



TO: City of Wilsonville
BY: Keisuke Harry, P.E.
REVIEWED BY: Nick Robertson, P.E., S.E.
DATE: February 2021
SUBJECT: Boeckman Dip Alternative Analysis Memorandum - Embankment

Table of Contents

Executive Summary.....2
Background2
Design Standards, Project Assumptions, and Limitations.....3
Design Standards..... 3
Project Assumptions 4
Limitations 5
Permitting and Fish Passage5
Embankment Alternative7
Culvert Design 8
Embankment Alternative with Full Road Closure.....9
Impacts 9
Constructability 10
Embankment Alternative with On-site Detour..... 10
Impacts 10
Retaining Walls 10
Constructability 10
Cost Estimate 11

FIGURES

Figure 1: Proposed Bridge Section
Figure 2: Proposed Roadway Section

APPENDICES

Appendix A: Plan and Profile
Appendix B: On-site Detour Figures
Appendix C: Cost Estimates
Appendix D: Construction Time Estimates

Executive Summary

The City requested DOWL to evaluate an embankment alternative for Boeckman Road as a follow-on to the 2019 Boeckman Dip Alternatives Analysis. The purpose of this memo is to determine the environmental and right-of-way impacts and overall project costs associated with an embankment alternative. For the embankment alternative, DOWL evaluated two options for construction: staging with an on-site detour and a full-closure of Boeckman Road. This memo also evaluates fish passage requirements for both a bridge and embankment alternative.

Based on our evaluation of fish passage requirements it is very likely the existing Boeckman Creek culvert will need to be replaced for any of the alternatives that have been studied. Both embankment alternatives pose significant impacts to traffic, adjacent properties, and trees. While it is possible to construct the culvert using a staged method with the on-site detour, a road closure is still necessary to construct the new culvert below the existing roadway.

The full-closure alternative is the least expensive alternative and has the shortest construction time of 20 months. The disadvantage of this alternative is that Boeckman Road would be closed during the entire duration of construction. While the on-site detour alternative has a shorter road closure of 15 months, the duration of construction is significantly longer at 33 months. The on-site detour would also require an additional 23,200 square feet of temporary construction easements and removal of approximately 10 more trees on the north side of Boeckman Road. Most of these tree impacts affect a single property owner and will result in significant impact to their property. An on-site detour also adds approximately \$1.8M to the total project costs.

The City would like to protect the significant tree on the south side of Boeckman Road. This tree might be able to be protected with a retaining wall, but the next design phase will need to confirm that this approach would be adequate. A pedestrian tunnel and a wildlife tunnel will be included adjacent to the new culvert.

Background

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 Wilsonville's (City) Transportation System Plan (TSP) designates the road as a minor arterial. The City is preparing to widen Boeckman Road and improve the vertical profile of the roadway.

In 2014, DOWL completed a feasibility study evaluating two bridge 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 the gravity sewer line. Therefore, the City selected Option A as the preferred bridge alternative.

Features of Option A include:

- A new 380-foot bridge that raises the roadway profile approximately 20 feet
- Accommodations for wildlife, a future pedestrian path and maintenance access along Boeckman Creek

- Maintaining the existing horizontal alignment
- A 60-foot-wide bridge and 77-foot-wide roadway section (see Figures 1 and 2)
- Flexibility for the City to determine the final accommodations for bicycles and pedestrians
- 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
- Protecting the significant tree at 7550 Boeckman Road

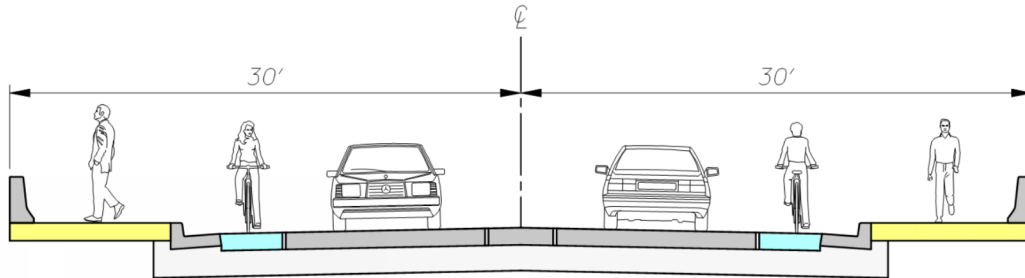


Figure 1 – Proposed Bridge Section

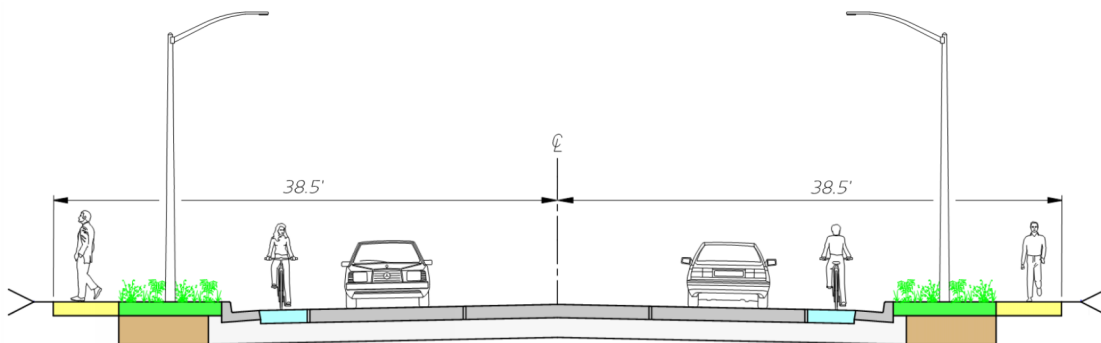


Figure 2 – Proposed Roadway Section

In 2019, DOWL completed an alternatives study evaluating the impacts and costs associated with maintaining traffic during construction and to update Option A with current construction costs. As part of the study, DOWL provided a high-level estimate to restore the original stream channel. An addendum was issued for this report in January 2021 to update the project conclusions and costs based on the results of the environmental and hydraulic analysis described in this memorandum.

Design Standards, Project Assumptions, and Limitations

DOWL evaluated the project and all design 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)
- Wilsonville Stormwater & Surface Water Design & Construction Standards (2015)
- Oregon Administrative Rule (OAR) 635-412-0035

Project Assumptions

Design

- The existing fill, which serves as the current roadway embankment material, can be repurposed as permanent embankment material.
- Hydraulics will not govern the vertical profile of the roadway.
- Seismic hazards, such as liquefaction and lateral spread, are not believed to pose significant risk, but will not be fully assessed until additional geotechnical exploration is undertaken during final design.
- The existing access road north of Boeckman Road will be relocated to connect to Morgan Farms. The south side of Boeckman Road will be accessed through the proposed pedestrian tunnel.
- The left-turn lane taper for westbound Boeckman Road will not extend onto the embankment section.
- Stormwater management requirements will be met using conventional treatment. Offsetting water quality treatment for the widened roadway surface along the raised embankment will be provided along the east and west approaches within the project area.
- The Oregon Department of Fish and Wildlife (ODFW) will concur with an active channel width (ACW) determination of 12 feet or less.
- Modification of the existing culvert to meet fish passage requirements is not considered feasible due to a combination of unknown structural capacity, age of the existing culvert, constructability considerations, and the reduced hydraulic capacity resulting from modifications that would improve fish passage.

Impacts

- Right-of-way (ROW) acquisition areas are based on a ROW width of 81 feet, except near the embankment section where the cost is based on 89 feet.
- The project must avoid permanently impacting the new development on the north side of Boeckman Road, east of the dip.
- Construction activities to remove the existing culvert and install the new culvert must occur during the in-water work window (IWWW) from July 15 through October 15 which may impact when the project can be bid and completed.
- If federal permitting is triggered and National Marine Fisheries Service (NMFS) consultation is required, NMFS will approve the proposed culvert as stream simulation or a combination of stream simulation and hydraulic design.
- NMFS or ODFW will not require natural or artificial lighting within the culvert.

Cost Estimating

- The project will not receive any federal funding.
- Cost estimates are in 2021 dollars.

- Cost estimates do not include future intersection improvements.
- A 2% allowance is included in the cost estimates for aesthetic enhancements.
- Reimbursable franchise utility costs may exist on the north side of Boeckman Road at Morgan Farms. These costs are accounted for in the project contingency.
- City utility replacement, relocation, or upgrades have not been evaluated at this time, but are not believed to be significant.
- ROW costs are based on \$17.50 per square foot for permanent ROW acquisition, \$12 per square foot for permanent easements, and \$9 per square foot for temporary easements. Tree impacts and negotiations are not considered in the project costs at this time.

Limitations

The current analysis is a planning-level study. There are several limitations to the current project understanding that require additional investigation as design progresses. These items contribute to the assigned 40% contingency for all cost estimates.

- A survey of the current conditions should be conducted to more accurately capture the site topography, which is particularly important for determining the impacts to 7727 Boeckman Road and Morgan Farms.
- A geotechnical analysis should be conducted for temporary and permanent retaining wall design.
- A tree survey should be conducted to determine the impacts of the on-site detours to the surrounding trees.
- An archeological investigation, as discussed in the permitting and fish passage section, is needed to determine the cultural relevance of the site and the presence or absence of related artifacts.
- An evaluation of the site is needed to identify the presence or absence of flora or fauna covered under the Endangered Species Act (ESA).
- A complete wetland and waters delineation is needed to identify resource boundaries.
- The hydraulic analysis does not take into consideration or determine the magnitude of the flow rate increase anticipated downstream as a result of replacing the existing culvert. As downstream impacts are unknown at this time, no costs to mitigate downstream impacts are included in the study. If necessary, the ability to construct mitigation within the current project limits is more feasible for an open channel than for a replacement culvert.
- Costs for stormwater facilities are included based on a cursory evaluation of the space available. Detailed stormwater analysis and design will need to be completed as part of the final design.

Permitting and Fish Passage

Boeckman Creek and associated wetlands are present within the project area and are likely jurisdictional to the U.S. Army Corps of Engineers (USACE) and the Department of State Lands (DSL). Based upon field reconnaissance and estimating resource boundaries, wetlands are located adjacent to Boeckman Creek immediately upstream of the crossing. Portions of the wetland on the west side of the channel appear to extend southwest, upslope of where existing fill intersects with

the canyon slope. Water in this area appears to come from groundwater seepage and an upslope roadside ditch. A very small portion of this potential wetland may extend into the proposed fill. Further, there is a stormwater outfall located north of Boeckman Road and west of the overflow culvert. Stormwater from the outfall appears to be routed through a constructed facility before discharging through a rock-lined channel and spreading out down the existing embankment material. This facility is not anticipated to be considered a jurisdictional wetland. It is anticipated that all crossing replacement options will result in very minimal impacts to regulated wetlands and waters.

DSL exempts certain activities from removal/fill permit requirements, including maintenance or reconstruction of water control structures such as culverts (OAR 141-085-0530 (4)). To maintain exempt status, a project must not permanently widen a crossing by more than 20% of its original footprint within a stream or result in significant impacts to wetlands or waters that were not part of the original project. Based on the concepts proposed in this memo, it is expected that the project will meet this requirement and will be exempt from DSL review. Details developed during final design may alter this determination. A wetland delineation report should be prepared and may need to be submitted to DSL for concurrence to verify wetland boundaries and confirm the project minimizes impacts. Ongoing coordination with DSL to reaffirm project exemption status is also recommended.

The proposed concept for culvert replacement should be considered an in-kind replacement that is eligible for exemption from Section 404 review. USACE exemptions from Clean Water Act (CWA) Section 404 are not as clear as DSL exemptions. Section 404(f) exempts maintenance activities for currently serviceable structures so long as the activities do not modify the character, scope, or size of the original fill design. Confirmation from USACE that the project is exempt from Section 404 should be sought early in the final design process.

If exemptions from USACE and/or DSL permitting are not applicable, approvals from each agency would be required. A Joint Permit Application (JPA) would be submitted to each agency. The project would likely qualify under a Nationwide Permit for USACE and a General Permit for DSL. Minor impacts to wetlands associated with construction at the culvert ends may require mitigation, which could be accomplished through the purchase of mitigation bank credits. It is not anticipated that these approvals would significantly change the overall project cost or schedule.

As part of a USACE approval process, the project would be required to obtain Section 401 Water Quality Certification from the Oregon Department of Environmental Quality (DEQ). DEQ will require a copy of the JPA at the time of submittal to USACE, as well as a post-construction stormwater management plan meeting their requirements.

As summarized by Pacific Habitat Services (PHS) in the March 2020 Fish Passage Assessment, Boeckman Creek is known to support ESA-listed steelhead and Chinook species downstream of the project. Although these species have not been documented as far upstream as the project location, it is assumed that they may now be able to reach the culvert due to restoration projects completed downstream. The project would need to obtain ESA Section 7 consultation from NMFS if there is any federal (USACE) permitting nexus. The project may qualify for programmatic coverage under the USACE-NMFS Standard Local Operating Procedures for Endangered Species (SLOPES) V programmatic biological opinion. If NMFS does not grant approval of the project under SLOPES, an individual consultation and biological opinion (BO) would be required.

Based on the hydraulic analysis completed to date, a replacement crossing that spans 1.0 times the ACW would meet NMFS fish passage criteria and would likely receive a BO. Based on the current level of understanding a 12 foot replacement culvert is likely permissible, though additional coordination is required. NMFS would process their review concurrent with the USACE permit process. It should be noted that SLOPES typically requires replacement crossings to provide a span length of at least 1.5 times the ACW. Therefore, some level of risk remains that the width of the culvert used for the embankment alternative may need to be increased to 18 feet if both a federal nexus is triggered and SLOPES V is used.

DOWL evaluated available existing data and completed a limited site visit to aid in determining potential fish passage implications for each of the alternatives evaluated herein. DOWL estimated the average ACW of Boeckman Creek to be approximately 12 feet. The ACW was determined based on field indicators and was found to be roughly coincident with the bankfull elevation. Measurements upstream ranged from 7-10 feet, while measurements downstream ranged from 10-12 feet when taken away from the culvert outfall.

Additional supporting studies that are likely necessary include a cultural resources baseline report (archaeological and historic) and a hazardous materials corridor study (HMCS). Although it is unknown whether cultural resources exist within the project area, USACE will evaluate the project for potential Section 106 impacts, and the baseline reporting will aid in their determination. A HMCS is recommended any time there is ROW acquisition, significant ground disturbance, or significant off-site disposal requirements.

The project area is located within the City's Significant Resource Overlay Zone (SROZ). Although minor impacts within this zone are anticipated, the project is exempt under code section 4.139.04, subsections .07 and .08. Although exempt, the project must be designed and constructed to minimize disturbance and promote slope stability. Additional local permitting may include coverage under a 1200-CN erosion control permit if ground disturbance exceeds one acre. These requirements are unlikely to significantly affect project costs or schedule.

As previously mentioned, Boeckman Creek contains native migratory fish upstream and downstream of the existing culvert. As such, fish passage rules apply at the project site if there is a trigger action. Based on consultation with ODFW in October 2020, it is our understanding that any of the proposed improvements to Boeckman Road at this location will be considered a trigger event. Therefore, this project will be required to comply with ODFW fish passage requirements and must submit a fish passage plan for review and approval.

DOWL also met with ODFW and the City on-site in October 2020 to discuss crossing alternatives. ODFW confirmed the presence of native migratory fish and that the project will trigger fish passage review. ODFW stated a strong preference to replace the existing culvert with a bridge to allow for channel restoration through the project area. They indicated that although stream miles upstream of the crossing location are limited, the quality of habitat that is available is good and ODFW must take this into account when making their decisions relative to Oregon's fish passage law. During this meeting, the City noted that out-of-basin flows need to be accounted for as there is potential for downstream impacts if flow control is removed.

Embankment Alternative

This evaluation considered constructing the roadway using embankment instead of a bridge. The embankment alternative was evaluated with roadway sections consistent with the 2019 Alternatives Study. The main roadway section is 77 feet wide; over Boeckman Creek, the roadway will narrow to a total width of 60 feet (see Appendix A for the proposed plan and profile).

To construct the embankment alternative, the existing culvert will be replaced with a new reinforced concrete box culvert that meets ODFW fish passage requirements. Due to the size of the culvert, open trench excavation will be used for installation, which requires approximately 21,000 cubic yards of excavation. Approximately 74,000 cubic yards of permanent embankment material is required to fill the culvert excavation and build up the roadway to final grade. In order to access the construction site for the box culvert, the contractor will require a temporary access road. The new culvert is expected to be constructed adjacent to the existing culvert and will not require temporary water management to construct.

Retaining walls were considered for this alternative but did not offer a significant advantage over the all-embankment option. The retaining walls did not significantly reduce the quantity of embankment enough to offset the cost of wall construction. The headwalls of the box culvert could be used to limit the length of fill within the creek, but there is no discernible advantage in doing so from a roadway or environmental perspective.

A new pedestrian tunnel is expected to be installed adjacent to the new culvert and is conceptually shown in Appendix A. The pedestrian tunnel is part of a future regional trail that runs approximately parallel to Boeckman Creek. A detailed evaluation of the new tunnel is not part of the scope of this memorandum. Design of the tunnel will need to consider safety, lighting, and overall user experience. Maintenance vehicles are expected to use the tunnel to access the existing sewer line and Boeckman creek south of the embankment, however a full analysis of maintenance vehicle access needs has not yet been completed. Planning-level costs for a new 12-foot by 12-foot by 180-foot long reinforced concrete culvert is included in the cost estimate for each embankment alternative. This is considered the absolute minimize size to address the pedestrian and maintenance needs. While it is lower cost than a larger tunnel, it will result in a greatly reduced user experience and limits maintenance use.

Survey data from 2014, supplemented with a LIDAR surface to capture the limits of the on-site detour alignment and embankment limits, serve as the basis for this evaluation. The accuracy of this data is sufficient for this feasibility analysis, but full ground survey would be required during final design. DOWL has reviewed the development plans for the Morgan Farms construction to determine probable impacts as part of this analysis. Like the 2019 Alternatives Study, the two alternatives considered consist of a north on-site detour and a full road closure.

Culvert Design

The existing culvert is a 302-foot-long, 60-inch-wide corrugated metal pipe (CMP). The culvert has a grated inlet structure that receives the upstream flow at an approximate 90-degree angle to the culvert barrel. The outlet of the culvert has a plain end that projects from the embankment fill, and the invert of the culvert is at-grade at both the upstream and downstream ends. The pipe exhibits signs of deterioration that are consistent with the age of the structure, including but not limited to corrosion, deformation, and joint imperfection. Preliminary hydraulic modeling of the

culvert confirms that the conditions within the culvert are expected to essentially prevent fish passage for the required range of flow rates.

Preliminary hydraulic modeling of a replacement culvert indicates that ODFW fish passage requirements are met using a 12-foot-wide by 7-foot-tall by 268-foot-long reinforced concrete box culvert using the stream simulation approach. The 12-foot span allows the active channel to be maintained through the structure. The culvert invert will be buried three feet below the channel bed; oversized rock and native bed material will be installed in the bottom of the culvert during construction to re-establish a bed slope consistent with the adjacent stream reaches. The clearance from the ACW elevation to the top of the culvert opening will be approximately four feet.

The length of the culvert was reduced by using 5-foot-tall headwalls installed above the crown of the culvert, as well as 45-degree wingwalls. Hydraulic modeling of the proposed culvert and bed treatment shows that the structure is capable of producing flow depths and velocities that are consistent with adjacent stream reaches for flows between the 5% and 95% exceedance flows for the months where fish passage is required (all months of the year except July through September). Detailed design of a low-flow channel in the bed material was not completed as a part of the analysis but is expected to be necessary to produce more favorable flow depths during low-flow conditions.

The 100-year storm event was also considered to evaluate the acceptability of the structure relative to City surface water standards. The proposed culvert has adequate capacity to convey the 100-year storm without flowing full, which is an increase in the conveyance capacity of the crossing. The increased capacity of the crossing and replacement culvert are expected to result in an increase in flow rates downstream as less runoff will be temporarily stored upstream of the road embankment. A detailed hydraulic analysis should be completed to evaluate potential increased flooding risk to downstream areas as well as to determine the potential for detrimental impacts to Boeckman Creek.

Wildlife passage improvements could be made at the crossing. The height of the replacement culvert could be increased to 10 feet to produce an opening height of seven feet or more; however, the length of the culvert and lack of ambient light may be enough of a deterrent to limit wildlife passage. Installation of a second tunnel crossing at a higher elevation would result in a shorter pipe with improved ambient lighting. The second tunnel would need to have an opening height of at least seven feet with the bottom of the culvert being flat. The cost estimate includes planning-level costs for providing a second tunnel for wildlife passage.

Embankment Alternative with Full Road Closure

Impacts

This option would require approximately 22,477 square feet of permanent ROW acquisition and 11,085 square feet of permanent slope easements. The City would like to protect the significant tree (large Oregon white oak) identified at 7550 SW Boeckman Road, which could potentially be accomplished by constructing a retaining wall. The logistics of the retaining wall were not evaluated as part of this analysis and are not expected to significantly affect the overall cost estimate, though it could be determined that saving the tree is not practical. That determination would likely be based on an arborist's evaluation using a more developed project design.

Constructability

The full-closure alternative's total construction duration is estimated to be 20 months. This alternative offers the shortest construction duration but requires the longest full road closure. This alternative also minimizes impacts to adjacent properties north of Boeckman Road when compared to the on-site detour alternative.

Temporary water management during a full road closure would be accomplished by leaving the existing culvert in place until the floor, walls, and bed material for the replacement culvert are installed. Once installed, the channel would be rerouted to the new culvert and the original culvert can be demolished; no temporary diversion of water is expected.

Embankment Alternative with On-site Detour

Impacts

In order to maintain traffic with an on-site detour, construction of the embankment alternative would have additional impacts to those described above. The on-site detour alternative includes a 2-lane, on-site detour parallel with the permanent alignment (see Appendix B for figures). The on-site detour would be constructed by widening the existing roadway 71 feet to the north. The temporary slope of the on-site detour does not extend beyond the final roadway embankment, and therefore, does not result in additional creek impacts. Retaining walls will be used at each end of the widening to minimize temporary impacts. However, because of the additional width required at each end of the project, this temporary widening requires an additional 23,200 square feet of construction easement as compared to the full-closure alternative. Additional tree impacts are also expected on the north side of the road as a result of the temporary widening.

The detour would use a design speed of 25 miles per hour (MPH) and consist of two 11-foot travel lanes shared with bicycles, and a 5-foot pedestrian path. The vertical alignment would follow the existing substandard roadway profile. Boeckman Road east of Canyon Creek Road is not a designated truck route; therefore, the temporary alignment is designed to accommodate a WB-40 truck.

Retaining Walls

This alternative includes two temporary retaining walls. Retaining Wall "A" is located along the west side cut slope at 7727 Boeckman Road. Retaining Wall "A" is 230 feet long, has a maximum height of 7.5 feet, and will require the removal of approximately six additional trees. Retaining Wall "B" is located along the east side cut slope at Morgan Farms. Retaining Wall "B" is 65 feet long, five feet tall, and will require the removal of approximately four additional trees.

Constructability

The total construction duration of the project with an on-site detour is estimated to be 33 months from the beginning of construction to substantial completion. Construction can be performed using

four stages. See Table 1 below. To provide an on-site detour, two temporary full closures of Boeckman Road would still be required. An 11-month closure will be required for Stage 2, and an additional 4-month closure is required to complete Stage 4.

The embankment used to construct the on-site detour can be used as part of the final roadway embankment material. All temporary slopes will be constructed at a 1.5H:1V slope. Complex traffic and temporary water management staging would be required to construct the culvert, embankment section, and detour. See Appendix B for conceptual staging figures.

Table 1 – On-site Detour Staging

Stage	Traffic	Construction	Temporary Water Management
1	Existing Boeckman Road	<ul style="list-style-type: none"> Construct culvert north of Boeckman Road Begin on-site detour construction 	<ul style="list-style-type: none"> Utilize existing culvert
2	Temporary closure	<ul style="list-style-type: none"> Complete on-site detour and connect to Boeckman Road Construct culvert portion directly under the existing roadway 	<ul style="list-style-type: none"> Utilize temporary culvert inside the new culvert segment that connects to the remaining portion of the existing culvert
3	On-site detour	<ul style="list-style-type: none"> Construct south portion of culvert Construct south side of Boeckman Road within the dip 	<ul style="list-style-type: none"> Transition flow to new culvert after completion
4	Temporary closure	<ul style="list-style-type: none"> Remove on-site detour Construct Boeckman Road east and west of the dip Construct remaining north side embankment and road within the dip 	<ul style="list-style-type: none"> Utilize new culvert

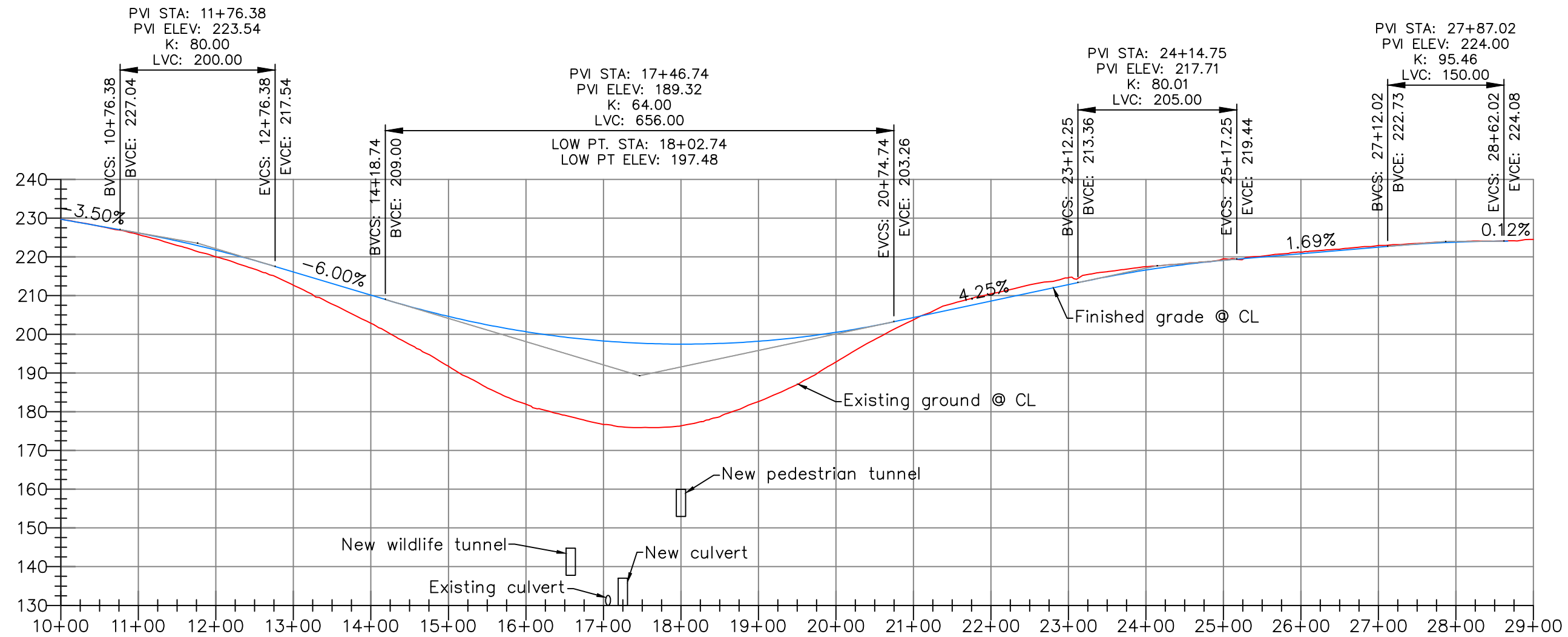
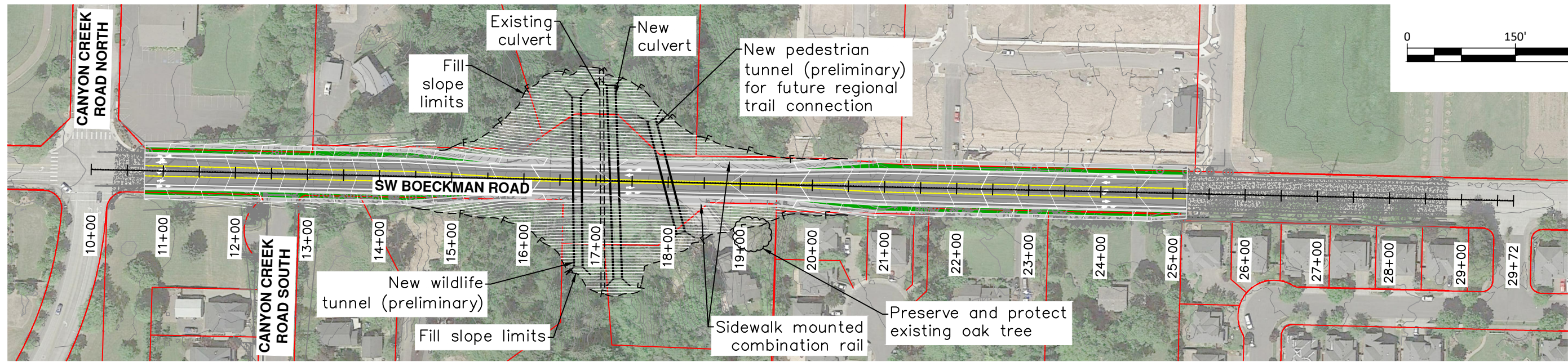
Cost Estimate

The following table summarizes the estimated project cost of each embankment alternative, which includes culvert replacement based on the initial feedback from ODFW. The costs shown are based on a preliminary-level design and are intended for comparison purposes only. The total cost is reflected in 2021 dollars and includes preliminary engineering, construction engineering, ROW, construction survey work, and a 40% contingency to reflect the current level of design. The cost estimate does not include any costs for mitigating potential downstream impacts of removing the existing flow control structure.

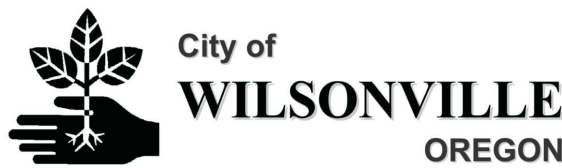
Table 2 – Embankment Alternative Cost Estimate

	Full Road Closure	On-site Detour
Total Cost (2021)	\$15,600,00	\$17,400,000

Appendix A: Plan and Profile

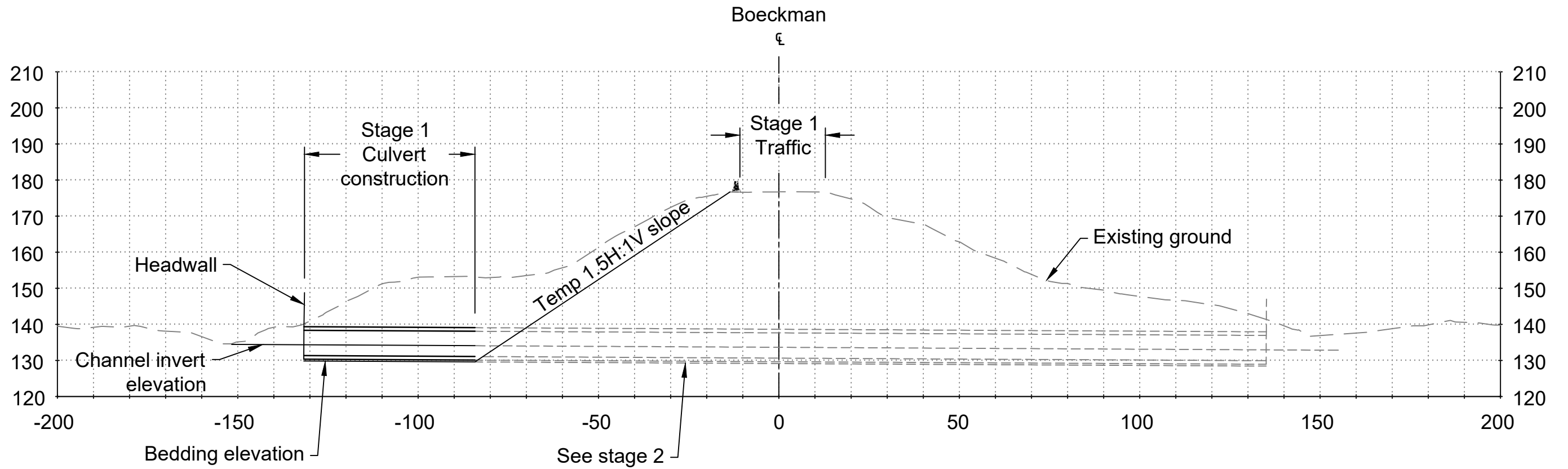


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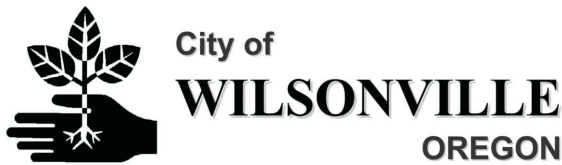
BOECKMAN CREEK EMBANKMENT	
SW BOECKMAN ROAD CITY OF WILSONVILLE	
PLAN AND PROFILE	A1

Appendix B: On-site Detour Figures

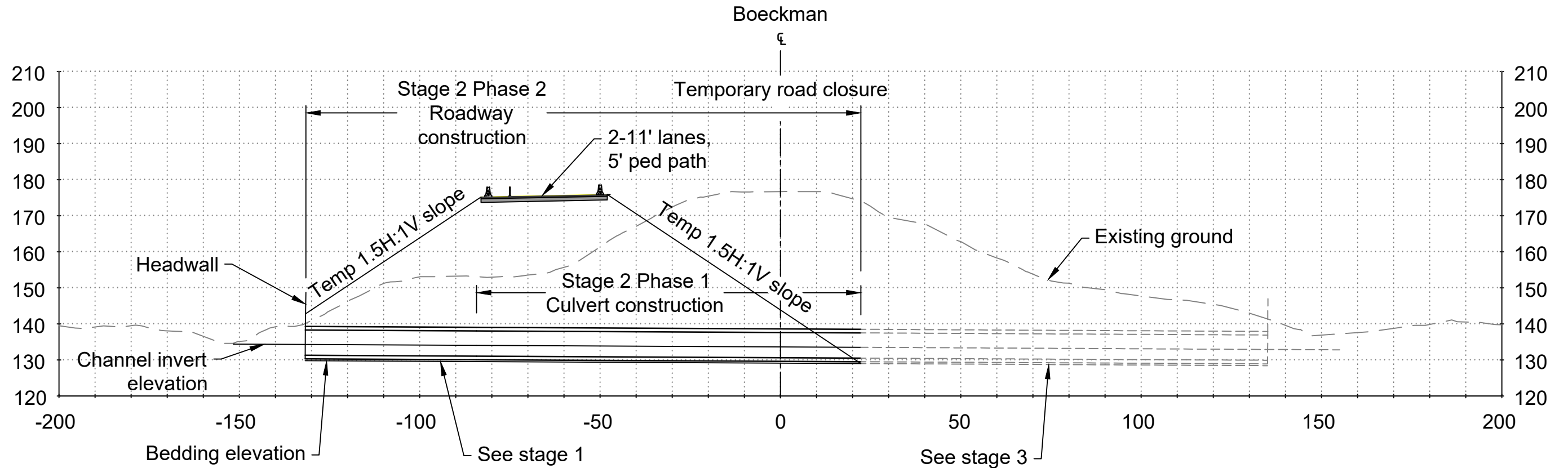


Note: Wildlife and pedestrian tunnels not shown at culvert section.

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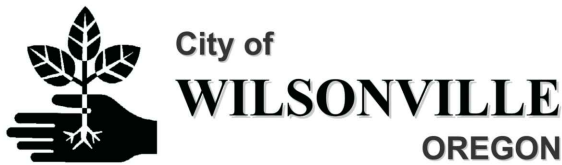


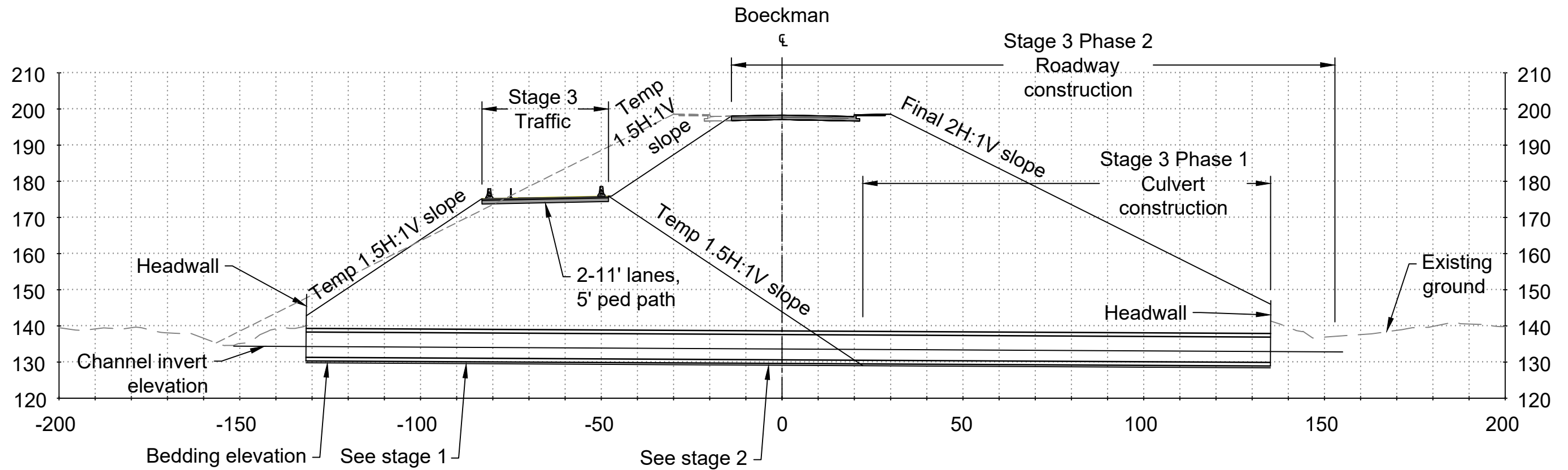
BOECKMAN CREEK EMBANKMENT SW BOECKMAN ROAD CITY OF WILSONVILLE	
ON-SITE DETOUR - STAGE 1	B1



Note: Wildlife and pedestrian tunnels not shown at culvert section.

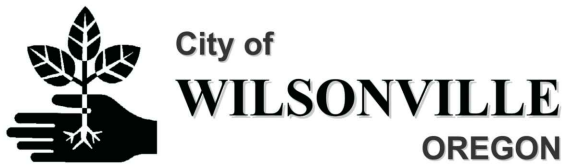
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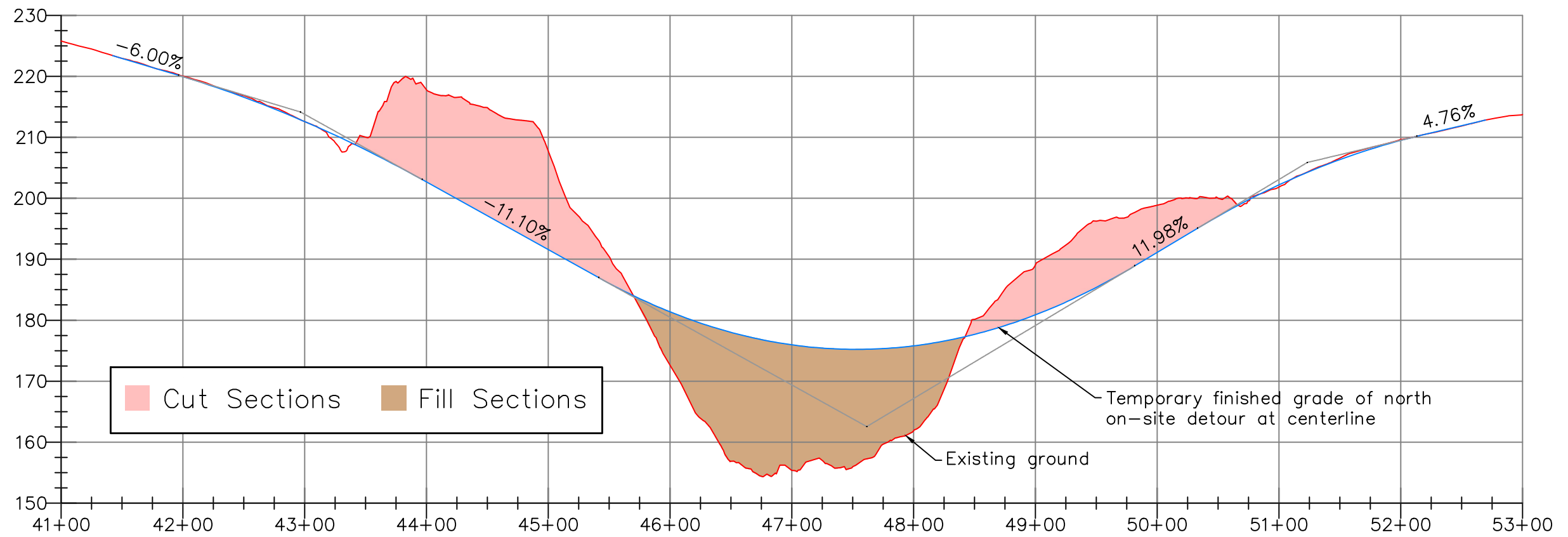
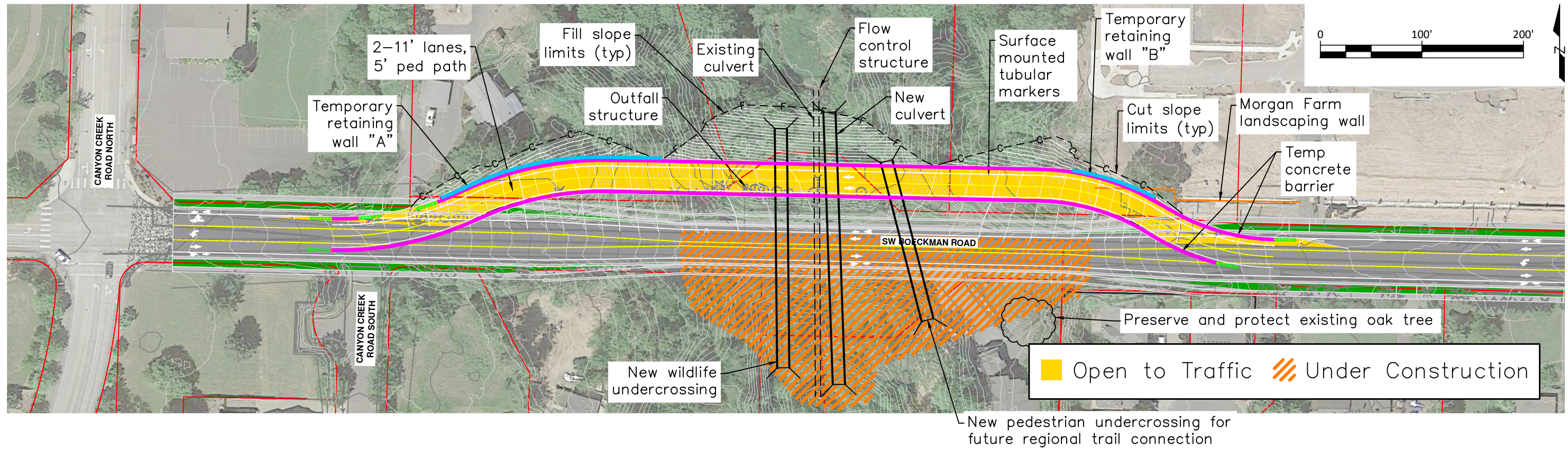


Note: Wildlife and pedestrian tunnels not shown at culvert section.

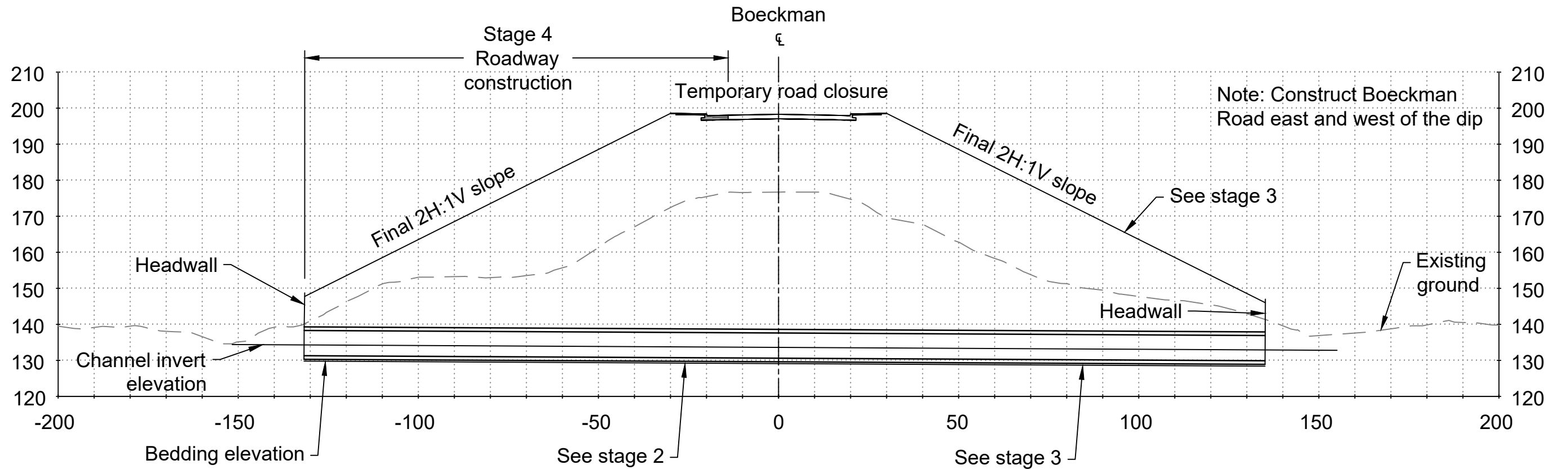
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BOECKMAN CREEK EMBANKMENT SW BOECKMAN ROAD CITY OF WILSONVILLE	
ON-SITE DETOUR - STAGE 3	B3

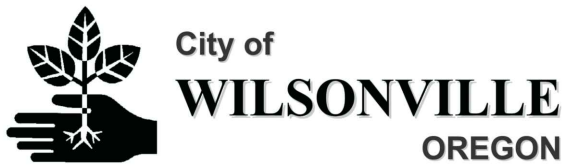


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Note: Wildlife and pedestrian tunnels not shown at culvert section.

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BOECKMAN CREEK EMBANKMENT

SW BOECKMAN ROAD
CITY OF WILSONVILLE

ON-SITE DETOUR - STAGE 4

B5

Appendix C: Cost Estimates

PRELIMINARY - COST ESTIMATE					
City of Wilsonville					
SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Embankment Closure				Clackamas	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Grading, Structures, Paving, Signing, Illumination	0.31	1/14/21	DOWL	
ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	\$0	\$713,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	\$50,000	\$50,000
0225	TEMPORARY SIGNAL	LS	1	\$200,000	\$200,000
0231-0100000A	CONSTRUCT AND REMOVE TEMPORARY ACCESS ROAD	LS	1	\$95,000	\$95,000
0280.0100000A	EROSION CONTROL	LS	1	3%	\$226,700
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	2%	\$148,100
0320.0100000A	CLEARING AND GRUBBING	AC	5	\$25,000	\$125,000
0330.0105000K	GENERAL EXCAVATION	CUYD	21,145	\$30	\$634,350
0330.0123000K	EMBANKMENT IN PLACE	CUYD	74,141	\$35	\$2,594,935
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	\$2.00	\$16,076
0640.0100000M	AGGREGATE BASE	CUYD	1,538	\$45	\$69,210
0744	ACP MIXTURE, 2 INCH THICK	TON	783	\$100	\$78,300
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	\$95	\$659,965
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	\$40	\$108,640
0759.0128000J	CONCRETE WALKS 4"	SQFT	7,870	\$8.00	\$62,960
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	\$12.00	\$16,920
0400's	STORM SEWER AND DRAINAGE	LS	1	\$110,000	\$110,000
0595-0100200F	PRECAST REINFORCED CONCRETE BOX CULVERTS*	FT	268	\$2,000	\$536,000
	WILDLIFE CROSSING BOX CULVERT**	FT	240	\$2,200	\$528,000
	PEDESTRIAN CROSSING BOX CULVERT**	FT	180	\$2,500	\$450,000
0470-0101000E	CONCRETE HEADWALL	SF	648	\$150	\$97,200
0390-0105000K	LOOSE RIPRAP, CLASS 200	CUYD	280	\$80	\$22,400
	WATERWAY ENHANCEMENT	CUYD	140	\$20	\$2,800
1012.0000000R	WATER QUALITY SWALE	EACH	2	\$30,000	\$60,000
STRUCTURES					
0587	TRAFFIC BARRIER AND MOMENT SLAB	FT	1,280	\$500	\$640,000
SIGNING, STRIPING & ILLUMINATION					
00800's	STRIPING	LS	1	\$18,000	\$18,000
00900's	SIGNING	LS	1	\$11,000	\$11,000
00900's	ILLUMINATION	LS	1	\$365,000	\$365,000
RIGHT OF WAY DEVELOPMENT AND CONTROL					
01000's	STREAM AND HABITAT RESTORATION	LS	1	\$120,000	\$120,000
SUBTOTAL, Construction Items					
	PRELIMINARY ENGINEERING			15%	\$1,314,000
	PERMANENT RIGHT-OF-WAY AND EASEMENTS	SQFT	22,477	\$17.5	\$394,000
	PERMANENT EASEMENTS	SQFT	11,085	\$12.0	\$134,000
	CONSTRUCTION ENGINEERING			12%	\$1,051,000
	CONSTRUCTION SURVEY WORK			3%	\$224,000
	ART AND AESTHETIC ALLOWANCE			2%	\$175,200
	CONTINGENCY			40%	\$3,504,000
PROJECT COST IN 2021 DOLLARS					\$15,600,000

*In-culvert improvements are included in other line items, namely 'Loose Riprap , Class 200' and 'Waterway Enhancement'

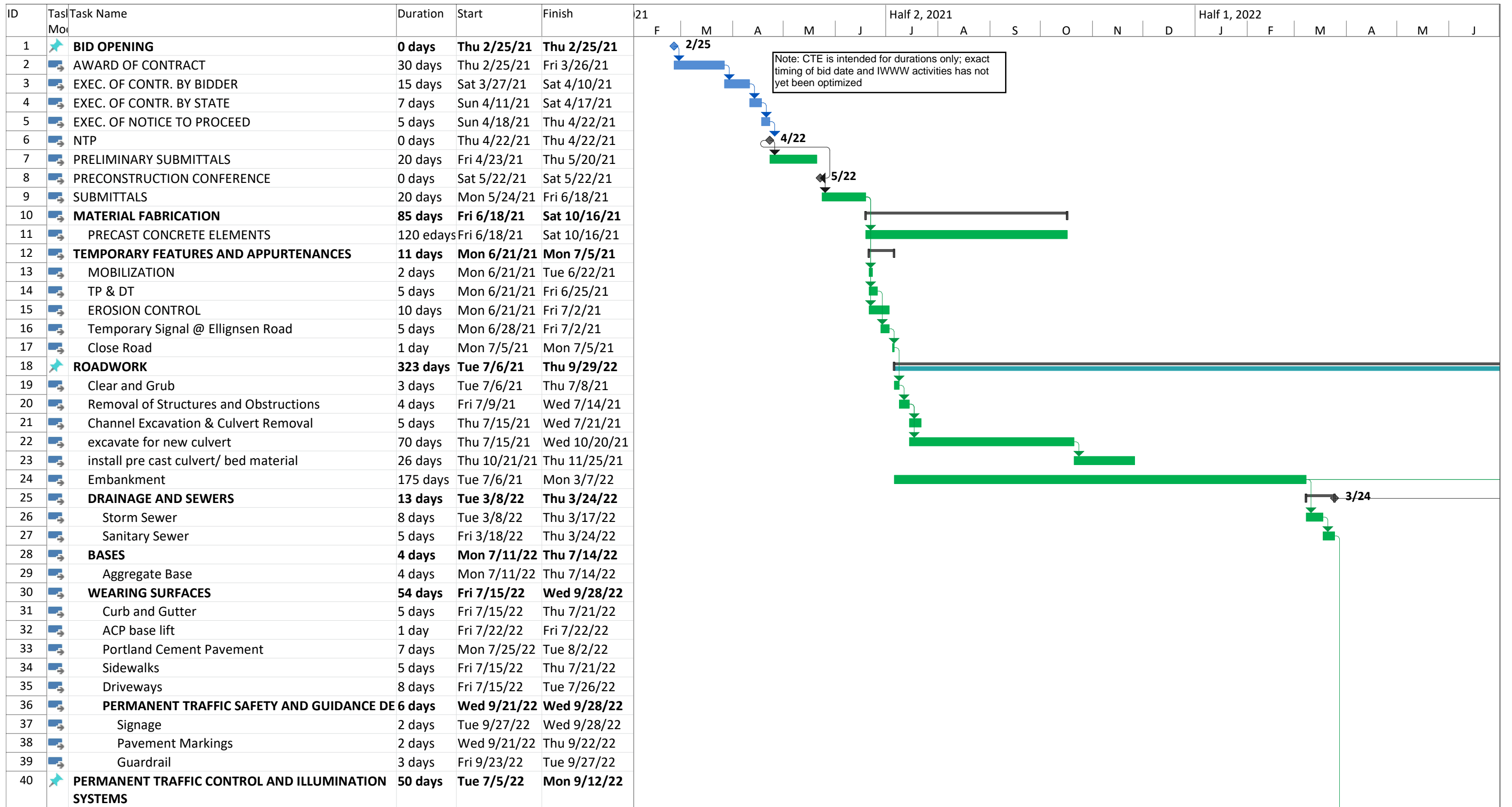
**wildlife and pedestrian culvert costs include headwalls and other all other anticipated functional improvements

PRELIMINARY - COST ESTIMATE					
City of Wilsonville					
SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Embankment On-site Detour				Clackamas	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Grading, Structures, Paving, Signing, Illumination	0.31	1/14/21	DOWL	
ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.010000A	MOBILIZATION	LS	All	\$0	\$768,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	3%	\$260,000
0225.0126000F	TEMPORARY CONCRETE BARRIER, REFLECTORIZED	FT	1,760	\$18	\$31,680
0225.0134000E	TEMPORARY IMPACT ATTENUATOR, NARROW SITE SYSTEM	EACH	6	\$3,000	\$18,000
0225	TEMPORARY SIGNAL	LS	1	\$200,000	\$200,000
0230.0100000A	CONSTRUCT AND REMOVE DETOURS	LS	1	\$378,000	\$378,000
0231-0100000A	CONSTRUCT AND REMOVE TEMPORARY ACCESS ROAD	LS	1	\$95,000	\$95,000
0256.0109100A	TEMPORARY RETAINING WALL 'A', PREFABRICATED MODULAR GRAVITY	SQ FT	1,400	\$85	\$119,000
0256.0109100A	TEMPORARY RETAINING WALL 'B', PREFABRICATED MODULAR GRAVITY	SQ FT	325	\$85	\$27,625
0280.0100000A	EROSION CONTROL	LS	1	3%	\$248,000
0245	TEMPORARY WATER MANAGEMENT	LS	1	\$20,000	\$20,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	2%	\$162,000
0320.0100000A	CLEARING AND GRUBBING	AC	6	\$25,000	\$150,000
0330.0105000K	GENERAL EXCAVATION	CUYD	21,145	\$30	\$634,350
0330.0123000K	EMBANKMENT IN PLACE	CUYD	74,141	\$35	\$2,594,935
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	\$2.00	\$16,076
0640.0100000M	AGGREGATE BASE	CUYD	1,538	\$45	\$69,210
0744	ACP MIXTURE, 2 INCH THICK	TON	783	\$100	\$78,300
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	\$95	\$659,965
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	\$40	\$108,640
0759.0128000J	CONCRETE WALKS 4"	SQFT	7,870	\$8.00	\$62,960
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	\$12.00	\$16,920
0400's	STORM SEWER AND DRAINAGE	LS	1	\$110,000	\$110,000
0595-0100200F	PRECAST REINFORCED CONCRETE BOX CULVERTS*	FT	268	\$2,000	\$536,000
	WILDLIFE CROSSING BOX CULVERT**	FT	240	\$2,200	\$528,000
	PEDESTRIAN CROSSING BOX CULVERT**	FT	180	\$2,500	\$450,000
0470-0101000E	CONCRETE HEADWALL	SF	576	\$150	\$86,400
0390-0105000K	LOOSE RIPRAP, CLASS 200	CUYD	280	\$80	\$22,400
	WATERWAY ENHANCEMENT	CUYD	140	\$20	\$2,800
1012.0000000R	WATER QUALITY SWALE	EACH	2	\$30,000	\$60,000
1040	LANDSCAPE WALL	FT	115	\$105	\$12,075
STRUCTURES					
0587	TRAFFIC BARRIER AND MOMENT SLAB	FT	1,280	\$500	\$640,000
SIGNING, STRIPING & ILLUMINATION					
00800's	STRIPING	LS	1	\$18,000	\$18,000
00900's	SIGNING	LS	1	\$11,000	\$11,000
00900's	ILLUMINATION	LS	1	\$365,000	\$365,000
RIGHT OF WAY DEVELOPMENT AND CONTROL					
01000's	STREAM AND HABITAT RESTORATION	LS	1	\$120,000	\$120,000
SUBTOTAL, Construction Items					
	PRELIMINARY ENGINEERING			15%	\$1,452,000
	PERMANENT RIGHT-OF-WAY	SQFT	22,477	\$17.5	\$394,000
	PERMANENT EASEMENTS	SQFT	11,085	\$12.0	\$134,000
	TEMPORARY RIGHT-OF-WAY	SQFT	23,217	\$9.0	\$209,000
	CONSTRUCTION ENGINEERING			12%	\$1,162,000
	CONSTRUCTION SURVEY WORK			3%	\$225,000
	ART AND AESTHETIC ALLOWANCE			2%	\$193,600
	CONTINGENCY			40%	\$3,872,000
PROJECT COST IN 2021 DOLLARS					\$17,400,000

*In-culvert improvements are included in other line items, namely 'Loose Riprap , Class 200' and 'Waterway Enhancement'

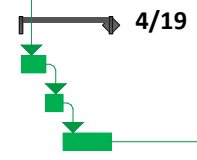
**wildlife and pedestrian culvert costs include headwalls and other all other anticipated functional improvements

Appendix D: Construction Time Estimates



Project: Boeckman Dip Option D Rev1: Full Closure Date: Wed 10/28/20	Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
	Split		External Tasks		Inactive Summary		Manual Summary		Progress	
	Milestone		External Milestone		Manual Task		Start-only		Manual Progress	
	Summary		Inactive Task		Duration-only		Finish-only			

ID	Task Name	Duration	Start	Finish	21																	
					Half 2, 2021					Half 1, 2022												
Mo					F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
41	Signal Modifications	2 days	Tue 7/5/22	Wed 7/6/22																		
42	Illumination	24 days	Tue 7/5/22	Fri 8/5/22																		
43	Switching conduit and wire	4 days	Tue 7/5/22	Fri 7/8/22																		
44	Pole foundations	3 days	Mon 7/11/22	Wed 7/13/22																		
45	Poles, lamps and ballasts	3 days	Wed 8/3/22	Fri 8/5/22																		
46	RIGHT OF WAY DEVELOPMENT AND CONTROL	67 days	Wed 9/21/22	Thu 12/22/22																		
47	Water Quality Facilities	5 days	Wed 9/21/22	Tue 9/27/22																		
48	Landscaping	5 days	Wed 9/21/22	Tue 9/27/22																		
49	Misc (monuments, mail boxes, etc.)	5 days	Wed 9/21/22	Tue 9/27/22																		
50	WATER SUPPLY SYSTEMS	18 days	Fri 3/25/22	Tue 4/19/22																		
51	Piping	5 days	Fri 3/25/22	Thu 3/31/22																		
52	Appurtenances	3 days	Fri 4/1/22	Tue 4/5/22																		
53	Testing	10 days	Wed 4/6/22	Tue 4/19/22																		
54	FLOAT	60 edays	Thu 12/22/22	Mon 2/20/23																		
55	PUNCHLIST	5 days	Tue 2/21/23	Mon 2/27/23																		
56	SUBSTANTIAL COMPLETION	0 days	Mon 2/27/23	Mon 2/27/23																		
57	PLANT ESTABLISHMENT	365 edays	Tue 9/27/22	Wed 9/27/23																		
58	FINAL COMPLETION	0 days	Wed 9/27/23	Wed 9/27/23																		



Project: Boeckman Dip Option D Rev1: Full Closure Date: Wed 10/28/20	Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
	Split		External Tasks		Inactive Summary		Manual Summary		Progress	
	Milestone		External Milestone		Manual Task		Start-only		Manual Progress	
	Summary		Inactive Task		Duration-only		Finish-only			

