I-70 OVER FOREST SERVICE ROAD STRUCTURE F-13-S_MINOR REPLACEMENT FEASIBILITY STUDY

PROJECT N0: FBR 0702-385 (22712)

CDOT REGION 3

SUMMIT COUNTY, CO

Prepared for:

COLORADO
Department of Transportation
Statewide Bridge Enterprise

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REV 1 - Final Report Submittal

Structure F-13-S_MINOR Replacement Feasibility Study

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1. Introduction

The Colorado Bridge Enterprise (BE) listed structure F-13-S_Minor as eligible for FASTER funding as a result of the structure becoming structurally deficient based on an inspection performed on July 24th, 2017. The outcome of this study will help BE plan funding for the replacement of this structure.

CDOT Region 3 (Mountain Residency) has requested the assistance of AECOM to evaluate existing structure conditions and provide alternatives for replacement. The purpose of this feasibility report is to:

1) Evaluate the structure and provide replacement alternatives with viable solutions
2) Provide a technical summary of the unique critical issues for future design and construction
3) Provide a schedule, estimate, and preliminary project delivery recommendation for the structure

This study will identify potential issues associated with the replacement of Structure F-13-S_Minor, a concrete box culvert (CBC) located in Region 3. This report summarizes data gathering activities undertaken to determine impacts associated with the replacement. A conceptual cost estimate, schedule, project delivery assessment, and Accelerated Bridge Construction (ABC) rating are also included.

Figure 1 – Structure F-13-S_MINOR, looking south

a. FASTER ELIGIBLE BRIDGES

In 2009, Governor Bill Ritter signed into law Colorado Senate Bill 09-108, Funding Advancement for Surface Transportation and Economic Recovery, otherwise known as FASTER. A portion of the funding generated from a "bridge safety surcharge" is dedicated specifically to Colorado's most deficient bridges – those bridges identified as structurally deficient, or functionally obsolete, and rated "poor" by the Colorado Department of Transportation (CDOT). FASTER created a new entity, the BE, with the business purpose to "finance, repair, reconstruct, and replace any designated bridge in the state" per C.R.S. 43-4-805 (2) (b). Per Resolution #BE-18-06-02, a bridge which has a National Bridge Inventory (NBI) rating of 4 or less for Items 58, 59, 60, or 62 is defined as "poor" and "structurally deficient".

The program maintains an ongoing tally of the "poor" designated structures eligible to receive FASTER funding since the legislation was passed into law. When the law was enacted in 2009, 128 bridge structures were rated "poor." CDOT Staff Bridge currently updates the poor list twice a year and since program inception an additional 223 structures have been rated as "poor".

2. Background

a. STRUCTURE LOCATION

Structure F-13-S_Minor is located under I-70 at milemarker (MM) 211, approximately 2.6 miles west of the Eisenhower-Johnson Memorial Tunnel, in Summit County, Colorado. The structure crosses under I-70 and is used as a turn-around location for CDOT maintenance and emergency vehicles. The exit also provides access to a maintenance road that leads down to Straight Creek. The structure slopes from north to south at a7.2% grade. I-70, above the structure, slopes downward from east to west at a 6% along the westbound (WB) lanes and 7.5% along the eastbound (EB) lanes. This structure is also located near the site of a future recommended wildlife undercrossings (MM 208.5 and 212.2), as noted in the ALIVE Memorandum of Understanding (MOU) Agreement (see Section 4, for additional information).

b. STRUCTURE HISTORY

The existing structure is a 14-foot high, 20-foot wide single-cell concrete box culvert (CBC) originally constructed in 1966. In 1971, it was extended from the original length of 164 feet to 194 feet to accommodate I-70 construction (landslide shifted alignment south). The CBC has a skew angle of 0° 55' 0", relative to the I-70 alignment. During construction of the extension, a concrete collar was added to a 19-foot section of the CBC, to account for additional fill. There are two flared wingwalls located at each end of the CBC but there is no available as-built information of the wingwalls, only the box structure. Based on survey data, the wingwalls are approximately 18 feet to 19 feet long and are set at a 45 degree angle measured from the centerline of the walls. Fill heights vary from 6 feet to 18 feet along the length of the CBC. The bottom slab is partially covered with an asphalt wearing surface. Both southern wingwalls have displaced from the headwall approximately 4 inches. The northwest wingwall has not moved, but has a large diagonal crack towards the end of the wall that has been repaired. The northeast wingwall has displaced away from the headwall approximately 4 inches and has a significant diagonal crack (3/16 inch) that starts midway at the top of the wall and propagates to the culvert wall. More information can be found in the structure inspection reports included in Appendix C.

c. Existing Structure Evaluation and Deficiencies

The National Bridge Inventory (NBI) Coding Guide was used to evaluate the structural components. Structure F-13-S_Minor is listed as structurally deficient (SD) due to the condition of the top slab and walls. CDOT Staff Bridge conducted an inspection in April 2017 which was followed by another detailed inspection performed by Region 3 on July 24, 2017. The follow-up inspection and the *Sufficiency Rating Investigation and Inspection* report confirmed this condition. Highlights of these investigative efforts are summarized below:

- Structure Inspection and Inventory Report (SIA) includes a coding of 4 (poor) for Item 62 (Culvert).
- A load rating analysis found that the dead load alone exceeded the capacity of the structure. Failure occurred once fill reached or exceeded approximately 12 feet. The maximum existing fill on the structure is approximately 18 feet. Both headwalls are severely damaged with exposed rebar and several large shear cracks exist on both walls of the CBC.
- The top slab has several large, full-width cracks with large areas of delamination.
- Insufficient vertical clearance of the existing structure is evident by the scrape marks on the roof from apparent vehicular impact. Compounding the issue of vertical clearance, ice builds up in the structure during the winter which further reduces the vertical clearance. The ice also presents a sliding hazard for vehicles approaching the structure from the north.
- Prior to the revised SIA report that listed the structure as structurally deficient, it was deemed functionally obsolete (FO) for insufficient vertical clearance.

The project team, with CDOT concurrence, has determined that rehabilitation isn't feasible due to the severity of the structural deficiencies; a post-rehabilitation life expectancy of less than thirty years; and insufficient vertical clearance. Therefore, only structure replacement options are considered and a Life Cycle Cost Analysis (LCCA) considering rehabilitation alternatives is not required. Refer to Appendix C for the as-built plans, structure extension plans, the April 2017 Structure Inspection Report (SIA), and the July 2017 Structure Inspection and Sufficiency Rating Investigation Report.

3. Replacement Alternative Considerations

The following project site constraints were considered during the development of the structure replacement alternatives.

a. Structure Opening

The existing structure is a 20-foot wide by 14-foot tall concrete box culvert (CBC). There is an asphalt wearing surface over the bottom slab that reduces vertical clearance. During cold weather, ice builds up on the bottom of the structure that further reduces the vertical clearance. CDOT maintenance personnel have reported inadequate vertical clearance when their vehicles scrape the top slab of the box. This was verified during our visual inspection on October 10, 2018.

The existing structure width (span) of 20 feet only allows one-way traffic in the CBC. A turning radius analysis revealed that the existing span appears to be inadequate for two-way traffic. During the initial investigations and discussions with CDOT Region 3, CDOT Maintenance, and the Summit County Fire Department, the project team agreed that a wider opening is required to facilitate access, provide additional horizontal clearance within the structure, and promote pedestrian safety during structure inspections. Additionally, access into the north CBC entrance becomes problematic in the winter months due to icy conditions and profile grade of the access approach road. This winter access road condition may result in the

inability of a maintenance vehicle to navigate safely through the structure without hitting the structure walls. This has been confirmed upon inspection of the structure where it is evident vehicles have slid into the northwest wingwall.

The project team reviewed the existing inspection reports and as-built plans, developed project criteria, and met with CDOT and BE to confirm proposed structure opening requirements. The following table summarizes the information used to determine the structure opening.

Publication	Vertical Clearance	Structure Width
CDOT Bridge Design Manual (BDM)	15 feet for low speed and low volume under-crossings. Includes 6 inches for future overlay (Section 2.2.2) with CDOT Staff Bridge approval	Conforms to AASHTO
FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges	>16.5 feet = "Excellent" Rating 16.5 feet = "Very Good" Rating 15.5 to 16.5 feet = "Good" Rating	Required Clear Span: > 48 feet = "Excellent" Rating 48 feet = "Very Good" Rating 46 feet = "Good" Rating
AASHTO LRFD Road Tunnel Design and Construction Specifications	Minimum vertical clearance for tunnels shall be 16 feet, unless otherwise specified by owner. (Section 2.7.1)	Shall not encroach on vehicle dynamic envelope. Shall be equal to or larger than approach roadway plus 2 feet.
AASHTO Green Book	16 feet for highways and 14 feet for other roads and streets. (Chapters 8 and 4; respectively)	30 feet minimum 44 feet desirable (Section 4.16.4)
FHWA – Technical Manual for Design of Construction of Road Tunnels	14 feet to 16 feet (Section 2.3)	References Green book. Shall not encroach on vehicle dynamic envelope.

Table 1 - Structure Opening References

In addition to these references, the project team met with CDOT and BE on December 19, 2018 to review this criterion and its applicability for this project site. During these discussions, the need for two-way traffic was revealed. Based on conversations with CDOT Maintenance, safety concerns related to head to head plow truck conflicts exist. There have been multiple instances where a plow truck enters the structure and moments later another truck enters in the other direction. As a result, the truck entering last has to back up without sight distance. During icy and dark conditions, trucks have hit the structure. Two-way access would also allow for traffic to bypass a disabled vehicle in the structure. In addition, two-way access allows for I-70 traffic turn-around during EJMT closure while maintaining emergency/maintenance vehicle access in the opposite direction. Therefore, it was determined that the new structure width will need to accommodate two-way traffic and account for head-to-head turning movement of the design vehicle (see Section 5g, Access Road Turning Templates for more information). The clear span within the proposed structure was set to 36 feet which includes two 12-foot lanes, two 4-foot shoulders and two 2-foot barriers. While not a requirement, the curb-to-curb width of 32 feet meets the minimum opening for an animal crossing, per the CDOT BDM (Chapter 12.5) and is close to the minimum opening width of 40 feet as prescribed by Colorado Parks and Wildlife (CPW). It should be noted that the 32-foot curb-to-curb width will result in a "poor" rating (Code 4) for lateral underclearance (SIA Item 69b). However, the functional use as a maintenance roadway instead of a

public roadway does not warrant the additional costs to provide the required shoulder widths of a public roadway (11.2 feet) to achieve a "good" rating. Therefore, the project team determined that the lateral underclearance rating should not dictate the structure width.

The minimum vertical clearance will be based on the requirements outlined in FHWA's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. BE indicated that an "excellent" rating (Code 9) is desired. To achieve an "excellent" rating (Code 9), the vertical clearance must exceed 16.5 feet. A vertical clearance of 16.5 feet would give SIA Item 63 a "very good" rating (Code 8). However, a rating of "good" (Code 7) is acceptable to BE if there is a justification for a variance from the CDOT BDM, which results in a 15.5-foot minimum vertical clearance. The vertical clearance of the structure will vary depending on the structure type; however, it will be optimized while still maintaining the required fill heights. All structure types explored in this report (other than tunneling method alternatives) will result in a vertical clearance over 16.5 feet.

Increasing the vertical clearance will help alleviate the clearance reduction caused by ice buildup, but it will not address the root cause. Mitigating measures should be considered in future design phases to address the ice buildup in the existing structure. These measures include trenching water before it reaches the structure or adding a side ditch in the structure to prevent water from flowing and freezing in travel areas.

b. Minimum Fill

Fill height on the existing structure varies from 6 feet to 18 feet along the length of the structure transverse to I-70. The fill height varies from 11 feet to 18 feet for the portion of the CBC underneath the I-70 mainline pavement. The as-built plans specify the structure was designed for 5 feet of fill both at the ends and within the median area and 12 feet of fill for the portions under the roadway. In order to set the roadway elevation in the proposed CBC, a minimum cover must be determined that considers the following seasonal factors:

- Bridges freeze before the approach roadway in spring and fall when the temperature approaches freezing. Placing a depth of fill, equal to or greater than the minimum asphalt and base course required, will mitigate this concern.
- Differential frost heave can affect the asphalt pavement over the structure and result in additional loading on the structure. Providing select backfill will mitigate this issue.

Based upon the results of our project site findings, discussions with CDOT staff, and reference manual information, the project team recommends a minimum fill height of 4 feet for portions underneath the roadway. This exceeds the frost depths prescribed by Summit County. There may be additional fill height requirements to satisfy constructability and design requirements for structure alternatives with tunneling construction methods.

c. Structure Location and Maintaining Access during Construction

Two alignment alternatives were explored for the replacement option. The first alternative uses the existing CBC alignment. This location minimizes construction cost since a significant amount of the excavation is occupied by the existing CBC. However, maintenance and emergency vehicles will need to use an alternate route during construction.

The second alternative proposes a 40-foot shift west of the existing alignment. The 40-foot shift was chosen to minimize impacts to the existing structure. The existing CBC would be abandoned and backfilled with

flow-fill and/or other embankment material. The cost for abandoning the existing structure, filling the void, and closing access ranges between $100k and $200k. Shifting the alignment westward requires steepening the approach ramps and modifying several of the drainage features if the existing invert elevations of the structure are maintained. CDOT provided a maximum allowable grade for the approaches of 7% to minimize safety risk. If the invert elevations are raised to match adjacent grades, the amount of fill over the structure will be reduced and the potential to provide acceptable vertical clearance may be compromised. An eastward shift of the structure was not explored due to the proximity to the landslide area (Slide 1) just east of the existing structure. See Section 4b, Geohazard – Straight Creek Landslide Report (1971) for more information. Maintaining traffic on I-70 and providing an alternate route for the existing CBC users is of the utmost importance. CDOT has confirmed that the existing CBC can be closed during construction and that maintenance and emergency vehicles can use the Eisenhower Tunnel West Portal Loop Road. Additionally, construction activities must allow full access to the Straight Creek Access Road which is located on the south end of the existing CBC. Both alignment alternatives will impact I-70 traffic and efficient construction methods and phasing are paramount.

The first alignment alternative using the existing CBC alignment is preferred since CDOT is permitting the existing CBC to be closed during construction, maintenance and emergency vehicles would be redirected to the West Portal Loop Road. In addition, this alternative minimizes excavation, avoids significant regrading of the approach ramps, and minimizes impacts to drainage features.

d. Bridge Service Life

The BE document *Strategies for Enhancing Bridge Service Life*, provides strategies for extending the service life of structures from the standard 75 years to 100 years and also provides guidance for choosing which structures are candidates for a longer service life. The intent of the document is to identify structures that have a low probability for being widened due to traffic demand and location. This will avoid "throwaway" costs associated with the higher up-front costs associated with a longer service life.

According to the flow chart provided in the aforementioned BE document, Structure F-13-S_Minor has a Tier 1 designation based on criteria including proximity to population, average daily traffic (ADT) and geographic location. The current and future (2038) ADT along I-70 are 36,000 and 45,830 vehicles, respectively. However the project team, along with CDOT and BE, concluded that the structure is a strong candidate for a 100-year design life. I-70 was built as a 4-lane with 2-acceleration/deceleration lanes, then later re-striped to a 6-lane without acceleration/deceleration lanes in 1972. While there are currently no plans to widen it in the future, there is room in the median if it were ever required. Furthermore, any rehabilitation efforts would be costly and have significant impacts to traffic on I-70. For these reasons, the project team believes Tier 3 strategies are warranted and a 100-year design life is recommended.

e. Durability/Maintenance

Structure replacement alternatives will need to satisfy the above bridge service life requirements with structure components that are durable and minimize future maintenance of the structure. As part of these requirements the project team will consider the following in the development of the replacement alternatives:

- Precast Components: These elements are fabricated under controlled environments which add durability when compared to cast-in-place concrete structures.
- Concrete Mix Designs: Mix designs for cast-in-place concrete structures may incorporate higher air-entrainment or use additives/inhibitors to increase durability and reduce long-term maintenance. The

project team will also consider the current concentration levels of sulfate and chlorides as the mix design is finalized.

- Waterproofing: A waterproofing membrane and/or spray-applied materials will help to eliminate/minimize moisture penetration of the newly constructed structure. The use of water-stops and local injection of sealants can also help to reduce damage.
- Drainage: The design must provide adequate provisions for drainage behind the new structure. The use of perforated sheet drains, properly sized weep-holes, and granular backfill will nearly eliminate any hydrostatic pressure on the structure and provide a path for moisture to exit.

4. Stakeholder and Local Agency Coordination

a. Summit County

Structure F-13-S_Minor is located in eastern Summit County. Nearly 80% of the County's land is comprised of the White River National Forest. The population density is approximately 39 people per square mile.

b. Existing Studies

I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS)

The *I-70 Mountain Corridor Programmatic Environmental Impact Statement (PEIS)* provides background on CDOT's collaboration with stakeholders as well as provides recommendations for transportation solutions along the I-70 Mountain Corridor. The I-70 mountain corridor includes the 144 miles between Denver and Glenwood Springs. The purpose of the PEIS is to increase capacity, improve accessibility and mobility, and decrease congestion along the I-70 corridor while accommodating environmental sensitivity, community values, and transportation safety. The site of Structure F-13-S_Minor is located within the corridor.

A Landscape Level Inventory of Valued Ecosystem Components (ALIVE)

The ALIVE (A Landscape Level Inventory of Valued Ecosystem Components) Committee is composed of the United States Fish and Wildlife Service (USFWS), United States Forest Service (USFS), Colorado Parks and Wildlife (CPW), Bureau of Land Management (BLM), CDOT, Federal Highway Administration (FHWA), and county, city, and local representatives. In April 2008, these agencies executed a Memorandum of Understanding (MOU) to recognize the responsibilities pertaining to the I-70 Mountain Corridor Tier I PEIS and Tier II NEPA (National Environmental Policy Act) documentation. As part of this MOU, these agencies examined habitat connectivity and animal-vehicle collisions along the I-70 corridor and identified 13 areas where the I-70 mountain corridor interferes with wildlife migration (referred to as wildlife linkage interference zones). The existing structure falls within Zone 9B of this study area (See Table 1, Linkage Interference Zones and Recommended Mitigation of the MOU). More information can also be found in Appendix D.

Stream and Wetland Ecological Enhancement Program (SWEEP)

The Stream and Wetland Ecological Enhancement Program (SWEEP) Committee was formed to identify and address environmental issues related to wetlands, streams, aquatic species, and fisheries in the I-70 Mountain Corridor. The SWEEP Committee included representatives from federal and state agencies, watershed associations, Clear Creek County, and special interest groups.

Sediment Control Action Plan (SCAP) for Black Gore Creek and Straight Creek

The *Sediment Control Action Plan (SCAP) for Black Gore Creek and Straight Creek (CDOT, 2002)* includes mitigation strategies for Straight Creek which is listed as an impaired water under the Clean Water Act. Additional information is included in the *I-70 Mountain Corridor PEIS Water Resources Technical Report (CDOT, March 2011).*

Geohazard – Straight Creek Landslide Report (1971)

Based on information presented in the *Report of Geological Investigations and Recommendations on the Straight Creek Landslide*, *(Robert K Barrett and Dale M. Cochran, December 1971)*, initial construction of I-70 triggered multiple landslides on the north side of the I-70 following slope cutting operations between approximately MM 210 and MM 212. The landslides were originally identified as Slides 1 through 4 and Slides A and B. Slide 1 (1969 State Highway NO. 70, Plan Set Sta. No.290 to 302) was identified just to the east of the location where Structure F-13-S_Minor was constructed. Slide 1 was investigated and mitigated with some extent of excavation/slope regrading, and installation of rubber membrane-lined ditches, cut ditches, and subsurface drain pipes to reduce the hydrostatic pore pressure buildup within the existing colluvium and decomposed bedrock material.

The western edge of the active portion of Slide 1 appears to be approximately 160 feet east of the existing structure F_13_S_Minor (See the Existing Conditions Plan, Appendix B). Based on recent discussions with CDOT Region 3 Maintenance personnel, the landslide appears to be encroaching upon the outside shoulder and cut-ditch area along WB I-70 at an approximate rate of 3 inches to 6 inches per year. This active zone of the Slide 1 area is not expected to impact the replacement of the existing CBC, provided that excavation operations do not extend eastward into the western (lateral) edge of the landslide mass.

As discussed in the *1971 Straight Creek Landslide Report*, excavation within the toe (and in the case of the proposed culvert replacement, **excavation into the western/lateral edge) of the active landslide is not recommended.**

Based on information provided in the *1971 Straight Creek Landslide Report,* a zone of disturbed bedrock between the surface and a depth of 32 feet to 65 feet may be the focus of much of the landslide movement. Historical movement observed in the fractured and altered bedrock is related to periods of high groundwater. The intention of the project team is to totally avoid the landslide area; however, depending on the scope of any planned excavation, the western/lateral edge of deep-seated movement in these materials may encroach upon the proposed structure project limits. This will need to verified and addressed at final design, refer to the *Straight Creek Landslide Report (1971)* for additional information.

It is recommended that monitoring the landslide through visual inspection by qualified personnel or survey of bench marks be performed during construction. Installation of slope inclinometer instrumentation in advance of construction can indicate whether there is a component of the landslide movement toward the existing CBC. Region 3 ROW and Survey section is in the process of adding a Drone Lidar unit, it may be a useful tool for sequential photos of possible landslide movements.

Exposed bedrock outcrops on the cut slope north of the existing CBC appear to be stable; however, numerous boulders and rocks were noted within the ditch area. The catchment ditch area should be maintained during construction operations or the placement of temporary concrete barriers should be considered to help protect construction personnel from rockfall.

Maintaining proper drainage on the cut slope and fill slope areas of the project is recommended. Erosion of the south fill slope was noted southeast of the existing southern end of the turnout area, resulting in near

vertical slope sections. These vertical slope sections pose a risk to losing additional slope edge material as the slope reposes to its stable slope angle.

Sufficiency Rating Investigation and Inspection (2017)

CDOT Region 3 recently completed a sufficiency rating and follow-up inspection on the structure to confirm results identified in the April 2017 bi-annual inspection report. The on-site inspection efforts by CDOT identified additional deterioration above what was noted in the report. As a result, several of the SIA component scores were lowered resulting in a lower sufficiency rating than previously recorded. Refer to Appendix C for additional information.

c. FHWA

As part of the project design coordination requirements, CDOT contacted the Federal Highway Administration (FHWA) to discuss the project's applicability with the FHWA Interstate Access Policy Guide. The discussions resulted in the following conclusions:

- Upon review of the policy guide, this project best aligns with the "Locked Gate" access point criteria. The proposed structure replacement is not expected to become a publicly accessible structure.
- Since the structure provides access to the interstate, there will be FHWA involvement.

5. Critical Issues and Recommendations

a. Design Criteria

Project solutions and structure replacement alternatives will be developed in accordance with the following design specifications:

- AASHTO LRFD Bridge Design Specifications
- AASHTO and CDOT Roadside Design Guidelines
- CDOT Bridge Design Manual (BDM)

A more detailed design criteria document utilizing CDOT Form 463, Design Data, will be completed in subsequent design phases of this replacement project. Design data on Form 463 includes, but is not limited to, highway classification, traffic volumes, geometric standards, project characteristics, right-of-way (ROW) issues, major structures, and utilities. Form 463 summarizes many of the assumptions presented in the following sections. Project details should be added and/or verified as the concept design is advanced through the CDOT project development process.

b. Geotechnical

In September 2018, RockSol Consulting Group, Inc. completed three soil/bedrock borings on the west side of the existing structures. Borings B-1, B-2 and B-3 were completed near the south end, median and north end, respectively. The borings were advanced using ODEX (down-the-hole hammer/casing advance) drilling methods, supplemented with split-spoon sampling typically at 5-foot to 10-foot intervals. Bedrock was cored at Boring B-3.

Considering that the surface grade varies by 30 feet between the three boring locations, the general subsurface profile consists of loose to extremely dense, silty to gravelly fill sand with cobble- to boulder-sized rock fragments from existing grade to a depth of 11 feet to 25 feet, followed by native, medium dense to extremely

dense, silty, clayey and gravelly sand with cobbles and boulders to the maximum depth of exploration in B-1 (75 feet) and B-2 (50.5 feet). Gneiss bedrock was encountered at 33 feet in B-3. Indications of groundwater were identified at 57 feet below grade in B-1, and 34 feet below grade in B-3.

RockSol's foundation type recommendations include shallow spread footings and drilled shafts. Driven piles are not recommended due to the presence of boulders in the overburden material. A factored bearing resistance (Load and Resistance Factor Design (LRFD) method) of 11 kips per square foot (ksf) is provided for spread footings. A minimum drilled shaft depth is 30 feet below the structure invert. A design value for end-bearing of drilled shafts was not provided due to the variable depth to bedrock. Side resistance values, reduction factors, and lateral resistance parameters for drilled shafts are provided in the RockSol Report included in Appendix F.

The conclusions of this report and additional discussions on the geohazard conditions along the I-70 Corridor were discussed with CDOT Staff Materials on October 23, 2018. Note a supplemental investigation will be required to provide soil design parameters and recommendations for the I-70 median wall as discussed in Section G. Roadway Characteristics and Traffic, I-70 Shoulder Improvements. See Appendix G, Correspondence for additional information.

c. Survey Data Research/Right-Of-Way

The project team met with CDOT Region 3, via phone conference, on August 15, 2018 to discuss the upcoming survey, right-of-way, and utility investigation requirements. Highlights of this meeting and our team's onsite survey efforts included the following:

- All existing right-of-way (ROW) is within an existing highway deed through the U.S. Forest Service (USFS) and therefore, no ROW issues are anticipated.
- Existing project control proved difficult to confirm. Additional efforts by the team were required to re-establish project control.

Refer to Appendix G for the Pre-Survey Conference – Preliminary Survey Form for additional information.

As part of the sediment control projects for Straight Creek, CDOT obtained a Special Use Permit from USFS. This permit allows CDOT access across the existing A-Line and onto the Straight Creek Frontage Road. This road provides access to the CDOT maintained sediment ponds leading to the West Portal Loop Road.

d. Utility Survey and Identification

Surface Utility Engineering (SUE) investigations must be conducted in accordance with CDOT's recent 811 Summary (SB 18-167) which requires location of underground utilities that meets or exceeds Quality Level B. However, during the aforementioned phone conference on August 15, 2018, the project team and CDOT agreed that Quality Level D is adequate for the purpose of this report.

Table 2 below lists utility type, utility owners, contact information, and location of each utility within the project vicinity. All utility owners shall be contacted to confirm their utility, type, location, special requirements and/or considerations, easements, and any planned improvements.

Utility	Utility Owner	Contact	Number	Location
Fiber Optic	Century Link	Kirk Clap (Engineering representative for Summit County)	970-328-8257	Underground runs parallel south of EB I-70
Fiber Optic	CDOT	Jill Scott Marc Travis	303-512-5805 970-683-7534	Underground runs parallel north of WB I-70. Shares duct with Comcast fiber Optic.
Fiber Optic	Comcast	Blake Nelson	303-603-0959	Underground runs parallel north of WB I-70. Shares duct with CDOT fiber optic.
Electric	Xcel Energy	Esther Mainline	303-716-2037 800-895-4999	Underground runs parallel north of WB I-70

Table 2 - Utility Coordination List

An underground fiber optic, owned by Century Link, runs parallel to I-70 on the south side of the EB lanes. An underground fiber optic and electric line runs parallel to I-70 on the north side of the WB lanes. CDOT shares the fiber optic conduit with Comcast and Xcel Energy owns the electric line. These utilities must be protected in place during construction. No conduits are anticipated to be incorporated into the proposed structure.

In 2017, the fiber optic line, running parallel to the I-70 WB lanes was replaced, including the section at the project site. Plans for this replacement (CDOT Project Number ITS SW01-527) do not show the electric line or the fiber optic line south of the I-70 EB lanes. Potholing will be required to verify location and depth of utilities. Potholing will be deferred until the next design phase.

e. Environmental Overview

The project team performed a desktop environmental review of the study area for the proposed project. Overall, very few, if any resources are anticipated to be impacted by construction. Given the low probability for impacts to environmental resources, it is expected that the project will be cleared with a Categorical Exclusion (CatEx). Supporting documentation for some resources, such as cultural and paleontological resources; hazardous materials; threatened and endangered species; migratory birds; vegetation (including riparian) and noxious weeds; water resources and quality; and wetlands and waters of the U.S. may be required. In addition, coordination with resource agencies (CPW, USFS, USFWS) as well as ALIVE and SWEEP should occur during the NEPA process. The project team will also need to coordinate with USFS to ensure that access to Straight Creek is maintained throughout construction. Details can be found in Appendix D.

f. Hydraulic Overview

The project team performed a site investigation on September 21, 2018 to confirm the drainage conditions and existing drainage features of the project site. United States Geological Survey (USGS) contours, along with the site investigation, confirmed the approximate drainage basin delineation.

Tributary Flows:

A 50-year recurrence interval was chosen for analysis, per CDOT's Drainage Design Manual for flows that directly enter a major storm system. Preliminary flows for the 100-year event were calculated using the TR-55 method developed by the Natural Resources Conservation Service (NRCS).

The results of the 100-year TR-55 methodology were in relative agreement with the results provided by StreamStats' TR-55 based analysis; however, the results of StreamStats' regression equation based analysis are significantly different than the TR-55 based analysis completed by the project team. It is recommended that future evaluation efforts and final design efforts evaluate the 50-year criteria based on the unique setting of the structure and the ramifications resulting from experiencing an event greater that the 50-year event. The structure's elevation, snow melt hydrology, land slide conditions, observed sediment and debris loading, and snow storage requirements may warrant a design recurrence interval greater than the 50-year event.

Roadway flows were not analyzed as part of this report because they are considered minor in comparison to the off-site tributary area and will be passed through the existing drainage features prior to arrival of the off-site flows. See Appendix E for basin delineation. Off-site flows discharging to the project area were estimated and are presented in Table 4. Basin 1 is the area estimated to discharge directly to the project area, and Basin 2 is the area discharging to the upstream (east) of the project that could be conveyed to the project area if the inlet responsible for capturing this discharge were clogged or blocked by snow. The drainage area of 165 acre and associated peak flow Q(50) of 15 cubic feet per second (cfs), provided by the as-builts, could not be duplicated with available data.

Basin	50-YR Peak FLOW (cfs)	100-YR Peak FLOW (cfs)
1	16.4	18.1
2	4.6	5.1

Table 3 – Estimated Off-Site Tributary Flows

I-70 Concrete Box Culvert (CBC) Drainage:

As previously described, the existing CBC is primarily used as turnaround passage for emergency, maintenance, and snow plow vehicles, not as a drainage passage. Flows are captured prior to reaching the culvert through a storm drainage system located along the shoulder of I-70. However, the CBC likely conveys flows during the spring runoff when the adjacent storm water infrastructure is covered with snow and during severe rainfall events when the adjacent storm water infrastructure is at capacity or impacted by debris and/or sediment.

I-70 Westbound Lanes Drainage:

The I-70 WB lanes are superelevated directing flow from the left lane toward the right lane. Flows traverse to an existing natural swale located between the shoulder and the toe of the slope. Four groundwater relief drains were installed into the side slope located east of the CBC along the WB lanes. Seepage collected and conveyed by these pipes along with additional seepage at the base of the toe produce constant flow in the existing roadside ditch running parallel to the WB shoulder. Flow continues to the west into an existing modified Type D inlet located north of the CBC. Record information drawings indicate that there are three Type D (Special) inlets in series for sediment and flow collection just upstream of the Type D inlet. The downstream inlet has an orifice plate that regulates flows collected by the three upstream inlets. After passing through the orifice plate, flows are then are conveyed to an additional Type D line that conveys flows under I-70 through a 48-inch corrugated metal pipe (CMP) and outfalls on the EB side slope, directly into Straight Creek. The I-70 as-built plans revealed that the existing 48-inch CMP was lined with a 36-inch HDPE (High density poly-ethylene) with annular grout, beneath I-70 and the south end of the existing outfall was

reconstructed with a 48-inch diameter plastic pipe rundown and grouted riprap outlet protection. The existing pipe beneath I-70 is considered to have a conveyance capacity equal to a 36-inch pipe.

Only the tops of the three Type D (Special) inlets were identified during a site visit but, as-builts and survey data indicate that the inlet rims are approximately 2 feet below the existing sediment level. Therefore, a natural swale has formed directly over the three Type D (Special) inlets and passes flow directly to the last Type D inlet, thereby indicating that the covered inlets are at maximum sediment capacity. **A bypass through the structure will be needed for maintenance.**

I-70 Eastbound Lanes Drainage:

The I-70 EB lanes are also superelevated. Roadway runoff is collected in the grass median and a concrete swale located in the shoulder. Flow collected in the median is conveyed along I-70 to inlets located in the median. Flows east of the CBC that are collected along the shoulder flow west toward a trench drain connected to a Type 13 inlet and outfalls into a sediment basin located just east of the southeast wingwall. This existing sediment pond appears to be somewhat undersized; however, routine sediment removal appears to be occurring and the system appears to be functioning as intended. Flows discharged by the sediment pond are directed to Straight Creek.

A small area of flow is collected in a Type C inlet located near the southwest wingwall and outfalls on the EB side slope, directly into Straight Creek.

Existing Drainage System Capacity:

Based on the observations made during the site visit and subsequent off-site hydrologic investigation, the existing drainage system appears to have sufficient storage and capacity to handle the 50-year event when the system is properly maintained, primarily through the removal of sediment build-up. Snow storage activities within the area could impact drainage system performance; however, bypass of flows from the project site is unlikely given the roadway grades and local topography. Construction of the median wall will impact the median drainage and will need to be addressed at final design. No other construction impacts are anticipated.

g. ROADWAY CHARACTERISTICS AND TRAFFIC

I-70 through the project area is on the National Highway System and falls under the access control classification of Interstate System; Freeway Facility (F-W). The functional classification of I-70 is an Interstate with a 2017 ADT of 36,000 vehicles per day. It is a two-way, divided highway through mountainous terrain with a posted speed of 60 miles per hour. The WB direction has a 35 miles per hour speed limit for vehicles over 26,000 pounds gross vehicle weight rating (GVWR) due to the steep grades. The existing roadway typical section has three 12-foot lanes with varying shoulder widths. At the structure location, EB I-70 has approximately a 4-foot inside shoulder and a 10-foot outside shoulder while WB I-70 has approximately a 4-foot inside shoulder and an 8-foot outside shoulder. Guardrail is present on the outside shoulder in the EB and WB direction and concrete barrier and guardrail is present in the median through the project area. The median widens from 0 feet at locations with concrete barrier to approximately 40 feet at the structure location. The elevation difference between EB and WB I-70 at the structure location is approximately 10 feet.

The only access points in the project area are the emergency pull outs and the ingress/egress to the existing CBC. The sight distance for the WB ingress to the structure from the highway is limited due to the roadway curvature and restricted shoulder widths. Widening the WB shoulder to increase sight distance and realigning

I-70 WB will improve safety. Shoulder widening would also provide construction phasing benefits helping to minimize traffic impacts during construction. See below for more detailed discussion.

I-70 Corridor Safety Assessment

Within the last 12 years, CDOT has conducted two safety assessment reports within the project area. A September 2006 report was part of a resurfacing project from MM 202 to MM 213, and an October 2012 report was part of another resurfacing project. The October 2012 report studied the EB I-70 uphill truck lane from MM 203.9 to MM 213.5. A summary of conclusions and recommendations from the two reports are as follows:

- The September 2006 report states that based on both accident rate review and safety performance function analysis, the total accident frequency on this segment of I-70 is higher than the average of other similar highways throughout the State. Accident severity (the frequency of injury or fatal accidents), in contrast, is average to slightly lower than average. The elevated total accident frequency is due to the higher numbers of less severe property damage crashes. The primary contributing factors in crash occurrence along the project segment (MM 202 to MM 213) are the adverse weather and road conditions associated with the mountainous location and high traffic volume during the winter.
- Update and/or repair guardrail and median barrier, utilize durable pavement marking material, and keep the shoulder areas in good condition.
- The October 2012 report notes that the incidence of crashes on this segment of EB I-70 is primarily related to driver error, adverse winter weather and road surface conditions, and periodic congestion. In general, crash frequency is not unexpectedly high and there are few crash types that were over-represented for this type of facility.

Access Road Turning Templates

Several vehicles were evaluated to determine if the new structure and location will accommodate the turning paths of these vehicles. Initially, the project team identified the CDOT snow plow and Summit County ladder truck for the turning template analysis; however, follow-up discussions with CDOT confirmed that the CDOT snow plow and a WB-50 design vehicle would be used to determine structure location and sizing. As part of this effort, the project team looked at realigning a portion of the I-70 WB alignment to increase the WB shoulder width and reduce the exiting vehicle design speeds so that the vehicles could safely exit onto the WB ingress road without impacting WB traffic. It is important to note that this realignment is also required for the proposed phasing approach, and can be a permanent solution to accommodate the increased shoulder widths and increase safety on mainline I-70. As shown in Figures 2 through 5, both the snow plow and the WB-50 design vehicle can successfully make turns from both WB and EB I-70 into the structure.

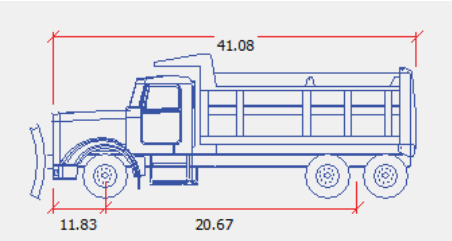


Figure 2 - CDOT Snow Plow Vehicle Data

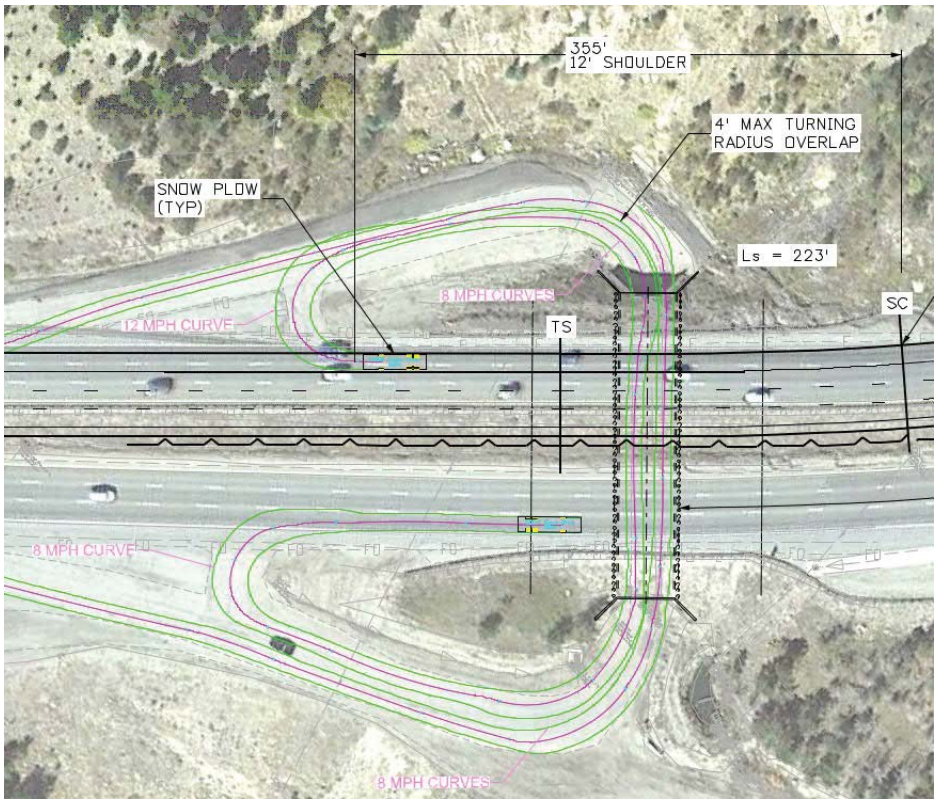


Figure 3 - CDOT Snow Plow Turn Template

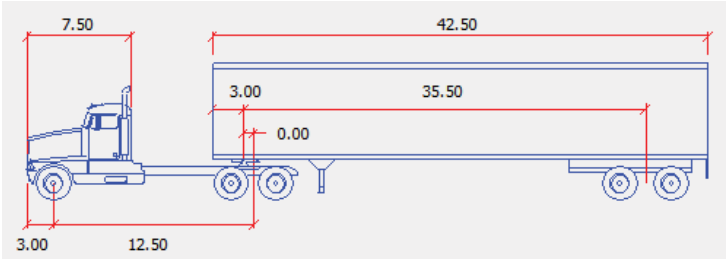


Figure 4 - WB-50 Vehicle Data

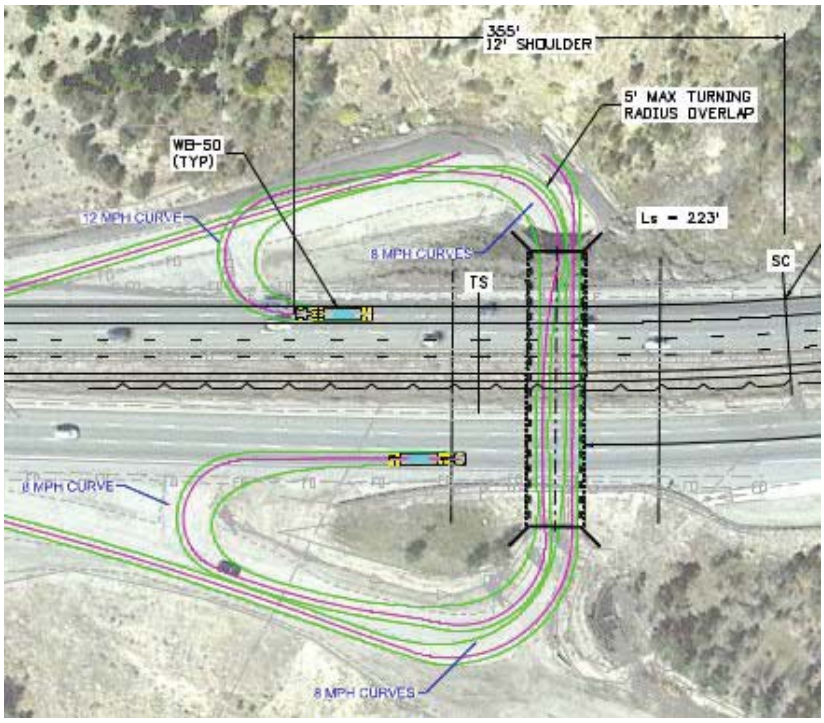


Figure 5 - WB-50 Turn Template

I-70 Shoulder Improvements

As previously mentioned the WB I-70 shoulder should be widened to increase sight distance and better accommodate the turning movements for design vehicles entering the proposed structure. After discussions with CDOT and review of I-70 as-built data, the project team developed conceptual I-70 alignment alternatives to determine the feasibility and approximate length of impact along I-70 WB. This design increases the WB shoulder widths allowing design vehicles to use a 12-foot shoulder to turn from I-70 into the proposed structure. A summary of the project team's approach and the initial design results are summarized below and shown in Figure 6.

- Consider the WB exit only since this location has the most design challenges such as limited sight distance reduced shoulder widths, and design speed. The design speed should be based on the turning movement of a WB50 from the shoulder that fits within the horizontal project limits.
- Identify the maximum allowable shift of I-70 WB to the south that will not impact the I-70 EB alignment. Incorporate a median wall to maximize the WB shift to the south. The southern edge of the I-70 EB shoulder will remain in its current location. The median wall will also serve to facilitate construction phasing.
- The project team compared the cost, feasibility, and maximum allowable alignment shift of WB I-70 when either using a Type 3 guardrail placed away from the wall or placed on the wall using a moment slab. A maximum shift of 17.5-feet is possible based on the minimum offset for the guardrail from the wall. A 22.5-foot shift can be accommodated using a moment slab however would add significant cost to the project. The 17.5-foot shift of I-70 WB allows a CDOT snow plow to make the turn at 12 MPH and allows a WB50 vehicle to make the turn at 12 MPH with a bit of wheel tracking into the ditch at the bottom of the hill. Since these turning movements and vehicle speeds are reasonable,

using a moment slab to support the guardrail becomes cost prohibitive. Final design should also consider new barrier types.

- Ideally, increasing the existing I-70 WB outside shoulder width from 8 feet to 12 feet is desired at the WB exit access to allow the aforementioned turning movements. It is also desired to minimize the length of I-70 that is widened and therefore, as shown in Figure 6, the project team set the length of the widened shoulder to 355 feet. From that point, the proposed shoulder tapers from 12 feet back to 8 feet at the east project tie-in. If required, the alignment can shift further south but would require a moment slab, as previously mentioned.
- The conceptual design uses a superelevation of 8% which is based on the radius, design speed stated in the as-built plans, and current CDOT design criteria for a 65 MPH design speed. Additional survey data is needed to determine the actual superelevation and future design requirements.
- Some initial tasks and considerations include: (1) confirm the wall limits for which additional survey and advanced design are required, (2) understand how the permanent shift affects the existing median drainage, and (3) validate the design once the roadway vertical and horizontal design is performed.
- An opening width of 36 feet allows head-to-head traffic from both EB and WB directions with minimal overlap for both vehicles.

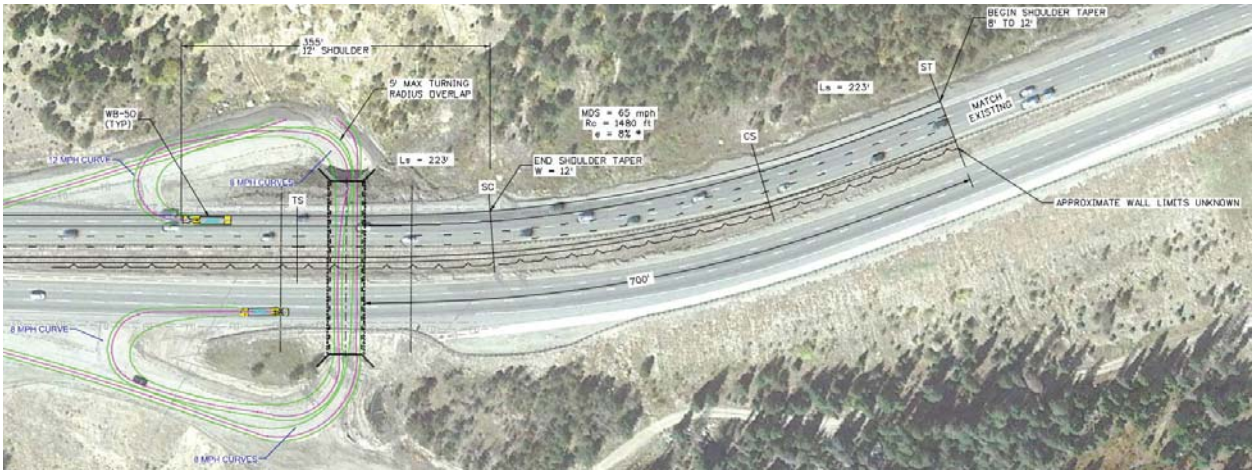


Figure 6 – Westbound I-70 Shoulder Widening Concept

h. STRUCTURE ALTERNATIVES

Structure alternatives will be categorized by two main construction methods; cut and cover construction and construction using tunneling methods. The structure types described below represent alternatives considered to date, but may be expanded during preconstruction design. The advantages and disadvantages described below are intended to be comparisons to the other alternatives included in this report. It is important to note that initially during the conceptual design, the project team considered a maximum clear span of 24 feet which only permitted one-way traffic. The clear span was later changed to 36 feet to allow two-way traffic.

Cut and Cover Alternatives

Three cut and cover alternatives were investigated. Two are buried bridges, one of which uses adjacent, precast, prestressed concrete box (BX) girders and the other uses shallow, precast concrete arches. A precast single-cell concrete box culvert (CBC) was initially explored when the clear span was 24 feet. When the team agreed to increase the clear span to 36 feet, the CBC was not deemed a viable option, see more information in the sections below. All alternatives use permanent drilled shafts as shoring to reduce the limits of excavation and minimize temporary shoring. The drilled shafts can be installed during temporary lane closures, prior to the typical construction phasing discussed in the Section K. Construction Phasing. Temporary lane closures would be required during night and off peak hours. **Due to the proximity of the landslide area east of the structure (Slide 1), it is recommended to not excavate the westbound lanes as it could initiate a landslide.** See shoring plan, in Appendix B, for more information.

More conventional cut and cover methods using excavations with 2:1 slopes and structures supported on CIP shallow foundations were investigated. This option required a massive amount of excavation and concrete for constructing the footings and stem walls. The cut and cover method also required a significant amount more temporary shoring, parallel to I-70. For these reason this option became cost prohibitive and deemed not viable. A cost estimate of the shallow foundation option can be found in Appendix A, Cost Estimates. See Section 5j, Shoring Types, for additional information on shoring.

Buried Bridge - Adjacent Precast Box Girders

Precast, prestressed concrete box girders (BX) are a commonly constructed superstructure type in Colorado and are typically produced in heights varying from approximately 18 inches to 44 inches. As the name suggests, these shallow box sections are placed side by side, eliminating the need for formwork to construct the 5-inch to 6-inch deck topping.

This alternative requires 30-inch diameter drilled shafts spaced at 4 feet on center, supporting a cast-in-place or precast abutment cap, and the BX girders. The initial excavation will extend to the bottom elevation of the abutment caps. After the abutments are set and the BX girders erected, structure backfilling and pavement reconstruction can be completed so that I-70 traffic can be active while the existing structure is removed and remaining excavation is completed. This approach significantly reduces traffic impacts. A shotcrete facing will be placed to cover the drilled shafts and exposed fill underneath the bridge.

Advantages:

- Bridge layout is flexible. Without too much impact to the overall project cost, the vertical clearance and the span can be increased which will accommodate larger design vehicles and better meet animal crossing requirements.
- Reduced impacts to I-70 traffic. The contractor can elect to place superstructure and backfill above the superstructure prior to removing excavation and existing structure below girders. This can reduce impacts to I-70 traffic.

- Using precast elements such as the box girders, abutments, and wingwalls can accelerate construction and reduce traffic impacts.
- This alternative provides the most protection against water intrusion due to having an end diaphragm, a reinforced concrete deck topping, and a waterproofing membrane. However, placing these components is likely to add 2 to 4 weeks to the total construction duration when compared to the precast concrete arch alternative.
- Shallow structure depths will help increase vertical clearance.
- Precast, prestressed concrete girders have a better long-term performance record than cast-in-place structures.

Disadvantages:

- Heavier superstructure resulting in increased substructure and foundation costs.
- This option requires more shoring than precast box culvert (CBC) alternative due to the excavation requirements for the abutment placement, in comparison the CBC alternative has no excavation beyond the limits of the drilled shafts.
- While this method presents opportunities for reducing the duration of I-70 traffic impacts, the overall construction schedule will be longer to accommodate the curing time associated with the concrete deck.

Buried Bridge - Precast Concrete Arch

Precast concrete arch superstructures are common for short- to medium-span structures. For this alternative, the ends of side-by-side arch sections are grouted into place on a small cast-in-place or precast concrete abutment cap supported by deep foundation elements. The concrete arch can be installed quickly and can incorporate precast headwalls and wingwalls to further reduce construction time. Various predetermined and custom sizes are available to accommodate specific project requirements.

This alternative requires 36-inch diameter drilled shafts spaced at 4.5 feet on center and will be constructed similar to the Buried Bridge – Adjacent Precast Box Girder alternative.

Advantages:

- Precast arch segments can be placed quickly and backfilling above the structure can begin immediately upon arch placement (after waterproofing) which results in reduced construction time and traffic impacts.
- Although there are likely fewer construction joints between precast arch segments than the box girder alternative, protection against water intrusion is less reliable because there is only a waterproofing membrane over the arch joints and not a reinforced concrete topping. However, this alternative excludes placing a reinforced concrete topping.
- This alternative is the least impactful to I-70 traffic. Similar to the box girder alternative, the contractor can elect to place the superstructure and backfill above prior to excavation and removing the existing structure below the arch.

Disadvantages:

- Arched segments are not typically constructed along 7% longitudinal slopes. This profile requirement may result in more expensive substructure elements, and may require additional closure pours due to the stepped construction of the arches, which could increase construction time.
- Arch segments create large outward thrust forces which result in larger, more expensive foundation elements.

- The arch depth will exceed the BX girder depth which will result in increased excavation and temporary shoring quantities (depth to abutment elevation increases).
- Most expensive buried bridge superstructure alternative.

Precast Concrete Box Culvert

Precast concrete box culverts (CBCs) are a popular method of construction in Colorado for stream crossings and single-lane roadway crossings. These rectangular sections typically have spans ranging from 4 feet to 20 feet, but a slightly longer 24-foot clear span was initially investigated prior to the clear span changing to 36 feet. **With the new the 36-foot clear span requirement, the team agreed that the CBC alternative is not considered feasible or cost effective and would not be further investigated. The remainder of this alternative discussion is based on a 24-foot clear span.**

For a 24-foot clear span, the project team recommends using two, u-shaped sections fabricated on site and placed one on top of the other. This alternative requires 30-inch diameter drilled shafts spaced at 4 feet on center that are used as permanently placed construction shoring on each side of the CBC. Excavation between the shafts is necessary down to the proposed culvert bottom. The existing structure will be removed prior to setting the new CBC sections. After setting the upper u-shaped section, flow-fill will be placed between the drilled shafts and outside edge of the new CBC. After backfilling and placing the roadway subbase, pavement reconstruction can begin. Due to the simplicity of construction, this alternative will have the shortest construction duration and also present the lowest risk from a safety perspective.

Advantages:

- Contractors are familiar with constructing precast box culverts, which can minimize the construction duration.
- This alternative may have the most construction joints; however, the construction duration is minimized by only having to place a waterproofing membrane rather than a reinforced concrete deck.
- Requires the least amount of excavation and shoring, compared to buried bridge alternatives.

Disadvantages:

- Limited structure sizes due to shipping and construction considerations. Larger spans typically have thicker slabs and walls which reduce the cost effectiveness of the structure. Higher shipping costs (due to weight) increase the total project cost and make this structure type cost prohibitive.
- This option requires full excavation and removal of the existing CBC prior to placing the new structure and backfill which will increase the construction duration and traffic impacts.

Both buried bridge, cut and cover alternatives can be constructed with a proposed invert elevation above the existing invert elevation. By raising the invert 2 feet on the north side and 3 feet on the south side, the access roadway approach slopes would flatten from 6.9% to 5.3 % on the north side of the structure and from 5.38% to 3.5% on the south side of the structure. This configuration would also reduce the slope in the structure from 7.2% to 6.6%. Raising the inverts may result in a smaller vertical clearance than what is shown in Appendix B, Feasibility Study Plans however, it will improve the overall geometry and safety associated with the structure.

Structures Using Tunneling Methods

Structures built using tunneling methods were initially investigated during this conceptual design when the clear span was set at 24 feet. As previously stated, subsequent discussions resulted in setting the clear span to 36 feet to accommodate two-way traffic. There are feasible tunneling methods for a 24-foot clear span at this

location; however, these same methods cannot accommodate a clear span of 36 feet while maintaining the existing invert elevations. Therefore, tunneling methods are not a viable alternative and will not be further investigated. The information below represents the investigation of a 24-foot span and is for information only.

Various methods for constructing the crossing under I-70 were considered, including tunneling and trenchless technology. Typically, tunneling is used for larger-sized passages from 8 feet to 60 feet in diameter and this method generally requires workers in the tunnel operating plant and equipment to construct and support the excavation. Trenchless technology is a general term used for the installation or repair of generally circular conduits underground with minimal excavation from the ground surface. For new construction, trenchless technology includes pipe jacking, micro-tunneling, auger boring, sequential excavation, and horizontal directional drilling.

Several project site constraints were considered during the development of the tunneled alternatives. The existing embankment material consists of uniformly graded, non-plastic material with boulders and cobble throughout the subgrade. This non-cohesive material can be problematic for tunneled alternatives since the stability of the material during excavation and construction can be compromised. Additionally, large bores through boulder and cobbled-filled material can be cost-prohibitive. The proposed 24-foot wide by 15-foot high opening also limits the available tunneled alternatives. With minimum widths identified at 24 feet, trenchless technologies appear to be a more relevant construction methodology for evaluation.

Brief descriptions of the various methods including photographs of typical equipment used for each construction method are provided below.

Box Jacking Method

Box jacking installs prefabricated square or rectangular units normally made of reinforced concrete. Precast box sections are delivered to the jacking site, slid into position, and thrust forward as the face is excavated. The lead box section may have an angled (extended in the crown) short steel shield with overcut. This geometry allows for lubrication and for the lead section to be thrust into the ground to provide some crown support. Generally, the face is unsupported and excavated manually or with small excavators in larger size boxes, to the natural angle of repose for the material.

Advantages:

- Eliminates/minimizes I-70 traffic impacts.

Disadvantages:

- If the material becomes unstable, breasting timbers have to be placed and there is a danger of substantial ground flows and settlement.
- Extensive temporary construction is required at the south end for a reaction wall and hydraulic jacking equipment.
- Box jacking is not a viable option at this time and in this location due to limited expertise in the United States, risk of settlement, the need for supplemental grouting, and there is likely a higher cost.

Arched Tunneling Method.

The presence of the existing structure just under I-70 allows the construction of a new arch structure using the existing CBC. The roof of the existing structure provides temporary support during the segmented structure removal, excavation, and new construction. This approach reduces the risk of settlement, displacement, and even collapse during this critical excavation phase compared to off-alignment tunneling methods.

The following general tasks describe the construction method and sequence of work.

- Drill and grout behind existing walls to stabilize the ground.
- Drill and install micro-piles spaced at 15 feet to 20 feet on center.
- For a width of roughly 4-feet, demolish the existing structure invert/walls and excavate slots at 15 feet to 20 feet on center.
- Construct concrete invert and walls in the 4-foot wide slots and continue throughout the structure.
- Install "FUKO" type grout hoses under the existing roof slab to ensure complete consolidation and contact between the existing structure and the new arch. These grout tubes are used to disperse the grout and close the interface between the existing and new structures. They are also used along wall surfaces that are concreted up against the arch to ensure proper contact and load transfer from the existing structure to the new.
- Install reinforcing steel, formwork, and place concrete for the new arch structure in stages of 30 feet to 40 feet throughout the structure.
- Start over and demolish the existing structure invert/walls between the already constructed slots and continue with a staggered phasing throughout the structure.
- Install "FUKO" type grout hoses against the existing walls.
- Construct the wall sections with a staggered phasing.
- Place contact grout between the existing and new roof slabs and along top of the walls.
- Construct new headwalls and wingwalls at each end.

Advantages:

- Eliminates/minimizes I-70 traffic impacts.
- Proposed construction methods use conventional geotechnical methods for shoring-type infrastructure.
- Constructing the new structure at the same location minimizes excavation quantities and structure costs.
- The existing structure is used as construction support before the excavation phases of the new structure, minimizing the risk of displacement, settlement, and even collapse during the excavation phase.

Disadvantages:

- Proposed arched construction provides only a 22-foot clear width and lowers the existing invert to an elevation approximately 6 feet below the existing structure. Additional excavation depths of about 10 feet are required to provide the 24-foot clear width. This design impacts the functional capacity of the current drainage infrastructure at both ends of the structure.
- The access road approach grades to the structure entrances become slightly steeper (from 7% to 9.5% grade) which could create unsafe driving conditions during inclement weather.
- The grouting and micro-pile works (if necessary) requires specialized contractors.

- The work space is limited and the contractor will need to have some experience in this kind of operation.

Box Tunneling Method.

This method is similar to the arched tunneling concept and constructs the new structure below the existing structure's top slab. This approach reduces the risk of settlement and displacement during this critical phase compared to off-alignment tunneling methods. The box tunnel alternative assumes the following general approach:

- Erect temporary shoring on each side of the new invert segments.
- Sawcut and remove 4-foot to 6-foot wide segments intermittently along the structure from the invert to the new foundation elevation.
- Install reinforcing steel and construct the new invert segment on both sides of the structure.
- Cut the wall and excavate a new 4.5-foot wide wall and place concrete on both sides of the structure.
- Erect form work, reinforcing steel, and place concrete for the new roof slab.
- Complete the remaining excavation to construct the remaining invert, wall, and roof sections.

"FUKO" type grout hoses should be installed against the surface of the existing roof slab prior to placing concrete for the new roof slab and the joint between the walls to insure proper contact and load transfer from the existing structure to the new structure.

Advantages:

- Eliminates/minimizes I-70 traffic impacts.
- Proposed construction methods use conventional geotechnical methods for shoring-type infrastructure.
- Constructing the new structure at the same location minimizes excavation quantities and structure costs.
- Existing structure used as a temporary construction support before the excavation phases for the new structure. Since the existing box is removed in alternate segments, the remaining sections offer the required support during the excavation and construction phases of the new section. Additional temporary supports may be required.

Disadvantages:

- Proposed construction lowers the existing invert to an elevation 4 feet to 6 feet below the existing structure. This design impacts the functional capacity of the current drainage infrastructure at both ends of the structure.
- Greater potential for long-term deflection issues, since the horizontal roof slab has more flexibility compared to arched shape roof.
- The access road approach grades to the structure entrances become slightly steeper from the existing grade of approximately 7% to 8% grade on the north side which could create unsafe driving conditions during inclement weather.

Of the aforementioned tunneling methods, the project team considered the arch tunneling method to be the only viable alternative at this location for a clear span of 24 feet. The other tunneling methods were presented to be all inclusive in this Study. Only the arch tunneling was advanced through conceptual design phase prior to changing the clear span to 36 feet. Detailing and cost estimates were provided for the arched tunneling alternative. As previously stated, the required span increase to 36 feet eliminates tunneling methods from further investigation.

i. Structure Alternative Evaluations

Table 4 summarizes qualitative ratings for each structure type based on the defined evaluation criteria below. These ratings provide a general and comparative assessment of each alternative against the defined criteria and the other alternatives. Refer to the previous section for additional discussion of each alternative.

Structure Cost: Represents the initial construction cost of the project.

Accelerated Bridge Construction (ABC): Identifies the feasibility of implementing accelerated construction techniques to provide cost-effective benefits to the project (e.g., use of precast components, alternative delivery methods).

Roadway and Traffic: At what level does the alternative impact the existing roadway and traffic features? Does the alternative require significant roadway reconstruction?

SWMP/Hydraulic: At what level does the alternative affect temporary/permanent water quality and the existing site drainage? Are there adequate drainage facilities to accommodate runoff during construction?

Durability/Maintenance: Based on the proposed construction, assess the structure's durability and maintenance requirements. Does the structure maximize the use of precast components and/or minimize the number of joints? Does it provide easy access to perform inspections and/or perform regular maintenance?

Risk: Assess the general level of project risk. Does the alternatives require a complex design approach and/or specialized construction techniques? Will the specification warrant a performance-based specification to assure conformance to design or construction?

Structure Type	Structure Cost	ABC Construction	Rdwy and Traffic	SWMP/ Hydraulic	Durability / Maintenance	Risk
Adjacent Prestressed Concrete Box Girders	Moderate	Moderate	High	Low	Better	Moderate
Precast Concrete Arch	High	Moderate	High	Low	Good	Moderate

Table 4 – Comparative Alternative Assessment

j. Shoring Types

Temporary shoring will be required to minimize excavation along I-70 and maintain two lanes of I-70 traffic in each direction throughout the construction duration. Depending upon the preferred alternative, shoring depths between 10 feet and 30 feet are anticipated. As referenced in RockSol's Geotechnical Investigation Report (see Appendix F), temporary soil nail walls and driven steel piles with timber lagging are the most feasible alternatives for this work. Drilled caisson walls are feasible however other temporary wall types mentioned would be more cost-effective. In this Study, drilled shafts would serve as permanent foundation for the buried bridge options and also temporary shoring during construction. The boulders and cobbles found in the subsurface material prohibit driving sheet pile cost effectively. See Appendix B, Feasibility Study Plans, for temporary wall limits and locations.

k. Construction Phasing

Construction methods and traffic impacts may be different depending on the location of the structure. According to the *CDOT Region 3 Lane Closure Strategy, Third Edition (2017)* single- and dual-lane closures are allowed in the project area. However, it is critical to keep two lanes of traffic open at all times to avoid back-

ups. The construction phasing plan was developed to avoid having travel lanes cross the centerline median and to avoid overbuilding the structure to the outside. It is important to recognize that the construction phasing detailed below is just one approach that may have many variations based on the structure type, construction methods, and construction typical section requirements. Items such as drainage elements, temporary pavement, retaining wall (shoring) quantities would change based on final design. For the purpose of this report, the following assumptions were made:

- Overbuilding beyond the original structure limits to accommodate phasing is not recommended
- A minimum of two 11-foot travel lanes required in each direction during construction
- 2-foot inside shoulder
- 4-foot outside shoulder
- 2-foot space for temporary concrete barrier (TCB)
- 1-foot to 2-foot buffer space between back of TCB and construction cut limits

Traffic control for the work zone shall meet CDOT standard drawing S-630-1 for each phase of construction. A work zone reduction in speed limit was not assumed in the phasing concept. The following sections describe the requirements and impacts associated with constructing the structure alternatives using a cut and cover construction approach.

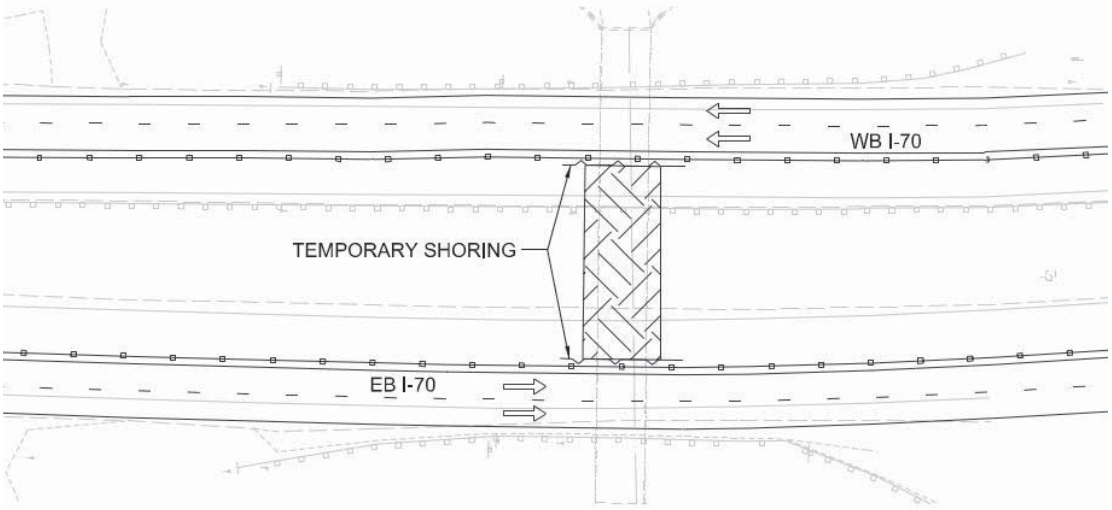
Reconstruction at Existing Location

Replacing the existing structure in the existing location using cut and cover methods requires a three-phase construction approach given the stipulations provided by CDOT. See Figure 7 - Construction Phasing Plan.

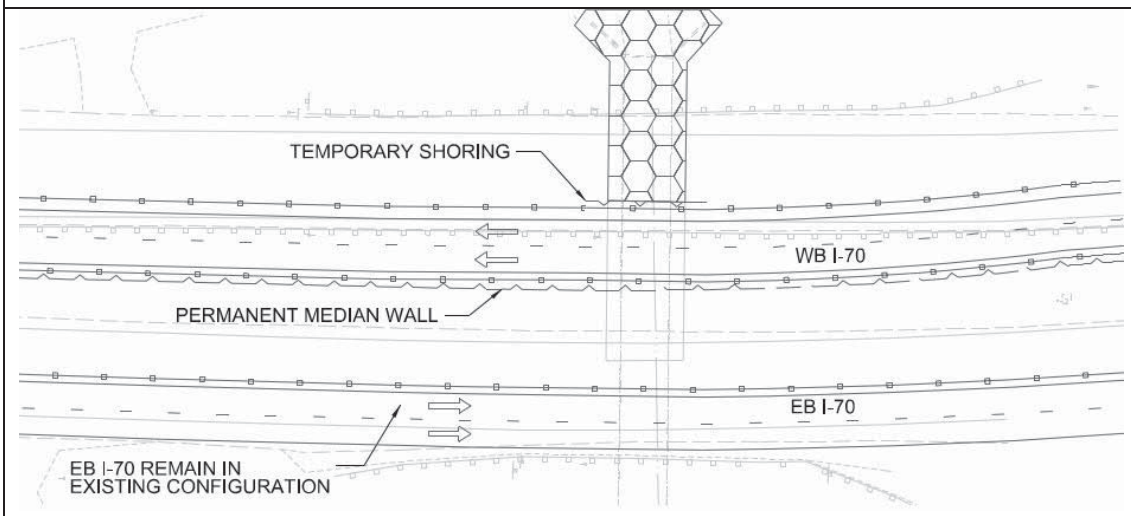
The first phase shifts both directions of travel to the outside on existing asphalt to construct the middle "third" of the structure. An extended single-lane closure in each direction is required to reduce travel from three lanes to two lanes during construction. The closure shall follow the Region's lane closure strategy.

The second phase shifts WB traffic to the inside such that the remaining portion of the structure under the WB lanes can be built. To allow for this construction, the WB lanes need to shift into the existing median. A retaining wall must be constructed in the first phase to allow the shift. An extended single lane closure in accordance with the Region 3 lane closure strategy is required to reduce travel from three lanes to two lanes. Eastbound traffic will remain in the two lane configuration from phase one. Shifting the WB lanes south and constructing the retaining wall affects the existing drainage ditch and inlets located within the I-70 median. These will need to be addressed in the next phase of design. The project team assumed a lump sum drainage cost would be added to the cost estimate to account for all drainage related issues.

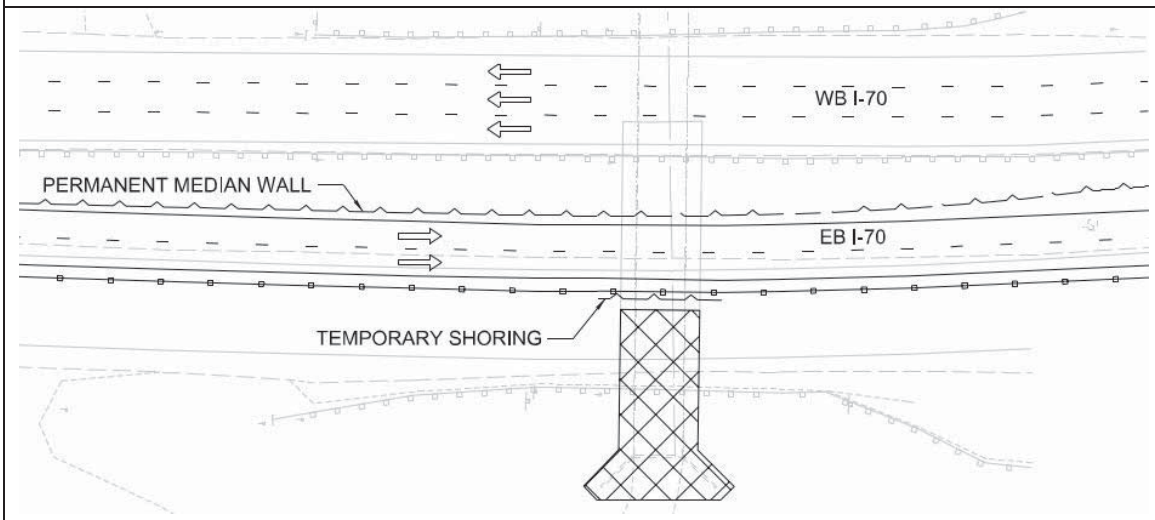
The third phase is similar to the second phase but in the EB direction. Eastbound travel lanes shift to the inside such that the remaining portion of the structure under the EB lanes can be built. An extended single lane closure in accordance with the Region 3 lane closure strategy is required to reduce travel from three lanes to two lanes. The median retaining wall from the second phase can be left in place and used for this phase. Westbound traffic will be placed back into the existing three-lane configuration.



Phase 1



Phase 2



Phase 3

Figure 7 – Construction Phasing Plan

Reconstruction at New Location

Constructing a new structure off the alignment of the existing structure using cut and cover methods can use the same phasing as if it were constructed in the existing location. Specific elements of the phasing plan may change, such as length of wall needed, but the overall scheme can remain the same. See Section 3c, Structure Location and Maintaining Access During Construction for additional information.

I. ACCELERATED BRIDGE CONSTRUCTION OPPORTUNITIES

In accordance with the CDOT BDM Section 39, the project team evaluated the structure alternatives to determine if accelerated bridge construction (ABC) technologies should be considered. This protocol was originally developed by BE and helped CDOT establish a consistent methodology in which project-specific design information (e.g., traffic, bridge importance factor, detour lengths) is used to determine if ABC methods can be used. For this project, the project team identified the following design information:

- ADT: 36,000 (2017); Use component score of 5
- Delay/Detour Time: Based on CDOT's Lane Rental Worksheet, the team estimated a 10 minute delay associated with the proposed construction phasing: Use component score of 5
- Bridge Importance: The I-70 Mountain Corridor is a vital link to east/west traffic through Colorado; Use component score of 5
- User Cost: CDOT identified user costs associated with a complete closure of I-70 at $1,000,000 per hour; Use component score of 5
- Economy of Scale: The repetitiveness of both structure alternatives would result in construction efficiencies through each construction phase; Use component score of 3
- Safety: Multiple traffic phases are planned over a two to three month duration; Use component score of 4
- Railroad Impacts: N/A
- Site Conditions: Access from both ends of the existing structure will help facilitate accelerated methods; Use component score of 5

By inputting these component scores into CDOT's Pre-Scoping ABC Rating Worksheet, the project team determined an ABC rating score of 88 (refer to Appendix I for additional information). This result confirms that an ABC approach is well substantiated. Cost considerations were not determined as part of this ABC evaluation effort since traffic impacts associated with any type of construction along the I-70 Mountain Corridor are significant.

6. Estimate

According to CDOT Design Bulletin, "FASTER Colorado Bridge Enterprise Projects": *"Funding for a Bridge Enterprise project can be either FASTER Bridge funds only or may have a combination of Federal Bridge and FASTER bridge funds included. … Projects that use the FASTER bridge funds need to have the scope of the project for any non-bridge work limited to that necessary to replace or rehabilitate the bridge and bring the bridge up to current roadway and structural standards. This may include portions of roadway approaches that require work to facilitate the bridge rehabilitation or replacement."*

Included in the structure estimates found in Appendix A are the additional program costs associated with utilities, SWMP/drainage, maintenance of traffic and reconstruction of Structure F-13-S_Minor. Reconstruction of the roadway pavement, shoulders and roadside barriers is also required to facilitate the structure alternatives and has been included in the estimate. This construction also includes costs associated

with constructing temporary shoring walls and a permanent retaining wall within the I-70 median, as required for the construction phasing approach. A 30% contingency has been included.

The Construction Engineering (CE) cost for CDOT charges are included within this estimate. The CE cost is calculated as a percentage of the bid items on the project. Typically, the CE pool rate is a standard rate for all CDOT projects. However, for BE projects, that percentage will be estimated based upon the total anticipated costs of the project. The CE rate used for this study is 25% and includes cost for both CDOT Construction Engineering and Consultant fees. Refer to Table 5 for a program cost summary.

	Program Cost	Cost Index
Precast Arch Structure	$ 12,263,000	1.11
Prestressed Adjacent Box Girder	$ 11,074,000	1.00

Table 5 – Program Cost Summary

a. BE Funding Eligible Items

In accordance with BE Guidance Document 6 *"Project Funding Eligibility for Bridge Items – Plans Review"*, only certain features of a project are considered eligible for funding (See Section 10, References). BE Staff will conduct reviews of project plans at specific milestones during project development, including scoping, FIR, and FOR.

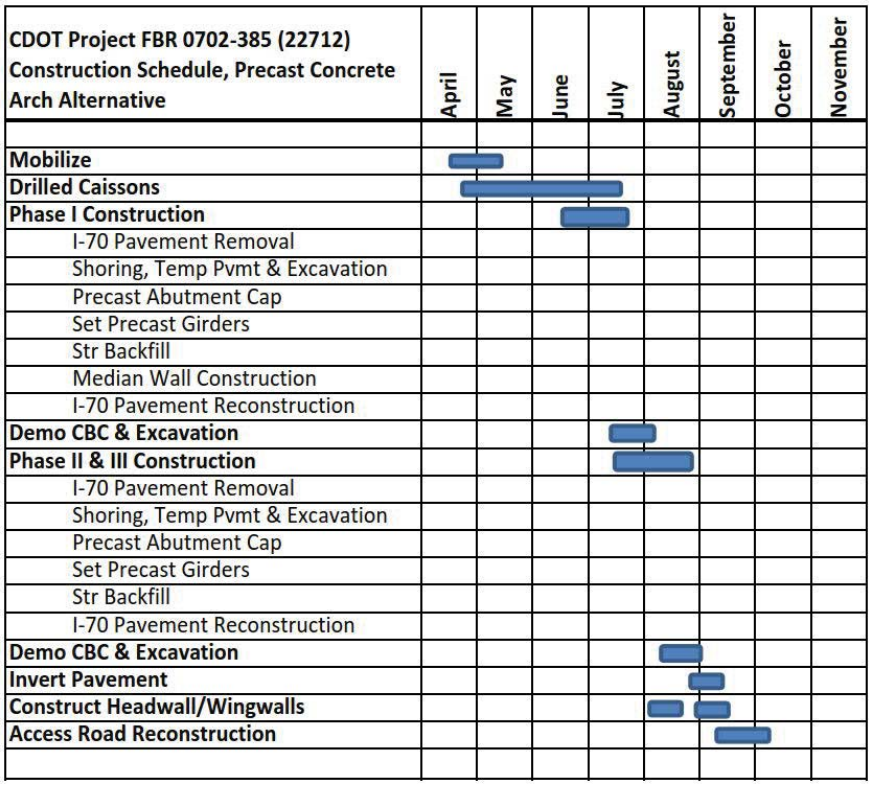
In general, items such as roadway improvements, ramps, larger spans or fencing to accommodate wildlife crossing, other than what is necessary, are not typically eligible for BE funding. However, during the design CDOT contacted CPW staff to review the I-70 PEIS requirements, confirm area wildlife crossing recommendations, and inquire about the availability of supplemental funding. These discussions also validated the information contained in the ALIVE Memorandum of Understanding (see Section 4b, Existing Studies for additional information). As noted in Table 1 of the ALIVE MOU, wildlife crossings are recommended in Zone 9a Laskey Gulch at MP 208.3 and Zone 9b Hamilton Gulch at MP 212.2. Although recommendations are not made at the structure's location at MP 211, it is the only practical location for a future wildlife crossing as the 212.2 location is unlikely due to proximity to the Eisenhower tunnel. Final design will accommodate wildlife as much as possible; however, unless required in the I-70 PEIS, the consideration of supplemental funding for a wildlife crossing is not eligible.

7. Schedule

The project team developed conceptual construction schedules for each alternative based on the following comments and/or assumptions (see Figure 8). These schedules identify the major work tasks required within each project phase. Note that detailed construction scheduling using estimated production rates for each activity were not generated, unless noted below.

- Project schedules were based upon a 5-day work week with mobilization in late April.
- For each cut and cover alternative, the construction of the drilled caissons needs to be completed prior to starting the phased construction approach. This work can be completed using temporary lane closures at night. Based on discussions with Rocksol it is assumed that 2 drilled shafts will be drilled per night (Refer to Appendix G, Correspondence).
- The project area is within a Lynx area and is therefore limited to 4 nights of construction per week.

- The Prestressed Adjacent Box Girder Alternative had a longer construction schedule to account for the additional CIP concrete construction (i.e. concrete deck and end diaphragm placement/curing).
- Construction of the median wall is critical path and must be complete prior to phases II and III.
- It is assumed that Phases II & III will be constructed simultaneously.
- **Asphalt is not typically available from Silverthorne after November 1st. If asphalt is unavailable it will need to be brought in from another location or the pavement of the approach ramps will need to be deferred to the following construction season.**
- **Both schedules identify a substantial completion date to highlight an early opening and return to normal I-70 traffic operations.**
- **Schedules shown offer an aggressive construction schedule. Weekend work and/or accelerated construction methods may be required to complete construction in one construction season.**

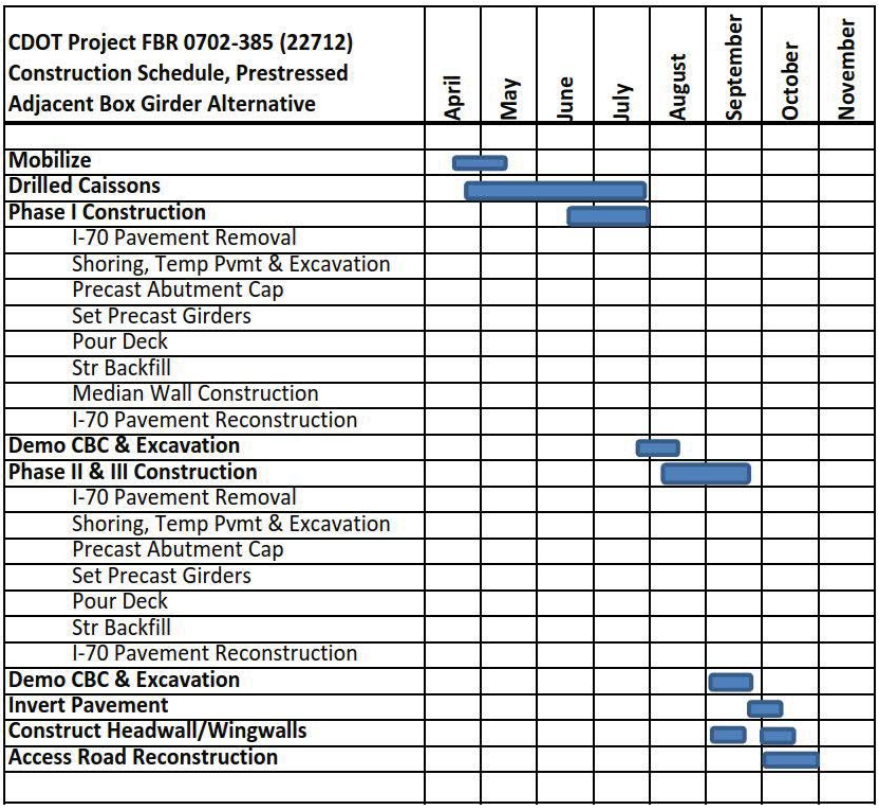


Precast Concrete Arch Alternative

NTP:
Late April

Substantial Completion:
Early October

Duration:
174 calendar days
25 weeks
60 MOT days



Prestressed Adjacent Box Girder Alternative

NTP:
Late April

Substantial Completion:
Late October

Duration:
188 calendar days
27 weeks
80 MOT days

Figure 8 – Conceptual Construction Schedules

8. Preliminary Project Delivery Matrix

The project delivery method will have a significant influence on the project cost, schedule, and consensus building. Understanding and utilizing the appropriate delivery method is paramount to the success of this project. Utilizing the CDOT approved approach for project delivery selection, the project team evaluated methods including Design-Bid-Build (DBB), Design-Build (DB) and Construction Manager/General Contractor (CM/GC). It must be emphasized that CDOT will conduct an internal Project Delivery Selection Process to determine the project delivery method. The following provides a few thoughts of each delivery method from a risk management perspective and serves for information only:

- DBB delivery applies most of the risk and control of the project to CDOT. In DBB, CDOT "owns" the details of design during construction and as a result, is responsible for the cost of any errors and omissions encountered in construction.
- DB applies most of the risk to the design-builder. The design-builder controls the details of design and is responsible for the cost of their errors and omissions encountered in construction. However, CDOT still maintains oversight and can accept or reject Alternative Technical Concepts (ATCs) which drive the parameters used during final design. DB typically allows for the highest level of innovation due to the design-builder's efforts to find a best-valued project solution which include ATCs.
- CM/GC allows more of a shared risk approach. CDOT establishes separate contracts with a construction manager (designer) and a general contractor which are executed concurrently. CDOT, the designer, and the contractor work together to deliver cost-effective solutions for a project. The significant characteristic of this delivery method is CDOT and the construction manager are both at risk for the final cost and construction duration.

Project Goals, Attributes and Constraints

To help better understand which delivery method provides CDOT a best-value approach, we have identified the following project goals, attributes and site constraints:

- Design and construct a structure that is fully funded through Colorado's Bridge Enterprise Program within the programmed budget.
- Develop a design solution that minimizes traffic impacts and can be constructed between April and October. Note that the construction schedule is a critical aspect of this project and it will need to be further evaluated during final design. It is preferred that construction be kept to one season.
- Proposed construction methods need to minimize and/or eliminate impacts to the active landslides east and west of the project area.
- No right-of-way acquisitions are expected for this work. CDOT has an existing easement and special-use permit with US Forest Service at this location.
- Electrical and fiber-optic lines are on site but actual locations and depths need to be confirmed.

Initial project delivery method screening is provided in Table 6 which shows that DBB and CM/GC are both favorable delivery methods. Additional team discussions and completion of CDOT's Alternative Delivery Matrix, as recommended by CDOT's Innovative Contracting Advisory Committee, are warranted to confirm a preferred approach.

Preliminary Project Delivery Matrix

PRIMARY Evaluation Factors	DBB	DB	CM/GC	NOTES
Delivery Schedule	+	+	+	With an April 2020 construction NTP, no delivery method provides added value provided that design has started enough time in advance and required permits and environmental clearances are in place. If the project needs to be accelerated, DB and CM/GC provides an advantage over DBB.
Project Complexity & Innovation	-	-	++	Innovative excavation under I-70 and/or accelerated construction methods with the goal of minimum disruption to traffic poses constructability challenges. Early Contractor input is valuable on this complex project. **DBB:** Little or no opportunity for contractor input during design. **DB:** CDOT may have less input and control over innovation during the DB process. **CM/GC:** Best process with collaboration between CDOT, the designer, and the contractor.
Level of Design	-	+	++	Not a standard design project. The goal of cost-effective delivery would require early consideration of means and methods of construction incorporated into design. **DBB:** Limited contractor input minimizes design/construction innovation. Consider value engineering activities to promote cost-effectiveness, constructability, and innovation. **DB:** RFP, technical requirements, scope, and quality procedures need to be clearly defined during procurement. CDOT will have less control after notice of award. **CM/GC:** Collaborative design process controlled by CDOT will deliver a quality project as expected. CM/GC permits an initial preliminary design by the consultant/CDOT and then collaboration with the contractor to develop the final design.
Cost	+	++	-	Integrated design and constructability process with early team coordination could provide cost-effective solution. **DBB:** Cost savings through early contractor input would not be realized; however DBB can result in more competitive bids **DB:** DB team collaboration helps identify the least cost alternative. **CM/GC:** Designer/Contractor/CDOT collaboration can result in moderate cost savings.
Perform Initial Risk Assessment	-	+	++	**DBB:** Active landslide areas and utility related risks are better resolved and managed. Constructability, innovation and unknown risks would be assumed by CDOT. **DB:** Unknown risks can have negative impact on the cost. Contractor is held responsible for most risks for schedule, cost and unknowns. **CM/GC:** Strong CDOT management is required to negotiate and optimize risks. Better avoidance of risks with contractor input.
Secondary Evaluation Factors	**DBB**	**DB**	**CM/GC**	**NOTES**
Staff Experience /Availability	+	-	+	CM/GC requires more negotiation of guaranteed maximum price and more CDOT management time.
Level of Oversight & Control	++	-	+	DBB provides CDOT full control over the design and construction process.
Competition & Contractor Experience	++	-	+	DBB allows for priced based selection. DB allows for price and non-price factors in the selection process. CM/GC allows for qualifications (non-priced) based contractor selection.
Scores	**15**	**13**	**18**	

Most appropriate delivery method	++	3
Appropriate delivery method	+	2
Least appropriate delivery method	-	1

Table 6 - Project Delivery Matrix Summary

9. Outstanding Design/Next Steps

Throughout the development of the feasibility study, the project team met with the local agencies and CDOT to identify any outstanding design features that need to be incorporated into the upcoming preconstruction design efforts. The design features are identified below.

Obtain Colorado Bridge Enterprise Approvals. Meet with BE to obtain confirmation of eligible project-specific construction and allocated funding.

Confirm Recommended Alternative and Project Delivery Method. Arrange project team meeting with CDOT, stakeholders (as needed), and BE staff to select the preferred alternative. Review and discuss the pros/cons associated with each alternative delivery method.

Early Action Preliminary Design. Perform SUE utility investigations; identify "blind" drainage connection depths and locations; re-evaluate user cost determinations; confirm stakeholder participation and coordination requirements; **initiate additional subsurface design investigations for the median wall; and start environmental resource investigations.**

Landslide Assessments. Consider more in-depth evaluations and/or analysis to identify and mitigate landslide risk for the proposed reconstruction.

10. References

National Bridge Inventory (NBI) Coding Guide.

Colorado Bridge Enterprise, 2011, *CBE Guidance Documents, Project Finding Eligibility for Bridge Items – Plans Review*

Colorado Bridge Enterprise, 2015. *Strategies for Enhancing Bridge Service Life*

Colorado Department of Transportation, 2011. *CDOT Roadway Design Guide*.

Colorado Department of Transportation, 2013. *CDOT Project Development Manual*.

Colorado Department of Transportation, 2018. *CDOT Bridge Design Manual*

"Highway Data Explorer." *Online Transportation Information System*. Colorado Department of Transportation. http://dtdapps.coloradodot.info/Otis/HighwayData#/ui/0/2/criteria/070A/133.772

American Association of State Highway and Transportation Officials (AASHTO), 2011. *Roadside Design Guide, 4th Edition*.

American Association of State Highway and Transportation Officials (AASHTO), 2017. *LRFD Bridge Design Specifications, 8th Edition*.

Appendices

APPENDIX A – COST ESTIMATES

Estimated Project Worksheet

I-70 Dillon Structure Replacement
CDOT Project No FBR 0702-385 (22712)
Burried Bridge Option - Prestressed Adjacent Box Girders

Pre-Scoping Date: 2/11//2019

ITEM NO.	ITEM DESCRIPTION	UNITS	QUANTITY	UNIT COST	TOTAL COST
201-00000	Clearing and Grubbing	LS	1	$ 10,000.00	$10,000
202-00120	Removal of Concrete Box Culvert	EA	1	$ 50,000.00	$50,000
202-00220	Removal of Asphalt mat	SY	1611	$ 10.00	$16,112
202-01130	Removal of Guardrail Type 3	LF	1756	$ 6.00	$10,536
203-00060	Embankment Material (Complete in Place)	CY	930	$ 25.00	$23,250
206-00000	Structure Excavation	CY	8464	$ 25.00	$211,612
206-00100	Structure Backfill (Class 1)	CY	6005	$ 45.00	$270,218
206-01750	Shoring/Temporary Walls	SF	6876	$ 50.00	$343,775
206-01751	Permanent Wall	SF	13925	$ 75.00	$1,044,394
304-06000	Aggregate Base Course (Class 6)	Ton	1673	$ 35.00	$58,555
403	Hot Mix Asphalt (Temporary)	Ton	957	$ 90.00	$86,130
403	Hot Mix Asphalt (Permanent)	Ton	2808	$ 90.00	$252,720
503-00024	Drilled Caisson (30 Inch)	LF	5000	$ 200.00	$1,000,000
515-00120	Waterproofing (Membrane)	SY	967	$ 25.00	$24,175
601-03040	Concrete Class D (Bridge)	CY	143	$ 750.00	$107,250
601-21010	Precast Concrete Unit	CY	200	$ 900.00	$180,000
602-00020	Reinforcing Steel (Epoxy Coated)	LB	37237	$ 1.50	$55,856
603-77011	Culvert Wingwall (3-sided Culvert)(Type 1)	SF	1200	$ 75.00	$90,000
606-00301	Guardrail Type 3	LF	1756	$ 30.00	$52,680
618-01992	Prestressed Concrete Box (Depth Less Than 32 Inches)	SF	8217	$ 60.00	$493,020
630-80370	Concrete Barrier (Temporary)	LF	2450	$ 40.00	$98,000
641-10000	Shotcrete	SY	556	$ 125.00	$69,500

	% RANGE	% USED	COST	
Project Construction Bid Items	Project Dependent	N/A	**$4,547,783**	(A)
Contingencies	(10% - 30%) of (A)	30%	$1,364,335	(B)
ITS/Lighting	(6-10%) of (A+B) Default = 6%	0%	$0	(C)
Utility Relocation	(3-10%)of (A+B) Default = 6%	5%	$295,606	(D)
Drainage/Erosion Control/SWMP	(1-5%) of (A+B) Default = 5%	3%	$177,364	
Drainage Costs Associated with I-70 Shift - Phasing			$200,000	
Total Drainage Costs			$377,364	(E)
Construction Signing and Traffic Control	5 to 25% of (A+B) Default = 20%	3%	$177,364	(F)
Large bid items associated with phasing included in construction bid items				
Mobilization	(4 to 10%) of (A+B+C+D+E+F) Default = 7%	5%	$328,123	(G)
Total of Construction Bid Items	(A+B+C+D+E+F+G)		**$7,090,573**	(H)
Force Account - Utilities	(1 to 2%) of (H) Default = 2%	2%	$141,811	(I)
Force Account - Misc.	(10 to 15%) of (H) Default = 12%	12%	$850,869	(J)
Subtotal of Construction Cost	(H+I+J)		**$8,083,254**	(K)
Designer Fee	(12%) of (K)	12%	$969,990	
Constr Mmgt/Inspection	(10 to 25%) of (K)	25%	$2,020,813	
Total Program Cost			**$11,074,058**	

Estimated Project Worksheet

I-70 Dillon Structure Replacement
CDOT Project No FBR 0702-385 (22712)
Burried Bridge - Precast Concrete Arch Option

Pre-Scoping Date: 2/11//2019

ITEM NO.	ITEM DESCRIPTION	UNITS	QUANTITY	UNIT COST	TOTAL COST
201-00000	Clearing and Grubbing	LS	1	$ 10,000	$10,000
202-00120	Removal of Concrete Box Culvert	LS	1	$ 50,000	$50,000
202-00220	Removal of Asphalt mat	SY	1611	$ 10.00	$16,112
202-01130	Removal of Guardrail Type 3	LF	1756	$ 6.00	$10,536
203-00060	Embankment Material (Complete in Place)	CY	930	$ 25.00	$23,250
206-00000	Structure Excavation	CY	9745	$ 25.00	$243,616
206-00100	Structure Backfill (Class 1)	CY	7117	$ 45.00	$320,259
206-01750	Shoring/Temporary Walls	SF	7192	$ 50.00	$359,598
206-01751	Shoring/Permanent Wall	SF	13925	$ 75.00	$1,044,394
304-06000	Aggregate Base Course (Class 6)	Ton	1673	$ 35.00	$58,555
403	Hot Mix Asphalt (Temporary)	Ton	957	$ 90.00	$86,130
403	Hot Mix Asphalt (Permanent)	Ton	2808	$ 90.00	$252,720
503-00036	Drilled Caisson (36 Inch)	LF	4500	$ 350.00	$1,575,000
515-00120	Waterproofing (Membrane)	SY	945	$ 25.00	$23,625
601-21010	Precast Concrete Unit	CY	204	$ 900.00	$183,600
603-77001	Culvert Headwall (3-sided Culvert)(Type 1)	SF	619	$ 75.00	$46,425
603-77011	Culvert Wingwall (3-sided Culvert)(Type 1)	SF	1200	$ 75.00	$90,000
603-73608	36x8 Ft Concrete 3-Sided Culvert (Precast)	Each	1	$ 375,000.00	$375,000
603-73609	36x8 Ft Concrete 3-Sided Culvert (Precast) - Install Only	Each	1	$ 75,000.00	$75,000
606-00301	Guardrail Type 3	LF	1756	$ 30.00	$52,680
630-80370	Concrete Barrier (Temporary)	LF	2450	$ 40.00	$98,000
641-10000	Shotcrete	SY	445	$ 125.00	$55,625
	*Shoring does not include caissons costs. See shoring plan				
	**Shotcrete placed in front of exposed drilled caisson				

	% RANGE	% USED	COST	
Project Construction Bid Items	Project Dependent	N/A	**$5,050,125**	(A)
Contingencies	(10% - 30%) of (A)	30%	$1,515,038	(B)
ITS/Lighting	(6-10%) of (A+B) Default = 6%	0%	$0	(C)
Utility Relocation	(3-10%)of (A+B) Default = 6%	5%	$328,258	(D)
Drainage/Erosion Control/SWMP	(1-5%) of (A+B) Default = 5%	3%	$196,955	
Drainage Costs Associated with I-70 Shift - Phasing			$200,000	
Total Drainage Costs			$396,955	(E)
Construction Signing and Traffic Control	5 to 25% of (A+B) Default = 20%	3%	$196,955	(F)
Large bid items associated with phasing included in construction bid items				
Mobilization	(4 to 10%) of (A+B+C+D+E+F) Default = 7%	5%	$364,367	(G)
Total of Construction Bid Items	(A+B+C+D+E+F+G)		**$7,851,697**	(H)
Force Account - Utilities	(1 to 2%) of (H) Default = 2%	2%	$157,034	(I)
Force Account - Misc.	(10 to 15%) of (H) Default = 12%	12%	$942,204	(J)
Subtotal of Construction Cost	(H+I+J)		**$8,950,934**	(K)
Designer Fee	(12%) of (K)	12%	$1,074,112	
Constr Mmgt/Inspection	(10 to 25%) of (K)	25%	$2,237,734	
Total Program Cost			**$12,262,780**	

Estimated Project Worksheet

I-70 Dillon Structure Replacement
CDOT Project No FBR 0702-385 (22712)
Burried Bridge Option - Full Excavation with Spread Footings

Pre-Scoping Date: 2/11//2019

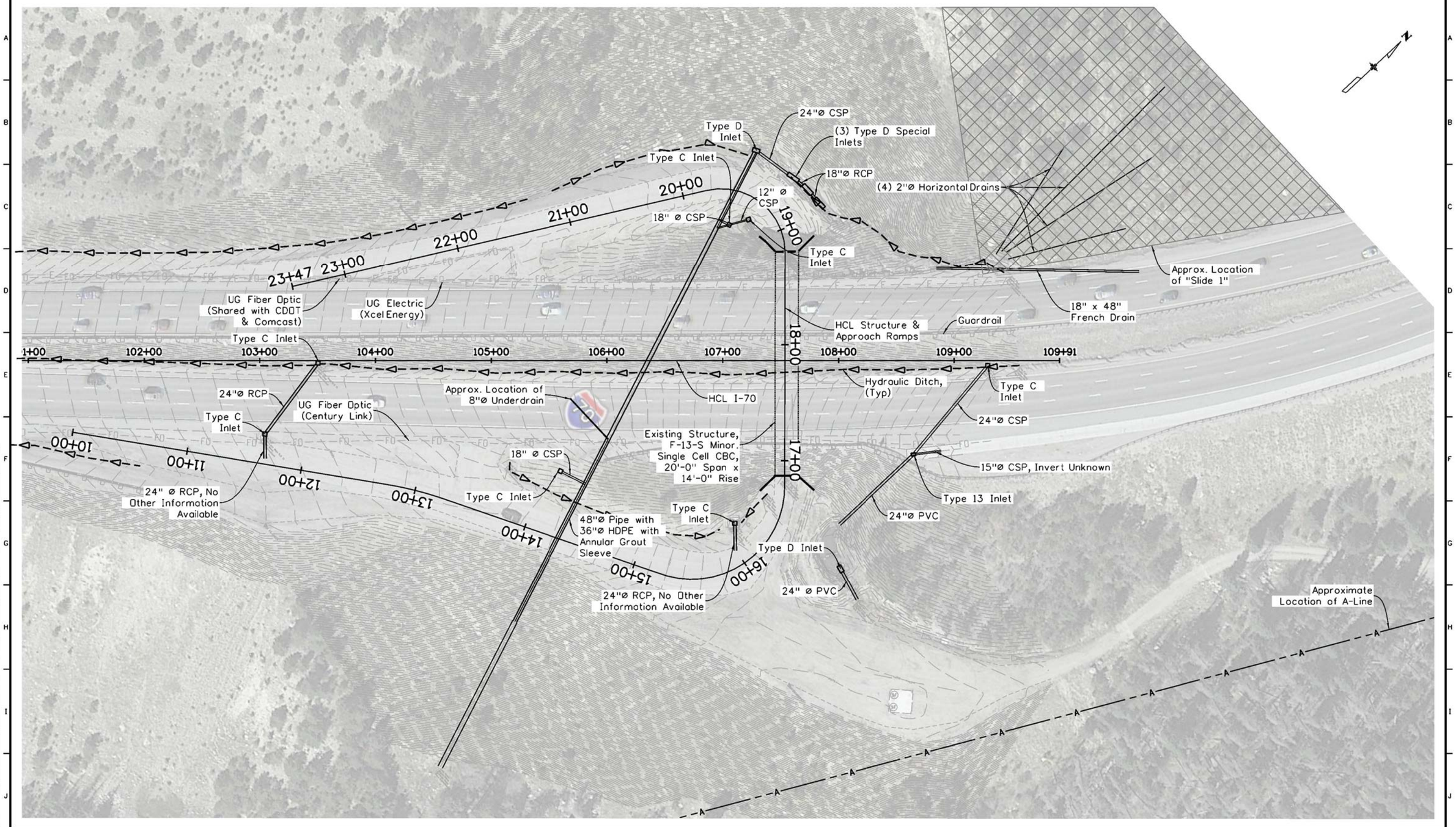
ITEM NO.	ITEM DESCRIPTION	UNITS	QUANTITY	UNIT COST	TOTAL COST
201-00000	Clearing and Grubbing	LS	1	$ 10,000	$10,000
202-00120	Removal of Concrete Box Culvert	EA	1	$ 50,000	$50,000
202-00220	Removal of Asphalt mat	SY	1611	$ 10.00	$16,112
202-01130	Removal of Guardrail Type 3	LF	1756	$ 6.00	$10,536
203-00060	Embankment Material (Complete in Place)	CY	930	$ 25.00	$23,250
206-00000	Structure Excavation	CY	22983	$ 20.00	$459,661
206-00100	Structure Backfill (Class 1)	CY	19563	$ 45.00	$880,320
206-01750	Shoring/Temporary Walls	SF	12890	$ 50.00	$644,475
206-01751	Permanent Wall	SF	14469	$ 75.00	$1,085,175
304-06000	Aggregate Base Course (Class 6)	Ton	1673	$ 35.00	$58,555
403	Hot Mix Asphalt (Temporary)	Ton	957	$ 90.00	$86,130
403	Hot Mix Asphalt (Permanent)	Ton	2808	$ 90.00	$252,720
515-00120	Waterproofing (Membrane)	SY	956	$ 25.00	$23,900
601-03040	Concrete Class D (Bridge)	CY	1598	$ 750.00	$1,198,500
602-00020	Reinforcing Steel (Epoxy Coated)	LB	176321	$ 1.50	$264,482
603-77011	Culvert Wingwall (3-sided Culvert)(Type 1)	SF	1200	$ 75.00	$90,000
606-00301	Guardrail Type 3	LF	1756	$ 30.00	$52,680
618-01992	Prestressed Concrete Box (Depth Less Than 32 Inches)	SF	8217	$ 60.00	$493,020
630-80370	Concrete Barrier (Temporary)	LF	2560	$ 40.00	$102,400

	% RANGE	% USED	COST	
Project Construction Bid Items	Project Dependent	N/A	**$5,801,916**	(A)
Contingencies	(10% - 30%) of (A)	30%	$1,740,575	(B)
ITS/Lighting	(6-10%) of (A+B) Default = 6%	0%	$0	(C)
Utility Relocation	(3-10%)of (A+B) Default = 6%	5%	$377,125	(D)
Drainage/Erosion Control/SWMP	(1-5%) of (A+B) Default = 5%	3%	$226,275	
Drainage Costs Associated with I-70 Shift - Phasing			$200,000	
Total Drainage Costs			$426,275	(E)
Construction Signing and Traffic Control	5 to 25% of (A+B) Default = 20%	3%	$226,275	(F)
Large bid items associated with phasing included in construction bid items				
Mobilization	(4 to 10%) of (A+B+C+D+E+F) Default = 7%	5%	$418,608	(G)
Total of Construction Bid Items	(A+B+C+D+E+F+G)		**$8,990,773**	(H)
Force Account - Utilities	(1 to 2%) of (H) Default = 2%	2%	$179,815	(I)
Force Account - Misc.	(10 to 15%) of (H) Default = 12%	12%	$1,078,893	(J)
Subtotal of Construction Cost	(H+I+J)		**$10,249,481**	(K)
Designer Fee	(12%) of (K)	12%	$1,229,938	
Constr Mmgt/Inspection	(10 to 25%) of (K)	25%	$2,562,370	
Total Program Cost			**$14,041,789**	

Estimate Notes:

Item No.	Note:
202-00220	Only existing shoulders were removed.
202-01130	Existing gaudarail on westbound lanes was assumed to be removed and replaced within project limits.
203	Unclassified Excavation and embankment refers to ditch in median, required for phasing.
206-01750	Shoring does not include caisson costs. See shoring plan.
304-403	Assumed 6-inches of HMA and 6-inches of ABC. Assumed 2" overlay for full project area.
606	Guardrail required along full length of permanent wall.
624	Drainage costs associated with phasing.
641	Shotcrete placed in front of exposed drilled shafts.

APPENDIX B – FEASIBILITY STUDY PLANS



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	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/8/2019	
File Name: Existing Condition Map.dgn	
Horiz. Scale: 1:80	Vert. Scale: As Noted

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CDOT
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Frisco, CO 80443
Phone: 303-512-5600 FAX:
Region 3
GLA

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No Revisions:
Revised:
Void:

EXISTING CONDITIONS

Designer:	M. Vause	Structure Numbers	F-13-S_Minor
Detailer:	M. Vause		
Subset:	Culvert	Subset Sheets:	C01 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number 1

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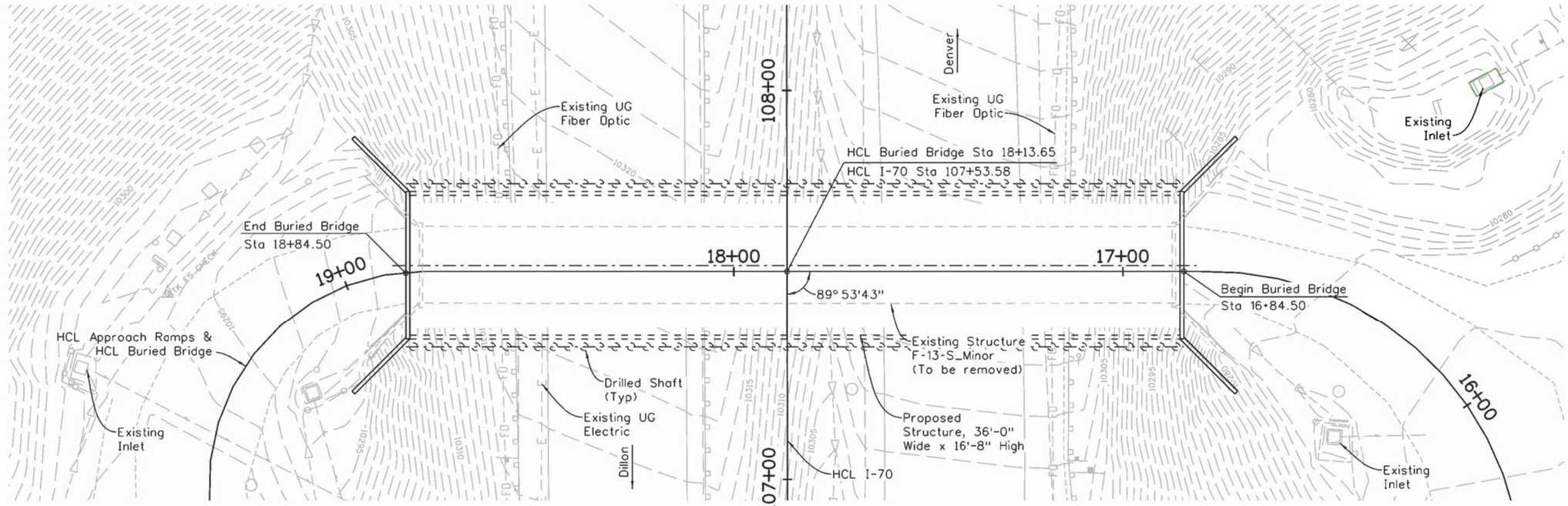
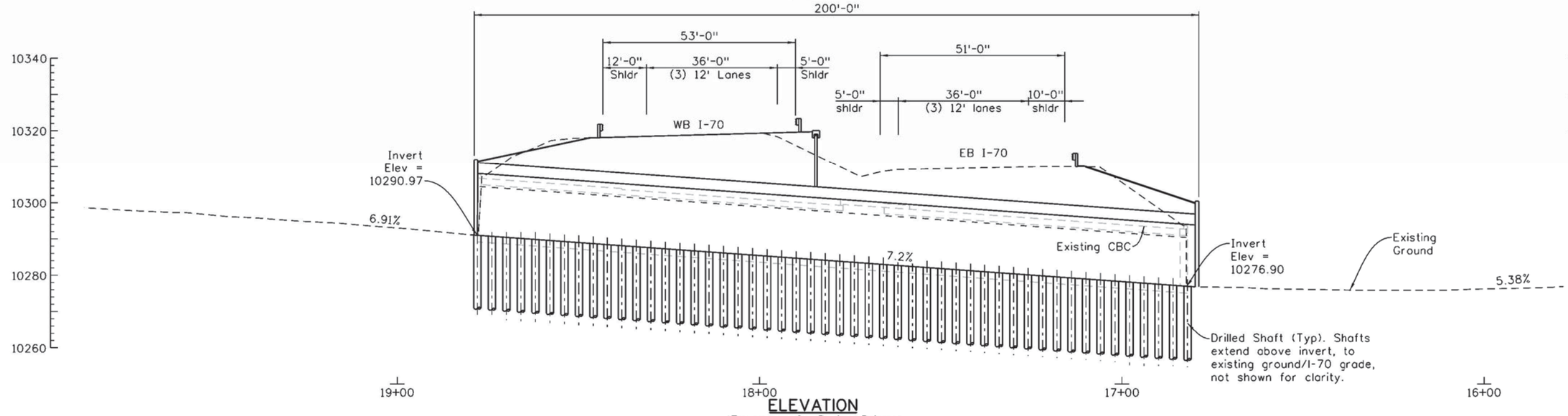


PLAN



ELEVATION

(Taken @ HCL Buried Bridge)
Looking Upstation
Prestressed Adjacent Box Girder Alternate shown. Precast Arch Alternative Similiar

Quantities: Designed By / Checked By — Initial / Date
Detail: Detailed By / Checked By — Initial / Date
Design: Designed By / Checked By — Initial / Date

Print Date: 4/11/2019
File Name: GenLayout02 CBC.dgn
Horiz. Scale: 1:30 Vert. Scale: As Noted

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Phone: 303-512-5600 FAX:
Region 3 GLA

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Revised:
Void:

GENERAL LAYOUT
BURIED BRIDGE ALTERNATIVE

Designer: M. Vause
Detailer: M. Vause
Subset: Culvert
Structure Numbers: F-13-S_Minor
Subset Sheets: C02 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number

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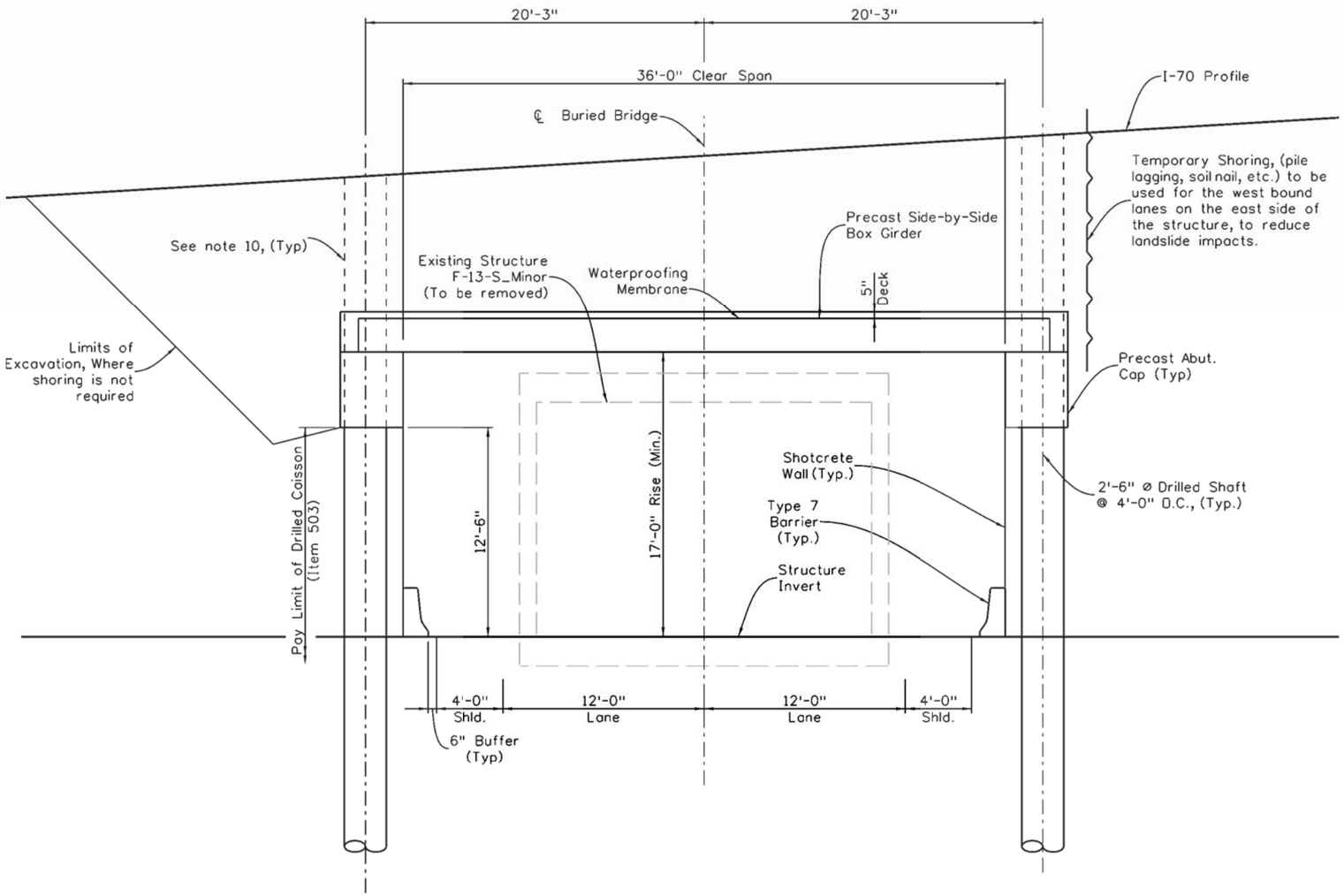

TYPICAL SECTION

NOTES

1. Drill caissons (50 each side, 100 total). Assume 50'-0" length, each.
2. Place temporary shoring walls along I-70 Mainline to accommodate MOT Phase configuration requirements.
3. Remove asphalt pavement and embankment.
4. Place precast abutment caps and place precast box girder.
5. Waterproof and backfill above structure.
6. Place I-70 roadway asphalt & open traffic.
7. Repeat steps 2-5 for remaining construction phases.
8. Excavate remaining fill under newly built bridge & remove existing CBC. Note, this step can be done in phases, prior to placing the girders.
9. Asphalt & place barriers below structure.
10. Drilled shafts are drilled from existing I-70 profile during temporary nighttime closures. Shaft construction limited to 4 nights/week due to Lynx habitat. Costs associated with drilling from I-70 profile to bottom of abutment cap are included in the cost of the work.

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/11/2019
File Name: Tunnel_Section04.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted

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Region 3 GLA

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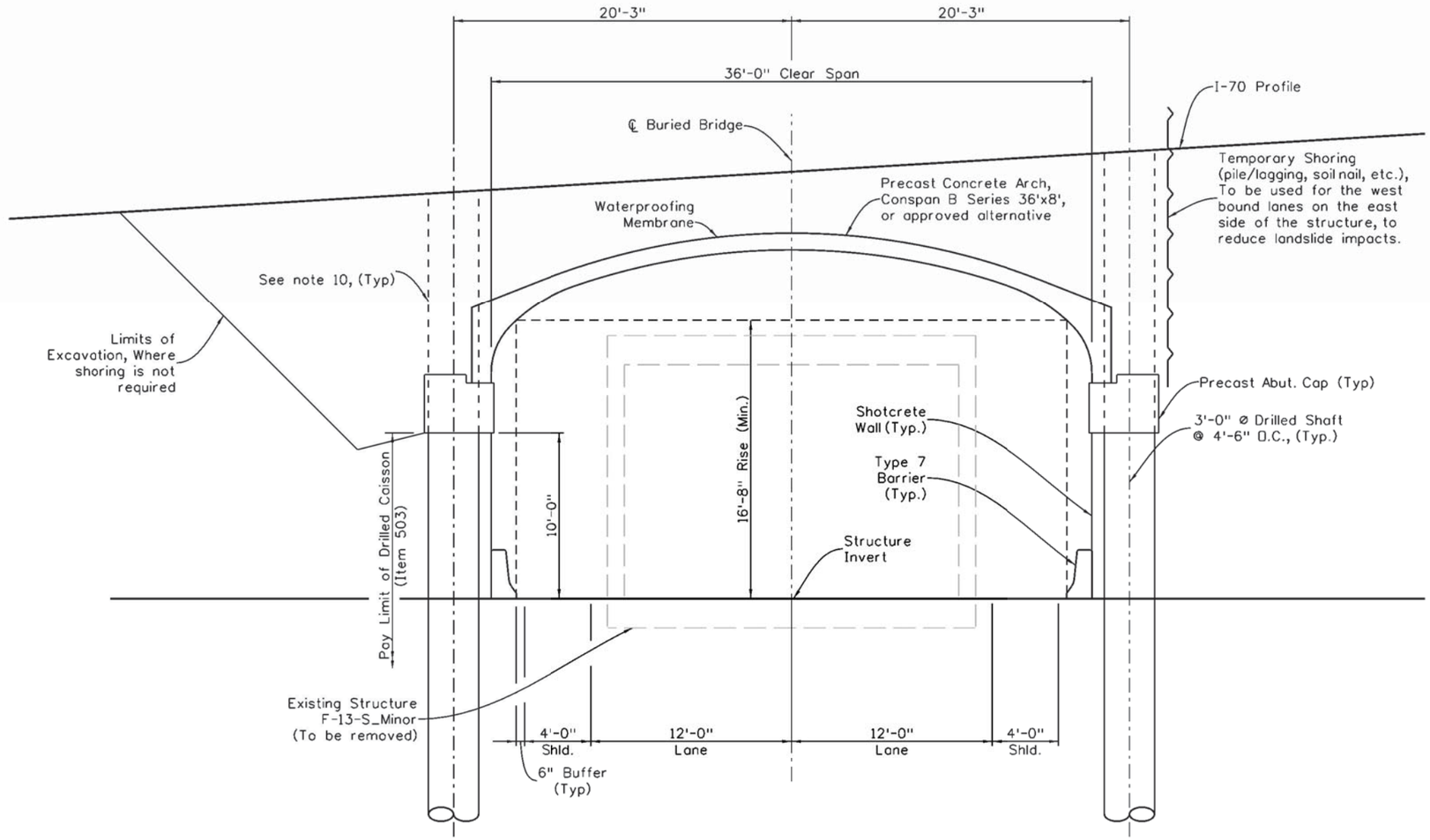
Revised:
Void:

BURIED BRIDGE ALTERNATIVE
PRESTRESSED ADJACENT BX GIRDERS

Designer: M. Vause
Detailer: M. Vause
Subset: Culvert
Structure Numbers: F-13-S_Minor
Subset Sheets: C03 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number



NOTES

1. Drill caissons (45 each side, 90 total). Assume 50'-0" length, each.
2. Place temporary shoring walls along I-70 Mainline to accommodate MOT Phase configuration requirements.
3. Remove asphalt pavement and embankment.
4. Place precast abutment caps and place precast box girder.
5. Waterproof and backfill above structure.
6. Place I-70 roadway asphalt & open traffic.
7. Repeat steps 2-5 for remaining construction phases.
8. Excavate remaining fill under newly built bridge & remove existing CBC. Note, this step can be done in phases, prior to placing the arch.
9. Asphalt & place barriers below structure.
10. Drilled shafts are drilled from existing I-70 profile during temporary nighttime closures. Shaft construction limited to 4 nights/week due to Lynx habitat. Costs associated with drilling from I-70 profile to bottom of abutment cap are included in the cost of the work.

TYPICAL SECTION

Design				Detail				Quantities			
	INITIAL	DATE			INITIAL	DATE			INITIAL	DATE	
Designed By			Detailed By				Quantities By				
Checked By			Checked By				Checked By				

Print Date: 4/11/2019
File Name: Tunnel_Section05.dgn
Horiz. Scale: 1:1 Vert. Scale: As Noted

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Region 3 GLA

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Revised:	
Void:	

BURIED BRIDGE ALTERNATIVE
PRECAST CONCRETE ARCH

Designer:	M. Vause	Structure Numbers	F-13-S_Minor
Detailer:	M. Vause		
Subset:	Culvert	Subset Sheets:	C04 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number

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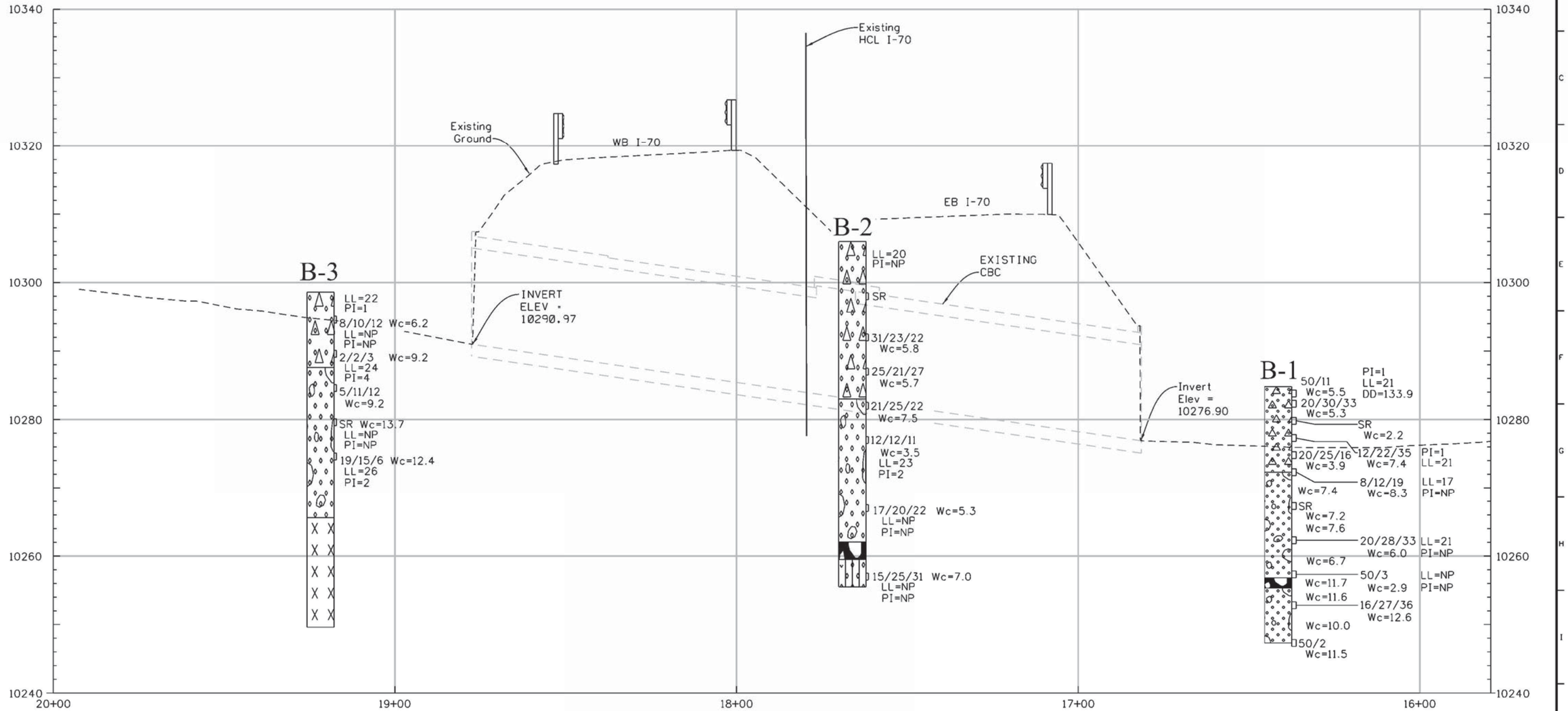
LEGEND

- Bedrock - SILTSTONE
- Native - SAND, silty
- Native - SAND, gravelly
- Native - BOULDERS AND COBBLES
- Fill - SAND, gravelly



ELEVATION

(Taken @ HCL CBC)
Looking down station I-70

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/8/2019
File Name: Geology_Profile.dgn
Horiz. Scale: 1:30 Vert. Scale: As Noted

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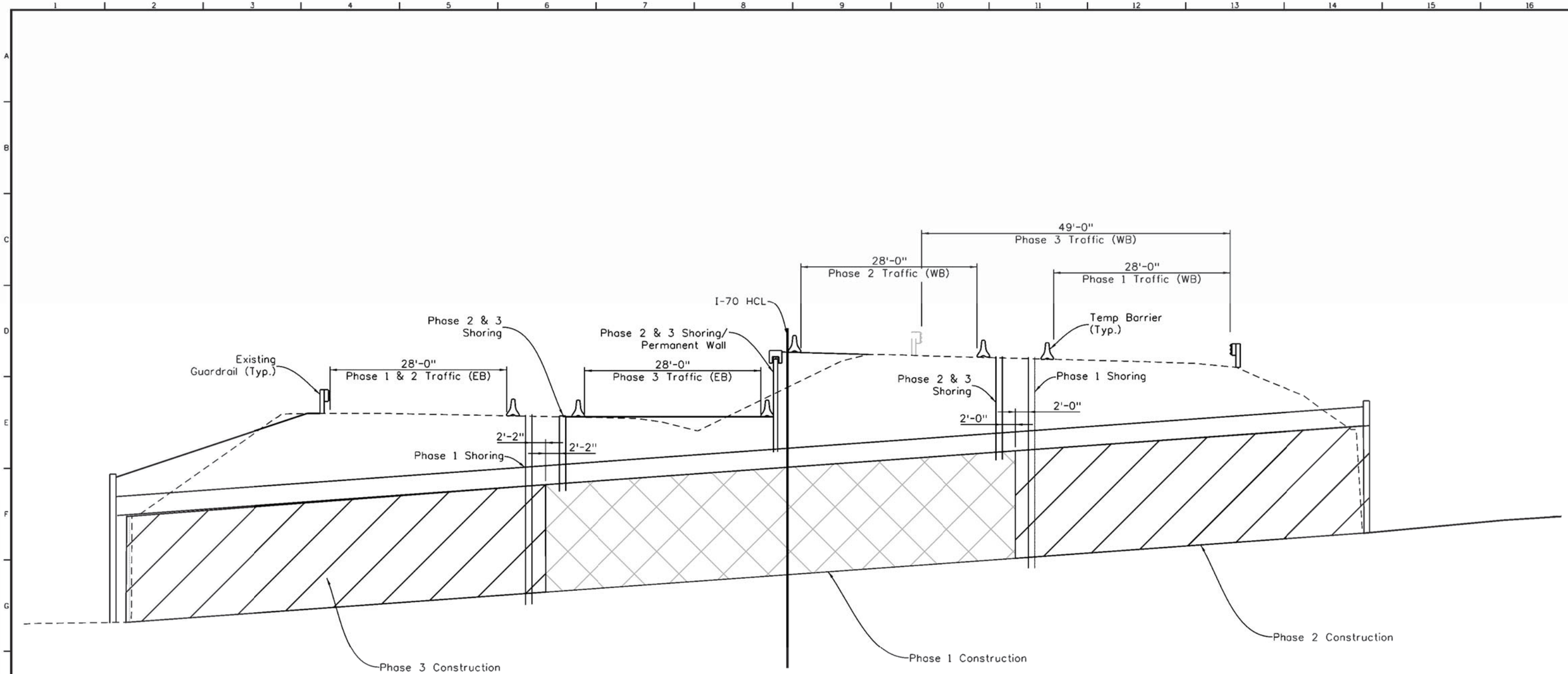
Revised:	
Void:	

GEOLOGY PROFILE

Designer:	M. Vause	Structure Numbers	F-13-S_Minor
Detailer:	M. Vause		
Subset:	Culvert	Subset Sheets:	C05 of C09

Project No./Code	
FBR 0702-385	
22712	
Sheet Number	5



STRUCTURE ELEVATION

Buried Bridge Alternate Shown
Looking West

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

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File Name: Phasing Exhibit.dgn
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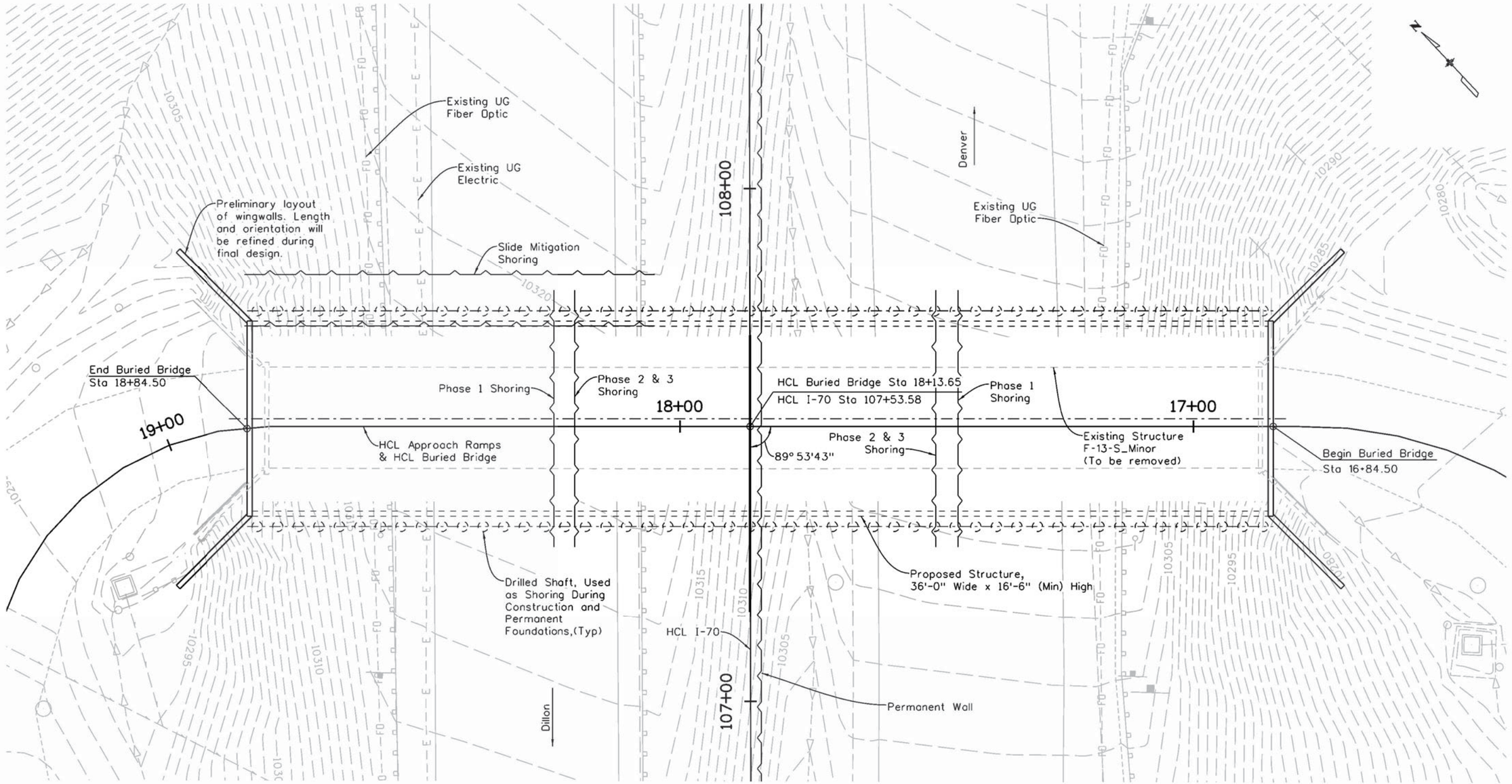
No Revisions:
Revised:
Void:

CONSTRUCTION PHASING
TYPICAL SECTION

Designer: M. Vause
Detailer: M. Vause
Subset: Culvert
Structure Numbers: F-13-S_Minor
Subset Sheets: C06 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number 6



SHORING PLAN

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/8/2019
File Name: Shoring Plan.dgn
Horiz. Scale: 1:20 Vert. Scale: As Noted

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Phone: 303-512-5600 FAX:
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SHORING PLAN

Designer: M. Vause
Detailer: M. Vause
Subset: Culvert
Structure Numbers: F-13-S_Minor
Subset Sheets: C07 of C09

Project No./Code: FBR 0702-385
22712
Sheet Number 7

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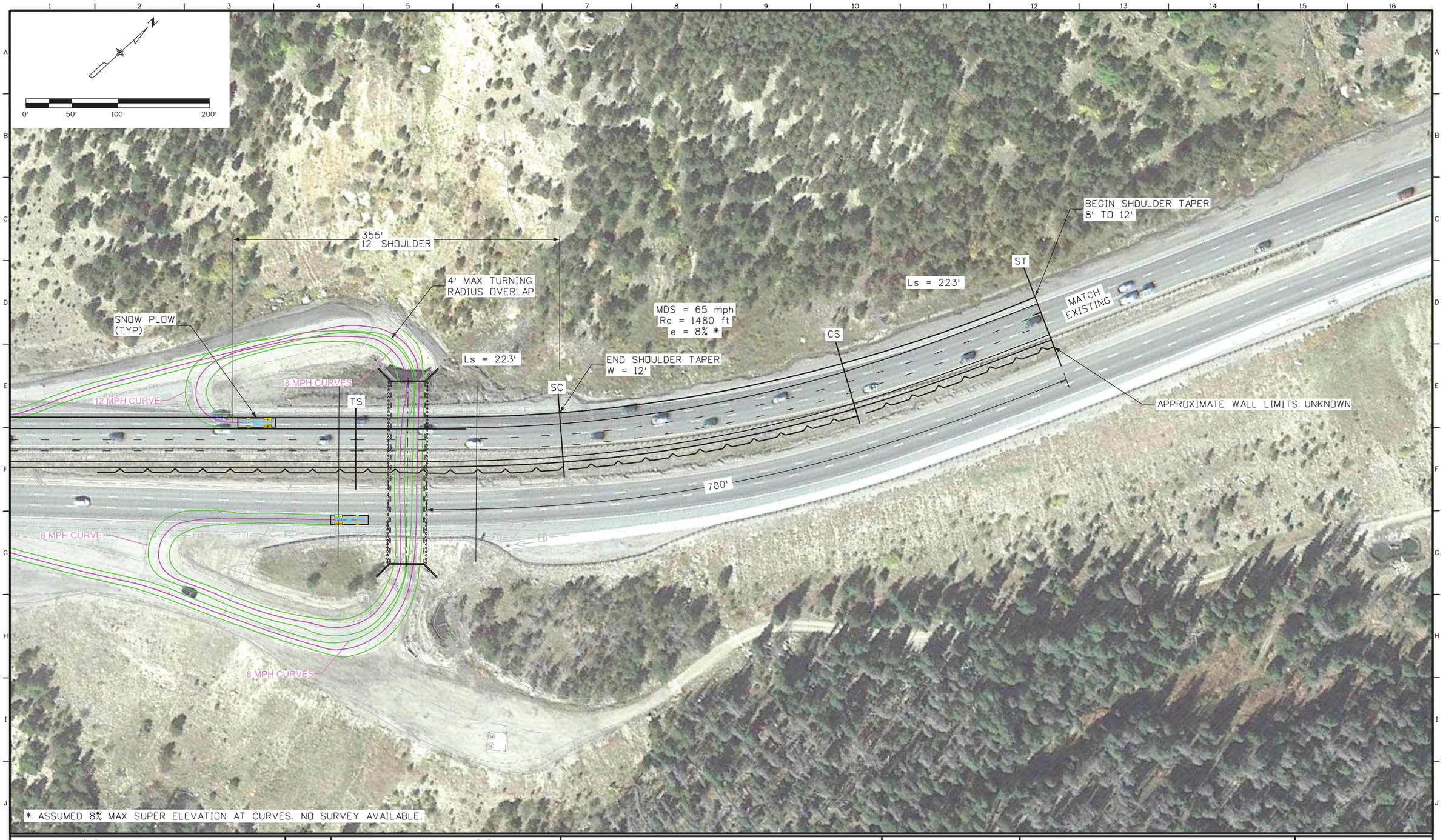

* ASSUMED 8% MAX SUPER ELEVATION AT CURVES. NO SURVEY AVAILABLE.

Design			Detail			Quantities		
	INITIAL	DATE		INITIAL	DATE		INITIAL	DATE
Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/9/2019
File Name: Snow Plow
Horiz. Scale: 1:100.02 Vert. Scale: As Noted

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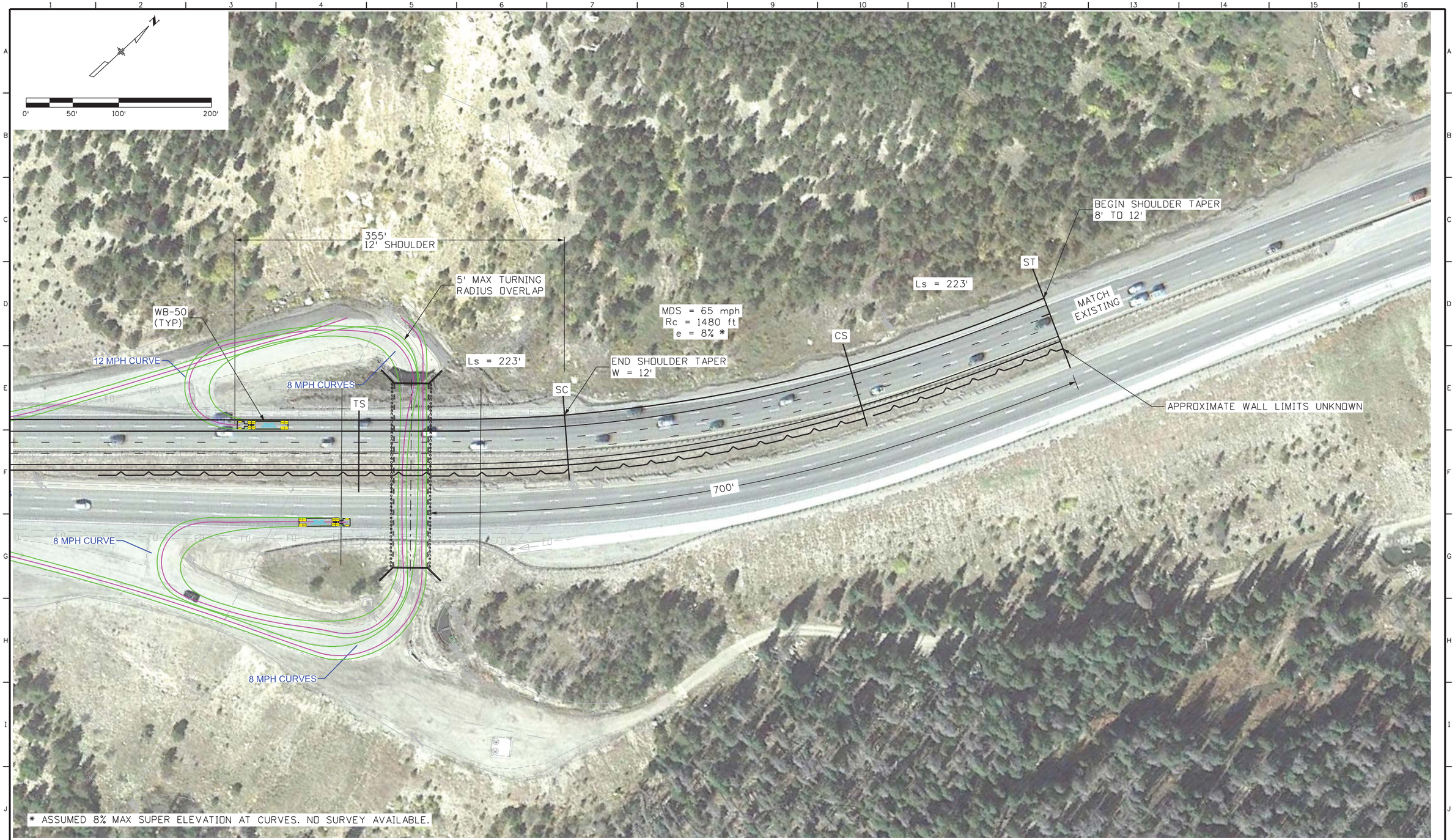
Revised:
Void:

I-70 CONCEPT DESIGN WESTBOUND SNOW PLOW

Designer:	M. Vause	Structure Numbers	F-13-S_Minor
Detailer:	M. Vause		
Subset:	Culvert	Subset Sheets:	C08 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number



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Designed By			Detailed By			Quantities By		
Checked By			Checked By			Checked By		

Print Date: 4/9/2019	
File Name: WB-50	
Horiz. Scale: 1:100	Vert. Scale: As Noted

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Region 3
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Revised:
Void:

I-70 CONCEPT DESIGN WESTBOUND WB-50

Designer:	M. Vause	Structure Numbers	F-13-S_Minor
Detailer:	M. Vause		
Subset:	Culvert	Subset Sheets:	C09 of C09

Project No./Code
FBR 0702-385
22712
Sheet Number

APPENDIX C - STRUCTURE INSPECTION REPORTS

STRUCTURE INSPECTION - OCTOBER 10TH 2018

COLORADO
Department of Transportation
Division of Engineering Support

Inspection Date	10/10/18
Attendees	Maegan Vause, Reed Brockman, Jared Fattoross
Location	CBC @ MP 211 along I-70
Conditions	Cold temperatures, snowy & foggy conditions.

- North end marked 1964
- South End Marked 1970
- Length of structure = 196'
- Opening: 20' span, 14' rise
- Bottom of slab has asphalt fill on top
- Vertical Clearance: SW = 13'-11", SE = 14'-0", NE = 13'—11", NW = 13'-9"

NE Wingwall

- Top back side edge of chamfer perpendicular to to bf corner of retaining wall = 4.5" from edge of headwall to bf corner ww
- Distance from face of headwall to corner of ww-4"
- Blue line = reference line = "x" measured along chamfer 14'-7" from top of wall.
- Hanging string from top of wall down to blue line distance from string to wall – 6 3/8 " (to find inclination of wall)
- Large diagonal crack from top of wall (half way from end) that propagates at 45 degrees down to headwall.

South Wingwalls

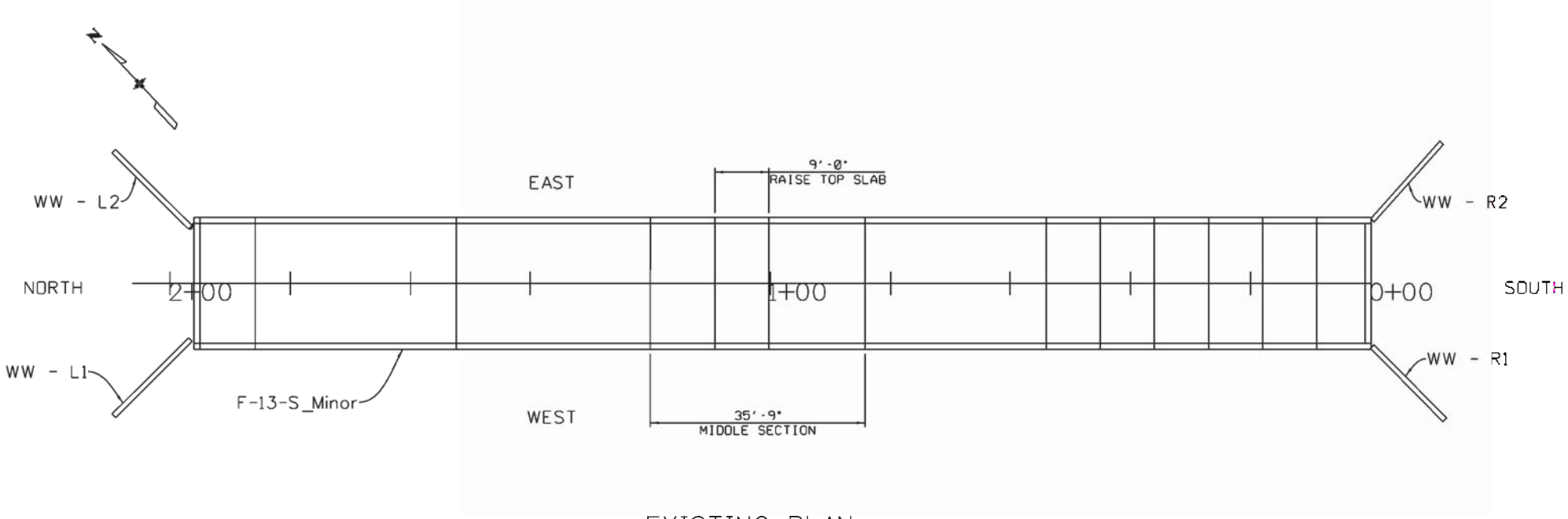
- Both southern wingwalls have been pushed put from headwall 4-4.5"

Box Notes

- Assigned alignment is from South to North.
- South approach has several potholes. Full width of roadway approximately 25'-0'from inlet.
- 3'-0" Ø pothole at outlet of box
- Sat 0+00 - Bottom slab – east quarter point, spalled beyond reinforcement. Approximately 24" (785).
- Headwall damaged. Spall beyond reinforcement full width of box. Approximately 18" into slab, 4" deep.
- Sta 0+02 - East wall – hole: 6" tall, 4" deep
- Sta 0+20, 3rd cell – crack projects down from top at joint, both walls. 4" deep, 6" wide. (790 West wall) (788 & 789 East wall)
- Sta 0+.46.5, 6th cell. Matching vertical cracks (one on each wall) connected by crack on top slab, full span. Crack width approx. 2" (791 east wall) (792 west wall) (793 top slab)
- Sta 0+60.5 Vertical crack on east side of wall (794)
- Middle section is from 0+84.75 to 1+20.50 (35.75' length). The middle 9' top slab is raised 18" (1+00.75 to 1+09.75)
- Sta 0+84.75 16" spall around joint. (795 east wall) (796 west wall) (797 top slab)
- Top slab between 0+84.75 and 1+00.75: 6" transverse crack with efflo. Transverse cracks along joint, average spacing ≈ 2'-0". Numerous areas of delamination and spalling. (crack 798)
- Sta 1+00.75 – south "headwall" at top slab raise – severe cracking and insipient spalling with exposed reinforcement. (800 east) (802 west)
- Raised top slab from 1+00.75 to 1+09.75 diagonal cracks propagating from both walls (804 east) (805 west)
- Top slab from 1+09.75 to 1+20.50 (806 top slab)
- Cell from 1+20.50 to 1+52.92 – East wall – hairline cracks with minor efflo. Spaced @ 10' O.C.
- Sta 1+40.42 Ceiling cracks near construction joint, propagates down east wall (not west wall). (807 east wall) (808 ceiling)
- Sta 1+52.42 Problem at the soffit and west wall. Cracking 6" on either side of joint (809). Spalling on west wall joint (810).
- Cell from 1+52.42 to 1+85.83 – scrapes on top slab from vehicles (811). No other issues in this cell.
- Sta 1+86.00 – insipient spalling across top slab joint. 12" on either side of the joint. (812)
- Cell from 1+86 to 1+96 – delamination and spalling on top slab. Longitudinal and transverse cracking. Numerous areas of insipient spalling. Delaminated area approximately 12' wide and 8' long approximately 8' from north end of the structure.
- North headwall damaged. Rebar exposed and bent outward. Spall 10" high and 10" deep.

Erosion

- South end – minor amount of erosion directly above headwall that is pushing small amounts of earth over the headwall. Small amount of erosion behind SE wing wall & SW wing wall. Grass growing behind walls and trees aren't leaning – leads one to think the earth is stable.
- North End – A lot of erosion behind the NE wingwall that flows inside of box, last 4' of wingwall length. Erosion at top of box that pushes soil over headwall. Some erosion behind NW wing wall however grass is growing.



EXISTING PLAN

SUFFICIENCY RATING AND INVESTIGATION

COLORADO
Department of Transportation

Sufficiency Rating Investigation and Inspection

July 24, 2017

Reviewer: Sarah Navarro

Bridge F-13-S_Minor, I-70 over Forest Service Rd., 53-year old structure

Single Celled Reinforced Concrete Box Culvert (20-ft x 14-ft)

Table of Contents

Bridge F-13-S_Minor, I-70 over Forest Service Rd., 53-year old structure

Single Celled Reinforced Concrete Box Culvert (20-ft x 14-ft)

Background: SIA and construction completion date on plans show that the culvert was built in 1966, however the stamp on the north headwall shows 1964. The single celled reinforced concrete box culvert (20-ft span by 14-ft height) was initially 164-ft long, then extended 30-ft to the south (under west-bound lanes) in 1970. Culvert is currently 194-ft long.

Capacity: Based on both original plans 1963 and extension plans 1969, the culvert was detailed/designed for a maximum of 12-ft of fill. Based on structural analysis of the structure using dimensions/reinforcement on the plans, the culvert was designed for dead load only, live load was not accounted for. Although live load effects for a fill depth of 12-ft can be estimated to be 5% or less of the total load, Standard Specifications for Highway Bridges (Allowable Stress Design and Load Factor Design Methods) used at time of design, states under section 6.4.2, "For single spans, the effect of live load may be neglected when depth of fill is more than 8-ft AND exceeds the span length…". It would have been beneficial to account for live load because although minimal, I-70 today serves an estimated 3,000 trucks per day (with total ADT estimated at 30,000).

It is unknown when, but at some point I-70 must have been vertically re-aligned because the current maximum depth of fill is estimated at 18-ft. SIA's for the structure show a fill depth (#66T) of 16.67-ft since 2005 (oldest SIA found in the bridge library dated 2005). On 7/24/17, employees from Bridge Enterprise Residency surveyed top of roadway surface at edge of shoulder by the use of transit survey equipment. Based on the survey, West-Bound has a maximum of 12-ft of fill and East-Bound has a maximum of 18-ft of fill.

When reviewing SIA reports for the last 5 years, the live load capacity (#64 & 66) at the inventory and operating levels were reported as 99-tons up to 2013. This capacity was based on section 14-2 of CDOT's Bridge Rating Manual, which states to default to 99-tons if live load is considered negligible. Capacity was reduced starting with SIA dated 4/28/15, where capacity at the inventory level was reported at 80.1-tons and 89.9-tons at the operating level. Assumingly, capacity was reduced based on the condition of the structure.

Inspection and Condition: Per SIA 4/03/17, the sufficiency rating is reported as 55. The culvert condition (#62) is rated as 5 fair condition and the structural evaluation (#67) is rated as 5 fair condition. The vertical clearance of the single cell is 13.8-ft which is

inadequate and therefore rated as serious condition (3), classifying the culvert as functionally obsolete.

The following text in black was reported on SIA, red indicates notes from 7/24/17:

CULVERT: Vert. cracks in both walls widen to 1/2 inch with spalled edges near base at 22 ft. (PHOTOS 6/05 & 6/07) & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other light to moderate vert. cracks, & many minor scrapes on both walls.
Observed roughly 13 vertical/diagonal shear cracks in walls, ranging from 1/8 to 4-inches wide with exposed rebar and spalling. Refer to Photo 22 for largest. Also, bottom of east wall on south end has deteriorated for a long section with minimal contact between bottom slab and wall. A video was taken to show heavy leakage at worse section.

Top slab has 8-10 longit. cracks actively leaking, and some delam. with efflor., especially at cold joints. Top slab is spalled (spot with exposed rebar), cracked, and delaminated at elevation change below median with active leaking. (See 1995, 2007, and 2009 Photos) Lower soffit section (below EBND lanes) has full length horizontal crack in facia where slab changes elevation in midsection of cell. Crack is open over 1/2 inch and shows heavy efflor and active leakage. Horizontal crack appears to have worsened as concrete is unsound, refer to Photos 17 & 18 with exposed rebar and section loss

Top slab is delaminated/spalled at ends below both headwalls, with exposed corroded rebar. (See 2007 & 2009 Photos) Top slab has been blackened by diesel exhaust.
Bottom slab partially covered with asphalt. Visible concrete is worn, and there is 25 ft. of spalls near left end, half have rebar exposed. (Could not see due to ice and snow cover during 2013 inspection)
Bottom of top slabs have scrapes and damage from live load, no vertical clearance signs at entrances

WINGWALLS: Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched. Couple of cracks in #2 Lt.; one with efflor., and one heavy diagonal crack (open to 3/16 inch) and chipping along edges, and #2 Lt. also spalled at end. Scrapes and chips along both wings on Lt. Some light scale, minor scrapes, and minor spalls on #1 Rt. wingwall. Few vert. cracks some with efflor. in both wings on right. Minor erosion behind all. #1 Lt. pushed slightly at top; #2 Lt. pushed about 4 inches at top, and spalled along joint and embankment material spilling through at bottom; #1 Rt. and #2 Rt. pushed 4 inches.

HEADWALLS: Some light to moderate scale on rt. headwall, and light scale on Lt. Spalled with exposed rebar along the bottom edge of both.

Conclusion and Recommendation: The single celled reinforced concrete box culvert was designed for dead load only (12-ft maximum fill, refer to plans attached), live load was neglected due to high fill. Fill over the box has increased since design/construction, resulting in insufficient capacity. Since the dead load alone exceeds capacity, the live load capacity results in 0. Therefore, it is highly recommended to significantly reduce live load capacity (#64 & 66), which is currently 80.1-tons at the inventory level and 89.9-tons at the operating level. However it is not recommended to reduce live load capacity to 0, because although calculations and analysis indicate so, engineering judgement must consider factor of safety and condition of the structure. In addition, a bridge structure would need to be immediately closed if a live load capacity of 0 was to be reported. Reducing the capacity to posted levels could be considered, however it would restrict usage to some trucks based on weight. In light of all considered, **it is recommended that capacity be reduced to 22-tons at the inventory level and 36-tons at the operating level.** This would more accurately represent capacity without requiring posted loads and avoiding closure of the structure, which in turn would also result in a more accurate sufficiency rating. It must also be noted and emphasized that this culvert is not a water-crossing, but serves as a service road for authorized state and emergency personnel. With the culvert serving as a live load underpass crossing, safety is crucial.

Based on insufficient capacity and conditions observed by Bridge Enterprise on 7/24/17, **it is recommended to lower both the culvert condition (#62) and the structural evaluation (#67) to 4 poor condition**. Spalls are greater than 1-inch deep and greater than 6-inches in diameter in some members/areas. Some patched areas were unsound, confirmed with hammer, and show signs of distress. Exposed rebar show section loss on bottom of top slab and areas on walls. Efflorescence areas show heavy build-up and rust staining. Many cracks were observed, with a few wide and migrating into heavy pattern cracking. Settling exceeds tolerable limits as indicated by the many shear cracks. See Photos 1-26 for inspection observations.

It is also highly recommended that vertical clearance signs be installed at both entrances of the culvert as it evident that live load has come in contact with the culvert as indicated by scrapes and damage to the bottom of the top slab. In addition, it would also be beneficial to install CDOT's signs that reads, "BOX DOWN, WING UP?" With I-70 being a high volume interstate, precautions should be taken to avoid further damage.

In regards to recommendations listed above regarding the sufficiency rating, several **scenarios were evaluated as shown in Table 1 on page 5.** Staff Bridge to make final determination as to which items should be revised.

	Lower operating (#64) to 22-tons and inventory (#66) to 36-tons	Lower culvert (#62) and str. eval. (#67) to 4 poor condition	Incorporating all recommendations
Current Sufficiency Rating	55	55	55
New Sufficiency Rating	40	40	25
Classification:	Functionally Obsolete	Structurally Deficient	Structurally Deficient

Table 1

Photo 1 WB shoulder at guardrail, erosion 15-inches deep

Photo 2 NW Wingwall, showing 1 large diagonal sealed fracture extending from top to bottom of wing and 1 smaller sealed horizontal crack

Photo 3 NW Wingwall showing sealed fracture, 4-iches of displacement

Photo 4 NW Wingwall showing diagonal 1/8-inch crack extending from joint to bottom

Photo 5 NW Wingwall at culvert joint, significant spalling

Photo 6 NE Wingwall, 1 diagonal crack extending from top to culvert joint, other vertical and horizontal sealed cracks migration

Photo 7 NE Wingwall, showing 3/8 to 1/2-inch crack with spalling in between migrating smaller crack, refer to photo 6

Photo 8 NE Wingwall, showing 1/2-inch crack at culvert joint, crack appears to be deep. Also showing spalling/scaling, refer to photo 6

Photo 9 North headwall/edge of top slab, exposed rebar, concrete at bottom spalled off at edge. Also showing scrapes from live load.

Photo 10 North End showing delamination/effloresence and scrapes from live load

Photo 11 West wall, vertical 1/4-inch shear crack migrating from top to bottom located at 26-ft from north end

Photo 12 Close up of 1/4-inch crack from Photo 11

Photo 13 West wall at 44-ft from north, spalled and exposed rebar

Photo 14 East Wall at 44- from North, spalled concrete. Construction joint not shown at this location on plans

Photo 15 East Wall/Top Slab at construction joint 53-ft from North. Actively leaking and showing stalactites, efflorescence, delamination

Photo 16 Top Slab at 85-ft from North (WB median) showing 1/2-inch to 2-inch shear crack migration from top slab down through wall

Photo 17 Top Slab at 90-ft from North (EB median), showing efflorescence, delamination, unsound and spalling, and large crack migration throughout entire top slab down through wall

Photo 18 Section loss, refer to photo 17

Photo 19 West Wall at 50-ft from south, showing vertical 1/2 to 3/4-inch shear crack

Photo 20 East Wall at 55-ft from south, showing 2-migrating cracks varying 1/8 to 1/2-inch and spalling

Photo 21 West Wall at 48-ft from south, showing multiple migrating cracks varying between 1/8 to 2-inches

Photo 22 West Wall at 22-ft from south, showing diagonal shear crack ranging from 1/8 to 4-inches, migrating from top to bottom, spalling

Photo 23 East Wall at 22-ft from south, showing diagonal shear crack ranging from 1/8 to 4-inches, migrating from wall into bottom slab

Photo 24 East Wall at south end showing concrete deterioration and section loss at bottom for several feet, heaving leakage

Photo 25 close up of photo 24, see video

Photo 26 Bottom edge of top slab at south send, major spalling with exposed rebar along entire edge

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

inspkey

Bridge Key: F-13-S_MINOR | Inspection Date: 04/03/2017 | Sufficiency Rating: 55 | FO

NBI Reporting ID:	F-13-S_MINOR
Rgn/Sect 2E/2M:	32
Tran Region 2T:	11
County Code 3:	117
SUMMIT	
Place Code 4:	00000
non-city	
Rte.(On/Under) 5A:	1
Signing Prefix 5B:	1
Level of Service 5C:	1
Direction Suffix 5E:	0
Feature Intersected 6:	
FOREST SERVICE ROAD	
Facility Carried 7:	
I 70 ML	
Alias Str No.8A:	
Prll Str No. 8P:	
N/A	
Location 9:	
2.6 MI W OF EISENHWR TUNL	
Max Clr 10:	99.99
BaseHiway Net12:	1
IrsinvRout 13A:	000000070A
IrssubRout No13B:	00
Latitude 16:	39d 39' 56.82"
Longitude 17:	105d 58' 39.99"
Range 18A:	77 W
Township 18B:	77
Section 18C:	35
Detour Length 19:	11 mi
Toll Facility 20:	3
Custodian 21:	01
Owner 22:	01
Functional Class 26:	01
Year Built 27:	1966
Lanes On 28A:	6
Lanes Under 28B:	1
ADT 29:	29,000
Year of ADT 30:	2011
Design Load 31:	5
Apr Rdwy Width 32:	84.00 ft
Median 33:	2
Skew 34:	1 °
Structure Flared 35:	0
Sfty Rail 36a/b/c/d:	1 1 1 1
Rail ht36h:	27.0 in

Hist Signif 37:	5
Posting status 41:	A
Service on/un 42A/B:	1 1
Main Mat/Desgn 43A/B:	1 19
Appr Mat/Desgn 44A/B:	0 0
Main Spans Unit 45:	1
Approach Spans 46:	0
Horiz Clr 47:	42.00 ft
Max Span 48:	20.0 ft
Str Length 49:	20.0 ft
Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft
Width Curb to Curb 51:	0.00 ft
Width Out to Out 52:	196.0 ft
Deck Area:	3907
Min Clr Ovr Brdg 53:	99.99
Min Undrclr Ref 54A:	H
Min Underclr 54B:	13.8 ft
Min Lat Clrnce Ref R 55A:	H
Min Lat Undrclr R 55B:	1.0 ft
Min Lat Undrclr L 56:	0.0 ft
Deck 58:	N
Super 59:	N
Sub 60:	N
Channel/Protection 61:	N
Culvert 62:	5
Oprtng Rtg Method 63:	1 LF Load Factc
Operating Rating 64:	89.9
Inv Rtng Method 65:	1 LF Load Factc
Inventory Rating 66:	80.1
Asph/Fill Thick 66T:	200.0 in
Str. Evaluation 67:	5
Deck Geometry 68:	N
Undrclr Vert/Hor 69:	3
Posting 70:	5
Waterway Adequacy 71:	N
Approach Alignment 72:	8
Type Of Work 75A:	-1
Work Done By 75B:	!
Length of Improvment 76:	0
Insp Team Indicator 90B:	BLUE TEAM
Inspector Name 90C:	MAESA
Frequency 91:	24 months
FC Frequency 92A:	
UW Frequency 92B:	
SI Frequency 92C:	
FC Inspection Date 93A:	

UW Inspection Date 93B:	
SI Date 93C:	
Bridge Cost 94:	$0
Roadway Cost 95:	$0
Total Cost 96:	$0
Year of Cost Estimate 97:	1980
Brdr Brdg Code/% 98A/B:	-2
Border Bridge Number 99:	
Defense Highway 100:	1
Parallel Structure 101:	N
Direction of Traffic 102:	2
Temporary Structure 103:	!
Highway Systems 104:	1
Fed Lands Hiway 105:	0
Year Reconstructed 106:	
Deck Type 107:	N
Wearing Surface 108A:	N
Membrane 108B:	N
Deck Protection 108C:	N
Truck ADT 109:	10.00 %
Trk Net 110:	1
Pier Protection 111:	1
NBIS Length 112:	Y
Scour Critical 113:	N
Scour Watch 113M:	_
Future ADT 114:	43,500
Year of Future ADT 115:	2031
CDOT Str Type 120A:	CBC
CDOT Constr Type 120B:	2.
Inspection Indic 122A:	_
Inspection Trip 122AA:	0.00
Scheduling Status 122B:	0
Maintenance Patrol 123:	9
Expansion Dev/Type 124:	N
Brdg Rail Type/Mod 125A/B:	FB 0
Posting Trucks 129A/B/C:	0.0 0.0 0.0
Str Rating Date 130:	01/28/1997
Special Equip 133:	Unknown
Vert Clr N/E 134A/B/C:	X 99.99 0.00
Vert Clr S/W 135A/B/C:	X 99.99 0.00
Vertical Clr Date:	02/22/1991
Weight Limit Color 139:	0
Str Billing Type:	U
Userkey 1, Insp System:	ONSYS
Userkey 4, Insp Sched:	ODD JUN F_2
Userkey 5, Pin Sched:	
Userkey 7, 113 Doc Date:	
Inspection Key:	OISQ

Inspector Name:	MAESA

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A
Mile Post (ON) 11: 211.005 mi

inspkey

Element Inspection Report

Elm/Env	Description	Unit	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4
241/1	**Re Conc Culvert**	**ft**	196	72%	141	10%	20	18%	35	0%	0

Vert. cracks in both walls widen to 1/2 inch with spalled edges near base at 22 ft. (PHOTOS 6/05 & 6/07) & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other light to moderate vert. cracks, & many minor scrapes on both walls.

Top slab has 8-10 longit. cracks actively leaking, and some delam. with efflor., especially at cold joints. Top slab is spalled (spot with exposed rebar), cracked, and delaminated at elevation change below median with active leaking. (See 1995, 2007, and 2009 Photos) Lower soffit section (below EBND lanes) has full length horizontal crack in facia where slab changes elevation in midsection of cell. Crack is open over 1/2 inch and shows heavy efflor and active leakage. Top slab is delaminated/spalled at ends below both headwalls, with exposed corroded rebar. (See 2007 & 2009 Photos) Top slab has been blackened by diesel exhaust.

Bottom slab partially covered with asphalt. Visible concrete is worn, and there is 25 ft. of spalls near left end, half have rebar exposed. (Could not see due to ice and snow cover during 2013 inspection)

9327/1	**Culvert Wingwalls**	**(EA)**	4	25%	1	75%	3	0%	0	0%	0

Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched.
Couple of cracks in #2 Lt.; one with efflor., and one heavy diagonal crack (open to 3/16 inch) and chipping along edges, and #2 Lt. also spalled at end.
Scrapes and chips along both wings on Lt.
Some light scale, minor scrapes, and minor spalls on #1 Rt. wingwall.
Few vert. cracks some with efflor. in both wings on right.
Minor erosion behind all.
#1 Lt. pushed slightly at top; #2 Lt. pushed about 4 inches at top, and spalled along joint and embankment material spilling through at bottom; #1 Rt. and #2 Rt. pushed 4 inches.

9335/1	**Culvert Headwalls**	**(EA)**	2	50%	1	50%	1	0%	0	0%	0

Some light to moderate scale on rt. headwall, and light scale on Lt. Spalled with exposed rebar along the bottom edge of both.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
358.05	Converted Work Candidates	4/11/2001	-1	2015	1000

Seal cracks in culvert walls.

358.05	Converted Work Candidates	6/14/2005	-1	2015	2000

Remove and replace delaminating concrete in floor of culvert where it is spalling with exposed rebar.

Colorado Department of Transportation

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

Structure Inspection and Inventory Report (English Units)

inspkey

358.06	Converted Work Candidates	4/11/2001	-1	2015	2500

Anchor wingwalls with dead-man cables to stabilize movement.

360.03	Converted Work Candidates	6/16/2009	-1	2015	3500

Replace fill that has washed away from roadway embankment for Westbound I-70 traffic above culvert, and at fwd end. Consider building up curbs along Lt. rail (WBnd traffic) and direct flow down a beaver slide.

Bridge Notes

About 2 ft. deep erosion trough in roadway embankment for WBnd I-70 traffic above CBC (washing around 4 posts), and several spots at Lt. fwd end. (See 2009 Photo) It starts at edge of asphalt and exposes 2 ft. of flex beam rail post.

10/2009: Reviewed and Item112 determined to be long enough.

In the #2 lane just west of the CBC, there is a broken post in the guardrail.

Inspection Notes

Temperature: 31 Degrees
Time: 2:00 pm
Weather: P/C

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

inspkey

Scope:

☑ NBI ☑ Element ☐ Underwater ☐ Fracture Critical ☐ Other Type: Regular NBI

Team Leader Inspection Check-off:

☐ FCM's
☐ Posting Signs
☐ Essential Repair Verification
☐ Vertical Clearance
☐ Stream Bed Profile

Inspection Team: BLUE TEAM

Inspection Date: 04/03/2017

Inspector: A. Maes

Inspector (Team Leader): ALVIN MAES

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO	I 70-3(22)217	1

Rev. Length, 7-1-63 J.R.W.
Rev. Index, 8-19-63, J.R.W.

COLORADO DEPARTMENT OF HIGHWAYS

R.O.W. Acquired Under I 70-3(16)212

AS CONSTRUCTED
REVISED DATE JAN 3 1967

PLAN AND PROFILE OF PROPOSED
FEDERAL AID PROJECT NO. I 70-3(22)217
STATE HIGHWAY NO. 91
SUMMIT COUNTY
AS CONSTRUCTED
REVISED JAN 3 1967

SCALES OF ORIGINAL DRAWINGS

ON PLAN, 1 IN. = 100 FT.
ON PROFILE, 1 IN. = 100 FT. HORIZONTAL; 1 IN. = 10 FT. VERTICAL

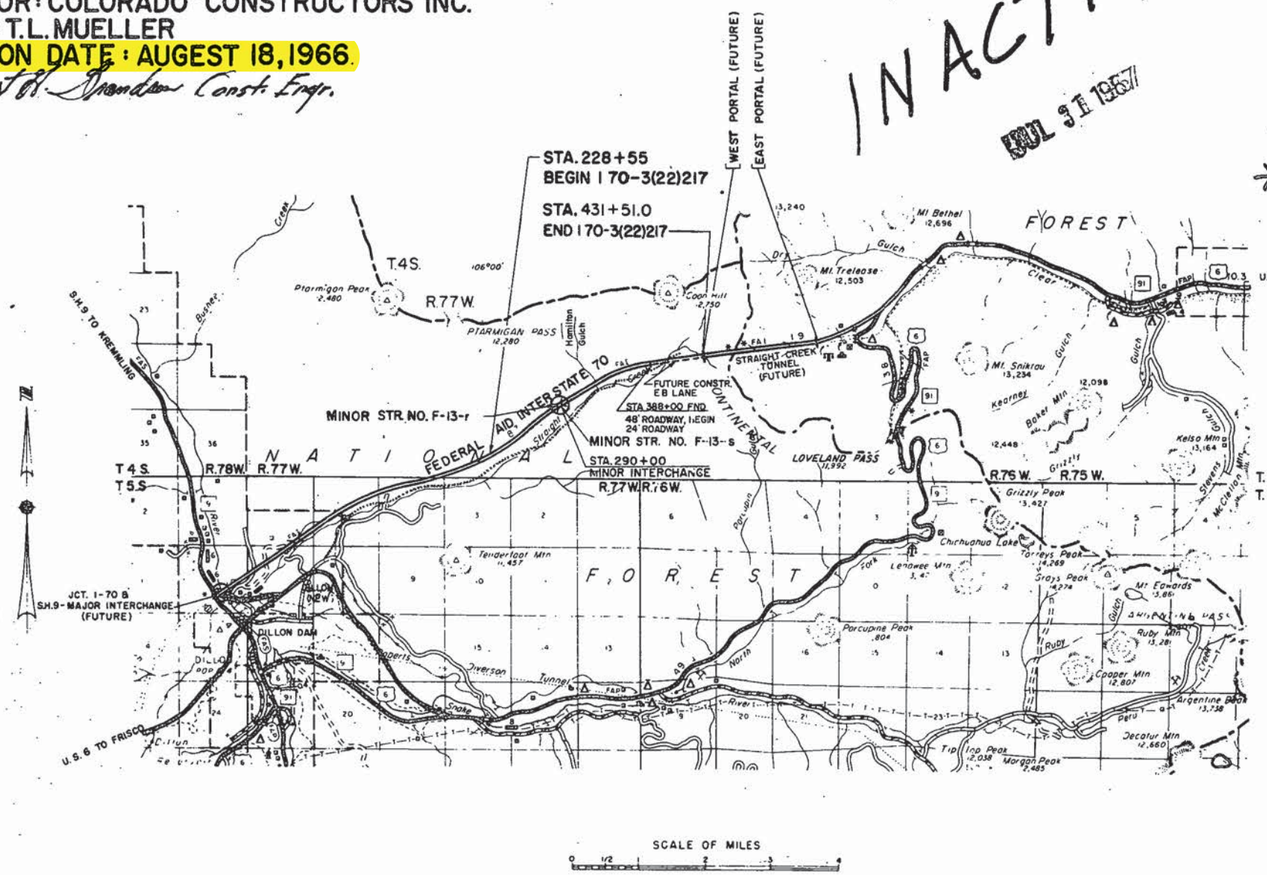
GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD.
GROSS LENGTH OF PROJECT } 20,307.5 FT. = 3.846 MILES
NET LENGTH OF PROJECT }

INACTIVE
JUL 3 1 1967

CONVENTIONAL SIGNS

CENTER LINE (PLAN SHEET ℄ / BEGIN PROJ. TITLE SHEET END PROJ.)
COUNTY LINE
TOWNSHIP OR RANGE LINE
LAND LINES (SECTION LINE, ¼ SECTION LINE, ⅛ SECTION LINE)
CITY LIMITS
RAILROAD (PLAN SHEET / TITLE SHEET)
BARBED WIRE FENCE
WOVEN WIRE - COMBINATION FENCE
TELE. & TELEG. LINE
POWER LINE
PRESENT ROAD (PLAN SHEETS)
RIGHT OF WAY LINE (R.O.W. MARKER)
ACCESS POINTS (FREEWAYS)
C OF A. LINE (CONTROL OF ACCESS) (26' OP. / OP-OPENING / 16' OP)
ACCESS DENIED BY DEED
TOP OF CUTS
TOE OF FILLS
DETOUR

CONTRACTOR: COLORADO CONSTRUCTORS INC.
ENGINEER: T.L. MUELLER
COMPLETION DATE: AUGEST 18, 1966.
Robert H. Brandon Const. Engr.



SCALE OF MILES
0 1/2 1 2 3 4

INDEX OF SHEETS

* No. 23x is not in this set. 3/14/67

SEE SPECIAL PROVISIONS FOR NOTICE TO BIDDERS

COLORADO
DEPARTMENT OF HIGHWAYS

APPROVED: Merrill A. Mechlin 5-1-63
CHIEF ENGINEER DATE

DONALD C. SUTHERLAND, INC.
CONSULTING CIVIL ENGINEERS
DENVER COLORADO

Dec. 27, 1962
SUBMITITED BY: DONALD C. SUTHERLAND 375 REGISTERED PROFESSIONAL ENGINEER AND LAND SURVEYOR STATE OF COLORADO
DATE
Donald C. Sutherland
P.E. & L.S. COLO # 375

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

APPROVED: _____ DATE

_____
DIVISION ENGINEER

PLEASE DO NOT FOLD

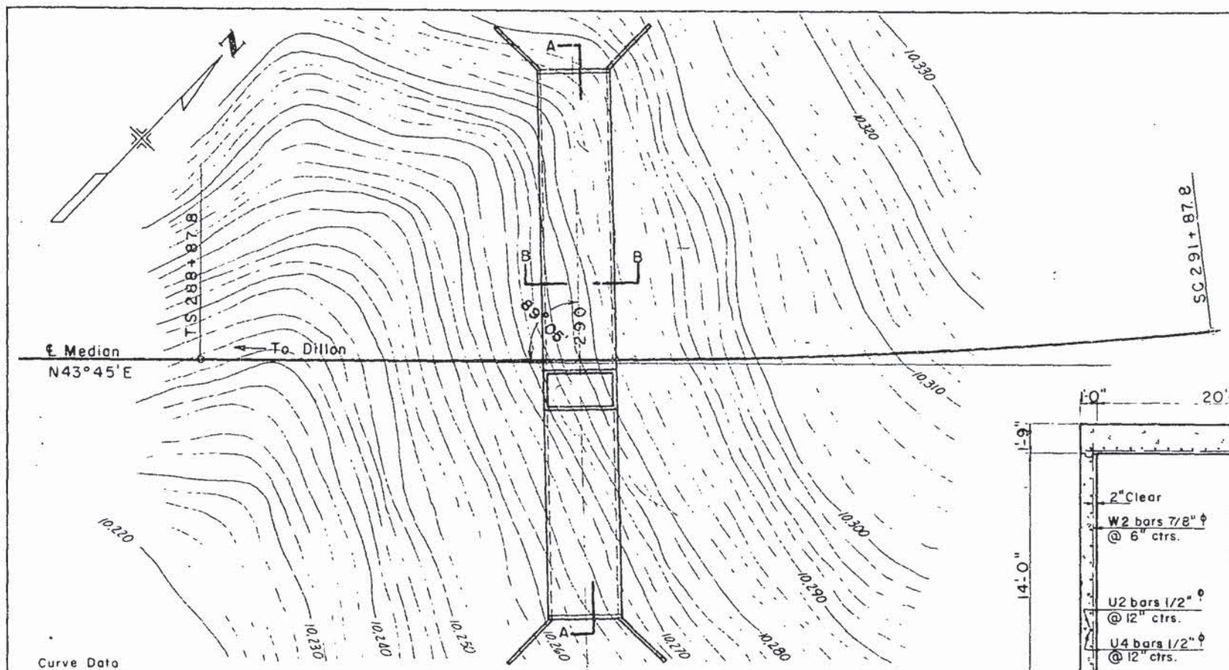
2-15-67

REVISIONS

Rev 5/18/64 New Sheet to include W.O. No 653- W.E.M.

FED ROAD DIV NO	DISTRICT	PROJECT NO	SHEET NO	TOTAL SHEETS
9	COLO.	170-3(22)217	13	

REVISIONS		
4-20-64	LENGTH & QUAN.	SRM

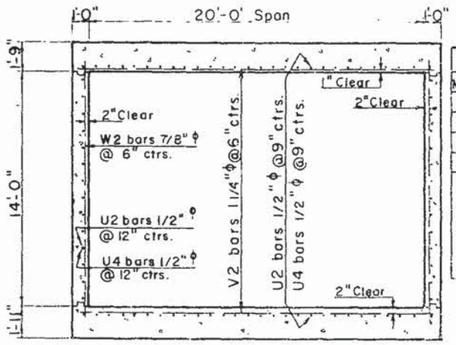


Curve Data
Δ 22°29'42" L
Ts 435.3'

Δc 10°29'42" Θs 6°00'
Dc 4°00' Ls 300'
Lc 262.4' LT 200.1'
Rc 1432.5' ST. 100.1'

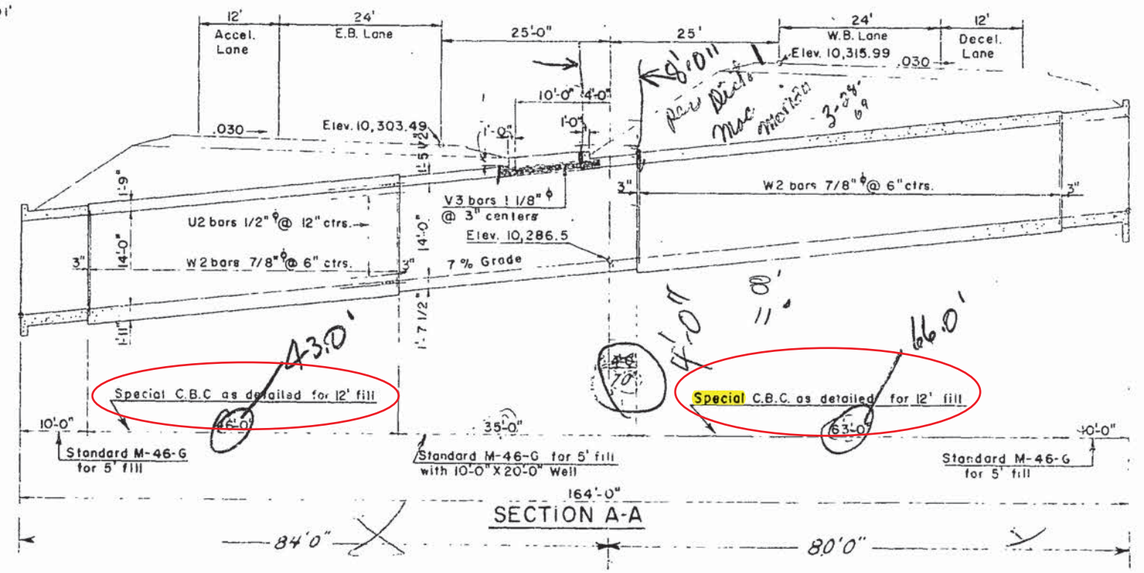
HSD 850.0'
S .080'
MDS 65 MPH

PLAN



BAR LIST FOR DAYLIGHT OPENING					BAR LIST FOR 46' SPECIAL C.B.C.					BAR LIST FOR 63' SPECIAL C.B.C.				
Mark	Size	No. Reqd.	Type	Length	Mark	Size	No. Reqd	Type	Length	Mark	Size	No. Reqd	Type	Length
V3.1	1/8"	12	Straight	14'-0"	V2	1 1/4"	184	Straight	21'-8"	V2	1 1/4"	252	Straight	21'-8"
					W2	7/8"	184	"	17'-3"	W2	7/8"	252	"	17'-3"
					U2	1/2"	168	"	24'-2"	U4	1/2"	168	"	32'-8"
SUMMARY					SUMMARY					SUMMARY				
168 Lin. Ft. 1 1/8" ϕ bars @ 2.8 = 471					4060 Lin. Ft. 1/2" ϕ bars @ 0.668 = 2712					5488 Lin. Ft. 1/2" ϕ bars @ 0.668 = 3666				
Plus 1% for overrun = 5					3174 Lin. Ft. 7/8" ϕ bars @ 2.044 = 6488					4347 Lin. Ft. 7/8" ϕ bars @ 2.044 = 8885				
Total = 476					3987 Lin. Ft. 1 1/4" ϕ bars @ 4.303 = 17156					5460 Lin. Ft. 1 1/4" ϕ bars @ 4.303 = 23495				
					Plus 1% for overrun = 264					Plus 1% for overrun = 360				
					Total = 26620					Total = 36406				

SECTION B-B



SECTION A-A

SUMMARY OF QUANTITIES FOR ENTIRE STRUCTURE

Item	Description	Unit	46' C.B.C. 12' Fill	63' C.B.C. 12' Fill	55' C.B.C. 5' Fill	2 Headwalls & 4 Wings	Total Quantity
46	Class A Concrete	Cu.Yd	186	254	189	73	702
47.	Reinforcing Steel (incl. 1% overrun)	Lbs.	26,620	36,405	26,166	6560	95,752
Ⓞ	1/2" Expansion joint material (Type III)	Sq.Ft				66	66

Ⓞ Include in bid price of Class A Concrete

Note: General notes and details of 20' X 14' Concrete Box Culvert under a 5 foot fill are shown on Standard M-46-G.

Side walls and bottom through daylight section conform to Standard M-46-G.

GENERAL NOTES

LOADING DATA.
LIVE LOAD A.A.S.H.O. 1944 M20-44
DEAD LOAD ASSUMES 18 LBS. PER SQ. FT. ADDITIONAL WEARING SURFACE WHICH INCLUDES THE 9 INCH CONCRETE MONOLITHIC WEARING SURFACE SHOWN.

DESIGNING DATA.
A.A.S.H.O. 1944 UNIT STRESSES
fc 1,000 Lbs. per Sq. In.
fs 20,000 Lbs. per Sq. In.
n = 10

COLORADO DEPARTMENT OF HIGHWAYS

GENERAL LAYOUT & DETAILS OF 20'x14' CONCRETE BOX CULVERT (109' LENGTH UNDER 12' FILL)

Across Forest Road
Sta. 290+00
Near Dillon Sec. 35 T. 4 S. R. 77 W

Designed by JWM	Approved by
Made by SRM	Bridge Engineer
Checked by	Date. 19

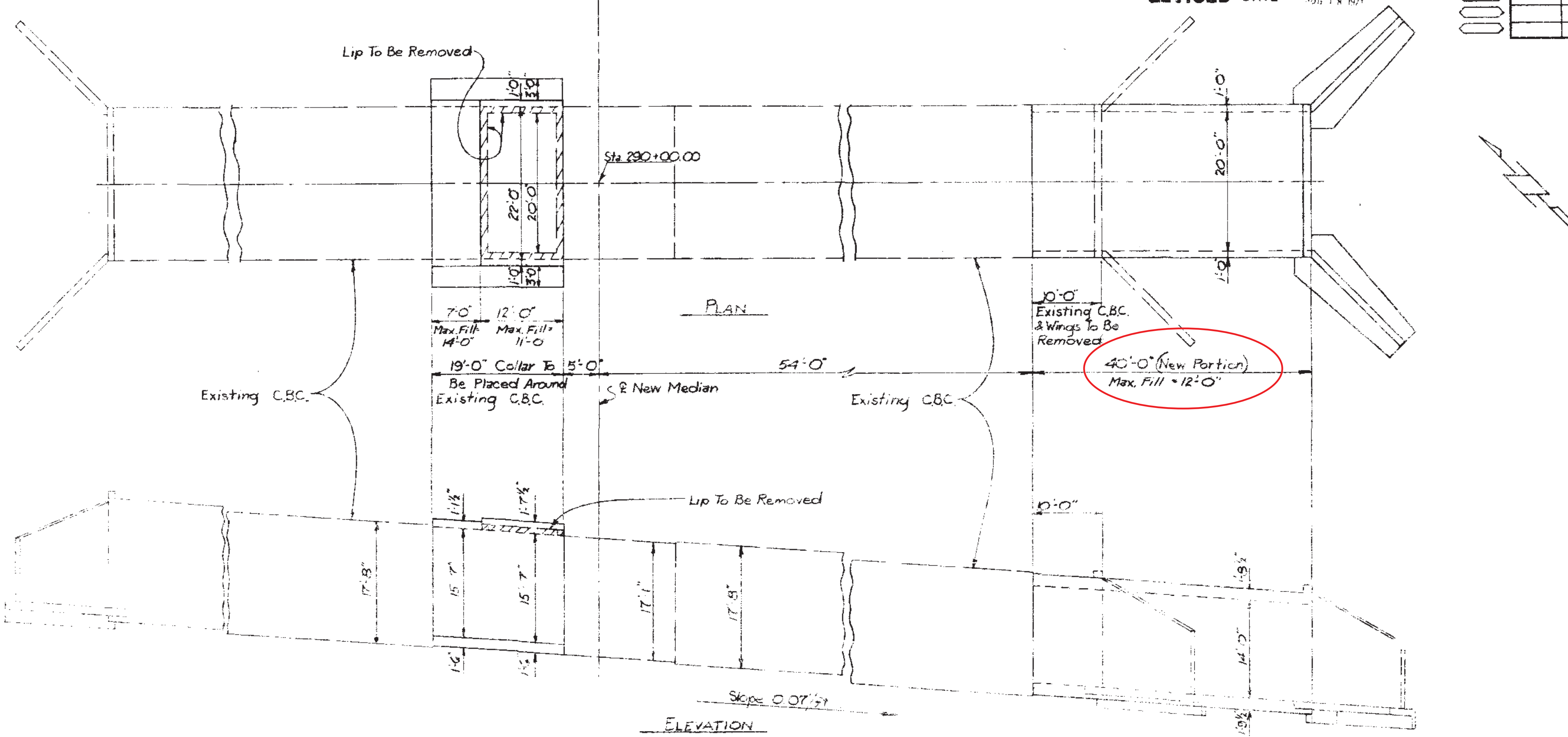
STRUCTURE NO. F-13-S

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 70-3(66)212	15	

AS CONSTRUCTED
REVISED DATE AUG 18 1971

REVISIONS



See Sheet No. for General Notes.

SUMMARY of QUANTITIES

Item No.	Description	Unit	Collar	C.B.C. Extension	Headwalls & 2 Wingwalls	Total	Book	Page	Sheet
201	Removal of Portions of Present Struct.	Ea.				1	7	7	
601	Concrete Class "A"	C.Yd.	54.7	151.7	36.6	243	7	7	
602	Reinforcing Steel	Lb.	7601	[illegible]	3230	24762	7	7	
[illegible]	[illegible]	Sq.Ft.			35	35	7	7	

[illegible] Included In The Bid Price For Item No. 601 Concrete Class "A"

[illegible]

DESIGNED BY	JLB	3-69
CHECKED BY	RJS	
DETAILED BY	EPA	4-69
QUANTITIES BY	RJS	
CHECKED BY	TCF	4-69

DIVISION OF HIGHWAYS

Construction Layout
Summary of Quantities
[illegible]

Approval:
Bridge Engineer
Date:
Designer: JLB
Detailer: EPA
Structure Number: F-13-S
DWG. No. B 1 OF 3

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS – STATE OF COLORADO
FORM 117
JULY 1958

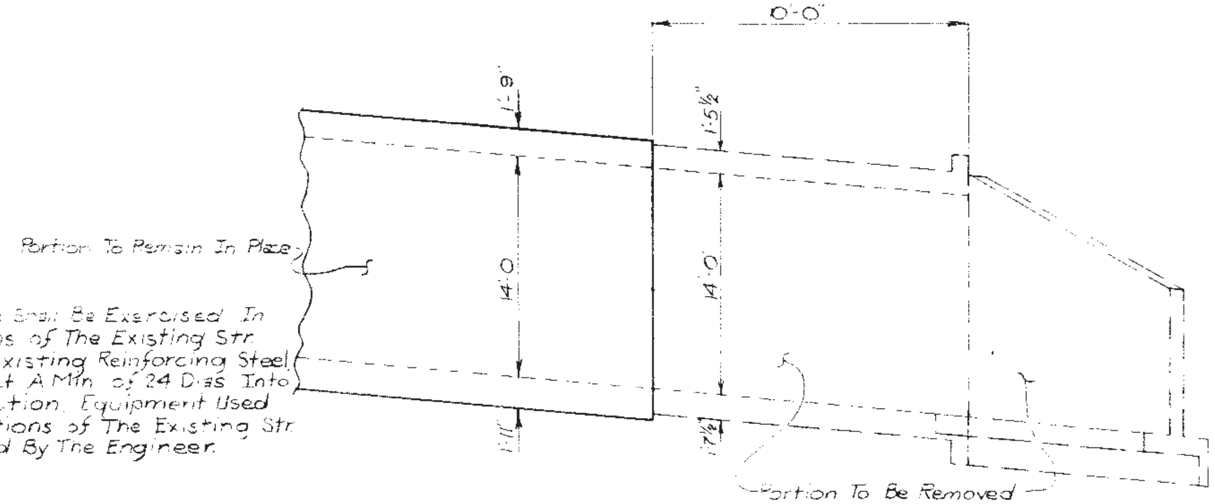
FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I70-3(60)212	16	

REVISIONS

AS CONSTRUCTED
REVISED DATE

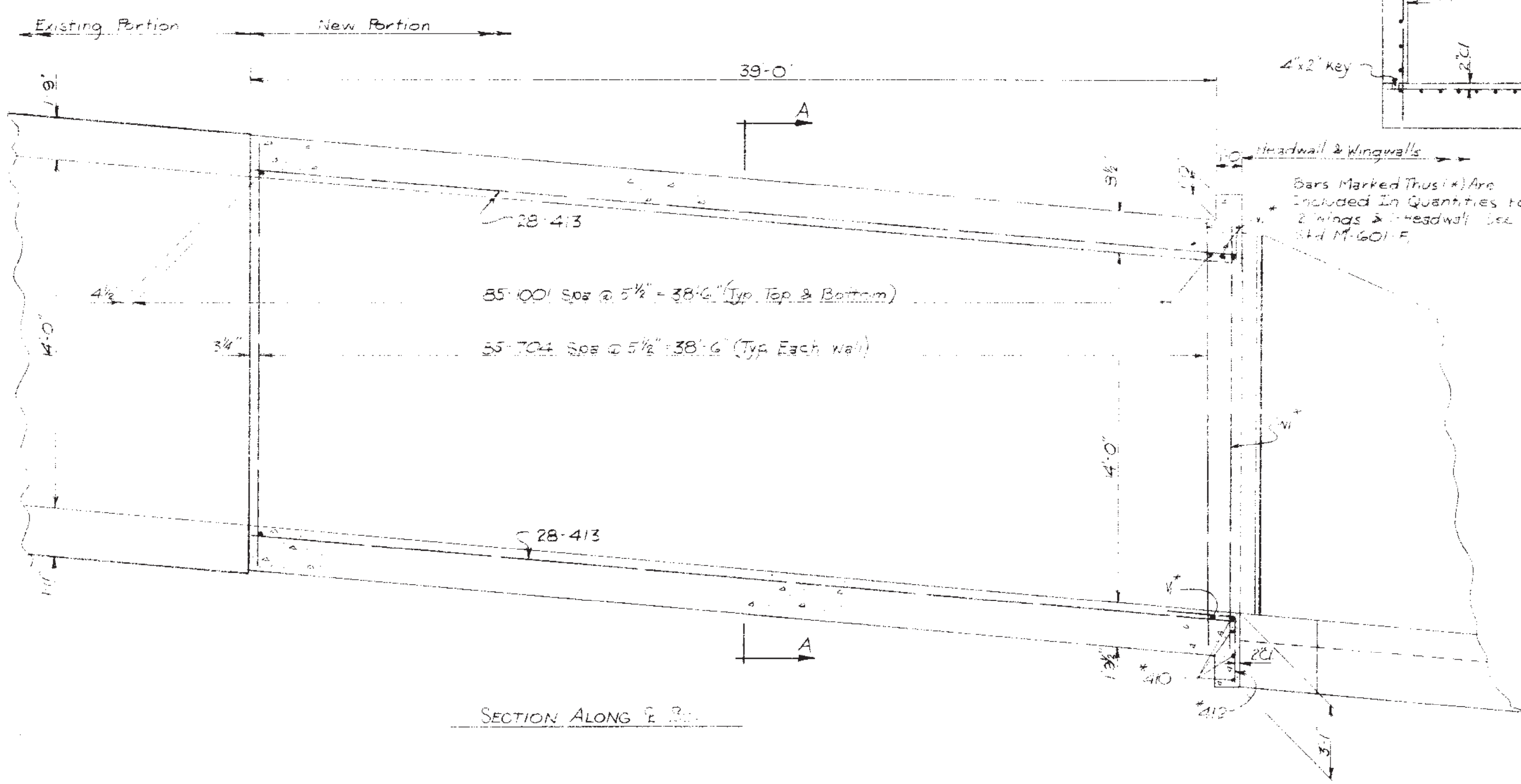
DESIGNED BY	INITIAL JLB	DATE 3-69	CHECKED BY	TCF	4-69
CHECKED BY			QUANTITIES BY		
DETAILED BY	EPA	4-69	CHECKED BY	TCF	

Note: Special Care Shall Be Exercised In Removing Portions of The Existing Str. To Preserve The Existing Reinforcing Steel Which Shall Project A Min. of 24 Dias Into The New Construction. Equipment Used In Removing Portions of The Existing Str. Shall Be Approved By The Engineer.



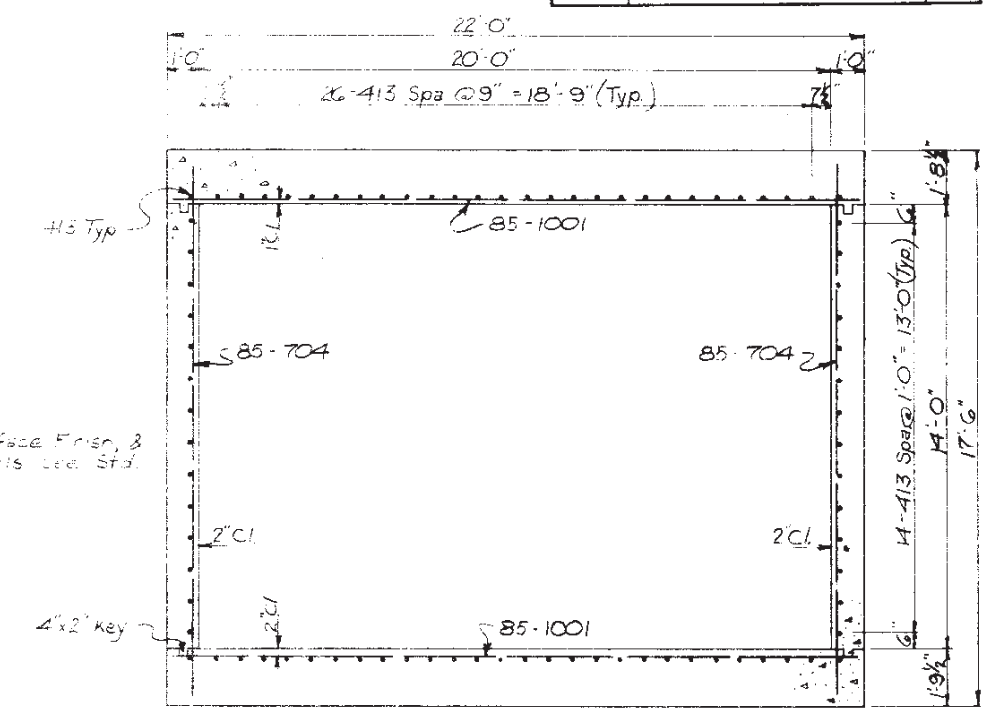
REMOVAL DETAILS

For Headwall, Wingwall, Surface Finish, & Indentured Year No. Details See Std. M-601-F (Use H = 14'-0")



SECTION ALONG ℄ BBL.

Bars Marked Thus (*) Are Included In Quantities for 2 Wings & 1 Headwall See Std. M-601-F.



SECTION AA

Book #7 Page 13

BAR LIST — OUTLET

Mark	No. Req'd	Length	Type	Dimensions l	m
413	84	39' 6"	Str.		
704	170	17'-0"	Str		
1001	170	21'-8"	Str.		

Bar Summary
3332 L.F. ½"ϕ @ 0.668#/ft. = 2226 lbs.
2890 L.F. ⅞"ϕ @ 2.044#/ft. = 5907 lbs.
3683 L.F. 1¼"ϕ @ 4.303#/ft = 15,848 lbs.
Total = 23,981 lbs.

DIVISION OF HIGHWAYS

OUTLET DETAILS
REMOVAL DETAILS
CBC EXTENSION
(290+)

Approved: [signature] P.E.
Bridge Engineer
Date: Apr. 25, 1969

Designer: JLB
Detailer: EPA
Structure Numbers: F-13-S

DWG. No. B 2 OF 3

PREVIOUS INSPECTION REPORTS

Routine Inspection
Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

Bridge Key: F-13-S_MINOR | Inspection Date: 04/03/2017 | Sufficiency Rating: 39.0 | SD

NBI Reporting ID:	F-13-S_MINOR
Rgn/Sect 2E/2M:	32
Tran Region 2T:	11
County Code 3:	117
SUMMIT	
Place Code 4:	00000
non-city	
Rte.(On/Under) 5A:	1
Signing Prefix 5B:	1
Level of Service 5C:	1
Direction Suffix 5E:	0
Feature Intersected 6:	
FOREST SERVICE ROAD	
Facility Carried 7:	
I 70 ML	
Alias Str No.8A:	
Prll Str No. 8P:	
N/A	
Location 9:	
2.6 MI W OF EISENHWR TUNL	
Max Clr 10:	99.99
BaseHiway Net12:	1
IrsinvRout 13A:	000000070A
IrssubRout No13B:	00
Latitude 16:	39d 39' 56.82"
Longitude 17:	105d 58' 39.99"
Detour Length 19:	11 mi
Toll Facility 20:	3
Custodian 21:	01
Owner 22:	01
Functional Class 26:	01
Year Built 27:	1966
Lanes On 28A:	6
Lanes Under 28B:	1
ADT 29:	29,000
Year of ADT 30:	2011
Design Load 31:	5 MS 18 (HS 20)
Apr Rdwy Width 32:	84.00 ft
Median 33:	2
Skew 34:	1 °
Structure Flared 35:	0
Sfty Rail 36a/b/c/d:	1 1 1 1
Rail ht36h:	27.0 in
Hist Signif 37:	5
Posting status 41:	A
Service on/un 42A/B:	1 1

Main Mat/Desgn 43A/B:	1 19
Appr Mat/Desgn 44A/B:	0 0
Main Spans Unit 45:	1
Approach Spans 46:	0
Horiz Clr 47:	42.00 ft
Max Span 48:	20.0 ft
Str Length 49:	20.0 ft
Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft
Width Curb to Curb 51:	0.00 ft
Width Out to Out 52:	196.0 ft
Deck Area:	3907
Min Clr Ovr Brdg 53:	99.99
Min Undrclr Ref 54A:	H
Min Underclr 54B:	13.8 ft
Min Lat Clrnce Ref R 55A:	H
Min Lat Undrclr R 55B:	1.0 ft
Min Lat Undrclr L 56:	0.0 ft
Deck 58:	N
Super 59:	N
Sub 60:	N
Channel/Protection 61:	N
Culvert 62:	4
Oprtng Rtg Method 63:	1 LF Load Factc
Operating Rating 64:	89.9
Operating Factor 64:	
Inv Rtng Method 65:	1 LF Load Factc
Inventory Rating 66:	80.1
Inventory Factor 66:	
Asph/Fill Thick 66T:	200.0 in
Str. Evaluation 67:	4
Deck Geometry 68:	N
Undrclr Vert/Hor 69:	3
Posting 70:	5 At/Above Lega
Waterway Adequacy 71:	N
Approach Alignment 72:	8
Type Of Work 75A:	-1
Work Done By 75B:	!
Length of Improvment 76:	0
Insp Team Indicator 90B:	BLUE TEAM
Inspector Name 90C:	MAESA
Frequency 91:	24 months
FC Frequency 92A:	
UW Frequency 92B:	
SI Frequency (Pin) 92C:	
FC Inspection Date 93A:	
UW Inspection Date 93B:	
SI Date (Pin) 93C:	

Bridge Cost 94:	$0
Roadway Cost 95:	$0
Total Cost 96:	$0
Year of Cost Estimate 97:	1980
Brdr Brdg Code/% 98A/B:	-2
Border Bridge Number 99:	
Defense Highway 100:	1
Parallel Structure 101:	N
Direction of Traffic 102:	2
Temporary Structure 103:	!
Highway Systems 104:	1
Fed Lands Hiway 105:	0
Year Reconstructed 106:	
Deck Type 107:	N
Wearing Surface 108A:	N
Membrane 108B:	N
Deck Protection 108C:	N
Truck ADT 109:	10.00 %
Trk Net 110:	1
Pier Protection 111:	1
NBIS Length 112:	Y
Scour Critical 113:	N
Scour Watch 113M:	_
Future ADT 114:	43,500
Year of Future ADT 115:	2031
CDOT Str Type 120A:	CBC
CDOT Constr Type 120B:	2.
Inspection Indic 122A:	_
Inspection Trip 122AA:	0.00
Scheduling Status 122B:	0
Maintenance Patrol 123:	9
Expansion Dev/Type 124:	N
Brdg Rail Type/Mod 125A/B:	FB 0
Posting Trucks 129A/B/C:	0.0 0.0 0.0
Str Rating Date 130:	01/28/1997
Special Equip 133:	Unknown
Vert Clr N/E 134A/B/C:	X 99.99 0.00
Vert Clr S/W 135A/B/C:	X 99.99 0.00
Vertical Clr Date:	02/22/1991
Weight Limit Color 139:	0, White
Str Billing Type:	U
Userkey 1, Insp System:	ONSYS
Userkey 4, Insp Sched:	ODD JUN F_2
Userkey 5, UW Sched:	
Userkey 6, Pin Sched:	
Userkey 7, 113 Doc Date:	
Inspection Key:	OISQ

Inspection Type:	Regular NBI
Inspector Name:	MAESA

Data Responsibility: Asset Management | Inspection | Rating

Element Inspection Report

Elm/Env	Description	Unit	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4
241/1	**Re Conc Culvert**	**ft**	196	72%	141	10%	20	18%	35	0%	0

Vert. cracks in both walls widen to 1/2 inch with spalled edges near base at 22 ft. (PHOTOS 6/05 & 6/07) & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other light to moderate vert. cracks, & many minor scrapes on both walls.

Top slab has 8-10 longit. cracks actively leaking, and some delam. with efflor., especially at cold joints. Top slab is spalled (spot with exposed rebar), cracked, and delaminated at elevation change below median with active leaking. (See 1995, 2007, and 2009 Photos) Lower soffit section (below EBND lanes) has full length horizontal crack in facia where slab changes elevation in midsection of cell. Crack is open over 1/2 inch and shows heavy efflor and active leakage. Top slab is delaminated/spalled at ends below both headwalls, with exposed corroded rebar. (See 2007 & 2009 Photos) Top slab has been blackened by diesel exhaust.

Bottom slab partially covered with asphalt. Visible concrete is worn, and there is 25 ft. of spalls near left end, half have rebar exposed. (Could not see due to ice and snow cover during 2013 inspection)

9327/1	**Culvert Wingwalls**	**(EA)**	4	25%	1	75%	3	0%	0	0%	0

Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched.
Couple of cracks in #2 Lt.; one with efflor., and one heavy diagonal crack (open to 3/16 inch) and chipping along edges, and #2 Lt. also spalled at end.
Scrapes and chips along both wings on Lt.
Some light scale, minor scrapes, and minor spalls on #1 Rt. wingwall.
Few vert. cracks some with efflor. in both wings on right.
Minor erosion behind all.
#1 Lt. pushed slightly at top; #2 Lt. pushed about 4 inches at top, and spalled along joint and embankment material spilling through at bottom; #1 Rt. and #2 Rt. pushed 4 inches.

9335/1	**Culvert Headwalls**	**(EA)**	2	50%	1	50%	1	0%	0	0%	0

Some light to moderate scale on rt. headwall, and light scale on Lt. Spalled with exposed rebar along the bottom edge of both.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
358.05	Converted Work Candidates	4/11/2001	-1	2015	1000

Seal cracks in culvert walls.

358.05	Converted Work Candidates	6/14/2005	-1	2015	2000

Remove and replace delaminating concrete in floor of culvert where it is spalling with exposed rebar.

358.06	Converted Work Candidates	4/11/2001	-1	2015	2500

Anchor wingwalls with dead-man cables to stabilize movement.

360.03	Converted Work Candidates	6/16/2009	-1	2015	3500

Replace fill that has washed away from roadway embankment for Westbound I-70 traffic above culvert, and at fwd end. Consider building up curbs along Lt. rail (WBnd traffic) and direct flow down a beaver slide.

Bridge Notes

About 2 ft. deep erosion trough in roadway embankment for WBnd I-70 traffic above CBC (washing around 4 posts), and several spots at Lt. fwd end. (See 2009 Photo) It starts at edge of asphalt and exposes 2 ft. of flex beam rail post.

10/2009: Reviewed and Item112 determined to be long enough.

In the #2 lane just west of the CBC, there is a broken post in the guardrail.

Inspection Notes

10-2-2017 - LEC, after a Sufficiency Rating Review based on a report from the Region, F-13-S_MINOR MISC Sufficiency Rating and Inspection 2017 07 24, dated 7-24-2017, Item 62 was changed to 4.

Temperature: 31 Degrees
Time: 2:00 pm
Weather: P/C

Routine Inspection
Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A
Mile Post (ON) 11: 211.005 mi

Scope:

☑ NBI ☑ Element ☐ Underwater ☐ Fracture Critical ☐ Other Type: Regular NBI

Team Leader Inspection Check-off:

☐ FCM's
☐ Posting Signs
☐ Essential Repair Verification
☐ Vertical Clearance
☐ Stream Bed Profile

Inspection Team: BLUE TEAM

Inspection Date: 04/03/2017

Inspector: A. Maes

Inspector (Team Leader): ALVIN MAES

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

inspkey

Bridge Key: F-13-S_MINOR | Inspection Date: 04/03/2017 | Sufficiency Rating: 55 | FO

NBI Reporting ID:	F-13-S_MINOR
Rgn/Sect 2E/2M:	32
Tran Region 2T:	11
County Code 3:	117
SUMMIT	
Place Code 4:	00000
non-city	
Rte.(On/Under) 5A:	1
Signing Prefix 5B:	1
Level of Service 5C:	1
Direction Suffix 5E:	0
Feature Intersected 6:	
FOREST SERVICE ROAD	
Facility Carried 7:	
I 70 ML	
Alias Str No.8A:	
Prll Str No. 8P:	
N/A	
Location 9:	
2.6 MI W OF EISENHWR TUNL	
Max Clr 10:	99.99
BaseHiway Net12:	1
IrsinvRout 13A:	000000070A
IrssubRout No13B:	00
Latitude 16:	39d 39' 56.82"
Longitude 17:	105d 58' 39.99"
Range 18A:	77 W
Township 18B:	77
Section 18C:	35
Detour Length 19:	11 mi
Toll Facility 20:	3
Custodian 21:	01
Owner 22:	01
Functional Class 26:	01
Year Built 27:	1966
Lanes On 28A:	6
Lanes Under 28B:	1
ADT 29:	29,000
Year of ADT 30:	2011
Design Load 31:	5
Apr Rdwy Width 32:	84.00 ft
Median 33:	2
Skew 34:	1 °
Structure Flared 35:	0
Sfty Rail 36a/b/c/d:	1 1 1 1
Rail ht36h:	27.0 in

Hist Signif 37:	5
Posting status 41:	A
Service on/un 42A/B:	1 1
Main Mat/Desgn 43A/B:	1 19
Appr Mat/Desgn 44A/B:	0 0
Main Spans Unit 45:	1
Approach Spans 46:	0
Horiz Clr 47:	42.00 ft
Max Span 48:	20.0 ft
Str Length 49:	20.0 ft
Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft
Width Curb to Curb 51:	0.00 ft
Width Out to Out 52:	196.0 ft
Deck Area:	3907
Min Clr Ovr Brdg 53:	99.99
Min Undrclr Ref 54A:	H
Min Underclr 54B:	13.8 ft
Min Lat Clrnce Ref R 55A:	H
Min Lat Undrclr R 55B:	1.0 ft
Min Lat Undrclr L 56:	0.0 ft
Deck 58:	N
Super 59:	N
Sub 60:	N
Channel/Protection 61:	N
Culvert 62:	5
Oprtng Rtg Method 63:	1 LF Load Factc
Operating Rating 64:	89.9
Inv Rtng Method 65:	1 LF Load Factc
Inventory Rating 66:	80.1
Asph/Fill Thick 66T:	200.0 in
Str. Evaluation 67:	5
Deck Geometry 68:	N
Undrclr Vert/Hor 69:	3
Posting 70:	5
Waterway Adequacy 71:	N
Approach Alignment 72:	8
Type Of Work 75A:	-1
Work Done By 75B:	!
Length of Improvment 76:	0
Insp Team Indicator 90B:	BLUE TEAM
Inspector Name 90C:	MAESA
Frequency 91:	24 months
FC Frequency 92A:	
UW Frequency 92B:	
SI Frequency 92C:	
FC Inspection Date 93A:	

UW Inspection Date 93B:	
SI Date 93C:	
Bridge Cost 94:	$0
Roadway Cost 95:	$0
Total Cost 96:	$0
Year of Cost Estimate 97:	1980
Brdr Brdg Code/% 98A/B:	-2
Border Bridge Number 99:	
Defense Highway 100:	1
Parallel Structure 101:	N
Direction of Traffic 102:	2
Temporary Structure 103:	!
Highway Systems 104:	1
Fed Lands Hiway 105:	0
Year Reconstructed 106:	
Deck Type 107:	N
Wearing Surface 108A:	N
Membrane 108B:	N
Deck Protection 108C:	N
Truck ADT 109:	10.00 %
Trk Net 110:	1
Pier Protection 111:	1
NBIS Length 112:	Y
Scour Critical 113:	N
Scour Watch 113M:	_
Future ADT 114:	43,500
Year of Future ADT 115:	2031
CDOT Str Type 120A:	CBC
CDOT Constr Type 120B:	2.
Inspection Indic 122A:	_
Inspection Trip 122AA:	0.00
Scheduling Status 122B:	0
Maintenance Patrol 123:	9
Expansion Dev/Type 124:	N
Brdg Rail Type/Mod 125A/B:	FB 0
Posting Trucks 129A/B/C:	0.0 0.0 0.0
Str Rating Date 130:	01/28/1997
Special Equip 133:	Unknown
Vert Clr N/E 134A/B/C:	X 99.99 0.00
Vert Clr S/W 135A/B/C:	X 99.99 0.00
Vertical Clr Date:	02/22/1991
Weight Limit Color 139:	0
Str Billing Type:	U
Userkey 1, Insp System:	ONSYS
Userkey 4, Insp Sched:	ODD JUN F_2
Userkey 5, Pin Sched:	
Userkey 7, 113 Doc Date:	
Inspection Key:	OISQ

Inspector Name:	MAESA

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

inspkey

Element Inspection Report

Elm/Env	Description	Unit	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4
241/1	**Re Conc Culvert**	**ft**	196	72%	141	10%	20	18%	35	0%	0

Vert. cracks in both walls widen to 1/2 inch with spalled edges near base at 22 ft. (PHOTOS 6/05 & 6/07) & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other light to moderate vert. cracks, & many minor scrapes on both walls.

Top slab has 8-10 longit. cracks actively leaking, and some delam. with efflor., especially at cold joints. Top slab is spalled (spot with exposed rebar), cracked, and delaminated at elevation change below median with active leaking. (See 1995, 2007, and 2009 Photos) Lower soffit section (below EBND lanes) has full length horizontal crack in facia where slab changes elevation in midsection of cell. Crack is open over 1/2 inch and shows heavy efflor and active leakage. Top slab is delaminated/spalled at ends below both headwalls, with exposed corroded rebar. (See 2007 & 2009 Photos) Top slab has been blackened by diesel exhaust.

Bottom slab partially covered with asphalt. Visible concrete is worn, and there is 25 ft. of spalls near left end, half have rebar exposed. (Could not see due to ice and snow cover during 2013 inspection)

9327/1	**Culvert Wingwalls**	**(EA)**	4	25%	1	75%	3	0%	0	0%	0

Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched.
Couple of cracks in #2 Lt.; one with efflor., and one heavy diagonal crack (open to 3/16 inch) and chipping along edges, and #2 Lt. also spalled at end.
Scrapes and chips along both wings on Lt.
Some light scale, minor scrapes, and minor spalls on #1 Rt. wingwall.
Few vert. cracks some with efflor. in both wings on right.
Minor erosion behind all.
#1 Lt. pushed slightly at top; #2 Lt. pushed about 4 inches at top, and spalled along joint and embankment material spilling through at bottom; #1 Rt. and #2 Rt. pushed 4 inches.

9335/1	**Culvert Headwalls**	**(EA)**	2	50%	1	50%	1	0%	0	0%	0

Some light to moderate scale on rt. headwall, and light scale on Lt. Spalled with exposed rebar along the bottom edge of both.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
358.05	Converted Work Candidates	4/11/2001	-1	2015	1000

Seal cracks in culvert walls.

358.05	Converted Work Candidates	6/14/2005	-1	2015	2000

Remove and replace delaminating concrete in floor of culvert where it is spalling with exposed rebar.

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

					inspkey
358.06	Converted Work Candidates	4/11/2001	-1	2015	2500

Anchor wingwalls with dead-man cables to stabilize movement.

360.03	Converted Work Candidates	6/16/2009	-1	2015	3500

Replace fill that has washed away from roadway embankment for Westbound I-70 traffic above culvert, and at fwd end. Consider building up curbs along Lt. rail (WBnd traffic) and direct flow down a beaver slide.

Bridge Notes

About 2 ft. deep erosion trough in roadway embankment for WBnd I-70 traffic above CBC (washing around 4 posts), and several spots at Lt. fwd end. (See 2009 Photo) It starts at edge of asphalt and exposes 2 ft. of flex beam rail post.

10/2009: Reviewed and Item112 determined to be long enough.

In the #2 lane just west of the CBC, there is a broken post in the guardrail.

Inspection Notes

Temperature: 31 Degrees
Time: 2:00 pm
Weather: P/C

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

inspkey

Scope:

☑ NBI ☑ Element ☐ Underwater ☐ Fracture Critical ☐ Other Type: Regular NBI

Team Leader Inspection Check-off:

☐ FCM's
☐ Posting Signs
☐ Essential Repair Verification
☐ Vertical Clearance
☐ Stream Bed Profile

Inspection Team: BLUE TEAM

Inspection Date: 04/03/2017

Inspector: A. Maes

Inspector (Team Leader): ALVIN MAES

Colorado Department of Transportation

Highway Number (ON) 5D: 070A _
Mile Post (ON) 11: 211.005 mi

Structure Inspection and Inventory Report (English Units)

Bridge Key: F-13-S_MINOR Inspection Date: 04/28/2015 Sufficiency Rating: 55.0 FO

NBI Reporting ID:	F-13-S_MINOR
Rgn/Sect 2E/2M:	32
Tran Region 2T:	11
County Code 3:	117
SUMMIT	
Place Code 4:	00000
non-city	
Rte.(On/Under) 5A:	1
Signing Prefix 5B:	1
Level of Service 5C:	1
Direction Suffix 5E:	0
Feature Intersected 6:	
FOREST SERVICE ROAD	
Facility Carried 7:	
I 70 ML	
Alias Str No.8A:	
Prll Str No. 8P:	
N/A	
Location 9:	
2.6 MI W OF EISENHWR TUNL	
Max Clr 10:	99.99
BaseHiway Net12:	1
IrsinvRout 13A:	000000070A
IrssubRout No13B:	00
Latitude 16:	39d 39' 56"
Longitude 17:	105d 58' 39"
Range 18A:	77 W
Township 18B:	77
Section 18C:	35
Detour Length 19:	11.0 mi
Toll Facility 20:	3
Custodian 21:	01
Owner 22:	01
Functional Class 26:	01
Year Built 27:	1966
Lanes on 28A:	6
Lanes Under 28B:	
ADT 29:	29,000
Year of ADT 30:	2011
Design Load 31:	5
Apr Rdwy Width 32:	84.0 ft
Median 33:	2
Skew 34:	1.00 °
Structure Flared 35:	0
Sfty Rail 36a/b/c/d:	1 1 1 1
Rail ht36h:	27.00 in

Hist Signif 37:	5	
Posting status 41:	A	
Service on/un 42A/B:	1	1
Main Mat/Desgn 43A/B:	1	19
Appr Mat/Desgn 44A/B:	0	0
Main Spans Unit 45:	1	
Approach Spans 46:	0	
Horiz Clr 47:	42.0 ft	
Max Span 48:	20.0 ft	
Str Length 49:	20.0 ft	
Curb Wdth L/R 50A/B:	0.0 ft	0.0 ft
Width Curb to Curb 51:	0.0 ft	
Width Out to Out 52:	196.0 ft	
Deck Area:	3,907.30	
Min Clr Ovr Brdg 53:	99.99	
Min Undrclr Ref 54A:	H	
Min Underclr 54B:	13.7 ft	
Min Lat Clrnce Ref R 55A:	H	
Min Lat Undrclr R 55B:	1.0 ft	
Min Lat Undrclr L 56:	0.0 ft	
Deck 58:	N	
Super 59:	N	
Sub 60:	N	
Channel/Protection 61:	N	
Culvert 62:	5	
Oprtng Rtg Method 63:	1 LF Load Factc	
Operating Rating 64:	89.95	
Inv Rtng Method 65:	1	
Inventory Rating 66:	80.14	
Asph/Fill Thick 66T:	200.00 in	
Str. Evaluation 67:	5	
Deck Geometry 68:	N	
Undrclr Vert/Hor 69:	3	
Posting 70:	5	
Waterway Adequacy 71:	N	
Approach Alignment 72:	8	
Type Of Work 75A:		
Work Done By 75B:		
Length of Improvment 76:	0.00	
Insp Team Indicator 90B:	R	
Inspector Name 90C:	Jackson, Chad	
Frequency 91:	24 months	
FC Frequency 92A:		
UW Frequency 92B:		
SI Frequency 92C:		
FC Inspection Date 93A:		

UW Inspection Date 93B:			
SI Date 93C:			
Bridge Cost 94:	$0		
Roadway Cost 95:	$0		
Total Cost 96:	$0		
Year of Cost Estimate 97:	0		
Brdr Brdg Code/% 98A/B:			
Border Bridge Number 99:			
Defense Highway 100:	1		
Parallel Structure 101:	N		
Direction of Traffic 102:	2		
Temporary Structure 103:	_		
Highway Systems 104:	1		
Fed Lands Hiway 105:	0		
Year Reconstructed 106:			
Deck Type 107:	N		
Wearing Surface 108A:	N		
Membrane 108A:	N		
Deck Protection 108C:	N		
Truck ADT 109:	10 %		
Trk Net 110:	1		
Pier Protection 111:	1		
NBIS Length 112:	Y		
Scour Critical 113:	N		
Scour Watch 113M:	_		
Future ADT 114:	43,500		
Year of Future ADT 115:	2031		
CDOT Str Type 120A:	CBC		
CDOT Constr Type 120B:	2.		
Inspection Indic 122A:	_		
Inspection Trip 122AA:	0.00		
Scheduling Status 122B:	0		
Maintenance Patrol 123:	9		
Expansion Dev/Type 124:	N		
Brdg Rail Type/Mod 125A/B:	FB	0	
Posting Trucks 129A/B/C:	0	0	0
Str Rating Date 130:	01/28/1997		
Special Equip 133:			
Vert Clr N/E 134A/B/C:	X	99.99	0.00
Vert Clr S/W 135A/B/C:	X	99.99	0.00
Vertical Clr Date:	02/22/1991		
Weight Limit Color 139:	0		
Str Billing Type:	U		
Userkey 1 - System:	ONSYS		
Userkey 4 - OffSys Sched:			
Userkey 5 :			
Userkey 7 - Update Ind.:			
BridgeGroup	ODD JUN F_2		

Inspector Name: Jackson, Chad

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Element Inspection Report

Elm/Env	Description	Unit	Total Qty	% in 1	Qty. St. 1	% in 2	Qty. St. 2	% in 3	Qty. St. 3	% in 4	Qty. St. 4
241/1	**Re Conc Culvert**	**ft**	196	72%	141	10%	20	18%	35	0%	0
9327/1	**Culvert Wingwalls**	**(EA)**	4	25%	1	75%	3	0%	0	0%	0
9335/1	**Culvert Headwalls**	**(EA)**	2	50%	1	50%	1	0%	0	0%	0

Elm/Env	Description	Element Notes
241/1	**Re Conc Culvert**	Vert. cracks in both walls widen to 1/2 inch with spalled edges near base at 22 ft. (PHOTOS 6/05 & 6/07) & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other light to moderate vert. cracks, & many minor scrapes on both walls. Top slab has 8-10 longit. cracks actively leaking, and some delam. with efflor., especially at cold joints. Top slab is spalled (spot with exposed rebar), cracked, and delaminated at elevation change below median with active leaking. (See 1995, 2007, and 2009 Photos) Lower soffit section (below EBND lanes) has full length horizontal crack in facia where slab changes elevation in midsection of cell. Crack is open over 1/2 inch and shows heavy efflor and active leakage. Top slab is delaminated/spalled at ends below both headwalls, with exposed corroded rebar. (See 2007 & 2009 Photos) Top slab has been blackened by diesel exhaust. Bottom slab partially covered with asphalt. Visible concrete is worn, and there is 25 ft. of spalls near left end, half have rebar exposed. (Could not see due to ice and snow cover during 2013 inspection)
9327/1	**Culvert Wingwalls**	Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched. Couple of cracks in #2 Lt.; one with efflor., and one heavy diagonal crack (open to 3/16 inch) and chipping along edges, and #2 Lt. also spalled at end. Scrapes and chips along both wings on Lt. Some light scale, minor scrapes, and minor spalls on #1 Rt. wingwall. Few vert. cracks some with efflor. in both wings on right. Minor erosion behind all. #1 Lt. pushed slightly at top; #2 Lt. pushed about 4 inches at top, and spalled along joint and embankment material spilling through at bottom; #1 Rt. and #2 Rt. pushed 4 inches.
9335/1	**Culvert Headwalls**	Some light to moderate scale on rt. headwall, and light scale on Lt. Spalled with exposed rebar along the bottom edge of both.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Target Year	Est Cost
358.05	Converted Work Candidates	4/11/2001	-1	2015	1000

Seal cracks in culvert walls.

358.05	Converted Work Candidates	6/14/2005	-1	2015	2000

Remove and replace delaminating concrete in floor of culvert where it is spalling with exposed rebar.

358.06	Converted Work Candidates	4/11/2001	-1	2015	2500

Anchor wingwalls with dead-man cables to stabilize movement.

360.03	Converted Work Candidates	6/16/2009	-1	2015	3500

Replace fill that has washed away from roadway embankment for Westbound I-70 traffic above culvert, and at fwd end. Consider building up curbs along Lt. rail (WBnd traffic) and direct flow down a beaver slide.

Bridge Notes

About 2 ft. deep erosion trough in roadway embankment for WBnd I-70 traffic above CBC (washing around 4 posts), and several spots at Lt. fwd end. (See 2009 Photo) It starts at edge of asphalt and exposes 2 ft. of flex beam rail post.

10/2009: Reviewed and Item112 determined to be long enough.

In the #2 lane just west of the CBC, there is a broken post in the guardrail.

Inspection Notes

Temperature: 50 Degrees
Time: 1:00 pm
Weather: Clear, sunny

Colorado Department of Transportation

Structure Inspection and Inventory Report (English Units)

Scope:

☑ NBI ☑ Element ☐ Underwater ☐ Fracture Critical ☐ Other Type: Regular NBI

Team Leader Inspection Check-off:

☐ FCM's
☐ Posting Signs
☐ Essential Repair Verification
☐ Vertical Clearance
☐ Stream Bed Profile

Inspection Team:

Inspection Date: 04/28/2015

Inspector: Jackson, Chad

Inspector (Team Leader)

Highway Number (ON) 5D: 0070A 1

Mile Post (ON)11: 211.005 mi

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Bridge Key: F-13-S MINOR | Inspection Date: 6/14/2005 | Sufficiency Rating: 55.0 | Not Ap

Rgn/Sectn 2E/2M:	15	Hist Signif 37:	5	UW Inspection Date 93B:			
Trans Region 2T	11	Posting status 41:	A	SI Date 93C:			
County Code 3:	117	Service on/un 42A/B:	1 1	Bridge Cost 94:	$ 0		
SUMMIT		Main Mat/Desgn 43A/B:	1 19	Roadway Cost 95:	$ 0		
Place Code 4:	00000	Appr Mat/Desgn 44A/B:	0 0	Total Cost 96:	$ 0		
N/A		Main Spans Unit 45:	1	Year of Cost Estimate 97:			
Rte.(On/Under)5A:	1	Approach Spans 46:	0	Brdr Brdg Code/% 98A/B:			
Signing Prefix 5B:	1	Horiz Clr 47:	42.0 ft	Border Bridge Number 99:			
Level of Service 5C:	8	Max Span 48:	20.0 ft	Defense Highway 100:	1		
Directional Suffix 5E:	0	Str Length 49:	20.0 ft	Parallel Structure 101:	N		
Feature Intersected 6:		Curb Wdth L/R 50A/B:	0.0 ft 0.0 ft	Direction of Traffic 102:	2		
FOREST SERVICE ROAD		Width Curb to Curb 51:	0.0 ft	Temporary Structure 103:	_		
Facility Carried 7:		Width Out to Out 52:	196.0 ft	Highway System 104:	1		
I 70 ML		Deck Area:	3,907.3 sq. ft	Fed Lands Hiway 105:	0		
Alias Str No.8A:		Min Clr Ovr Brdg 53:	99.99	Year Reconstructed 106:	0000		
		Min Undrclr Ref 54A:	H	Deck Type 107:	N		
Prll Str No. 8P		Min Undrclr 54B:	13.7 ft	Wearing Surface 108A:	N		
		Min Lat Clrnce Ref R 55A:	H	Membrane 108B:	N		
Location 9:		Min Lat Undrclr R 55B:	1.0 ft	Deck Protection 108C:	N		
2.6 MI W OF EISENHOWER TU		Min Lat Undrclr L 56:	0	Truck ADT 109:	3 %		
Max Clr 10:	99.99	Deck 58:	N	Trk Net 110:	1		
BaseHiway Net12:	1	Super 59:	N	Pier Protection 111:			
IrsinvRout 13A	000000070A	Sub 60:	N	NBIS Length 112:	N		
IrssubRout No13B:	00	Channel/Protection 61:	N	Scour Critical 113:	N		
Latitude 16:	39d 39' 90"	Culvert 62:	5	Scour Watch 113M:	_		
Longitude 17:	105d 58' 70"	Oprtng Rtg Method 63:	1 LF Load Fact	Future ADT 114:	38,188		
Range18A:	77 W	Operating Rating 64:	99.0	Year of Future ADT 11:	2020		
Township18B:	77	Inv Rtng Method 65:	1	CDOT Str Type 120A:	CBC		
Section18C:	35	Inventory Rating 66:	99.0	CDOT Constr Type 120B:	2.		
Detour Length 19:	11.0 mi	Asph/Fill Thick 66T:	200 "in"	Inspection Indic 122A:	14		
Toll Facility 20:	3	Str. Evaluation 67:	5	Inspection Trip 122AA:	2		
Custodian 21:	1	Deck Geometry 68:	N	Scheduling Status 122B:	0		
Owner 22:	1	Undrclr Vert/Hor 69:	3	Maintenance Patrol 123:	9		
Functional Class 26:	01	Posting 70:	5	Expansion Dev/Type124:	N		
Year Built 27:	1966	Waterway Adequacy 7:	N	Brdg Rail Type/Mod 125A/B:	F 0		
Lanes on 28A:	6	Approach Alignment 72:	8	Posting Trucks 129A/B/C:	0 0 0		
Lanes Under 28B:	1	Type of Work 75A:		Str Rating Date 130:	1/28/1997		
ADT 29:	26,156	Work Done By 75B:		Speical Equip 133:			
Year of ADT 30:	2000	Length of Improvment 76:	0.0 ft	Vert Clr N/E 134A/B/C:	X 99.99 0.00		
Design Load 31:	5	Insp Team Indicator 90B:	White Team (Ric	Vert Clr S/W 135A/B/C:	X 99.99 0.00		
Apr Rdwy Width 32:	84.0 ft	Inspector Name 90C:	CHURCHESK	Vertical Clr Date:	6/14/2005		
Median 33:	2	Frequency 91:	24 months	Weight Limit Color: 139	0		
Skew 34:	5.00 °	FC Frequency 92A:	24	Str Billing Type:	U		
Structure Flared 35:	0	UW Frequency 92B:	24	Userkey 1 - System:	Onsys		
Sfty Rail 36a/b/c/d:	1 1 1 1	SI Frequency 92C:	24	Userkey 7-Update Indi:			
Rail ht36h:	30 "in"	FC Inspection Date 93A:					

Inspector Name: CHURCHESK

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Element Inspection Report

Elm/Env	Description	Units	Total Qty	% in 1	CS 1	% in 2	CS 2	% in 3	CS 3	% in 4	CS 4	% in 5	CS 5
241/1	Concrete Culvert	(LF)	196	72 %	141	10 %	20	18 %	35	0 %	0	0 %	0
327/1	Culvert Wingwalls	(EA)	4	25 %	1	75 %	3	0 %	0	0 %	0	0 %	0
335/1	Culvert Headwalls	(EA)	2	50 %	1	50 %	1	0 %	0	0 %	0	0 %	0

Elem/Env	Description	Element Notes
241/1	Concrete Culvert	Top slab blackened by diesel exhaust. Vert. cracks in walls widen to 1/2 inch near base at 22 ft. (photo), & 48 ft. from rt. end. Bottom slab cracked in same location from settling. Many other lighter vert. cracks, & many minor scrapes on both walls. Top slab has 8-10 longit. cracks actively leaking, or with efflor. Top slab delaminated at elevation change below median (photo). Bottom slab partially covered with asphalt. Exposed concrete is worn and there is 25 ft. of spalls near left end, half have rebar exposed. Top slab is delaminated/spalled at ends below both headwalls, with exposed rebar.
327/1	Culvert Wingwalls	Couple diagonal cracks with efflor. in #1 Lt., other crack/break in #1 Lt. has been patched. Couple of light cracks in #2 Lt., one with efflor., other is heavy diagonal crack open to 3/16 inch and chipping along edges. #2 Lt. is also spalled at end. Minor erosion behind all. #1 Lt. pushed slightly at top; #2 Lt. pushed about 3 inches at top, and spalled along joint; #1 Rt. and #2 Rt. pushed 4 inches.
335/1	Culvert Headwalls	Light scale on rt. headwall. Minor spall and rock pocket in rt. headwall.

Maintenance Activity Summary

MMS Activity	Description	Recommended	Status	Year Completed	Est Cost
358.05	Substr	4/11/2001	-1	2007	0

Seal cracks in culvert walls.

358.06	Substr	4/11/2001	-1	2007	0

Anchor wingwalls with dead-man cables to stabilize movement.

358.05	Substr	6/14/2005	-1	2007	-1

Remove and replace delaminating concrete in floor of culvert where it is spalling with exposed rebar.

Colorado Department of Transportation
Structure Inspection and Inventory Report (English Units)

Bridge Notes

Inspection Notes

Temperature: 50 Degrees
Time: 11:25
Weather: Clear

Scope:

☑ **NBI:** ☑ **Element:** ☐ **Underwater:** ☐ **Fracture Critical:** ☐ **Other:** **Type:** Regular NBI

Inspector: CHURCHESK **Inspection Team:**

Inspection Date: 06/14/2005

Inspector

APPENDIX D - PRELIMINARY ENVIRONMENTAL REVIEW

COLORADO DEPARTMENT OF TRANSPORTATION

Preliminary Environmental Review

Date: 8 October 2018	**Project Code #:** FBR 0702-385 (22712)
Region/Program: Region 3	**Project Location:** Dillon
Route: I-70	**Road Name:** I-70/Forest Service Road
Milepost: 211	**Roadway Type:** Interstate Highway
County: Summit County	**Year Built:** 1966

Structure F-13-S_Minor, Looking North

Feature Intersected: I-70	**Bridge ID#:** F-13-S_Minor	**Structure Type:** RCBC	**Surface Type:** Asphalt/Concrete

Proposed Action:

Structure F-13-S_Minor is proposed to be replaced in approximately the same location.

ENVIRONMENTAL SETTING AND POTENTIALLY AFFECTED RESOURCES

Setting / Resource / Circumstance	Adjacent or Potentially Affected Resources			Comments
	Yes	No	N/A	
Air Quality	☐	☐	☒	The project area is in an air quality non-attainment area.
Archaeological Resources	☐	☒	☐	Based on review of the SHPO Compass database in September 2018, there are no known archaeological resources identified within the project area. However, archaeological resources may be encountered during construction. CDOT Spec 107.23 will need to be followed.
Hazardous Materials	☐	☒	☐	According to information in the I-70 Mountain Corridor PEIS, there are no hazardous materials sites identified within five miles of MP 211. While unlikely, it's possible hazardous materials could be encountered during construction. CDOT will complete the ISA during the NEPA design phase.
Historic Resources/Section 4(f)	☐	☒	☐	Based on review of the SHPO Compass database in September 2018, there are no known historic resources identified within the project area. The nearest historic resource is a half mile away to the west and is designated not eligible. The structure itself is over 50 years old, but is located along a part of the interstate considered exempt from Section 106 due to the ACHP Interstate Highway Exemption. It can likely be cleared internally by CDOT's Senior Historian. It is possible for unrecorded historic resources to be encountered during construction. CDOT standard Spec 107.23 for unanticipated discoveries will need to be followed.

ENVIRONMENTAL SETTING AND POTENTIALLY AFFECTED RESOURCES

Setting / Resource / Circumstance	Adjacent or Potentially Affected Resources			Comments
	Yes	No	N/A	
Parks and Recreational Resources, Section 4(f)/6(f)	☐	☐	☒	There are no designated bike lane/pedestrian paths, recreational facilities, parks or Section 6(f) properties in the project area.
Threatened & Endangered, Candidate and Colorado State Sensitive Species	☒	☐	☐	The project area is located in the subalpine zone. Based on a review of IPaC data from the USFWS ECOS website in October 2018, there are seven federally listed species and two state listed species that potentially occur within the project area and project vicinity; however, there is no critical habitat for any of the species. Federally listed species include Canada Lynx, Mexican Spotted Owl, Bonytail Chub, Colorado Pikeminnow, Greenback Cutthroat Trout, Humpback Chub, and Razorback Sucker. State listed species include Boreal Toad and Northern Leopard Frog. During the NEPA design phase USFS species will also need to be evaluated. Since the proposed project is located within a disturbed area and involves replacement of an existing structure under I-70,Project activities are unlikely to adversely affect any federal or state-listed species. In addition, per the I-70 Mountain PEIS coordination with CPW to evaluate ALIVE and SWEEP should occur (See I-70 Mountain PEIS appendices).
Railroads	☐	☐	☒	There are no railroads within the project area that would be impacted by the proposed project.
Utilities	☒	☐	☐	There are several utilities within the project area including the following:1) an underground fiber optic, owned by Century Link that runs parallel to I-70 on the south side of the EB lanes; and 2) an underground fiber optic and electric line that runs parallel to I-70 on the north side of the WB lanes. CDOT shares the fiber optic conduit with Comcast, and Xcel Energy owns the electric line. These utilities must be protected in place during construction.
General Wildlife and Migratory Birds	☒	☐	☐	Several general wildlife species and migratory birds may be present within the vicinity of the project area and include, but are not limited to elk, bighorn sheep, deer, squirrels, marmots, bear, bats, birds, and fish. Migratory bird nests and/or roosting sites also may be present in the vicinity of the project area. CDOT Spec 240 will need to be followed. The ALIVE and SWEEP MOUs from the I-70 Mountain Corridor PEIS states that the project area (MP 211) is located in Zone 9b and recommends a wildlife crossing at MP 212.2. This area is currently outside the project area.

ENVIRONMENTAL SETTING AND POTENTIALLY AFFECTED RESOURCES

Setting / Resource / Circumstance	Adjacent or Potentially Affected Resources			Comments
	Yes	No	N/A	
Economic Resources	☐	☐	☒	No economic resources are located within the project area.
Farmland	☐	☐	☒	No prime or unique farmland is located within the project area.
Floodplains	☐	☒	☐	The proposed project would not require work to be conducted within the floodplain of Straight Creek therefore floodplain development permit would not be required.
Geology and Soils	☐	☐	☒	The project area is predominately hard granite and is located within a general rockfall area. The proposed project is not anticipated to adversely affect geological resources or soils.
Land Use	☐	☒	☐	The existing land use of the proposed project area is a concrete box culvert that is underneath I-70. The proposed project would replace this culvert in approximately the same location. The land use will remain the same after the project is implemented. No change in surrounding land use is anticipated. The Ptarmigan Peak Wilderness area is located to the north of the project area and the White River National Forest is located to the south.
Noise	☐	☐	☒	The proposed project is considered a Type III project and there are no sensitive receptors within 500 feet of the proposed edge of traveled lanes. However, the project area does include undeveloped or unpermitted lands, so an abbreviated noise analysis and technical memo will be required to provide a noise contour map to local government agencies.
Paleontological Resources	☐	☒	☐	The sediments in the project area are glacial till from the Pinedale glaciation. Based on the I-70 Mountain Corridor PEIS, the project area is located in an area with low sensitivity for paleontological resources. In addition, data reviewed from the Denver Museum of Nature and Science and the museum at CU did not have localities near the project area. However, paleontological resources may be encountered during construction. CDOT's Staff Paleontologist will ID and evaluate the rock formation that may be exposed during excavation. CDOT Spec 107.23 will need to be followed.
Residential/Business Right- of-Way	☐	☐	☒	The proposed project is entirely within the highway easement on the US Forest Service ROW. CDOT has a special use permit from the US Forest Service for the existing access to Straight Creek of the south structure access. No additional ROW or relocations are required.

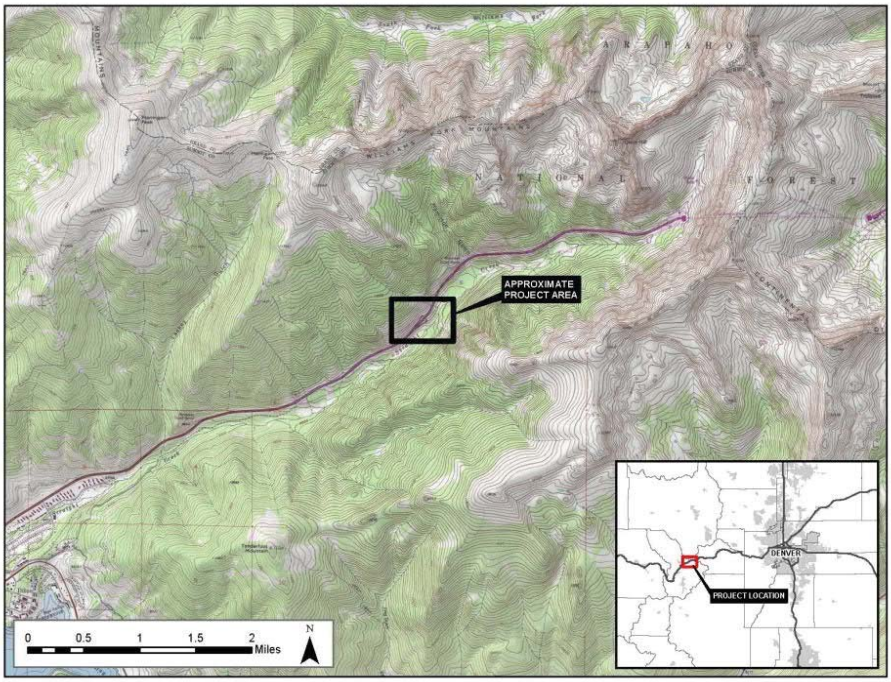
ENVIRONMENTAL SETTING AND POTENTIALLY AFFECTED RESOURCES

Setting / Resource / Circumstance	Adjacent or Potentially Affected Resources			Comments
	Yes	No	N/A	
Riparian/Senate Bill 40 (SB 40)	☒	☐	☐	An unnamed roadside drainage located on the north side of I-70 northeast of the existing structure was observed during a September 2018 site visit. It may come under the jurisdiction of SB40 and should be determined during NEPA. No fish are present. CDOT HQ briefly evaluated the drainage
Social Resources/ Environmental Justice	☐	☐	☐	No social resources or environmental justice populations are located within the project area.
Transportation Resources (rail, bus, bike, pedestrian, etc)	☒	☐	☐	Construction of the proposed project may temporarily affect traffic operations on I-70 for vehicles, bus service and freight. There are no rail, bike or pedestrian facilities within the project area.
Vegetation and Noxious Weeds	☒	☐	☐	Since ground disturbance is anticipated; vegetation and noxious weeds within the project area could be disturbed during construction. Summit County's Noxious Weed list includes two List A weeds (Myrtle Spurge and Orange Hawkweed), 25 List B weeds, and four List C weeds.
Visual Resources/Aesthetics	☐	☐	☒	The proposed project is below the I-70 grade and would not impact any visual resources in the project vicinity.
Water Resources and Quality	☐	☒	☐	The project area is within the Blue River sub-basin which includes Straight Creek. Straight Creek flows east to west and is located downhill to the south and adjacent to, but outside the project area. Direct or indirect impacts to Straight Creek are not anticipated with construction of the proposed project. Refer to the Sediment Control Action Plan (SCAP) developed to address mitigation strategies for Straight Creek. BMPs should be implemented to avoid runoff during construction.
Wetlands and Waters of the U.S.	☐	☒	☐	According to the USFWS National Wetlands Inventory map there are no wetlands within the project area. General wetlands may be present adjacent to the project area, but are not within the project area and are not anticipated to be impacted by construction of the proposed project. In addition to Straight Creek, there is an unnamed roadside drainage on the north side of I-70 northeast of the existing structure that was observed during a site visit in September 2018. Along with any associated wetlands, the drainage maybe considered waters of the U.S. CDOT HQ delineated the drainage as part of a previous project and did not identify hydric soils. Coordination with ALIVE and SWEEP should occur.
Other(s)	☐	☐	☒	

NEXT STEPS / ADDITIONAL STUDIES / PERMITS REQUIRED FOR PROPOSED ACTION

Information/Resource	Action	Due Date
Archaeological and Paleontological Resources	Research and potential field surveys should be conducted prior to construction to verify that no new listed sites are present. Project should adhere to and comply with CDOT Spec 107.23.	During 30% design
Hazardous Materials	An Initial Site Assessment (CDOT Form #881) should be performed during the NEPA process.	During 30% design
Historic Resources and Section 4(f) Evaluation (if required)	CDOT's senior historian should be consulted to determine whether the structure is exempt from Section 106.	During 30% design
Threatened & Endangered, Candidate and Colorado State Sensitive Species	A current IPaC report should be obtained. Coordination with CPW, USFS, USFWS, ALIVE and SWEEP should occur during the NEPA Process. Concurrence of No Effects on TES species from USFWS should be obtained prior to construction.	During 30% design
General Wildlife and Migratory Birds	The official nesting season is April 1 - August 31. While no nests were observed on the structure, it will need to be surveyed and maintained free of nesting birds prior to and during construction. A qualified biologist will need to survey for, and manage migratory birds or their nests. If an active nest (eggs or fledglings) are found on the structure, or within 50 feet, work will need to cease until all the young fully fledge (fly away on their own). Refer to ALIVE and SWEEP MOUs in the I-70 Mountain Corridor PEIS.	Prior to and during construction
Riparian/Senate Bill 40 (SB 40)	Determine whether or not the unnamed drainage falls under SB40 jurisdiction and whether it can be cleared under the Programmatic SB40 Certification.	Prior to construction
Vegetation and Noxious Weeds	An official survey for vegetation (including riparian) and noxious weeds prior to start of construction should be conducted. Project should adhere to and comply with CDOT policies regarding weed free topsoil and equipment, as well as reseeding techniques, timing, and noxious weed best management practices. All disturbed vegetation will be reseeded with an appropriate native seed mix approved by Summit County and the US Forest Service.	Prior to construction
Water Resources and Quality	Compliance with the SCAP for Straight Creek and implementation of BMPs to protect water resources and quality.	Prior to and during construction
Wetlands/ Waters of the U.S.	Project area should be surveyed for wetlands prior to construction. Coordination with SWEEP should occur during the NEPA process.	During 30% design

MAPPING AND PHOTOS

Name	Photo/Map	Date (Direction)
Location of Project.		N/A
Aerial view of project.		N/A

MAPPING AND PHOTOS

Name	Photo/Map	Date (direction)
Overview of structure		April 2018 Standing on south side of I-70 looking north.
Overview of structure		October 2018 Standing on north side of I-70 looking south.