CITY COUNCIL MEETING
STAFF REPORT

Meeting Date: February 3, 2020	**Subject:** Boeckman Dip Bridge Alternatives Analysis (CIP #4212) **Staff Member:** Nancy Kraushaar, PE, Civil Engineer and Zachary J. Weigel, PE, Capital Projects Engineering Manager **Department:** Community Development
Action Required	**Advisory Board/Commission Recommendation**
☐ Motion ☐ Public Hearing Date: ☐ Ordinance 1st Reading Date: ☐ Ordinance 2nd Reading Date: ☐ Resolution ☒ Information or Direction ☐ Information Only ☐ Council Direction ☐ Consent Agenda	☐ Approval ☐ Denial ☐ None Forwarded ☒ Not Applicable **Comments:** N/A
Staff Recommendation: N/A	
Recommended Language for Motion: N/A	
Project / Issue Relates To:	

☐Council Goals/Priorities	☒Adopted Master Plan(s): Transportation System Plan Project UU-01	☐Not Applicable

ISSUE BEFORE COUNCIL:

Staff will brief Council on the Boeckman Dip Bridge project development work completed to date and requests Council discussion and direction on a number of future project issues and next steps.

EXECUTIVE SUMMARY:

The proposed "Boeckman Dip Bridge" will upgrade a section of Boeckman Road that was constructed in the 1960s according to USGS mapping records. At that time the road was straightened from its previous switchback alignment, and a large corrugated metal pipe (CMP) culvert was installed to convey creek flows.

Boeckman Road, one of only three east-west cross-town arterials in Wilsonville, serves an important role in the City's transportation system; becoming even more important as the Frog Pond neighborhoods build out. The bridge project, included in the Wilsonville Transportation Plan (TSP) as Project UU-01, will upgrade the existing steep and narrow rural roadway alignment to urban standards. The bridge will provide safe bicycle and pedestrian facilities that connect residential neighborhoods, jobs, schools, and commercial land uses. The alignment will improve sight distances through the area, particularly at the Canyon Creek Road intersection, which will be signalized in the near future, and remove the barrier that the steep road creates for bicycles. The bridge will also provide for wildlife passage under Boeckman Road.

The TSP also includes the Boeckman Creek Trail (Projects RT 01A, 01B, and 07), a north-south trail through east Wilsonville that follows Boeckman Creek and will ultimately extend all the way from the Frog Pond neighborhoods to Memorial Park. The Boeckman Dip Bridge project work scope has to date assumed the existing access/maintenance road north of Boeckman Road will remain but will be relocated to the east. Staff recommends the project also address how a future Boeckman Creek Trail alignment can best be accommodated within the project reach.

Over time, the Boeckman Creek basin was significantly altered not only by urban development within the basin but possibly more importantly by modifications to its natural drainage basin boundaries. Substantial drainage areas were added and out-of-basin flows were diverted to the Boeckman Creek basin. These areas are north and west of Boeckman Road including Mentor Graphics up to and including Argyle Square.

Designed to address and manage these out of basin flows in order to protect against flooding and the overall integrity of Boeckman Creek, the main creek culvert is enhanced with flow control infrastructure as illustrated in the photos below. These include a benched embankment on the north (upstream) side of the Boeckman Road with an emergency overflow culvert; a main culvert and flow control structure at the creek level; and an inundation easement. Comparative elevations are:

Boeckman Road surface at low point: elevation = 176+/- feet
Upper bench and emergency overflow culvert: elevation = 154+/- feet
Main culvert near base of flow control structure: elevation = 140+/- feet

Main Large Corrugated Metal Pipe (CMP) Culvert Conveys Creek Flows Under the Road

North to South View from Boeckman Creek up to Boeckman Road – Shows flow control structure for culvert and creek level, upper bench and road (see car)

Emergency Overflow Culvert (42”x66” CMP - Corrugated Metal Pipe) Located on Upper Bench

Profile from Road to Upper Bench

Upper Bench Looking Down at Creek and Flow Control Structure

Project Development Update - Engineering Reports Completed to Date

The OBEC Consulting Engineers (OBEC) **May 2014 "Boeckman Dip Planning Design Narrative for Frog Pond Master Plan"** explores alignments and develops costs for two bridge options:
Option A – 305-ft long bridge meeting the minimum profile (vertical grade) to comply with design standards (6 percent maximum grade) - $13.1 million*
Option B – 432-ft long bridge with flatter slope (3.5 percent maximum grade) to accommodate a possible east to west sewer line (sewer was since determined to not be needed) - $17.9 million*
**These cost estimates are both in 2013 dollars and include a 30 percent planning contingency of which detour and traffic control costs were considered a part of.*

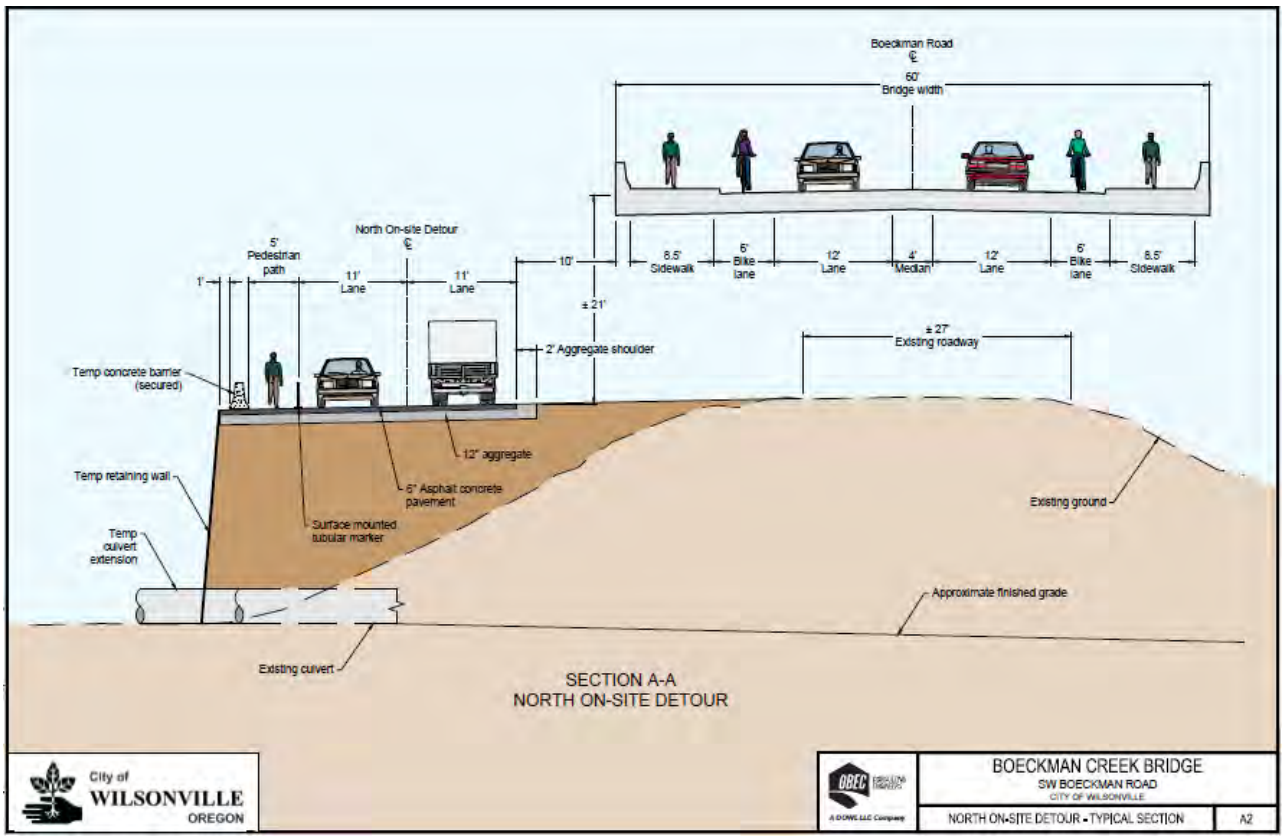
The OBEC narrative concludes that Option A results in the shortest bridge at the least cost. Both options:

- Build out the Boeckman Road Dip to accommodate bicycles and pedestrians on both sides of the road,
- Remove the roadway embankment fill down to the upper level bench and emergency overflow culvert, and
- Include a concrete roadway section.

The OBEC (dba DOWL) **December 2019 "Boeckman Dip Alternative Analysis Memorandum"** explores costs, permitting, and right-of-way implications for three construction detour alternatives focusing on minimizing a full road closure. The Option A bridge is lengthened 80 feet (380-foot long bridge) for all three to preserve a significant tree at 7550 Boeckman Road.

The memorandum also updates cost estimates to 2021 dollars and provides a separate cost estimate range for removing the large CMP culvert under Boeckman Road and associated upstream flow control infrastructure with the upper bench embankment for "Full Channel Restoration". Please note that a Full Channel Restoration approach represents a tremendous undertaking that has not been included in the scope of work for the project to date.

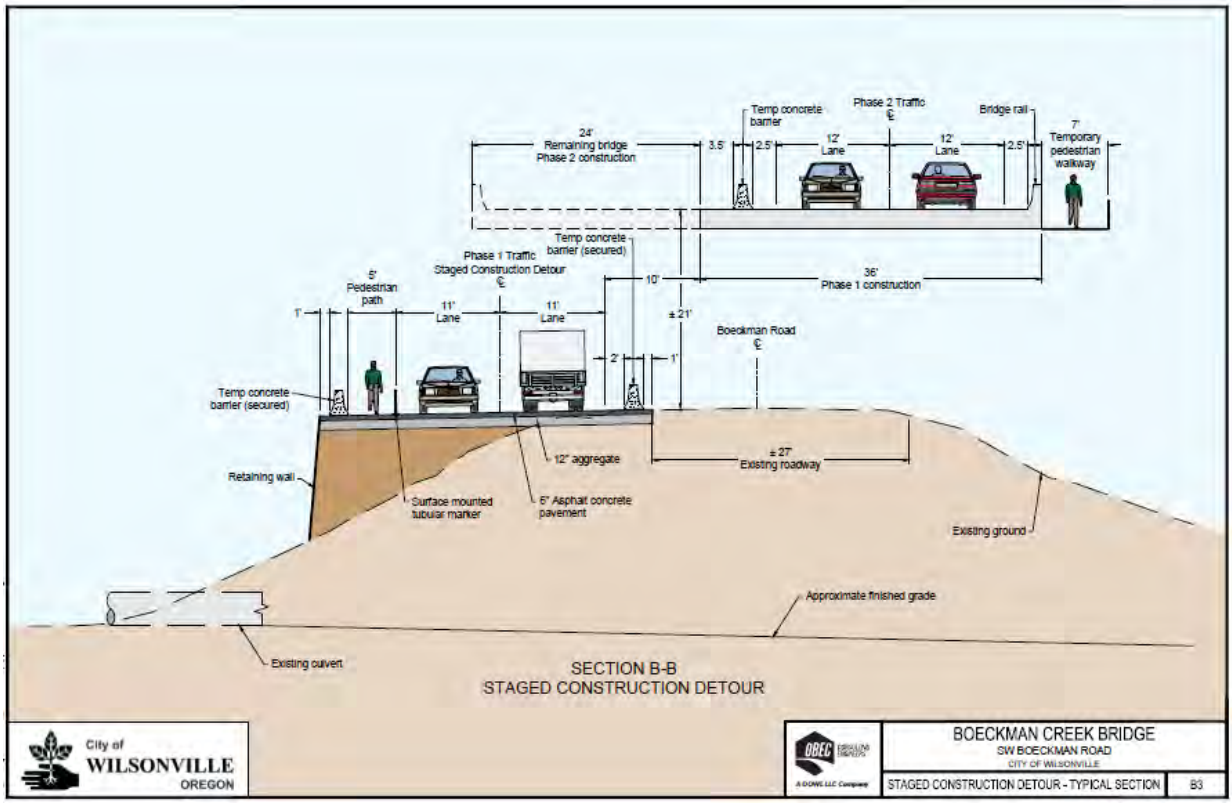
Alternative 1 – "North On-site Detour" constructs a temporary full two-lane road, widening the existing road 60 feet to the north. The bridge would be built over the existing road, while traffic uses the temporary road. All vegetation would be removed in the area of the temporary road; the area would be replanted after the temporary road is removed. The memo estimates a 15-month construction duration (to substantial completion) and two-week and four-week full road closures are needed to complete construction. Alternative 1 potentially impacts approximately 27 additional trees (typically red alder and Douglas fir) and a possible wetland on the upper bench compared to a full road closure. See "North On-site Detour Section A-A" and photo of temporary road detour impact area below.



Temporary Detour Road Impact Area on North Side of Boeckman Road

Alternative 2 – "South On-site Detour" constructs a temporary road on the south side of the existing Boeckman Road. This option has been deemed impractical due to property impacts to an existing retaining wall and homes on Bouchaine Court in Arbor Crossing.

Alternative 3 – "Staged Construction Detour" constructs a Phase 1 temporary two-lane road to be used as a detour while constructing the south side of the bridge. Phase 2 would construct the north side of the bridge while traffic is routed onto the south side of the bridge constructed during Phase 1. This alternative would widen the existing road 36 feet to the north. All vegetation would be removed from the temporary road footprint; the area would be replanted after the temporary road is removed. The memo estimates a 17-month construction duration (to substantial completion) and two-week and four-week plus intermittent one to two-day full road closures needed to complete construction. Alternative 3 potentially impacts approximately 17 additional trees (typically red alder and Douglas fir) and a possible wetland on the upper bench compared to a full road closure. See North On-site Detour Section A-A below.



The memorandum concludes the "Full Closure" detour offers least cost, the shortest construction time of 12 months, and potentially impacts the fewest trees; Alternative 1 detour is medium cost (approximately $1 million more detour costs) and construction time; and Alternative 3 detour is highest cost (approximately $1.2 million more detour costs) and construction time. Alternative 1 would be preferred over Alternative 3 because it is less expensive, offers more construction staging area, and has a shorter construction time. Please note that bridge construction and detour options should be further explored and include contractor input during the project's 30 percent design phase.

The memorandum estimates the Option A bridge (lengthened 80 feet) cost (including a 30 percent contingency) associated with these three detour options. The three cost estimates reflect the new and more detailed information on detour construction, right-of-way, and traffic control, and 2021 dollars using a 4 percent inflation factor.

Bridge with Alternative 1 Detour – $18.2 million
Bridge with Alternative 3 Detour – $19.8 million
Bridge with Full Road Closure – $16.4 million

For a "Full Channel Restoration" bridge option, the memorandum estimates a separate additional cost range of $2 to $3.7 million (to any of the detour alternatives) and a three to six-month extension to construction time. Please note that these estimates could be greater depending on the extent of fill/embankment removal and environmental permit requirements such as the extent of channel alterations and mitigation beyond the bridge project reach.

As part of the OBEC (dba DOWL) memorandum, DKS Associates prepared the **June 2019 "Wilsonville Boeckman Road Dip Detour – Traffic Study"** that evaluates the effect that a full closure and the associated traffic diversion would have on the rest of the transportation system. The study concludes that impacts to the majority of the study intersections are minor; they can support the temporary diversion of PM peak hour traffic volumes from Boeckman Road with the exception of the Stafford Road/65th Avenue intersection. This intersection fails under existing (2019) conditions as well as with full closure detour conditions. A temporary traffic signal to relieve congestion at this intersection would help mitigate the impacts of the Boeckman Road closure. The intersection is under Clackamas County jurisdiction and the signal requires their approval.

DETOUR SUMMARY	Alt. 1 (North)	Alt. 3 (Staged)	Alt. 4 (Closure)
Cost (Above Available Funds)	**$18.2M** ($3.7M)	**$19.8 M** ($5.3M)	**$16.4M** ($1.9M)
Boeckman Road Impacts	25 mph speed	30 mph speed	Temp. Signal & Stafford & 65th
Boeckman Road Closures	2	2 + intermittent	1
Road Closure Period (Total)	6 weeks	6 weeks + days	40 weeks (9 months)
Construction Period	15 months	17 months	12 months
Temporary Access Width*	60 feet	36 feet	None
Environmental Impacts**	Highest	High	Lowest

Note: The Costs summarized above do not include the separate cost range for a Full Channel Restoration
*Total width of tree and vegetation removal and stream impacts to allow for temporary shifting of traffic on the north side of Boeckman Road that will be restored at the end of the Project.
** Environmental impacts include removal of trees and vegetation and temporary extension of culvert within the Boeckman Creek channel.

Future Project Issues and Next Steps

Staff requests that the City Council discuss and provide direction on the following project issues and design considerations as the project moves forward.

Full Channel Restoration and Hydraulic/Hydrologic Study – The most critical next step for the project will be to decide if a Full Channel Restoration approach is desired and feasible. As currently scoped, the roadway embankment will be removed down to the upper bench on the north side of the road. The existing emergency overflow culvert likely will be replaced with some sort of overflow channel incorporated into the resulting finished grade. This approach preserves the existing main culvert and flow control structure. Pursuing Full Channel Restoration that removes this infrastructure necessitates a comprehensive Hydraulic/Hydrologic study.

To determine the feasibility of Full Channel Restoration, the impacts of the associated flow modifications to Boeckman Creek and the stability of the creek bed and banks through the project reach and downstream to the Willamette River must be understood. As noted previously in this report, the Boeckman Creek drainage basin area was significantly altered from its natural basin boundaries. The flow control infrastructure serves to manage the drainage from out-of-basin flows diverted to Boeckman Creek. Its removal requires careful analysis and an understanding of impacts and how flow can continue to be correctly managed.

Staff requests direction from Council on whether or not the City wishes to pursue Full Channel Restoration with the bridge project.

If Council chooses to not pursue the Full Channel Restoration, staff recommends that a hydraulic/hydrologic study be initiated with a more limited project scope. The study should at a minimum evaluate the need for infrastructure upgrades for potential capacity and/or life-cycle deficiencies. The study could also explore modifications to the main culvert and flow control structure that would be beneficial for fish passage and/or other potential stream enhancements.

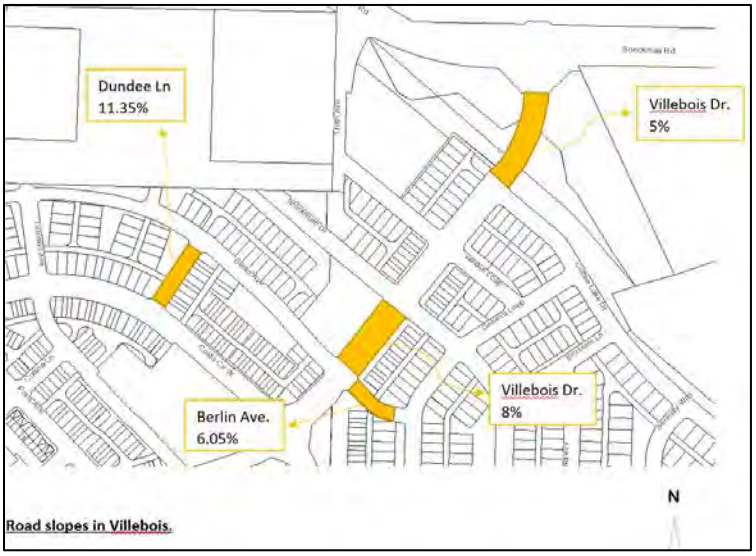
The adopted 2012 Stormwater Master Plan includes Project ST-7, Boeckman Creek at Boeckman Road Stormwater Study. Staff recommends this project move forward now with a scope that focuses on providing stream flow and stormwater management information needed for the bridge project. The project was not included in the adopted Capital Improvement Plan (project list) used to update the City's current stormwater rate and system development charge (SDC). Staff recommends the project list be updated by resolution to include the project with an updated cost. This information can then be incorporated in the proposed 2020 Stormwater Rate and SDC analysis.

Bridge Length – Staff requests confirmation from Council to continue (or not) with the added 80 feet to protect the significant Oregon white oak tree at 7550 Boeckman Road (see photo below).

Bridge Aesthetics – Staff requests Council direction on adding art and/or architectural detail such as bridge end treatments (and to what extent) and/or a viewing platform to the bridge design. These bridge enhancements will add cost to the project. Does the Council wish to limit bridge aesthetics to a certain budget? Please note that the adopted Frog Pond West Master Plan calls out the Boeckman Bridge as an opportunity for a "gateway" treatment that could include:

- A strong vertical element
- Materials and design compatible with natural setting of Boeckman Creek Corridor
- Potential location and integration with access to Boeckman trail
- Emphasize Boeckman Creek identity

Bridge Vertical Profile (Grade) – The current design profile meets minimum bridge design standards with a 6 percent maximum vertical grade. Staff requests direction from Council to look at options that flatten the slope to ease bicycle and pedestrian travel on the bridge noting that this is one of only three cross-town east-west arterials and should be designed to well serve all travel modes. For reference, comparative fairly steep Villebois street slopes are illustrated below.



Proposed Bridge Section – The current design cross-section includes 8.5-foot wide sidewalks, 6-foot wide bike lanes, two 12-foot travel lanes and a 4-foot median (see Figure 1 below) for a 60-foot wide bridge (see below). Staff requests that the cross-section continue to be refined to assure that all modes have the necessary width for safe travel.

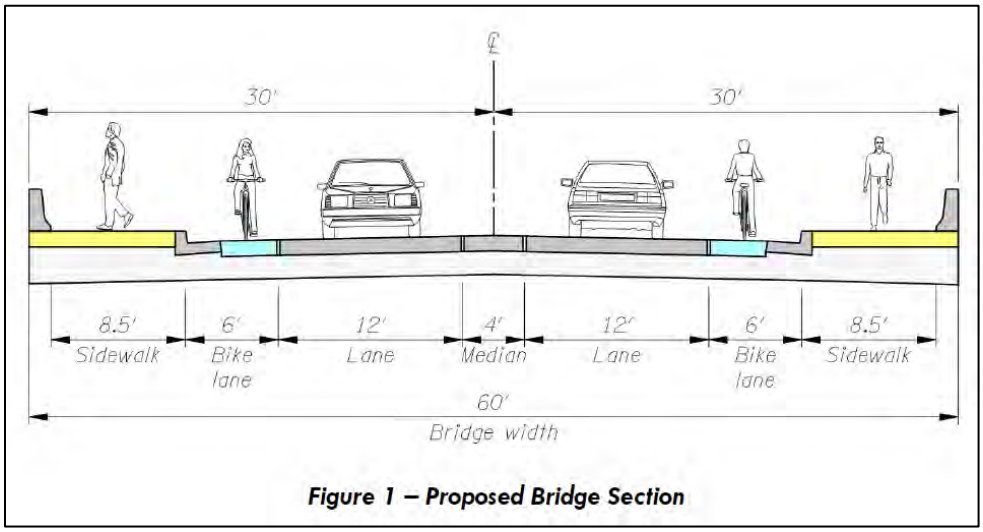


Figure 1 – Proposed Bridge Section

Alternative Project Delivery (Contracting) Methods - Staff is evaluating a variety of Project Delivery Methods for the Boeckman Dip Bridge project and will present findings at a future City Council meeting for Council consideration and direction.

Additional Funding Sources – Staff is evaluating a number of options to fill the gap in bridge project funding based on updated bridge design assumptions, inflation, and other added analysis and will present these options to City Council for consideration at a future meeting.

EXPECTED RESULTS:

The staff briefing will update the City Council on project progress and allow for discussion and direction for the project as it moves forward.

TIMELINE:

Should City Council direct staff to proceed with a hydraulic/hydrologic study, the City will immediately procure professional services with an engineering consulting firm to scope and perform the analysis. Upon completion of the hydraulic/hydrologic study, staff will brief the Council on the results. Staff expects to then be ready to move directly forward with either a traditional or an alternative project delivery approach for the bridge design and construction in Q3 of 2020.

CURRENT YEAR BUDGET IMPACTS:

The approved FY 2019-20 budget includes $935,000 in Year 2000 Urban Renewal District funds for project design and overhead associated with the Boeckman Dip Bridge project (CIP #4212). The project is to be designed jointly with the Boeckman Road Street Improvements – Frog Pond project (CIP #4205) and the Canyon Creek/Boeckman Traffic Signal project (CIP #4206).

Should City Council direct staff to proceed with a hydraulic/hydrologic study to help inform the Boeckman Dip Bridge project, a supplemental budget adjustment will be necessary to add Stormwater System Development Charge and Stormwater Operating funds to the current fiscal year budget estimated at $80,000. The full amount of funding for the Boeckman Dip Bridge, Boeckman Road and Canyon Creek Signal will not be expended this current Fiscal Year and will need to be re-appropriated next fiscal year.

FINANCIAL REVIEW / COMMENT:

Reviewed by: CAR Date: 1/29/2020

Limited funding is available from the Stormwater Operating fund.

LEGAL REVIEW / COMMENT:

Reviewed by: BAJ Date: 1/29/2020

COMMUNITY INVOLVEMENT PROCESS:

A community involvement process will be defined and incorporated into the work scope for further project design work. Preliminary public outreach occurred when the Year 2000 Urban Renewal Plan was amended to include construction funding for the project. The project has been discussed with the community as the Frog Pond neighborhood was planned and as land use applications have been approved. The community also had the opportunity to learn about the project during the Transportation System Plan adoption process.

POTENTIAL IMPACTS or BENEFIT TO THE COMMUNITY:

The adopted Wilsonville Transportation System Plan includes the Boeckman Dip Bridge to replace the existing road. Widening for bike lanes and sidewalks, updating the vertical profile to meet Public Works standards and improving sight distance is necessary to provide sufficient transportation infrastructure to accommodate growth and will also benefit the existing community. The bridge will also improve wildlife passage under Boeckman Road.

ALTERNATIVES:

Numerous alternatives are outlined in this staff report. This work session provides Council the opportunity to discuss and provide direction on these alternatives for the Boeckman Dip Bridge Project.

CITY MANAGER COMMENT:

N/A

ATTACHMENT:

A. December 2019 OBEC (dba DOWL) Memorandum

Attachment A

Boeckman Dip Alternative Analysis Memorandum

City of Wilsonville, Oregon

December 2019

DOWL

MEMORANDUM

TO: City of Wilsonville
FROM: Nick Robertson
DATE: December 2019
SUBJECT: Boeckman Dip Alternative Analysis Memorandum

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FIGURES

APPENDICES

EXPIRES: 12/31/2020

Introduction

Boeckman Road is a decades-old rural roadway constructed on an embankment with vertical grades that fail to comply with current design criteria. The City of Wilsonsville's (City) Transportation System Plan (TSP) designates the road as a minor arterial. The City is preparing to construct a new bridge to replace the existing culvert over Boeckman Creek, widen Boeckman Road, and improve the vertical profile of the bridge/roadway.

In 2014, OBEC Consulting Engineers, a DOWL LLC Company (OBEC), completed a feasibility study evaluating two alignment options to improve the vertical profile, replace the culvert, and re-establish the creek bed. The evaluation assumed Boeckman Road would be closed during construction. Option A raised the vertical profile the minimum amount necessary to meet design standards. Option B raised the vertical profile further to accommodate a future gravity sewer line. Since 2014, the City determined that the roadway profile does not need to accommodate gravity sewer. Therefore, the City selected Option A as the preferred alternative.

Features of Option A include:

- A new 300-foot bridge that raises the roadway profile approximately 20 feet
- Maintaining the existing horizontal alignment
- Boeckman Road section as shown in Figure 1
- Retaining walls at each abutment along the north and south of the roadway
- Jointed concrete pavement (PCC) to match roadway sections to the east and west

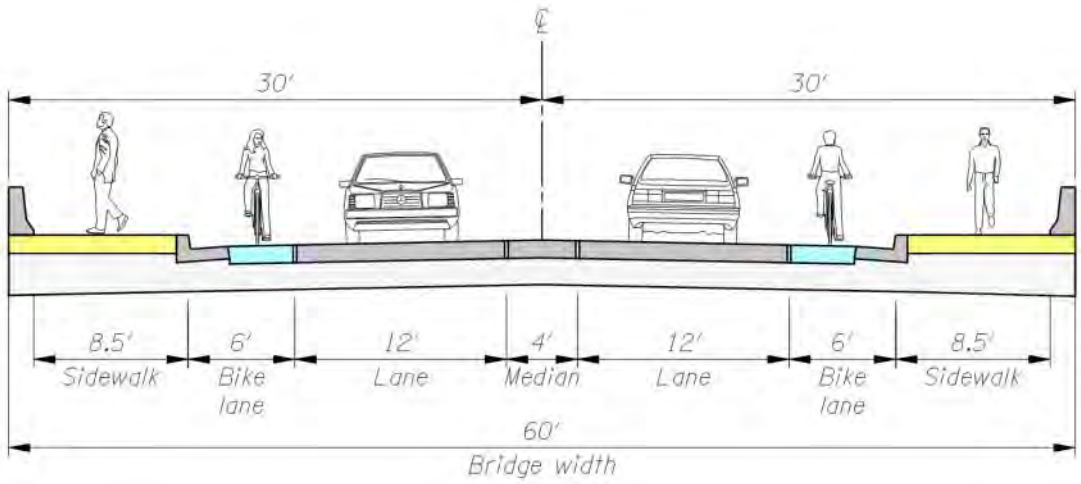


Figure 1 – Proposed Bridge Section

Since the 2014 report, the City has determined that a full closure of Boeckman Road during construction is undesirable. The purpose of this feasibility analysis is to determine the impacts and costs associated with constructing an on-site detour during construction and to update Option A with current construction costs.

The full closure and full on-site detour alternatives are believed to be the most efficient options available from a cost and traffic impact perspective, respectively. Many other potential construction alternatives exist, including accelerated bridge construction (ABC) and a partial

detour alternative. The pros and cons of the other alternatives will be discussed in qualitative terms as part of this analysis to provide a framework for future project refinement.

The findings in this narrative are based on survey data provided by others and preliminary alignments prepared by OBEC. Shannon and Wilson (S&W) provided geotechnical consultation as part of the 2014 feasibility study. DKS Associates (DKS) provided traffic analysis to evaluate the impacts to nearby intersections that would occur with a full closure of Boeckman Road during construction.

Design Standards, Project Design Assumptions, and Limitations

OBEC evaluated the alternatives in accordance with the following design standards, project design assumptions, and limitations.

Design Standards

- *2011 American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets*
- Americans with Disabilities Act (ADA) Accessibility Guidelines
- Wilsonville TSP 2013
- Wilsonville Public Works Standards (2017)
- *2012 AASHTO Load and Resistance Factor Design Bridge Design Specifications*

Project Design Assumptions

- Typical sections are identified in Appendices A and B.
- Bridge aesthetic treatment and view platforms are not included.
- Existing roadway fill will be removed to the elevation of the existing overflow culvert to improve wildlife connectivity.
- The existing flow control structure and lower culvert will remain in place (based on discussions with the City, a section has been added to this memo addressing a scenario that removes the flow structure and all fill down to the creek bed).
- Hydraulics will not govern the vertical profile of the bridge/roadway.
- Seismic hazards, such as liquefaction and lateral spread, are not fully assessed in terms of risk or additional project cost.
- The existing access road north of Boeckman Road will not be maintained and will be relocated to connect to Morgan Farms Phase 1.
- The left turn lane taper for westbound Boeckman Road will not extend onto the bridge.
- Stormwater management will be conventional on-site treatment.
- Cost estimates are in 2021 dollars using 4% inflation.
- Cost estimates do not include future intersection improvements.
- No landscaping costs are included.
- Utility conflicts and relocation costs are not included.
- Reimbursable franchise utility costs are anticipated on the north side of Boeckman Road at Morgan Farms.

- The cost to repair the Morgan Farms landscape wall has been accounted for in the on-site detour alternatives.
- City utility replacement, relocation, or upgrades are not included.
- Right of way (ROW) acquisition areas are based on a ROW width of 81 feet, except near the bridge where the cost is based on 89 feet.
- ROW costs are based on $17.50 per square foot for permanent ROW acquisition and $9 per square foot for temporary easements.
- Avoid permanently impacting new development on the north side of Boeckman Road, east of the proposed bridge.
- The proposed bridge alternative identified in the 2014 feasibility study will be extended 80 feet to the east (for a new total bridge length of 380 feet) to reduce impacts to the significant tree at 7550 Boeckman Road.
- No in-water work window (IWWW) will be required for construction.

Limitations

There are several limitations to the current project understanding that require additional investigation as design progresses. These items contribute to the assigned 30% contingency for all cost estimates.

- A survey of the current conditions should be conducted to capture more accurately the impacts to 7727 Boeckman Road and Morgan Farms.
- A geotechnical analysis should be conducted for the required bridge foundations, structural section of the on-site detour, and retaining walls.
- An evaluation should be performed to determine the compatibility of the east abutment retaining walls with the existing retaining wall at 7488 SW Bouchaine Court.
- A tree survey should be conducted to determine the impacts of the on-site detours to the surrounding trees.
- Previously, it was assumed the Boeckman Creek fill would be excavated to just below the existing overflow culvert. A refined hydraulic analysis and environmental study should be conducted to determine the excavation necessary below the permanent bridge. Planning level project costs to restore the creek are found at the end of this report.
- Prior to proceeding with any proposed crossing alternatives, outreach to all resource and regulatory agencies should be completed. Specifically, Oregon Department of Fish and Wildlife (ODFW) should be consulted to confirm whether or not the project will need to address Oregon Fish Passage law and receive fish passage plan approval. Passage may need to be addressed if greater than 50% of the existing fill above the Boeckman Creek culvert is removed as part of the project.

On-site Detour Alternatives

This evaluation considered three on-site detour alternatives focused on minimizing the full road closure during construction. The three alternatives considered consist of a north on-site detour, a south on-site detour, and a staged construction detour.

Survey data from 2014, supplemented with a LIDAR surface to capture the limits of the detour alignments, serves as the basis for this evaluation. The accuracy of this data is sufficient for this

feasibility analysis, but full ground survey will be required when the project moves into the design phase. One significant change since 2014 is the Morgan Farms Phase 1 construction. OBEC reviewed the development plans to determine probable impacts as part of this analysis.

Boeckman Road east of Canyon Creek Road is not a designated truck route; therefore, all temporary alignments are designed to accommodate a WB-40 truck.

Alternative 1 – North On-site Detour

Alternative 1 includes a full 2-lane on-site detour parallel with the permanent alignment (see Appendix A for figures). The on-site detour would be constructed by widening the existing roadway 60 feet to the north. To temporarily widen the roadway, the existing storm outfall and overflow culvert would need to be extended. This alternative requires approximately 21,000 square feet of temporary construction easements.

The detour would use a design speed of 25 miles per hour (MPH) and consist of two 11-foot lanes and a 5-foot pedestrian path. The vertical alignment would follow the existing substandard profile.

Constructability

The detour alignment provides 10 feet of separation between the proposed bridge and the eastbound detour travel lane, which gives the contractor approximately 25 feet of staging area between the existing roadway edge of pavement and the on-site detour gravel shoulder that is absent in other alternatives.

Traffic control flagging will be required to construct the temporary widening and a 2-week full road closure is necessary to connect the detour to the existing roadway. A 1-month full road closure is expected to construct the roadway east and west of the bridge, after the bridge and abutment walls are constructed.

The total construction duration is estimated to take 15 months from beginning of construction to substantial completion. It is estimated a total of six weeks of full road closures will be required to complete construction.

Retaining Walls

This alternative includes three temporary retaining walls. Retaining Wall "A" is located across Boeckman Creek and supports the widening of the existing roadway to the north. Retaining Wall "A" is 275 feet long with a maximum height of approximately 24 feet. Retaining Wall "B" is located along the west side cut slope at 7727 Boeckman Road. Retaining Wall "B" is 225 feet long and has a maximum height of 7.5 feet. Retaining Wall "C" is located along the east side cut slope at Morgan Farms. Retaining Wall "C" is 60 feet long and five feet tall.

Permitting

Environmental and permitting impacts are very similar between the on-site detour alternatives. No wetlands were delineated during the initial survey in 2014, but a potential wetland was visually identified near the existing storm outfall during a field visit. Further evaluation is needed to determine the potential impacts to wetlands for any of the design alternatives. This alternative results in the removal of the most significant number of trees, but many of these trees are likely to be removed to accommodate the final configuration. Extension of the overflow culvert pipe would

be required for this alternative; however, no permits or approvals related to in-water work would be required since this culvert does not appear to fall within the jurisdictional waterway and likely does not provide fish passage other than during flood events. If temporary fills exceed 50% by volume of the existing roadbed material directly above the existing main stream culvert, fish passage requirements may be triggered and early consultation with ODFW is recommended.

Alternative 2 – South On-site Detour

The south on-site detour was determined to be impractical for the following reasons.

Property Impacts

There are unavoidable impacts to the existing retaining wall and one or more homes on Bouchaine Court. The impacts that would result from constructing the south on-site detour are mostly outside the footprint of the new bridge and retaining wall. See Figure 2 for reference.

Significant Tree Impacts

There is a significant tree (large Oregon white oak) identified at 7550 SW Boeckman Road. To construct a south on-site detour, this tree would need to be removed. See Figure 2 for reference.

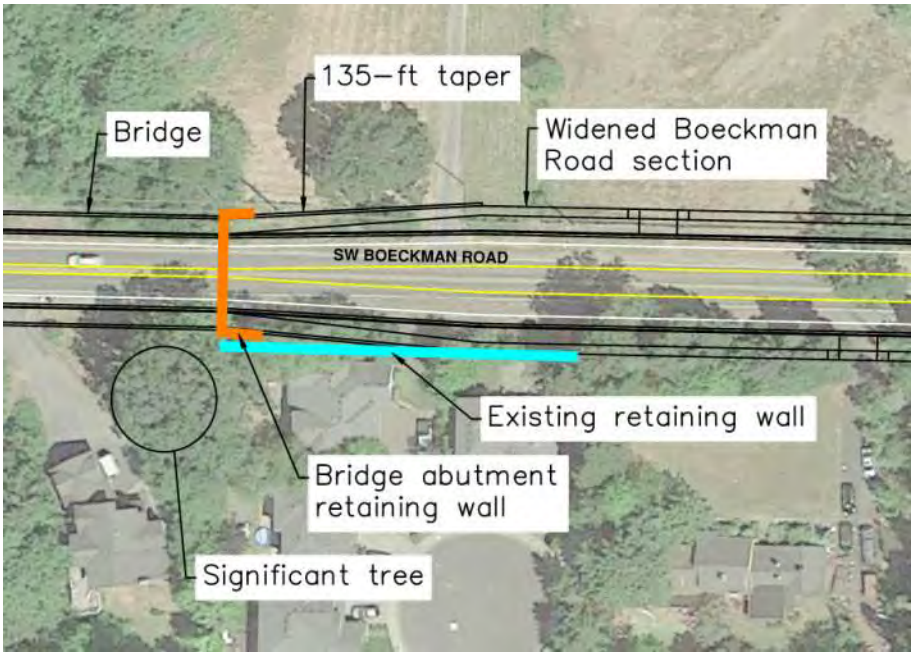


Figure 2 – South On-site Detour

This assessment considered a south on-site detour that would consist of two 11-foot lanes and a 5-foot pedestrian path. The detour would be constructed by widening the roadway approximately 55 feet, extending the existing overflow culvert, and constructing a temporary retaining wall across Boeckman Creek.

Alternative 3 – Staged Construction Detour

The staged on-site detour would be completed in three phases. Phase 1 would construct the on-site detour, routing traffic to the north while constructing the southern portion of the bridge. Phase 2 would construct the northern portion of the bridge while traffic is routed onto the southern portion constructed in Phase 1. Phase 3 would construct the remaining roadway east and west of the bridge with flagging and road closures as needed for construction. A staged detour was considered for two reasons: (1) reduced impacts to the adjacent northern properties; and (2) potentially reduced durations of road closures.

Alternative 3 includes a full 2-lane staged detour parallel with the permanent alignment (see Appendix B for figures). This alternative would be constructed by widening the roadway 36 feet to the north. This alternative requires approximately 11,250 square feet of temporary construction easements.

The staged on-site detour would use a design speed of 30 MPH and consist of two 11-foot lanes and a 5-foot pedestrian path. The vertical alignment would follow the existing substandard profile.

Constructability

Phase 1 would construct 36 feet of the southern portion of the bridge and roadway while traffic is routed to the on-site detour. There will be a 10-foot separation between the bridge construction and the eastbound detour travel lane, which gives the contractor approximately six feet of working area. Traffic control flagging will be required to construct the temporary detour widening and a 2-week full road closure will be required to connect the detour to the existing roadway.

Phase 2 shifts traffic onto the Phase 1 bridge construction and provides two 12-foot lanes with 2.5 feet shy distances between the bridge rail and temporary traffic barrier and a 7-foot temporary cantilevered pedestrian walkway. A 4-week closure will be required to connect the existing roadway to the Phase 1 construction. The detour road constructed in Phase 1 can be used as a construction staging area and provides approximately 13 feet between the edge of the completed bridge and the northern traffic barrier.

In order to shift traffic onto the Phase 1 bridge construction, traffic will need to be routed where permanent sidewalk would be. Therefore, a temporary 12-foot widening on the south side of Boeckman Road will be required in Phase 2. Permanent sidewalk would then be constructed in Phase 3.

Phase 3 will construct the north half of the widened roadway section east and west of the bridge. Flagging and additional short road closures will be necessary to adjust traffic control during construction. We do not expect these closures to take longer than one or two days to transition between stages of traffic control.

The total construction duration is estimated to take 17 months from beginning of construction to substantial completion. It is estimated six weeks of full road closures will be required to complete Phase 1 and Phase 2. Phase 3 will require flagging and an additional 1- or 2-day road closures as needed to direct traffic during construction.

Retaining Walls

Phase 1 requires three temporary retaining walls. Retaining Wall "A" is located across Boeckman Creek and supports the widening of the existing roadway to the north. Retaining Wall "A" is 275 feet long with a maximum height of approximately 16 feet. Retaining Wall "B" is located along the west bridge abutment. Retaining Wall "B" is 150 feet long with a maximum height of approximately 18 feet. Retaining Wall "C" is located along the east bridge abutment. Retaining Wall "C" is 90 feet long with a maximum height of approximately 12 feet. Retaining Walls "B" and "C" allow the southern half of the bridge abutments to be constructed during Phase 1 to route traffic onto the bridge during Phase 2.

Phase 2 has two additional temporary retaining walls. Retaining Wall "D" is located west of the west bridge abutment. Retaining Wall "D" is 290 feet long with a maximum height of approximately nine feet. Retaining Wall "E" is located east of the east bridge abutment. Retaining Wall "E" is 50 feet long with a maximum height of approximately four feet. Retaining Walls "D" and "E" allow the road grade to be raised to match the bridge. Once Retaining Walls "D" and "E" are constructed, traffic can be routed onto the 36-foot wide portion of the bridge constructed in Phase 1. These walls must be constructed mostly during road closure as discussed above.

Permitting

Environmental and permitting impacts of this alternative are similar to the northern on-site alternative with fewer tree impacts. No special considerations or additional permits/approvals for this alternative are anticipated.

Option A Update

The Option A (full road closure) cost estimate identified in the 2014 report was updated for the added bridge length to reduce impacts to the significant tree. The estimate is based on current 2019 unit prices, Oregon Department of Transportation (ODOT) Weighted Average Item Prices for 2018, ODOT Traffic Control Plan Cost Estimator, and similar projects in the Portland Metro area. To develop a 2021 construction cost, 4% inflation per year was applied to the total cost.

DKS analyzed the level of service (LOS) and volume-to-capacity (V/C) ratio for 11 intersections in the project vicinity that would be affected by closure of Boeckman Road. DKS assessed the impact of the closure on these intersections. Only the Stafford Road/65th Avenue intersection failed current and future (2021) detour conditions. DKS determined a temporary traffic signal during the closure would result in the LOS meeting Clackamas County standards. The preliminary estimated cost for design and construction of the temporary traffic signal is $200,000, which is included in the updated Option A cost estimate. Refer to Appendix D for the complete traffic study.

The total construction duration is estimated to take 12 months from beginning of construction to substantial completion. It is estimated nine months of full road closures will be required to complete Option A.

Other Alternatives Considered

Accelerated Bridge Construction

ABC was considered as part of this analysis. Based on the existing site geometry, certain ABC techniques, such as constructing the bridge on a temporary alignment and sliding it into place, are not feasible at this site. In addition to the large grade difference between the existing and future roadway profiles, construction of an off-site bridge would require extensive temporary works in order to provide the contractor sufficient access to fabricate the bridge superstructure prior to sliding it into place. The temporary ROW needs would be similar to the detour alternatives, and the costs would be higher due to the increased complexity.

However, other ABC techniques may be suitable, which could reduce the total length of closure. Examples include constructing foundation elements during daytime lane closures and maximizing the use of precast elements (including end panels, decks, and pile caps) and high-performance concrete, which have potential to reduce the closure time by two months, or more. These time savings measures would increase the overall project cost. The next design phase should compare cost-to-time benefits of these and other appropriate ABC techniques.

Partial Detours

A 1-lane on-site detour would require widening the existing roadway 50 feet to the north. This would slightly reduce impacts to the Morgan Farms development and 7727 SW Boeckman Road, but temporary construction easements and three temporary retaining walls will still be required to construct the 1-lane detour. This alternative would require either a temporary signal on Boeckman Road or 24-hour flagging for the duration of the project and does not offer a significant advantage over the north on-site detour.

A 1-lane staged detour would require widening the existing roadway approximately 13 feet to the north. Similar to the staged construction detour, Phase 1 would route one lane of traffic to the north while a southern portion of the bridge is constructed. Phase 2 would route one lane of traffic onto the Phase 1 bridge construction. Additional construction would be required in Phase 3 to further widen the roadway before two lanes of traffic can resume on Boeckman Road. Four temporary retaining walls along Boeckman Road and a retaining wall across Boeckman Creek would still be required. This alternative still presents challenging traffic control staging, which would require either a temporary signal on Boeckman Road or 24-hour flagging for the duration of the project, and does not offer a significant advantage over the Staged Construction Detour.

Full Channel Restoration

The 2014 design report based the construction cost estimates on the assumption that the existing roadway would be removed down to the toe of the existing road slope (approximate elevation 155). Based on discussion with the City, including a November 2019 site visit, there would be significant environmental gains by removing all of the existing fill and restoring Boeckman Creek.

In order to restore the creek bed to its original condition, fill would need to be removed down to approximately elevation 135 and the existing flow structure would need to be removed. Based on the existing ground LIDAR surface, an existing wetland to the north was estimated at 95 feet wide and an existing wetland to the south was estimated at 65 feet wide. Assuming a channel

width congruent with the existing wetlands, a channel width tapering from 95 feet to 65 feet with 2H:1V side slopes was evaluated.

Adjacent properties would be affected by the full channel restoration. Approximately 12,400 square feet of permanent slope easement would be required to construct the side slopes of the channel. It may be feasible to complete the restoration with a reduced channel width and shallower side slopes. Reducing the channel width would reduce excavation costs and impacts to adjacent properties while shallower side slopes would provide greater slope stability and provide easier restoration and planting.

Further evaluation of environmental impacts and a hydraulic analysis would be necessary to determine if the channel width can be reduced and the flow structure removed. See Appendix G for the estimated impacts and planning-level costs for full channel restoration. The full channel restoration, which includes the removal of fill and structures, taller bridge columns, and stream channel restoration, is estimated to increase costs between $2,000,000 and $3,700,000 and add three to six months to the construction duration. This is the additional project cost and construction duration for any of the three alternatives to include full stream restoration as part of the project.

Summary

The following table summarizes the estimated project cost of each alternative. The costs shown are based on a preliminary level design and are meant for comparison purposes only. Alternative 2 costs were not calculated due to the south on-site detour being impractical. Instead, Alternative 3 costs were evaluated. The total cost is reflected in 2021 dollars (assuming a 4% inflation rate) and includes preliminary engineering, construction engineering, ROW, construction survey work, and a 30% contingency to reflect the current level of design.

Table 1 – Cost Comparison

	Alternative 1	Alternative 2	Alternative 3	Full Road Closure
Detour*	$870,000	N/A**	$910,000	$200,000***
Traffic Control	$280,000	N/A**	$490,000	$50,000
ROW	$590,000	N/A**	$503,000	$410,000
Total (2021)	$18,200,000	N/A**	$19,800,000	$16,400,000

* Detour costs are for bid items associated with construction only and do not include additional costs such as mobilization, ROW, and preliminary engineering.
** Per prior discussion, this alternative was deemed impractical.
*** Temporary traffic signal design and construction costs

If the City decides to include full stream restoration as part of the project, the total (2021) cost of each alternative must be increased by between $2,000,000 and $3,700,000. The Full Road Closure option cost increase would be on the lower to middle end of this range, while Alternatives 1 and 3 would be on the middle to higher end of this range.

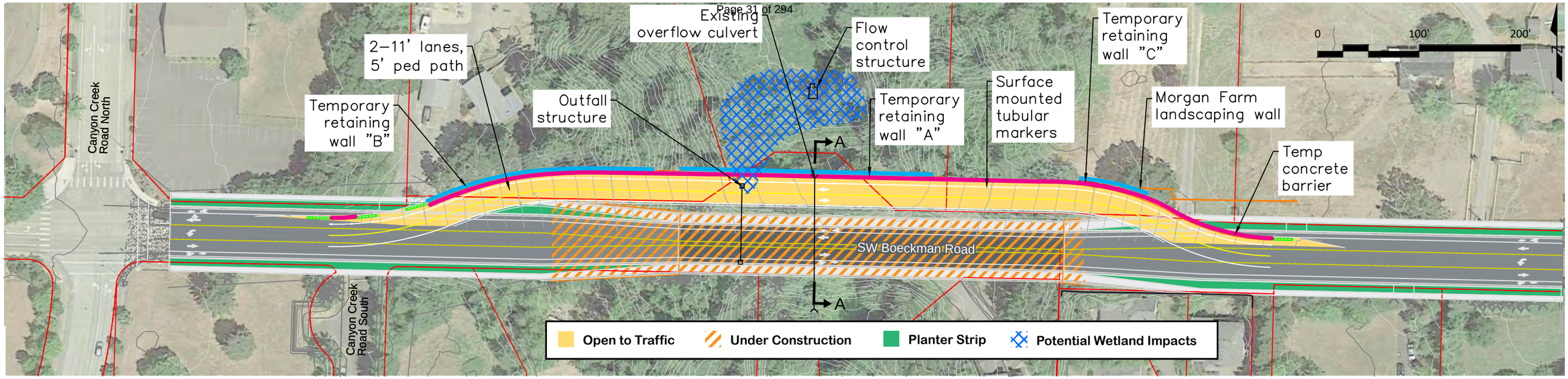
The following table summarizes the advantages and disadvantages of each alternative.

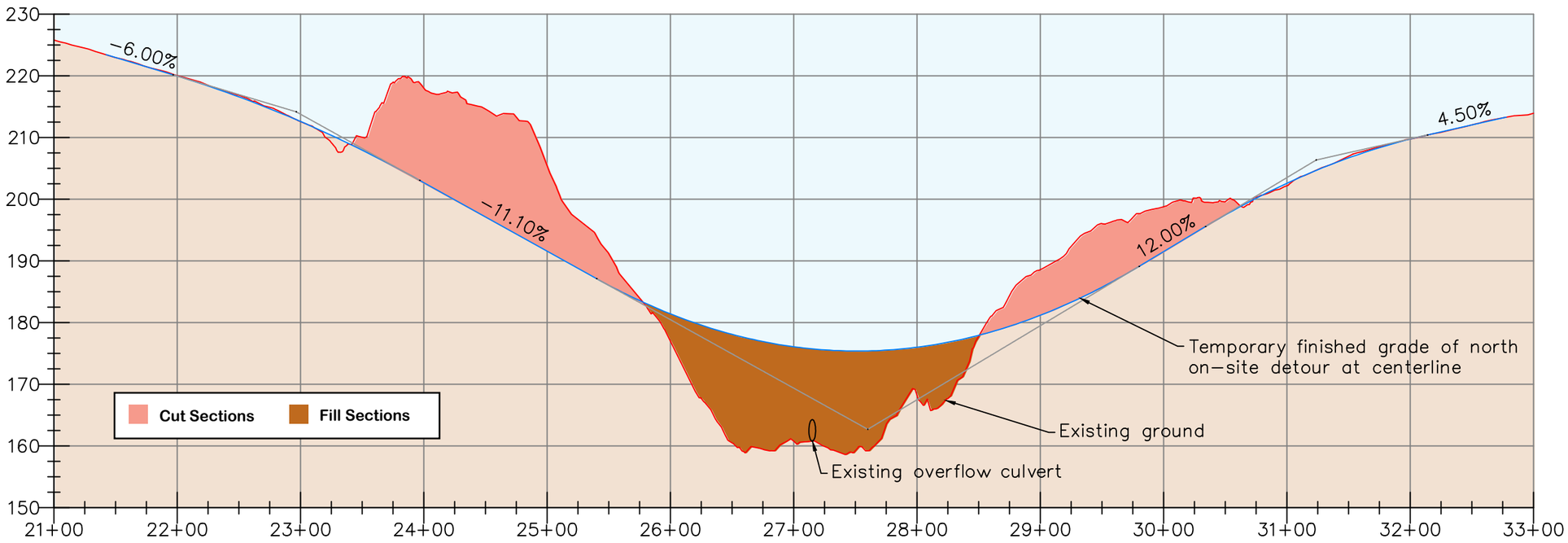
Table 2 – Comparison of Detour Alternatives

Alternative	Advantages	Disadvantages
1	• Allows full construction of the bridge and abutment retaining walls in one stage • Easier construction than Alternative 3 • Least expensive detour alternative • Reduces full road closures	• Largest area of temporary construction easements • Impacts properties to the north • Speed reduction to 25 MPH • 27 additional trees effected compared to full road closure • Overflow culvert and storm outfall extension required
2	• None	• Impacts to existing retaining wall and home to the south • Significant tree removal • Overflow culvert extension required
3	• No culvert extension required • Reduces impacts to the properties to the north compared to Alternative 1 • Smaller area of temporary construction easements than Alternative 1 • Reduces full road closures	• Difficult to construct/limits space for contractor • Speed reduction to 30 MPH • 17 additional trees effected compared to full road closure • Most expensive alternative • Longest construction time • Impacts properties to the north
Full Road Closure	• Least expensive alternative • Most constructable • Fewest trees impacted • Smallest area of temporary construction easements if needed. • One IWWW • Shortest construction time	• Longest full road closure

A full road closure remains the preferred option. It has the shortest construction time at approximately 12 months and is significantly less expensive. However, of the on-site detour alternatives considered, Alternative 1 with the north on-site detour would be preferred over the staged construction detour since it is less expensive, offers more construction staging area, and has a shorter construction time.

Appendix A





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

NORTH ON-SITE DETOUR | A1

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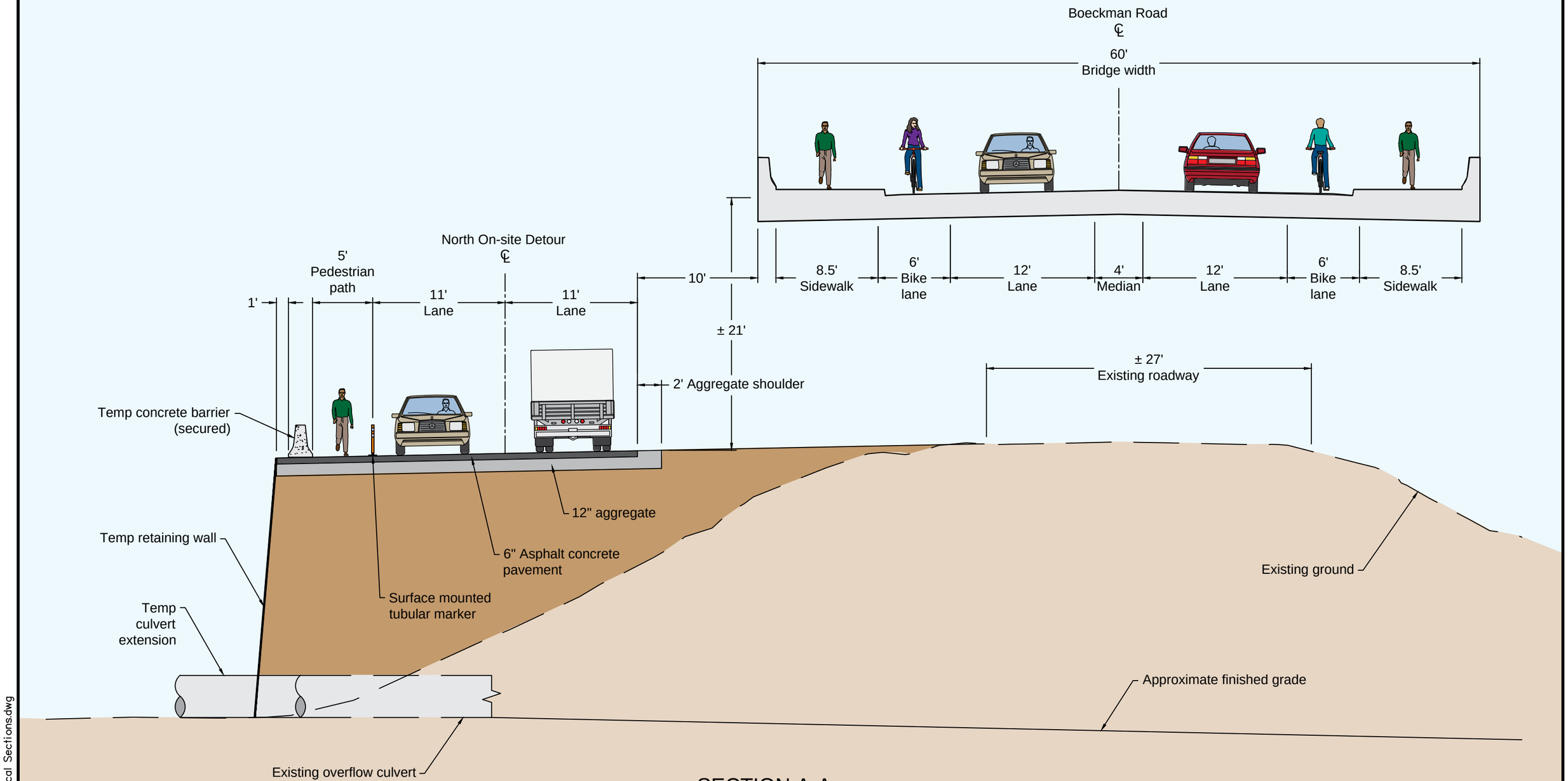

SECTION A-A
NORTH ON-SITE DETOUR

City of WILSONVILLE OREGON

OBEC CONSULTING ENGINEERS
A DOWL LLC Company

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

NORTH ON-SITE DETOUR - TYPICAL SECTION | A2

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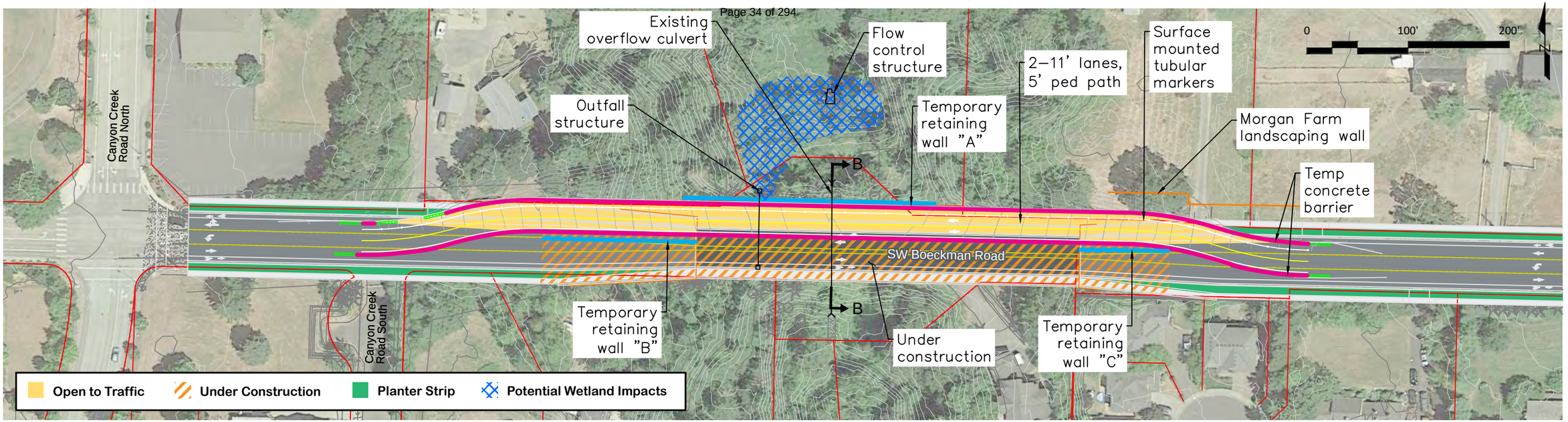
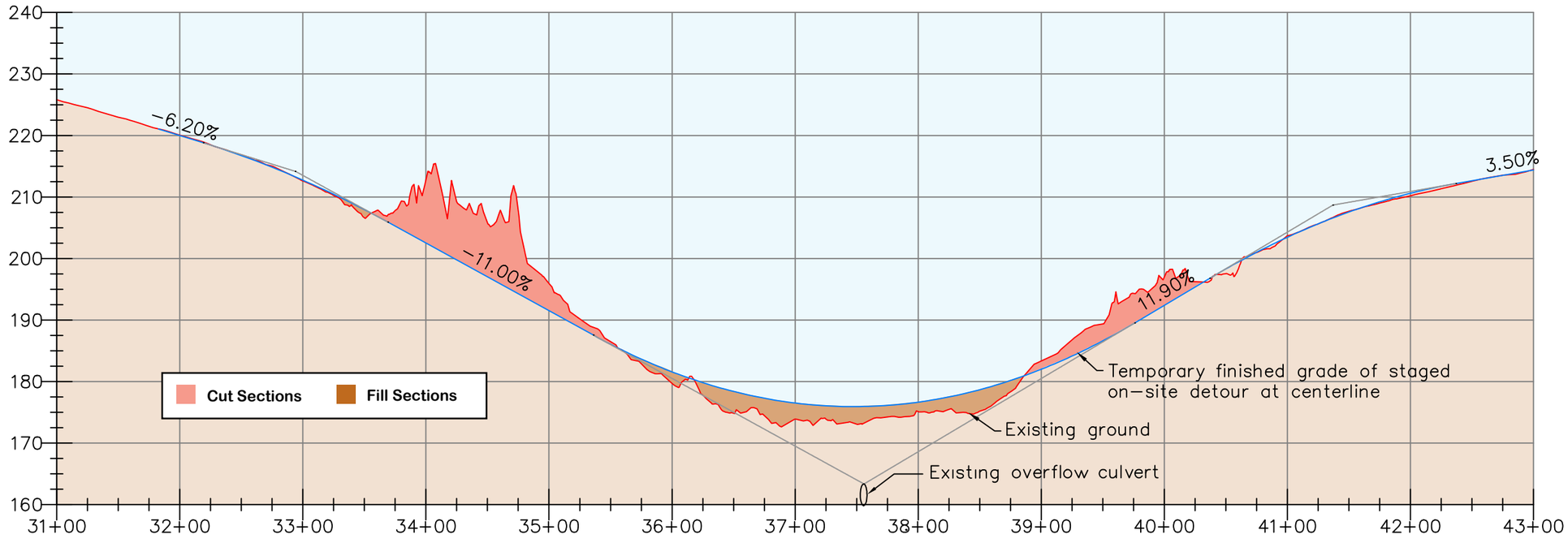
Appendix B





City of WILSONVILLE OREGON

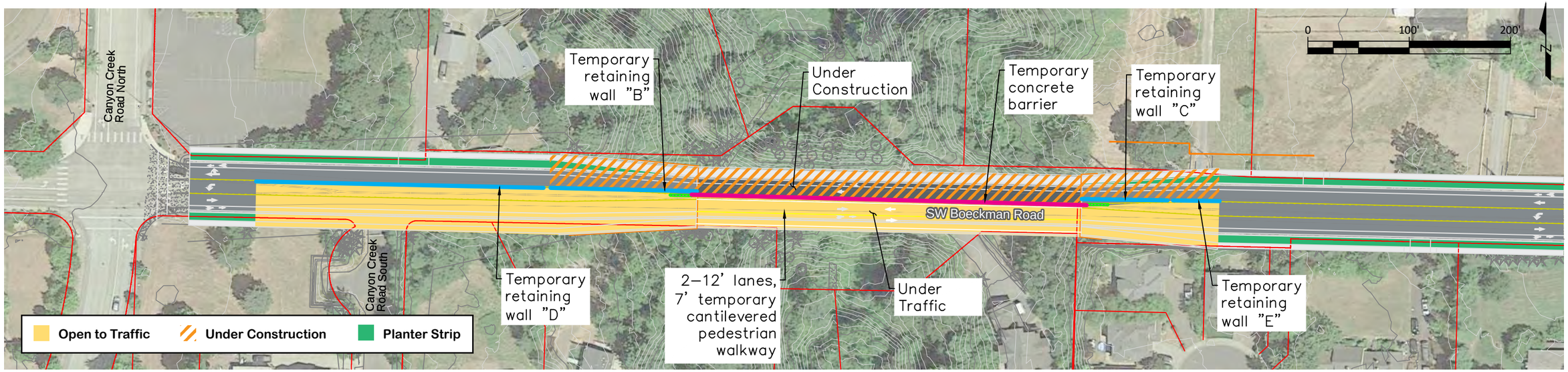
BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

STAGED CONSTRUCTION DETOUR - PHASE 1 | B1

C:\obec\pwobec01\d0361468\Exhibit - Half Bridge.dwg



City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

STAGED CONSTRUCTION DETOUR - PHASE 2	B2

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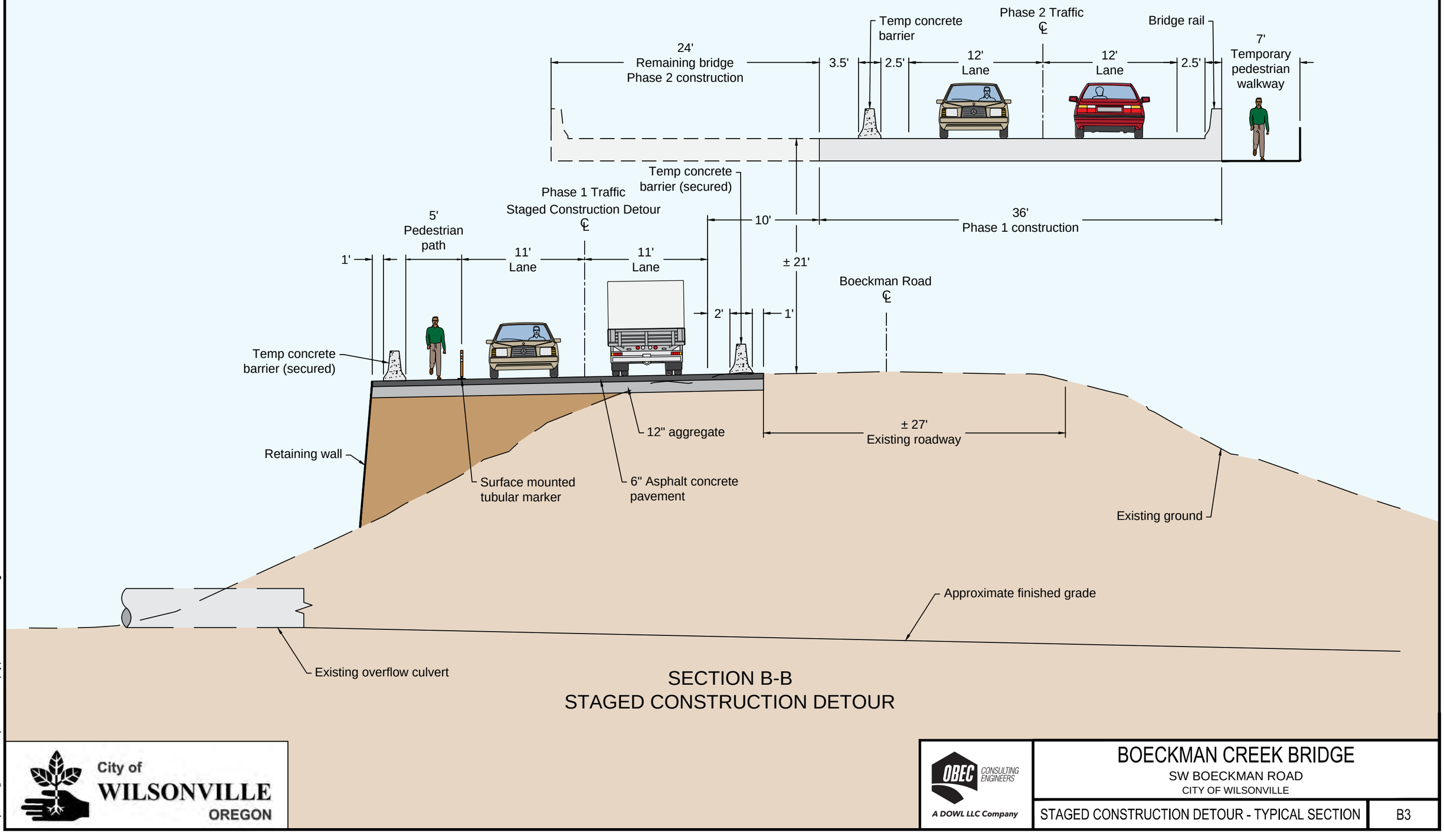

SECTION B-B
STAGED CONSTRUCTION DETOUR

City of
WILSONVILLE
OREGON

OBEC CONSULTING ENGINEERS
A DOWL LLC Company

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

STAGED CONSTRUCTION DETOUR - TYPICAL SECTION | B3

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Appendix C

PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Updated Option A				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Grading, Drainage, Structures, Paving, Signing, Illumination	0.31	12/11/19	OBEC	

ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$755,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	$50,000	$50,000
225	TEMPORARY SIGNAL	LS	1	$200,000	$200,000
0280.0100000A	EROSION CONTROL	LS	1	2%	$164,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$81,000
0320.0100000A	CLEARING AND GRUBBING	AC	5	$1,500	$7,500
0330.0105000K	GENERAL EXCAVATION	CUYD	21,531	$20	$430,620
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	$1.00	$8,038
0640.0100000M	AGGREGATE BASE	CUYD	1,538	$45	$69,229
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	$80	$555,760
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	$20	$54,320
0759.0128000J	CONCRETE WALKS 4"	SQFT	13,873	$6.00	$83,238
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$9.00	$12,690
00400's	Storm & drainage	LS	1	$110,000	$110,000
1012-0000000R	WATER QUALITY SWALE	LS	1	$30,000	$30,000
STRUCTURES					
0596.0104000J	RETAINING WALL, MSE - West Side	SQFT	3,975	$90	$357,750
0596.0104000J	RETAINING WALL, MSE - East Side	SQFT	1,100	$90	$99,000
00500's	STEEL OR CONCRETE BRIDGE	SQFT	22,800	$250	$5,700,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$17,000	$17,000
00900's	Signing	LS	1	$10,000	$10,000
00900's	Illumination	LS	1	$350,000	$350,000
SUBTOTAL, Construction Items					**$9,145,000**
	PRELIMINARY ENGINEERING			15%	$1,372,000
	RIGHT-OF-WAY	SQFT	22,477		$400,000
	CONSTRUCTION ENGINEERING			12%	$1,097,000
	CONSTRUCTION SURVEY WORK			3%	$239,000
	CONTINGENCY			30%	$2,744,000
****PARTIAL PROJECT COST IN 2019 DOLLARS**					**$15,000,000**
****PARTIAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$16,300,000**

PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - North On-site Detour				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	**Grading, Structures, Paving, Signing, Illumination**	**0.31**	**12/11/19**	**OBEC**	
ITEM NUMBER	**ITEM DESCRIPTION**	**UNIT**	**AMOUNT**	**UNIT COST**	**TOTAL**
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$813,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	3%	$280,000
0225.0126000F	TEMPORARY CONCRETE BARRIER, REFLECTORIZED	FT	870	$18	$15,660
0225.0134000E	TEMPORARY IMPACT ATTENUATOR, NARROW SITE SYSTEM	EACH	4	$500	$2,000
0230.0100000A	CONSTRUCT AND REMOVE DETOURS	LS	1	$320,000	$320,000
0256.0109100A	TEMPORARY RETAINING WALL 'A', MSE	SQ FT	4,625	$80	$370,000
0256.0109100A	TEMPORARY RETAINING WALL 'B', PREFABRICATED MODULAR GRAVITY	SQ FT	1,375	$80	$110,000
0256.0109100A	TEMPORARY RETAINING WALL 'C', PREFABRICATED MODULAR GRAVITY	SQ FT	300	$80	$24,000
0280.0100000A	EROSION CONTROL	LS	1	2%	$177,100
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$87,700
0320.0100000A	CLEARING AND GRUBBING	AC	5	$1,500	$7,500
0330.0105000K	GENERAL EXCAVATION	CUYD	21,531	$20	$430,620
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	$1.00	$8,038
0640.0100000M	AGGREGATE BASE	CUYD	1,538	$45	$69,229
0640-0101000M	AGGREGATE SHOULDERS	CUYD	79	$30	$2,370
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	$80	$555,760
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	$20	$54,320
0759.0128000J	CONCRETE WALKS 4"	SQFT	13,873	$6.00	$83,238
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$9.00	$12,690
00400's	Storm & drainage	LS	1	$110,000	$110,000
0445.010064CF	66 INCH CULVERT PIPE, OVER 20FT DEPTH	FT	10	$1,500.00	$15,000
0445.035012DF	12 INCH STORM SEWER PIPE, OVER 20 FT DEPTH	FT	20	$100.00	$2,000
0470.0323000E	CONCRETE INLETS, TYPE M-O	EACH	1	$4,000.00	$4,000
1012.0000000R	WATER QUALITY SWALE	LS	1	$30,000	$30,000
1040	LANDSCAPE WALL	FT	65	$100	$6,500
STRUCTURES					
0596.0104000J	RETAINING WALL, MSE - West Side	SQFT	3,975	$90	$357,750
0596.0104000J	RETAINING WALL, MSE - East Side	SQFT	1,100	$90	$99,000
00500's	STEEL OR CONCRETE BRIDGE	SQFT	22,800	$250	$5,700,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$17,000	$17,000
00900's	Signing	LS	1	$10,000	$10,000
00900's	Illumination	LS	1	$350,000	$350,000
SUBTOTAL, Construction Items					**$10,124,000**
	PRELIMINARY ENGINEERING			15%	$1,519,000
	PERMANENT RIGHT-OF-WAY	SQFT	22,477		$394,000
	TEMPORARY RIGHT-OF-WAY	SQFT	18,821		$170,000
	CONSTRUCTION ENGINEERING			12%	$1,215,000
	CONSTRUCTION SURVEY WORK			3%	$240,000
	CONTINGENCY			30%	$3,037,000
****PARTIAL PROJECT COST IN 2019 DOLLARS**					**$16,700,000**
****PARTIAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$18,100,000**

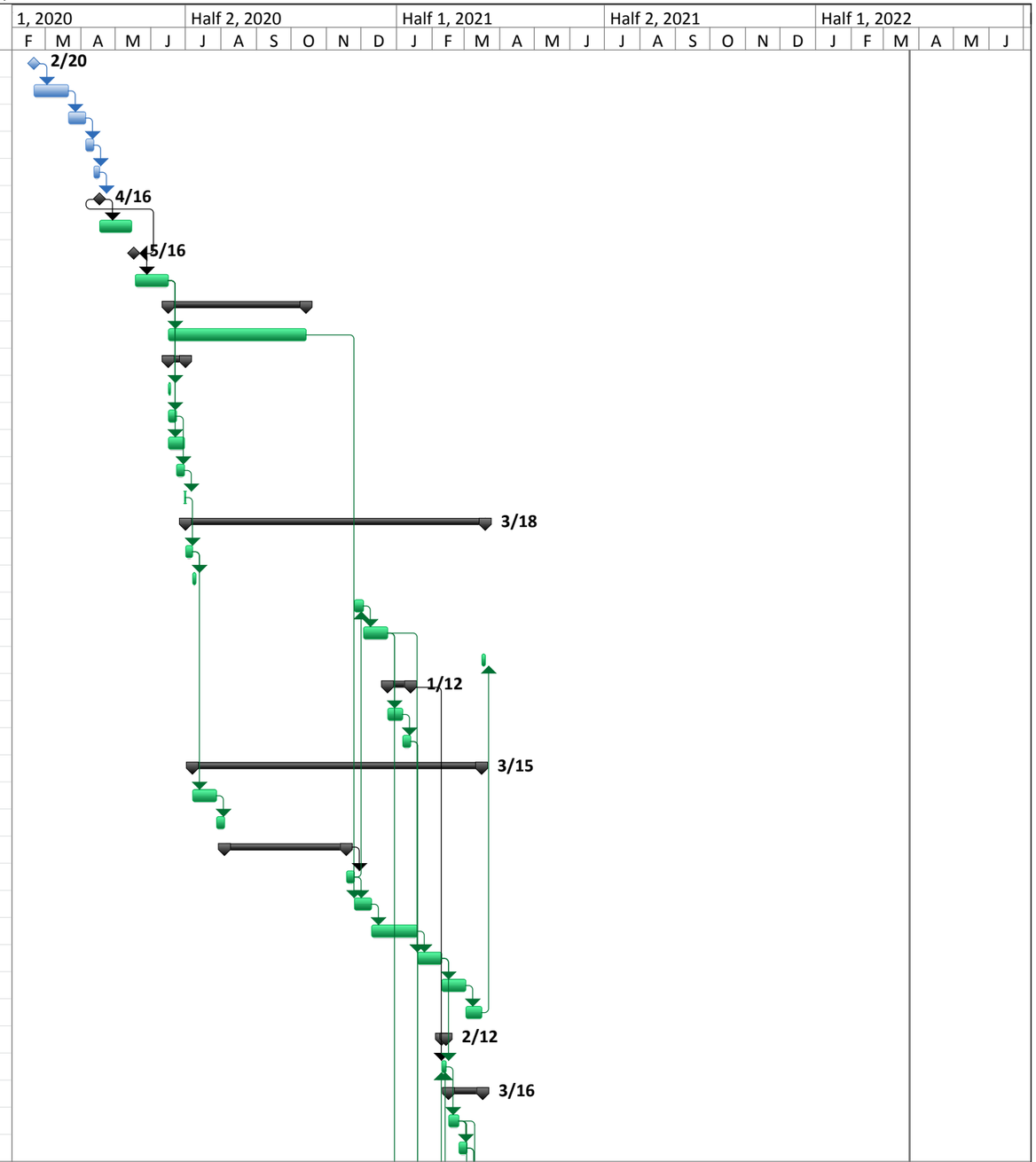
PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Staged Construction				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Grading, Structures, Paving, Signing, Illumination	0.31	12/11/19	OBEC	
ITEM NUMBER	**ITEM DESCRIPTION**	**UNIT**	**AMOUNT**	**UNIT COST**	**TOTAL**
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$879,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	5%	$490,000
0225.0126000F	TEMPORARY CONCRETE BARRIER, REFLECTORIZED	FT	1,762	$18	$31,716
0225.0134000E	TEMPORARY IMPACT ATTENUATOR, NARROW SITE SYSTEM	EACH	6	$500	$3,000
0225	TEMPORARY PEDESTRIAN STRUCTURE	LS	1	$20,000	$20,000
0230.0100000A	CONSTRUCT AND REMOVE DETOURS	LS	1	$330,000	$330,000
0256.0109100A	TEMPORARY RETAINING WALL 'A', MSE	SQ FT	2,685	$80	$214,800
0256.0109100A	TEMPORARY RETAINING WALL 'B'	SQ FT	1,945	$80	$155,600
0256.0109100A	TEMPORARY RETAINING WALL 'C'	SQ FT	680	$80	$54,400
0256.0109100A	TEMPORARY RETAINING WALL 'D'	SQ FT	1,045	$80	$83,600
0256.0109100A	TEMPORARY RETAINING WALL 'E'	SQ FT	126	$80	$10,080
0280.0100000A	EROSION CONTROL	LS	1	2%	$191,500
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$94,800
0310.0119000F	ASPHALT PAVEMENT SAW CUTTING	FT	1020	$2	$2,040
0320.0100000A	CLEARING AND GRUBBING	AC	4	$1,500	$6,000
0330.0105000K	GENERAL EXCAVATION	CUYD	21,531	$25	$538,275
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	$1.00	$8,038
0640.0100000M	AGGREGATE BASE	CUYD	1,538	$45	$69,229
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	$80	$555,760
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	$20	$54,320
0759.0128000J	CONCRETE WALKS 4"	SQFT	13,873	$6.00	$83,238
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$9.00	$12,690
00400's	Storm & drainage	LS	1	$110,000	$110,000
1012.0000000R	WATER QUALITY SWALE	LS	1	$30,000	$30,000
1040	LANDSCAPE WALL	FT	30	$100	$3,000
STRUCTURES					
0596.0104000J	RETAINING WALL, MSE - West Side	SQFT	3,975	$90	$357,750
0596.0104000J	RETAINING WALL, MSE - East Side	SQFT	1,100	$90	$99,000
00500's	STEEL OR CONCRETE BRIDGE	SQFT	22,800	$275	$6,270,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$17,000	$17,000
00900's	Signing	LS	1	$10,000	$10,000
00900's	Illumination	LS	1	$350,000	$350,000
SUBTOTAL, Construction Items					**$11,135,000**
	PRELIMINARY ENGINEERING			15%	$1,670,000
	PERMANENT RIGHT-OF-WAY	SQFT	22,477		$394,000
	TEMPORARY RIGHT-OF-WAY	SQFT	10,989		$99,000
	CONSTRUCTION ENGINEERING			12%	$1,336,000
	CONSTRUCTION SURVEY WORK			3%	$260,000
	CONTINGENCY			30%	$3,341,000
****PARTIAL PROJECT COST IN 2019 DOLLARS**					**$18,300,000**
****PARTIAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$19,800,000**

Appendix D

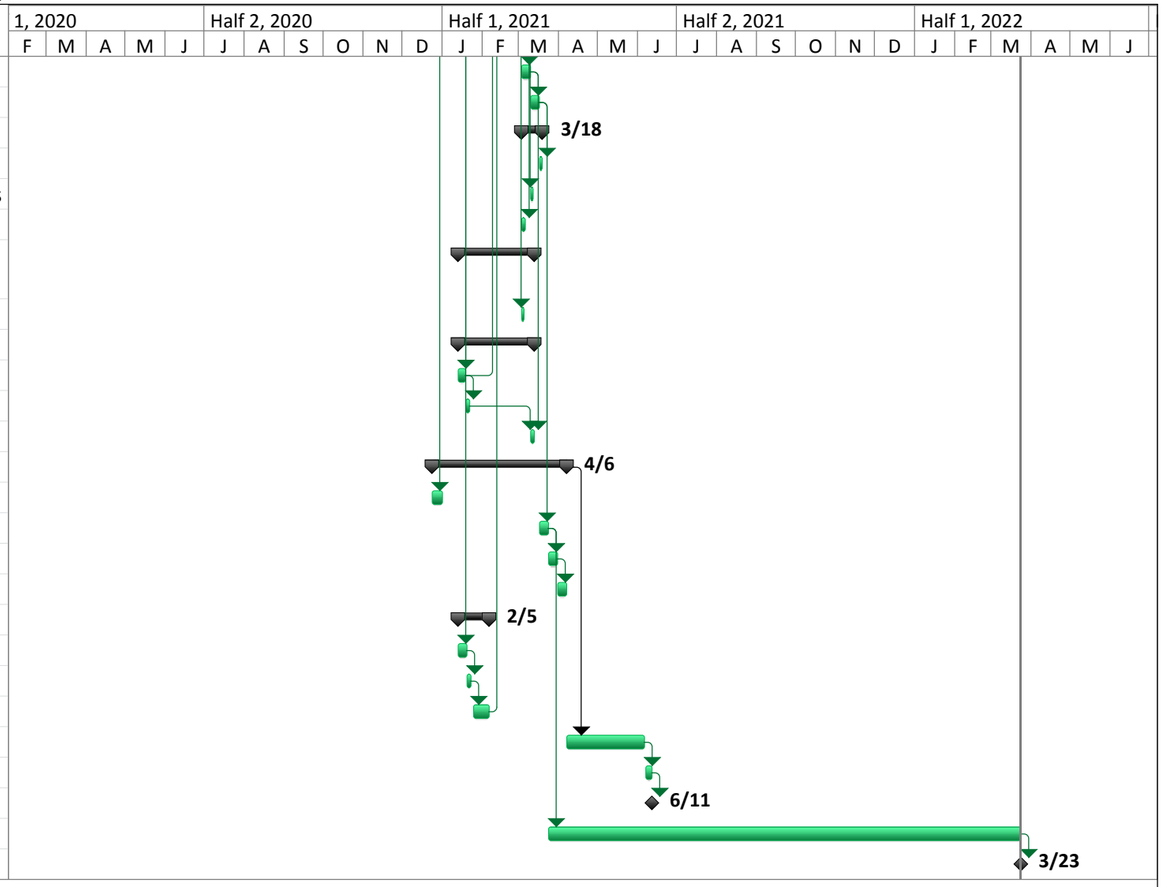
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**BID OPENING**	**0 days**	**Thu 2/20/20**	**Thu 2/20/20**	
2		AWARD OF CONTRACT	30 days	Thu 2/20/20	Fri 3/20/20	1
3		EXEC. OF CONTR. BY BIDDER	15 days	Sat 3/21/20	Sat 4/4/20	2
4		EXEC. OF CONTR. BY STATE	7 days	Sun 4/5/20	Sat 4/11/20	3
5		EXEC. OF NOTICE TO PROCEED	5 days	Sun 4/12/20	Thu 4/16/20	4
6		NTP	0 days	Thu 4/16/20	Thu 4/16/20	5
7		PRELIMINARY SUBMITTALS	20 days	Fri 4/17/20	Thu 5/14/20	6
8		PRECONSTRUCTION CONFERENCE	0 days	Sat 5/16/20	Sat 5/16/20	6SF+30 edays
9		SUBMITTALS	20 days	Mon 5/18/20	Mon 6/15/20	8
10		**MATERIAL FABRICATION**	**85 days**	**Mon 6/15/20**	**Tue 10/13/20**	
11		PRECAST CONCRETE ELEMENTS	120 edays	Mon 6/15/20	Tue 10/13/20	9
12		**TEMPORARY FEATURES AND APPURTENANCES**	**11 days**	**Tue 6/16/20**	**Tue 6/30/20**	
13		MOBILIZATION	2 days	Tue 6/16/20	Wed 6/17/20	9
14		TP & DT	5 days	Tue 6/16/20	Mon 6/22/20	9
15		EROSION CONTROL	10 days	Tue 6/16/20	Mon 6/29/20	9
16		Temporary Signal @ Ellignsen Road	5 days	Tue 6/23/20	Mon 6/29/20	14
17		Close Road	1 day	Tue 6/30/20	Tue 6/30/20	16
18		**ROADWORK**	**184 days**	**Wed 7/1/20**	**Thu 3/18/21**	
19		Clear and Grub	4 days	Wed 7/1/20	Mon 7/6/20	17
20		Removal of Structures and Obstructions	3 days	Tue 7/7/20	Thu 7/9/20	19
21		Channel Excavation & Culvert Removal	5 days	Wed 11/25/20	Wed 12/2/20	65
22		Embankment	15 days	Thu 12/3/20	Wed 12/23/20	21
23		Removal of Surfacing & old road under bridge	3 days	Tue 3/16/21	Thu 3/18/21	70
24		**DRAINAGE AND SEWERS**	**13 days**	**Thu 12/24/20**	**Tue 1/12/21**	
25		Storm Sewer	8 days	Thu 12/24/20	Tue 1/5/21	22
26		Sanitary Sewer	5 days	Wed 1/6/21	Tue 1/12/21	25
27		**BRIDGE**	**177 days**	**Tue 7/7/20**	**Mon 3/15/21**	
28		Drilled shafts & Driven Piling	15 days	Tue 7/7/20	Mon 7/27/20	19
29		Structure Excavation	5 days	Tue 7/28/20	Mon 8/3/20	28
30		**substructure**	**75 days**	**Tue 8/4/20**	**Tue 11/17/20**	
65		Structure Backfill	5 days	Wed 11/18/20	Tue 11/24/20	30
66		superstructure	10 days	Wed 11/25/20	Wed 12/9/20	65,11
67		Deck	40 edays	Wed 12/9/20	Mon 1/18/21	66
68		Impact panels	15 days	Tue 1/19/21	Mon 2/8/21	67,22
69		Rail	21 edays	Mon 2/8/21	Mon 3/1/21	68
70		Misc Items	10 days	Tue 3/2/21	Mon 3/15/21	69
71		**BASES**	**4 days**	**Tue 2/9/21**	**Fri 2/12/21**	
72		Aggregate Base	4 days	Tue 2/9/21	Fri 2/12/21	85,96,24,68
73		**WEARING SURFACES**	**22 days**	**Mon 2/15/21**	**Tue 3/16/21**	
74		Portland Cement Concrete Pavement	7 days	Mon 2/15/21	Tue 2/23/21	72
75		Curb and Gutter	5 days	Wed 2/24/21	Tue 3/2/21	74



Project: Boeckman Dip
Option A: Full Closure
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

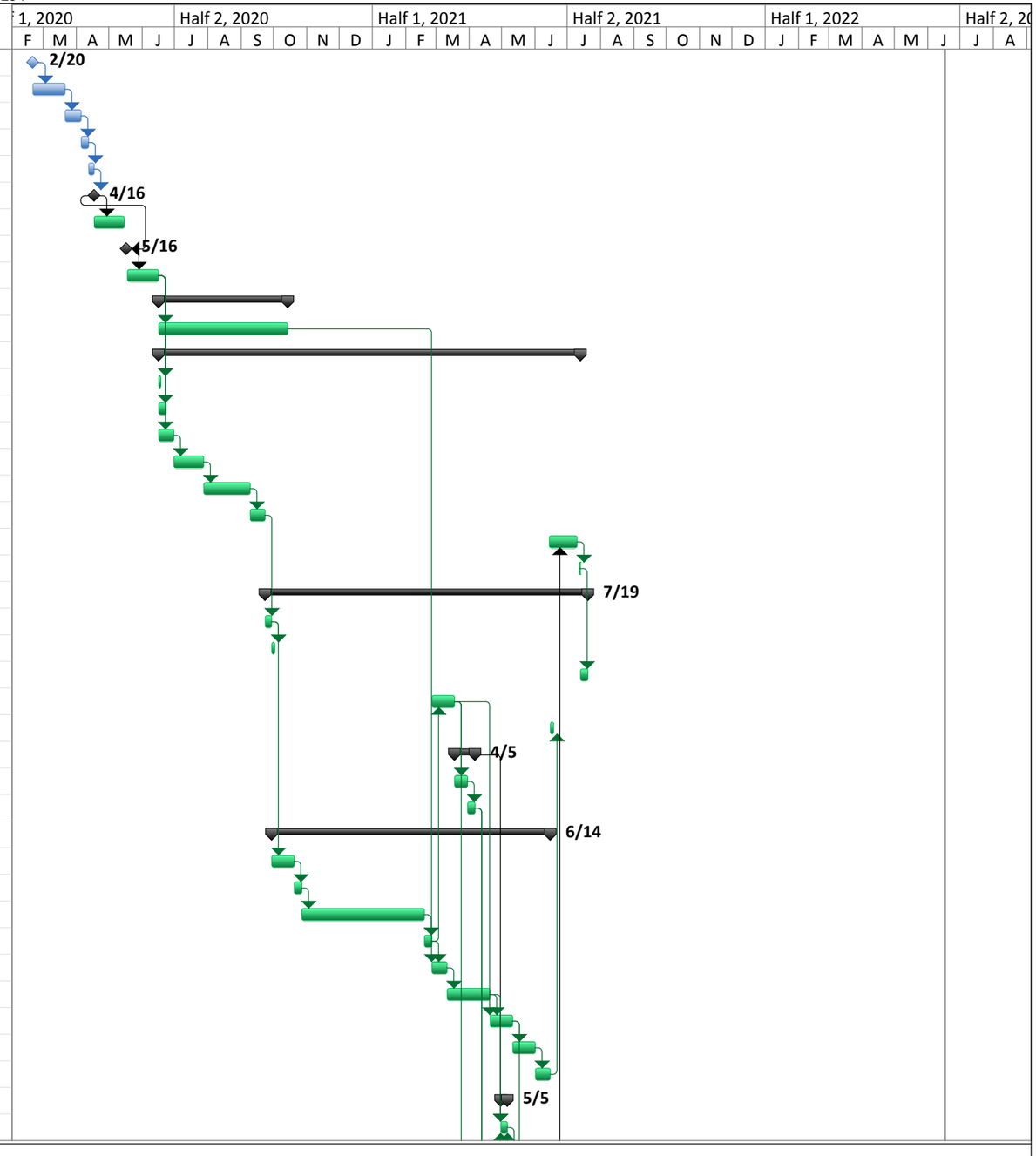
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
76		Sidewalk	5 days	Wed 3/3/21	Tue 3/9/21	75
77		Driveways	5 days	Wed 3/10/21	Tue 3/16/21	76
78		**PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES**	**12 days**	**Wed 3/3/21**	**Thu 3/18/21**	
79		Signage	2 days	Wed 3/17/21	Thu 3/18/21	77
80		Pavement Markings	2 days	Wed 3/10/21	Thu 3/11/21	74FS+14 edays
81		Guardrail	3 days	Wed 3/3/21	Fri 3/5/21	75
82		**PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS**	**43 days**	**Wed 1/13/21**	**Fri 3/12/21**	
83		Signal Modifications	2 days	Wed 3/3/21	Thu 3/4/21	74FS+5 days
84		**Illumination**	**43 days**	**Wed 1/13/21**	**Fri 3/12/21**	
85		Switching conduit and wire	4 days	Wed 1/13/21	Mon 1/18/21	26
86		Pole foundations	3 days	Tue 1/19/21	Thu 1/21/21	85
87		Poles, lamps and ballasts	3 days	Wed 3/10/21	Fri 3/12/21	86,76
88		**RIGHT OF WAY DEVELOPMENT AND CONTROL**	**73 days**	**Thu 12/24/20**	**Tue 4/6/21**	
89		Water Quality Facilities	5 days	Thu 12/24/20	Thu 12/31/20	22
90		Landscaping	5 days	Wed 3/17/21	Tue 3/23/21	77
91		Fencing	5 days	Wed 3/24/21	Tue 3/30/21	90
92		Misc (monuments, mail boxes, etc.)	5 days	Wed 3/31/21	Tue 4/6/21	91
93		**WATER SUPPLY SYSTEMS**	**18 days**	**Wed 1/13/21**	**Fri 2/5/21**	
94		Piping	5 days	Wed 1/13/21	Tue 1/19/21	26
95		Appurtenances	3 days	Wed 1/20/21	Fri 1/22/21	94
96		Testing	10 days	Mon 1/25/21	Fri 2/5/21	95
97		**FLOAT**	**60 edays**	**Tue 4/6/21**	**Sat 6/5/21**	88
98		**PUNCHLIST**	**5 days**	**Mon 6/7/21**	**Fri 6/11/21**	97
99		**SUBSTANTIAL COMPLETION**	**0 days**	**Fri 6/11/21**	**Fri 6/11/21**	98
100		**PLANT ESTABLISHMENT**	**365 edays**	**Tue 3/23/21**	**Wed 3/23/22**	90
101		**FINAL COMPLETION**	**0 days**	**Wed 3/23/22**	**Wed 3/23/22**	100



Project: Boeckman Dip
Option A: Full Closure
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

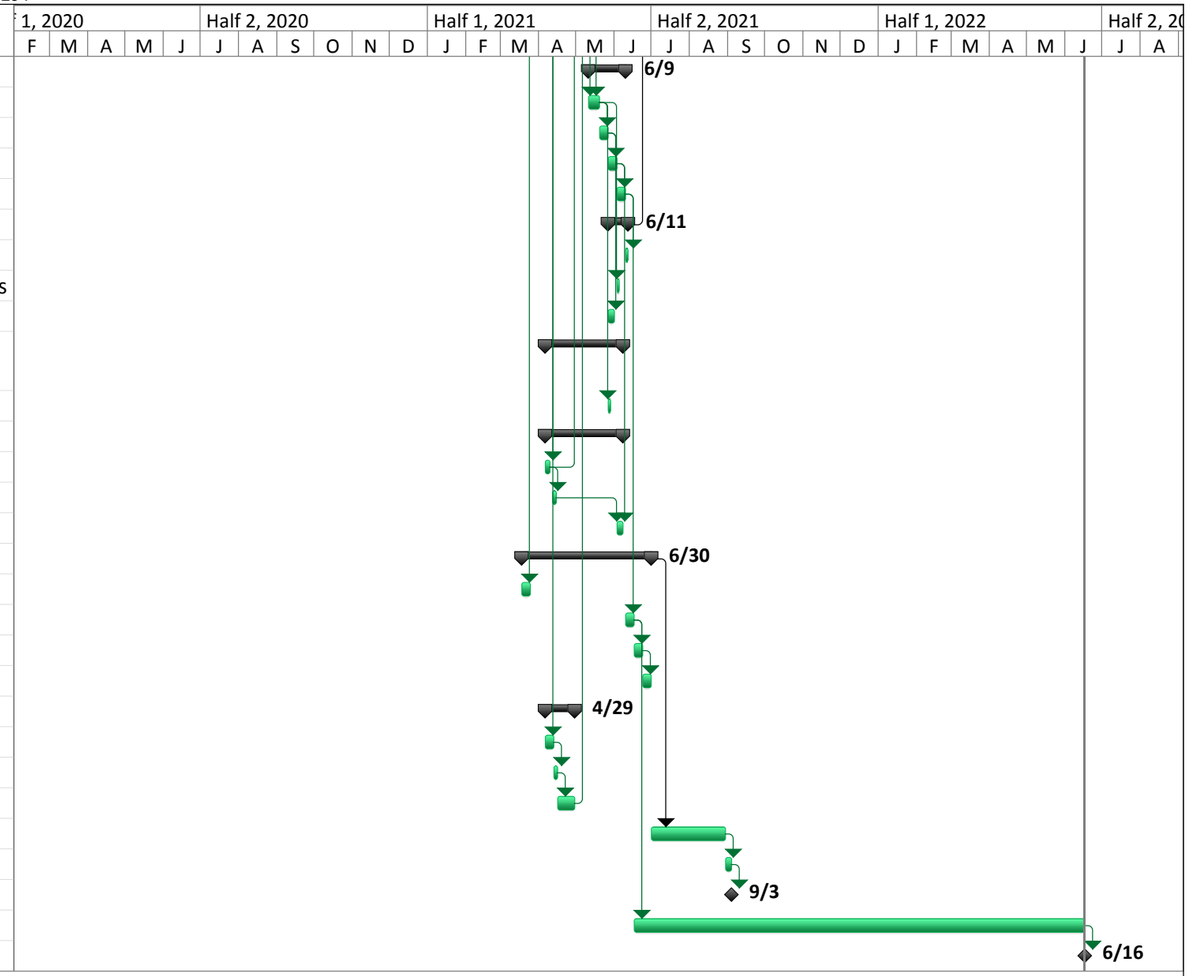
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**BID OPENING**	**0 days**	**Thu 2/20/20**	**Thu 2/20/20**	
2		AWARD OF CONTRACT	30 days	Thu 2/20/20	Fri 3/20/20	1
3		EXEC. OF CONTR. BY BIDDER	15 days	Sat 3/21/20	Sat 4/4/20	2
4		EXEC. OF CONTR. BY STATE	7 days	Sun 4/5/20	Sat 4/11/20	3
5		EXEC. OF NOTICE TO PROCEED	5 days	Sun 4/12/20	Thu 4/16/20	4
6		NTP	0 days	Thu 4/16/20	Thu 4/16/20	5
7		PRELIMINARY SUBMITTALS	20 days	Fri 4/17/20	Thu 5/14/20	6
8		PRECONSTRUCTION CONFERENCE	0 days	Sat 5/16/20	Sat 5/16/20	6SF+30 edays
9		SUBMITTALS	20 days	Mon 5/18/20	Mon 6/15/20	8
10		**MATERIAL FABRICATION**	**85 days**	**Mon 6/15/2(**	**Tue 10/13/20**	
11		PRECAST CONCRETE ELEMENTS	120 edays	Mon 6/15/20	Tue 10/13/20	9
12		**TEMPORARY FEATURES AND APPURTENANCES**	**277 days**	**Tue 6/16/20**	**Mon 7/12/21**	
13		MOBILIZATION	2 days	Tue 6/16/20	Wed 6/17/20	9
14		TP & DT	5 days	Tue 6/16/20	Mon 6/22/20	9
15		EROSION CONTROL	10 days	Tue 6/16/20	Mon 6/29/20	9
16		Construct Detour Alignment	20 days	Tue 6/30/20	Mon 7/27/20	15
17		Construct Detour Alignment Walls	30 days	Tue 7/28/20	Tue 9/8/20	16
18		Closure for transition work	10 days	Wed 9/9/20	Tue 9/22/20	17
19		Closure for transition work	20 days	Mon 6/14/21	Fri 7/9/21	47
20		Switch Traffic to new alignment	1 day	Mon 7/12/21	Mon 7/12/21	19
21		**ROADWORK**	**212 days**	**Wed 9/23/2(**	**Mon 7/19/21**	
22		Clear and Grub	4 days	Wed 9/23/20	Mon 9/28/20	18
23		Removal of Structures and Obstructions	3 days	Tue 9/29/20	Thu 10/1/20	22
24		Channel Excavation & Culvert Removal	5 days	Tue 7/13/21	Mon 7/19/21	20
25		Embankment	15 days	Thu 2/25/21	Wed 3/17/21	34
26		Removal of Surfacing & old road under bridge & walls	3 days	Tue 6/15/21	Thu 6/17/21	39
27		**DRAINAGE AND SEWERS**	**13 days**	**Thu 3/18/21**	**Mon 4/5/21**	
28		Storm Sewer	8 days	Thu 3/18/21	Mon 3/29/21	25
29		Sanitary Sewer	5 days	Tue 3/30/21	Mon 4/5/21	28
30		**BRIDGE**	**183 days**	**Tue 9/29/20**	**Mon 6/14/21**	
31		Drilled shafts	15 days	Tue 9/29/20	Mon 10/19/20	22
32		Structure Excavation	5 days	Tue 10/20/2(	Mon 10/26/20	31
33		substructure	80 days	Tue 10/27/2(	Wed 2/17/21	32
34		Structure Backfill	5 days	Thu 2/18/21	Wed 2/24/21	33
35		superstructure	10 days	Thu 2/25/21	Wed 3/10/21	34,11
36		Deck	40 edays	Wed 3/10/21	Mon 4/19/21	35
37		Impact panels	15 days	Tue 4/20/21	Mon 5/10/21	36,25
38		Rail	21 edays	Mon 5/10/21	Mon 5/31/21	37
39		Misc Items	10 days	Tue 6/1/21	Mon 6/14/21	38
40		**BASES**	**4 days**	**Fri 4/30/21**	**Wed 5/5/21**	
41		Aggregate Base	4 days	Fri 4/30/21	Wed 5/5/21	54,65,27,36



Project: Boeckman Dip
Option B: North Onsite Detour
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

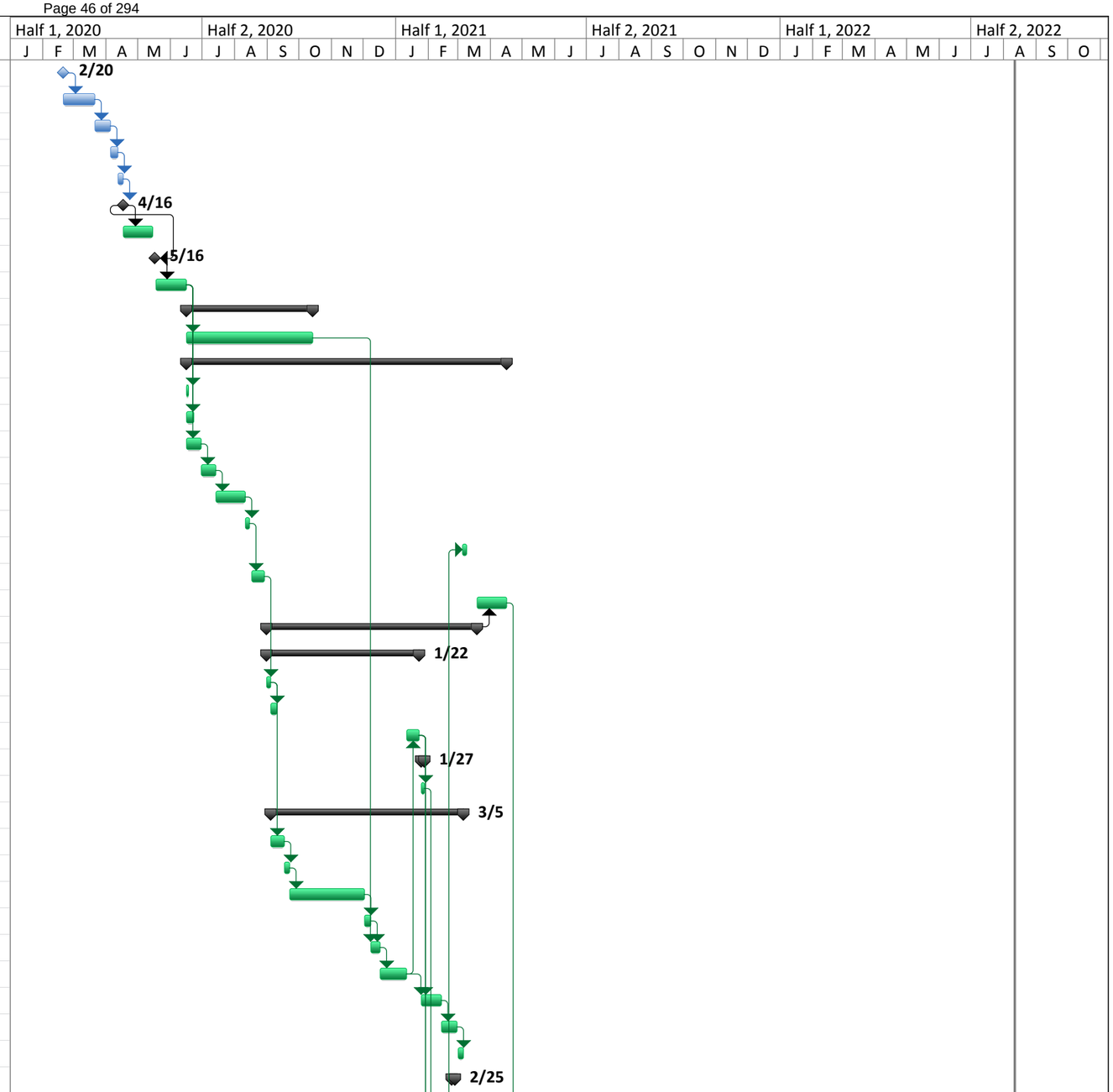
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
42		**WEARING SURFACES**	**22 days**	**Tue 5/11/21**	**Wed 6/9/21**	
43		Portland Cement Concrete Pavement	7 days	Tue 5/11/21	Wed 5/19/21	41,37
44		Curb and Gutter	5 days	Thu 5/20/21	Wed 5/26/21	43
45		Sidewalk	5 days	Thu 5/27/21	Wed 6/2/21	44
46		Driveways	5 days	Thu 6/3/21	Wed 6/9/21	45
47		**PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES**	**12 days**	**Thu 5/27/21**	**Fri 6/11/21**	
48		Signage	2 days	Thu 6/10/21	Fri 6/11/21	46
49		Pavement Markings	2 days	Thu 6/3/21	Fri 6/4/21	43FS+14 edays
50		Guardrail	3 days	Thu 5/27/21	Mon 5/31/21	44
51		**PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS**	**45 days**	**Tue 4/6/21**	**Mon 6/7/21**	
52		Signal Modifications	2 days	Thu 5/27/21	Fri 5/28/21	43FS+5 days
53		**Illumination**	**45 days**	**Tue 4/6/21**	**Mon 6/7/21**	
54		Switching conduit and wire	4 days	Tue 4/6/21	Fri 4/9/21	29
55		Pole foundations	3 days	Mon 4/12/21	Wed 4/14/21	54
56		Poles, lamps and ballasts	3 days	Thu 6/3/21	Mon 6/7/21	55,45
57		**RIGHT OF WAY DEVELOPMENT AND CONTROL**	**75 days**	**Thu 3/18/21**	**Wed 6/30/21**	
58		Water Quality Facilities	5 days	Thu 3/18/21	Wed 3/24/21	25
59		Landscaping	5 days	Thu 6/10/21	Wed 6/16/21	46
60		Fencing	5 days	Thu 6/17/21	Wed 6/23/21	59
61		Misc (monuments, mail boxes, etc.)	5 days	Thu 6/24/21	Wed 6/30/21	60
62		**WATER SUPPLY SYSTEMS**	**18 days**	**Tue 4/6/21**	**Thu 4/29/21**	
63		Piping	5 days	Tue 4/6/21	Mon 4/12/21	29
64		Appurtenances	3 days	Tue 4/13/21	Thu 4/15/21	63
65		Testing	10 days	Fri 4/16/21	Thu 4/29/21	64
66		**FLOAT**	**60 edays**	**Wed 6/30/21**	**Sun 8/29/21**	57
67		**PUNCHLIST**	**5 days**	**Mon 8/30/21**	**Fri 9/3/21**	66
68		**SUBSTANTIAL COMPLETION**	**0 days**	**Fri 9/3/21**	**Fri 9/3/21**	67
69		**PLANT ESTABLISHMENT**	**365 edays**	**Wed 6/16/21**	**Thu 6/16/22**	59
70		**FINAL COMPLETION**	**0 days**	**Thu 6/16/22**	**Thu 6/16/22**	69



Project: Boeckman Dip
Option B: North Onsite Detour
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

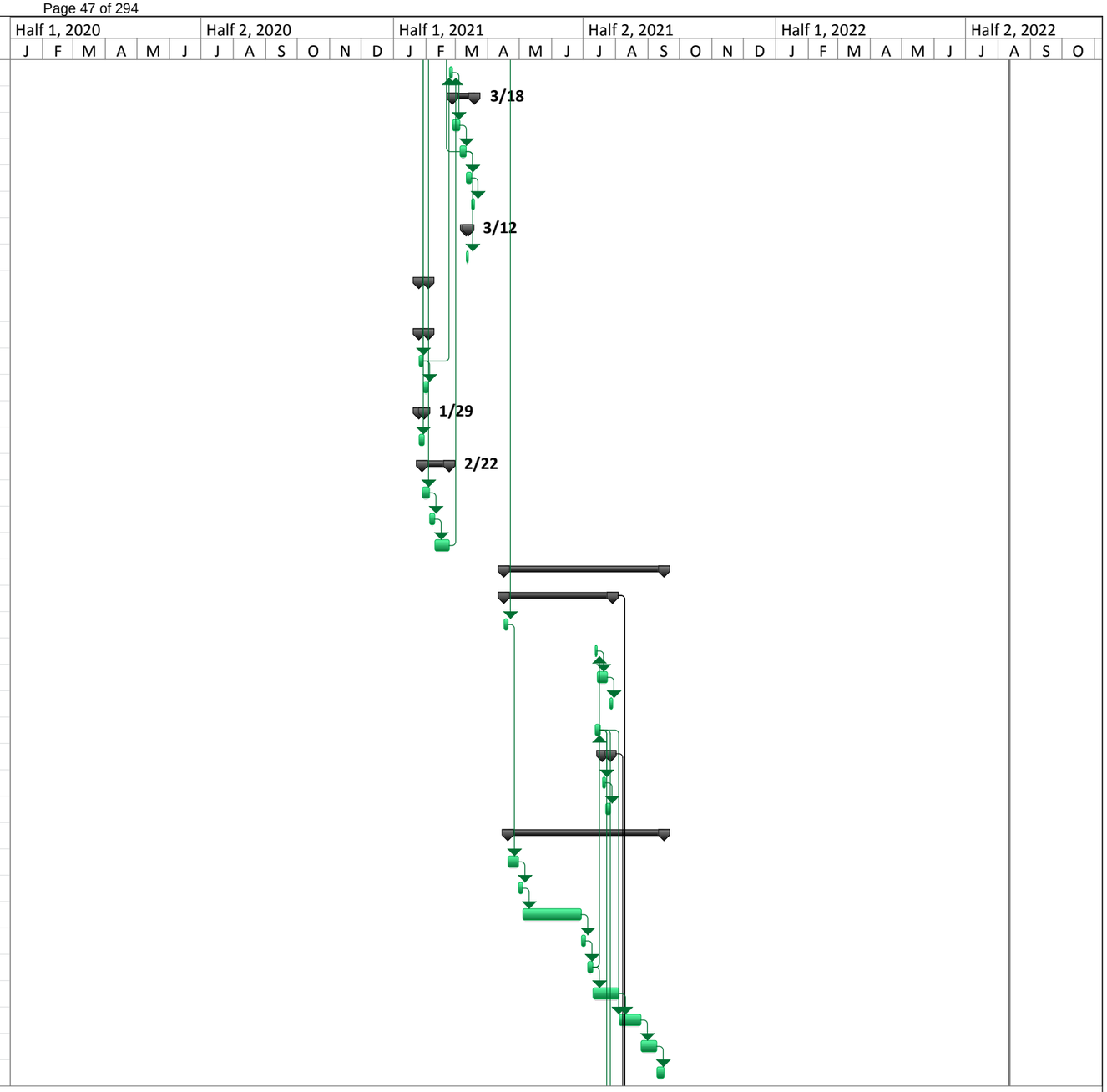
ID	Task Mode	Task Name	Duration	Start	Finish
1		**BID OPENING**	**0 days**	**Thu 2/20/20**	**Thu 2/20/20**
2		AWARD OF CONTRACT	30 days	Thu 2/20/20	Fri 3/20/20
3		EXEC. OF CONTR. BY BIDDER	15 days	Sat 3/21/20	Sat 4/4/20
4		EXEC. OF CONTR. BY STATE	7 days	Sun 4/5/20	Sat 4/11/20
5		EXEC. OF NOTICE TO PROCEED	5 days	Sun 4/12/20	Thu 4/16/20
6		NTP	0 days	Thu 4/16/20	Thu 4/16/20
7		PRELIMINARY SUBMITTALS	20 days	Fri 4/17/20	Thu 5/14/20
8		PRECONSTRUCTION CONFERENCE	0 days	Sat 5/16/20	Sat 5/16/20
9		SUBMITTALS	20 days	Mon 5/18/20	Mon 6/15/20
10		**MATERIAL FABRICATION**	**85 days**	**Mon 6/15/20**	**Tue 10/13/20**
11		PRECAST CONCRETE ELEMENTS	120 edays	Mon 6/15/20	Tue 10/13/20
12		**TEMPORARY FEATURES AND APPURTENANCES**	**215 days**	**Tue 6/16/20**	**Thu 4/15/21**
13		MOBILIZATION	2 days	Tue 6/16/20	Wed 6/17/20
14		TP & DT	5 days	Tue 6/16/20	Mon 6/22/20
15		EROSION CONTROL	10 days	Tue 6/16/20	Mon 6/29/20
16		Temporary Widening & Access	10 days	Tue 6/30/20	Mon 7/13/20
17		Temporary Walls	20 days	Tue 7/14/20	Mon 8/10/20
18		Temporary Wideningfor detour	4 days	Tue 8/11/20	Fri 8/14/20
19		Temporary Widening for stage 2 switch	2 days	Fri 3/5/21	Mon 3/8/21
20		Closure for Transition Work	10 days	Mon 8/17/20	Fri 8/28/20
21		Closure for Transition Work	20 days	Fri 3/19/21	Thu 4/15/21
22		**STAGE 1**	**141 days**	**Mon 8/31/20**	**Thu 3/18/21**
23		**ROADWORK**	**102 days**	**Mon 8/31/20**	**Fri 1/22/21**
24		Clear and Grub	4 days	Mon 8/31/20	Thu 9/3/20
25		Removal of Structures and Obstructions	3 days	Fri 9/4/20	Wed 9/9/20
26		Embankment	10 days	Mon 1/11/21	Fri 1/22/21
27		**DRAINAGE AND SEWERS**	**3 days**	**Mon 1/25/21**	**Wed 1/27/21**
28		Storm Sewer	3 days	Mon 1/25/21	Wed 1/27/21
29		**BRIDGE**	**128 days**	**Fri 9/4/20**	**Fri 3/5/21**
30		Drilled shafts	8 days	Fri 9/4/20	Wed 9/16/20
31		Structure Excavation	3 days	Thu 9/17/20	Mon 9/21/20
32		substructure	50 days	Tue 9/22/20	Tue 12/1/20
33		Structure Backfill	4 days	Wed 12/2/20	Mon 12/7/20
34		superstructure	7 days	Tue 12/8/20	Wed 12/16/20
35		Deck	25 edays	Wed 12/16/20	Sun 1/10/21
36		Impact panels	15 days	Mon 1/25/21	Fri 2/12/21
37		Rail	15 edays	Fri 2/12/21	Sat 2/27/21
38		Misc Items	5 days	Mon 3/1/21	Fri 3/5/21
39		**BASES**	**3 days**	**Tue 2/23/21**	**Thu 2/25/21**



Project: Boeckman Dip
Option C: Staged Construction
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

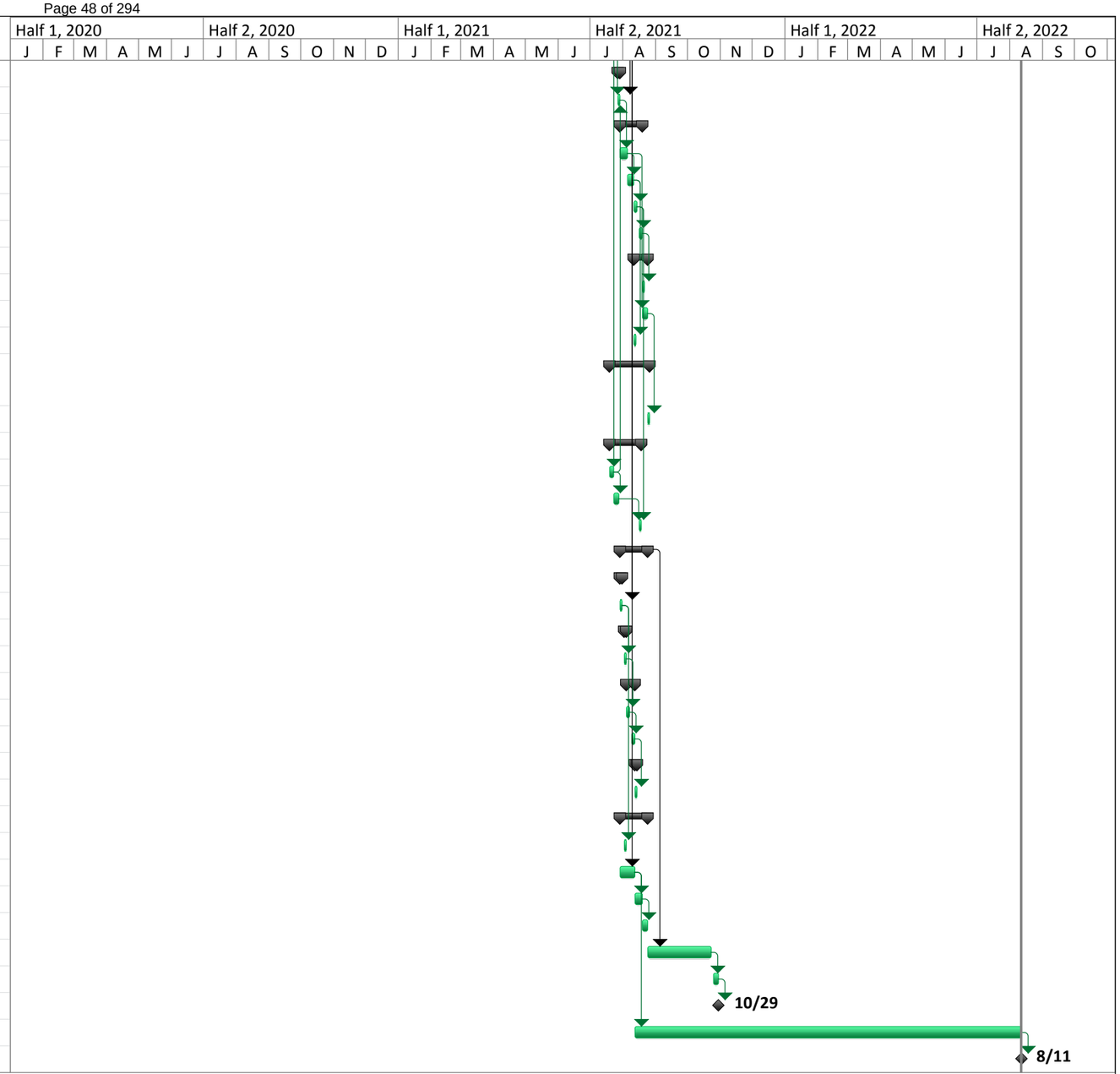
ID	Task Mode	Task Name	Duration	Start	Finish
40		Aggregate Base	3 days	Tue 2/23/21	Thu 2/25/21
41		**WEARING SURFACES**	**15 days**	**Fri 2/26/21**	**Thu 3/18/21**
42		Portland Cement Concrete Pavement	5 days	Fri 2/26/21	Thu 3/4/21
43		Curb and Gutter	4 days	Fri 3/5/21	Wed 3/10/21
44		Sidewalk	3 days	Thu 3/11/21	Mon 3/15/21
45		Driveways	3 days	Tue 3/16/21	Thu 3/18/21
46		**PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES**	**2 days**	**Thu 3/11/21**	**Fri 3/12/21**
47		Guardrail	2 days	Thu 3/11/21	Fri 3/12/21
48		**PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS**	**7 days**	**Mon 1/25/21**	**Tue 2/2/21**
49		**Illumination**	**7 days**	**Mon 1/25/21**	**Tue 2/2/21**
50		Switching conduit and wire	4 days	Mon 1/25/21	Thu 1/28/21
51		Pole foundations	3 days	Fri 1/29/21	Tue 2/2/21
52		**RIGHT OF WAY DEVELOPMENT AND CONTROL**	**5 days**	**Mon 1/25/21**	**Fri 1/29/21**
53		Water Quality Facilities	5 days	Mon 1/25/21	Fri 1/29/21
54		**WATER SUPPLY SYSTEMS**	**18 days**	**Thu 1/28/21**	**Mon 2/22/21**
55		Piping	5 days	Thu 1/28/21	Wed 2/3/21
56		Appurtenances	3 days	Thu 2/4/21	Mon 2/8/21
57		Testing	10 days	Tue 2/9/21	Mon 2/22/21
58		**STAGE 2**	**109 days**	**Fri 4/16/21**	**Wed 9/15/21**
59		**ROADWORK**	**74 days**	**Fri 4/16/21**	**Wed 7/28/21**
60		Clear and Grub	2 days	Fri 4/16/21	Mon 4/19/21
61		Removal of Structures and Obstructions	2 days	Mon 7/12/21	Tue 7/13/21
62		Removal of Surfacing & widening	8 days	Wed 7/14/21	Fri 7/23/21
63		Channel Excavation & Culvert Removal	3 days	Mon 7/26/21	Wed 7/28/21
64		Embankment	5 days	Mon 7/12/21	Fri 7/16/21
65		**DRAINAGE AND SEWERS**	**6 days**	**Mon 7/19/21**	**Mon 7/26/21**
66		Storm Sewer	3 days	Mon 7/19/21	Wed 7/21/21
67		Sanitary Sewer	3 days	Thu 7/22/21	Mon 7/26/21
68		**BRIDGE**	**107 days**	**Tue 4/20/21**	**Wed 9/15/21**
69		Drilled shafts	8 days	Tue 4/20/21	Thu 4/29/21
70		Structure Excavation	2 days	Fri 4/30/21	Mon 5/3/21
71		substructure	40 days	Tue 5/4/21	Mon 6/28/21
72		Structure Backfill	4 days	Tue 6/29/21	Fri 7/2/21
73		superstructure	5 days	Mon 7/5/21	Fri 7/9/21
74		Deck	25 edays	Fri 7/9/21	Tue 8/3/21
75		Impact panels	15 days	Wed 8/4/21	Tue 8/24/21
76		Rail	15 edays	Tue 8/24/21	Wed 9/8/21
77		Misc Items	5 days	Thu 9/9/21	Wed 9/15/21



Project: Boeckman Dip
Option C: Staged Construction
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline
Split	External Tasks	Inactive Summary	Manual Summary	Progress
Milestone	External Milestone	Manual Task	Start-only	
Summary	Inactive Task	Duration-only	Finish-only	

ID	Task Mode	Task Name	Duration	Start	Finish
78		**BASES**	**2 days**	**Tue 7/27/21**	**Wed 7/28/21**
79		Aggregate Base	2 days	Tue 7/27/21	Wed 7/28/21
80		**WEARING SURFACES**	**15 days**	**Thu 7/29/21**	**Wed 8/18/21**
81		Portland Cement Concrete Pavement	5 days	Thu 7/29/21	Wed 8/4/21
82		Curb and Gutter	4 days	Thu 8/5/21	Tue 8/10/21
83		Sidewalk	3 days	Wed 8/11/21	Fri 8/13/21
84		Driveways	3 days	Mon 8/16/21	Wed 8/18/21
85		**PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES**	**9 days**	**Wed 8/11/21**	**Mon 8/23/21**
86		Signage	2 days	Thu 8/19/21	Fri 8/20/21
87		Pavement Markings	3 days	Thu 8/19/21	Mon 8/23/21
88		Guardrail	2 days	Wed 8/11/21	Thu 8/12/21
89		**PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS**	**28 days**	**Mon 7/19/21**	**Wed 8/25/21**
90		Signal Modifications	2 days	Tue 8/24/21	Wed 8/25/21
91		**Illumination**	**22 days**	**Mon 7/19/21**	**Tue 8/17/21**
92		Switching conduit and wire	4 days	Mon 7/19/21	Thu 7/22/21
93		Pole foundations	3 days	Fri 7/23/21	Tue 7/27/21
94		Poles, lamps and ballasts	2 days	Mon 8/16/21	Tue 8/17/21
95		**STAGE 3**	**18 days**	**Thu 7/29/21**	**Mon 8/23/21**
96		**ROADWORK**	**2 days**	**Thu 7/29/21**	**Fri 7/30/21**
97		Removal of Widening	2 days	Thu 7/29/21	Fri 7/30/21
98		**BASES**	**2 days**	**Mon 8/2/21**	**Tue 8/3/21**
99		Aggregate Base	2 days	Mon 8/2/21	Tue 8/3/21
100		**WEARING SURFACES**	**6 days**	**Wed 8/4/21**	**Wed 8/11/21**
101		Curb and Gutter	3 days	Wed 8/4/21	Fri 8/6/21
102		Sidewalk	3 days	Mon 8/9/21	Wed 8/11/21
103		**PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES**	**2 days**	**Thu 8/12/21**	**Fri 8/13/21**
104		Pavement Markings	2 days	Thu 8/12/21	Fri 8/13/21
105		**RIGHT OF WAY DEVELOPMENT AND CONTROL**	**18 days**	**Thu 7/29/21**	**Mon 8/23/21**
106		Water Quality Facilities	2 days	Mon 8/2/21	Tue 8/3/21
107		Landscaping	10 days	Thu 7/29/21	Wed 8/11/21
108		Fencing	5 days	Thu 8/12/21	Wed 8/18/21
109		Misc (monuments, mail boxes, etc.)	3 days	Thu 8/19/21	Mon 8/23/21
110		**FLOAT**	**60 edays**	**Mon 8/23/21**	**Fri 10/22/21**
111		**PUNCHLIST**	**5 days**	**Mon 10/25/21**	**Fri 10/29/21**
112		**SUBSTANTIAL COMPLETION**	**0 days**	**Fri 10/29/21**	**Fri 10/29/21**
113		**PLANT ESTABLISHMENT**	**365 edays**	**Wed 8/11/21**	**Thu 8/11/22**
114		**FINAL COMPLETION**	**0 days**	**Thu 8/11/22**	**Thu 8/11/22**



Project: Boeckman Dip
Option C: Staged Construction
Date: Tue 7/9/19

Task	Project Summary	Inactive Milestone	Manual Summary Rollup	Deadline	
Split	External Tasks	Inactive Summary	Manual Summary	Progress	
Milestone	External Milestone	Manual Task	Start-only		
Summary	Inactive Task	Duration-only	Finish-only		

Appendix E

DKS
117 Commercial St NE
#310
Salem, OR 97301
503.391.8773
dksassociates.com

MEMORANDUM

DATE: June 17, 2019

TO: Nick Robertson | OBEC Consulting Engineers

FROM: Scott Mansur, P.E., PTOE | DKS Associates
Jenna Hills, E.I. | DKS Associates

SUBJECT: Wilsonville Boeckman Road Dip Detour – Traffic Study

---

The City of Wilsonville is currently preparing to construct a bridge on Boeckman Road over Boeckman Creek to replace the existing culvert, widen the road, and improve the vertical profile. Boeckman Road is a decades-old rural road constructed on an embankment with vertical grades that fail to comply with current design criteria. The City's Transportation System Plan (TSP) designates the road as a Minor Arterial. The City completed a design narrative in 2014 evaluating two alignment options to reduce the dip in the road, increase the vertical sight distance, remove the culvert, and re-establish the creek bed. Option A raises the vertical profile the minimum amount necessary to meet design standards and span the dip with a bridge. Option B raises the vertical profile further to accommodate gravity sewer grades. Since that time, it has been determined that the bridge structure and roadway profile does not need to accommodate gravity sewer and the City has moved forward with Option A as the preferred alternative. Both alternatives assumed a full road closure during construction.

The purpose of the traffic study is to evaluate the effect that a full closure of Boeckman Road and the associated traffic diversion would have on the rest of the transportation system, including the I-5/Wilsonville interchanges at Elligsen Road and Wilsonville Road. A map of the study intersections and the location of the anticipated road closure are shown in Figure 1.

Figure 1: Study Area

EXISTING CONDITIONS

The Existing Conditions section of this report focuses on current traffic conditions within the project study area to use as a comparison to the traffic conditions with traffic diversion from the Boeckman Road closure. Included below is discussion on the existing motor vehicle conditions, existing pedestrian and bicycle impacts, and transit route impacts.

MOTOR VEHICLE CONDITIONS

Existing transportation conditions were evaluated for the study area and are discussed in the sections below.

Roadway Network

The transportation characteristics of the key study area roadways and key cross streets are shown in Table 1 and include functional classification, number of travel lanes, posted speeds, and the presence of sidewalks and/or bike lanes. The functional classification is a key roadway characteristic because it specifies the purpose of the facility and is a determining factor of applicable cross-section, access spacing, and intersection performance standards. The functional classification of the following roadways can be found in the City of Wilsonville Transportation System Plan (TSP)[1] and the Oregon Department of Transportation (ODOT) website.

[1] Figure 3-2, *Wilsonville Transportation System Plan*, Adopted by Council, Amended April 2019

Table 1: Existing Study Area Roadway Characteristics

Roadway	Jurisdiction	Functional Classification	Travel Lanes	Posted Speed (mph)	Side-walk	Bike Lanes
95th Avenue	City of Wilsonville	Minor Arterial	3	35	Yes	Yes
Interstate 5	ODOT	Urban Interstate	6	65	No	No
Elligsen Road	ODOT [a] City of Wilsonville	District Highway (ODOT) Major Arterial [b] Minor Arterial [c] (City)	2-4	35	Partial [d]	Partial [d]
Canyon Creek Road	City of Wilsonville	Minor Arterial	3	35	Yes	Yes
65th Avenue	Clackamas County	Minor Arterial (Urban)	2	45	No	No
SW Stafford Road	City of Wilsonville	Major Arterial	2	45	No	No
SW Wilsonville Road	City of Wilsonville	Major Arterial	4-6	35	Yes	Yes
Boones Ferry Road	City of Wilsonville	Collector	3-4	35	Yes	Yes
Town Center Loop West	City of Wilsonville	Major Arterial	3	35	Yes	Yes
Town Center Loop East	City of Wilsonville	Collector	3	35	Yes	Yes

[a] ODOT jurisdiction from Day Road to Northbound Interchange Ramps; elsewhere City jurisdiction.
[b] Major Arterial from Day Road to Parkway Center Drive.
[c] Minor Arterial from Parkway Center Drive to Stafford Road.
[d] No bike lanes or sidewalk present east of Parkway Center Drive.

Existing Intersection Conditions

Existing intersection operations analysis was performed for all study intersections to establish baseline conditions. Intersections are the focus of detailed traffic operations analysis on non-freeway facilities because they are the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is nearly always diminished in their vicinity.

Intersection Performance Measures

Level of service (LOS) and volume-to-capacity (V/C) ratios are two commonly used performance measures that provide a gauge of intersection operations. In addition, they are often incorporated into agency mobility standards. Descriptions are given below:

> ***Level of service (LOS):*** A "report card" rating (A through F) based on the average delay experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity. This condition is typically evident in long queues and delays.
>
> ***Volume-to-capacity (V/C) ratio*:** A decimal representation (between 0.00 and 1.00) of the proportion of capacity that is being used (i.e., the saturation) at a turn movement, approach leg,

or intersection. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases, and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and lengthy delays.

Performance Measures

Intersection performance measures vary by jurisdiction of the roadways. The study intersections under ODOT jurisdiction have mobility targets as provided in the Oregon Highway Plan.[2] The ODOT mobility target for the Wilsonville I-5 interchange ramps is a 0.90 v/c ratio[3]. The study intersection under the jurisdiction of Clackamas County has a minimum LOS standard of LOS E and study intersections under the jurisdiction of the City of Wilsonville have an operating standard of LOS D.

Intersection Volumes

To determine existing intersection traffic operations, PM peak hour vehicle turn movement counts were collected at the eleven study area intersections during the weekday (4:00 PM to 6:00 PM)[4]. The peak hour counts are shown in Figure 2 and detailed twenty-four-hour traffic counts are included in Appendix A.

[2] Table 6, Oregon Highway Plan, Oregon Department of Transportation, Updated in August 2005.

[3] When the interchange vicinity is fully developed, and adequate storage is available on the interchange ramp to prevent queues from backing up on the main line, then the mobility target can be increased to a 0.90 v/c ratio. This standard has been confirmed with ODOT on past studies.

[4] Traffic counts were collected on May 9th and May 15th, 2019.

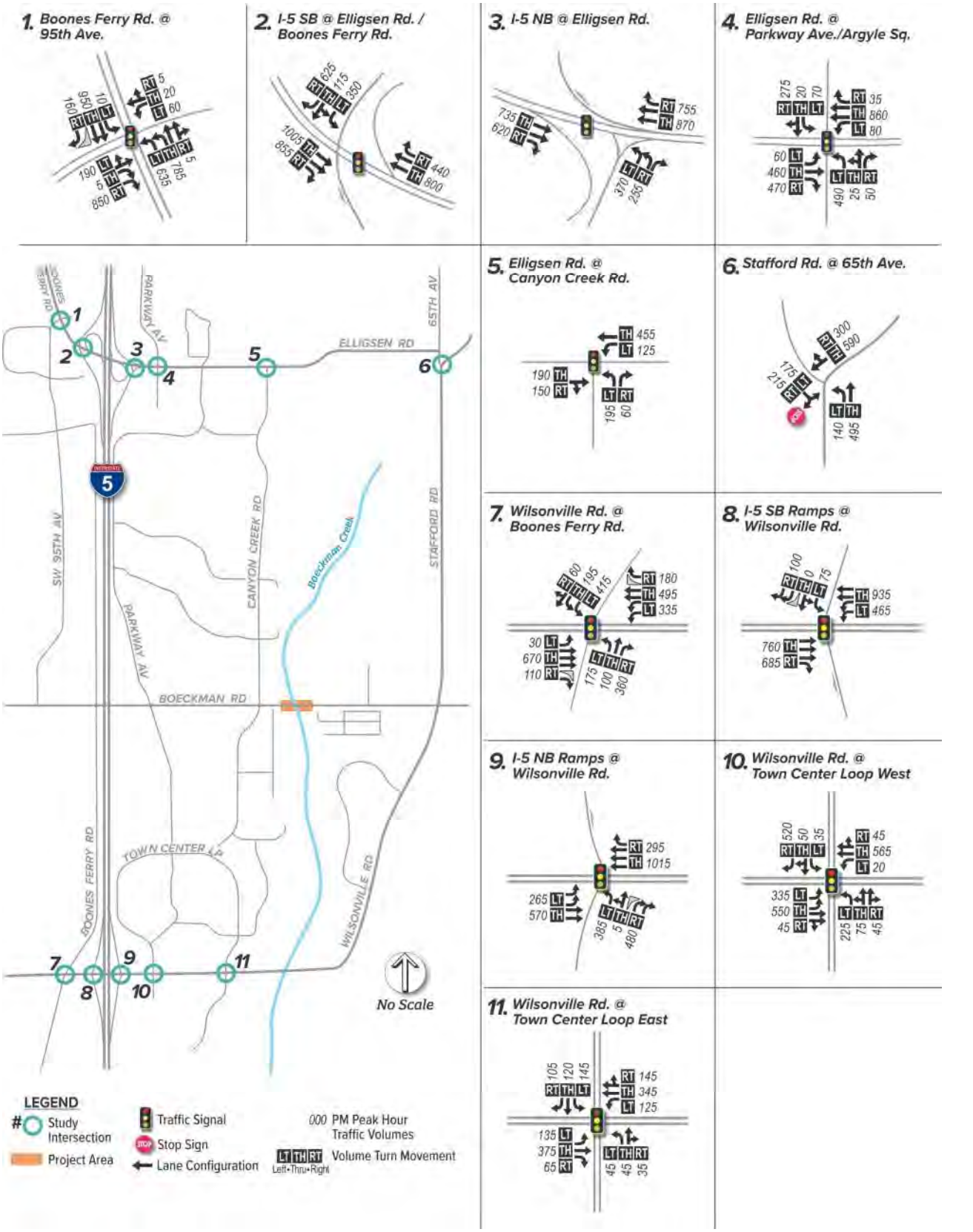


Figure 2: 2019 Existing Conditions Traffic Volumes

Intersection Operations

The existing traffic operating conditions at the study intersections was determined for the 2019 weekday PM peak hour (shown in Table 2). Detailed HCM results are provided in Appendix B.

Table 2: 2019 PM Peak Hour Intersection Operations

	Intersection	Jurisdiction	Operating Standard	Traffic Control	P.M. Peak Hour		
					LOS	*Delay*	*V/C*
1	Elligsen Rd/95th Ave	City	LOS D	Signalized	C	25.8	0.78
2	Elligsen Rd/I-5 SB Ramp	ODOT	V/C < 0.90	Signalized	B	16.2	0.78
3	Elligsen Rd/I-5 NB Ramp	ODOT	V/C < 0.90	Signalized	C	24.3	0.56
4	Elligsen Rd/Argyle Square-Parkway Ave	City	LOS D	Signalized	C	34.0	0.60
5	Elligsen Rd/Canyon Creek Rd	City	LOS D	Signalized	A	9.0	0.47
6	Stafford Rd/ 65th Ave	County	LOS E	TWSC	B/F	>100	>1.0
7	Wilsonville Rd/Boones Ferry Rd	City	LOS D	Signalized	D	36.8	0.66
8	Wilsonville Rd/I-5 SB Ramp	ODOT	V/C < 0.90	Signalized	D	47.9	0.42
9	Wilsonville Rd/I-5 NB Ramp	ODOT	V/C < 0.90	Signalized	C	25.4	0.49
10	Wilsonville Rd/Town Center Loop W	City	LOS D	Signalized	D	35.4	0.54
11	Wilsonville Rd/Town Center Loop E	City	LOS D	Signalized	C	21.9	0.42

Signalized Intersections:
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection
v/c = Volume-to-capacity Ratio of Intersection

Unsignalized intersection:
Delay = Critical Movement Approach Delay (sec.)
LOS = Major Street LOS/Minor Street LOS
V/C = Critical Movement Volume-to-Capacity Ratio

During the 2019 weekday PM peak hour, all of the study intersections meet the jurisdictional operating standards with the exception of Stafford Road/65th Avenue intersection that currently operates at LOS F. The long delays at this intersection were confirmed based on recent field observations and are shown in the pictures on the next page.

Southbound queues on 65th Avenue during the PM peak hour can reach up to 2,500 feet at the Stafford Road intersection. This picture shows southbound traffic at the Elligsen Road intersection.

Eastbound queues on Elligsen at 65th Avenue intersection can reach up to 1,500 feet during the PM peak hour. This picture shows the queue on Elligsen Road at the 65th Road intersection.

PEDESTRIAN AND BICYCLE IMPACTS

At the intersection of Boeckman Road/Canyon Creek Road, pedestrian and bicycle counts were collected. The counts indicate that up to 5 bicycles and up to 10 pedestrians use Boeckman Road in the vicinity of the Boeckman dip during the PM peak hour (likely more usage throughout the day). Due to a lack of pedestrian and bicycle facilities to the north along Elligsen Road and Stafford Road, Wilsonville Road would be the recommended route for diverted pedestrian and bicycle travel.

TRANSIT ROUTES IMPACTS

The Wilsonville SMART Transit System provides transit service within the City of Wilsonville and outlying areas. There are no SMART routes that utilize Boeckman Road at the closure point of the Boeckman dip project, and therefore, no transit route impacts are expected. SMART Transit Route 4 provides service east of the Boeckman Road dip, along Wilsonville Road and Advance Road, and service to Meridian Creek Middle School.

FUTURE CONDITIONS

This chapter reviews the impacts that the Boeckman Road closure and the associated traffic diversion will have on the study area transportation system. This analysis includes discussion on the future year traffic volumes, traffic modeling, and intersection operating conditions.

FUTURE TRAFFIC VOLUMES

Future operating conditions were analyzed at the study intersections for the following future traffic scenarios. The comparison of the following scenarios enables the assessment of road closure impacts:

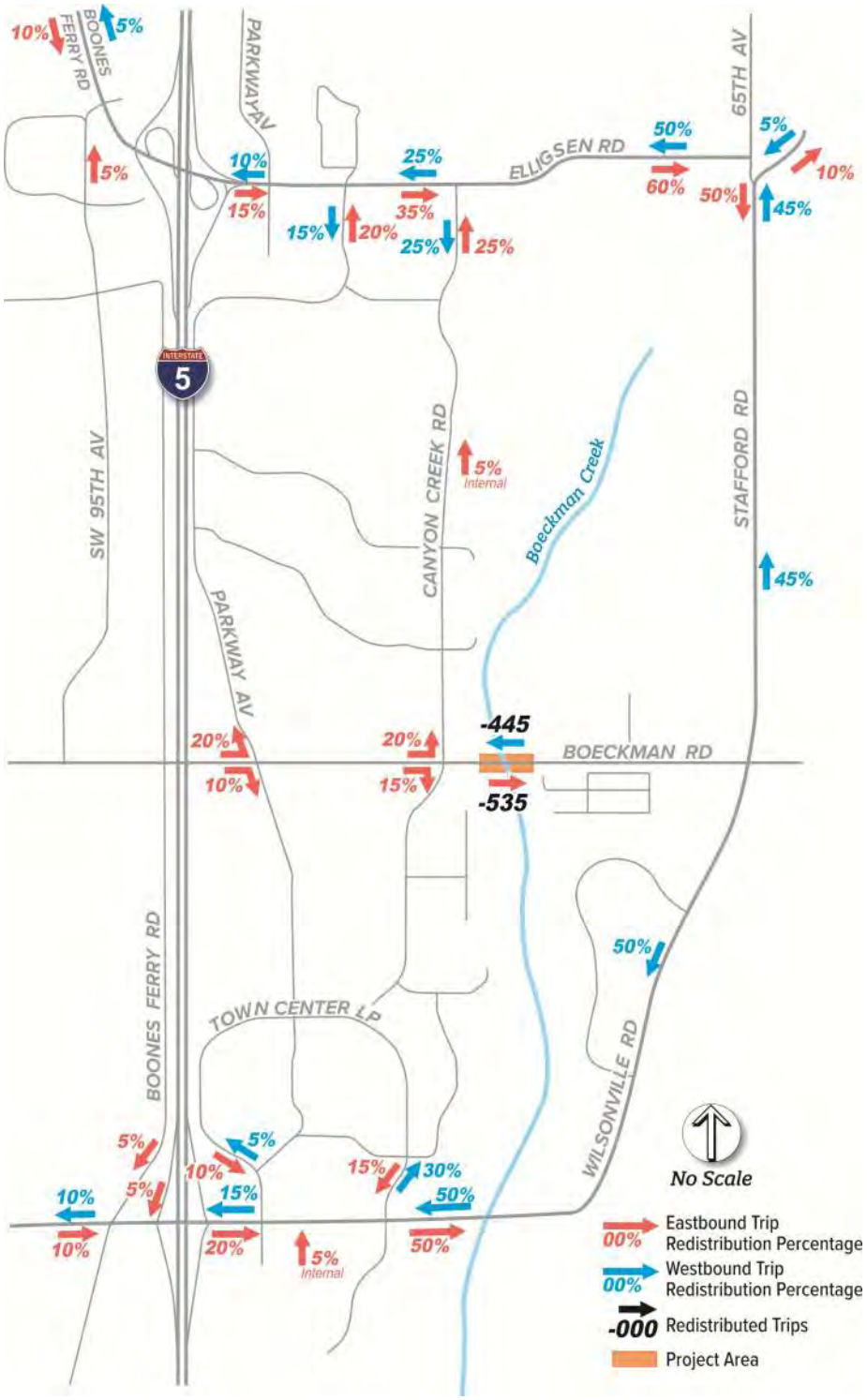
- 2021 Background
- 2021 Background + Boeckman Road Closure and Traffic Diversion

The Background volumes include the future growth expected from 2019 to 2021 as indicated in the Wilsonville Visum Small Community Model (discussed further below). The Background volumes also include trips associated with the Frog Pond Stafford Meadows and Morgan Farm developments, which are expected to contain 194 homes by 2021. Future traffic volumes were estimated at the study intersections for both scenarios and are shown in Figure 3 and Figure 4 on the following pages.

TRAFFIC MODELING

To estimate the growth that is expected to occur between the existing year volumes (2019) and the estimated construction year (2021), growth assumptions along key roadways were estimated using the Wilsonville Visum Small Community Model. Growth assumptions that were applied to the existing year volumes ranged between 1% and 6% (streets in the vicinity of Frog Pond had higher growth assumptions due to the level of development expected).

The Wilsonville Visum Small Community Model was also used to determine the traffic diversion onto other city, county and ODOT streets due to the Boeckman Road closure. A select link matrix of Boeckman Road provided an estimate of origin-destination pairs for existing traffic patterns. These patterns were used to reduce turning movement volumes along routes impacted by the closure and also increase turning movement volumes along new desired routes as indicated by the Visum Small Community Model. Appendix C contains the Visum model plots.



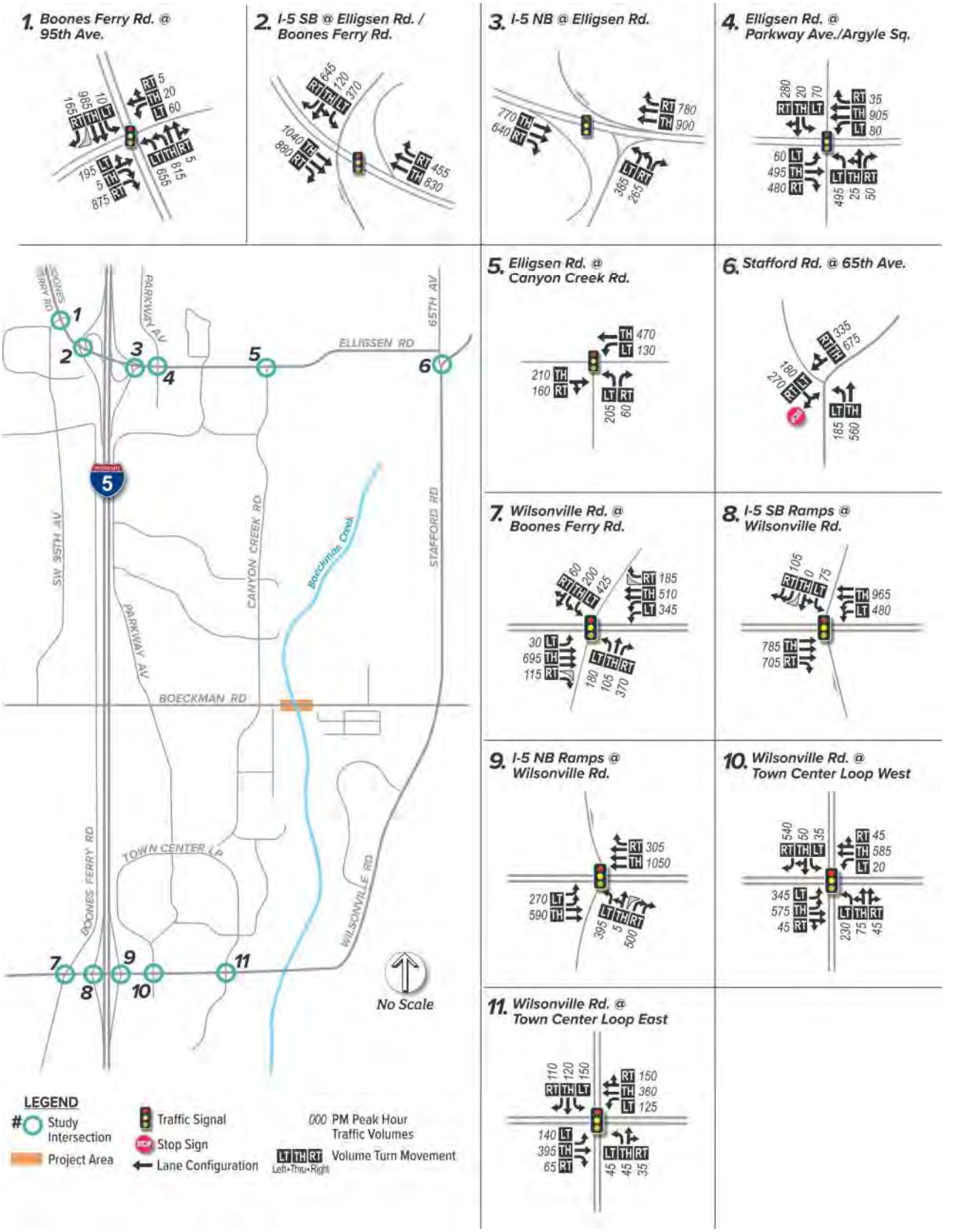


Figure 3: 2021 PM Peak Hour Traffic Volumes – Background Volumes

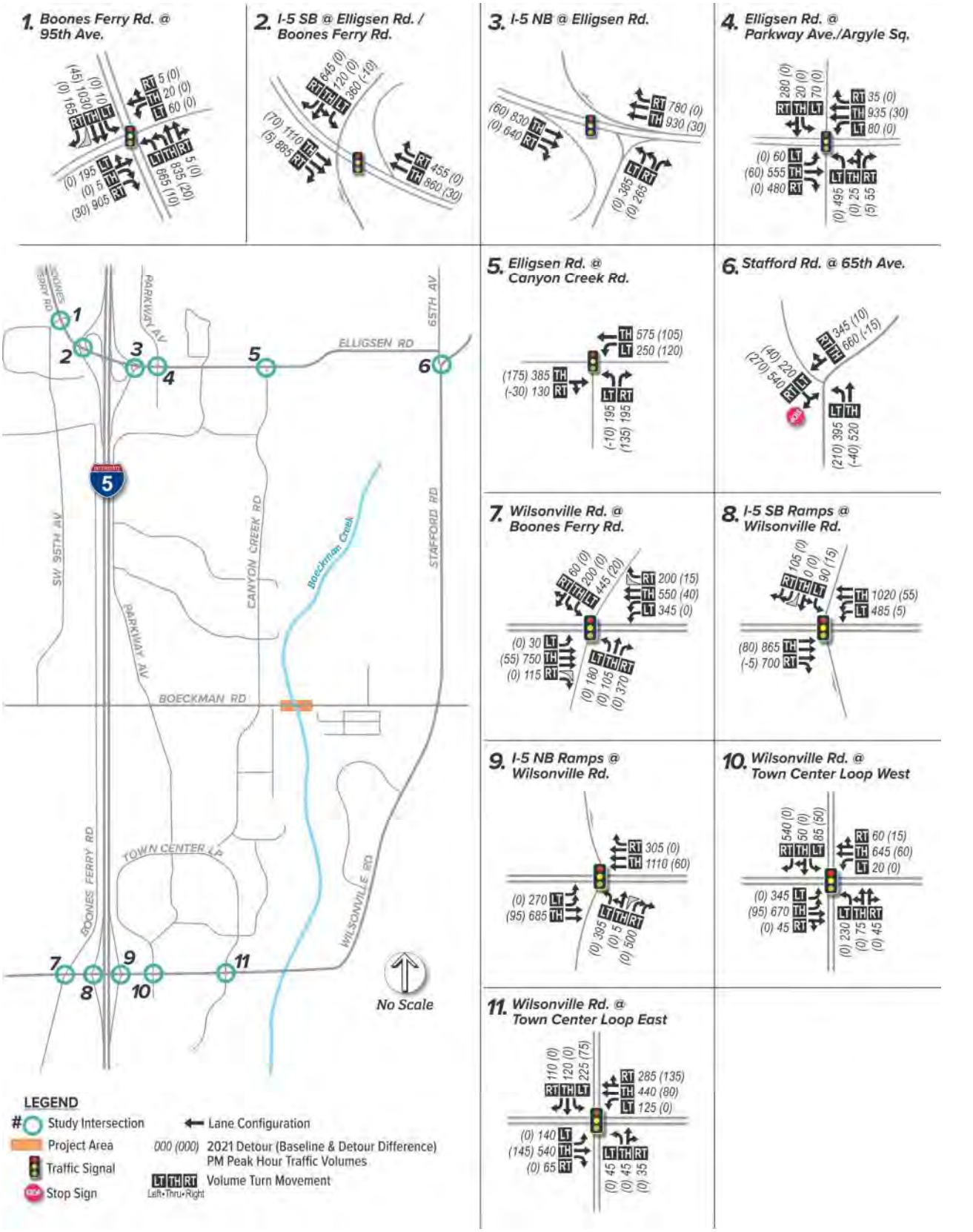


Figure 4: 2021 PM Peak Hour – Background + Traffic Diversion/Detour Traffic Volumes

FUTURE INTERSECTION OPERATIONS

Future analysis scenarios represent the additional traffic that is generated by 2021 background growth and the traffic rerouting generated by the closure of Boeckman Road. Detailed HCM results are provided in Appendix D and Appendix E.

The study intersection operating conditions with the 2021 background traffic and the traffic that is redistributed after the detour is in place are listed in Table 3. The stop-controlled intersection of Stafford Road/65th Avenue does not meet minimum operational standards under future conditions due to the lengthy delays experienced by left-turning vehicles from 65th Avenue onto Stafford Road.

Table 3: 2021 PM Peak Hour Intersection Operations

	Intersection	Juris-diction	Operating Standard	2021 Background			2021 Background + Detour		
				LOS	*Delay*	*V/C*	*LOS*	*Delay*	*V/C*
1	Elligsen Rd/95th Ave	City	LOS D	C	26.5	0.81	C	27.0	0.83
2	Elligsen Rd/I-5 SB Ramp	ODOT	V/C < 0.90	B	17.0	0.80	B	17.0	0.80
3	Elligsen Rd/I-5 NB Ramp	ODOT	V/C < 0.90	C	25.4	0.58	C	24.4	0.58
4	Elligsen Rd/Argyle Sq-Parkway Ave	City	LOS D	C	33.9	0.62	C	33.2	0.63
5	Elligsen Rd/Canyon Creek Rd	City	LOS D	A	9.7	0.49	B	12.1	0.62
6	Stafford Rd/ 65th Ave	County	LOS E	**B/F**	**>100**	**>1.0**	**C/F**	**>100**	**>1.0**
7	Wilsonville Rd/Boones Ferry Rd	City	LOS D	D	37.0	0.66	D	37.3	0.68
8	Wilsonville Rd/I-5 SB Ramp	ODOT	V/C < 0.90	D	48.7	0.42	D	48.0	0.43
9	Wilsonville Rd/I-5 NB Ramp	ODOT	V/C < 0.90	C	25.0	0.50	C	24.0	0.51
10	Wilsonville Rd/Town Center Loop W	City	LOS D	D	35.4	0.56	C	33.2	0.59
11	Wilsonville Rd/Town Center Loop E	City	LOS D	C	21.9	0.43	C	25.2	0.60

Signalized Intersections:
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection
v/c = Volume-to-capacity Ratio of Intersection

Unsignalized intersection:
Delay = Critical Movement Approach Delay (sec.)
LOS = Major Street LOS/Minor Street LOS
V/C = Critical Movement Volume-to-Capacity Ratio

Bold and highlighted: Intersection fails to meet jurisdictional operating standard.

During the PM peak hour, a total of 980 vehicles are estimated to be rerouted throughout the city due to the Boeckman Road closure in 2021. As shown in Table 4 below, the vehicle-miles traveled (VMT) increases by 465 VMT during the PM peak hour with the road closure.

Table 4: 2021 Vehicle Miles Traveled (VMT)

Time Period	Without Boeckman Road Closure	With Boeckman Road Closure	Difference
PM Peak Hour	100,690	101,155	465
Daily	1,006,900	1,011,550	4,650

The PM peak hour VMT is calculated by the Wilsonville Visum Model. The daily VMT is based on a typical 1:10 ratio of PM peak volumes to daily volumes, making the estimated daily VMT difference 4,650 VMT.

SUMMARY

As discussed in this report, the impacts to the majority of the study intersections are minor and are able to support the temporary diversion of PM peak hour traffic volumes on Boeckman Road with the exception of the Stafford Road/65th Avenue intersection. This intersection fails under existing year (2019) conditions as well as under future year (2021) detour conditions. Considerations for a temporary traffic signal to relieve congestion at this intersection would help mitigate the impacts of the Boeckman Road closure. As shown in Table 5 below, the delay and operations would significantly improve with a temporary traffic signal installed. Since this intersection is under Clackamas County jurisdiction, coordination and approval from the county would be required.

Table 5: 2021 PM Peak Hour Intersection Operations – With Temporary Traffic Signal

	Intersection	Jurisdiction	Operating Standard	2021 Background + Detour			2021 With Temporary Signal		
				LOS	*Delay*	*V/C*	*LOS*	*Delay*	*V/C*
6	Stafford Rd/ 65th Ave	County	LOS E	**C/F**	**>100**	**>1.0**	D	48.2	0.99

Signalized Intersections:
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection
v/c = Volume-to-capacity Ratio of Intersection

Unsignalized intersection:
Delay = Critical Movement Approach Delay (sec.)
LOS = Major Street LOS/Minor Street LOS
V/C = Critical Movement Volume-to-Capacity Ratio

Bold and highlighted: Intersection fails to meet jurisdictional operating standard.

Temporary Traffic Signal Estimate

A temporary traffic signal was identified at the Stafford Road/65th Avenue intersection to improve delay, safety and operations during the Boeckman Road closure. Due to the high speeds on Stafford Road, additional budget was included for supplemental traffic signal signage and warning signs to alert drivers to the temporary traffic signal. Table 6 provides the planning level cost estimates for design and construction. It should be noted that once Boeckman Road is opened, the temporary traffic signal would need to be removed. Details of the installation and removal logistics would be subject to coordination and approval with Clackamas County.

Table 6: Temporary Traffic Signal Cost Estimate

Location	Improvement	Planning Level Cost Estimate
Stafford Rd/ 65th Ave	Temporary Traffic Signal	$200,000[5]

[5] Assumes $170,000 for construction and $30,000 for design and construction engineering.

APPENDICES

Appendix A – Traffic Count Data

Appendix B – Existing 2019 HCM Reports

Appendix C – Wilsonville Visum Small Community Model Plots

Appendix D – Future 2021 Background HCM Reports

Appendix E – Future 2021 Background + Boeckman Road Traffic Detour HCM Reports

Appendix F

BOECKMAN DIP PLANNING DESIGN NARRATIVE
for
Frog Pond Master Plan
City of Wilsonville, Oregon

May, 2014

OBEC Consulting Engineers

Corporate Office:
920 Country Club Road, Suite 100B
Eugene, Oregon 97401
541.683.6090

TABLE OF CONTENTS

APPENDICES

BOECKMAN DIP PLANNING DESIGN NARRATIVE
for
Frog Pond Master Plan
City of Wilsonville, Oregon

Introduction

The City of Wilsonville (City) is currently preparing a Master Plan (MP) for the 175-acre Frog Pond area. Part of the MP is to eliminate the dramatic sag vertical curve on Boeckman Road between Canyon Creek and Wilsonville Road that does not comply with current design standards. This vertical curve is known as the Boeckman Dip. The roadway along the dip is very steep, results in poor sight distance, and creates a hazard for bicyclists and pedestrians. The City's Transportation System Plan (TSP) designates Boeckman Road as a Minor Arterial. The City recently constructed some temporary improvements along the south side of Boeckman Road to reduce conflicts between vehicular traffic and other modes of travel.

This narrative briefly addresses the planning-level design completed to provide the City with a cost estimate to remove existing fill and an overflow culvert, and span the dip with a bridge while improving the vertical curve to meet current design standards. Two alternatives were identified as follows:

1. Raise the vertical profile the minimum amount necessary to meet current design standards, and span over the dip with a bridge.
2. Raise the vertical profile to accommodate gravity sewer grades, which could reduce long-term demand on the Memorial Park pump station.

The findings in this narrative are based on survey data provided by others and preliminary alignments prepared by OBEC Consulting Engineers (OBEC). Shannon and Wilson (S&W) provided geotechnical consultation.

Design Standards and Assumptions

The alternatives developed in the planning effort are in accordance with the following design standards and project design assumptions.

Standards

- 2011 American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*
- Americans with Disabilities Act (ADA) Accessibility Guidelines
- Wilsonville Transportation System Plan (TSP) 2013
- Wilsonville Public Works Standards (2006)
- *2012 AASHTO Load and Resistance Factor Design Bridge Design Specifications*

The design will also comply with the 2011 *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG). Roadway design criteria from the above standards are summarized in Appendix A.

Assumptions:

- Road and bridge typical sections are identified in Appendix B.
- All construction would occur during a full closure of Boeckman Road.
- Bridge aesthetic treatment and view platforms are not included.
- The existing flow control structure and lower culvert will remain in place.
- Hydraulics will not govern the vertical profile of the bridge and/or road.
- Seismic hazards such as liquefaction and lateral spread are not fully assessed in terms of risk or additional project cost.
- The existing access road north of Boeckman Road will be maintained but relocated east.
- The left turn lane taper for westbound Boeckman Road will not extend onto the bridge.
- Stormwater is not investigated, but is assumed to be conventional on-site treatment.
- Cost estimates are in 2013 dollars and assume federal-aid project delivery. Inflation to anticipated year of construction should be applied in MP.
- No traffic signals at nearby intersections are included.
- Utility conflicts and relocations were not considered.
- City utility replacement, relocation, or upgrades are not considered.
- Right-of-way acquisition costs were provided by the City.
- Reimbursable utility costs are not considered.
- All construction work can be accomplished without the use of work bridges.

Evaluation Summary

Roadway Design

Improving the substandard vertical profile will be accomplished by raising the low point and flattening the sag vertical curve, along with flattening and lengthening the adjoining crest vertical curves. Approximately 20 to 30 feet of existing roadway fill above the flow control structure and culvert will be removed in the area of the proposed bridge construction. There is an existing overflow culvert at the base of this fill that will be removed as well.

Two roadway vertical alignments (Options A and B) are presented in Appendices C and D. Each alignment essentially maintains the existing horizontal alignment while providing for the substantially wider Boeckman Road typical section. Approximately 18,000 cubic yards of fill will be removed in the dip to accommodate wildlife passage while restoring the area to a more natural setting. The approximate removal limits are depicted in the attachments. Jointed concrete pavement (PCC) will be the structural roadway section for Boeckman Road to match the west and east roadway sections that have been reconstructed in the last several years.

The respective vertical profile for each option is described below.

Option A

Appendix C presents the minimum sag vertical curve necessary to meet City and AASHTO standards. The resulting profile raises the low point of the road approximately 20-feet compared with the existing profile and ties into the crest vertical curves at each end. Grades were established to avoid reconstruction of existing PCC roadway and to minimize effects to side streets and driveways that intersect the road.

Option B

Appendix D presents a higher profile that accommodates a gravity sewer line that would run east to west along Boeckman Road. Layout and elevation information to establish a sewer line profile along Boeckman Road was provided by the City's Master Plan consultant. The information used is as follows:

- 24-inch sewer line at a basic slope of 0.12%
- Manholes located at 400-foot centers will drop the line 0.2 feet
- Resulting "net" slope is 0.17% which is used for the sewer line profile along Boeckman Road
- The controlling elevation is the existing manhole at STA 12+50 with a sewer invert of EL 207 feet

Compared with Option A, the profile increase is approximately 15 feet. Compared with the existing conditions, the profile increase is approximately 35 feet. The profile is high enough to accommodate the sewer line under the bridge, hung from the deck.

Structure Design

A conceptual multiple span bridge and retaining wall layout is included for each profile option to cross the dip with a standard sag vertical curve. The limits of the bridge are governed by the existing topography, depth of the dip, presence of the flow control structures, and the vertical profiles. Option A requires a bridge approximately 300 feet long with 500 feet of retaining wall. Option B requires a bridge approximately 425 feet long with 925 feet of retaining wall.

The bridge type could be steel or prestressed concrete girders supported on steel piles or concrete drilled shafts. Regardless of which option is selected for advancement to the City's next phase, conveying runoff across the bridge will require careful attention. The sag vertical curve creates a low point on the bridge and in the case of Option B, the very flat sag vertical curve will make it challenging to avoid ponding on the bridge.

Geotechnical

Local geology indicates that the project site consists of Willamette Silt and Hillsboro Formation above the Columbia River Basalt Group. Two borings, BH-1 and BH-2, were drilled at the approximate bridge abutment locations to a depth of 80 feet. The soils encountered were:

- **Fill** – Primarily includes the pavement section.
- **Willamette Silt** – Underlies the fill and consists 13.5 to 15.5 feet of loose to medium dense silt to silty sand with low to non-plasticity. The SPT N values range between 3 and 24 blows per foot with an average of 13 blows per foot.
- **Hillsboro Formation** – Underlies the Willamette Silt and consists of at least 63.5 feet of medium stiff to stiff Lean CLAY (CL). The SPT N values range between 4 and 13 blows per foot with an average of about 7 blows per foot.

The bridge will be supported by driven piles or drilled shaft. Due to presence of the deep clay deposit, the deep foundations will be designed primarily for skin friction. Based upon the explored subsurface conditions, the drilled shaft may be constructed by using uncased holes. The subsurface conditions are characterized as Site Class E for seismic hazards. The soils do not appear to be susceptible to liquefaction or related effects.

Construction of the MSE walls and the roadway embankments will result in settlement. While the majority of the settlement will occur during or shortly after construction, the Hillsboro Formation will experience some post-construction consolidation settlement. Therefore, a post-construction settlement period may be required prior to final paving, utility installation, constructing wall facing or other elements sensitive to settlement. The actual settlement period will be determined during final design.

Other Disciplines

Consideration of other design and permitting disciplines are outside the scope of this MP task. These include, but are not limited to, hydraulics and stormwater, full geotechnical analysis, traffic, signing, striping and illumination design, natural and cultural resources permitting, landscaping, mitigation and restoration, hazardous materials assessment, local permits, utility design and coordination, constructability, and public involvement. Right-of-way was only considered to provide a preliminary assessment of permanent acquisition costs without establishing a defined project footprint. Actual costs could be more than shown in this estimate. However, the cost will be approximately the same for either option and while raising the project cost, would not affect the cost difference between the two options.

Conclusion

Options A and B to address the Boeckman Dip are presented in this narrative and Appendices C and D. The planning-level cost estimates for each option are provided in Appendix E along with assumptions used to prepare the cost estimates. A summary of each option is provided below in Table 1.

Table 1: Options A and B Summary

Option	Cost	Summary
A	$13,100,000	This option provides the minimum profile improvement to comply with design standards. It results in the shortest bridge and is the least cost.
B	$17,900,000	This option provides a profile improvement to accommodate a future east-west gravity sewer line on the bridge. It results in a longer bridge and is the largest cost.

Each option includes building out Boeckman Road to accommodate bicycles and pedestrians on both sides of the road. The roadway section is PCC to match adjoining sections. The City will select the preferred option based on an overall cost assessment considering infrastructure and utility improvements associated with each option.

APPENDIX A

OBEC CONSULTING ENGINEERS

Design Standards Form
Roadway

Project: Boeckman Creek Bridge Date: 04/08/2014

Project Designer: Matthew Phillips, PE. Project No.: 0256-0023

Type of Project: (New Const., Reconst., 3-R) Reconst.

Functional Class: Minor Arterial

ADT:

Traffic	Year	ADT
Current (date ADT taken)	2014	3,374
Design ADT (20 years from const.)	2034	6,586

Note: If no design ADT is available, use growth rate for county or 2% growth rate if no other data is available.

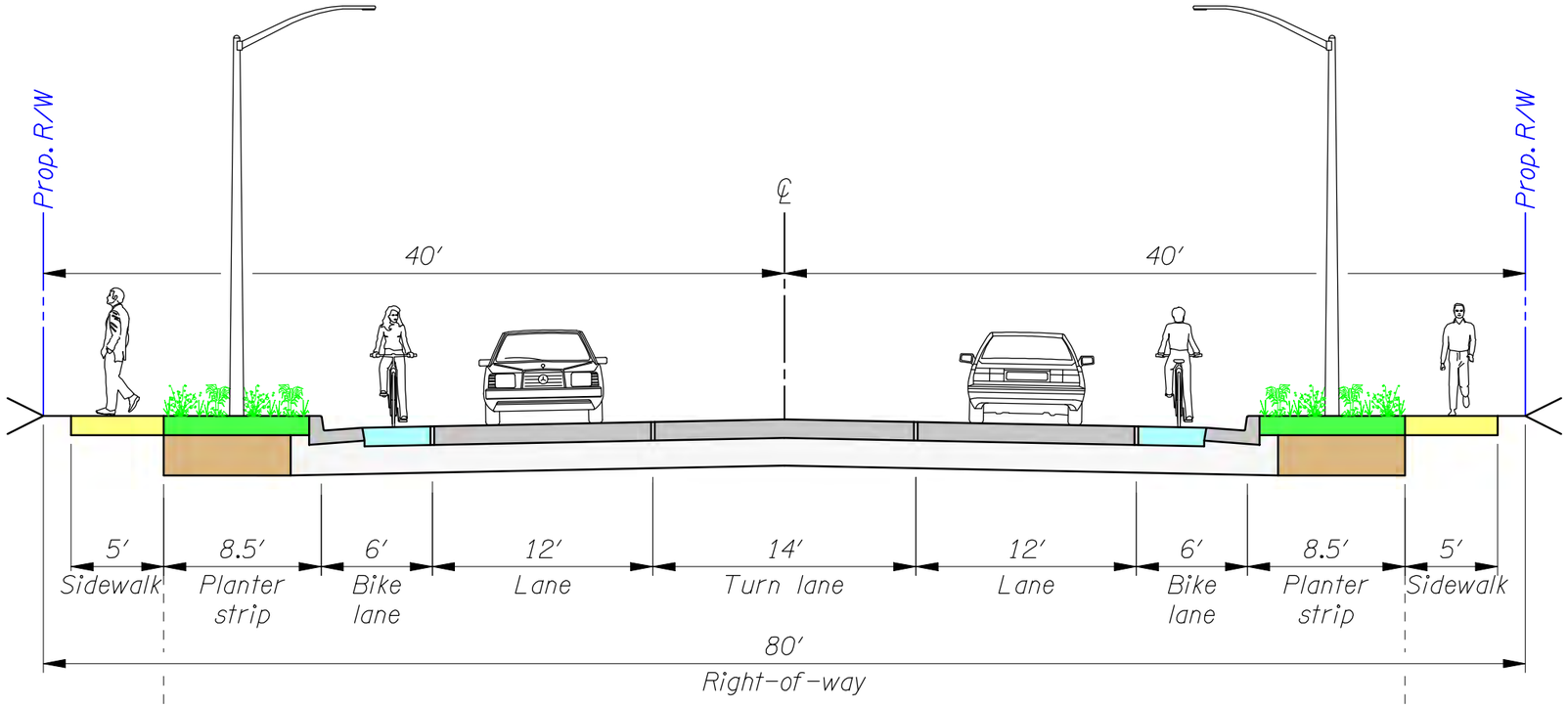
Design Standards: (ODOT, AASHTO, Other (name standard) (1) AASHTO 2011, 6th Ed, (2) Wilsonville TSP 2013 (3) City of Wilsonville Public Works Standards 2006, (4) ODOT Highway Design Manual 2012, (5) AASHTO RDG

Type of Terrain: Rolling

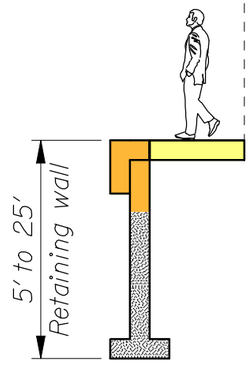
GEOMETRIC DESIGN STANDARD

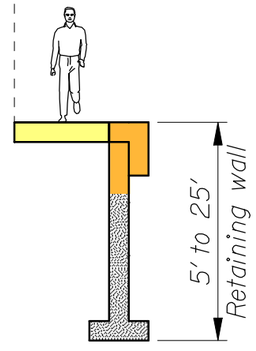
	PAGE NO.	STANDARD	PROPOSED	EXCEPTION
Design Speed (mph)			40mph	
Traveled Way Width (ft.)	3-14 (2)	11' to 12'	12'	No
Shoulder Width (ft.)	3-14 (2)	6'	6'	No
Bike Lane Width (ft.)	3-14 (2)	6'	6'	No
Parking Width (ft.)	3-14 (2)	0'	0'	No
Sidewalk Width (ft.)	3-14 (2)	5' Min	5'	No
Bridge Width (ft.)	7-31 (1)	28' *	60’	No
Horizontal Curvature (min. radius)	3-45 (1) 60 (3)	4770' ** 855'	NA	No
Vertical Curvature (crest) (K value = L/A)	61 (3) 3-155 (1)	60 to 80 44	Opt. A: 80 Opt B: NA	No
Vertical Curvature (sag) (K value – L/A)	62 (3) 3-161 (1)	60 to 70 64	Opt. A: 64 Opt. B: 243	No
Grade (max. percent)	7-29 (1) 60 (3)	8% 6%	Opt. A: 6% Opt. B: 3.5%	No
Stopping Sight Distance (min.)	7-3 (1)	305'	Opt. A: 307’ Opt. B: 950’	No
Cross Slope (min. percent)	70 (3)	2%	2%	No
Superelevation (max. percent)	70 (3)	5%	2%	No
Vertical Clearance (ft.)	7-6 (1)	16'	NA	No
Superelevation Runoff (ft.) (@ max. e)	3-61 (1)	104'	NA	No
Clear zone	3-3 (5)	14’ to 18’	18’	No
	Comments: * Curb to Curb width ** Normal Crown			

APPENDIX B



BOECKMAN ROAD TYPICAL SECTION
A-A





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

TYPICAL SECTION | 1 OF 2

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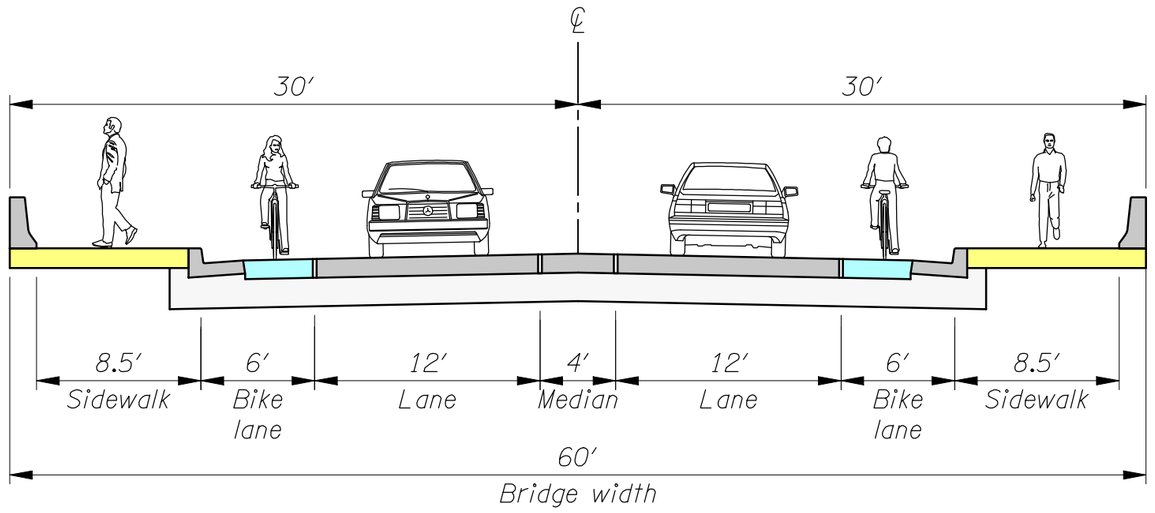

BOECKMAN BRIDGE TYPICAL SECTION
B-B

City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

TYPICAL SECTION	2 OF 2

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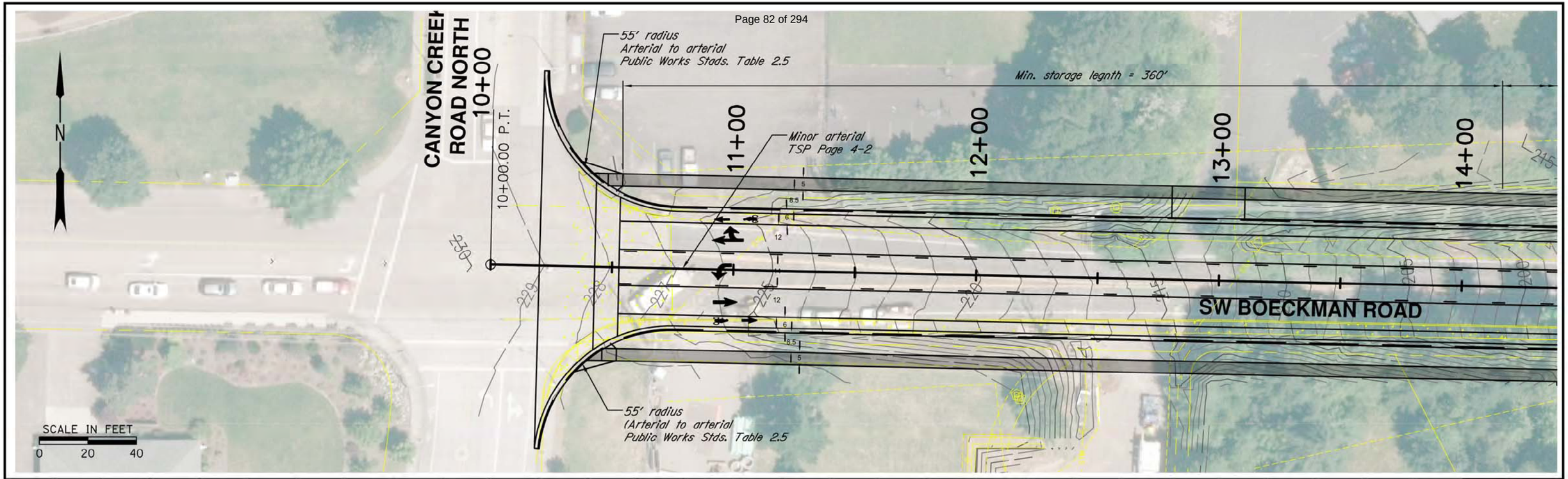
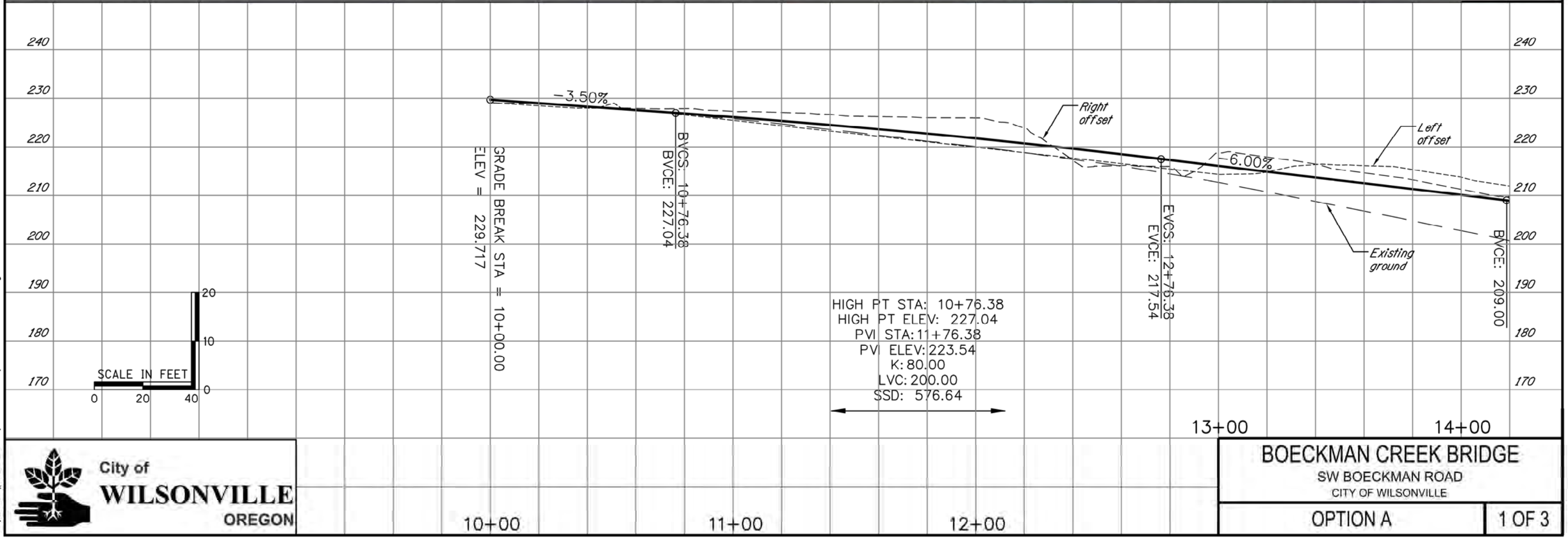
APPENDIX C

04-10-2014





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A

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04-10-2014

Min. deceleration legnth = 160'
Per AASHTO Table 9-22 minus 10 MPH 9-127
(40 MPH design speed)

15+00 16+00 17+00 18+00 19+00 20+00

N

S88° 44' 13.45"E

SW BOECKMAN ROAD

Taper legnth = 135'
L= (W x S²)/60
40 MPH, 5' (Equal widening)

Bridge legnth = 300'

Taper legnth = 135'
L= (W x S²)/60
40 MPH, 5' (Equal widening)

SCALE IN FEET
0 20 40

LOW PT STA: 18+02.74
LOW PT ELEV: 197.48
PVI STA: 17+46.74
PVI ELEV: 189.32
K: 64.00
LVC: 656.00
SSD: 306

Left offset

RVCS: 14+18.74

Right offset

Existing ground

Sl. 1H:2V

Sl. 1H:2V

Existing 42"x66" CMP
Sta. 17+09, elev. 153.89 @ ℄

SCALE IN FEET
0 20 40
0 10 20

15+00 16+00 17+00 18+00 19+00 20+00

City of
WILSONVILLE
OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A

2 OF 3

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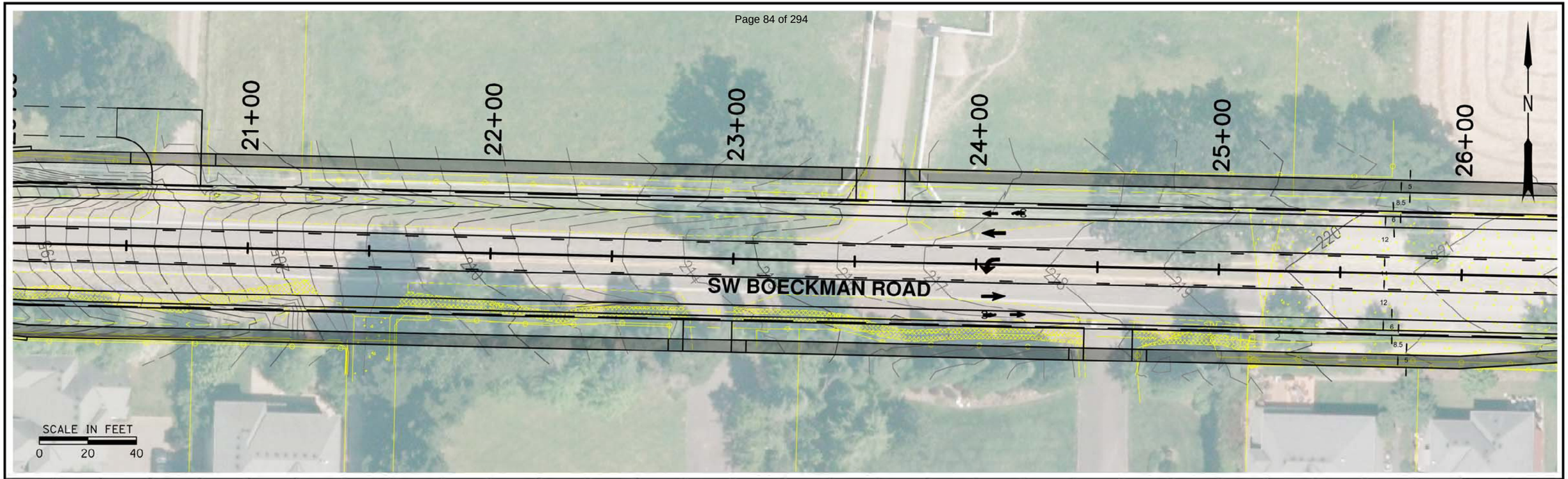
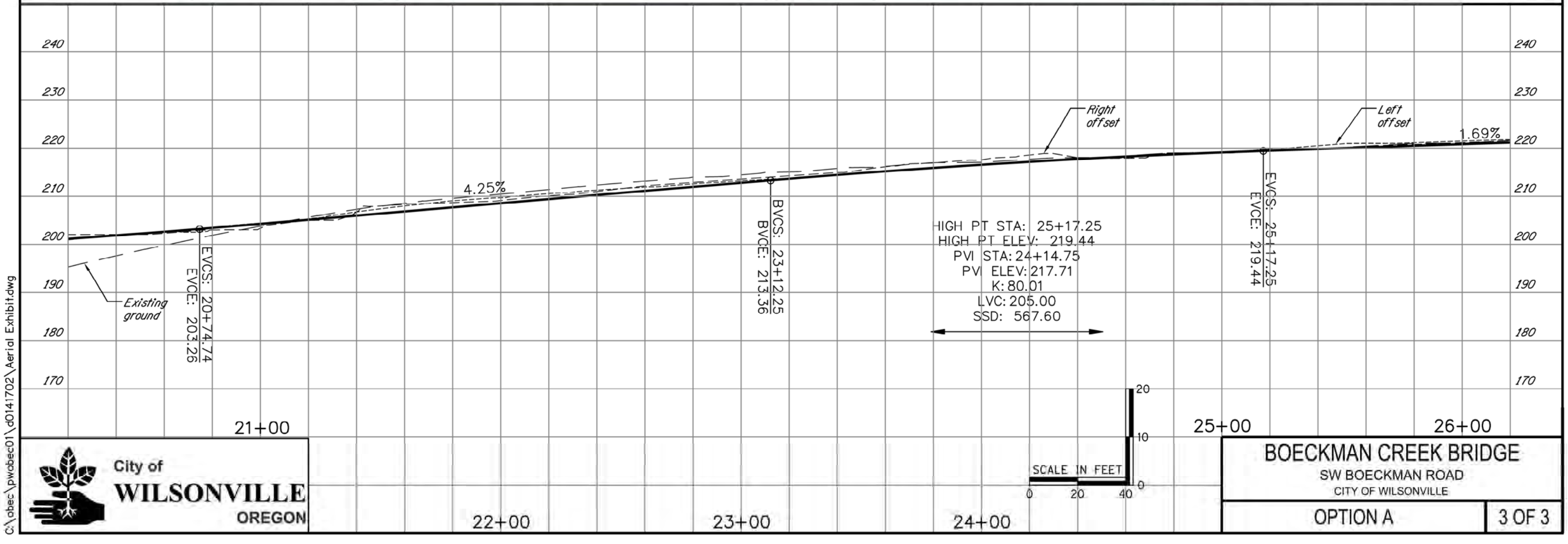
04-10-2014





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A | 3 OF 3

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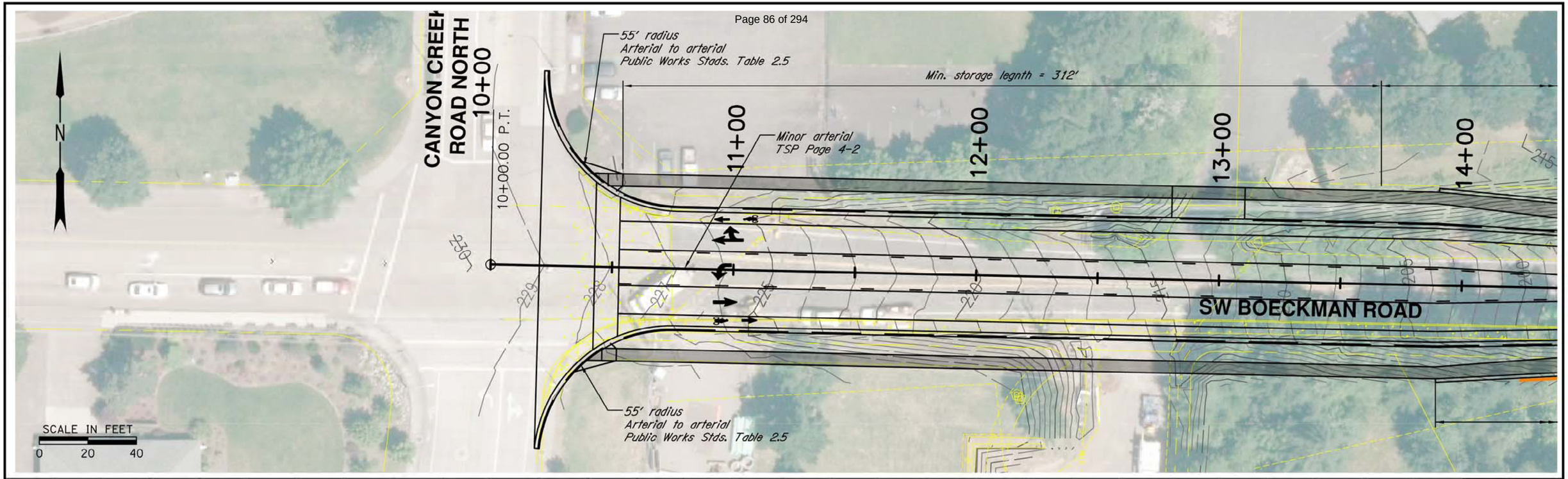
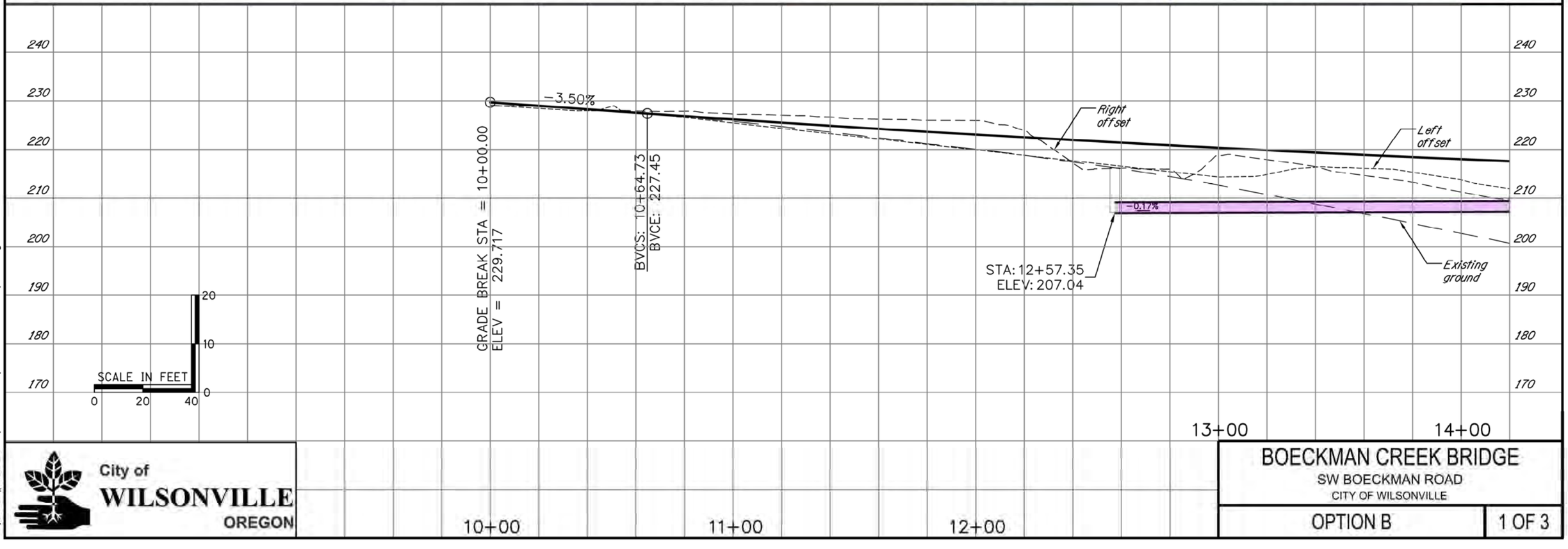
APPENDIX D

04-10-2014





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION B | 1 OF 3

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04-10-2014

Min. deceleration legnth = 160'
Per AASHTO Table 9-22 minus 10 MPH 9-127
(40 MPH design speed)

14+00 15+00 16+00 17+00 18+00 19+00 20+00

N

S88° 44' 13.45"E

SW BOECKMAN ROAD

Taper legnth = 135'
L= (W x S²)/60
40 MPH, 5' (Equal widening)

Bridge length = 425'

Taper legnth = 135'
L= (W x S²)/60
40 MPH, 5' (Equal widening)

SCALE IN FEET
0 20 40

Left offset

Right offset

LOW PT STA: 19+14.00
LOW PT ELEV: 212.59
PVI STA: 17+14.73
PVI ELEV: 204.70
K: 242.65
LVC: 1300.00
SSD: 950

-0.1%

Sl. 1H:2V

Sl. 1H:2V

Existing ground

Existing 42"x66" CMP
Sta. 17+09, elev. 153.89 @ ℄

220 210 200 190 180 170 160 150

SCALE IN FEET
0 20 40
20 10 0

15+00 16+00 17+00 18+00 19+00 20+00

City of
WILSONVILLE
OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION B | 2 OF 3

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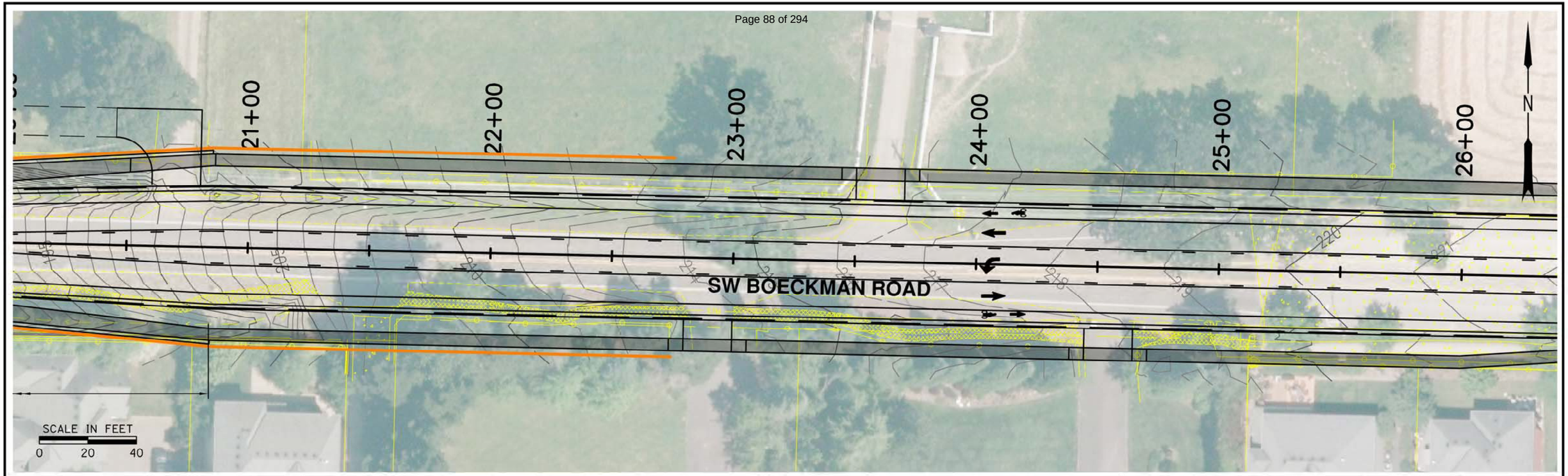
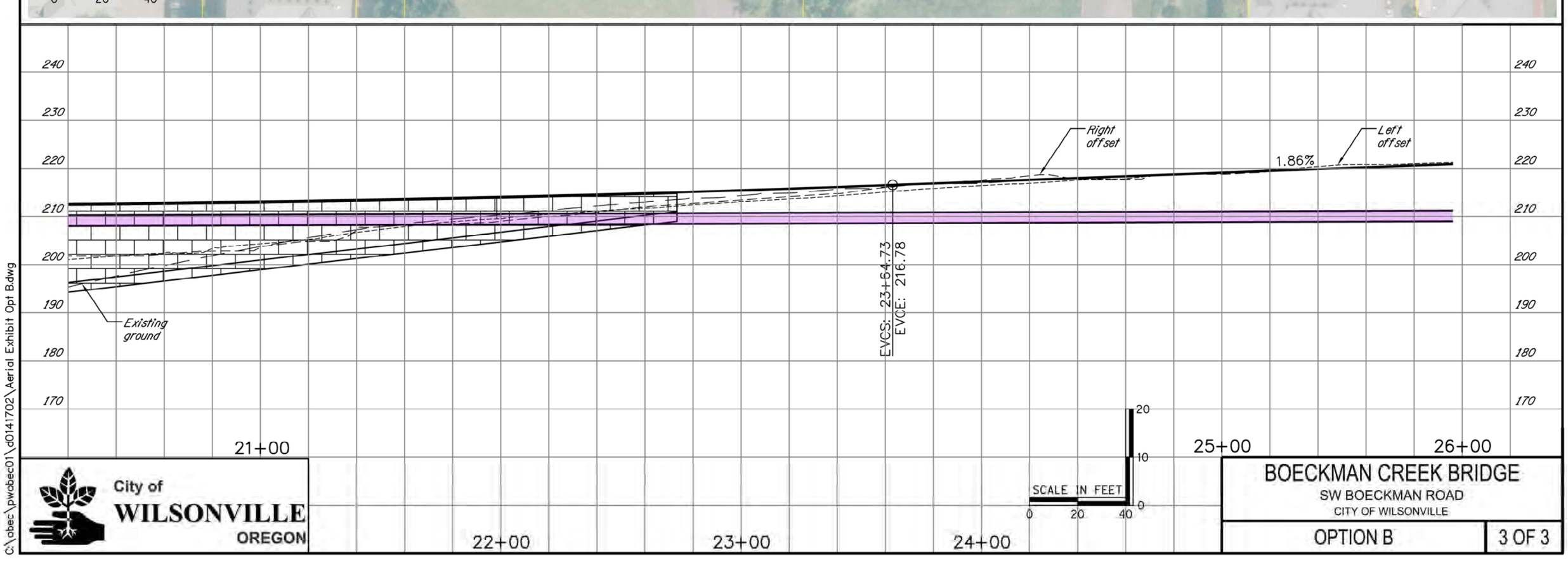
04-10-2014





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION B | 3 OF 3

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APPENDIX E

PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Option A				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	**Structures, Grading, Paving, Illumination**	**0.31**	**5/28/14**	**OBEC**	

ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$632,000
0225-0100000A	TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	LS	1	$10,000	$10,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$69,400
0320.0100000A	CLEARING AND GRUBBING	AC	4	$1,000	$4,000
0330.0105000K	GENERAL EXCAVATION	CUYD	21,531	$10	$215,310
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	$1.00	$8,038
0640.0100000M	AGGREGATE BASE	CUYD	1,538	$30	$46,152
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	$55	$382,085
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	$15	$40,740
0759.0128000J	CONCRETE WALKS 4"	SQFT	13,873	$5.00	$69,365
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$7.00	$9,870
00400's	Storm & drainage	LS	1	$100,000	$100,000
1012-0000000R	WATER QUALITY SWALE	LS	1	$25,000	$25,000
STRUCTURES					
0596-0104000J	RETAINING WALL, MSE - West Side	SQFT	3,975	$75	$298,125
0596-0104000J	RETAINING WALL, MSE - East Side	SQFT	3,600	$75	$270,000
00500's	STEEL OR CONCRETE BRIDGE	SQFT	18,000	$300	$5,400,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$15,000	$15,000
00900's	Signing	LS	1	$5,000	$5,000
00890's	Illumination	LS	1	$50,000	$50,000
SUBTOTAL, Construction Items					**$7,650,000**
	PRELIMINARY ENGINEERING			15%	$1,148,000
	RIGHT-OF-WAY				$900,000
	CONSTRUCTION ENGINEERING			12%	$918,000
	CONSTRUCTION SURVEY WORK			3%	$210,000
	CONTINGENCY			30%	$2,295,000
****PARTIAL PROJECT COST**					**$13,200,000**

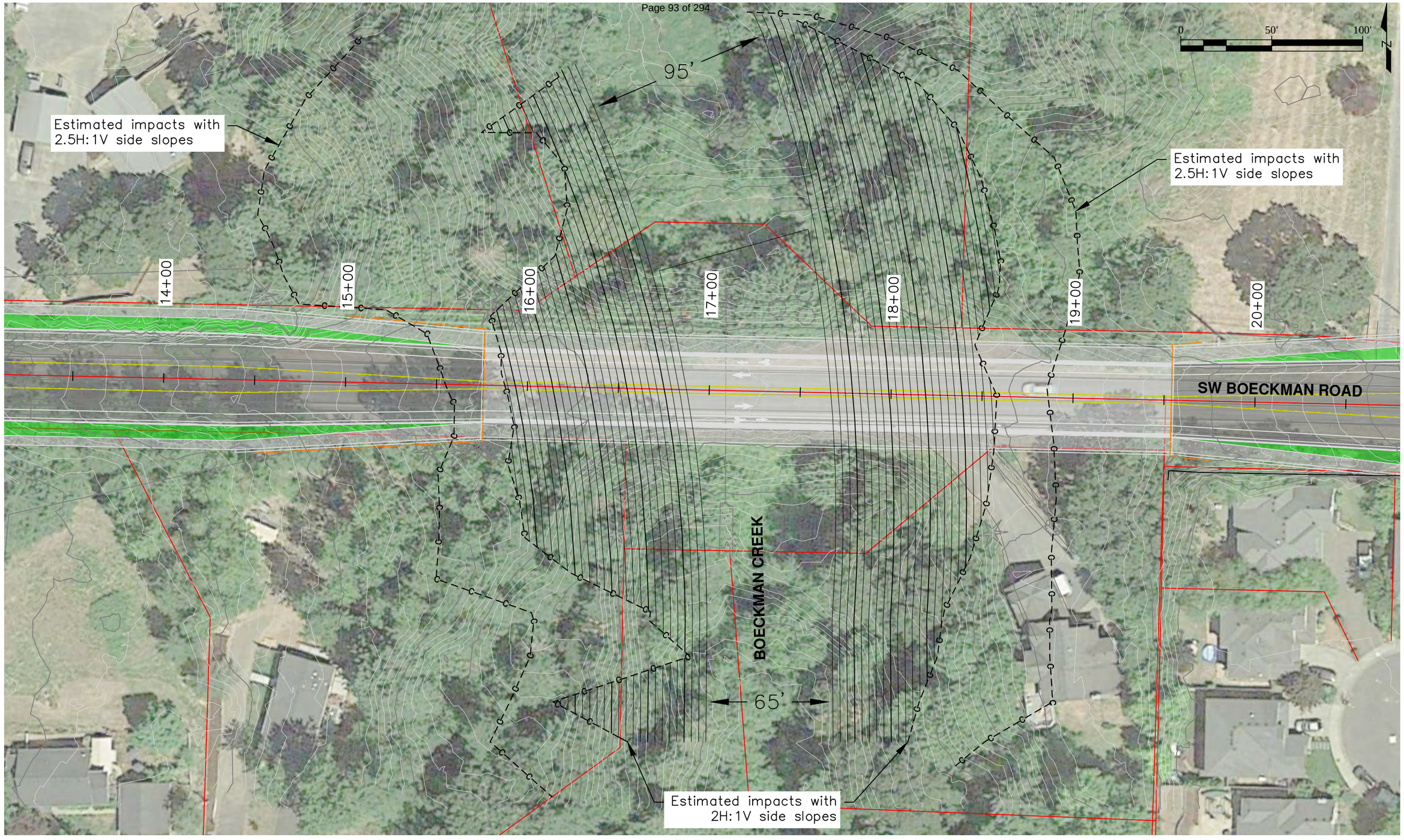
PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Option B				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	**Structures, Grading, Paving, Illumination**	**0.31**	**5/28/14**	**OBEC**	

ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$877,000
0225-0100000A	TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	LS	1	$10,000	$10,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$96,400
0320.0100000A	CLEARING AND GRUBBING	AC	4	$1,000	$4,000
0330.0105000K	GENERAL EXCAVATION	CUYD	19,382	$10	$193,820
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	7,330	$1.00	$7,330
0640.0100000M	AGGREGATE BASE	CUYD	1,413	$30	$42,379
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,294	$55	$346,170
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,466	$15	$36,990
0759.0128000J	CONCRETE WALKS 4"	SQFT	12,626	$5.00	$63,130
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$7.00	$9,870
00400's	Storm & drainage	LS	1	$100,000	$100,000
1012-0000000R	WATER QUALITY SWALE	LS	1	$25,000	$25,000
STRUCTURES					
0596-0104000J	RETAINING WALL, MSE - West Side	SQFT	4,515	$75	$338,625
0596-0104000J	RETAINING WALL, MSE - East Side	SQFT	10,010	$75	$750,750
00500's	STEEL OR CONCRETE BRIDGE	SQFT	25,500	$300	$7,650,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$15,000	$15,000
00900's	Signing	LS	1	$5,000	$5,000
00890's	Illumination	LS	1	$50,000	$50,000
SUBTOTAL, Construction Items					**$10,621,000**
	PRELIMINARY ENGINEERING			15%	$1,593,000
	RIGHT-OF-WAY				$900,000
	CONSTRUCTION ENGINEERING			12%	$1,275,000
	CONSTRUCTION SURVEY WORK			3%	$292,000
	CONTINGENCY			30%	$3,186,000
****PARTIAL PROJECT COST**					**$17,900,000**

Appendix G



City of
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OREGON

Note:
No ordinary high water was delineated when evaluating full channel restoration impacts. Impacts were derived from assumed wetland areas based on an existing ground LIDAR surface. Further evaluation of environmental impacts and a hydraulic analysis is required to better determine the impacts of full channel restoration.

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

FULL CHANNEL RESTORATION	G1

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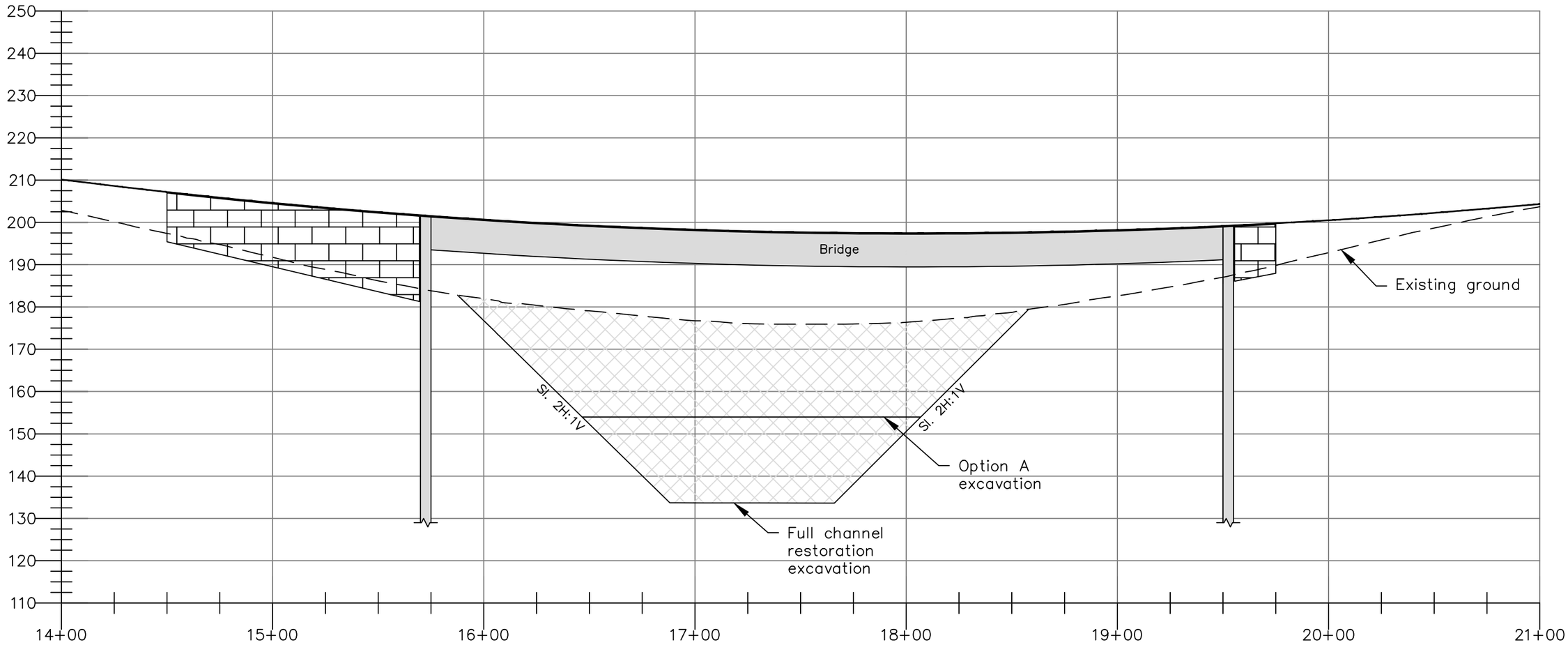

City of
WILSONVILLE
OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

FULL CHANNEL RESTORATION - PROFILE | G2

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PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Extra for Full Channel Restoration				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	**Grading, Structures, Paving, Signing, Illumination**	**0.31**	**12/13/19**	**OBEC**	
ITEM NUMBER	**ITEM DESCRIPTION**	**UNIT**	**AMOUNT**	**UNIT COST**	**TOTAL**
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$127,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	3%	$50,000
0280.0100000A	EROSION CONTROL	LS	All	2%	$27,700
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$13,700
0320.0100000A	CLEARING AND GRUBBING	AC	2	$1,500	$3,000
0330.0105000K	GENERAL EXCAVATION	CUYD	22,600	$30	$678,000
STRUCTURES					
00500's	STEEL OR CONCRETE BRIDGE	SQFT	22,800	$25	$570,000
RIGHT OF WAY DEVELOPMENT AND CONTROL					
01000's	STREAM AND HABITAT RESTORATION	LS	All	$120,000	$120,000
SUBTOTAL, Construction Items					**$1,589,000**
	PRELIMINARY ENGINEERING			15%	$238,000
	PERMINANT SLOPE EASEMENTS	SQFT	12,382		$160,000
	CONSTRUCTION ENGINEERING			12%	$191,000
	CONSTRUCTION SURVEY WORK			3%	$42,000
	PLANNING COST RANGE (-20% TO +50%)				
**** LOW ADDITIONAL PROJECT COST IN 2019 DOLLARS**					**$1,800,000**
**** HIGH ADDITIONAL PROJECT COST IN 2019 DOLLARS**					**$3,400,000**
**** LOW ADDITIONAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$2,000,000**
**** HIGH ADDITIONAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$3,700,000**

** We are providing a range due to the uncertainty of the additional work. Added work may differ depending on which alternative is selected.