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

Concept #

Appendix B. Preliminary Deadwood Box H&H Analysis

Technical Memo

Date:	Wednesday, December 02, 2020
Project:	US14A / US85 Deadwood Box Corridor Study (#NH014A(28)40, PCN 06Y6)
To:	SDDOT
From:	Todd Yerdon, PE
Subject:	Deadwood Box H&H Analysis

1.0 Introduction

The South Dakota Department of Transportation (SDDOT), in conjunction with the City of Deadwood (the City) and Federal highway Administration (FHWA), is completing a corridor and environmental study for a portion of US Highway 14 Alternate (US14A)/US Highway 85 (US85)/Pioneer Way in the City. Included in this study is the structure over Whitewood Creek, which is a 2,039 foot long structure and referred to as the "Deadwood Box." This structure channels both Whitewood Creek and a portion of Deadwood Creek below US14A/US85/Pioneer Way and is reaching the end of its serviceable life. The H&H analysis will identify floodplain impacts as a result of various options presented in the corridor study.

2.0 Existing FEMA Analysis

Whitewood Creek through the City of Deadwood is part of a FEMA Flood Insurance Study (FIS) dated April 17, 2012 for Lawrence County, South Dakota and incorporated areas. As part of the FIS, detailed floodplain analysis has been completed for Whitewood Creek, and detailed base flood elevations (BFE) for Whitewood Creek have been documented in the FIS.

HDR requested the effective Whitewood Creek hydraulic model from FEMA. FEMA provided two separate hydraulic models. The first model was a PDF printout of the original HEC-2 model developed in 1977 which is the effective model for cross sections E through J. The second model was an updated HEC-RAS model developed in 2007 which is the effective model for cross sections A through C and K through O as shown in the FIS. While the 2007 HEC-RAS model does not represent the results for cross sections E through J in the FIS, the HEC-RAS model still incorporates those cross sections from the effective HEC-2 model into the HEC-RAS analysis creating a complete HEC-RAS model of Whitewood Creek through Deadwood.

Existing Condition Deadwood Box Hydraulic Analysis

The effective 2007 HEC-RAS model was utilized as the base model for this analysis since the model already incorporates the HEC-2 data for cross sections E through J making it the best available data for the area.

For the existing conditions analysis, HDR updated the vertical datum of the model from NGVD29 to NAVD88 according to the conversion factor (+1.95 feet) listed in the FIS for Whitewood Creek. All cross sections between cross section F and G were updated based on current ground survey of the channel and available LiDAR of the overbank areas. The existing Deadwood Box Structure was updated to be 36 feet wide based on survey measurements on the upstream end of the box culvert and the inverts of the box culvert were updated based on the survey. The height of the box was determined to be 13.3 feet tall based on survey and existing plans of the box culvert. HEC-RAS does not allow for a change in box culvert width midway in the culvert; therefore the upstream box culvert width of 36' was used for the entire box in the analysis with the understanding that the box expands out to 45' wide midway in the culvert. Based on these conditions, the culvert is inlet controlled for the 1% chance flood event.

Proposed Condition Deadwood Box Hydraulic Analysis

Multiple box options were evaluated for the proposed condition analysis. During the analysis it was determined the existing box culvert is inlet controlled, and inlet condition adjustments will impact upstream water surface elevations. That means a proposed box culvert opening would need to be 36' wide and 13.3 feet tall. The analysis determined that adding a center wall in the box for constructability reasons while maintaining a clear opening width of 36' did not impact upstream results in the model.

For any option, increases in water surface elevations must be avoided upstream of the Deadwood Box because existing buildings are in the floodplain and floodway; therefore, any rise must be mitigated, and will be extremely expensive.

OPTIONS 1, 2, AND 3

Proposed concept Options 1, 2, and 3 are all variations of replacing the existing box culvert with a proposed box culvert in the same general location. If the proposed inlet condition matches the existing culvert, then a no-rise condition will likely be met based on the preliminary HEC-RAS analysis.

Any increases to the inlet hydraulic capacity will provide reductions at the immediate upstream end of the box culvert, but creates a slight rise up to 1,800' upstream. Additional cross sections were added to the model to determine if the slight rise was due to instability in the model, and the addition of cross sections did not resolve the slight rise in water surface elevation.

Options 1, 2, and 3 contain the 1% storm in the proposed box structure causing minimal changes to the floodplain mapping depending on outlet location. It should be noted that the floodplain and floodway mapping in this location is not very accurate with respect to the existing culvert; therefore, the floodplain administrator could require a CLOMR and remapping to clean up the mapping at the culvert ends. Any remapping could be difficult

since FEMA has strict tie in requirements for remapping which poses a challenge when trying to tie into an existing map.

OPTION 4

Proposed concept Option 4 evaluated removing the box culvert from Pine Street through Lee Street and replace the Pine Street, Lee Street and Deadwood Street crossings with bridges. The channel area between each street would be opened up as an open concrete rectangular channel with a 45' wide bottom. A new box structure would be installed downstream of Lee Street and outlet at the existing box outlet location.

When evaluating various options it was determined that any improvements reduces water surface elevation at the structure and causes a slight rise upstream from the project. After numerous model iterations, no bridge options were identified that result in a no-rise due to model sensitivity. This does not mean a bridge option is not possible, but extensive modeling will need to be done to determine the bridge opening that could work.

Option 4 would require a CLOMR since part of the existing box alignment would be converted to an open channel. Any remapping could be difficult since FEMA has strict tie in requirements for remapping.

OPTION 5

Option 5 proposes installing a box culvert from Lee Street through Deadwood Street, and creating an open channel downstream from Deadwood Street with proposed bridge crossings at Lee Street and Wall Street. Similar to Options 1, 2, and 3, an upstream no-rise condition is met with a box size that is 36' wide clear opening and 13.3' tall with a middle wall in the box. The downstream channel was evaluated as a 36' wide concrete rectangular channel.

Option 5 would require a CLOMR since part of the existing box alignment would be converted to an open channel. Any remapping could be difficult since FEMA has strict tie in requirements for remapping.

3.0 Conclusion

Options 1, 2, and 3 provide an option that causes a no-rise condition upstream of the box culvert assuming the entrance condition is similar to the existing box culvert. Depending on the culvert outlet location, remapping of the project may be avoided with these options, but the floodplain administrator could require a CLOMR and remapping to clean up the existing floodplain mapping at the culvert ends. Any remapping could be difficult since FEMA has strict tie in requirements for remapping which poses a challenge when trying to tie into an existing map.

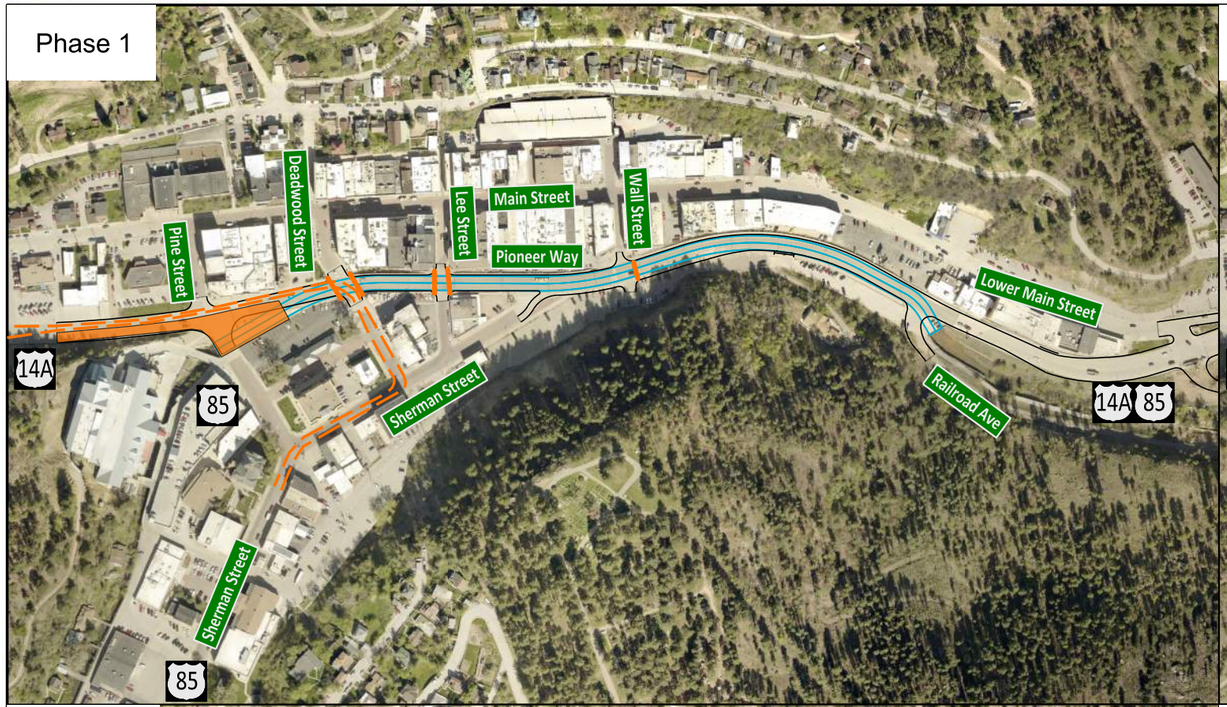
Options 4 and 5 will require a CLOMR no matter if a no-rise condition is met since part of the existing box culvert would be converted to an open channel. Option 4 appears to be the most

difficult option as far as obtaining a no-rise condition due to the sensitivity of the HEC-RAS model to changes. For this analysis no bridge option was determined that creates a no-rise condition upstream. Improvements in hydraulic conditions which reduce water surface elevations at the structure create a rise upstream.

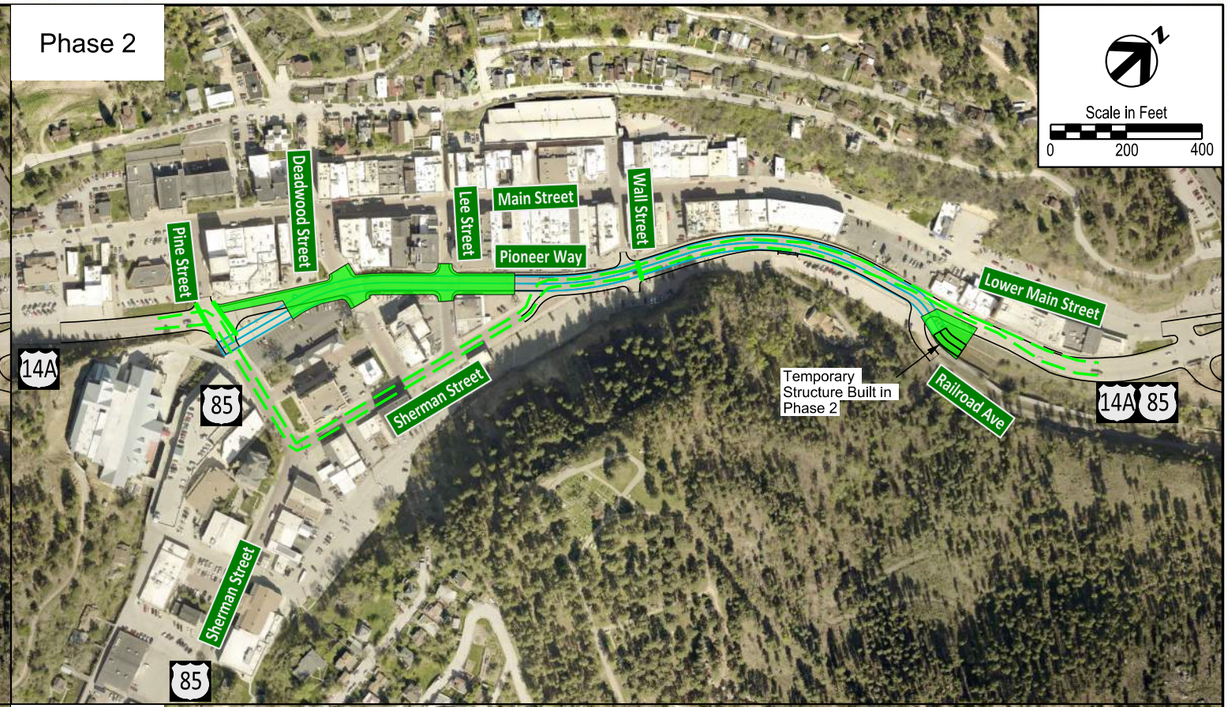
It should be noted that the modeling for each option is conceptual and additional analysis should be performed during the design phase of the project. The HEC-RAS model is sensitive to minor changes; therefore, the final structure selected should be evaluated based on final design elevations and widths to ensure a no-rise condition can be met. Any rise upstream in the channel will likely impact existing buildings which would require costly mitigation. The design team will need to work directly with the floodplain administrator during the design process to facilitate the floodplain permitting effort.

Appendix C. Preliminary Phasing of Concepts

Phase 1



Phase 2



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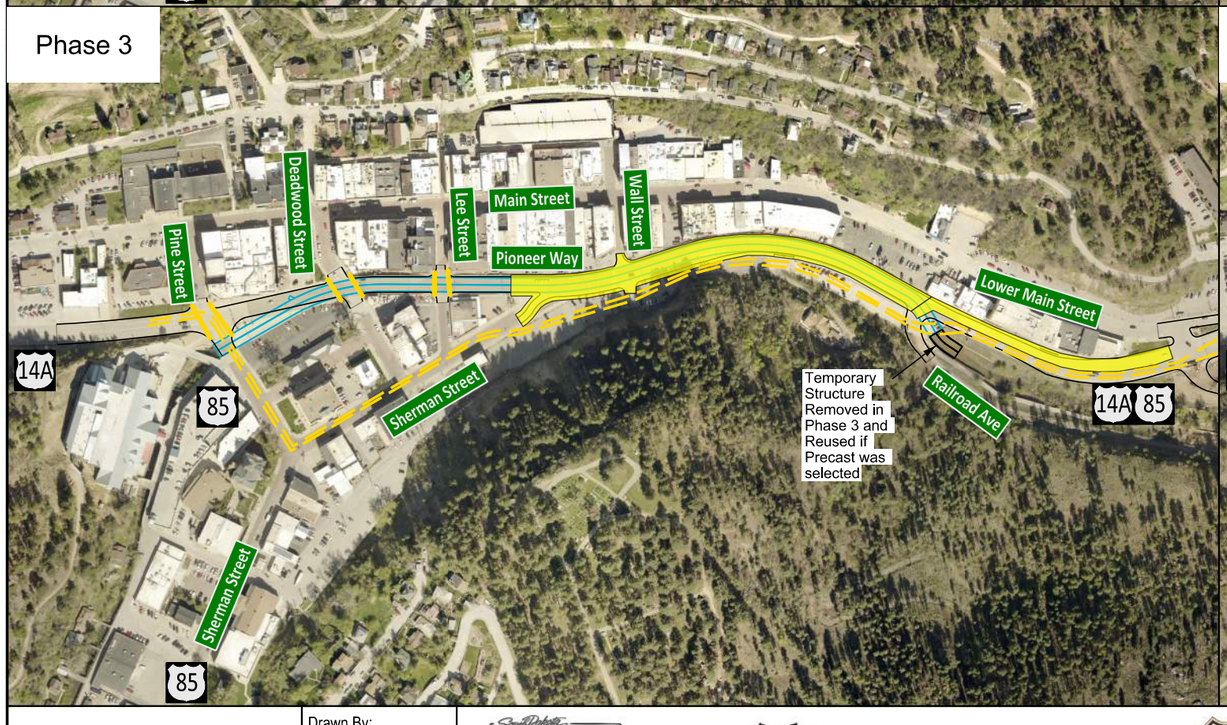
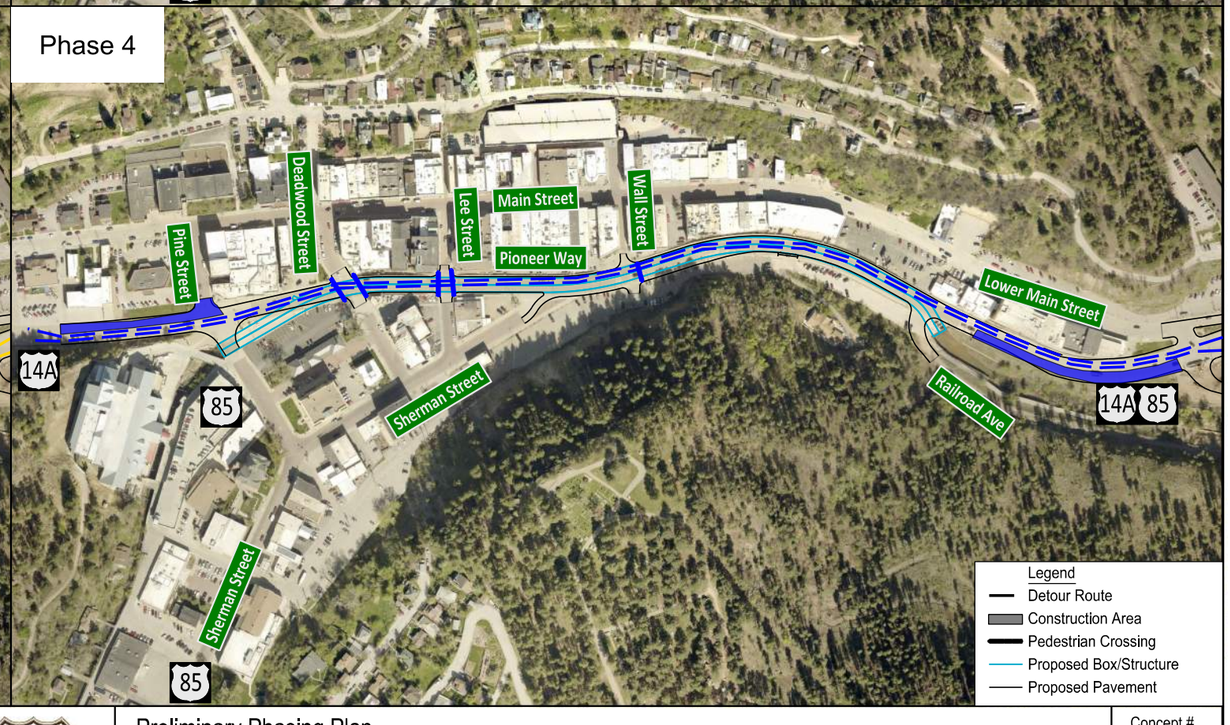


Phase 4



Drawn By:
Date:
Chked By:
Date:
Revision:

South Dakota DOT — Connecting South Dakota and the Nation

DEADWOOD SOUTH DAKOTA 1876

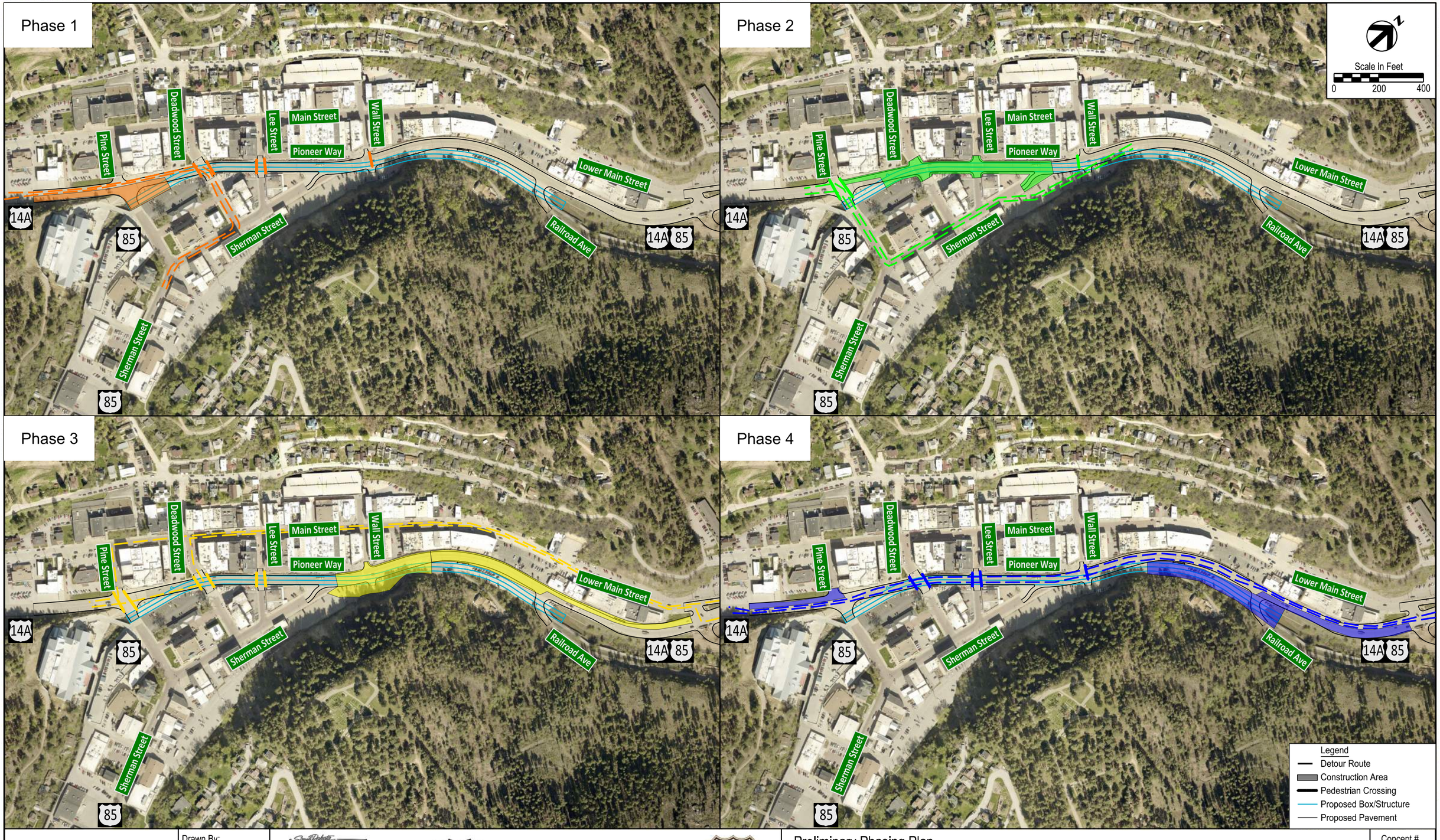
U.S. Department of Transportation Federal Highway Administration

US14A • US85 DEADWOOD BOX

Preliminary Phasing Plan

US14A / US85 Deadwood Box Corridor Study — Deadwood, SD

Concept # 1a



Drawn By:
Date:
Chked By:
Date:
Revision:

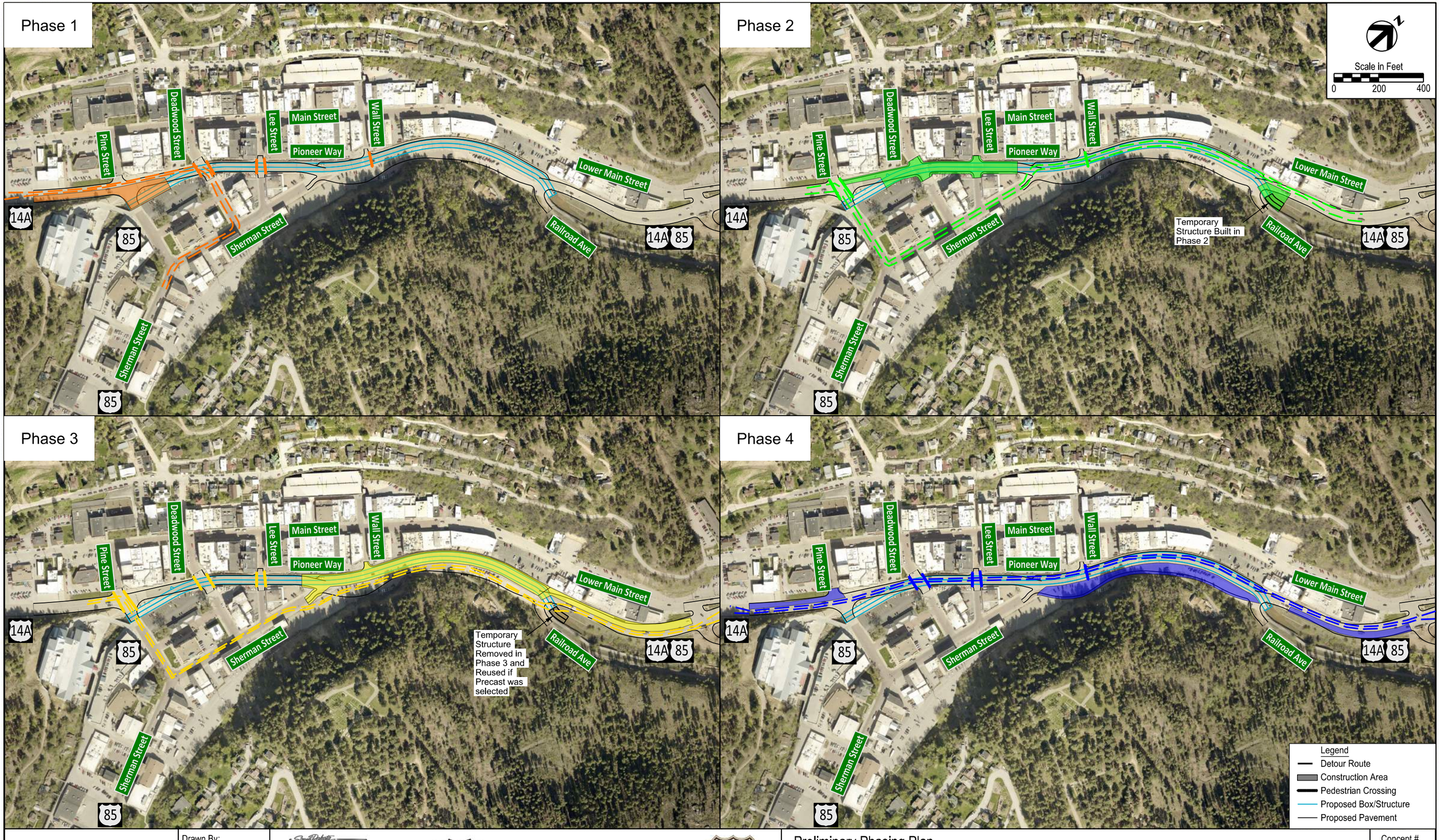
Preliminary Phasing Plan

US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

Concept #

1b



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Date:
Chked By:
Date:
Revision:

U.S. Department of Transportation
Federal Highway Administration

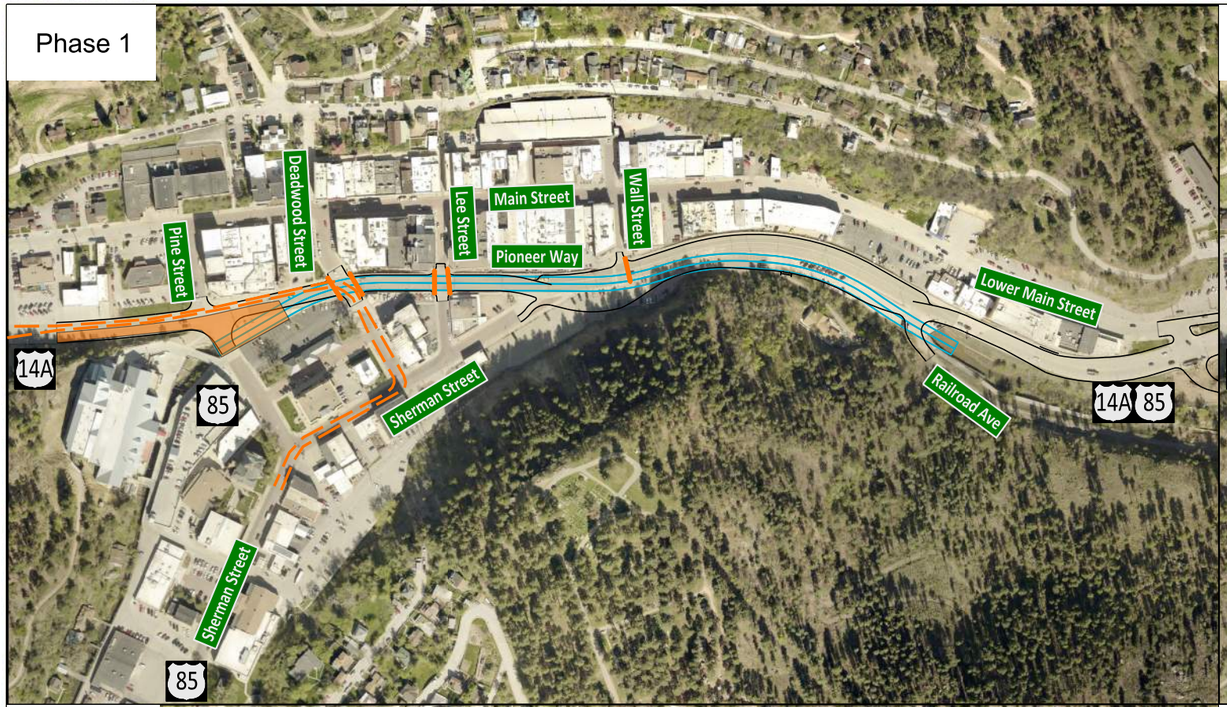
Preliminary Phasing Plan

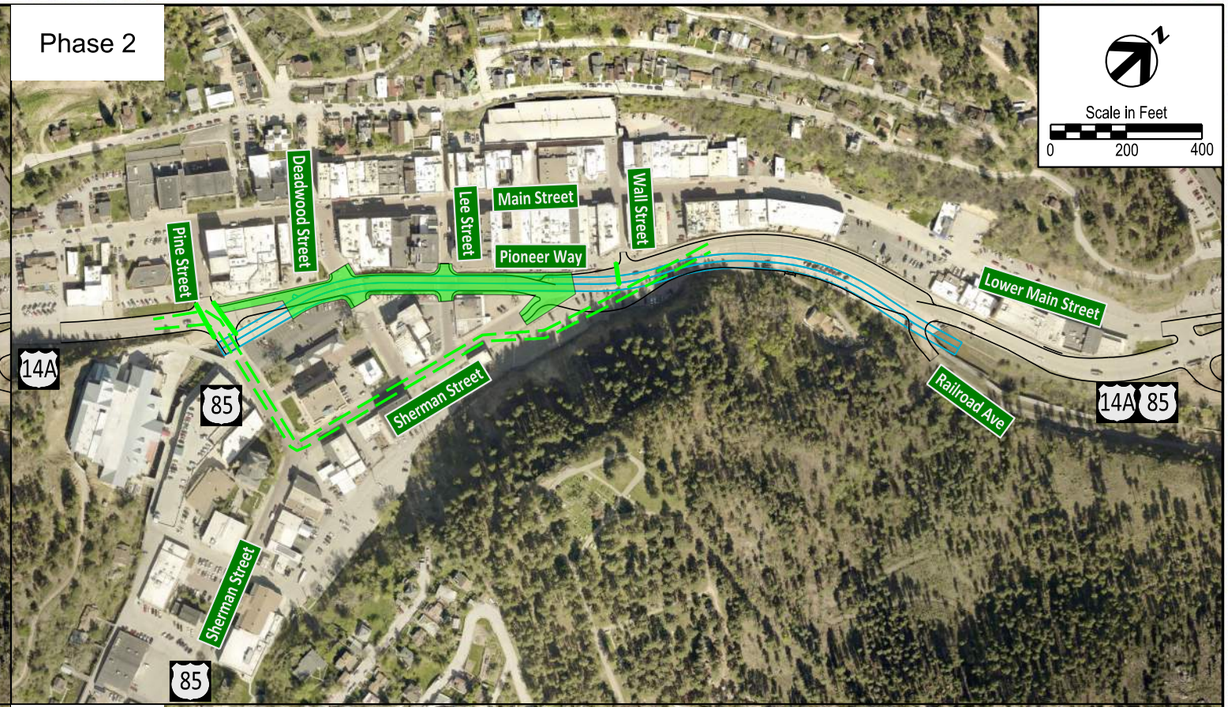
US14A / US85 Deadwood Box Corridor Study

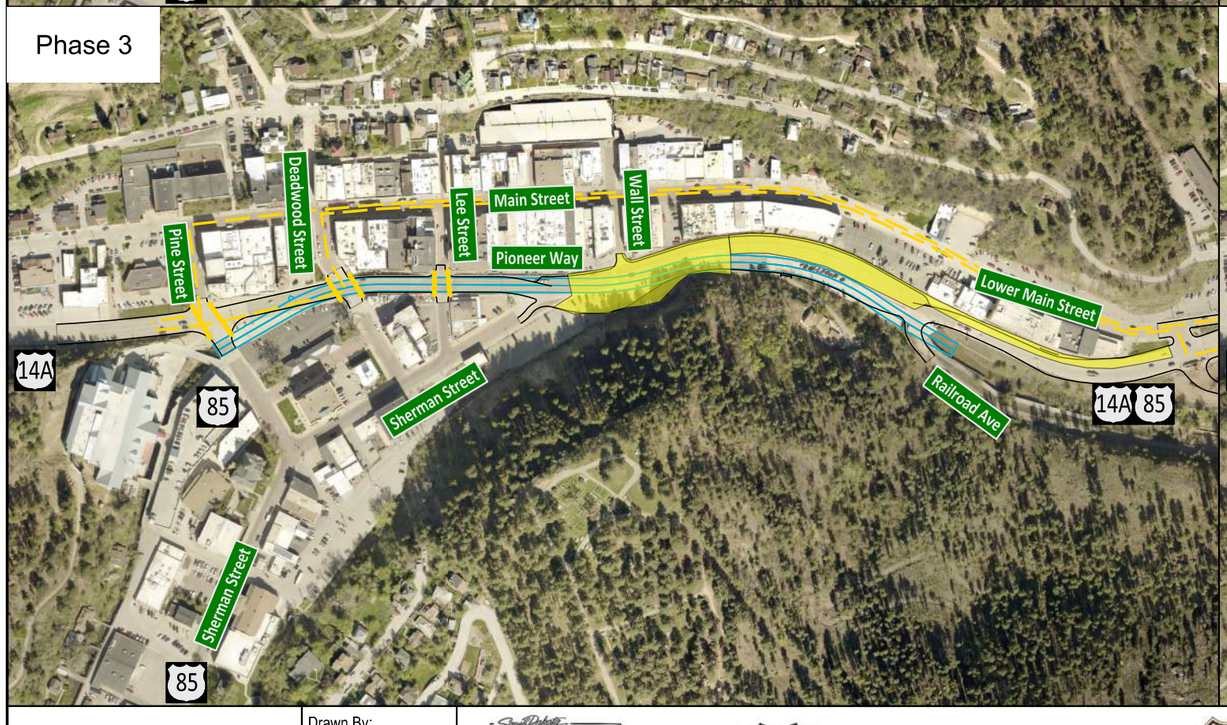
Deadwood, SD

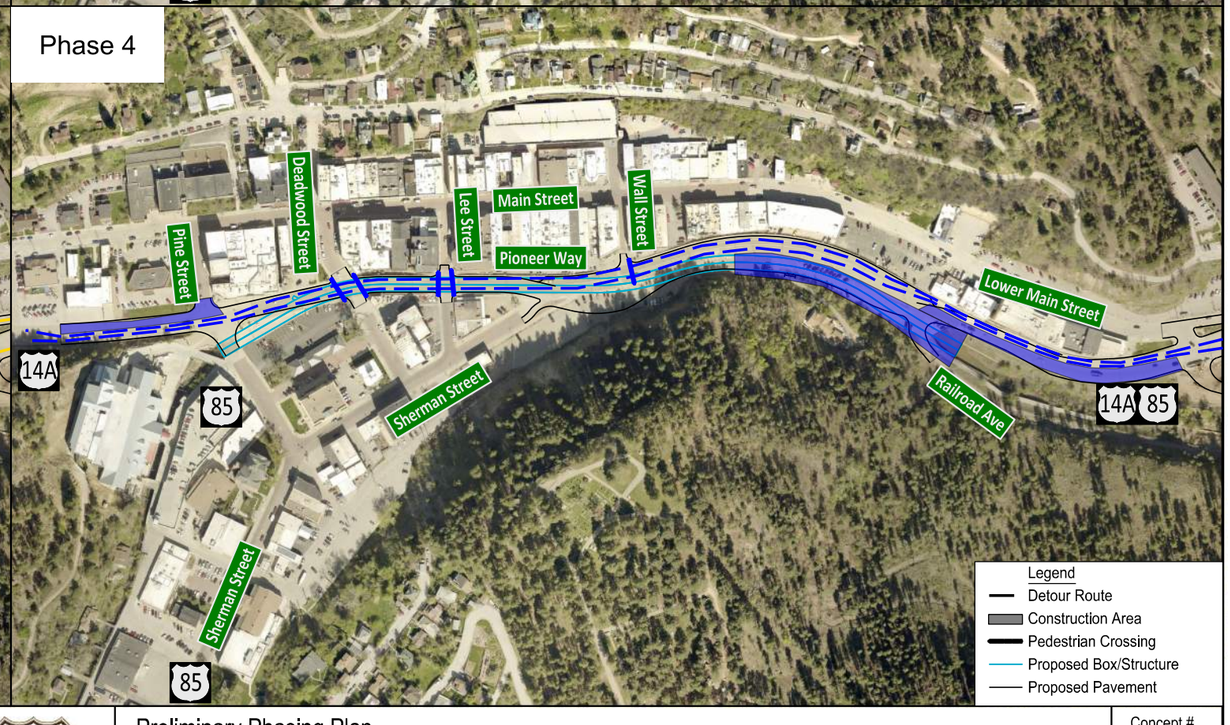
Concept #

1c









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Revision:

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Federal Highway Administration

US14A • US85 DEADWOOD BOX

Preliminary Phasing Plan

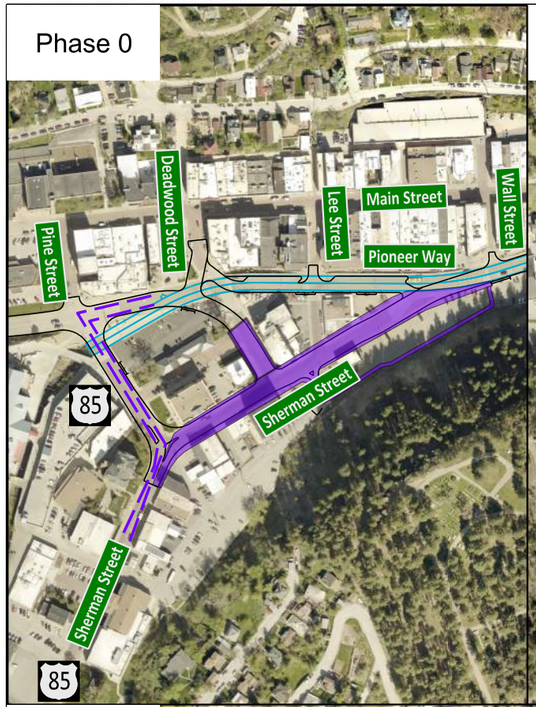
US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

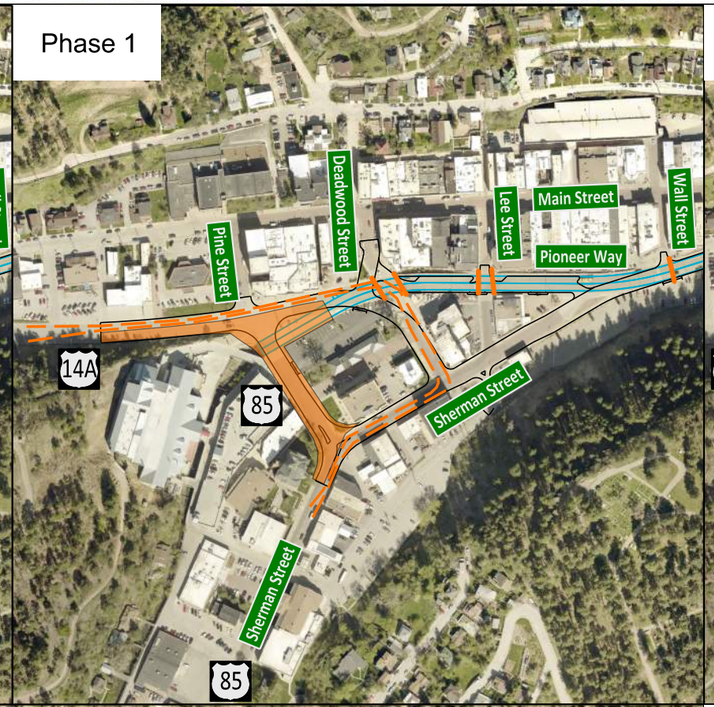
Concept #

1d

Phase 0



Phase 1



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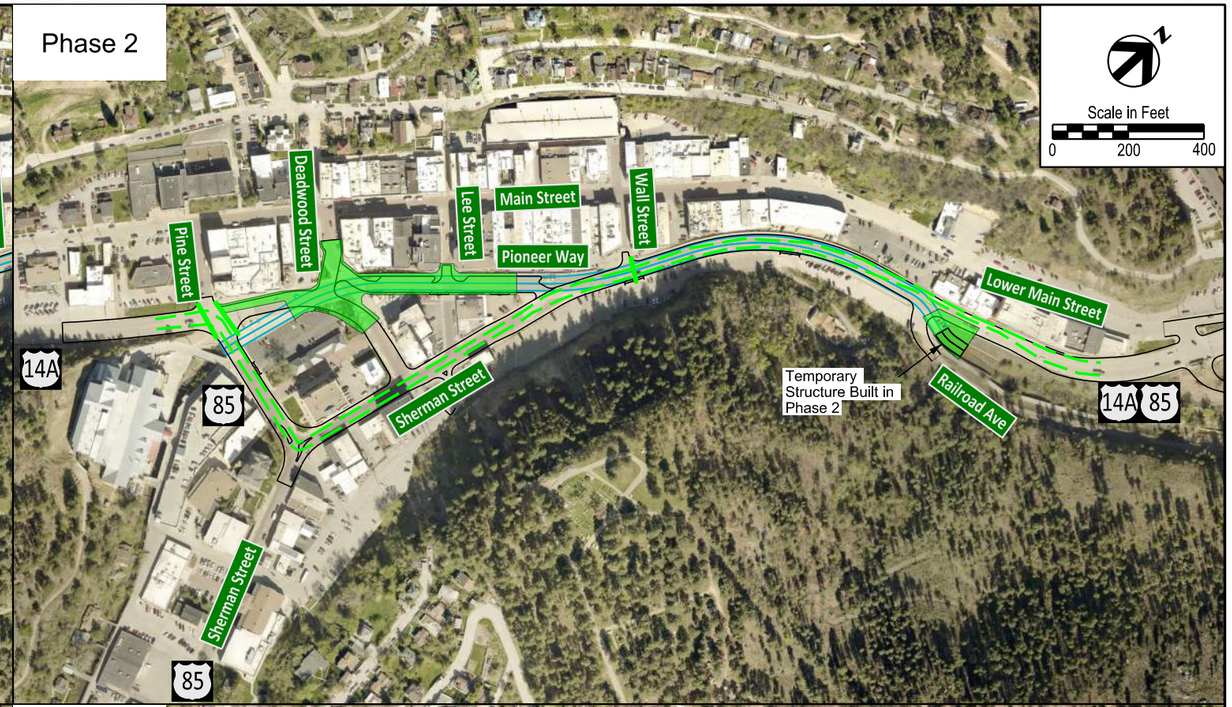

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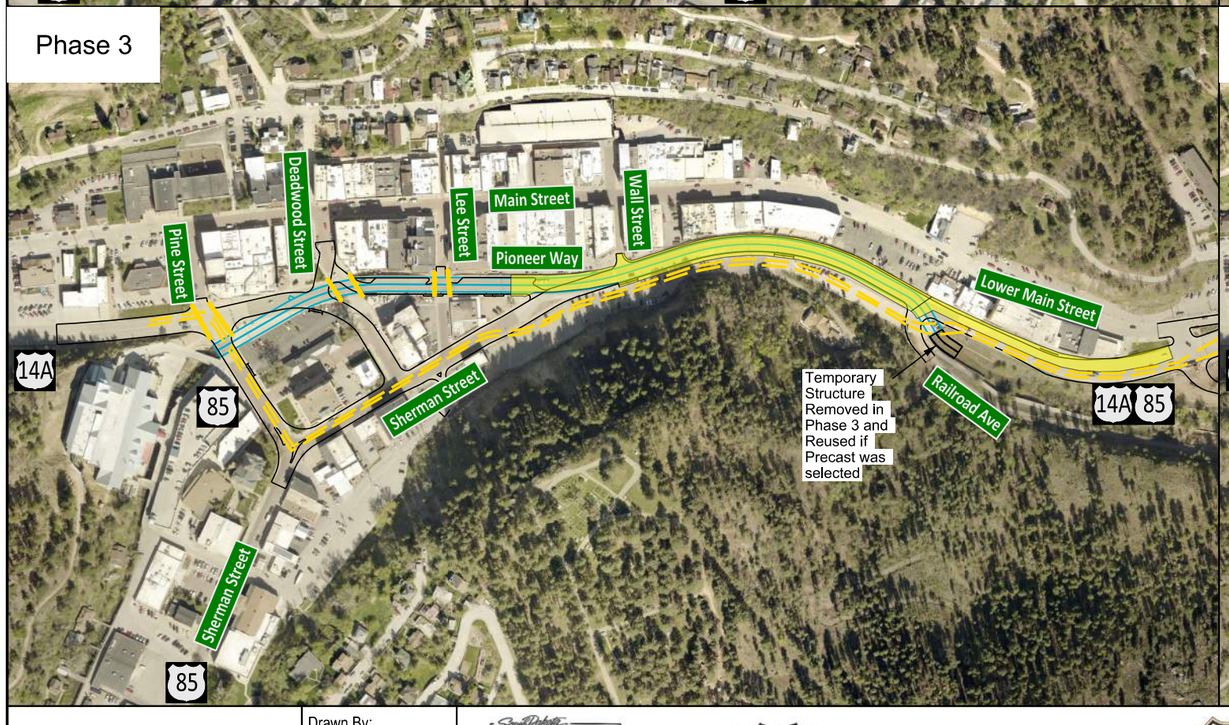

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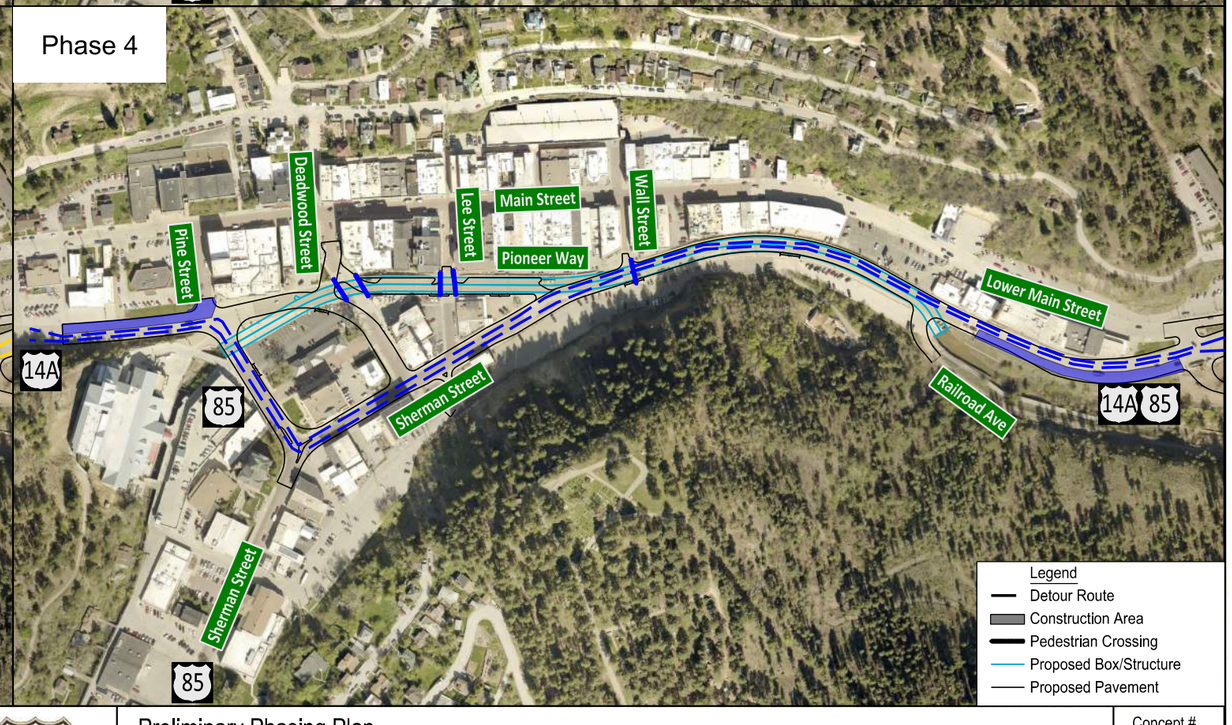

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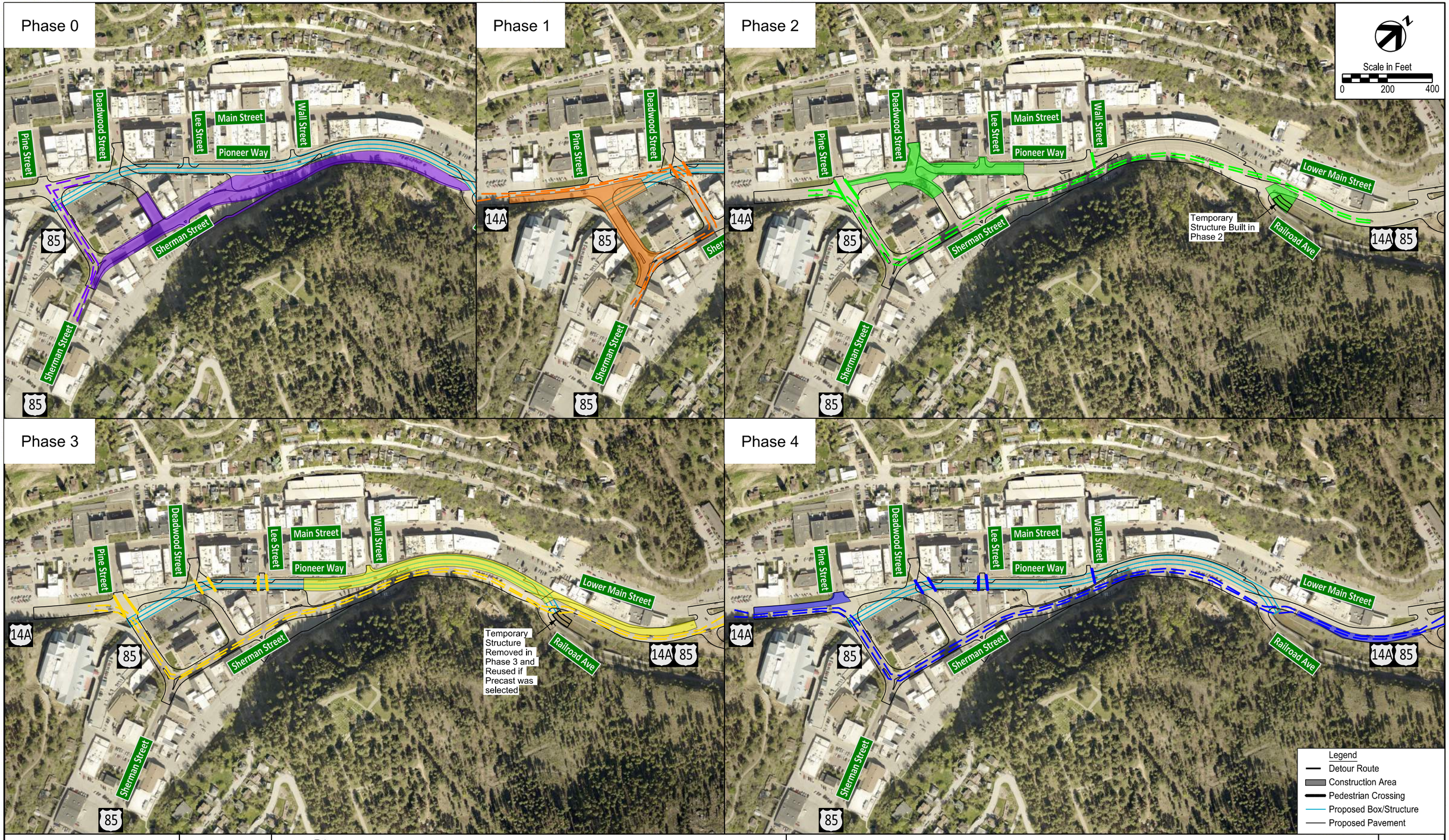
Concept #

2a



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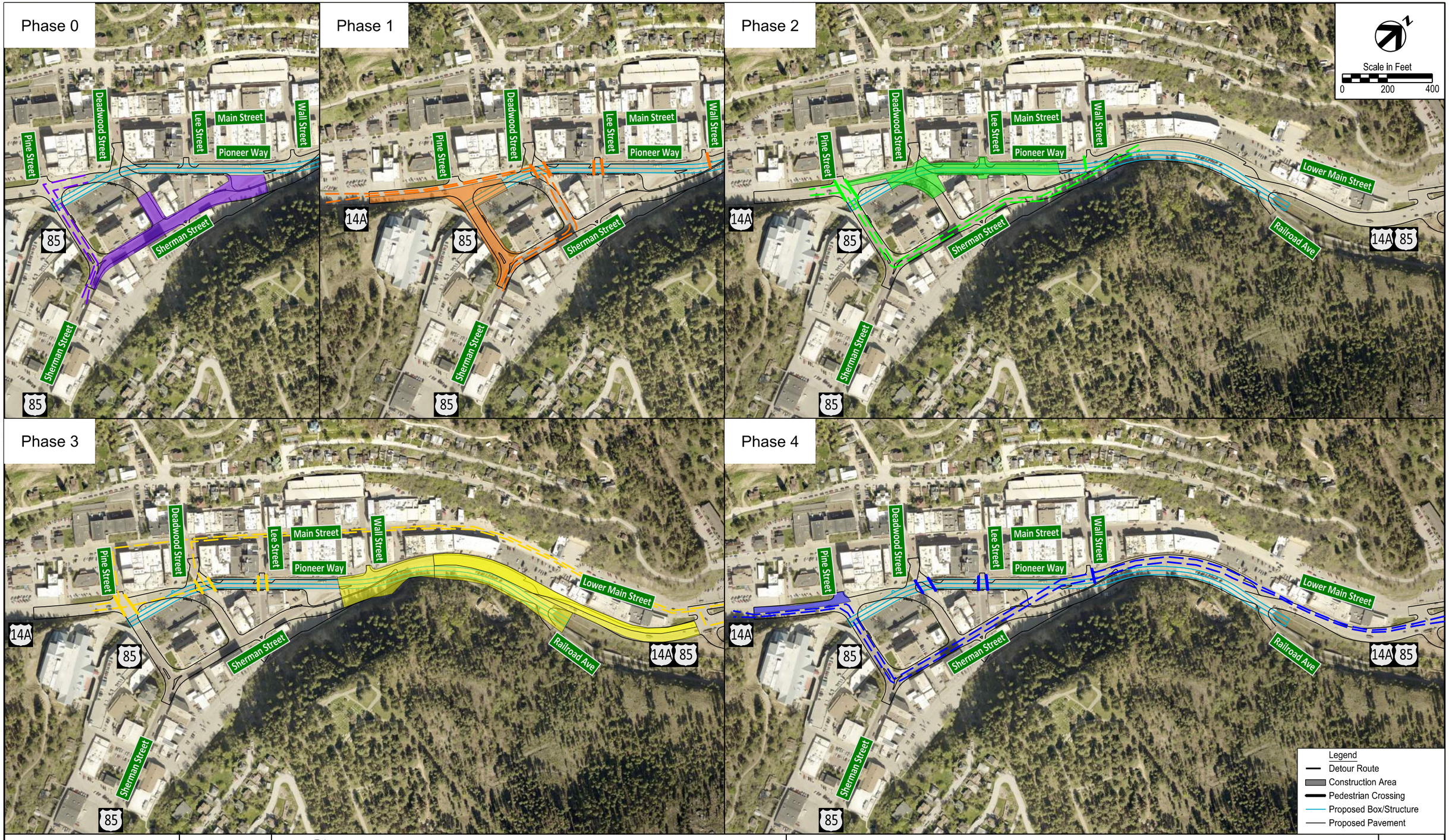
Deadwood, SD

Concept #

2b



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Concept #

2c

Phase 0

Phase 1

Phase 2

Phase 3

Phase 4

Scale in Feet
0 200 400

Pine Street
Deadwood Street
Lee Street
Main Street
Pioneer Way
Wall Street
Sherman Street
Lower Main Street
Railroad Ave
14A
85

Temporary Structure Built in Phase 2

Temporary Structure Removed in Phase 3 and Reused if Precast was selected

Legend
- Detour Route
- Construction Area
- Pedestrian Crossing
- Proposed Box/Structure
- Proposed Pavement

Drawn By:
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Date:
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Concept #
2d

Phase 1

Phase 2

Phase 3

Phase 4

Phase 5

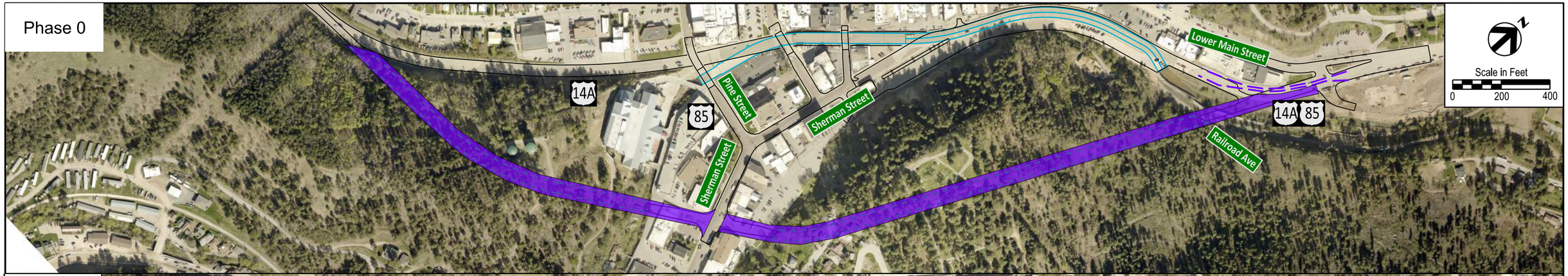
Phase 6

Scale in Feet
0 200 400

Legend
- Detour Route
- Construction Area
- Pedestrian Crossing
- Proposed Box/Structure
- Proposed Pavement

Drawn By: Date: Chked By: Date: Revision:	South Dakota DOT – Connecting South Dakota and the Nation	DEADWOOD 1876 SOUTH DAKOTA	U.S. Department of Transportation Federal Highway Administration	US14A • US85 DEADWOOD BOX	Preliminary Phasing Plan US14A / US85 Deadwood Box Corridor Study Deadwood, SD	Concept # 3a

Phase 0



Phase 1

Phase 2

	Drawn By: Date: Chked By: Date: Revision:	South Dakota DOT — Connecting South Dakota and the Nation 1876 DEADWOOD SOUTH DAKOTA U.S. Department of Transportation Federal Highway Administration US14A • US85 DEADWOOD BOX	Preliminary Phasing Plan US14A / US85 Deadwood Box Corridor Study — Deadwood, SD	Concept # 4a

Phase 0

Phase 1

Phase 2

Scale in Feet
0 250 500

Upper Main Street
Williams Street
Deadwood Street
Pine Street
Lee Street
Main Street
Wall Street
Pioneer Way
Lower Main Street
Sherman Street
Railroad Ave
14A
85
14A 85

Legend
Detour Route
Construction Area
Pedestrian Crossing
Proposed Box/Structure
Proposed Pavement

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Revision:

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US14A / US85 Deadwood Box Corridor Study

Deadwood, SD

Concept #
5a

Appendix D. Preliminary Utility Coordination Technical Memo

Memo

Date:	Wednesday, December 02, 2020
Project:	US14A/US85 Deadwood Box Corridor Study
To:	Study Advisory Team
From:	HDR
Subject:	Initial Concept Analysis – Preliminary Utility Coordination

Introduction

This memo was prepared to document existing utilities within the project area. The City of Deadwood's water and wastewater utilities were reviewed with the City to determine relative impacts of current roadway concepts and to identify any planned future improvements. Several private utilities (power, communication, and natural gas) are also located in the project area. The objective is to identify utilities within the project area, identify relevant facilities that are critical to daily utility operations and identify impacts to critical utilities associated with the current project concepts.

A meeting with the City of Deadwood's Public Works Director took place on November 18, 2020. Preliminary corridor concepts were presented and the corresponding impacts to the City's utilities were identified. A summary of the existing conditions and the impacts of each concept are provided. An existing box structure (Structure Number 41-161-156) is located under the current roadway for approximately 1,768 feet. The structure conveys Whitewood Creek through the project area and reconstruction concepts have varying degrees of impacts on existing utilities. The drainage structure varies in width from 36 to 43 feet and is 13.5 feet deep. Due to its size and proximity to existing utilities, concepts that involve relocation of the drainage structure have the largest impact on utility lines.

Existing Conditions

Subsurface utilities have been mapped with owner identification information. A utility map is provided in Appendix A.

Water Distribution System

The City's water distribution system crosses the existing US14A and drainage structure at three locations. Each crossing is accomplished by penetrating the box structure walls and crossing through the upper portion of the drainage channel. Two crossings, one at Pine Street and the other at Deadwood Street, are part of the City's high pressure distribution zone. The City indicated that one of these two high pressure mains is required to be in operation in order to convey water across the project area to existing customers located west of the project area. A third main crossing is located at Lee Street. The Lee Street crossing is a low pressure zone water main that is looped in this area. The Lee Street crossing can be temporarily taken out of service without significant impact to the water system. The City's preference is for the water

utility crossings to be reconstructed as they currently exist, which is to penetrate and pass through the box, rather than to be relocated around or under the structure.

Wastewater Collection System
The wastewater collection system parallels the existing highway in multiple locations. There is one crossing in the project area located at the northern end of the project near Railroad Ave. The collection system crossing conveys wastewater by gravity through the drainage structure. Continuous wastewater conveyance is required to prevent backups or disruption of service. Interruptions of sanitary sewer service will require bypass pumping or other means to continuously convey wastewater during construction related impacts to the existing system. The City's preference is for the wastewater utility crossing to be reconstructed as it currently exists, which is to penetrate and pass through the box.

Water and Wastewater Utility Maintenance History
The existing water and sanitary sewer lines that cross through the box structure have been in operation for many years without significant issues. The City indicated that cold weather does not impact the utility lines and high flows in the box structure have not impacted the pipelines.

Service Lines
Service lines are located throughout the project area to serve adjacent water and sanitary sewer customers. Service lines will need to be reconnected after any utility line replacement or relocation. Impacts to individual service lines is anticipated to be addressed in greater detail as concepts are refined.

A single water service line crosses the box structure to serve the property at 1 Railroad Street. No other service lines are known to cross through the box structure.

Private Utilities
The project corridor adjacent to the existing roadway and drainage structure is congested with several private utility lines. Buried and overhead lines exist adjacent to and crossing US14A. Private utility coordination meetings have not yet occurred and are anticipated to take place as concepts are narrowed down and refined. Private utility relocation is anticipated to be required prior to or during roadway reconstruction.

Future Improvements

Water Distribution System
A high pressure zone main dead-ends at the intersection of Sherman Street and US14A. To improve system efficiency, the high pressure main is planned to be extended north along the project corridor past the Deadwood Box outlet. From there the main would cross Whitewood Creek and connect to an existing high pressure water main located in Main Street.

The timing of the planned improvement was not identified. A water main corridor would need to be identified and reserved for the City.

Wastewater Collection System
No improvements are planned for the City's wastewater collection system.

Concept #1A

Concept #1A reconstructs the box structure and roadway in a similar location as existing. Impacts to existing utilities include addressing the three water main and one sewer main crossing. Utilities located adjacent and parallel to the box structure are assumed to remain in place as they would be outside of the excavation area required to reconstruct the box structure.

Figure 1 Concept #1A

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)

Impact to existing utilities relative to other concepts: Low

Concept #1B

Concept #1B reconstructs the roadway in a similar location as existing. The box would be reconstructed in its existing location on the southern end of the project and would be reconstructed in a new alignment on the northern end of the project. Realigning the box structure in this concept would impact existing utilities located adjacent to the east side of the existing structure (approximately 700 feet). Utility relocation would be required to clear the corridor required for the revised box structure alignment. Where the box structure is being realigned, the abandoned box structure area would be filled and could be utilized as a corridor for utility relocation.

Figure 2 Concept #1B

Summary of significant impacts (with approximate length of impacts):

- All underground utilities located north of Sherman Street and east of the existing box structure are impacted by the new box structure alignment (700 feet)
    - Impacts to water, sanitary sewer, power, and communication in this area.
- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent and west of the box structure (800 feet)

Impact to existing utilities relative to other concepts: Medium

Concept #1C

Concept #1C reconstructs the box structure in its existing location. The roadway would be reconstructed in its current location on the south end of the project and would be realigned toward the east on the north end of the project. Moving the roadway would impact underground utilities but less extensively than concept #1B, where excavation for the box structure would require relocation. In concept #1C, the existing utilities may be able to remain in their existing location with some modifications to account for the new roadway alignment. Modifications would include adjustment of sanitary manholes and water system valves and hydrants.

Figure 3 Concept #1C

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Likely modifications to existing utilities located in revised roadway alignment (700 feet)
    - Existing utilities include water, sanitary sewer, power, and communication
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)

Impact to existing utilities relative to other concepts: Low

Concept #1D

Concept #1D is a hybrid of concepts #1B and #1C. Concept #1D would reconstruct the roadway and box structure in their existing locations at the southern end of the project area. Both the roadway and box structure would be realigned at the northern end of the project. The utility impacts are similar to concept #1B, the existing utilities located in the conceptual box structure corridor would require relocation.

Figure 4 Concept #1D

Summary of significant impacts (with approximate length of impacts):

- All underground utilities located north of Sherman Street and east of the existing box structure are impacted by the new box structure alignment (700 feet)
    - Impacts to water, sanitary sewer, power, and communication in this area.
- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent and west of the existing box structure (800 feet)

Impact to existing utilities relative to other concepts: Medium

Concept #2A

Concept #2A would reconstruct the box structure in its existing location. The roadway would be realigned to make US 85 (Sherman Street) the through movement. Consistent with Concept #1 variations, Concept #2A has the least utility impacts due to the box structure being reconstructed in its current alignment. Some additional impacts are anticipated to the new through movement corridor but those would likely be limited to surface features such as fire hydrants, valve boxes, and manhole castings.

Figure 5 Concept #2A

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)
- Likely impacts to surface features along Sherman Street and Pine Street (1,400 feet)

Impact to existing utilities relative to other concepts: Low

Concept #2B

Concept #2B is similar to Concept #2A except the roadway would be realigned to the east of its existing alignment. The realignment would allow parking to be located on the west, adjacent to points of destination. The box structure would be reconstructed in its existing location. Concept #2B has similar utility impacts as other concepts that replace the box structure in its current location. Some additional impacts are anticipated to the new through movement corridor but those would likely be limited to surface features such as fire hydrants, valve boxes, and manhole castings.

Figure 6 Concept #2B

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)
- Likely impacts to surface features along Sherman Street, Pine Street, and existing US14A (2,300 feet)

Impact to existing utilities relative to other concepts: Medium Low

Concept #2C

Concept #2C would realign the roadway to make US 85 the through movement. Rather than reconstructing the box structure in its current location, it would be partially reconstructed on a new alignment. Similar to Concepts #1B and #1D the box structure would deviate from its current alignment at the northern end of the project, past the existing Sherman Street intersection.

Figure 7 Concept #2C

Summary of significant impacts (with approximate length of impacts):

- All underground utilities located north of Sherman Street and east of the existing box structure are impacted by the new box structure alignment (700 feet)
- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Likely impacts to surface features along Sherman Street, Pine Street, and existing US14A (2,300 feet)
- Potential impacts to utilities located adjacent and west of the existing box structure (800 feet)

Impact to existing utilities relative to other concepts: Medium High

Concept #2D

Concept #2D would, similar to all Concept #2 iterations, realign the roadway to make US 85 the through movement. This concept realigns US 85 to the east and avoids utilizing Sherman Street as the through corridor. The box structure would be reconstructed in its current location, utility impacts along the box structure are similar to other concepts that utilize the existing box structure alignment. Realigning US 85 to the south would impact the Miller Street parking area and continue south until the highway rejoins its current alignment. Subsurface utility location was not completed for the southern portion of this concept and potential impacts were not discussed in detail. If Concept #2D moves forward, additional utility location and conflict identification are anticipated to occur.

Figure 8 Concept #2D

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Impacts to utilities along Sherman Street, Pine Street, and existing US14A (2,300 feet)
- Potential impacts to utilities located adjacent and west of the existing box structure (800 feet)
- Unidentified impacts beyond the current extend of utility mapping.

Impact to existing utilities relative to other concepts: Medium High

Concept #3A

Concept #3A would elevate the roadway and revise impacted local streets. The box structure would be reconstructed in its current alignment. Utility impacts associated with the box structure would be consistent with other concepts that retain the box structure alignment. Additional impacts are anticipated due to grade changes and potential impacts with the elevated roadway foundations.

Figure 9 Concept #3A

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)
- Likely impacts at Sherman Street, Deadwood Street, and at the new overpass (1,400 feet)
- Likely impacts to utilities where grade changes and elevated roadway foundations would be required (currently unidentified)

Impact to existing utilities relative to other concepts: Medium High

Concept #4A

Concept #4A involves two tunnels through the hillsides and elimination of the current US14A between Upper Main Street to Sherman Street intersection. The box structure would be revised to a paved open channel structure where the roadway is removed. To the north, parking is proposed in place of the old roadway. In this area the box structure would be reconstructed in its current alignment.

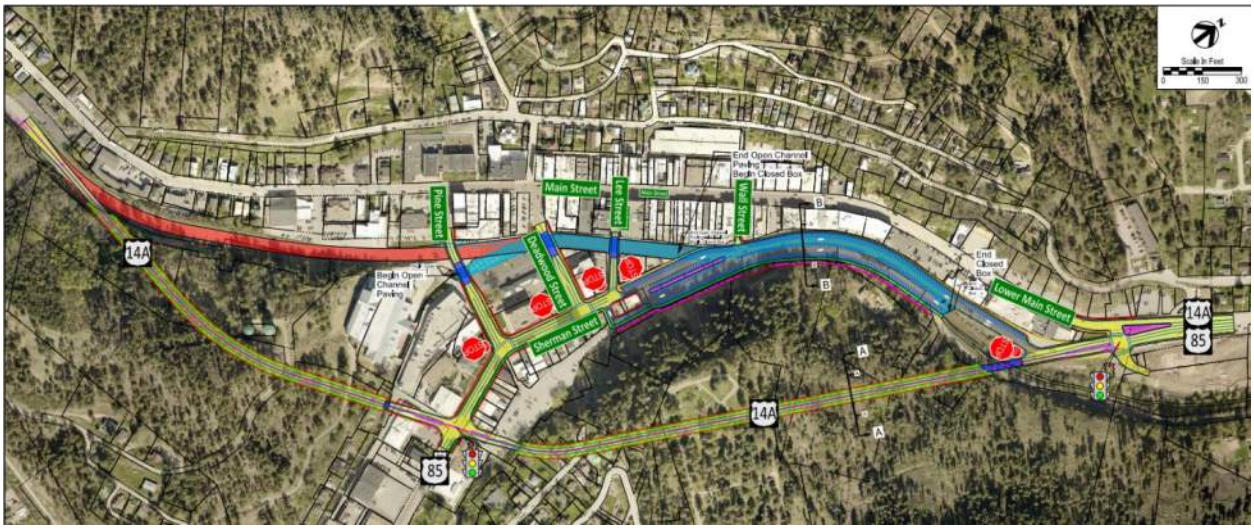


Figure 10 Concept #4A

Summary of significant impacts (with approximate length of impacts):

- Replace three water main crossings, new crossings would be exposed or relocated under the new open channel (150 feet)
- Replace one gravity sanitary sewer crossing (50 feet)
- Potential impacts to utilities located adjacent to the box structure (1,500 feet)
- Likely impacts at the intersection with US 85, additional investigation required if the concept moves forward

Impact to existing utilities relative to other concepts: Medium

Concept #5A

Concept #5A would relocate US14A onto an existing local street corridor. The existing box structure would be replaced with an open channel south of Deadwood Street to the termination point of the existing box structure. This concept has the most impacts to utilities and was only reviewed briefly due its conceptual nature. If Concept #5A moves forward, additional utility mapping and conflict identification is required.

Figure 11 Concept #5A

Due to the large extent of the conceptual impacts, individual utility impacts were not identified.

Impact to existing utilities relative to other concepts: High

Private Utility Impacts

In addition to the City of Deadwood's publicly owned utilities, there are several privately owned utility lines in the project area. Other known utility owners in the project area include:

- Lead-Deadwood Sanitary District
- CenturyLink
- SDN
- Vast
- Midco
- Montana Dakota Utilities (MDU)
- Black Hills Energy

Individual meetings with private utility owners are anticipated to occur as concepts are refined. A cursory review of the private utility locations indicates that there are varying impacts to each of the utilities.

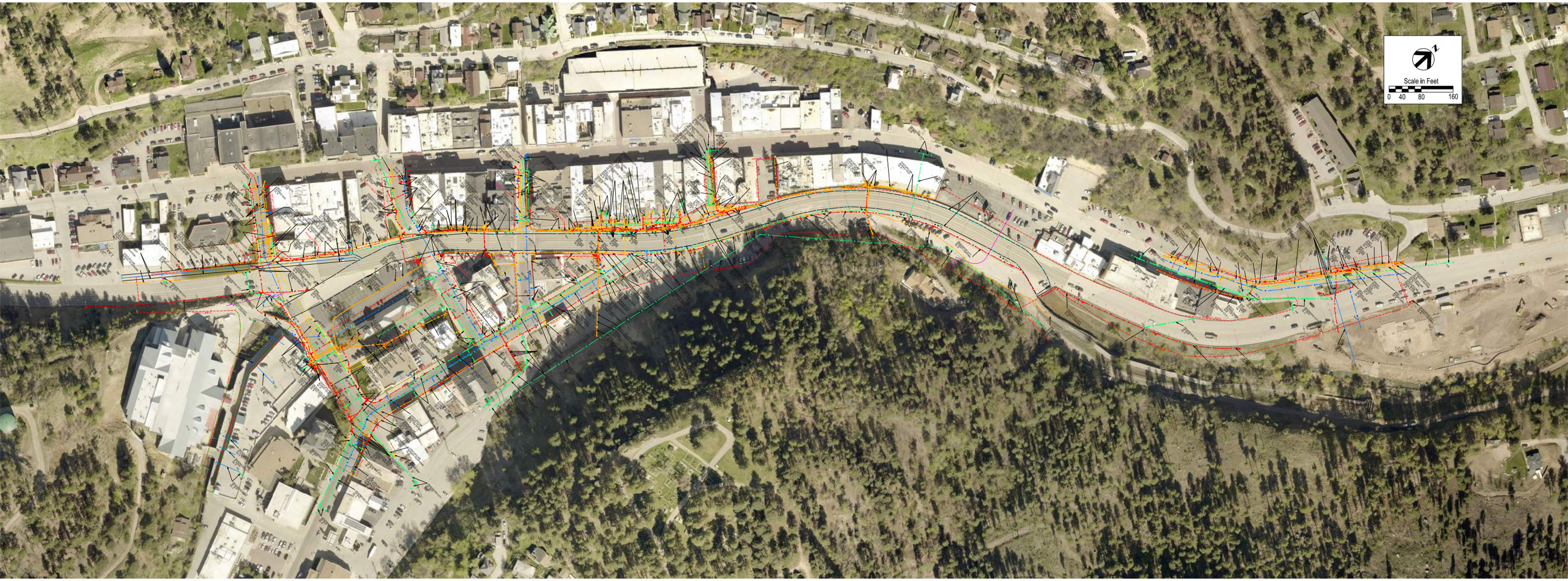
Summary of Relative Impacts

Each of the concepts was given a relative rating of impacts to existing utilities using a range of Low-Medium-High. A summary is provided in Table 1.

Table 1 Relative Impact to Existing Utilities by Concept

Concept Name	Relative Impact to Existing Utilities
1A	Low
1B	Medium
1C	Low
1D	Medium
2A	Low
2B	Medium Low
2C	Medium High
2D	Medium High
3A	Medium High
4A	Medium
5A	High

Appendix A – Existing Utility Map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Appendix E. Initial Concept Elimination from SAT Meeting #3 Memo

Memo

Date:	Wednesday, December 23, 2020
Project:	US14A/US85 Deadwood Box Corridor Study
To:	Study Advisory Team
From:	HDR
Subject:	Initial Concept Elimination from SAT Meeting #3

Introduction

Study Advisory Team (SAT) Meeting No. 3 was held on December 18, 2020 and eleven build concepts were presented and additional concept ideas were identified. The concepts were discussed resulting in an agreement for concepts to be presented to the public and a few concepts that were considered for elimination. This memo was prepared to document the discussions that occurred during the meeting including the additional concept ideas and concepts that were eliminated from further anslysis.

Additional Drainage Structure Concept Ideas

Two variations of a drainage structure tunnel were discussed as potential additional concepts. The concept ideas are listed below along with their merits and drawbacks. Rough alignments for these two options can be found at the end of this memo.

1) **Concept 6a**: Tunnel the drainage structure under the hillside between Sherman Street and the existing box outlet
    - Advantages
        - Future maintenance to the box and tunnel on the north end would have minimal impacts to traffic.
        - A CLOMR will likely not be required.
    - Drawbacks
        - Similar to Concepts 1b, 1d, and 2c, moving the north end of the channel to the east of its existing location complicates the constructability. These options would require extensive excavation to create the new channel. While constructing the new channel, shoring of the existing structure or adjacent buildings would be required in some areas due to the destabilization of the existing box. These options may require a long traffic closure along the existing US14A/US85 route for construction of the crossover point between the existing and new channel. During this time, traffic would likely need to be routed along Upper/Lower Main Street.
        - Impacts to one building.
        - Tunnel may not be deep enough or have enough cover on the west side. Open cut may be necessary for some of the tunnel excavation, further scaring the hillside.

  - Expected high costs of construction due to tunneling.
  - Soils in the hillside are unknown. Reinforcement of the tunnel and ongoing maintenance within a tunnel may be difficult if required.
- Recommendation: The drawbacks outweigh the benefits. Due to the impacts to a building, the expected high construction costs of tunneling, and the complications to constructability, it is recommended that Concept 6a is not pulled forward into the Initial Analysis of Concepts Report and should be eliminated from further analysis.

2) **Concept 6b**: Reroute drainage structure under US85 between Powerhouse Park and Center Street and tunnel the drainage structure under the hillside between Miller Street and to the north of the existing box outlet
   - Advantages
     - Minimal impacts to traffic except for the crossing at US85. Box reroute and tunnel can be built almost completely offline of the existing drainage system except for the termination points.
     - Future maintenance to the box and tunnel would have minimal impacts to traffic.
   - Drawbacks
     - Elongates the underground portion of the channel by an additional 1,000 feet. The existing box is approximately 2,000 feet and this option would increase that to approximately 3,000 feet. Due to the significant change to the box inlet and length, a CLOMR may be required.
     - Potential impacts to a total of 6 buildings. The elevation of the drainage structure between Powerhouse Park and Center Street would be the same as the foundations and basements of the buildings the box would need to go underneath. This would impact the buildings the box would need to go under and potentially the surrounding buildings as well.
     - Soils in the hillside are unknown. Reinforcement of the tunnel and ongoing maintenance within a tunnel may be difficult, if required.
     - Tunnel and rerouted box alignment is well outside of the study area. The study would be delayed if this concept is considered for further analysis.
     - Expected high costs initially for construction due to tunneling, high long-term maintenance costs, and property acquisitions.
   - Recommendation: The drawbacks outweigh the benefits. Due to the potential impacts to six buildings, the expected high construction costs of tunneling, and the possibility of a CLOMR, it is recommended that Concept 6b is not pulled forward into the Initial Analysis of Concepts Report and should be eliminated from further analysis.

Concepts Eliminated from Further Analysis

The following build concepts presented within the Initial Analysis of Concepts Report are recommended to be eliminated from further analysis.

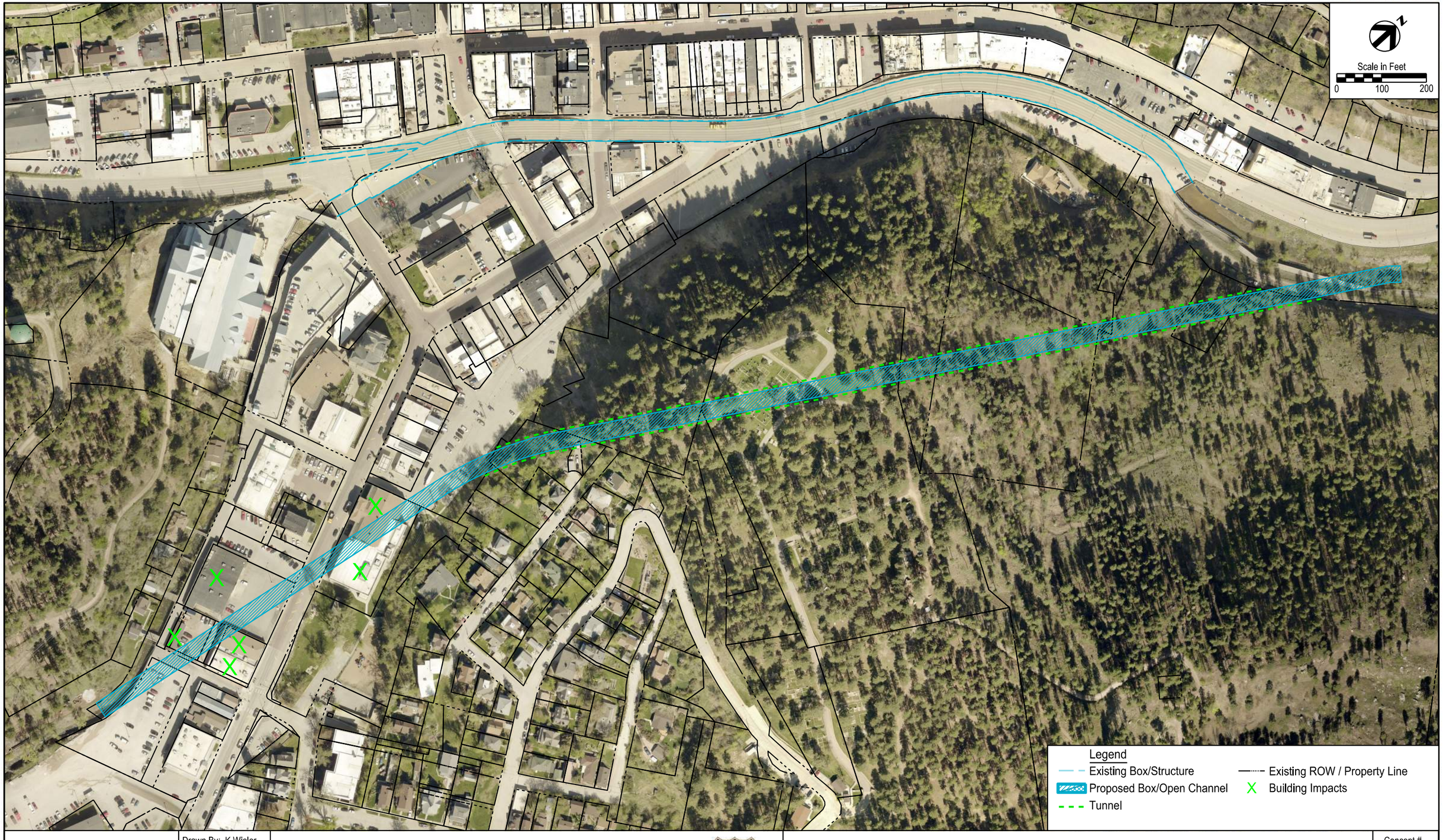
1) **Concept 3a**: Overpass
    - Reasons for eliminating include:
        - Construction of two structures - drainage structure and the overhead highway structure. The SAT was not in favor of the high cost of building both of these structures when only a drainage structure replacement is needed.
        - Additional costs associated with the 2 structures.
        - High long-term maintenance costs: Concept 3a tied with Concept 4a for the highest maintenance costs and is estimated to have $3.7 million in maintenance costs over the next 30 years.
        - Snow removal and icing concerns on the bridge/overpass and concerns with public safety.
        - Utility impacts due to the construction of the high embankment, retaining walls, abutments, and piers associated with the bridge.
        - Concerns with the affect the bridge will have on the viewshed.
    - Ultimately, the SAT agreed that this concept should be eliminated from further analysis due to the snow removal considerations, high comparative costs, and high utility impacts.
2) **Concept 4a**: Tunnel
    - Reasons for eliminating include:
        - This is the most expensive concept, with an estimated total cost of $154 Million, almost 2.6 times higher than the least expensive build concept.
        - This concept is expected to impact 7 buildings, four of which are historic.
        - Concept 4a tied with Concept 3a for the highest maintenance costs. This concept is estimated to have a total of $3.7 million in maintenance costs over the next 30 years.
        - This concept ranked the second lowest in the evaluation matrix within the Initial Analysis of Concepts Report.
    - Ultimately, the SAT agreed that this concept should be eliminated from further analysis due to the building impacts and high comparative costs.
3) **Concept 5a**: Highway on Local Network
    - Reasons for eliminating include:
        - This is the second most expensive concept, with an estimated total cost of $110 Million, almost 1.8 times higher than the least expensive build concept.
        - This concept is expected to impact 39 buildings, 25 of which are historic.
        - This concept is estimated to have the third highest amount of maintenance costs, a total of $3.3 million in maintenance costs over the next 30 years.

- Ultimately, the SAT agreed that this concept should be eliminated from further analysis due to the building impacts, high comparative costs, and significant safety implications of introducing high traffic volumes to a neighborhood roadway.

Scale in Feet
0 75 150

Legend
- Existing Box/Structure
- Proposed Box/Open Channel
- Tunnel
- Existing ROW / Property Line
- X Building Impacts

	Drawn By: K.Wieler Date: 12/22/2020 Chked By: S.Slowey Date: 12/22/2020 Revision:	US14A * US85 DEADWOOD BOX	US14A / US85 Deadwood Box Corridor Study Deadwood, SD	Concept # 6a



	Drawn By: K.Wieler Date: 10/23/2020 Chked By: S.Slowey Date: 10/23/2020 Revision:	US14A / US85 Deadwood Box Corridor Study	Deadwood, SD	Concept # 6b