US 97 and US 20 Bend North Corridor Project, Deschutes County, Oregon

Noise Technical Report Addendum

ODOT Key 21229

Final

December 2022

Oregon Department of Transportation

US 97 and US 20 Bend North Corridor Project, Deschutes County, Oregon

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Executive Summary

The purpose of this analysis is to update the 2014 Final Environmental Impact Statement (FEIS) noise analysis to evaluate the potential changes in predicted noise levels given the refinement in the alignment studied in 2014. This addendum to the FEIS noise analysis is based on the US 97 and US 20 Bend North Corridor Project (project), which extends from Empire Avenue to 0.5 mile north of Cooley Road.

From a noise perspective, the primary difference between the 2014 FEIS roadway alignment and the project is that US 97 was widened and has shifted approximately 900 feet closer to the residences east of the railroad. Additionally, at the northern end of the project, the new northbound (NB) Cooley Ramp brings the ramp closer to receivers in the project than in the 2014 FEIS roadway alignment. This project does not extend into the Hilltop and Juniper mobile home parks identified in the 2014 FEIS. The changes in the project design did not alter the conclusions of the 2014 FEIS noise analysis and no abatement was found to be both feasible and reasonable.

Noise Impacts and Abatement Considerations

This report identifies potential noise impacts and the acoustic feasibility and reasonableness of abatement measures according to the Oregon Department of Transportation (ODOT) *Noise Manual* (2011), and the *ODOT Noise Manual Interim Updates* (2020 and 2021), and *Code of Federal Regulations* Title 23, Part 772, which describes U.S. Federal Highway Administration procedures for the abatement of highway traffic noise and construction noise (2010).

The peak hour and peak-truck hour were both modeled and compared to determine the hour with the highest predicted noise levels for use in the noise study. The peak hour resulted in higher sound levels at front row receivers for this project and was used in this analysis.

The traffic noise levels modeled for the Existing Condition Noise Levels (2022) throughout the project area ranged from 52 to 73 A-weighted decibels (dBA) equivalent noise level (L_{eq}), and 37 sensitive land uses meet or exceed the ODOT Noise Abatement Approach Criteria (NAAC) threshold. The No Action Future Noise Levels (2040) ranged from 53 to 74 dBA, and 44 sensitive land uses meet or exceed the Oregon NAAC threshold. The project Future Noise Levels (2040) ranged from 54 to 74 dBA, and 66 sensitive land uses meet or exceed the Oregon NAAC threshold. The highest sound level of 74 dBA is predicted at the new receivers, which were permitted after the date of public knowledge (December 3, 2020).

Abatement, in the form of a noise barrier, was evaluated for areas that exceed the NAAC and are summarized as follows:

- Barrier 1: R2144, R2145, R2149 – Residences located east of US 97 and the railroad, on Jimbo Lane. R2151, R50, R54, R57, R3000-R3014, R3027 – Residences located east of US 97 and the BNSF Railway, on Vogt Road.
- Barrier 2: R4001, R4002, R111, R4014, R4015 – Located in the neighborhood east of US 97 and the BNSF Railway, south of Cooley Road. R114, R4017, R123, R4018, R4019, R4020, R4031, R4033, R4037, R131, R4022, R134, R4025, R4030, R4046, R4047, R4048, R143, R4049, R4050 – Located in the neighborhood east of US 97 and the BNSF Railway, north of Cooley Road.
- Barrier 3: R117 – Undeveloped land zoned as residential northwest of the proposed roundabout at US 20 and Cooley Road.

- Barrier 4: R2000-R2008, R2014-R2018, R2020-R2024 – These represent a total of 19 front-row, second-story residences, north of Empire Avenue, east of US 97. Noise levels in this area reach 74 dBA and are the highest throughout the project. Both first- and second-story residences were modeled , but because both points are within one unit, the worst case scenario was used. In this model, it was the second-story residences, and therefore, second-story levels are reported in this analysis.

Barriers 1 through 3 analyzed in this addendum were analyzed in the 2014 FEIS. The 2014 FEIS concluded that no barriers satisfied both the feasible nor reasonable criteria. Consistent with the prior analysis, no barrier was found to be feasible and reasonable in this updated analysis, thus unavoidable impacts continue to be predicted at the above locations. Barrier 4 is a newly analyzed barrier, because these receivers were constructed after the 2014 FEIS was completed.

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Acronyms and Abbreviations

API	area of potential impacts
CFR	*Code of Federal Regulations*
dB	decibel(s)
dBA	A-weighted decibel(s)
FEIS	Final Environmental Impact Statement
FHWA	U.S. Federal Highway Administration
L_{eq}	equivalent noise level
MP	milepost
NAAC	Noise Abatement Approach Criteria
NAC	Noise Abatement Criteria
NB	northbound
NTR	Noise Technical Report
ODOT	Oregon Department of Transportation
SB	southbound
TNM	traffic noise model
WB	westbound

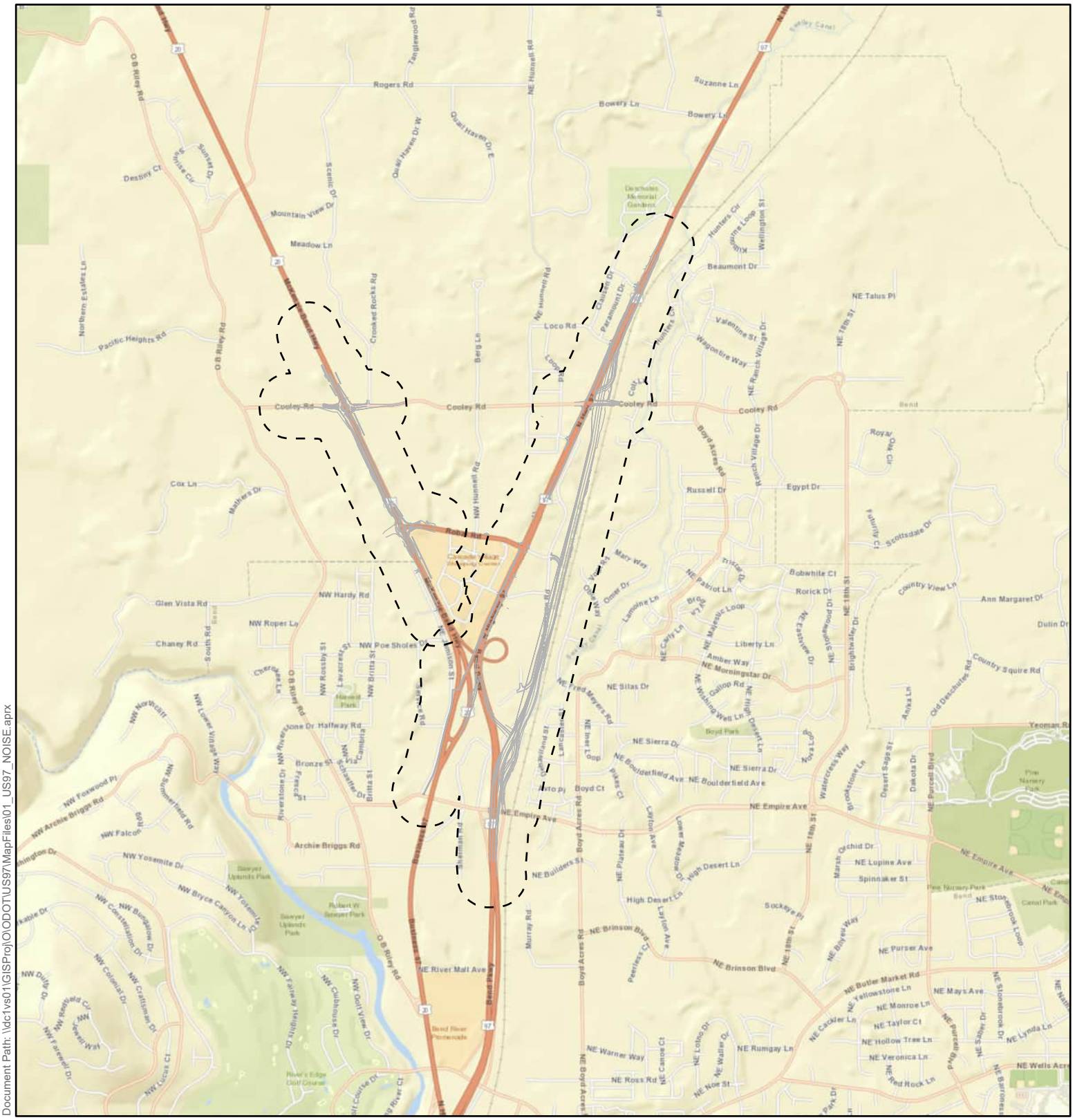
1. Introduction

This addendum to the Noise Technical Report (NTR) from the 2014 US 97 Bend North Corridor Project Final Environmental Impact Statement (FEIS) and Final Section 4(f) Evaluation (2014 FEIS) updates the prior traffic noise analysis for the noise-sensitive receptors adjacent to the proposed improvements for the US 97 and US 20 Bend North Corridor Design-Build Project (project). This addendum analyzes the noise levels with the geometry change resulting from the project. The project is defined as Type 1 by *Code of Federal Regulations* (CFR) Title 23, Part 772 (23 CFR 772) and a detailed traffic noise analysis is required because of the widening of the highway and ramps, new local arterial, and new roadway and ramps. This report was done in accordance with the Oregon Department of Transportation (ODOT) *Noise Manual* (2011), and the *ODOT Noise Manual Interim Update* (2020 and 2021a), and includes a description of the project area, noise fundamentals and standards, methods used for conducting the traffic noise analysis, traffic data used to assess potential impacts, a summary of existing and future traffic noise impacts, traffic noise abatement measures, mitigation analysis, and construction noise. This report follows the ODOT formal quality control process. Appendix A contains the process checklist.

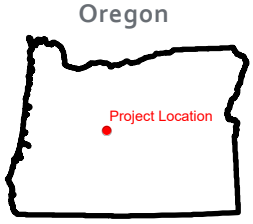
ODOT issued a notice-to-proceed in late June 2022 to Kiewit Corporation for a design-build contract for the project. The project is located on US 97 and US 20 in Deschutes County, Oregon and includes significant improvements to two major highway corridors in Central Oregon (US 97 and US 20) (Figure 1-1). The project includes the design and construction of the following transportation improvements:

- US 97 realignment east of its current location from Empire Avenue (Milepost [MP] 135.5) to north of Cooley Road (Clausen Drive, MP 133.9) including grade separated roadways at Cooley Road and required US 97 ramp connections including:
  - Northbound (NB) US 97 exit ramp to existing NB US 97 (MP 135.5), grade separated, with a connection to the existing westbound (WB) US 20 loop ramp
  - WB US 20 exit ramp to existing NB US 97
  - On-ramp to southbound (SB) US 97 from the existing Robal Lane connecting existing US 97 to the realigned US 97
  - On-ramp to NB US 97 from the existing US 97 and Cooley Road intersection (MP 134.1), grade separated
  - SB US 97 off-ramp to existing US 97 and Cooley Road intersection (MP 134.1), with right-in/right-out connections to the existing Clausen Road (MP 133.9) and Grandview Drive (MP 133.7) roadways
- Existing US 97 (future US 97 Business) update from MP 135 to northern project limits to meet Americans with Disabilities Act standards, pavement preservation, signal upgrades, and corresponding corridor improvements
- Low-stress (LTS 1 or 2) shared-use-path from Empire Avenue to the northern project limits
- Bridge overlay on the existing WB US 20 over existing SB US 97 connection to US 20 (Sisters Interchange) – Bridge No. 08829
- Intelligent Transportation System (ITS) upgrades throughout the project area
- A new transit stop along Robal Lane
- New emergency vehicle access on US 20 (MP 18.1) with an emergency flasher
- Quiet crossing of BNSF Railway at the existing Cooley Road at-grade crossing, MP 134.1
- Roadway improvements along US 20 from MP 17.3 to MP 18.3 including roundabouts at Robal Lane and Cooley Road

This area was previously analyzed in the 2014 EIS (ODOT 2014). This analysis amends the prior NTR to evaluate the changes in the design that have occurred since the 2014 FEIS.



Locator Map



Legend

- Project Linework
- Area of Potential Impact (API)

0 0.1 0.2 0.3 0.4 0.5 Miles

Figure 1-1
Project Area of Potential Impact

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

2. Land Use

2.1 Existing Land Use

Land use in the area of potential impacts (API) consisting of single-family residences, commercial, industrial, and undeveloped land is generally consistent with the NTR for the 2014 FEIS. Activity Category B (residential), Activity Category C (place of worship, hotels, commercial, and medical facility), Activity Category E (public land), Activity Category G (undeveloped land) are included in the project area. The eastern limit of the project area, east of the BNSF railroad tracks between Empire Avenue and Cooley Road, is primarily residential. This residential area is zoned as Special Planned District. The land use around the improvements at Cooley Road and US 20 consist of churches and undeveloped lands. The land use around Empire Avenue and US 97 consists of commercial, undeveloped, residential, and a park. The land use around US 97 and Robal Lane is residential, commercial, and undeveloped. Figure 2-1 shows the existing land uses.

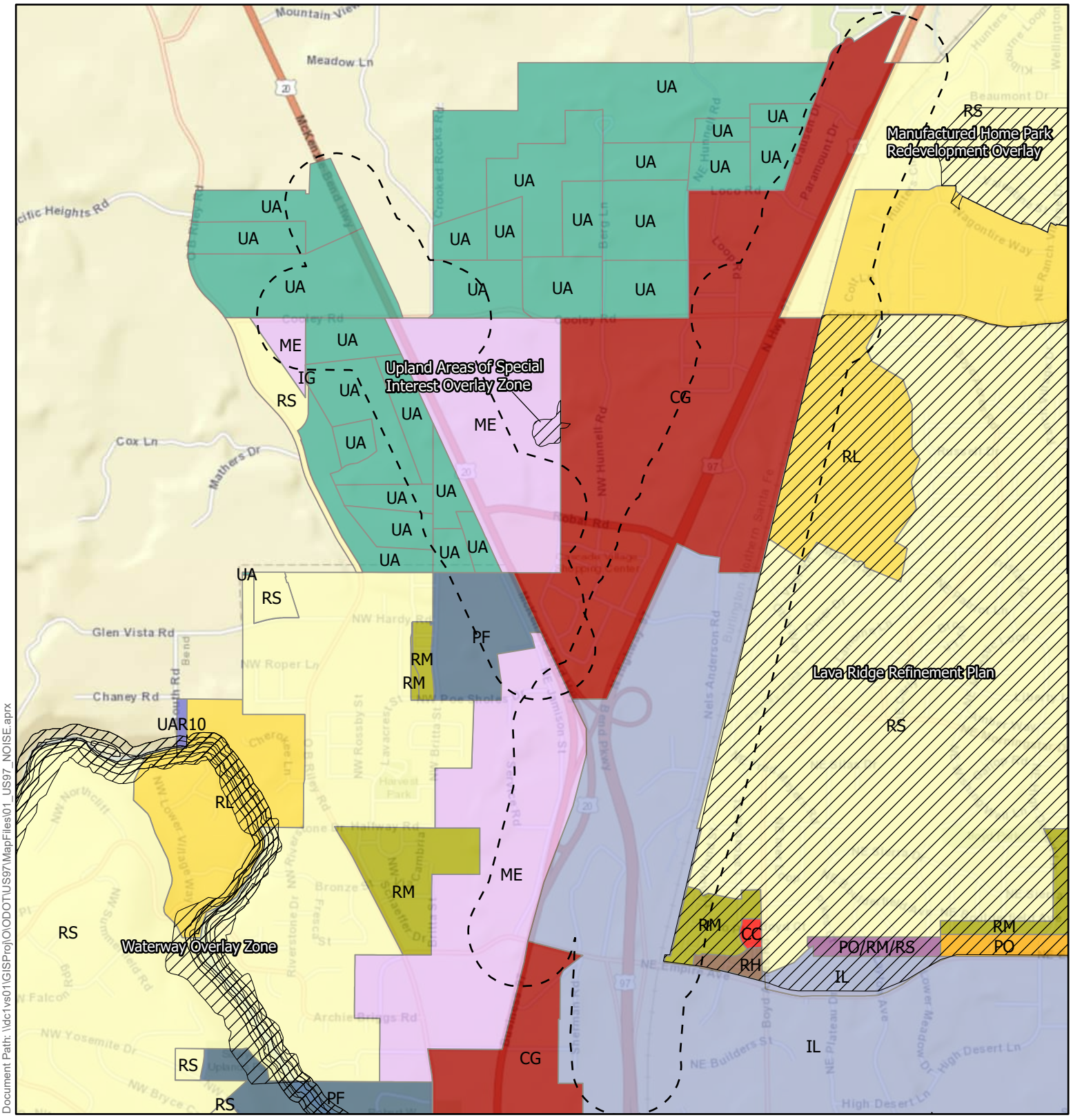
2.2 Land Use Before the Date of Public Knowledge

Undeveloped parcels throughout the API were examined for permitted future land uses before the date of public knowledge (December 3, 2020). It was determined that there are no permitted noise-sensitive land uses that would need to be considered as part of this updated analysis.

2.3 Land Use After the Date of Public Knowledge

A review of land use records was conducted to identify potential noise-sensitive land use changes since the date of public knowledge (December 3, 2020). Land use was examined throughout the project area to identify potential additional noise-sensitive land uses within the API. These findings were:

- The previously undeveloped land northeast of US 97 and Empire Avenue was developed with 111 new residences within the API. Construction was completed on the front row residences as recently as September 2022 (City of Bend 2022).
- The Bethlehem Inn northwest of US 97 and Robal Lane was converted to commercial use and is no longer a hotel. There was no permitted land uses that would be noise sensitive.
- A residential area is planned southeast of US 20 and Cooley Road. However, nothing has been permitted for the area.
- The Impact Faith Church, at the northern limit of the project, has moved out of the API.



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Legend

- Area of Potential Impact (API)

Zoning

- CC - Commercial Convenience
- CG - Commerical General
- IG - Industrial General
- IL - Industrial Light
- ME - Mixed Employment
- PF - Public Facilities
- PO - Professional Office
- PO/RM/RS
- RH - Residential Urban High Density
- RL - Residential Urban Low Density
- RM- Residential Urban Medium Density
- RS - Residential Urban Standard Density
- UA - Urbanizable Area
- UAR10
- Special Planned Districts

0 0.1 0.2 0.3 0.4 Miles

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Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

Figure 2-1
Existing Land Uses in the Study Area

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

3. Methodology

3.1 Area of Potential Effect

In accordance with the ODOT *Noise Manual*, the API was determined by examining the updated project area for potential impacts from the project (ODOT 2011). This project API is smaller than the API in the NTR from the 2014 FEIS. Figure 3-1 depicts the location of each receiver used in this study on aerial photos. While all noise-sensitive land uses adjacent to the project were included in the API, additional areas beyond the first-row receivers were also evaluated for inclusion in the API. This additional evaluation is consistent with the ODOT *Noise Manual*, which requires that the API include all areas where an impact may occur and not be simply confined to areas adjacent to the project components that meet the definition of a Type I project (ODOT 2011). Thus, part of the API determination process included analyzing receivers that would be affected by the project, and finding the limit where receivers are no longer affected by the project. This was accomplished in part by comparing the project and No Action levels. If it was found that there would not be an increase from the No Action to the project, it was concluded that the project does not have an impact on a receptor, and that area is not included in the API. The API extended approximately 500 feet beyond the construction limits to facilitate the analysis of all receptors that could be potentially impacted by the project. This analysis is focused on noise Activity Category B (residences) and Activity Category C (hotels). Residences east of the railroad tracks were modeled from Cooley Road south to Empire Avenue.

3.2 Regulatory Setting

3.2.1 Federal Regulations

The criteria for evaluating noise impacts used in this report are contained in 23 CFR Part 772 – *Procedures for Abatement of Highway Traffic Noise and Construction Noise* (FHWA 2010).

- Activity Category A includes lands where serenity and quiet are of extraordinary importance and preserving these qualities is essential to continue their intended purpose. These land uses are not commonly found, but if they are, they have an hourly sound level criterion that approaches or exceeds 57 decibels (dB) on an A-weighted scale (dBA) equivalent sound level (L_{eq}).
- Activity Category B applies to exterior impact criteria for single- and multifamily residences and is an hourly sound level criterion that approaches or exceeds 67 dBA L_{eq}.
- Activity Category C includes the exterior areas of a variety of nonresidential land uses that include schools, parks, and cemeteries, for which an hourly sound level criterion approaches or exceeds 67 dBA L_{eq}.
- Activity Category D includes interior land such as medical facilities, places of worship, and public meeting rooms (uses that do not have an outdoor frequent human use and where it is important for noise levels at the interior of the building to not be affected by outside noise) for which an hourly sound level criterion that approaches or exceeds 52 dBA L_{eq} has been established.
- Activity Category E includes other developed lands, such as commercial (for example, hotels/motels or other business areas), for which an hourly sound level criterion that approaches or exceeds 72 dBA L_{eq} has been established.
- There are no criteria levels for undeveloped lands that do not fall within the land uses of Categories A to F and are not yet permitted (Category G) nor agricultural, retail, or industrial land uses (Category F).

In addition to the Noise Abatement Criteria (NAC), the U.S. Federal Highway Administration (FHWA) also considers a traffic noise impact to occur if predicted sound levels result in a substantial increase above existing noise levels. FHWA guidance does not specifically define what constitutes a substantial increase, but instead gives state highway agencies flexibility in establishing their own definitions. The ODOT definition of a substantial increase is discussed in the following subsections.

3.2.2 State Regulations

The ODOT 2011 *Noise Manual* as well as 2020 and 2021 interim updates to the manual provide guidance to ensure that traffic noise studies and reports are consistent with applicable laws and regulations. Table 3-1 shows the ODOT noise-sensitive land use categories, FHWA NAC, ODOT Noise Abatement Approach Criteria (NAAC), and a description of the land use categories. FHWA and ODOT consider a traffic noise impact to occur if predicted peak hour traffic noise levels for the project approach or exceed the ODOT NAAC. ODOT defines "approach" as noise levels 2 dBA below the FHWA NAC (for example, the ODOT NAAC is 65 dBA for Activity Category B).

In addition to the criterion sound levels described in Table 3-1, FHWA and ODOT consider a traffic noise impact to occur if predicted sound levels are *substantially higher* than existing noise levels. While FHWA guidance does not specifically define substantially higher, FHWA provides state highway agencies the flexibility to establish their own definitions. The ODOT policy states that a predicted traffic noise level of 10 dBA or more over existing noise levels constitute a *substantial* increase in noise levels. Consequently, noise abatement must be considered if predicted design-year noise levels would result in an increase of 10 dBA or more over existing ambient noise levels.

Table 3-1. Noise Abatement Criteria and Noise Abatement Approach Criteria by Noise-Sensitive Land Use Activity Category

Activity Category	Activity Criteria[a]		Description of Land Use Activity Category
	FHWA NAC[b] L_{eq} (hourly dBA)	ODOT NAAC[c] L_{eq} (hourly dBA)	
A	57 (Exterior)	55	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve the land's intended purpose
B[d]	67 (Exterior)	65	Residential
C[d]	67 (Exterior)	65	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (Interior)	50	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[d]	72 (Exterior)	70	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in Categories A through D or F

Table 3-1. Noise Abatement Criteria and Noise Abatement Approach Criteria by Noise-Sensitive Land Use Activity Category

Activity Category	Activity Criteria[a]		Description of Land Use Activity Category
	FHWA NAC[b] L_{eq} (hourly dBA)	ODOT NAAC[c] L_{eq} (hourly dBA)	
F	–	–	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	–	–	Undeveloped lands that are not permitted

[a] The equivalent hourly sound level (L_{eq}[h]) activity criteria values are for impact determination only and are not design standards for noise abatement measures

[b] FHWA NAC

[c] ODOT NAAC, which includes undeveloped lands permitted for this activity category

[d] Includes undeveloped lands permitted for this activity

3.2.3 Local Ordinances

3.2.3.1 Deschutes County Noise Control Ordinance

The Deschutes County Noise Control Ordinance is found in Chapter 8.08.060(L) of the Deschutes County Code. The ordinance restricts general construction noise to between the hours of 7:00 a.m. and 10:00 p.m. (Deschutes County 2022).

3.2.3.2 City of Bend Noise Control Ordinance

The City of Bend Noise Disturbance ordinance is found in Section 5.50 of the City of Bend Code. The City ordinance restricts general construction noise to the hours of 7:00 a.m. and 10:00 p.m. (City of Bend 2012).

3.3 Measurement Procedures and Equipment

Additional measurements were not required to support this addendum to the NTR.

3.4 Selection of Noise-sensitive Receivers

Consistent with the prior analysis, the noise-sensitive locations were selected based on their proximity to the project, within a buffer zone that could be affected by traffic noise, assumed to be 500 feet. Most outdoor activity areas are near residences. The outdoor property adjacent to the residence is usually considered the frequent use. When there is both a front and back yard, the receiver placement was in the worst case location (that is, closer to the highway). Multistory family residences are located along the front row of Empire Avenue. At these residences, a receptor was modeled at the first floor activity area and second floor balcony.

3.5 Basis for Determining Worst-case Noise Condition

Peak vehicular hour traffic and peak-truck hour traffic for the design year were compared to determine the worst noise hour. Updated peak hour and peak-truck hour traffic were both modeled and results compared to determine the hour with the highest predicted noise levels for use in this analysis. The peak hour sound levels

were determined to be higher for the future build scenario throughout the project and was used for this analysis, consistent with the NTR from the 2014 FEIS. Appendix B contains results of the comparison between peak hour and peak-truck hour.

3.6 Noise Abatement Requirements

According to the 2011 ODOT *Noise Manual* guidelines, noise abatement measures should be considered when the predicted noise levels exceed the NAAC for existing land use or uses that have been issued a building permit before the date of public knowledge of the project (December 3, 2020). The feasibility and reasonableness of the considered mitigation should be evaluated for all locations predicted to exceed defined NAAC.

3.6.1 Acoustical Feasibility

To be considered acoustical feasible, mitigation should achieve at least a 5-dBA traffic noise reduction for the majority of impacted receptors. The engineering feasibility analysis also considers construction, maintenance, and other design issues. Noise abatement cannot create any safety or unacceptable maintenance problems or engineering fatal flaws. Factors reviewed could include:

- Barrier height
- Safety
- Site topography
- Access to businesses and residences
- Roadway compatibility and drainage impacts
- Utility conflicts and relocation requirements

A noise abatement measure would not be implemented where it would create a hazard or violate design standards.

A feasible noise barrier is considered appropriate to construct based on an evaluation of reasonableness factors.

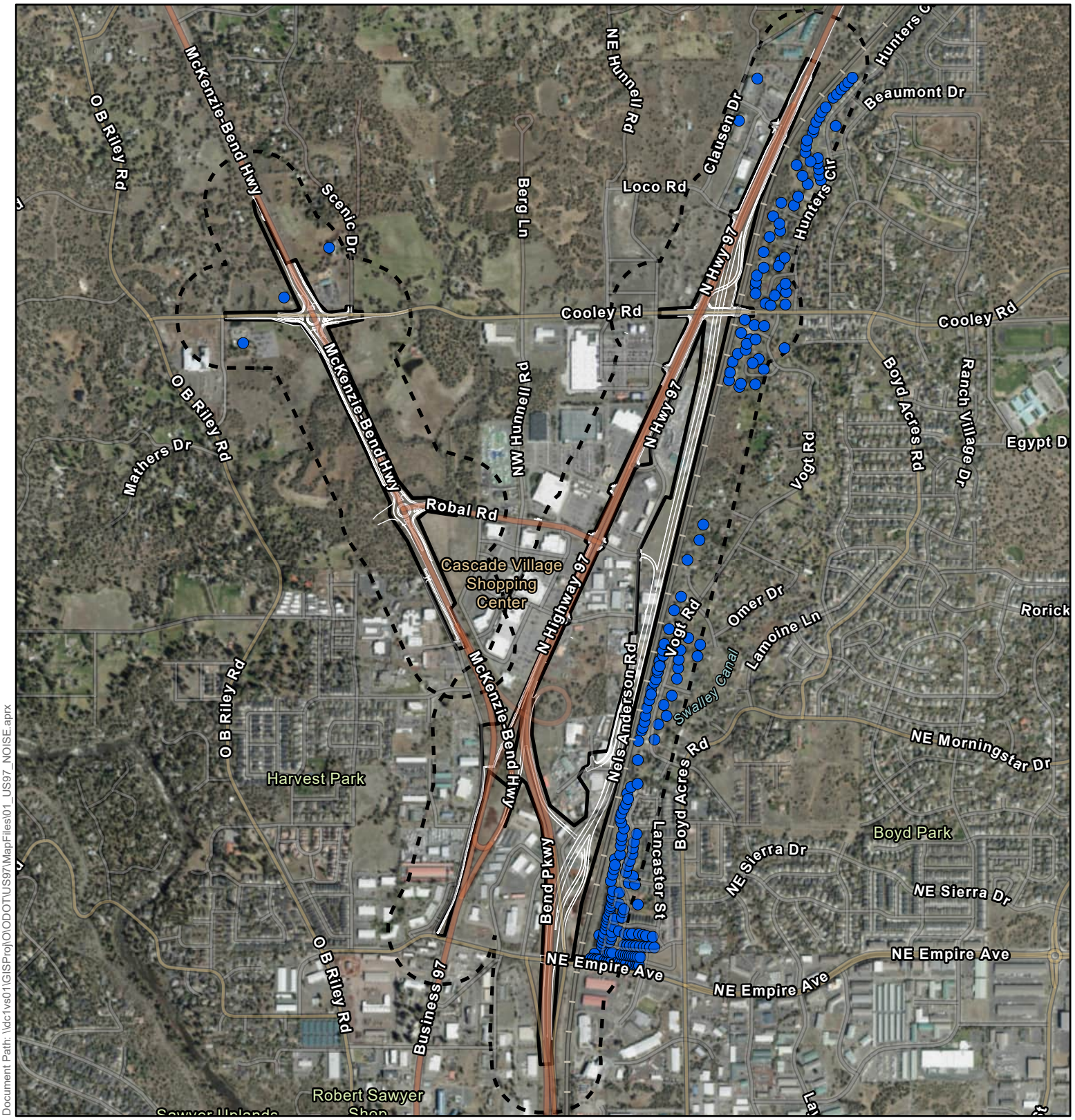
3.6.2 Reasonableness

Barrier Cost Effectiveness. The unit cost and the maximum cost per benefited residences was updated in the 2021 *ODOT Noise Manual Interim Update* (ODOT 2021a). A reasonable cost is considered to be a maximum of $37,500 per benefitted receptor, using a cost of $30 per square foot up to 16 feet tall. For walls higher than 16 feet and up to 25 feet tall, the cost increases to $37.5 per square foot for additional structural considerations. Costs for noise walls higher than 25 feet must be determined on a case-by-case basis. The typical maximum barrier cost of $37,500 can be exceeded, but will not be greater than $52,500 per benefited receiver, and must be justified using the ODOT Optional Reasonableness Criteria, which include:

- Receivers with high noise levels, 70 dBA or higher
- A large increase in traffic noise levels over existing levels
- Portion in mixed zoning development

Viewpoints of Benefitted Property Owners. A simple majority of benefitted receptors must be in favor of the abatement.

Design Goal Met. The abatement meets the ODOT noise reduction design goal of 7 dBA for one benefitted receptor.



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Locator Map

Legend

- Noise Receptors
- Project Limits
- Area of Potential Impact (API)

0 0.1 0.2 0.3 0.4 0.5 Miles

Figure 3-1
Noise Prediction Sites

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

4. Existing Noise Levels

4.1 Noise Measurements

Measurements were completed to support the NTR from the 2014 FEIS analysis. No new noise-sensitive areas were identified that would require additional measurements.

As part of this analysis, the validations were updated to include the more detailed data available from the project design effort. This included updating the terrain lines and railroad elevations. These updates were relatively minor and did not adversely affect the validation results.

Updates to terrain lines, building rows, and barriers were made throughout the model to reflect the topography and built environment more accurately. The validation models were re-run with these features and were still validated within +3 to -3 dB of the measurements. Table 4-1 provides a comparison of traffic noise levels.

Table 4-1. Comparison of Measured, Predicted, and Updated Traffic Noise Levels

Monitoring Location	2014 FEIS Measured Noise Level (dBA)	2014 FEIS Predicted Noise Level (dBA)	Updated Predicted Noise Level (dBA)	Difference from Updated to Measured (dBA)
ST08-1	44	45	45	−1
ST08-2	49	47	46	3
ST08-3	53	55	54	−1
ST08-4	57	59	59	−2
ST08-5 fence[a]	53	55	56	−3
ST08-9	56	54	55	1
ST08-11	52	50	50	2

[a] For a more detailed analysis on the fence that was included in the previous analysis, and the reason for removing it from this analysis, see Section 7.1.2.5.

As shown in Table 4-1, the modeled and measured results are within +3 to -3 dB for the 7 noise monitoring locations. Such differences show reasonable agreement between measured and predicted noise levels and indicates that the traffic noise model (TNM) 2.5 may be used to accurately predict noise exposure in the project area. Appendix C includes the TNM modeling files used to compare the noise monitoring results.

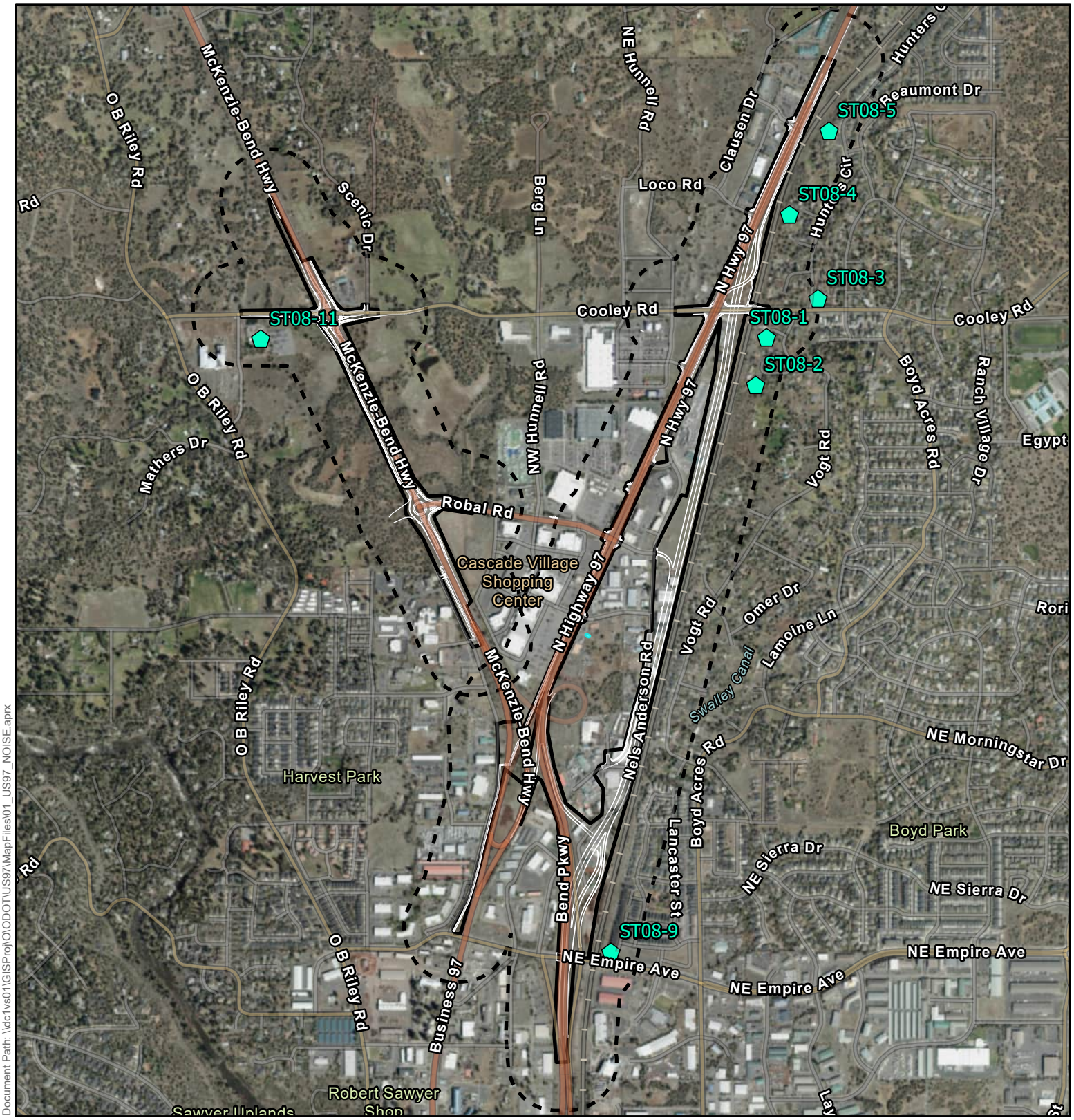
4.2 Non-transportation Related Noise Sources in Project Area

Long term measurements were reported in the NTR from the 2014 FEIS and identified the noise from the railroad contributes to the overall existing noise levels at residences located in proximity to the railroad tracks. It was determined that railroad-related noise is dominant in front row receivers along the BNSF Railway. Additionally, areas within 600 to 800 feet of the active railroad are periodically exposed to railroad noise that is louder than roadway traffic noise during the peak noise hour of the day. In these areas, traffic noise abatement would not be feasible because the railroad noise would continue at or above the NAAC. Additionally, the railroad is located between the noise receivers and abatement, and therefore the abatement would offer no noise reduction from the train traffic. The measured noise levels ranged from 44 dBA to 71 dBA. In the NTR from the 2014 FEIS, the following was noted:

- BNSF Railway operates 10 trips per day
- Six trips occur during the day
- Four trips occur at night
- No more than two trains operate per hour
- Trains typically operate around 25 to 35 miles per hour
- The schedule varies
- The length of trains varies from 0.5 mile to over approximately 1 mile in length
- Train disturbance could last up to 3 minutes at a time.
- Typically, there are two to three locomotives per train (ODOT 2014).

The NTR from the 2014 FEIS also noted that the BNSF Railway expected to expand services in approximately 10 years. BNSF confirmed that these services have been expanded since the 2014 FEIS to approximately 15 trips per day (BNSF Railway 2022).

Figure 4-1 shows the monitoring locations.



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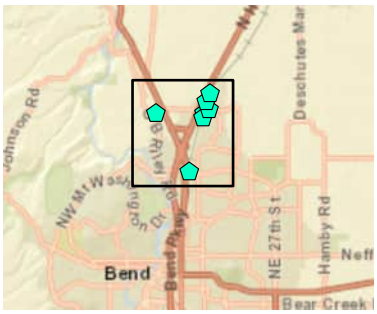
Locator Map



Legend

- Monitoring Locations
- Project Limits
- Area of Potential Impact (API)

0 0.1 0.2 0.3 0.4 Miles

Figure 4-1
Monitoring Locations

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

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Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

5. Modeled Noise Levels

Noise levels were modeled for locations throughout the project API for the Existing Condition, No Action, and this project. These results are described in the following subsections and detailed in Table 5-1. The modeling locations are depicted on Figure 3-1. These predicted levels were used to identify which receivers would be impacted as a result of this project. Appendix B includes the traffic information used for these models.

5.1 Modeled Existing Noise Levels

Traffic noise levels modeled for the 2022 Existing Condition scenario in the project area during the peak hour range from 52 to 73 dBA (Table 5-1). Thirty-seven residential uses currently have modeled traffic noise levels exceeding the ODOT NAAC. Traffic noise levels are highest at the residences north of Empire Avenue, east of US 97. The interior of neighborhoods further removed from the highway and major roadways contain the lowest traffic noise levels in the project area.

5.2 Modeled Future Noise Levels: No Action and the Project

5.2.1 No Action Scenario Future Noise Levels

The No Action scenario uses traffic volumes projected for the year 2040 with no changes to any roadways in the project API.

The 2040 No Action scenario modeled traffic noise levels are predicted to range from 53 to 74 dBA. Under the No Action scenario, changes in predicted traffic noise levels range from no change to an increase of 4 dBA when compared to the Existing Condition scenario (Tables 5-1 and 5-2). The increase of levels up to 4 dBA over the Existing Condition scenario is due to projected growth in traffic volumes.

Forty-four residential uses are predicted to have modeled traffic noise levels that exceed the ODOT NAAC under the 2040 No Action scenario. This is an increase of seven residences that exceed the ODOT criteria when compared to the existing conditions. These additional exceedances were predicted at residences north of Cooley Road (R131, R4014, R4015, R4018, R4019, R4026, and R4033), in the neighborhood east of US 97 and the railroad (Figure 5-1).

5.2.2 Project Future Noise Levels

This project modeled traffic noise levels that are projected to range from 54 to 74 dBA. For this project, changes in traffic noise levels are predicted to range from a decrease of 2 dBA to an increase of 12 dBA when compared to the Existing Condition scenario. When compared to the 2040 No Action scenario, the changes are a decrease of 3 dBA to an increase of 11 dBA above the Existing Condition scenario. These expected increases are due to increases in traffic volumes, construction of new roadways (which change the traffic flow patterns and move the roadways closer to the residences), and other project-related improvements. Conversely, the project traffic noise levels are predicted to be lower than Existing Condition and No Action scenario levels in the neighborhood north of Cooley Road and east of US 97 and the railroad because of the new concrete median barrier. There are impacts in all three scenarios at the new residences north of Empire Avenue.

The largest increases over existing conditions occur throughout the neighborhood east of US 97 and the railroad, on Vogt Road (R50, R3001-R3003, R3009, and R3010). Other substantial increases in 2040 project traffic noise levels over Existing Condition scenario levels occur throughout the neighborhoods

east of US 97 and the railroad, south of Cooley Road (R54, R3000, R3004, R3007, R3008, R3011, R3012, R3014, R3027). This project would shift US 97 from its current location closer to the receivers east of the railroad. In the NTR from the 2014 FEIS, the increase over existing ranged from approximately 9 to 14 dBA. The increases with this project are within the range previously identified in NTR from the 2014 FEIS. Receivers where the increase over the Existing Condition scenario yields noise levels above the impact threshold include the first-row receivers along US 97 (Figure 5-1). Front row receivers along Cooley Road are also impacted (R111, R4014, R4015, R114, R4031, R4037).

At the northern limits of the project, noise levels in the project are slightly lower (-2 dBA than existing due to the median barrier that acts as a buffer for some noise). The 2040 project scenario traffic noise levels are expected to exceed the ODOT NAAC of 65 dB for residential uses at 66 residential uses. This is 29 more exceedances than the Existing Conditions scenario, and 22 more exceedances than the 2040 No Action scenario.

Table 5-1 shows a summary of the total number of noise-sensitive land uses that meet or exceed the ODOT NAAC for the Existing Condition, No Action, and the project models. Table 5-2 shows the Existing Condition, No Action, and the project noise levels.

Table 5-1. Summary of Receivers that Meet or Exceed the ODOT NAAC

Scenario	Number that Meet or Exceed the ODOT NAAC
	NAC B
Existing Condition (2022)	37
No Action (2040)	44
Project Build (2040)	66

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R20	B	1	65	57	58	1	56	0	-1	-2
R25	B	1	65	58	59	1	58	0	0	-1
R29	B	1	65	57	58	1	57	0	0	-1
R35	B	1	65	54	55	1	54	0	0	-1
R40	B	1	65	60	60	0	62	0	2	2
R45	B	1	65	56	57	1	64	0	8	7
R50	B	1	65	56	56	0	67	1	11	11
R54	B	1	65	57	58	1	67	1	10	9
R55	B	1	65	53	53	0	56	0	3	3
R57	B	1	65	58	58	0	67	1	9	9
R64	B	1	65	53	54	1	61	0	8	7
R80	B	4	65	55	56	1	61	0	6	5
R91	B	1	65	55	56	1	60	0	5	4
R97	B	1	65	60	61	1	64	0	4	3
R99	B	1	65	60	61	1	62	0	2	1

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R102	B	1	65	57	59	2	59	0	2	0
R103	B	1	65	60	62	2	63	0	3	1
R104	C	1	65	56	57	1	57	0	1	0
R111	B	1	65	66	68	2	69	1	3	1
R114	B	1	65	67	69	2	69	1	2	0
R117	B	1	65	69	70	1	67	1	-2	-3
R119	B	1	65	61	63	2	63	0	2	0
R123	B	1	65	62	63	1	65	1	3	2
R127	B	1	65	60	62	2	62	0	2	0
R131	B	1	65	64	65	1	65	1	1	0
R133	B	1	65	61	61	0	61	0	0	0
R134	B	1	65	66	67	1	66	1	0	-1
R143	B	1	65	67	67	0	65	1	-2	-2
R145	B	1	65	57	58	1	57	0	0	-1
R2000[b]	B	1	65	72	74	2	74	1	2	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2001[b]	B	1	65	72	73	1	73	1	1	0
R2002[b]	B	1	65	73	74	1	74	1	1	0
R2003[b]	B	1	65	72	74	2	74	1	2	0
R2004[b]	B	1	65	72	74	2	74	1	2	0
R2005[b]	B	1	65	72	74	2	74	1	2	0
R2006[b]	B	1	65	72	74	2	74	1	2	0
R2007[b]	B	1	65	72	74	2	74	1	2	0
R2008[b]	B	1	65	72	74	2	74	1	2	0
R2010	B	1	65	58	59	1	58	0	0	-1
R2011	B	1	65	55	56	1	55	0	0	-1
R2012	B	1	65	56	57	1	57	0	1	0
R2013	B	1	65	59	60	1	60	0	1	0
R2014[b]	B	1	65	73	74	1	74	1	1	0
R2015[b]	B	1	65	73	74	1	74	1	1	0
R2016[b]	B	1	65	72	74	2	74	1	2	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2017[b]	B	1	65	72	74	2	74	1	2	0
R2018[b]	B	1	65	72	73	1	73	1	1	0
R2019	B	1	65	53	54	1	58	0	5	4
R2020[b]	B	1	65	72	73	1	73	1	1	0
R2021[b]	B	1	65	72	73	1	73	1	1	0
R2022[b]	B	1	65	72	73	1	73	1	1	0
R2023[b]	B	1	65	72	73	1	73	1	1	0
R2024[b]	B	1	65	72	73	1	73	1	1	0
R2025	B	1	65	55	56	1	56	0	1	0
R2026	B	1	65	54	54	0	54	0	0	0
R2027	B	1	65	57	58	1	58	0	1	0
R2028	B	1	65	59	60	1	60	0	1	0
R2029	B	1	65	58	59	1	59	0	1	0
R2030	B	1	65	55	56	1	56	0	1	0
R2031	B	1	65	53	54	1	54	0	1	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2032	B	1	65	54	55	1	55	0	1	0
R2033	B	1	65	57	58	1	58	0	1	0
R2034	B	1	65	59	60	1	60	0	1	0
R2076	B	1	65	57	58	1	57	0	0	-1
R2077	B	1	65	57	58	1	57	0	0	-1
R2078	B	1	65	57	59	2	58	0	1	-1
R2079	B	1	65	58	59	1	58	0	0	-1
R2080	B	1	65	58	59	1	58	0	0	-1
R2081	B	1	65	57	58	1	58	0	1	0
R2082	B	1	65	58	58	0	58	0	0	0
R2083	B	1	65	57	58	1	57	0	0	-1
R2084	B	1	65	57	58	1	57	0	0	-1
R2085	B	1	65	57	58	1	57	0	0	-1
R2086	B	1	65	57	58	1	57	0	0	-1
R2087	B	1	65	57	58	1	57	0	0	-1

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2088	B	1	65	57	57	0	57	0	0	0
R2089	B	1	65	56	57	1	57	0	1	0
R2090	B	1	65	56	57	1	57	0	1	0
R2091	B	1	65	56	57	1	57	0	1	0
R2092	B	1	65	56	57	1	57	0	1	0
R2093	B	1	65	56	57	1	57	0	1	0
R2094	B	1	65	56	57	1	57	0	1	0
R2095	B	1	65	58	58	0	58	0	0	0
R2096	B	1	65	57	58	1	58	0	1	0
R2097	B	1	65	57	58	1	56	0	-1	-2
R2098	B	1	65	57	58	1	57	0	0	-1
R2099	B	1	65	58	58	0	57	0	-1	-1
R2100	B	1	65	57	58	1	57	0	0	-1
R2101	B	1	65	57	58	1	57	0	0	-1
R2102	B	1	65	57	57	0	57	0	0	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2103	B	1	65	56	56	0	56	0	0	0
R2104	B	1	65	54	55	1	55	0	1	0
R2105	B	1	65	54	55	1	55	0	1	0
R2106	B	1	65	54	55	1	55	0	1	0
R2107	B	1	65	55	57	2	56	0	1	-1
R2108	B	1	65	55	56	1	56	0	1	0
R2109	B	1	65	55	57	2	57	0	2	0
R2110	B	1	65	56	57	1	57	0	1	0
R2111	B	1	65	55	57	2	57	0	2	0
R2112	B	1	65	56	57	1	57	0	1	0
R2113	B	1	65	56	57	1	57	0	1	0
R2117	B	1	65	55	56	1	56	0	1	0
R2118	B	1	65	55	56	1	56	0	1	0
R2119	B	1	65	55	56	1	56	0	1	0
R2120	B	1	65	55	56	1	56	0	1	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2121	B	1	65	55	56	1	56	0	1	0
R2122	B	1	65	55	56	1	56	0	1	0
R2123	B	1	65	54	55	1	56	0	2	1
R2124	B	1	65	60	61	1	61	0	1	0
R2125	B	1	65	60	61	1	61	0	1	0
R2126	B	1	65	60	60	0	61	0	1	1
R2127	B	1	65	60	60	0	61	0	1	1
R2128	B	1	65	58	59	1	60	0	2	1
R2129	B	1	65	57	57	0	60	0	3	3
R2130	B	1	65	56	57	1	60	0	4	3
R2131	B	1	65	58	58	0	61	0	3	3
R2132	B	1	65	57	57	0	60	0	3	3
R2133	B	1	65	56	57	1	57	0	1	0
R2134	B	1	65	57	58	1	57	0	0	-1
R2135	B	1	65	57	58	1	57	0	0	-1

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2136	B	1	65	57	57	0	57	0	0	0
R2137	B	1	65	56	57	1	57	0	1	0
R2138	B	1	65	56	57	1	57	0	1	0
R2139	B	1	65	55	56	1	57	0	2	1
R2140	B	1	65	54	55	1	57	0	3	2
R2141	B	1	65	55	55	0	57	0	2	2
R2142	B	1	65	55	56	1	58	0	3	2
R2143	B	1	65	59	59	0	64	0	5	5
R2144	B	1	65	60	60	0	66	1	6	6
R2145	B	1	65	60	60	0	67	1	7	7
R2146	B	1	65	56	57	1	64	0	8	7
R2147	B	1	65	56	57	1	65	1	9	8
R2148	B	1	65	56	56	0	64	0	8	8
R2149	B	1	65	56	56	0	65	1	9	9
R2150	B	1	65	56	56	0	63	0	7	7

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R2151	B	1	65	55	56	1	63	0	8	7
R3000	B	1	65	56	56	0	66	1	10	10
R3001	B	1	65	56	56	0	67	1	11	11
R3002	B	1	65	55	56	1	67	1	12	11
R3003	B	1	65	55	56	1	67	1	12	11
R3004	B	1	65	57	58	1	67	1	10	9
R3005	B	1	65	58	59	1	67	1	9	8
R3006	B	1	65	58	58	0	66	1	8	8
R3007	B	1	65	57	57	0	67	1	10	10
R3008	B	1	65	56	56	0	66	1	10	10
R3009	B	1	65	56	57	1	67	1	11	10
R3010	B	1	65	56	57	1	67	1	11	10
R3011	B	1	65	57	57	0	67	1	10	10
R3012	B	1	65	57	58	1	67	1	10	9
R3013	B	1	65	58	58	0	67	1	9	9

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R3014	B	1	65	57	57	0	67	1	10	10
R3015	B	1	65	53	54	1	58	0	5	4
R3016	B	1	65	52	53	1	58	0	6	5
R3017	B	1	65	52	52	0	56	0	4	4
R3018	B	1	65	54	55	1	59	0	5	4
R3021	B	1	65	56	56	0	60	0	4	4
R3022	B	1	65	57	57	0	61	0	4	4
R3023	B	1	65	53	54	1	58	0	5	4
R3024	B	1	65	53	54	1	57	0	4	3
R3025	B	1	65	52	53	1	55	0	3	2
R3026	B	1	65	53	54	1	57	0	4	3
R3027	B	1	65	55	56	1	65	1	10	9
R3028	B	1	65	54	55	1	63	0	9	8
R3029	B	1	65	53	54	1	60	0	7	6
R3030	B	1	65	54	55	1	60	0	6	5

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R4000	B	1	65	56	57	1	61	0	5	4
R4001	B	1	65	58	59	1	63	0	5	4
R4002	B	1	65	59	60	1	63	0	4	3
R4004	B	1	65	61	62	1	64	0	3	2
R4005	B	1	65	60	61	1	63	0	3	2
R4006	B	1	65	60	62	2	63	0	3	1
R4007	B	1	65	62	63	1	64	0	2	1
R4009	B	1	65	57	58	1	60	0	3	2
R4010	B	1	65	57	58	1	60	0	3	2
R4011	B	1	65	60	61	1	62	0	2	1
R4013	B	1	65	59	61	2	62	0	3	1
R4014	B	1	65	63	65	2	66	1	3	1
R4015	B	1	65	62	65	3	65	1	3	0
R4017	B	1	65	62	64	2	65	1	3	1
R4018	B	1	65	64	65	1	66	1	2	1

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R4019	B	1	65	64	65	1	66	1	2	1
R4020	B	1	65	63	64	1	65	1	2	1
R4022	B	1	65	65	66	1	65	1	0	-1
R4023	B	1	65	62	63	1	63	0	1	0
R4024	B	1	65	63	64	1	63	0	0	-1
R4025	B	1	65	69	70	1	68	1	-1	-2
R4026	B	1	65	64	65	1	63	0	-1	-2
R4027	B	1	65	63	64	1	63	0	0	-1
R4028	B	1	65	61	62	1	61	0	0	-1
R4029	B	1	65	63	64	1	63	0	0	-1
R4030	B	1	65	67	68	1	66	1	-1	-2
R4031	B	1	65	68	71	3	71	1	3	0
R4033	B	1	65	62	65	3	65	1	3	0
R4035	B	1	65	61	62	1	62	0	1	0
R4036	B	1	65	61	62	1	62	0	1	0

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R4037	B	1	65	66	70	4	69	1	3	-1
R4038	B	1	65	60	63	3	63	0	3	0
R4039	B	1	65	60	62	2	62	0	2	0
R4040	B	1	65	59	60	1	59	0	0	-1
R4041	B	1	65	60	61	1	60	0	0	-1
R4042	B	1	65	60	61	1	60	0	0	-1
R4043	B	1	65	61	62	1	61	0	0	-1
R4044	B	1	65	59	60	1	58	0	-1	-2
R4045	B	1	65	65	66	1	63	0	-2	-3
R4046	B	1	65	66	67	1	65	1	-1	-2
R4047	B	1	65	67	68	1	66	1	-1	-2
R4048	B	1	65	68	69	1	66	1	-2	-3
R4049	B	1	65	67	68	1	65	1	-2	-3
R4050	B	1	65	67	68	1	65	1	-2	-3
R4051	B	1	65	65	66	1	63	0	-2	-3

Table 5-2. Existing Condition, No Action, and the Project Noise Levels

Receiver ID	FHWA Land Use Activity	Number Receptors Represented	ODOT NAAC (dBA)	Existing Condition (2022)	No Action (2040)		Project Build (2040)			
				Noise Level (dBA)[a]	Noise Level (dBA)[a]	Increase over Existing (dBA)	Noise Level (dBA)[a]	Number of Impacts	Increase over Existing (dBA)	Increase over No Action (dBA)
R4052	B	1	65	66	67	1	64	0	-2	-3
R4053	B	1	65	63	64	1	62	0	-1	-2
R4054	B	1	65	60	61	1	59	0	-1	-2
R4055	B	1	65	61	62	1	59	0	-2	-3
R4056	B	1	65	60	61	1	59	0	-1	-2
R4057	B	1	65	60	61	1	60	0	0	-1
R4058	B	1	65	59	59	0	59	0	0	0
R4059	B	1	65	60	61	1	60	0	0	-1
R1001	C	1	65	62	63	1	61	0	-1	-2
R1002	C	1	65	62	63	1	62	0	0	-1
Summary		**Minimum**		52	53	0	54	-	-2	-3
		Maximum		73	74	3	74	-	12	11
		NAAC Impacts		--	--	--	--	66	--	--

[a] Predicted peak hour levels in Leq dBA from FHWA TNM version 2.5; prediction values greater than or equal to the ODOT NAAC are shaded.

[b] Second story balcony at residences adjacent to Empire Avenue.

Several additional areas are predicted to exceed the NAAC that did not exceed it in the NTR from the 2014 FEIS (Table 5-3).

Table 5-3. Additional Areas Predicted to Exceed the NAAC

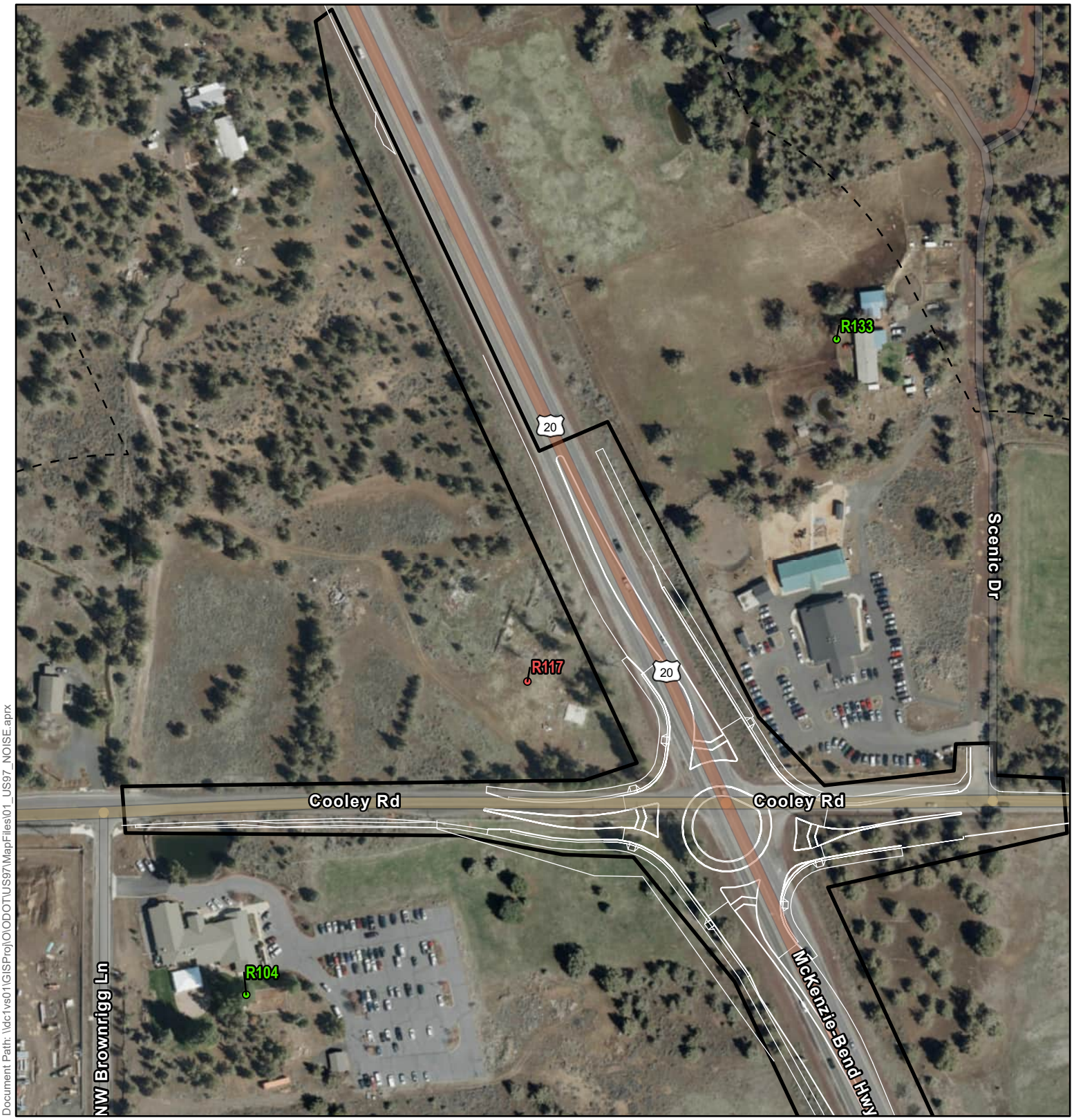
Modeled Location	NTR From the 2014 FEIS Build Alternative Level (dBA)	Project Final Design Build Level (dBA)	Difference (dBA)
R20	61	56	-5
R25	60	58	-2
R29	59	57	-2
R35	55	54	-1
R40	61	62	1
R45	60	64	4
R50	64	67	3
R54	65	67	2
R55	56	56	0
R57	67	67	0
R64	59	61	2
R80	62	61	-1
R91	60	60	0
R97	65	64	-1
R99	63	62	-1
R102	59	59	0
R103	64	63	-1
R104	55	57	2
R111	65	69	4
R114	Displaced	69	N/A
R117	68	67	-1
R119	62	63	1
R123	64	65	1
R127	60	62	2
R131	67	65	-2

Table 5-3. Additional Areas Predicted to Exceed the NAAC

Modeled Location	NTR From the 2014 FEIS Build Alternative Level (dBA)	Project Final Design Build Level (dBA)	Difference (dBA)
R133	59	61	2
R134	65	66	1
R143	60	65	5
R145	57	57	0

Note: Values greater than or equal to the ODOT NAAC are shaded.

These additional exceedances are primarily the result of the alignment shifts of this project moving closer to the noise-sensitive receivers than the proposed alignment analyzed in the NTR from the 2014 FEIS.



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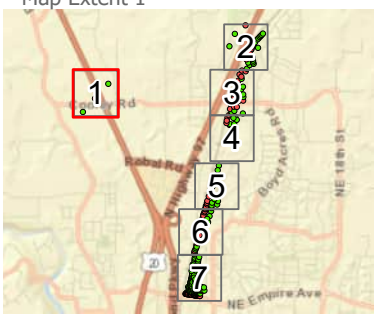


Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

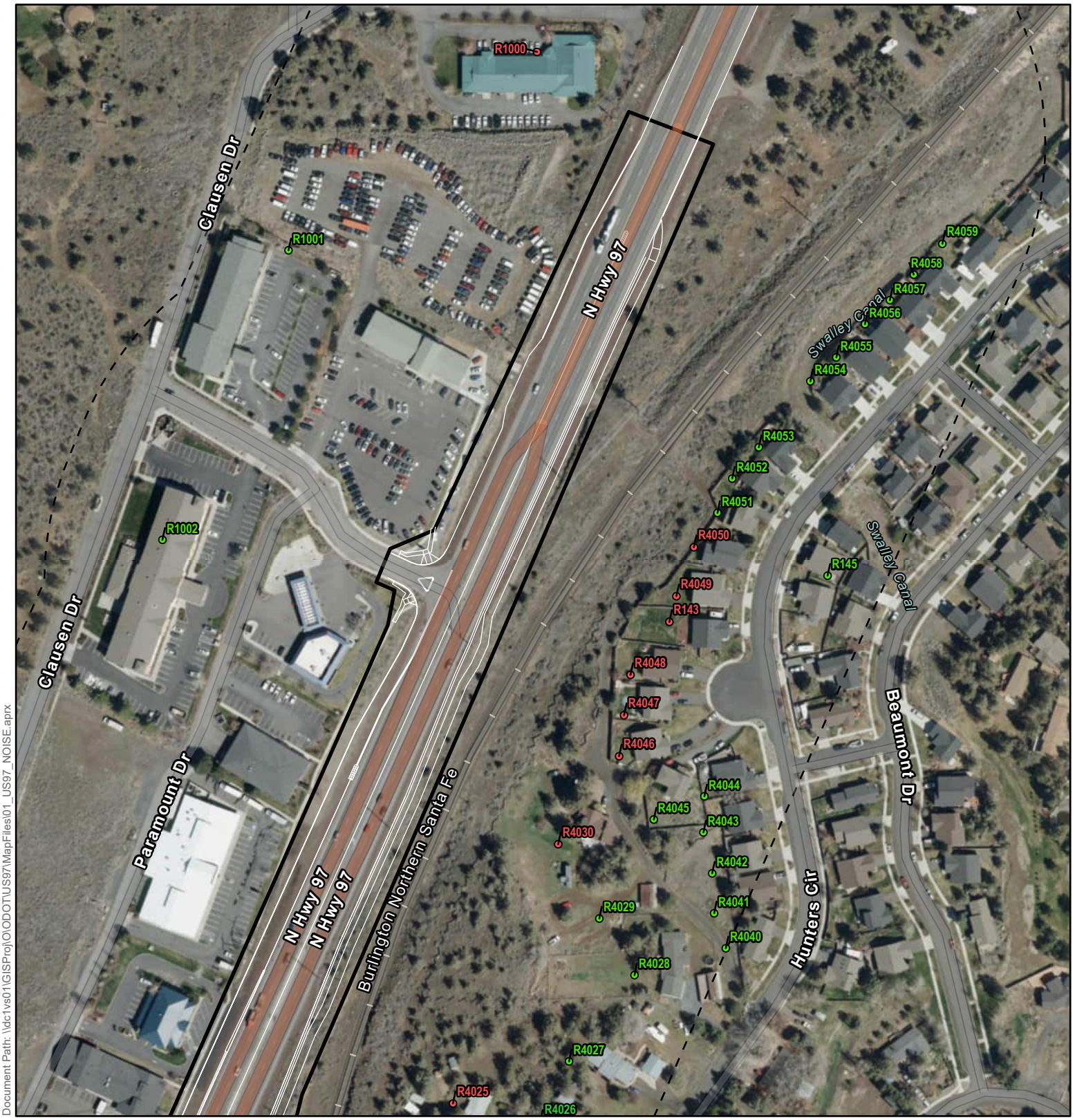
0 100 200 300 400 Feet

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



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Locator Map

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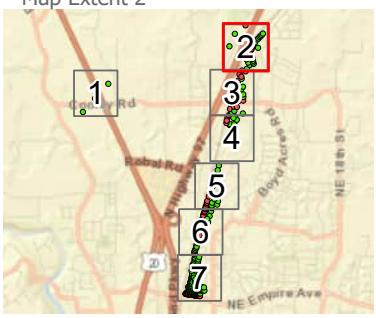


Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

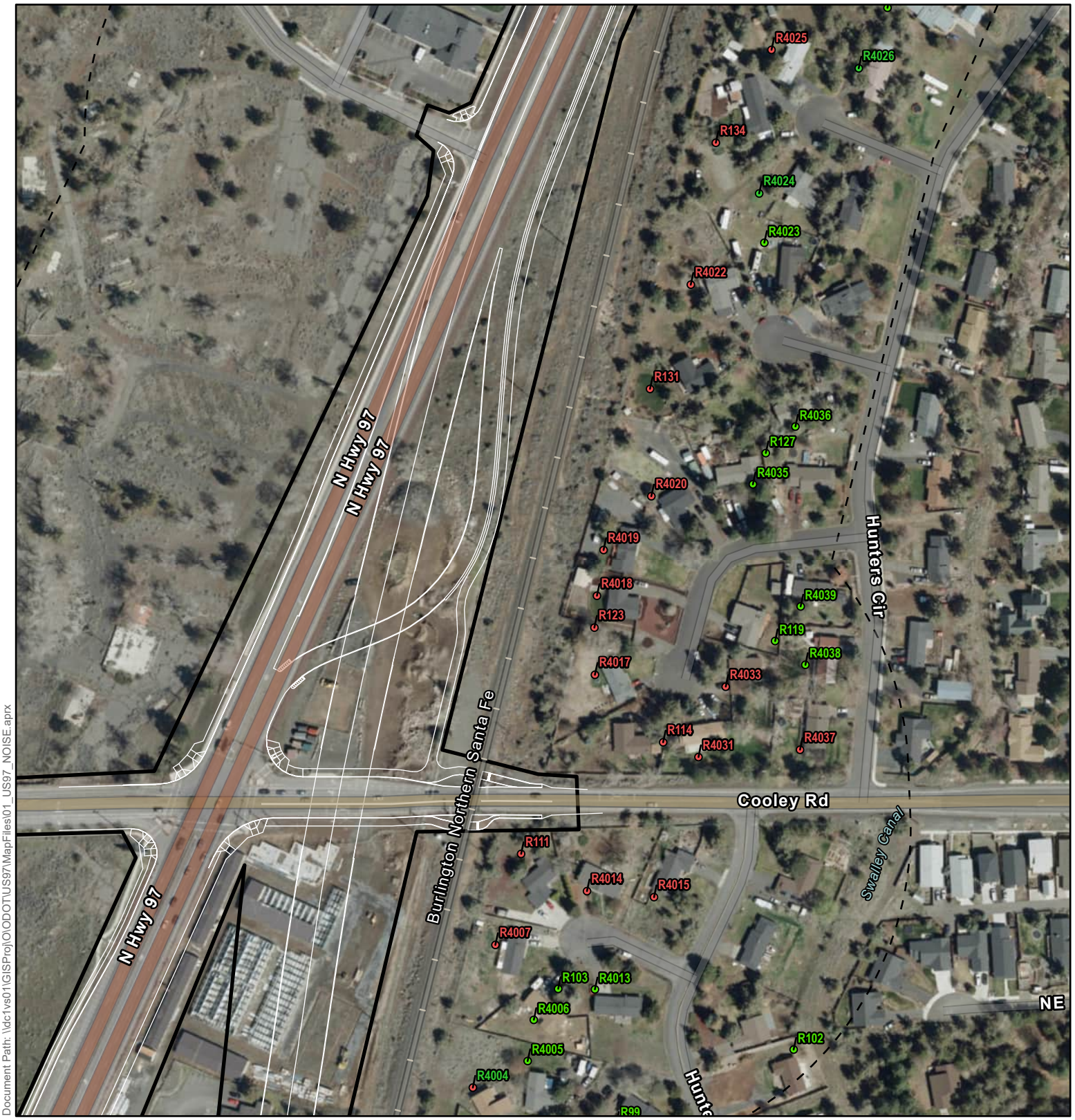
0 100 200 300 400 Feet

Jacobs

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



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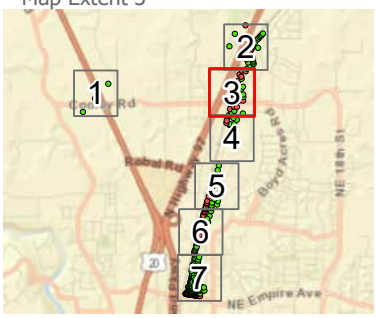

Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

0 100 200 300 400 Feet

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

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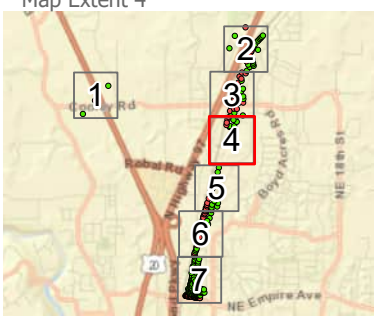
Locator Map

Map Extent 4



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

0 100 200 300 400 Feet

Jacobs

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

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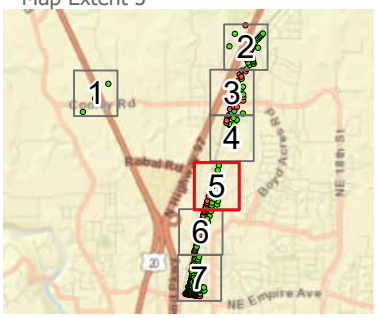
Locator Map

Map Extent 5



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

0 100 200 300 400 Feet

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

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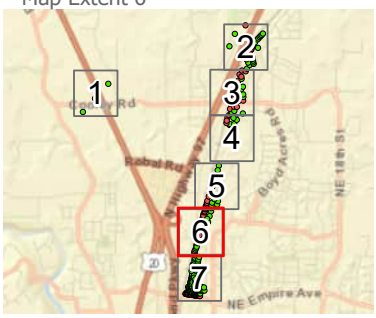
Locator Map

Map Extent 6



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

0 100 200 300 400 Feet

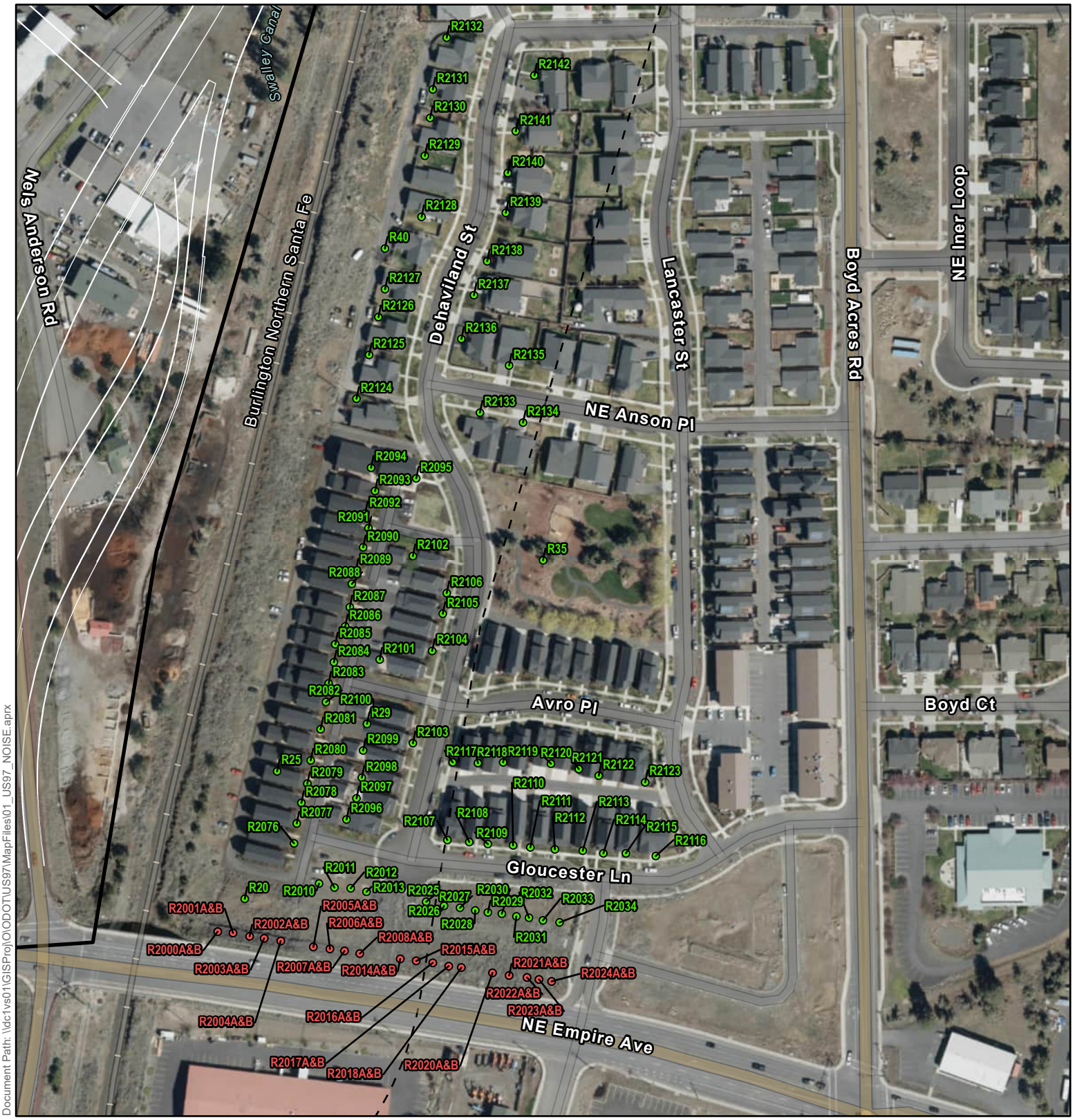
N

Jacobs

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



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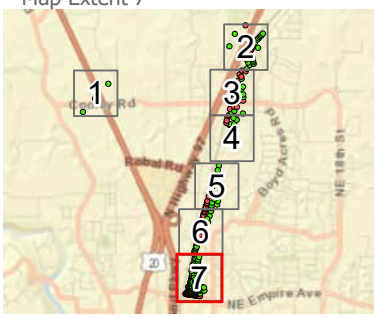
Locator Map

Map Extent 7



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Project Limits
- Area of Potential Impact (API)

0 100 200 300 400 Feet

Jacobs

Figure 5-1
Noise Prediction Sites - Detail

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

6. Traffic Noise Impacts

Figure 5-1 shows the exceedances of the NAAC that occur throughout the project at the following locations:

- 22 residences east of US 97, on Vogt Road and De Haviland Street. The project results in substantial increases (10 dBA) over the existing conditions east of US 97 on Vogt Street. The largest predicted increase is 12 dBA. Additionally, impacts in this area are limited to first-row receptors.
- 5 residences southeast of the US 97 and Cooley Road intersection.
- 20 residences northeast of the US 97 and Cooley Road intersection and further north.
- 1 single-family residence northwest of US 20 and Cooley Road intersection.
- 19 exceedances of the NAAC at the second-story balcony of residences adjacent to the north side of Empire Avenue, east of US 97. These residences experience noise levels up to 74 dBA, the highest levels within the project.

Other than the new receivers, these findings are generally consistent with the findings in the NTR from the 2014 FEIS.

7. Evaluation of Noise Abatement Measures

7.1 Considered Noise Abatement Measures

The ODOT *Noise Manual* and interim updates direct that noise abatement measures should be considered when the predicted noise levels approach or exceed the FHWA NAC, or when there is a substantial increase in noise resulting from the proposed project (ODOT 2011, 2020, 2021a; FHWA 2011). Consequently, noise abatement was considered for all impacted noise-sensitive receptor locations. Noise abatement measurements that are feasible and reasonable under ODOT traffic NAC were evaluated in accordance with the ODOT *Noise Manual* and interim updates (ODOT 2011, 2020, 2021a). Potential traffic noise abatement measures considered for the project include the following:

- Construction of noise barriers between the roadway and receptor locations where future peak hour noise levels approach or exceed the ODOT NAAC
- Alteration of the horizontal or vertical alignment of the roadway
- Implementation of traffic management measures (reduced speed limits, limitations, or restrictions on truck traffic)

The noise barrier option is the most practical and effective choice. Substantial realignment of US 97 and the associated interchanges would not be feasible without considerably more property acquisitions and expense. Additionally, US 97 and US 20 are major transportation routes, and, therefore, limiting truck traffic or reducing speed is not a feasible option for this project.

The ODOT *Noise Manual* and interim updates set forth the criteria for determining when an abatement measure is reasonable and feasible (ODOT 2011, 2020, 2021a). Abatement must meet the ODOT feasible and reasonableness criteria.

7.1.1 Feasibility

ODOT requires that for a noise abatement measure to be feasible, it must be able to reduce the noise level at greater than 50 percent of impacted receptors by at least 5 dBA. Other engineering factors area such as barrier height, safety, topography, drainage, utilities, and access issues are also considered when determining feasibility. Potential barriers directly east of the BNSF Railway were not considered feasible due to access issues and additional costs associated with constructing and maintaining the barriers.

7.1.2 Reasonableness

If abatement is determined to be feasible, the reasonableness of the barrier is considered. To be reasonable, one benefited receptor must achieve a noise reduction design goal of 7 dBA. Additionally, the abatement measure must not exceed the cost-effectiveness criterion of $37,500 for each benefitted receptor that would benefit by a reduction of at least 5 dBA. This cost is based on $30 per square foot for a barrier up to 16-feet tall and $37.5 per square foot for barrier heights from 16 feet to 25 feet, according to the ODOT *Noise Manual Interim Update* (ODOT 2021a). Estimating costs for barriers higher than 25 feet must be done on a case-by-case basis. In instances when noise levels exceed 70 dBA, a cost-effectiveness criterion of $52,500 per residence is applied to the barrier analysis.

The final part of determining if an abatement measure is reasonable is the viewpoint of property owners. Noise abatement survey letters to the benefited residents and property owners must be sent out to determine the viewpoints of the affected noise receptors. A simple majority (51 percent of all responding benefited residents and property owners) is needed to build noise abatement.

Impacts are scattered in a few areas of the project: residences east of US 97, Impact Faith Church at the northern end of the project, west of US 97, and one single-family residence northwest of the intersection of US 20 and Cooley Road.

7.1.2.1 Barrier 1 (R2144, R2145, R2149, R2151 R3000-R3014, R57) – Single Family Residences North of Empire On-ramp, east of BNSF Railway

Twenty-two receivers east of US 97 and the railroad tracks on De Haviland Street exceed the ODOT NAAC, and a barrier was analyzed east of US 97 and west of the railroad. A barrier approximately 2,400 feet long and 10 feet high would be required to satisfy the 5-dBA feasibility and 7-dBA reasonableness design goal. (Figure 7-1 and Table D-1 in Appendix D). However, the cost to construct this barrier would be $731,100, or $40,617 per benefited receptor. Because this is more than $37,500, the barrier is not considered reasonable. As a result, Barrier 1 is not recommended for inclusion in further project development.

7.1.2.2 Barrier 2 (R4001-R4002, R4014-R4015, R4017-R4020, R4022, R4025, R4030-R4031, R4033, R4037, R4046-R4050, R111, R114, R123, R131, R134, R143,) – Single Family Residences North and South of Cooley, east of BNSF Railway

Twenty-five receivers east of US 97 and the railroad tracks, north and south of Cooley Road, exceed the ODOT NAAC. A barrier approximately 3,600 feet long and 12 feet high would be required to satisfy the 5-dBA feasibility and 7-dBA reasonableness design goal at R4030, R4046, R4047, R4048, R4049, R134, and R143 (Figure 7-1 and Table D-1 in Appendix D). However, the cost to construct these barriers would be $1,280,640 or $116,422 per benefited receptor. As a result, Barrier 2 is not recommended for inclusion in further project development.

7.1.2.3 Barrier 3 (R117) – Undeveloped land zoned as residential, northwest of the proposed roundabouts at US 20 and Cooley Road

One receiver, northwest of the US 20 and Cooley interchange, exceeds the ODOT NAAC. A barrier approximately 840 feet long and 16 feet high would be required to satisfy the 5-dBA feasibility (Figure 7-1 and Table D-6 in Appendix D). However, the barrier is not able to achieve the 7-dBA reasonableness design goal at any height. Because of this, the barrier is not considered reasonable and is not recommended for inclusion in further project development.

7.1.2.4 Barrier 4 (R2000-R2008, R2014-R2018, R2020-R2024) – Front-row, second-story residences north of Empire Avenue, east of the US 97 on-ramp.

Nineteen front-row, second-story receivers, directly north of westbound Empire Avenue exceed the ODOT NAAC. Both the first- and second-story points were modeled, but because both points are within one unit, the worst case scenario was used. In this model, it was the second-story residences. The barrier was located east of the northbound US 97 on-ramp from Empire Avenue and west of the railroad tracks. Because of the large distance between the barrier and the residences, the barrier did not result in any benefitted receptors, even at 20 feet tall. As a result, Barrier 4 is not recommended for inclusion in further project development.

7.1.2.5 Barrier Analysis for Fence (ST08-5), included in 2014 FEIS

The NTR from the 2014 FEIS validated measurement at Point ST08-5 with an 8-foot-tall barrier between the measurement point and US 97. This barrier was likely intended to represent the wooden fence, which is not normally included as a barrier in the noise model. The validation was conducted both with and without the fence. Table 7-1 shows the results.

Table 7-1. Validation Results with 8-foot Barrier

Receiver	Measurement	Previous Modeled	Updated Modeled	Updated Difference/Validate
ST08-5 without fence	53	55	59	6 / NO
ST08-5 with fence	53	55	55	2 / YES

Without the fence, the model is not validated because it is not within 3 dBA of the measured level. Because there is no photograph of this measurement location, the validation results were evaluated assuming the measurement was located in the driveway or front yard (ST08-5A) rather than the backyard (ST08-5). Table 7-2 provides a summary of these results.

Table 7-2. Validation Results Assuming Measurement in Driveway or Front Yard

Receiver	Measurement	Updated Modeled	Updated Difference/Validate
ST08-5A without fence	53	52	-1 / YES
ST08-5A with fence	53	49	-4 / NO

This indicates that the model would validate without the fence, which is consistent with all other measurements conducted.

While the findings are interesting, of primary interest is if a new barrier would satisfy the feasible and reasonable criteria. A new barrier in this area was modeled both with and without the fence to determine if the fence influences the feasible and reasonable determination. If the fence was found to influence the feasible and reasonable finding, additional sound measurements would be considered given the uncertainty in the location of this measurement.

This barrier analysis found that both with and without the fence, a potential new sound barrier would not satisfy the reasonable criterion. The barrier examined in this area was modeled east of US 97, and west of the railroad tracks. It was approximately 3,900 feet long. With the fence, a 12-foot tall barrier achieved the noise reduction design goal of 7 dBA, with 14 benefitted receptors. However, it resulted in $107,604 per benefitted receptor, and therefore did not satisfy the reasonableness criterion. The same height, 12 feet, was required to satisfy the noise reduction design goal of 7 dBA when the fence was not included. This resulted in 12 benefitted receptors. The cost to construct this barrier would be $113,265 per benefitted receptor, and was also not of reasonable cost. Including the fence in the model does not influence the mitigation decision, thus additional sound measurement was not warranted.

7.2 Mitigation Analysis

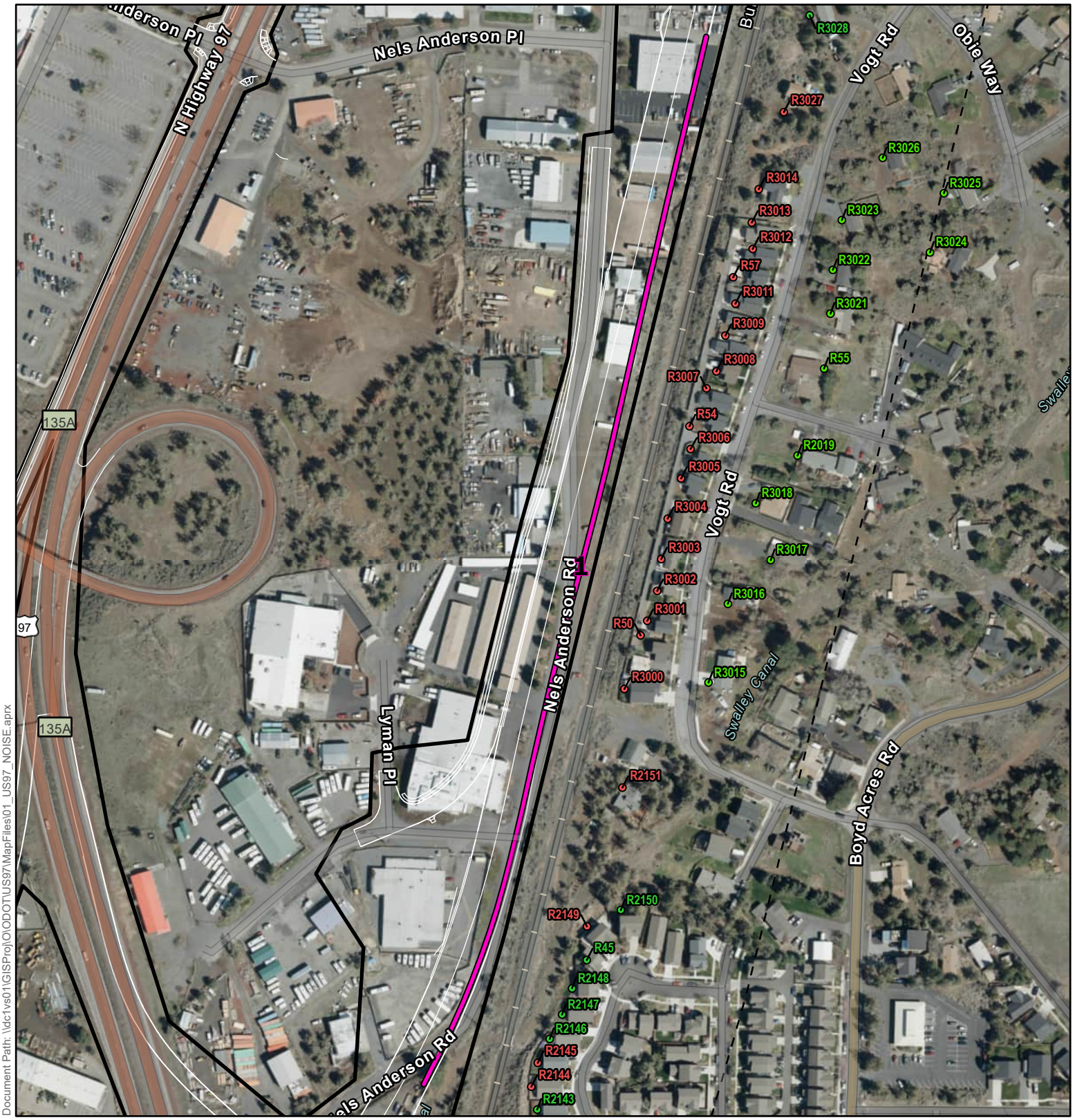
The reasonableness criteria was not met at any barriers analyzed. Barrier 2 is on structure and the additional cost of a barrier on structure was not included in this analysis. Potential engineering constraints would be more fully evaluated if the walls were found to be acoustically feasible and reasonable. Table 7-3 shows the results for each barrier. More details about each barrier and the impacted receivers are shown on the Figure 5-1 Mapbook.

Table 7-3. Detailed Feasibility and Reasonableness Abatement Analysis

Height (feet)	Total # of Benefitted Receptors	Achieves Design Goal of 7 dBA?	Length (feet)	Feasible?	Cost per Square Foot	Total Cost	Cost per Benefitted Receptor	Allowable Cost per Square Foot	Reasonable ?
Barrier 1									
8	1	No	2,435	Yes	30	$585,030	N/A	$37,500	No
10	18	Yes	2,435	Yes	30	$731,100	$40,617	$37,500	No
12	23	Yes	2,435	Yes	30	$877,440	$38,150	$37,500	No
14	23	Yes	2,435	Yes	30	$1,023,690	$44,508	$37,500	No
16	23	Yes	2,435	Yes	30	$1,169,880	$50,864	$37,500	No
Barrier 2									
8	0	No	3,561	No	30	$853,740	N/A	$37,500	No
10	0	No	3,561	Yes	30	$1,067,190	N/A	$37,500	No
12	7	Yes	3,561	Yes	30	$1,280,640	$116,422	$37,500	No
14	12	Yes	3,561	Yes	30	$1,494,120	$53,338	$37,500	No
16	13	Yes	3,561	Yes	30	$1,707,480	$56,916	$37,500	No
18	13	Yes	3,561	Yes	37.5	$2,401,538	$80,051	$37,500	No
20	13	Yes	3,561	Yes	37.5	$2,668,275	$83,384	$37,500	No
Barrier 3									
8	0	No	844	No	30	$202,410	N/A	$37,500	No
10	0	No	844	No	30	$253,020	N/A	$37,500	No
12	0	No	844	No	30	$303,630	N/A	$37,500	No
14	0	No	844	No	30	$354,300	N/A	$37,500	No
16	1	No	844	Yes	30	$404,940	$404,940	$37,500	No

Table 7-3. Detailed Feasibility and Reasonableness Abatement Analysis

Height (feet)	Total # of Benefitted Receptors	Achieves Design Goal of 7 dBA?	Length (feet)	Feasible?	Cost per Square Foot	Total Cost	Cost per Benefitted Receptor	Allowable Cost per Square Foot	Reasonable ?
Barrier 4									
8	0	No	267	No	30	$64,470	N/A	$52,500	No
10	0	No	267	No	30	$80,580	N/A	$52,500	No
12	0	No	267	No	30	$96,720	N/A	$52,500	No
14	0	No	267	No	30	$112,800	N/A	$52,500	No
16	0	No	267	No	30	$128,910	N/A	$52,500	No



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Locator Map

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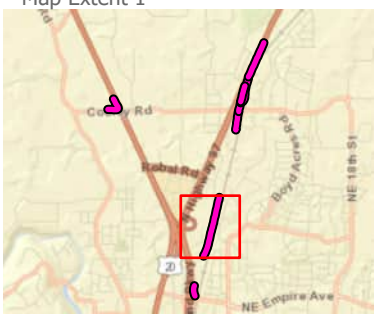


Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Potential Barriers
- Area of Potential Impact (API)
- Project Limits

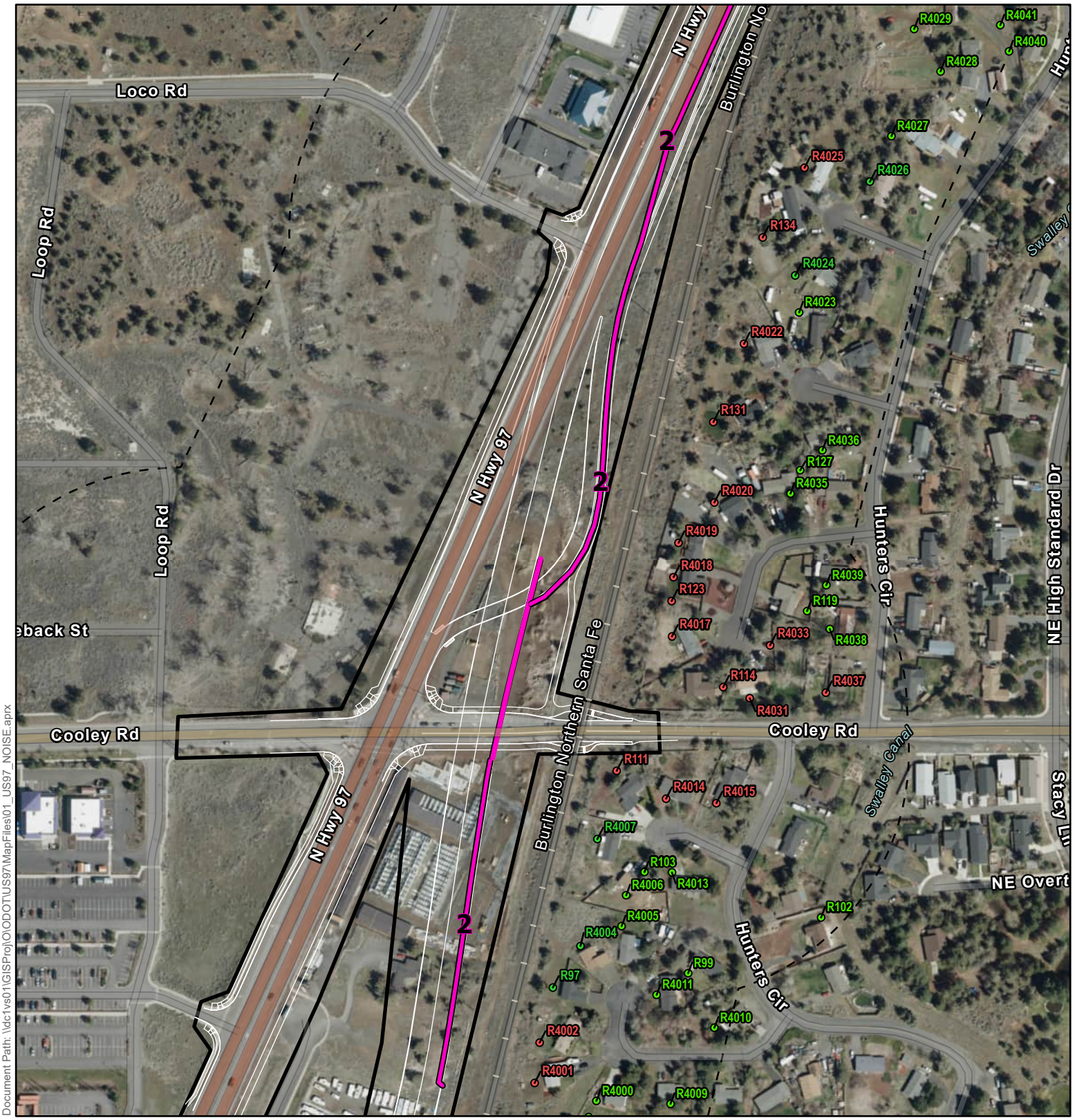
0 100 200 300 Feet

Figure 7-1
Barriers Analyzed

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



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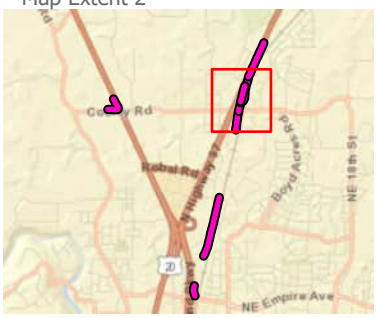
Locator Map

Map Extent 2



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Potential Barriers
- Area of Potential Impact (API)
- Project Limits

0 100 200 300 Feet

Figure 7-1
Barriers Analyzed

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

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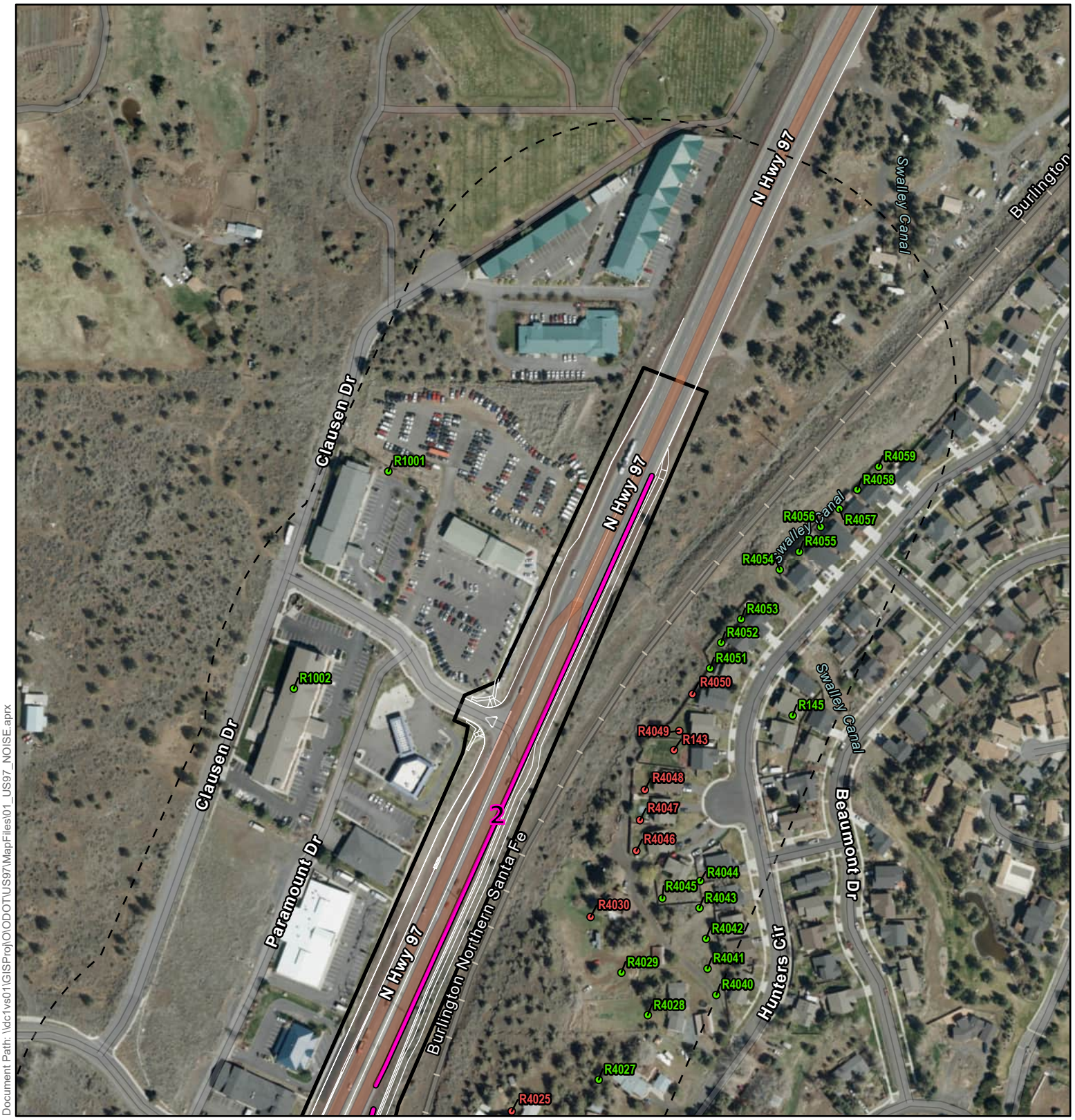

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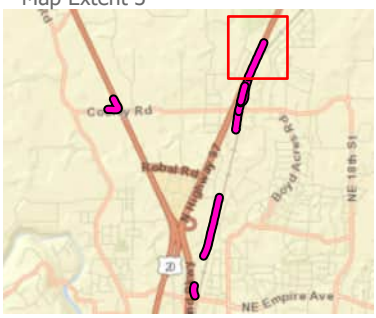
Map Extent 3



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Potential Barriers
- Area of Potential Impact (API)
- Project Limits

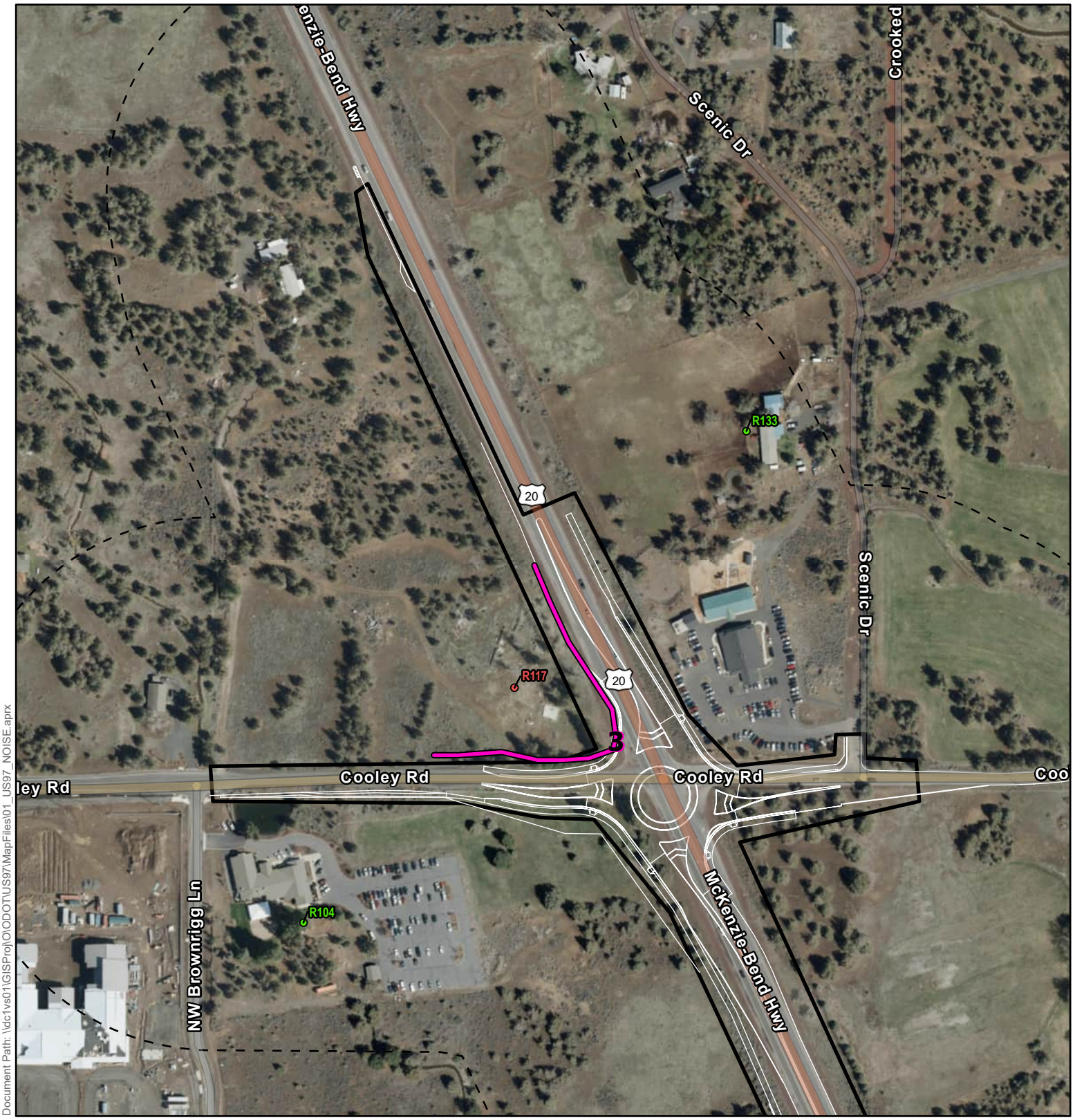
0 100 200 300 Feet

Figure 7-1
Barriers Analyzed

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

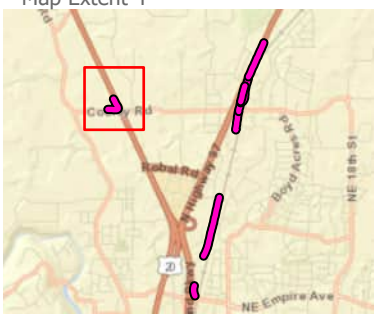
Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



Document Path: \\dc1vs01\GISProj\ODOT\US97\MapFiles\01_US97_NOISE.aprx

Locator Map

Map Extent 4



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Potential Barriers
- Area of Potential Impact (API)
- Project Limits

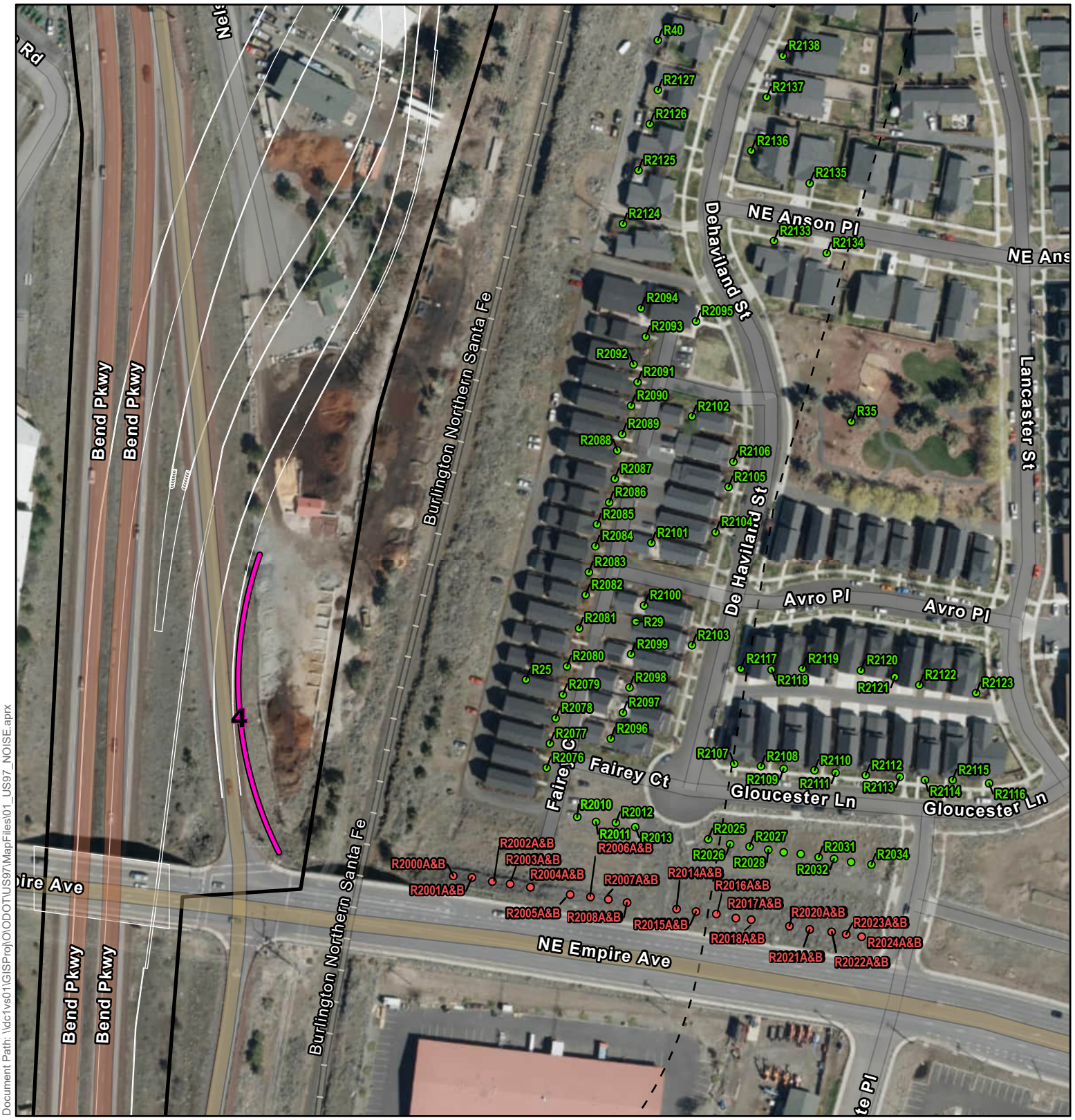
0 100 200 300 Feet

Figure 7-1
Barriers Analyzed

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

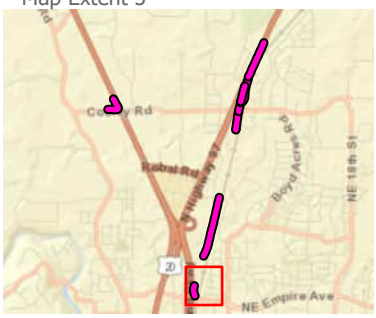
Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl



Document Path: \\dc1vs01\GISProj\O\ODOT\US97\MapFiles\01_US97_NOISE.aprx

Locator Map

Map Extent 5



Legend

- Impacted Noise Receptor
- Non-Impacted Noise Receptor
- Potential Barriers
- Area of Potential Impact (API)
- Project Limits

0 100 200 300 Feet

Figure 7-1
Barriers Analyzed

US 97 Cooley IC North Bend Corridor Improvement Project
Deschutes County, Oregon

Jacobs

Spatial Reference
Name: OCRS Bend-Redmond-Prineville NAD 1983 2011 LCC Feet Intl

8. References

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Appendix A
Formal Quality Control Process for Noise Deliverables

Formal QC Process for Noise Deliverables

QC process for internally produced Noise Technical Reports:

- Review by Noise Program Leader and a Professional Engineer with knowledge of noise modeling.
- The stamp and signature of the Professional Engineer on the Noise Technical Report serves as documentation of the formal QC.

QC process for internally produced Barrier Design Technical Memorandum:

- These are not typically produced by ODOT staff, but if it were to be done, QC would be performed by Noise Program Leader and a Professional Engineer with knowledge of noise modeling.
- The stamp and signature of the Professional Engineer on the document serves as documentation of the formal QC.

QC process for externally produced Noise Technical Reports:

- Consultant staff member (with noise expertise greater than or equal to the analyst) performs initial QC using the checklist from Appendix I of the Noise Manual which has been modified to include signature lines.
- An ODOT Noise Specialist performs additional QC and signs the checklist also when the report is satisfactory.
    - If ODOT review results in further revisions, the next draft of the report must be accompanied by a QC checklist for the new draft. The checklist should indicate the date of the report and what draft it is (1st, 2nd, 3rd, etc.).
- Additionally, a professional engineer in the same consulting firm which prepared the report must stamp the final document after an ODOT Noise Specialist has signed the QC form.
- Upon final approval of the report, a copy of the signed QC checklist and final report with PE stamp is to be provided to the Noise Program Leader.

QC process for externally produced Barrier Design Technical Memorandum:

- Consultant staff member (with noise expertise greater than or equal to the analyst) performs initial QC using the Quality Control Checklist for Noise Barrier Design Technical Memorandum.
- An ODOT Noise Specialist performs additional QC and signs the checklist also when the report is satisfactory.
    - If ODOT review results in further revisions, the next draft of the report must be accompanied by a QC checklist for the new draft. The checklist should indicate date of the report and what draft it is (1st, 2nd, 3rd, etc.).
- Additionally, a professional engineer in the same consulting firm which prepared the report must stamp the final document after an ODOT Noise Specialist has signed the QC form.
- Upon final approval of the memorandum, a copy of the signed QC checklist and final memorandum with PE stamp is to be provided to the Noise Program Leader.

Note: Noise Formal QC Process applies to projects that began project development during or after December 2019.

Oregon Department of Transportation

NOISE TECHNICAL REPORT
QUALITY CONTROL CHECKLIST

PROJECT NAME	KEY NUMBER	DRAFT NUMBER
US 97 and US 20 Bend North Corridor Project, Deschutes County, Oregon		2

NOISE ANALYST	SENIOR REVIEWER	REVIEW DATE
Rachel Saunders	Mark Bastasch	12/21/2022

Review Checklist

For check boxes that are missing or not applicable, please provide explanation in comments.

Table of Contents

- [x] Table of Contents (optional)

Summary

- [x] Concise project description
- [x] Noise levels ranges, by year, and alternative and noise impacts (include distance to Oregon NAAC levels for undeveloped land)
- [x] Abatement considerations and commitments
- [x] Construction Noise
- [ ] Information to local officials (1-2 sentences) See note below.

Introduction

- [x] Purpose of the report (why is this a Type 1 study?)

Project Description

- [x] Description of proposed construction
- [x] Existing alignment and proposed alignment shown on mapping
- [x] Number of existing and proposed travel lanes

Land Use

- [x] Existing houses, apartments, schools, places of worship, parks, businesses, etc. shown on 1::100 or 1:200 mapping
- [x] Identification of all activity categories in project area
- [x] Future Zoning and Comprehensive Land Use Plan Designations shown on mapping
- [ ] Displacements due to project construction

Methodology

- [x] Defining area of potential effect
- [x] Regulatory setting
- [x] Tables of NACs (include Oregon approach levels
- [x] Measurement procedures and equipment
- [x] Analysis procedures/model/version/model inputs/analysis years
- [x] Selection of noise sensitive receptors
- [x] Basis for worse-case noise condition (peak hour or peak truck hour)
- [x] Noise abatement requirements

Existing Acoustic Environment

☐ Selection of noise sensitive receptors including the number of equivalent units selected

Noise Measurements:

☐ Summary of each noise measurement location which includes noise sources present during monitoring

☐ Figure of monitoring locations shown on 1:100 or 1:200

■ Table summarizing date and time of measurements, traffic counts per vehicle type and direction, speed, and Leq level, distance of monitoring site from roadway

■ References to noise monitoring sheets and photographs of monitoring locations

Model Calibration:

■ Table of model calibration including measured and FHWA Traffic Noise Prediction Model modeled noise levels and difference

■ Modeling files for a calibration that include only traffic counts and speeds observed during monitoring

■ Statement confirming that measured and monitored noise levels differ by less than 3 dBA

■ References to modeling files

Traffic Noise Analysis

Predicted Leq Levels:

■ Comparison for worse case between peak hour and peak truck hour

■ Table of predicted noise levels for Existing

■ Table of predicted noise levels for No-Build Future

■ Tables of predicted noise levels for Build Future, all alternatives

■ Figures of prediction sites shown on 1:100 or 1:200 mapping

■ Discussion in text of noise levels ranges for exist, no-build and future build

Note: The number of tables used to summarize project noise levels will depend on size of project

Traffic Noise Summary

■ Summary table of Existing, No-Build Future, and Build Future noise that approach or exceed NAC for each alternative

■ Noise Abatement Criterion discussed and noise impacts using this criterion identified

■ Substantial Increase Criterion discussed and noise impacts using this criterion

■ Existing, No-Build Future, Build Future noise level that approach or meet NAC shown on 1:100 or 1:200 mapping

Noise Level Contours for Undeveloped Land

See note below.

☐ Predicted distances to Leq 65 dBA and 70 dBA for Category G

☐ Use 50-foot intervals or discrete locations

☐ Contour maps (optional if discrete Activity G receivers were reported in text)

Evaluation of Noise Abatement Measures

■ Discussion of alternative noise abatement measures: Alignment shifts, speed restrictions, grade changes, buffer zones, truck restrictions, etc.

Noise Abatement Measures

- [x] Number of equivalent-unit impacts mitigated per impacted receiver
- [x] Predicted noise levels without mitigation for each impacted receiver
- [x] Predicted noise levels with mitigation for each impacted receiver
- [x] Noise level reductions due to mitigation for each impacted receiver
- [x] Percent of first-row receivers achieving 5 dBA reduction
- [x] Total number of benefited receivers/units
- [x] Total number of benefited units receiving 7 dBA reduction in noise levels
- [x] Design goal requirements
- [x] Total cost as calculated in section 7.4.2 and cost per unit
- [x] Summary table of noise levels without barrier, with barrier, and noise reductions per receiver
- [x] Barrier summary table: length, height, area, cost, per equivalent unit, and recommendation
- [x] Locations of barriers shown on 1:100 or 1:200 map and marked as recommended for construction
- [x] Noise abatement likelihood statement
- [x] *Noise Evaluation and Recommendation* form for each noise abatement measure considered
- [x] Discussion of unavoidable impacts (by receiver as necessary)

Construction Noise Analysis

See note below.

- [ ] Typical construction noise levels
- [ ] Mitigation measures: Standard Control Specifications
- [ ] Nature and duration of construction noise
- [ ] Local ordinances relating to construction noise
- [ ] Land use of activities that may e affected by construction noise

Information for Local Government Officials

See note below.

- [ ] Discussion of noise compatible planning concepts
- [ ] Discussion of design year noise levels and distance to NAC criteria or NAC contours for undeveloped land
- [ ] Discussion of unavailability of federal funding for abatement after the date of public knowledge

Appendices

- [x] Traffic data used in the noise analysis
- [x] Electronic copies of all TNM modeling files, including TNM model calibration and mitigation files
- [x] Noise measurement field sheets and photographs (should include traffic counts taken in field)
- [ ] Special use area worksheets N/A
- [x] Abatement worksheets for recommended abatement

Other

Analyst should keep the following records on file: See note below.

- [ ] Calibration certificate of noise measurement
- [ ] Worksheets showing cost per residence calculation

Comments and Responses

This space is provided to document comments made by Consultant Quality Control Reviewer and how they were addressed by the Noise Analyst prior to transmitting the report to ODOT.

This is an addendum to the Noise Technical Report for the 2014 Final Environmental Impact Statement (FEIS). Because of this, some of the sections were not necessary for inclusion because the information was already covered in the FEIS.

Quality Control Signatures

I, the undersigned, attest that the quality of the subject report is acceptable and meets all requirements of federal noise regulation 23 CFR 772 and the ODOT Noise Manual.

Analyst	Consultant Quality Control Reviewer	ODOT Noise Specialist
Rachel M Saunders		

Appendix B
Traffic Data Used in the Noise Analysis

Existing

Link	Light Vehicles	Medium Trucks (inc. buses)	Heavy Trucks	Total
US 97 SB				
North of Grandview	1299	236	160	1695
South of Grandview	1303	237	160	1700
South of Clausen	1326	241	163	1730
South of Cooley	1311	238	161	1710
South of Robal	1666	304	205	2175
US 97 NB				
North of Grandview	1605	292	198	2095
North of Clausen	1644	299	202	2145
North of Cooley	1644	299	202	2145
North of Robal	1493	273	184	1950
North of Loop Ramp	1708	369	273	2350
Loop Ramp	421	77	52	550
North of NB On Ramp	1686	364	269	2900
NB On Ramp	530	*96*	65	691
North of NB Off Ramp	1249	227	154	2210
Empire NB Off Ramp	606	110	74	790
South of Empire	1249	227	154	3000
Cooley/US 20 Interchange				
Cooley WB, West of US 20	32	5	4	41
Cooley EB, West of US 20	67	11	8	86
Cooley WB, East of US 20	113	19	14	146
Cooley EB, East of US 20	151	26	18	195
US 20 NB, South of Cooley	1241	226	153	1620
US 20 SB, South of Cooley	729	133	90	952
US 20 NB, North of Cooley	1253	228	154	1635
US 20 SB, North of Cooley	748	136	92	976
Empire/US 97 NB On Ramp Interchange				
Empire WB, West of US 97 N	744	135	91	970
Empire EB, West of US 97 NB	721	130	89	940
Empire WB, East of US 97 NB	951	172	117	1240
Empire EB, East of US 97 NB	1008	183	124	1315
Robal/US 97 Interchange				
Robal WB, West of US 97	234	51	38	325
Robal EB, West of US 97	285	62	46	395
Robal WB, East of US 97	216	38	26	280
Robal EB, East of US 97	146	26	18	190
US 97 NB, South of Robal	1654	302	204	2160
Cooley/US 97 Interchange				
Cooley WB, West of US 97	191	35	24	250
Cooley EB, West of US 97	276	50	34	360
Cooley WB, East of US 97	345	63	42	450
Cooley EB, East of US 97	307	55	38	400

No Build

Link	Light Vehicles	Medium Trucks (inc. buses)	Heavy Trucks	Total
US 97 SB				
North of Grandview	1378	252	170	1800
South of Grandview	1432	262	176	1870
South of Clausen	1447	265	178	1890
South of Cooley	1505	275	185	1965
South of Robal	1823	333	224	2380
US 97 NB				
North of Grandview	2087	381	257	2725
North of Clausen	2164	395	266	2825
North of Cooley	2164	395	266	2825
North of Robal	1853	339	228	2420
North of Loop Ramp	2105	454	336	2895
Loop Ramp	831	152	102	1085
North of NB On Ramp	2894	625	462	3980
NB On Ramp	650	120	80	850
North of NB Off Ramp	2397	438	295	3130
Empire NB Off Ramp	819	150	101	1070
Cooley/US 20 Interchange				
Cooley WB, West of US 20	53	10	7	70
Cooley EB, West of US 20	230	42	28	300
Cooley WB, East of US 20	287	53	35	375
Cooley EB, East of US 20	215	39	26	280
US 20 NB, South of Cooley	1344	246	165	1755
US 20 SB, South of Cooley	930	170	115	1215
US 20 NB, North of Cooley	1490	272	183	1945
US 20 SB, North of Cooley	827	151	102	1080
Empire/US 97 NB On Ramp Interchange				
Empire WB, West of US 97 NB On Ram	1076	197	132	1405
Empire EB, West of US 97 NB On Ramp	811	149	100	1060
Empire WB, East of US 97 NB On Ramp	1325	242	163	1730
Empire EB, East of US 97 NB On Ramp	1229	225	151	1605
Robal/US 97 Interchange				
Robal WB, West of US 97	333	74	53	460
Robal EB, West of US 97	387	84	62	535
Robal WB, East of US 97	238	43	29	310
Robal EB, East of US 97	126	23	16	165
US 97 NB, South of Robal	1964	359	242	2565
Cooley/US 97 Interchange				
Cooley WB, West of US 97	321	59	40	420
Cooley EB, West of US 97	521	95	64	680
Cooley WB, East of US 97	686	125	84	895
Cooley EB, East of US 97	516	95	64	675

Build

Link	Light Vehicles	Medium Trucks (inc. buses)	Heavy Trucks	Total
New US 97 SB				
US 97 North of Grandview and NEW SB Cooley	1658	303	204	2165
New SB Cooley Off RAMP	624	114	77	815
US 97 South of Clausen Rd (New SB Cooley Off Ramp)	624	114	77	815
Robal SB On Ramp	644	117	79	840
US 97 SB South of Robal SB On Ramp	1296	88	88	1472
New US 97 NB				
US 97 North of Grandview	2164	395	266	2825
US 97 North of NB Cooley On Ramp/South of Grandview	2164	395	266	2825
New NB Cooley On Ramp	766	231	103	1100
US 97 NB North of New Empire NB On Ramp	1164	65	78	1307
NEW Empire NB ON Ramp	710	100	25	835
US 97 between 3rd Flyover to Loop and Emprie On Ramp	643	118	79	840
US 97 to 20 Loop Ramp	1221	51	13	1285
US 97 NB South of New 3rd Flyover to Loop Road	1964	359	242	2565
Off Ramp US 97 NB to Empire	593	109	73	775
Old US 97 SB				
US 97 North of Cooley	957	114	77	1148
US 97 South of Cooley	621	113	76	810
US 97 South of Robal	463	85	57	605
Old US 97 NB				
US 97 North of Robal	609	111	75	795
US 97 South of Robal	674	123	83	880
Loop Ramp				
Loop Ramp	647	45	8	700
Cooley/US 20 Interchange				
Cooley WB, West of US 20	118	22	15	155
Cooley EB, West of US 20	256	47	32	335
Cooley WB, East of US 20	414	75	51	540
Cooley EB, East of US 20	253	46	31	330
US 20 NB, South of Cooley	1252	229	154	1635
US 20 SB, South of Cooley	1145	209	141	1495
US 20 NB, North of Cooley	1282	235	158	1675
US 20 SB, North of Cooley	877	160	108	1145
Empire/New US 97 NB On Ramp Interchange				
Empire WB, West of US 97 NB On Ramp	678	124	83	885

Empire EB, West of US 97 NB On Ramp	774	141	95	1010
Empire WB, East of US 97 NB On Ramp	1240	227	153	1620
Empire EB, East of US 97 NB On Ramp	1313	240	162	1715
Robal/New US 97 Interchange				
Robal WB, West of US 97	241	44	30	315
Robal EB, West of US 97	674	123	83	880
Robal WB, East of US 97	111	20	14	145
Robal EB, East of US 97	716	131	88	935
US 97 SB, North of Robal	987	181	122	1290
Cooley/US 97 Interchange				
Cooley WB, West of US 97	360	66	44	470
Cooley EB, West of US 97	428	79	53	560
Cooley WB, East of US 97	632	115	78	825
Cooley EB, East of US 97	471	86	58	615

Appendix C
FHWA Traffic Noise Model Files
(provided electronically)

Appendix D
Barrier Optimization Table

U.S. Department of Transportation
Federal Highway Administration

Basic Noise Barrier Optimization Tool **12/20/2022**

US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon Barrier 1						
	8 Feet	**10 Feet**	**12 Feet**	**14 Feet**	**16 Feet**	**Units**
Average Wtd I.L. (benefited)	5.1	6	8.1	9	9.8	**dBA**
Maximum I.L.	5.1	6.7	9.3	10.3	11.2	**dBA**
Benefited/Impacted ≥ AFG	1	14	17	17	17	**# of dwelling units**
Benefited/Non Impact ≥ AFG	0	4	6	6	6	**# of dwelling units**
Total Benefited	1	18	23	23	23	**# of dwelling units**
Impacted Units ≥ NRDG	0	0	14	17	17	**# of dwelling units**
Benefited Units ≥ NRDG	0	0	19	22	23	**# of dwelling units**
Percent of impacts ≥ AFG	6%	82%	100%	100%	100%	**%**
Percent of benefits ≥ NRDG	0%	0%	83%	96%	100%	**%**
"Cost-Reasonable" ?	No	No	No	No	No	**----**
Surface Area	19,501	24,370	29,248	34,123	38,996	**sq-feet or sq-meters**
Surface Area/Ben Rec	19,501	1,354	1,272	1,484	1,695	**sq-ft or sq-m / ben rec**
Barrier Length	2,435	2,435	2,435	2,435	2,435	**ft or m**
Min Height	8	10	12	14	16	**ft or m**
Max Height	8	10	12	14	16	**ft or m**
Avg Height	8	10	12	14	16	**ft or m**
Total Barrier Cost	585,030	731,100	877,440	1,023,690	1,169,880	**$**
Cost/Ben Rec	585,030	40,617	38,150	44,508	50,864	**$ / ben rec**
Effectiveness/Cost Metric (E/C)	-	-	38.1	39.6	34.7	**----**

Acoustical Feasibility Goal (dBA)	5
Acoustical Feasibility Goal (%)	51%
Noise Reduction Design Goal (dBA)	7
Noise Reduction Design Goal (%)	1%

Basic Noise Barrier Optimization Tool

Effectiveness/Cost Metric (E/C) 0.0 **E/C** 0.0

Project Information

US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon
Contract No. 0
US 97 Noise Analysis
Barrier 1
Jacobs
Rachel Saunders
12/8/2022

U.S. Department of Transportation Federal Highway Administration

No Barrier Analysis

No Barrier

Total Units Exposed to Impact	**17**
# Impacts - NAC only	3
# Impacts - SI only	0
# Impacts - Both NAC & SI	14

Analysis1

unsaved

Average Wtd I.L. (benefited)	5.1	dB I.L. Avg
Maximum I.L.	5	dB I.L. Max
Benefited/Impacted ≥ AFG	1	# Prot Units
Benefited/Non Impact ≥ AFG	0	# Units
Total Benefited	1	# Ben Units
Impacted Units ≥ NRDG	0	# Units
Benefited Units ≥ NRDG	0	# Units
Percent of impacts ≥ AFG	6%	% Ben Units
Percent of benefits ≥ NRDG	0%	% NRDG Units
"Cost-Reasonable" ?	No	
Surface Area	19501	Sq Feet
Surface Area/Ben Rec	19501	Sq Feet
Barrier Length	2,435	Feet
Min Height	8.0	Feet
Max Height	8.0	Feet
Avg Height	8.0	Feet
Total Barrier Cost	$585,030	
Cost/Ben Rec	$585,030	

Analysis2

unsaved

Average Wtd I.L.	6.0	dB I.L. Avg
Maximum I.L.	7	dB I.L. Max
Benefited/Impacted ≥ AFG	14	# Prot Units
Benefited/Non Impact ≥ AFG	4	# Units
Total Benefited	18	# Ben Units
Impacted Units ≥ NRDG	0	# Units
Benefited Units ≥ NRDG	0	# Units
Percent of impacts ≥ AFG	82%	% Ben Units
Percent of benefits ≥ NRDG	0%	% NRDG Units
"Cost-Reasonable" ?	No	
Surface Area	24370	Sq Feet
Surface Area/Ben Rec	1354	Sq Feet
Barrier Length	2,435	Feet
Min Height	10.0	Feet
Max Height	10.0	Feet
Avg Height	10.0	Feet
Total Barrier Cost	$731,100	
Cost/Ben Rec	$40,617	

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited
R3013	1	B	1	67	Y	Impact!	1	63	4	Impact! w/ Bar		62	**5**	Impact! w/ Bar	
R3012	1	B	1	67	Y	Impact!	1	63	4	Impact! w/ Bar		62	4	Impact! w/ Bar	
R3009	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		62	**5**	Benefited/Impact	1
R3008	1	B	1	66	Y	Impact!	1	62	4	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R3007	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**6**	Benefited/Impact	1
54"	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**7**	Benefited/Impact	1
R3006	1	B	1	66	Y	Impact!	1	62	4	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R3005	1	B	1	66	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R3004	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**7**	Benefited/Impact	1
R3003	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**7**	Benefited/Impact	1
R3002	1	B	1	66	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R3001	1	B	1	67	Y	Impact!	1	62	**5**	Impact! w/ Bar		60	**6**	Benefited/Impact	1
50"	1	B	1	66	Y	Impact!	1	62	4	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R3000	1	B	1	66		Impact!	1	61	4	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R2151	1	B	1	63				60	3			59	**5**		
R2149	1	B	1	65		Impact!	1	60	**5**	Benefited/Impact	1	59	**6**	Benefited/Impact	1
45 (LT10-3)"	1	B	1	64				59	**5**			59	**6**	Benefited/Non-Imp	1
R2148	1	B	1	64				59	**5**			58	**5**	Benefited/Non-Imp	1
R2147	1	B	1	64				60	**5**			59	**6**	Benefited/Non-Imp	1
R2146	1	B	1	64				59	**5**			59	**5**	Benefited/Non-Imp	1
R2145	1	B	1	66	Y	Impact!	1	62	4	Impact! w/ Bar		61	**5**	Benefited/Impact	1
R2144	1	B	1	66		Impact!	1	62	4	Impact! w/ Bar		61	**5**	Impact! w/ Bar	
R2143	1	B	1	64				61	3			59	4		

E/C	38.1		E/C	39.6		E/C	34.7	
Analysis3			**Analysis4**			**Analysis5**		
unsaved			**unsaved**			**16 ft**		
Average Wtd I.L.	8.1	dB I.L. Avg	Average Wtd I.L.	9.0	dB I.L. Avg	Average Wtd I.L.	9.8	dB I.L. Avg
Maximum I.L.	9	dB I.L. Max	Maximum I.L.	10	dB I.L. Max	Maximum I.L.	11	dB I.L. Max
Benefited/Impacted ≥ AFG	17	# Prot Units	Benefited/Impacted ≥ AFG	17	# Prot Units	Benefited/Impacted ≥ AFG	17	# Prot Units
Benefited/Non Impact ≥ AFG	6	# Units	Benefited/Non Impact ≥ AFG	6	# Units	Benefited/Non Impact ≥ AFG	6	# Units
Total Benefited	23	# Ben Units	Total Benefited	23	# Ben Units	Total Benefited	23	# Ben Units
Impacted Units ≥ NRDG	14	# Units	Impacted Units ≥ NRDG	17	# Units	Impacted Units ≥ NRDG	17	# Units
Benefited Units ≥ NRDG	19	# Units	Benefited Units ≥ NRDG	22	# Units	Benefited Units ≥ NRDG	23	# Units
Percent of impacts ≥ AFG	100%	% Ben Units	Percent of impacts ≥ AFG	100%	% Ben Units	Percent of impacts ≥ AFG	100%	% Ben Units
Percent of benefits ≥ NRDG	83%	% NRDG Units	Percent of benefits ≥ NRDG	96%	% NRDG Units	Percent of benefits ≥ NRDG	100%	% NRDG Units
"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No	
Surface Area	29248	Sq Feet	Surface Area	34123	Sq Feet	Surface Area	38996	Sq Feet
Surface Area/Ben Rec	1272	Sq Feet	Surface Area/Ben Rec	1484	Sq Feet	Surface Area/Ben Rec	1695	Sq Feet
Barrier Length	2,435	Feet	Barrier Length	2,435	Feet	Barrier Length	2,435	Feet
Min Height	12.0	Feet	Min Height	14.0	Feet	Min Height	16.0	Feet
Max Height	12.0	Feet	Max Height	14.0	Feet	Max Height	16.0	Feet
Avg Height	12.0	Feet	Avg Height	14.0	Feet	Avg Height	16.0	Feet
Total Barrier Cost	$877,440		Total Barrier Cost	$1,023,690		Total Barrier Cost	$1,169,880	
Cost/Ben Rec	$38,150		Cost/Ben Rec	$44,508.26		Cost/Ben Rec	$50,864	

With Barrier Sound Levels, Impact and Benefit				**With Barrier Sound Levels, Impact and Benefit**				**With Barrier Sound Levels, Impact and Benefit**			
Leq(dBA)	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**
60	**7**	Benefited/Impact	1	59	**8**	Benefited/Impact	1	59	**8**	Benefited/Impact	1
60	**7**	Benefited/Impact	1	59	**8**	Benefited/Impact	1	58	**8**	Benefited/Impact	1
59	**8**	Benefited/Impact	1	58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1
58	**8**	Benefited/Impact	1	57	**9**	Benefited/Impact	1	56	**10**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
57	**9**	Benefited/Impact	1	56	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
57	**9**	Benefited/Impact	1	56	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
58	**9**	Benefited/Impact	1	57	**10**	Benefited/Impact	1	56	**11**	Benefited/Impact	1
57	**8**	Benefited/Impact	1	56	**9**	Benefited/Impact	1	55	**10**	Benefited/Impact	1
56	**7**	Benefited/Non-Imp	1	55	**8**	Benefited/Non-Imp	1	54	**9**	Benefited/Non-Imp	1
56	**9**	Benefited/Impact	1	56	**10**	Benefited/Impact	1	55	**10**	Benefited/Impact	1
56	**8**	Benefited/Non-Imp	1	55	**9**	Benefited/Non-Imp	1	54	**10**	Benefited/Non-Imp	1
56	**8**	Benefited/Non-Imp	1	55	**9**	Benefited/Non-Imp	1	54	**10**	Benefited/Non-Imp	1
56	**8**	Benefited/Non-Imp	1	56	**9**	Benefited/Non-Imp	1	55	**9**	Benefited/Non-Imp	1
56	**8**	Benefited/Non-Imp	1	56	**8**	Benefited/Non-Imp	1	55	**9**	Benefited/Non-Imp	1
59	**7**	Benefited/Impact	1	58	**8**	Benefited/Impact	1	57	**9**	Benefited/Impact	1
59	**7**	Benefited/Impact	1	58	**8**	Benefited/Impact	1	58	**8**	Benefited/Impact	1
58	**6**	Benefited/Non-Imp	1	57	**7**	Benefited/Non-Imp	1	56	**7**	Benefited/Non-Imp	1

U.S. Department of Transportation
Federal Highway Administration

Basic Noise Barrier Optimization Tool **12/20/2022**

US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon
Barrier 2

	8 Feet	10 Feet	12 Feet	14 Feet	16 Feet	18 Feet	20 Feet	Units
Average Wtd I.L. (benefited)			5.8	6.2	6.7	7.2	7.5	dBA
Maximum I.L.	3.2	4.6	7	8.5	9.4	10	10.5	dBA
Benefited/Impacted ≥ AFG	0	0	7	12	13	13	13	# of dwelling units
Benefited/Non Impact ≥ AFG	0	0	4	15	17	17	19	# of dwelling units
Total Benefited	0	0	11	27	30	30	32	# of dwelling units
Impacted Units ≥ NRDG	0	0	1	5	9	10	10	# of dwelling units
Benefited Units ≥ NRDG	0	0	1	5	11	17	19	# of dwelling units
Percent of impacts ≥ AFG	0%	0%	33%	57%	62%	62%	62%	%
Percent of benefits ≥ NRDG			9%	19%	37%	57%	59%	%
"Cost-Reasonable" ?			No	No	No	No	No	----
Surface Area	28,458	35,573	42,688	49,804	56,916	64,041	71,154	sq-feet or sq-meters
Surface Area/Ben Rec			3,881	1,845	1,897	2,135	2,224	sq-ft or sq-m / ben rec
Barrier Length	3,561	3,561	3,561	3,561	3,561	3,561	3,561	ft or m
Min Height	8	10	12	14	16	18	20	ft or m
Max Height	8	10	12	14	16	18	20	ft or m
Avg Height	8	10	12	14	16	18	20	ft or m
Total Barrier Cost	853,740	1,067,190	1,280,640	1,494,120	1,707,480	2,401,538	2,668,275	$
Cost/Ben Rec			116,422	55,338	56,916	80,051	83,384	$ / ben rec
Effectiveness/Cost Metric (E/C)	-	-	0.6	6.1	10.8	10.6	10.2	----

Acoustical Feasibilty Goal (dBA)	5
Acoustical Feasibilty Goal (%)	51%
Noise Reduction Design Goal (dBA)	7
Noise Reduction Design Goal (%)	1%

Basic Noise Barrier Optimization Tool

Project Information	No Barrier Analysis	Effectiveness/Cost Metric (E/C) 0.0	E/C 0.0	E/C 0.6
	No Barrier	Analysis1	Analysis2	Analysis3
		8 ft	10 ft	12 ft

US 97 Cooley IC North Bend Corridor Improvement Project,
Deschutes County, Oregon
Contract No. 0
US 97 Noise Analysis
Barrier 2
Jacobs
Rachel Saunders
10/10/2022

U.S. Department of Transportation Federal Highway Administration

	No Barrier	Analysis1 (8 ft)		Analysis2 (10 ft)		Analysis3 (12 ft)	
Total Units Exposed to Impact	21	Average Wtd I.L. (benefited)	dB I.L. Avg	Average Wtd I.L.	dB I.L. Avg	Average Wtd I.L.	5.8 dB I.L. Avg
# Impacts - NAC only	21	Maximum I.L.	3 dB I.L. Max	Maximum I.L.	5 dB I.L. Max	Maximum I.L.	7 dB I.L. Max
# Impacts - SI only	0	Benefited/Impacted ≥ AFG	0 # Prot Units	Benefited/Impacted ≥ AFG	0 # Prot Units	Benefited/Impacted ≥ AFG	7 # Prot Units
# Impacts - Both NAC & SI	0	Benefited/Non Impact ≥ AFG	0 # Units	Benefited/Non Impact ≥ AFG	0 # Units	Benefited/Non Impact ≥ AFG	4 # Units
		Total Benefited	0 # Ben Units	Total Benefited	0 # Ben Units	Total Benefited	11 # Ben Units
		Impacted Units ≥ NRDG	0 # Units	Impacted Units ≥ NRDG	0 # Units	Impacted Units ≥ NRDG	1 # Units
		Benefited Units ≥ NRDG	0 # Units	Benefited Units ≥ NRDG	0 # Units	Benefited Units ≥ NRDG	1 # Units
		Percent of impacts ≥ AFG	0% % Ben Units	Percent of impacts ≥ AFG	0% % Ben Units	Percent of impacts ≥ AFG	33% % Ben Units
		Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG	9% % NRDG Units
		"Cost-Reasonable" ?		"Cost-Reasonable" ?		"Cost-Reasonable" ?	No
		Surface Area	28458 Sq Feet	Surface Area	35573 Sq Feet	Surface Area	42688 Sq Feet
		Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec	3881 Sq Feet
		Barrier Length	3,561 Feet	Barrier Length	3,561 Feet	Barrier Length	3,561 Feet
		Min Height	8.0 Feet	Min Height	10.0 Feet	Min Height	12.0 Feet
		Max Height	8.0 Feet	Max Height	10.0 Feet	Max Height	12.0 Feet
		Avg Height	8.0 Feet	Avg Height	10.0 Feet	Avg Height	12.0 Feet
		Total Barrier Cost	$853,740	Total Barrier Cost	$1,067,190	Total Barrier Cost	$1,280,640
		Cost/Ben Rec		Cost/Ben Rec		Cost/Ben Rec	$116,422

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited
R4017	1	B	1	65		Impact!	1	64	1	Impact! w/ Bar		63	1	Impact! w/ Bar		64	2	Impact! w/ Bar	
R4018	1	B	1	66		Impact!	1	64	2	Impact! w/ Bar		64	2	Impact! w/ Bar		64	3	Impact! w/ Bar	
R4019	1	B	1	66		Impact!	1	64	2	Impact! w/ Bar		63	3	Impact! w/ Bar		63	4	Impact! w/ Bar	
R4020	1	B	1	65		Impact!	1	63	2	Impact! w/ Bar		62	2	Impact! w/ Bar		62	4	Impact! w/ Bar	
R4031	1	B	1	71		Impact!	1	70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar	
R4033	1	B	1	65		Impact!	1	64	1	Impact! w/ Bar		64	1	Impact! w/ Bar		64	1	Impact! w/ Bar	
R4035	1	B	1	62				60	1			60	2			60	3		
R4036	1	B	1	62				60	2			60	2			60	3		
R4038	1	B	1	63				62	1			62	1			62	1		
R4039	1	B	1	62				61	1			61	1			61	2		
R4022	1	B	1	65		Impact!	1	63	2	Impact! w/ Bar		62	3	Impact! w/ Bar		61	**5**	Impact! w/ Bar	
R4024	1	B	1	63				62	2			61	2			60	4		
R4025	1	B	1	68		Impact!	1	64	3	Impact! w/ Bar		64	4	Impact! w/ Bar		65	4	Impact! w/ Bar	
R4026	1	B	1	63				62	2			61	2			61	3		
R4027	1	B	1	63				61	2			61	2			59	4		
R4028	1	B	1	61				60	2			59	2			57	**5**		
R4029	1	B	1	63				61	2			60	3			58	**5**	Benefited/Non-Imp	1
R4030	0	B	1	66		Impact!	1	63	3	Impact! w/ Bar		62	4	Impact! w/ Bar		59	**7**	Benefited/Impact	1
R4040	0	B	1	59				58	1			58	2			56	4		
R4041	0	B	1	60				58	1			58	2			56	4		
R4042	0	B	1	60				58	2			58	2			56	4		
R4043	0	B	1	60				59	2			59	2			56	**5**		
R4044	0	B	1	58				57	1			57	1			55	3		
R4045	0	B	1	63				61	2			61	3			60	4		
R4046	0	B	1	65		Impact!	1	62	3	Impact! w/ Bar		62	3	Impact! w/ Bar		59	**7**	Benefited/Impact	1
R4047	0	B	1	66		Impact!	1	63	3	Impact! w/ Bar		62	3	Impact! w/ Bar		59	**6**	Benefited/Impact	1
R4048	0	B	1	66		Impact!	1	63	3	Impact! w/ Bar		63	3	Impact! w/ Bar		60	**6**	Benefited/Impact	1
R4049	0	B	1	65		Impact!	1	63	2	Impact! w/ Bar		63	3	Impact! w/ Bar		60	**5**	Benefited/Impact	1
R4050	0	B	1	65		Impact!	1	63	2	Impact! w/ Bar		63	2	Impact! w/ Bar		60	**5**	Impact! w/ Bar	
R4051	0	B	1	63				62	1			62	2			59	**5**		
R4052	0	B	1	64				62	1			62	2			60	4		
R4053	0	B	1	62				61	1			60	1			58	4		
114"	0	B	1	69		Impact!	1	69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	1	Impact! w/ Bar	
119"	0	B	1	63				62	1			62	1			62	2		
123"	0	B	1	64				63	1			63	2			63	3		
127"	0	B	1	62				60	2			60	2			60	3		
131"	0	B	1	65		Impact!	1	63	2	Impact! w/ Bar		62	3	Impact! w/ Bar		62	**5**	Impact! w/ Bar	
134 (ST08-4)"	0	B	1	65		Impact!	1	63	2	Impact! w/ Bar		63	3	Impact! w/ Bar		61	**5**	Benefited/Impact	1
143 (ST08-5)"	0	B	1	65		Impact!	1	63	2	Impact! w/ Bar		62	3	Impact! w/ Bar		60	**6**	Benefited/Impact	1
145"	0	B	1	57				57	1			56	1			55	3		
R4000	0	B	1	60				59	2			58	2			59	4		
R4001	0	B	1	63				61	2			59	4			61	**5**	Benefited/Non-Imp	1
R4002	0	B	1	63				61	2			59	4			60	**5**	Benefited/Non-Imp	1
R4004	0	B	1	64				61	3			60	4			61	**5**		
R4005	0	B	1	62				60	2			59	3			60	4		
R4006	0	B	1	62				60	2			60	3			60	4		
R4007	0	B	1	64				62	1			62	2			62	3		
R4009	0	B	1	59				58	1			58	2			58	3		

R4010	0	B	1	60				58	1		58	2		58	3					
R4011	0	B	1	62				60	2		60	2		60	4					
R4013	0	B	1	62				61	1		60	2		61	3					
R4014	0	B	1	**66**		Impact!	1	65	1	Impact! w/ Bar	65	1	Impact! w/ Bar	65	2	Impact! w/ Bar				
R4015	0	B	1	**65**		Impact!	1	64	1	Impact! w/ Bar	64	1	Impact! w/ Bar	64	1	Impact! w/ Bar				
91 (ST08-2)"	0	B	1	60				59	2		58	2		59	4					
97"	0	B	1	63				61	3		59	**5**		60	**6**	Benefited/Non-Imp	1			
99"	0	B	1	62				60	2		59	2		60	3					
102"	0	B	1	59				58	1		58	1		58	2					
103 (ST08-1)"	0	B	1	62				61	1		60	2		61	3					
111"	0	B	1	**68**		Impact!	1	68	0	Impact! w/ Bar	68	1	Impact! w/ Bar	68	1	Impact! w/ Bar				

E/C	6.1		E/C	10.8		E/C	10.6		E/C	10.2		E/C			E/C		
Analysis4			**Analysis5**			**Analysis6**			**Analysis7**			**Analysis8**			**Analysis9**		
14 ft			**16 ft**			**18 ft**			**20 ft**			**22 ft**			**24 ft**		
Average Wtd I.L.	6.2	dB I.L. Avg	Average Wtd I.L.	6.7	dB I.L. Avg	Average Wtd I.L.	7.2	dB I.L. Avg	Average Wtd I.L.	7.5	dB I.L. Avg	Average Wtd I.L.	7.7	dB I.L. Avg	Average Wtd I.L.	7.9	dB I.L. Avg
Maximum I.L.	9	dB I.L. Max	Maximum I.L.	9	dB I.L. Max	Maximum I.L.	10	dB I.L. Max	Maximum I.L.	11	dB I.L. Max	Maximum I.L.	11	dB I.L. Max	Maximum I.L.	11	dB I.L. Max
Benefited/Impacted ≥ AFG	12	# Prot Units	Benefited/Impacted ≥ AFG	13	# Prot Units	Benefited/Impacted ≥ AFG	13	# Prot Units	Benefited/Impacted ≥ AFG	13	# Prot Units	Benefited/Impacted ≥ AFG	13	# Prot Units	Benefited/Impacted ≥ AFG	14	# Prot Units
Benefited/Non Impact ≥ AFG	15	# Units	Benefited/Non Impact ≥ AFG	17	# Units	Benefited/Non Impact ≥ AFG	17	# Units	Benefited/Non Impact ≥ AFG	19	# Units	Benefited/Non Impact ≥ AFG	21	# Units	Benefited/Non Impact ≥ AFG	21	# Units
Total Benefited	27	# Ben Units	Total Benefited	30	# Ben Units	Total Benefited	30	# Ben Units	Total Benefited	32	# Ben Units	Total Benefited	34	# Ben Units	Total Benefited	35	# Ben Units
Impacted Units ≥ NRDG	5	# Units	Impacted Units ≥ NRDG	9	# Units	Impacted Units ≥ NRDG	10	# Units	Impacted Units ≥ NRDG	10	# Units	Impacted Units ≥ NRDG	10	# Units	Impacted Units ≥ NRDG	11	# Units
Benefited Units ≥ NRDG	5	# Units	Benefited Units ≥ NRDG	11	# Units	Benefited Units ≥ NRDG	17	# Units	Benefited Units ≥ NRDG	19	# Units	Benefited Units ≥ NRDG	21	# Units	Benefited Units ≥ NRDG	22	# Units
Percent of impacts ≥ AFG	57%	% Ben Units	Percent of impacts ≥ AFG	62%	% Ben Units	Percent of impacts ≥ AFG	62%	% Ben Units	Percent of impacts ≥ AFG	62%	% Ben Units	Percent of impacts ≥ AFG	62%	% Ben Units	Percent of impacts ≥ AFG	67%	% Ben Units
Percent of benefits ≥ NRDG	19%	% NRDG Units	Percent of benefits ≥ NRDG	37%	% NRDG Units	Percent of benefits ≥ NRDG	57%	% NRDG Units	Percent of benefits ≥ NRDG	59%	% NRDG Units	Percent of benefits ≥ NRDG	62%	% NRDG Units	Percent of benefits ≥ NRDG	63%	% NRDG Units
"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	No		"Cost-Reasonable" ?	Yes		"Cost-Reasonable" ?	Yes	
Surface Area	49804	Sq Feet	Surface Area	56916	Sq Feet	Surface Area	64041	Sq Feet	Surface Area	71154	Sq Feet	Surface Area	0	Sq Feet	Surface Area	0	Sq Feet
Surface Area/Ben Rec	1845	Sq Feet	Surface Area/Ben Rec	1897	Sq Feet	Surface Area/Ben Rec	2135	Sq Feet	Surface Area/Ben Rec	2224	Sq Feet	Surface Area/Ben Rec	0	Sq Feet	Surface Area/Ben Rec	0	Sq Feet
Barrier Length	3,561	Feet	Barrier Length	3,561	Feet	Barrier Length	3,561	Feet	Barrier Length	3,561	Feet	Barrier Length	0	Feet	Barrier Length	0	Feet
Min Height	14.0	Feet	Min Height	16.0	Feet	Min Height	18.0	Feet	Min Height	20.0	Feet	Min Height	0.0	Feet	Min Height	0.0	Feet
Max Height	14.0	Feet	Max Height	16.0	Feet	Max Height	18.0	Feet	Max Height	20.0	Feet	Max Height	0.0	Feet	Max Height	0.0	Feet
Avg Height	14.0	Feet	Avg Height	16.0	Feet	Avg Height	18.0	Feet	Avg Height	20.0	Feet	Avg Height	0.0	Feet	Avg Height	0.0	Feet
Total Barrier Cost	$1,494,120		Total Barrier Cost	$1,707,480		Total Barrier Cost	$2,401,538		Total Barrier Cost	$2,668,275		Total Barrier Cost	$0		Total Barrier Cost	$0	
Cost/Ben Rec	$55,337.78		Cost/Ben Rec	$56,916		Cost/Ben Rec	$80,051		Cost/Ben Rec	$83,384		Cost/Ben Rec	$0		Cost/Ben Rec	$0	

With Barrier Sound Levels, Impact and Benefit					With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit				With Barrier Sound Levels, Impact and Benefit			
Leq(dBA)	IL (db)	Impacted?	No.	Benefited	Leq(dBA)	IL (db)	Impacted?	No.	Benefited	Leq(dBA)	IL (db)	Impacted?	No.	Benefited	Leq(dBA)	IL (db)	Impacted?	No.	Benefited	Leq(dBA)	IL (db)	Impacted?	No.	Benefited
63	2	Impact! w/ Bar			62	2	Impact! w/ Bar			62	3	Impact! w/ Bar			62	3	Impact! w/ Bar			62	3	Impact! w/ Bar		
62	4	Impact! w/ Bar			62	4	Impact! w/ Bar			61	4	Impact! w/ Bar			61	5	Impact! w/ Bar			61	5	Benefited/Impact		1
61	**5**	Benefited/Impact		1	60	**6**	Benefited/Impact		1	60	**6**	Benefited/Impact		1	60	**6**	Benefited/Impact		1	59	**7**	Benefited/Impact		1
60	**5**	Impact! w/ Bar			59	**5**	Benefited/Impact		1	59	**6**	Benefited/Impact		1	58	**6**	Benefited/Impact		1	58	**7**	Benefited/Impact		1
70	0	Impact! w/ Bar			70	0	Impact! w/ Bar			70	0	Impact! w/ Bar			70	0	Impact! w/ Bar			70	0	Impact! w/ Bar		
64	1	Impact! w/ Bar			63	1	Impact! w/ Bar			63	1	Impact! w/ Bar			63	1	Impact! w/ Bar			63	1	Impact! w/ Bar		
58	4				58	4				57	4				57	**5**				57	**5**	Benefited/Non-Imp		1
58	4				58	4				57	**5**				57	**5**	Benefited/Non-Imp		1	57	**5**	Benefited/Non-Imp		1
61	1				61	1				61	1				61	2				61	2			
60	2				60	2				59	2				59	3				59	3			
59	**6**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	57	**8**	Benefited/Impact		1	56	**8**	Benefited/Impact		1	56	**9**	Benefited/Impact		1
58	**6**	Benefited/Non-Imp		1	57	**7**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1	56	**8**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1
60	**7**	Benefited/Impact		1	59	**8**	Benefited/Impact		1	58	**9**	Benefited/Impact		1	58	**10**	Benefited/Impact		1	57	**11**	Benefited/Impact		1
58	**5**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1	56	**8**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1
57	**6**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1
55	**6**	Benefited/Non-Imp		1	54	**7**	Benefited/Non-Imp		1	54	**8**	Benefited/Non-Imp		1	54	**8**	Benefited/Non-Imp		1	53	**9**	Benefited/Non-Imp		1
56	**7**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1	54	**8**	Benefited/Non-Imp		1	54	**9**	Benefited/Non-Imp		1	53	**9**	Benefited/Non-Imp		1
57	**9**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	56	**10**	Benefited/Impact		1	55	**11**	Benefited/Impact		1	55	**11**	Benefited/Impact		1
54	**5**	Benefited/Non-Imp		1	53	**6**	Benefited/Non-Imp		1	53	**6**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	52	**7**	Benefited/Non-Imp		1
54	**6**	Benefited/Non-Imp		1	54	**6**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	52	**8**	Benefited/Non-Imp		1
54	**6**	Benefited/Non-Imp		1	54	**6**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	52	**8**	Benefited/Non-Imp		1
54	**6**	Benefited/Non-Imp		1	54	**7**	Benefited/Non-Imp		1	53	**7**	Benefited/Non-Imp		1	53	**8**	Benefited/Non-Imp		1	52	**8**	Benefited/Non-Imp		1
54	4				54	4				54	**5**				53	**5**				53	**5**	Benefited/Non-Imp		1
57	**7**	Benefited/Non-Imp		1	56	**8**	Benefited/Non-Imp		1	55	**8**	Benefited/Non-Imp		1	55	**9**	Benefited/Non-Imp		1	54	**9**	Benefited/Non-Imp		1
57	**8**	Benefited/Impact		1	56	**9**	Benefited/Impact		1	56	**10**	Benefited/Impact		1	55	**10**	Benefited/Impact		1	55	**11**	Benefited/Impact		1
58	**8**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	56	**10**	Benefited/Impact		1	56	**10**	Benefited/Impact		1
59	**8**	Benefited/Impact		1	58	**8**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	57	**10**	Benefited/Impact		1
59	**6**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	58	**8**	Benefited/Impact		1	57	**8**	Benefited/Impact		1
59	**6**	Benefited/Impact		1	59	**6**	Benefited/Impact		1	58	**6**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	58	**7**	Benefited/Impact		1
58	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**7**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1	56	**7**	Benefited/Non-Imp		1
59	**5**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1
57	**5**				56	**5**	Benefited/Non-Imp		1	56	**6**	Benefited/Non-Imp		1	55	**6**	Benefited/Non-Imp		1	55	**6**	Benefited/Non-Imp		1
68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar		
61	2				61	2				61	2				61	2				61	2			
61	3				61	4				61	4				61	4				60	4			
58	4				57	4				57	**5**				57	**5**	Benefited/Non-Imp		1	56	**6**	Benefited/Non-Imp		1
59	**6**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	57	**8**	Benefited/Impact		1	57	**8**	Benefited/Impact		1
59	**7**	Benefited/Impact		1	58	**8**	Benefited/Impact		1	57	**9**	Benefited/Impact		1	56	**9**	Benefited/Impact		1	56	**10**	Benefited/Impact		1
58	**7**	Benefited/Impact		1	58	**7**	Benefited/Impact		1	57	**8**	Benefited/Impact		1	57	**8**	Benefited/Impact		1	57	**8**	Benefited/Impact		1
54	3				54	3				54	3				54	4				54	4			
57	4				56	4				56	4				56	4				56	4			
58	**5**	Benefited/Non-Imp		1	58	**5**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1
58	**5**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1
59	**5**				59	**5**	Benefited/Non-Imp		1	58	**5**	Benefited/Non-Imp		1	58	**5**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1
58	4				58	4				58	4				58	4				58	**5**			
59	3				59	4				59	4				59	4				58	4			
61	2				61	3				61	3				61	3				61	3			
56	3				56	3				56	3				56	3				56	4			
56	3				56	3				56	4				56	4				56	4			
58	4				58	4				58	4				58	4				57	**5**			
60	2				59	3				59	3				59	3				59	3			
65	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar		
64	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar			64	1	Impact! w/ Bar		
57	4				56	4				56	4				56	4				56	4			
58	**6**	Benefited/Non-Imp		1	58	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**6**	Benefited/Non-Imp		1	57	**7**	Benefited/Non-Imp		1
58	3				58	4				58	4				58	4				57	4			
57	2				57	2				57	2				57	2				57	2			
60	3				60	3				60	3				60	3				59	3			
68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar			68	1	Impact! w/ Bar		

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Basic Noise Barrier Optimization Tool **12/20/2022**

US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon
Barrier 3

	8 Feet	10 Feet	12 Feet	14 Feet	16 Feet	Analysis6	Analysis7	Analysis8	Analysis9	Analysis10	Analysis11	Analysis12	Analysis13	Analysis14	Analysis15	Units
Average Wtd I.L. (benefited)					5.2											dBA
Maximum I.L.	1.5	2.1	4.2	4.8	5.2	0	0	0	0	0	0	0	0	0	0	dBA
Benefited/Impacted ≥ AFG	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Benefited/Non Impact ≥ AFG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Total Benefited	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Impacted Units ≥ NRDG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Benefited Units ≥ NRDG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Percent of impacts ≥ AFG	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	%
Percent of benefits ≥ NRDG					0%											%
"Cost-Reasonable" ?					No											----
Surface Area	6,747	8,434	10,121	11,810	13,498	-	-	-	-	-	-	-	-	-	-	sq-feet or sq-meters
Surface Area/Ben Rec					13,498											sq-ft or sq-m / ben rec
Barrier Length	844	844	844	844	844	-	-	-	-	-	-	-	-	-	-	ft or m
Min Height	8	10	12	14	16	-	-	-	-	-	-	-	-	-	-	ft or m
Max Height	8	10	12	14	16	-	-	-	-	-	-	-	-	-	-	ft or m
Avg Height	8	10	12	14	16											ft or m
Total Barrier Cost	202,410	253,020	303,630	354,300	404,940	-	-	-	-	-	-	-	-	-	-	$
Cost/Ben Rec					404,940											$ / ben rec
Effectiveness/Cost Metric (E/C)	-	-	-	-	-											----

Acoustical Feasibilty Goal (dBA)	5
Acoustical Feasibilty Goal (%)	51%
Noise Reduction Design Goal (dBA)	7
Noise Reduction Design Goal (%)	1%

Basic Noise Barrier Optimization Tool

	Effectiveness/Cost Metric (E/C)	0.0	E/C	0.0	E/C	0.0	E/C	0.0	E/C	0.0
Project Information	**No Barrier Analysis**		**Analysis1**		**Analysis2**		**Analysis3**		**Analysis4**		**Analysis5**	
	No Barrier		**Barrier 8 feet**		**Barrier 10 feet**		**Barrier 12 feet**		**Barrier 14 feet**		**Barrier 16 feet**	
			Average Wtd I.L. (benefited)	dB I.L. Avg	Average Wtd I.L.	dB I.L. Avg	Average Wtd I.L.	dB I.L. Avg	Average Wtd I.L.	dB I.L. Avg	Average Wtd I.L. 5.2	dB I.L. Avg
			Maximum I.L. 2	dB I.L. Max	Maximum I.L. 2	dB I.L. Max	Maximum I.L. 4	dB I.L. Max	Maximum I.L. 5	dB I.L. Max	Maximum I.L. 5	dB I.L. Max
US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon	**Total Units Exposed to Impact** 1		Benefited/Impacted ≥ AFG 0	# Prot Units	Benefited/Impacted ≥ AFG 0	# Prot Units	Benefited/Impacted ≥ AFG 0	# Prot Units	Benefited/Impacted ≥ AFG 0	# Prot Units	Benefited/Impacted ≥ AFG 1	# Prot Units
Contract No. 0	# Impacts - NAC only 1		Benefited/Non Impact ≥ AFG 0	# Units	Benefited/Non Impact ≥ AFG 0	# Units	Benefited/Non Impact ≥ AFG 0	# Units	Benefited/Non Impact ≥ AFG 0	# Units	Benefited/Non Impact ≥ AFG 0	# Units
US 97 Noise Analysis	# Impacts - SI only 0		Total Benefited 0	# Ben Units	Total Benefited 0	# Ben Units	Total Benefited 0	# Ben Units	Total Benefited 0	# Ben Units	Total Benefited 1	# Ben Units
Barrier 3	# Impacts - Both NAC & SI 0		Impacted Units ≥ NRDG 0	# Units	Impacted Units ≥ NRDG 0	# Units	Impacted Units ≥ NRDG 0	# Units	Impacted Units ≥ NRDG 0	# Units	Impacted Units ≥ NRDG 0	# Units
Jacobs			Benefited Units ≥ NRDG 0	# Units	Benefited Units ≥ NRDG 0	# Units	Benefited Units ≥ NRDG 0	# Units	Benefited Units ≥ NRDG 0	# Units	Benefited Units ≥ NRDG 0	# Units
Rachel Saunders			Percent of impacts ≥ AFG 0%	% Ben Units	Percent of impacts ≥ AFG 0%	% Ben Units	Percent of impacts ≥ AFG 0%	% Ben Units	Percent of impacts ≥ AFG 0%	% Ben Units	Percent of impacts ≥ AFG 100%	% Ben Units
10/10/2022			Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG	% NRDG Units	Percent of benefits ≥ NRDG 0%	% NRDG Units
			"Cost-Reasonable" ?		"Cost-Reasonable" ?		"Cost-Reasonable" ?		"Cost-Reasonable" ?		"Cost-Reasonable" ? No	
			Surface Area 6747	Sq Feet	Surface Area 8434	Sq Feet	Surface Area 10121	Sq Feet	Surface Area 11810	Sq Feet	Surface Area 13498	Sq Feet
			Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec	Sq Feet	Surface Area/Ben Rec 13498	Sq Feet
			Barrier Length 844	Feet	Barrier Length 844	Feet	Barrier Length 844	Feet	Barrier Length 844	Feet	Barrier Length 844	Feet
			Min Height 8.0	Feet	Min Height 10.0	Feet	Min Height 12.0	Feet	Min Height 14.0	Feet	Min Height 16.0	Feet
			Max Height 8.0	Feet	Max Height 10.0	Feet	Max Height 12.0	Feet	Max Height 14.0	Feet	Max Height 16.0	Feet
			Avg Height 8.0	Feet	Avg Height 10.0	Feet	Avg Height 12.0	Feet	Avg Height 14.0	Feet	Avg Height 16.0	Feet
			Total Barrier Cost $202,410		Total Barrier Cost $253,020		Total Barrier Cost $303,630		Total Barrier Cost $354,300		Total Barrier Cost $404,940	
			Cost/Ben Rec		Cost/Ben Rec		Cost/Ben Rec		Cost/Ben Rec		Cost/Ben Rec $404,940	

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited
117"	1	B	1	67		Impact!	1	65	2	Impact! w/ Bar	
								64	2	Impact! w/ Bar	
								62	4	Impact! w/ Bar	
								62	5	Impact! w/ Bar	
								61	5	Benefited/Impact	1

U.S. Department of Transportation
Federal Highway Administration

Basic Noise Barrier Optimization Tool **12/20/2022**

US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon
Barrier 4

	8 Feet	10 Feet	12 Feet	14 Feet	16 Feet	18 feet	20 feet	22 feet	24 feet	Analysis10	Analysis11	Analysis12	Analysis13	Analysis14	Analysis15	Units
Average Wtd I.L. (benefited)																dBA
Maximum I.L.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0	0	0	0	0	0	dBA
Benefited/Impacted ≥ AFG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Benefited/Non Impact ≥ AFG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Total Benefited	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Impacted Units ≥ NRDG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Benefited Units ≥ NRDG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	# of dwelling units
Percent of impacts ≥ AFG	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	%
Percent of benefits ≥ NRDG																%
"Cost-Reasonable" ?																----
Surface Area	2,149	2,686	3,224	3,760	4,297	4,836	5,373	5,910	6,447	-	-	-	-	-	-	sq-feet or sq-meters
Surface Area/Ben Rec																sq-ft or sq-m / ben rec
Barrier Length	267	267	267	267	267	267	267	267	267	-	-	-	-	-	-	ft or m
Min Height	8	10	12	14	16	18	20	22	24	-	-	-	-	-	-	ft or m
Max Height	8	10	12	14	16	18	20	22	24	-	-	-	-	-	-	ft or m
Avg Height	8	10	12	14	16	18	20	22	24							ft or m
Total Barrier Cost	64,470	80,580	96,720	112,800	128,910	181,350	201,488	221,625	241,763	-	-	-	-	-	-	$
Cost/Ben Rec																$ / ben rec
Effectiveness/Cost Metric (E/C)	-	-	-	-	-	-	-	-	-							----

Acoustical Feasibilty Goal (dBA)	5
Acoustical Feasibilty Goal (%)	51%
Noise Reduction Design Goal (dBA)	7
Noise Reduction Design Goal (%)	1%

Basic Noise Barrier Optimization Tool

Project Information	No Barrier Analysis	Analysis1	Analysis2	Analysis3	Analysis4
	No Barrier	8 ft	10 ft	12 ft	14 ft
US 97 Cooley IC North Bend Corridor Improvement Project, Deschutes County, Oregon **Contract No. 0** **US 97 Noise Analysis** **Barrier 4** **Jacobs** Rachel Saunders 10/10/2022		Effectiveness/Cost Metric (E/C) 0.0	E/C 0.0	E/C 0.0	E/C 0.0
	Total Units Exposed to Impact 38	Average Wtd I.L. (benefited) dB I.L. Avg	Average Wtd I.L. dB I.L. Avg	Average Wtd I.L. dB I.L. Avg	Average Wtd I.L. dB I.L. Avg
	# Impacts - NAC only 36	Maximum I.L. 0 dB I.L. Max	Maximum I.L. 0 dB I.L. Max	Maximum I.L. 0 dB I.L. Max	Maximum I.L. 0 dB I.L. Max
	# Impacts - SI only 0	Benefited/Impacted ≥ AFG 0 # Prot Units	Benefited/Impacted ≥ AFG 0 # Prot Units	Benefited/Impacted ≥ AFG 0 # Prot Units	Benefited/Impacted ≥ AFG 0 # Prot Units
	# Impacts - Both NAC & SI 2	Benefited/Non Impact ≥ AFG 0 # Units	Benefited/Non Impact ≥ AFG 0 # Units	Benefited/Non Impact ≥ AFG 0 # Units	Benefited/Non Impact ≥ AFG 0 # Units
		Total Benefited 0 # Ben Units	Total Benefited 0 # Ben Units	Total Benefited 0 # Ben Units	Total Benefited 0 # Ben Units
		Impacted Units ≥ NRDG 0 # Units	Impacted Units ≥ NRDG 0 # Units	Impacted Units ≥ NRDG 0 # Units	Impacted Units ≥ NRDG 0 # Units
		Benefited Units ≥ NRDG 0 # Units	Benefited Units ≥ NRDG 0 # Units	Benefited Units ≥ NRDG 0 # Units	Benefited Units ≥ NRDG 0 # Units
		Percent of impacts ≥ AFG 0% % Ben Units	Percent of impacts ≥ AFG 0% % Ben Units	Percent of impacts ≥ AFG 0% % Ben Units	Percent of impacts ≥ AFG 0% % Ben Units
		Percent of benefits ≥ NRDG % NRDG Units	Percent of benefits ≥ NRDG % NRDG Units	Percent of benefits ≥ NRDG % NRDG Units	Percent of benefits ≥ NRDG % NRDG Units
		"Cost-Reasonable" ?	"Cost-Reasonable" ?	"Cost-Reasonable" ?	"Cost-Reasonable" ?
		Surface Area 2149 Sq Feet	Surface Area 2686 Sq Feet	Surface Area 3224 Sq Feet	Surface Area 3760 Sq Feet
		Surface Area/Ben Rec Sq Feet	Surface Area/Ben Rec Sq Feet	Surface Area/Ben Rec Sq Feet	Surface Area/Ben Rec Sq Feet
		Barrier Length 267 Feet	Barrier Length 267 Feet	Barrier Length 267 Feet	Barrier Length 267 Feet
		Min Height 8.0 Feet	Min Height 10.0 Feet	Min Height 12.0 Feet	Min Height 14.0 Feet
		Max Height 8.0 Feet	Max Height 10.0 Feet	Max Height 12.0 Feet	Max Height 14.0 Feet
		Avg Height 8.0 Feet	Avg Height 10.0 Feet	Avg Height 12.0 Feet	Avg Height 14.0 Feet
		Total Barrier Cost $64,470	Total Barrier Cost $80,580	Total Barrier Cost $96,720	Total Barrier Cost $112,800
		Cost/Ben Rec	Cost/Ben Rec	Cost/Ben Rec	Cost/Ben Rec

Receiver ID	Row	FHWA Act Cat	No. of Dwelling Units	Type of Impact: Bld Leq > NAC?	Type of Impact: Sub. Inc.?	Impact?	No. of Impacted Units	With Barrier Sound Levels, Impact and Benefit: Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited	Leq(dBA)	IL (db)	Impacted?	No. Benefited
R2000A	1	B	1	69		Impact!	1	69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar	
R2000B	1	B	1	74		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2001A	1	B	1	68		Impact!	1	68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
R2001B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2002A	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2002B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2003A	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2003B	1	B	1	74	Y	Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2004A	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2004B	1	B	1	74	Y	Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2005A	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2005B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2006A	1	B	1	71		Impact!	1	71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
R2006B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2007A	1	B	1	70		Impact!	1	70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar	
R2007B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2008A	1	B	1	70		Impact!	1	70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar	
R2008B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2014A	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2014B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2015A	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2015B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2016A	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2016B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2017A	1	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R2017B	1	B	1	74		Impact!	1	74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
R2018A	1	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R2018B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2020A	1	B	1	71		Impact!	1	71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
R2020B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2021A	1	B	1	71		Impact!	1	71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
R2021B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2022A	1	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R2022B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2023A	1	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R2023B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
R2024A	1	B	1	72		Impact!	1	72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
R2024B	1	B	1	73		Impact!	1	73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	

E/C	0.0		E/C	0.0		E/C	0.0		E/C	0.0		E/C	0.0	
Analysis5			**Analysis6**			**Analysis7**			**Analysis8**			**Analysis9**		
16 ft			**18 ft**			**20 ft**			**22 ft**			**24 ft**		
Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg	Average Wtd I.L.		dB I.L. Avg
Maximum I.L.	0	dB I.L. Max	Maximum I.L.	0	dB I.L. Max	Maximum I.L.	0	dB I.L. Max	Maximum I.L.	0	dB I.L. Max	Maximum I.L.	0	dB I.L. Max
Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units	Benefited/Impacted ≥ AFG	0	# Prot Units
Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units	Benefited/Non Impact ≥ AFG	0	# Units
Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units	Total Benefited	0	# Ben Units
Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units	Impacted Units ≥ NRDG	0	# Units
Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units	Benefited Units ≥ NRDG	0	# Units
Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units	Percent of impacts ≥ AFG	0%	% Ben Units
Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units	Percent of benefits ≥ NRDG		% NRDG Units
"Cost-Reasonable" ?			"Cost-Reasonable" ?			"Cost-Reasonable" ?			"Cost-Reasonable" ?			"Cost-Reasonable" ?		
Surface Area	4297	Sq Feet	Surface Area	4836	Sq Feet	Surface Area	5373	Sq Feet	Surface Area	5910	Sq Feet	Surface Area	6447	Sq Feet
Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet	Surface Area/Ben Rec		Sq Feet
Barrier Length	267	Feet	Barrier Length	267	Feet	Barrier Length	267	Feet	Barrier Length	267	Feet	Barrier Length	267	Feet
Min Height	16.0	Feet	Min Height	18.0	Feet	Min Height	20.0	Feet	Min Height	22.0	Feet	Min Height	24.0	Feet
Max Height	16.0	Feet	Max Height	18.0	Feet	Max Height	20.0	Feet	Max Height	22.0	Feet	Max Height	24.0	Feet
Avg Height	16.0	Feet	Avg Height	18.0	Feet	Avg Height	20.0	Feet	Avg Height	22.0	Feet	Avg Height	24.0	Feet
Total Barrier Cost	$128,910		Total Barrier Cost	$181,350		Total Barrier Cost	$201,488		Total Barrier Cost	$221,625		Total Barrier Cost	$241,763	
Cost/Ben Rec			Cost/Ben Rec			Cost/Ben Rec			Cost/Ben Rec			Cost/Ben Rec		

With Barrier Sound Levels, Impact and Benefit				**With Barrier Sound Levels, Impact and Benefit**				**With Barrier Sound Levels, Impact and Benefit**				**With Barrier Sound Levels, Impact and Benefit**				**With Barrier Sound Levels, Impact and Benefit**			
Leq(dBA)	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**	**Leq(dBA)**	**IL (db)**	**Impacted?**	**No. Benefited**
69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar		69	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar		68	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar		70	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar		74	0	Impact! w/ Bar	
72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar		71	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	
72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar		72	0	Impact! w/ Bar	
73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar		73	0	Impact! w/ Bar	