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5.10 Highway Noise

Since the Draft Environmental Impact Statement (DEIS), the following substantive changes have been made to this section:

- The Refined Preferred Alternative (RPA) has been introduced in **Sections 5.10** and **5.10.4**.
- **Section 5.10.3** has been retitled to reference Alternatives C1 through C4.
- **Section 5.10.4** has been added to provide the noise evaluation of the RPA.
- Figures showing noise barriers for Alternatives C1 through C4 have been replaced by figures showing noise barriers for the RPA. Figures for Alternatives C1 through C4 have been moved to the *Noise Technical Report* (**Appendix T**).

This section evaluates the potential noise impacts of the proposed I-69 Section 6 project in conformance with the National Environmental Policy Act (NEPA) and other federal regulations and guidance. The noise analysis describes and evaluates the existing and future acoustical environment at various receptors located along the proposed project.

The determination of noise abatement measures and locations is in compliance with FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772) and the INDOT 2017 "Traffic Noise Analysis Procedure."

I-69 Section 6 would upgrade the existing four-lane, divided highway of SR 37 to interstate highway design standards. Access to I-69 would be fully controlled and limited to interchanges, requiring the elimination of intersections and driveways, and the realignment of local service roads at selected locations. Five alternatives, C1, C2, C3, C4, and the Refined Preferred Alternative (RPA) are addressed in this section.[1] All are variations of the Tier 1 preferred alternative.

Alternatives C1 through C4 were evaluated in the DEIS, and Alternative C4 was identified as the preferred alternative when the DEIS was published. Based on public and agency comment on the DEIS, additional engineering, and value engineering studies, the RPA was developed as a refinement of Alternative C4. See **Chapter 3, Alternatives** for a description of each alternative, and **Chapter 6, Comparison of Alternatives** for more detail regarding the selection of Alternative C4 as the DEIS preferred alternative and the development and review of the RPA.

[1] *Alternative C4 includes two interchange options at Southport Road. Option A is the same as Alternative C2, except a diamond interchange would be used instead of a single point interchange. Option B uses a different interchange configuration, which would avoid the relocation of Aspen Lakes Apartments. See **Chapter 3, Alternatives, Section 3.7.7** for a complete description of Options A and B at Southport Road. All noise modeling for Alternative C4 assumes implementation of Option B. Noise impacts of Option A would be identical to Alternative C2 at Southport Road.*

5.10.1 Regulatory Policy

As noted above, the process for performing a traffic noise analysis is set forth in 23 CFR 772. This regulation, plus other guidance documents written to explain the regulation, identifies the following steps:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
  - through modeling, or
  - using noise measurements with concurrent classification counts of vehicles passing the noise monitoring site;
- Validate predicted noise levels through comparison between measured and predicted levels;
- Model future design year traffic noise levels which would yield the worst hourly traffic noise on a regular basis (design hour noise levels);
- Identify locations that would experience a noise impact based upon the Noise Abatement Criteria (NAC);
- Model noise abatement measures to mitigate the predicted design year traffic noise impacts; and
- Utilize FHWA's Traffic Noise Model® (TNM 2.5).

The INDOT Noise Policy is the state's tool for implementing 23 CFR 772. As presented in 23 CFR 772, noise abatement criteria vary according to land use. The noise level descriptor used is the one-hour equivalent sound level, Leq(1h). All modeling for the project is based on a one-hour level.

Noise mitigation measures are considered if an adverse noise impact has been determined. An adverse noise impact occurs when the predicted noise levels approach or exceed those values shown for the appropriate activity category in **Table 5.10-1**, or when the predicted traffic noise levels substantially exceed the existing noise levels. INDOT has defined the approach value to be within 1.0 dBA of the appropriate NAC[2] as shown in **Table 5.10-1**. INDOT has defined an increase in noise levels for which the future noise levels exceed the existing noise by 15.0 dBA as "substantially exceeding" existing levels.

The following parameters are used in the TNM® model to calculate an hourly L_{eq}(1h) at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;

[2] *"Traffic Noise Analysis Procedure," Indiana Department of Transportation, 2017, Page 3.*

- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles;
- Vehicle speed;
- Ground absorption; and
- Topographic features, including retaining walls and berms.

Table 5.10-1: FHWA Noise Abatement Criteria

Hourly A-Weighted Sound Level - Decibels (dBA)			
Activity Category	**Activity Criteria[1] Leq(h)**	**Evaluation Location**	**Description of Activity**
A	57	Exterior	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 its intended purpose.
B[2]	67	Exterior	Residential
C	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care 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	Auditoriums, day care 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	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
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.

1. Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
2. Includes undeveloped lands permitted for this activity category.
Source: Federal Highway Administration (23 CFR Part 772, Table 1).

5.10.2 Methodology

A traffic noise analysis was performed to determine the likely traffic noise impacts for the I-69 Section 6 build alternatives. The *Noise Technical Report* in **Appendix T** presents the results of the ambient noise measurements, the modeled existing and design year (2045) worst hourly traffic noise levels for each of the build alternatives, data collection sheets, meter information and calibration certificate, and the noise barrier analysis for all alternatives.

5.10.2.1 Noise Measurements

Existing noise level measurements were taken at 33 representative sites and four historic sites in the project corridor on December 15 and 16, 2015. A 20-minute measurement was taken at each site. The measurements were made in accordance with INDOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. The noise study areas and receivers are shown on Noise Analysis Maps at the end of this section. Traffic classification counts were taken concurrently with the noise measurements. The data collected at the 37 sites is presented in Table 2 of the *Noise Technical Report* located in **Appendix T**. The noise measurement sites, FS-1 through FS-33 and HS-1 through HS-4, are shown in Figure 2 of the *Noise Technical Report*. The noise levels at sites FS-1 through FS-33 ranged from 48.2 to 70.1 dBA L_{eq}, while the four historic sites, HS-1 to HS-4, ranged from 45.8 to 63.6 dBA L_{eq}.

5.10.2.2 Model Validation

TNM® 2.5 was used to validate the predicted noise levels through comparison with the measured and predicted noise levels. **Table 5.10-2** presents the site-by-site comparison. Noise levels were modeled at the thirty-seven noise measurement sites using existing digital terrain models of the study area and traffic counts taken at the time of the noise measurement. As vehicles were counted, they were also classified by vehicle type as car, medium truck, heavy truck, or bus. The modeled noise levels at the thirty-seven sites with concurrent traffic counts all compared within ±3 dB of the field measured levels.

Since the TNM® 2.5 modeled field data were within ± 3 dB of the measured noise levels, the model is assumed to be valid for this study.[3] At this point in the environmental analysis, the field measurements and the modeled noise levels using the traffic counts taken during the field noise measurements are set aside for the remainder of the noise analysis.

5.10.2.3 Noise Abatement Criteria

Noise abatement measures can include truck traffic restrictions, shifted roadway alignment, barriers or berms, and/or soundproofing. Each of these was evaluated and construction of noise barriers appears to be the most feasible and reasonable method to mitigate noise impact for this project. Restricting or prohibiting trucks is counter to the I-69 Section 6 project purpose and need. Design criteria and recommended termini for the proposed project does not allow for changes in alignment sufficient to provide a noticeable change in the traffic noise levels at the abutting the properties. A 15-foot tall noise berm would have a footprint ranging in width from 35 to 95 feet. Therefore, it is neither feasible or reasonable to construct noise berms along the corridor without acquiring substantial right of way. Soundproofing will be reviewed during final

[3] *"Traffic Noise Analysis Procedure," Indiana Department of Transportation, 2017, Page 4 of 11.*

design for Activity Category D land uses that remain above the NAC after the potential feasible and reasonable noise mitigation measures have been finalized.

Table 5.10-2: Comparison of Measured and Modeled Noise Levels

Field Site	Activity Category	Activity Criteria[1] Leq(h)	Noise Level, dBA L_{eq}(1h)		Difference in Noise Level dBA L_{eq}(1h) Modeled Minus Measured	Difference in Noise Level dBA Leq(1h) Modeled Minus Activity Criteria
			Measured	Modeled		
FS-1	B	67	58.5	60.6	2.1	-6.4
FS-2	E	72	66.0	64.2	-1.8	-7.8
FS-3	C	67	64.5	64.8	0.3	-2.2
FS-4	B	67	62.0	61.0	-1.0	-6.0
FS-5	B	67	61.9	62.8	0.9	-4.2
FS-6	C	67	58.1	60.4	2.3	-6.6
FS-7	B	67	64.9	63.8	-1.1	-3.2
FS-8	C	67	55.1	57.6	2.5	-9.4
FS-9	B	67	56.0	56.9	0.9	-10.1
FS-10	B	67	58.6	61.2	2.6	-5.8
FS-11	B	67	49.1	48.9	-0.2	-18.1
FS-12	B	67	68.1	65.1	-3.0	-1.9
FS-13	B	67	65.6	66.0	0.4	-1.0
FS-14	B	67	54.5	54.3	-0.2	-12.7
FS-15	B	67	55.2	56.7	1.5	-10.3
FS-16	B	67	61.5	62.7	1.2	-4.3
FS-17	B	67	67.0	67.1	0.1	0.1
FS-18	B	67	68.2	65.6	-2.6	-1.4
FS-19	B	67	70.1	69.3	-0.8	2.3 *
FS-20	B	67	69.6	68.0	-1.6	1.0 *
FS-21	C	67	56.2	56.1	-0.1	-10.9
FS-22	B	67	54.0	55.2	1.2	-11.8
FS-23	B	67	59.7	57.3	-2.4	-9.7
FS-24	B	67	63.6	65.1	1.5	-1.9
FS-25	C	67	67.7	64.7	-3.0	-2.3
FS-26	B	67	59.1	61.8	2.7	-5.2
FS-27	B	67	65.3	62.6	-2.7	-4.4
FS-28	B	67	48.2	48.4	0.2	-18.6
FS-29	B	67	58.9	60.7	1.8	-6.3
FS-30	B	67	63.3	64.0	0.7	-3.0
FS-31	B	67	62.1	64.6	2.5	-2.4
FS-32	B	67	54.5	55.1	0.6	-11.9

Field Site	Activity Category	Activity Criteria[1] Leq(h)	Noise Level, dBA L_{eq}(1h)		Difference in Noise Level dBA L_{eq}(1h) Modeled Minus Measured	Difference in Noise Level dBA Leq(1h) Modeled Minus Activity Criteria
			Measured	Modeled		
FS-33	B	67	57.2	59.9	2.7	-7.1
HS-1	B	67	53.1	52.1	-1.0	-14.9
HS-2	B	67	45.8	47.0	1.2	-20.0
HS-3	B	67	54.5	57.5	3.0 *	-9.5
HS-4	B	67	63.6	60.8	-2.8	-6.2

** Indicates potential adverse impact*

A noise analysis identifies "where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternatives."[4] Factors to be considered in determining noise abatement feasibility, as defined in the 2017 INDOT "Traffic Noise Analysis Procedure," are listed below.

> *"Acoustic Feasibility: INDOT requires that noise barriers achieve a 5dB(A) reduction at a majority (greater than 50%) of the impacted receptors. If a barrier cannot achieve this acoustic goal, abatement is considered to not be acoustically feasible.*
>
> *"Engineering Feasibility: INDOT requires noise abatement measures to be based on sound engineering practices and standards and requires that any measures be evaluated at the optimum location. For instances in which the roadway is located on fill and is at a higher location than nearby receptors, a barrier will be evaluated near the shoulder. For instances in which the roadway is located below the nearby receptors, a barrier will be evaluated near the edge of the right of way near the receptors. In addition, noise barriers require long, uninterrupted segments of barrier to be feasible. If there are existing access points and/or driveways, it is typically not feasible to construct effective noise barriers for the roadway due to sight distance and access. However, in some cases, changing access points in project design may improve safety and decrease conflicts resulting in noise abatement being feasible.*
>
> *"Engineering feasibility also takes into account topography, drainage, safety, barrier height, utilities, and access/maintenance needs (which may include right of way considerations). In situations where engineering considerations make noise barriers not feasible, the noise analysis will explicitly state the reasons (topography, drainage, safety, etc.)."*[5]

Factors to be considered in determining reasonableness, as defined in the 2017 INDOT "Traffic Noise Analysis Procedure," are listed on the following page.

[4] *"Traffic Noise Analysis Procedure," Indiana Department of Transportation, 2017, Page 8 of 11.*

[5] *Ibid, page 6 and 7 of 11.*

"To determine cost effectiveness, the estimated cost of constructing a noise barrier (including installation and additional necessary construction such as foundations or guardrails) will be divided by the number of benefited receptors (those who would receive a reduction of at least 5 dB(A)). A base material and design cost of $25,000 or less per benefited receiver is currently considered to be cost-effective."[6] The estimated construction costs of a noise barrier are based on a unit cost of $30.00 per square foot.[7]

"INDOT's goal for substantial noise reduction is to provide at least a 7.0 dB(A) reduction for benefited first row receptors in the design year. However, conflicts with adjacent lands may make it impossible to achieve substantial noise reduction at all benefited first row receptors. Therefore, the noise reduction design goal for Indiana is 7 dB(A) for a majority (greater than 50%) of the benefited first row receptors."

"Consideration and Obtaining Views of Residents and Property Owners. A survey will be mailed to each benefited resident. If the property owner is different from the current resident, both the resident and the property owners are surveyed. The concerns and opinions of the property owner and the unit occupants will be balanced with other considerations in determining whether a barrier is appropriate for a given location."[8]

5.10.3 Noise Evaluation of Alternatives C1 through C4

In preparing the DEIS, noise impacts and the potential feasibility of noise barriers were evaluated for four alternatives, Alternatives C1 through C4. The DEIS identified Alternative C4 as the preferred alternative, subject to comments on the DEIS and additional refinement during the preparation of the FEIS. Alternative C4 was refined based on public and agency comment, engineering refinements, and value engineering studies to define the Refined Preferred Alternative or RPA.

This section summarizes the findings of the noise analysis for Alternatives C1 through C4, as presented for public comment in the DEIS. The next section provides the same information for the RPA, developed after comments were received on the DEIS. This is followed by a series of maps to illustrate where noise barriers are feasible with the RPA.

5.10.3.1 Noise Modeling for Alternatives C1 through C4

The project study area was divided into 28 noise sensitive areas (NSAs) based on a combination of land use, traffic volumes, and density. Traffic data from the INDOT statewide travel demand model and the I-69 corridor model were used as input into TNM® to model existing (2010) and

[6] *Ibid, page 7 of 11.*

[7] *Ronald Bales, INDOT Environmental Services Division, email regarding "Re: Des. No. 1400326, I-65 from US-30 to SR 2, Added Travel Lanes, INDOT Noise Policy," June 6, 2014.*

[8] *Indiana Department of Transportation, Page 7 of 11.*

design year (2045) highest hourly noise levels along I-69 Section 6. As shown in **Appendix T**, 1,328 representative noise receivers representing 1,658 receptors, numbered N1 through N2021, were modeled for alternatives C1, C2, C3, and C4. These receivers were selected to model representative noise impacts at 1545 Activity Category B receptors, 14 Category C receptors, 26 Category E receptors, and 73 Category F receptors. The modeled noise levels are presented in **Appendix T**.

The projected number of properties that would be exposed to design year noise levels that approach or exceed the levels in **Table 5.10-1** are presented in **Table 5.10-3**.

Table 5.10-3: Noise Level Impacts by Land Use, Alternatives C1 through C4

Receptor (or Land Use) Type	2045 Exterior Noise Level Impacts			
	Alt C1	Alt C2	Alt C3	Alt C4
Residential	695	572	682	577
Places of Worship	2	1	1	1
Places of Worship (No Outdoor Use)	--	1	--	1
Schools	1	--	1	--
Schools (No Outdoor Use)	--	--	--	1
Active Sport Areas	1	1	2	--
Day Care Center	1	1	1	1
Medical Facilities	2	2	2	2
Medical Facilities (No Outdoor Use)	--	1	1	1
Playgrounds	--	--	--	--
Golf Course	--	--	--	--
Hotels	--	--	--	--
Hotels (No Outdoor Use)	--	--	--	--
Offices	--	--	--	--
Offices (No Outdoor Use)	--	--	--	--
Restaurants	--	--	2	--
Restaurants (No Outdoor Use)	--	--	--	--
Historic Residential	--	--	1	--
Bowling Alley	--	--	--	--
Movie Theater	--	--	--	--
Emergency Services	--	--	--	--
Industrial	--	--	--	--
Retail Facilities	--	--	--	--
Utilities	--	--	--	--
Warehousing	--	--	--	--
Total	702	579	693	584

5.10.3.2 Abatement Assessment for Alternatives C1 through C4

Noise barriers were modeled at 25 locations along I-69 Section 6 and I-465 in the DEIS. The results of the noise barrier analysis are summarized in **Table 5.10-4**. The table presents the proposed barrier location or identification number, the NSA area, barrier length, average height, number of impacted and benefited receptors, and a "yes or no" as to whether a noise barrier meets INDOT's feasibility criteria, as described in **Section 5.10.2.3**. The table also presents the estimated cost of the noise barrier, based on the TNM calculated area of the noise barrier times a cost of $30.00 per square foot, and the cost per benefited receptor. If the cost per benefited receptor is $25,000 or less, the noise barrier meets INDOT's cost reasonableness criteria. The feasible and reasonable noise barriers for Alternatives C1 through C4 as evaluated in the DEIS are identified in the last four columns of **Table 5.10-4**.

Alternatives C1, C2, C3, and C4 are very similar in the areas adjacent to noise barriers 1E through 11E, as well as barriers 5W, 6W, 1N, 2S and 3S. The cost per benefited receptor for these noise barriers ranged from $27,978 to $263,093, all greater than INDOT's reasonableness criteria of $25,000 per benefited receptor. Noise barriers 5E and 6E did not meet INDOT's definition of feasibility.

The feasible and reasonable noise barriers for Alternatives C1, C2, C3, and C4 are located in three areas:

- the densely-populated areas of Martinsville, west of the proposed project,
- at the far north end of the corridor just south and north of Southport Road, and
- south of I-465 east of Bluff Road.

There are nine feasible and reasonable noise barrier locations in Alternative C1, eight in Alternatives C2 and C3, and nine in Alternative C4. Noise receptors and potential feasible and reasonable noise barrier locations for Alternatives C1, C2, C3, and C4, as presented in the DEIS, are shown on maps in **Appendix T**.

Table 5.10-4: Noise Barrier Analysis Summary, Alternatives C1 through C4

Potential Barrier Location	NSA Area	Total Barrier Length (feet)	Average Height (feet)	No. of Impacted Receptors	No. of Benefited Receptors	Feasibility Criteria Met?	Cost of Barrier ($30/sq ft)	Cost per Benefited Receptor	Cost Reasonableness Criteria Met?			
									Alt C1	Alt C2	Alt C3	Alt C4
1E	1	1,100	21.3	3	8	Yes	$701,730	$87,716	No	No	No	No
1W	2	1,082	18	18	27	Yes	$584,460	$21,647	Yes	Yes	Yes	Yes
2W	3	2,555	15	26	73	Yes	$1,149,720	$15,750	Yes		Yes	
2W	3	2,928	18	31	78	Yes	$1,580,970	$20,269		Yes		Yes
2E	4	1,020	17.7	2	6	Yes	$541,830	$90,305	No	No	No	No
3W	5	3,840	15	104	179	Yes	$1,727,970	$9,653	Yes		Yes	
3W	5	3,400	18.7	81	141	Yes	$1,907,910	$13,531		Yes		Yes
4W	6	1,408	14.1	8	24	Yes	$597,690	$24,904	Yes	Yes	Yes	Yes
5W	8	1,300	22.2	5	14	Yes	$864,270	$61,734	No	No	No	No
3E	9	4,300	18.4	8	9	Yes	$2,367,840	$263,093	No	No	No	No
4E	10	1,300	22.6	3	8	Yes	$882,240	$110,280	No	No	No	No
5E	12	2,265	12	0	0	No	--	--				
6E	13	1,723	12	6	0	No	--	--				
7E	13	2,400	19.9	3	3	Yes	$1,431,030	$204,433	No	No	No	No
6W	14	900	15.7	12	11	Yes	$423,240	$38,476	No	No	No	No
7W	16	1,116	16.4	54	54	Yes	$548,580	$10,159	Yes		Yes	
7W	16	1,196	22	50	34	Yes	$782,430	$23,013		Yes		Yes
8-1W	19	2,819	17.7	33	60	Yes	$1,493,640	$24,894	Yes			
8-1W	19	2,800	18	38	61	Yes	$1,511,880	$24,785		Yes		
8W	19	4,888	22.46	65	141	Yes	$3,293,670	$23,359				Yes
8W	19	5,370	19.9	76	160	Yes	$3,203,520	$20,022			Yes	

Potential Barrier Location	NSA Area	Total Barrier Length (feet)	Average Height (feet)	No. of Impacted Receptors	No. of Benefited Receptors	Feasibility Criteria Met?	Cost of Barrier ($30/sq ft)	Cost per Benefited Receptor	Cost Reasonableness Criteria Met?			
									Alt C1	Alt C2	Alt C3	Alt C4
8-2W	19	1,901	19.4	36	59	Yes	$1,107,330	$18,768	Yes			
8-2W	19	1,700	21.2	25	45	Yes	$1,080,300	$24,007		Yes		
8E	17	2,015	20	8	10	Yes	$1,214,010	$121,401	No	No	No	No
9E	18	1,900	18.2	13	37	Yes	$1,035,180	$27,978	No	No	No	No
9W	21	2,138	19.6	14	45	Yes	$1,259,010	$27,978	No			
9W	21	2,068	20.7	18	46	Yes	$1,282,950	$27,890		No		
9W	21	2,374	18	19	49	Yes	$1,282,230	$26,168			No	
9W	21	1,989	18	33	53	Yes	$1,074,240	$20,269				Yes
10E	18	1,200	24	7	9	Yes	$863,910	$95,990	No	No	No	No
11E	20	2,000	17.5	26	23	Yes	$1,052,940	$45,780	No	No	No	No
12E	28	3,495	21	77	138	Yes	$2,201,280	$15,951	Yes	-		-
12E	28	700	12	8	6	Yes	$315,030	$35,003	-	No	-	
12E	28	3,417	18	82	138	Yes	$1,845,450	$13,373			Yes	
12E	28	3,407	18.77	82	129	Yes	$1,957,140	$15,172				Yes
1N	24	1,438	14.7	17	17	Yes	$634,650	$37,332	No	No	No	No
2S	25	1,321	9.5	12	9	Yes	$374,730	$41,637	No	No	No	No
3S	26	1,169	11.3	6	5	Yes	$396,750	$79,350	No	No	No	No
4S	28	5,657	19.4	99	132	Yes	$3,289,800	$24,923	Yes	Yes	Yes	Yes

5.10.4 Noise Evaluation of the Refined Preferred Alternative (RPA)

As with the evaluation of Alternatives C1 through C4 presented in the DEIS, the noise evaluation of the RPA consists of modeling representative noise receivers and conducting an abatement assessment using the criteria provided in **Section 5.10.2.3**. The locations of feasible and reasonable noise barriers for the RPA are shown in **Figure 5.10-1** through **Figure 5.10-14** at the end of this section.

5.10.4.1 Noise Modeling for the RPA

The RPA extends the western terminus of the project on I-465 from Mann Road to the Mooresville Road Bypass. This increased the number of NSAs for the DEIS from 28 to 30 for the RPA. Since the area modeled is larger, a direct comparison with Alternatives C1 through C4 is not practical. The revised model is effective, however, in fully analyzing noise barriers for the RPA.

A total of 1,475 TNM noise receivers representing 1,877 receptors, numbered N8 through N2214, were modeled for the existing condition and the RPA. These receivers were selected to model representative noise impacts at 1,771 Activity Category B receptors, 19 Category C receptors, 6 Category D receptors, 25 Category E receptors, and 56 Category F receptors. The location of each receiver is shown on Figures 3-2 through 3-47 in **Appendix T**.

The projected number of properties that would be exposed to design year noise levels that approach or exceed the levels in **Table 5.10-1** with implementation of the RPA are presented in **Table 5.10-5**.

Table 5.10-5: Noise Level Impacts by Land Use, RPA

Receptor (or Land Use) Type	2045 Exterior Noise Level Impacts
Residential	777
Places of Worship	1
Places of Worship (No Outdoor Use)	--
Schools	1
Schools (No Outdoor Use)	--
Active Sport Areas	1
Day Care Center	1
Medical Facilities	3
Medical Facilities (No Outdoor Use)	--
Playgrounds	2
Golf Course	--

Receptor (or Land Use) Type	2045 Exterior Noise Level Impacts
Hotels	--
Hotels (No Outdoor Use)	--
Offices	--
Offices (No Outdoor Use)	--
Restaurants	2
Restaurants (No Outdoor Use)	--
Historic Residential	--
Bowling Alley	--
Movie Theater	--
Emergency Services	--
Industrial	--
Retail Facilities	--
Utilities	--
Warehousing	--
Total	**788**

5.10.4.2 Abatement Assessment for the RPA

Noise barriers were modeled at 30 locations along I-69 Section 6 and I-465 for the analysis of the RPA. The results of the noise barrier analysis are summarized in **Table 5.10-6**. The table presents the proposed barrier location or identification number, the NSA area, barrier length, average height, number of impacted and benefited receptors adjacent to the proposed noise barrier, and a "yes or no" statement as to whether a noise barrier meets INDOT's feasibility criteria as previously defined. The table also presents the estimated cost of the noise barrier based on the TNM calculated area of the noise barrier times a cost of $30.00/square foot. The cost per benefited receptor is the cost of the noise barrier divided by the number of benefited receptors. If the cost per benefited receptor is $25,000 or less, the noise barrier meets INDOT's cost reasonableness criteria as previously defined. The feasible and reasonable noise barriers for the RPA are identified in the last column of **Table 5.10-6**.

There are ten feasible and reasonable noise barriers for the RPA; 1W, 2W, 3W, 7W, 8W, 9E, 9W, 12E, 4S and 6N. Note that Location 9E (adjacent to Wakefield Subdivision) was added after the DEIS was published. Conditions at that location changed due to a shift in the alignment of I-69 in the RPA. The cost per benefited receptor for noise barriers 1E, 2E, 3E – 5W, 6W, 7E, 7aW, 8E, 8aE, 10E, 11E, 1N – 3S, 5S and 7S ranges from $27,625 to $263,093, all of which are greater than INDOT's reasonableness criteria of $25,000 per benefited receptor. Noise barriers 5E and 6E did not meet INDOT's definition of feasibility. Noise receptors and potential feasible

and reasonable noise barrier locations are shown in **Figure 5.10-1** through **Figure 5.10-14** at the end of this section. More detailed information is presented in **Appendix T**.

5.10.5 Undeveloped Lands

There are many acres of undeveloped land north of Martinsville to the southern limits of the Indianapolis urban area along I-69 and along I-465 in the I-69/I-465 Section 6 study area. Based on the TNM modeling for the 28 NSA's, setback distances to 66 dB(A) Leq(1h) and 71 dB(A) Leq(1h) were developed. These setback distances were identified to assist local planning authorities in developing guidance and land use controls for future development of currently undeveloped lands. The intent is to avoid new development with land uses which are incompatible with the interstate as they would be affected by traffic noise. This could include limitations on residential development or other noise sensitive development immediately adjacent to I-69 Section 6.

The recommended setback distance for consideration in approvals of future proposed development, measured to the nearest edge of pavement, indicates where noise levels would be 66 dBA or greater. The distance to 66 dBA Leq(h) would range from 400 to 500 feet in the undeveloped areas paralleling the edge of pavement. The distance to 71 dB(A) Leq(1h) would range from 200 to 250 feet from the edge of pavement.

5.10.6 Construction Noise

In addition to noise from traffic, construction activities would cause a temporary increase in the ambient noise level along I-69 Section 6 and I-465. INDOT will be sensitive to local needs and may make adjustments to work practices to reduce inconvenience to the public.

The major construction elements of this project are expected to be demolition, hauling, grading, paving, and bridge construction. General construction noise impacts for passersby and those individuals living or working near the project can be expected particularly from demolition, earth moving, pile driving, and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The typical noise reduction qualities of the homes, places of worship, schools and businesses are believed to be sufficient to moderate the effects of intrusive construction noise. Considerations of local ordinances may also be required for noise abatement.

Table 5.10-6: Noise Barrier Analysis Summary, RPA

Proposed Barrier Location	NSA Area	Total Barrier Length (feet)	Average Height (feet)	No. Impacted Receptors	No. Benefited Receptors	Feasibility Criteria Met?	Cost of Barrier ($30/sq ft)	Cost per Benefited Receptor	Cost Reasonableness Criteria Met?
									RPA
1E	1	1,407	23.01	6	12	Yes	$985,890	$82,158	No
1W	2	1,082	18	18	27	Yes	$584,460	$21,647	Yes
2W	3	3,009	14.25	28	66	Yes	$1,318,200	$19,973	Yes
2E	4	1,020	21.06	2	6	Yes	$644,400	$107,400	No
3W	5	3,426	12.92	113	154	Yes	$1,332,531	$8,653	Yes
4W	6	1,408	15.86	8	23	Yes	$669,810	$29,122	No
5W	8	1,300	22.2	5	14	Yes	$864,270	$61,734	No
3E	9	4,300	18.4	8	9	Yes	$2,367,840	$263,093	No
4E	10	1,300	22.6	3	8	Yes	$882,240	$110,280	No
5E	12	2,265	12	0	0	No	-	-	-
6E	13	1,723	12	6	0	No	-	-	-
7E	13	2,400	19.9	3	7	Yes	$1,431,030	$204,433	No
6W	14	1,100	19.64	11	13	Yes	$647,880	$49,837	No
7W	16	1,501	21.20	29	44	Yes	$954,420	$21,691	Yes
7aW	16	1,656	15.12	4	4	Yes	$753,450	$188,363	No
8W	19	4,998	22.25	65	186	Yes	$3,336,240	$17,937	Yes
8E	17	1,703	17.82	8	8	Yes	$910,020	$113,753	No
8aE	17	500	18	6	3	Yes	$270,120	$90,040	No
9E	18	2,170	16.09	22	43	Yes	$1,029,246	$23,936	Yes

Proposed Barrier Location	NSA Area	Total Barrier Length (feet)	Average Height (feet)	No. Impacted Receptors	No. Benefited Receptors	Feasibility Criteria Met?	Cost of Barrier ($30/sq ft)	Cost per Benefited Receptor	Cost Reasonableness Criteria Met?
									RPA
9W	21	1,989	18	33	53	Yes	$1,074,240	$20,269	Yes
10E	20	1,200	24	7	9	Yes	$863,910	$95,990	No
11E	20	2,000	17.5	26	23	Yes	$1,052,940	$45,780	No
12E	20	3,407	18.77	82	129	Yes	$1,957,140	$15,172	Yes
1N	24	1,518	10.31	18	17	Yes	$469,620	$27,625	No
2S	25	1,321	9.5	12	9	Yes	$374,730	$41,637	No
3S	26	3,863	15.32	27	28	Yes	$1,783,590	$63,700	No
4S	28	5,657	19.4	99	132	Yes	$3,289,800	$24,923	Yes
5S	25	2,748	16.75	20	22	Yes	$1,381,050	$62,775	No
6N	29	2,769	15.15	89	102	Yes	$1,258,730	$12,341	Yes
7S	30	1,099	12.55	11	7	Yes	$413,520	$59,074	No

5.10.7 Summary

Noise abatement has been analyzed at 25 locations for Alternatives C1-C4. Based on the studies completed to date, the State of Indiana has identified a total of 702 receptors along I-69 Section 6 for Alternative C1, 579 receptors for Alternative C2, 693 receptors for Alternative C3, and 584 receptors for Alternative C4 that would be exposed to 2045 design year noise levels that approach or exceed the FHWA noise abatement criteria.

The RPA would expose 788 receptors to 2045 design year noise levels approaching or exceeding the FHWA noise abatement criteria.

Traffic noise barriers for Alternatives C1 through C4 were analyzed at 25 locations with TNM®2.5, and the results were presented in the DEIS. Noise abatement at these locations was based upon preliminary estimated costs and design criteria. Noise abatement in these locations were estimated, based on the alternative and NSAs in **Appendix T**, to range in cost from $584,580 to $3,289,800 and would reduce the noise level by a minimum of 7 dB(A) at a majority of the identified impacted receptors.

Traffic noise barriers for the RPA have been analyzed at 30 locations with TNM®2.5 after the DEIS was published. INDOT has determined that noise abatement as shown in **Table 5.10-6** is likely, but not guaranteed, at ten locations (see **Figure 5.10-1** through **Figure 5.10-14)**. Noise abatement at these locations (indicated by "yes" under "Cost Reasonableness Criteria Met?" in **Table 5.10-2)** is based upon preliminary estimated costs and design criteria. Noise abatement in these locations has been estimated to range in cost from $584,460 to $3,289,800 and will reduce the noise level by a minimum of 7 dB(A) at a majority of the identified impacted receptors. It should be noted that noise barriers designed to meet INDOT's design criteria may benefit noise receivers that were not indicated as impacted receivers.

A reevaluation of the noise analysis will occur during final design. If during final design it ias determined that conditions have changed such that noise abatement is not feasible and reasonable, the abatement measures might not be provided. The final decision on the installation of any abatement measure(s) will be made upon the completion of the project's final design and the public involvement process.

As part of the public involvement process, the viewpoints of the benefited residents and property owners will be sought and considered in determining the reasonableness of highway traffic noise abatement measures for the proposed I-69 Section 6 highway construction project. The viewpoints will be collected through mailed surveys or public meetings. INDOT will incorporate highway traffic noise consideration in on-going I-69 Section 6 public involvement through the completion of the proposed project.

Figure 5.10-1: Feasible and Reasonable Noise Barriers, RPA Map 1

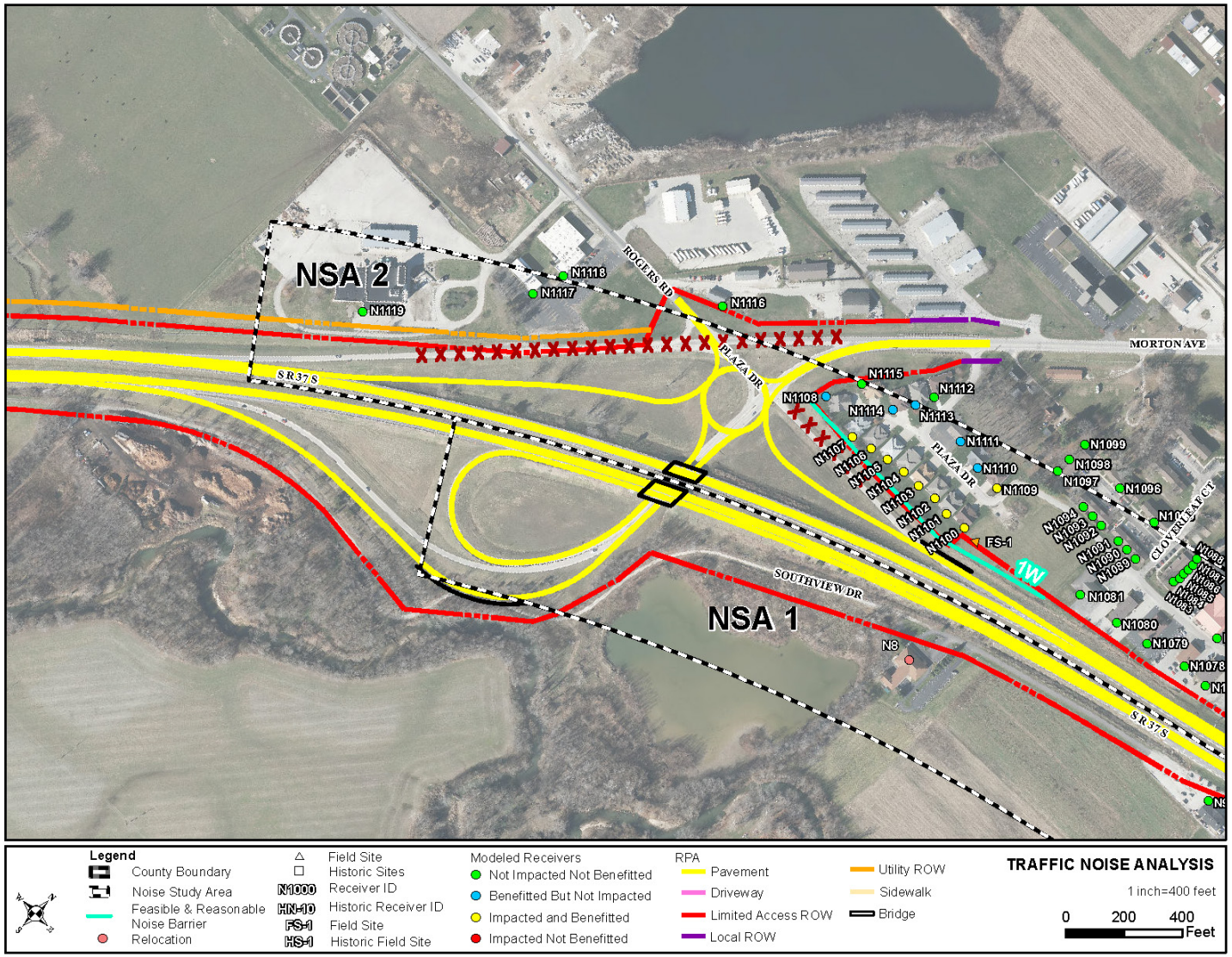

Figure 5.10-2: Feasible and Reasonable Noise Barriers, RPA Map 2

Figure 5.10-3: Feasible and Reasonable Noise Barriers, RPA Map 3

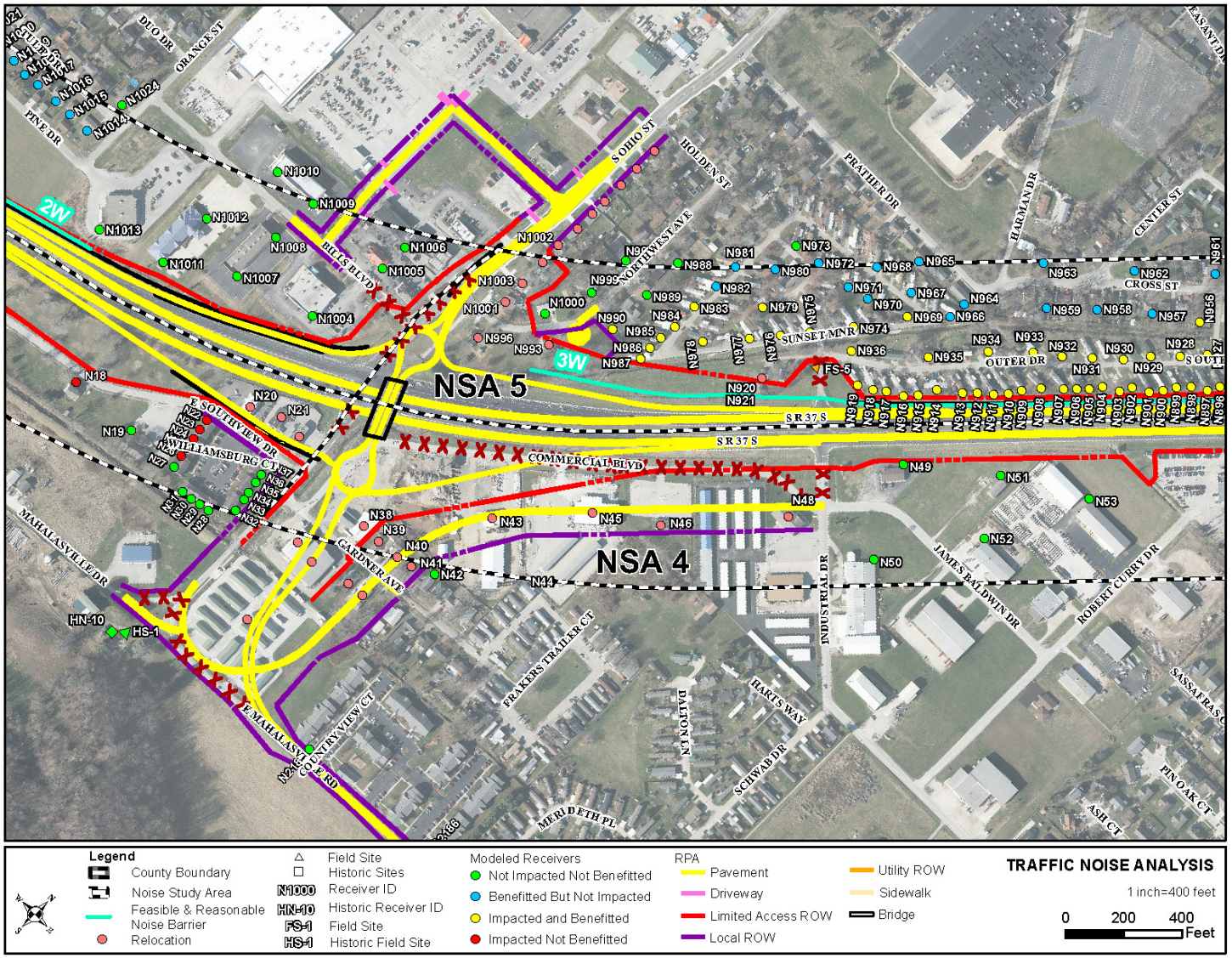

Figure 5.10-4: Feasible and Reasonable Noise Barriers, RPA Map 4

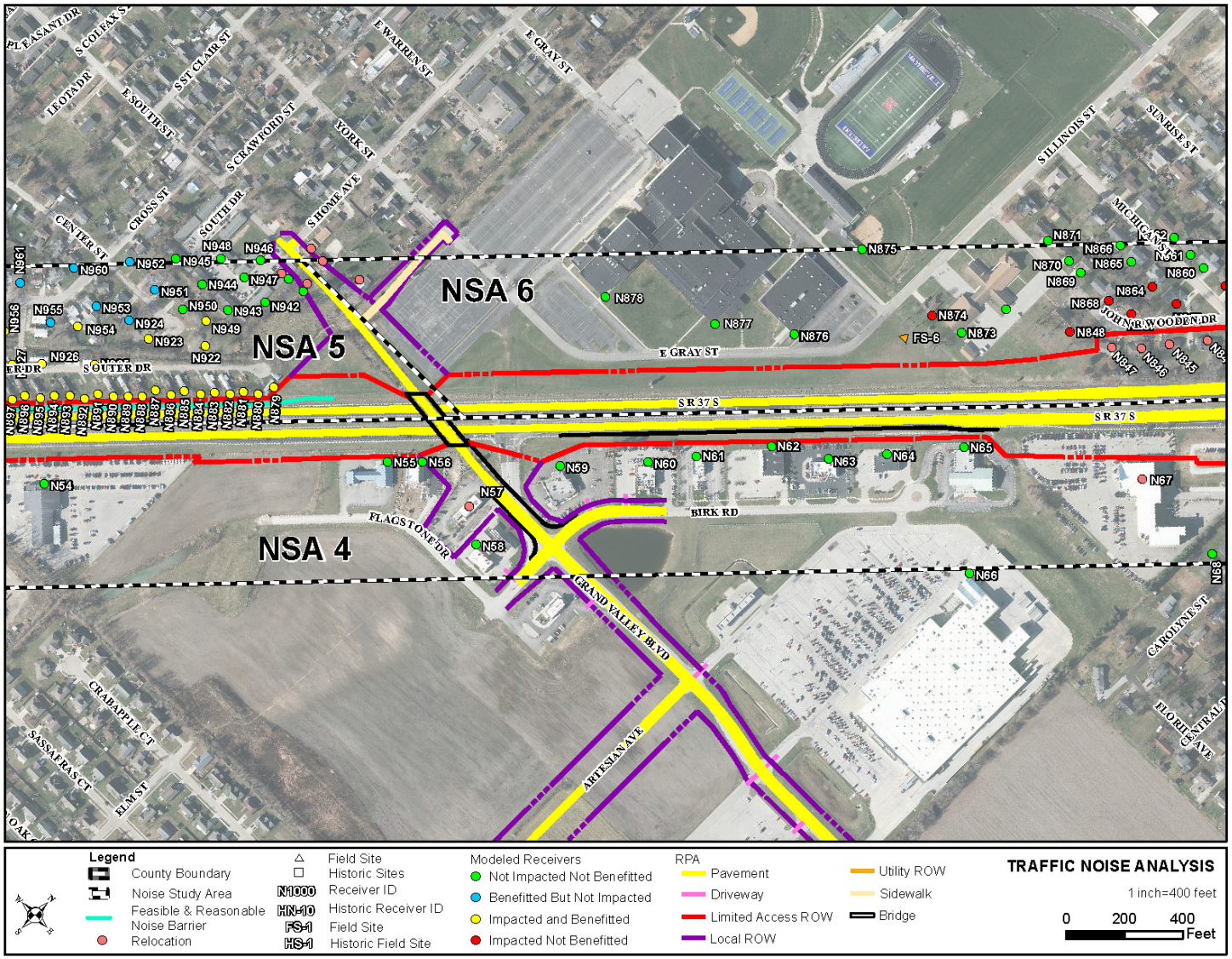

Figure 5.10-5: Feasible and Reasonable Noise Barriers, RPA Map 5

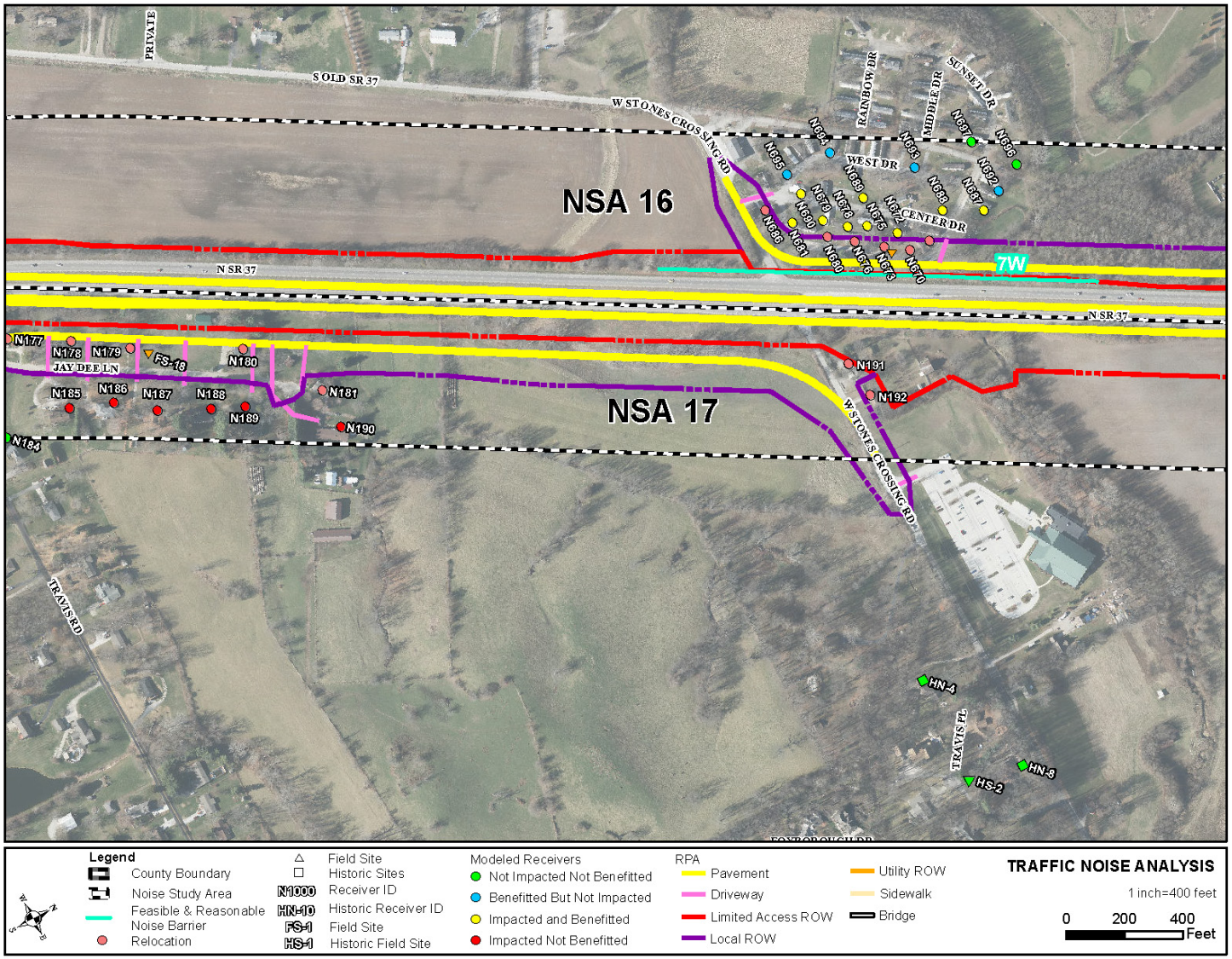

Figure 5.10-6: Feasible and Reasonable Noise Barriers, RPA Map 6

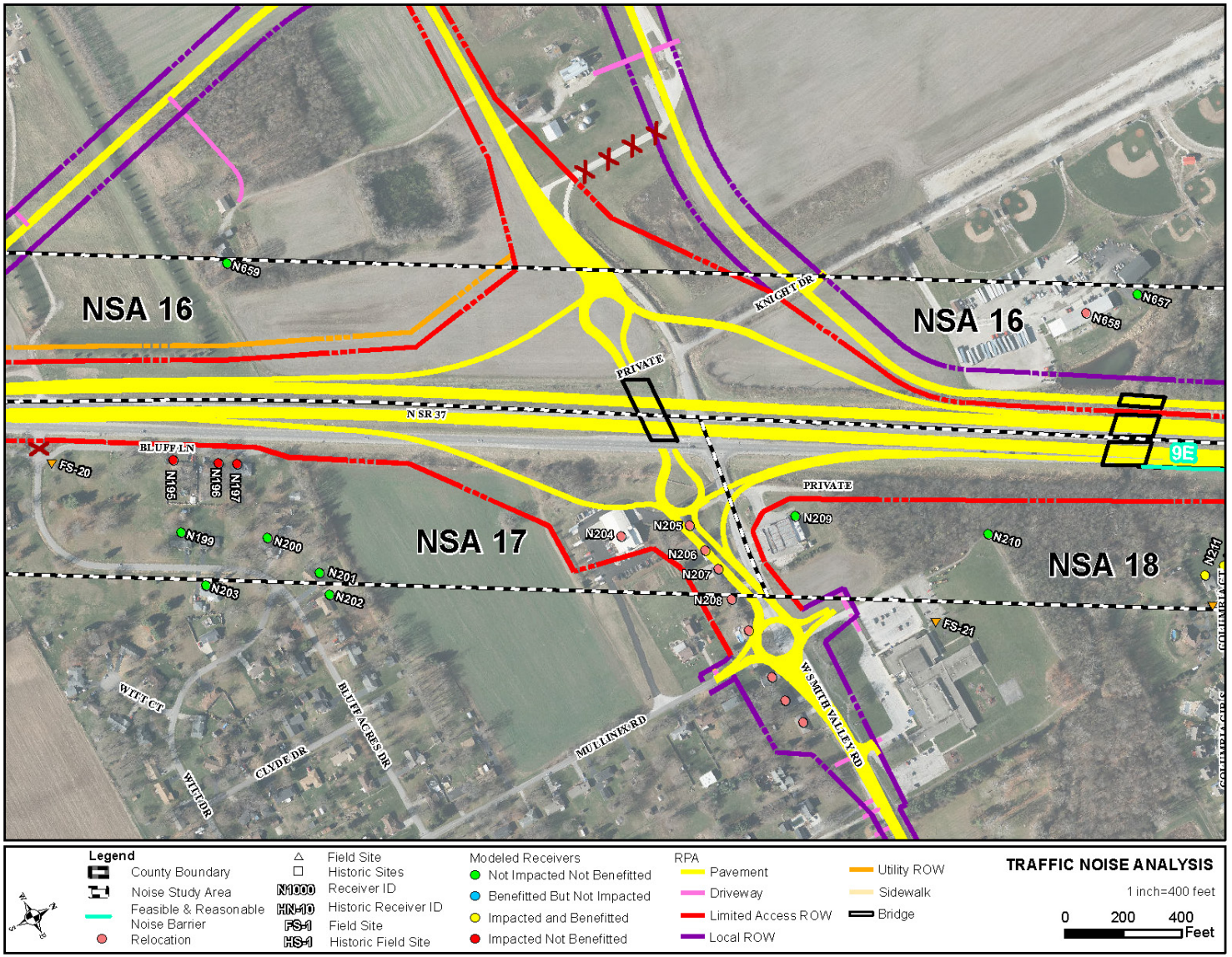

Figure 5.10-7: Feasible and Reasonable Noise Barriers, RPA Map 7

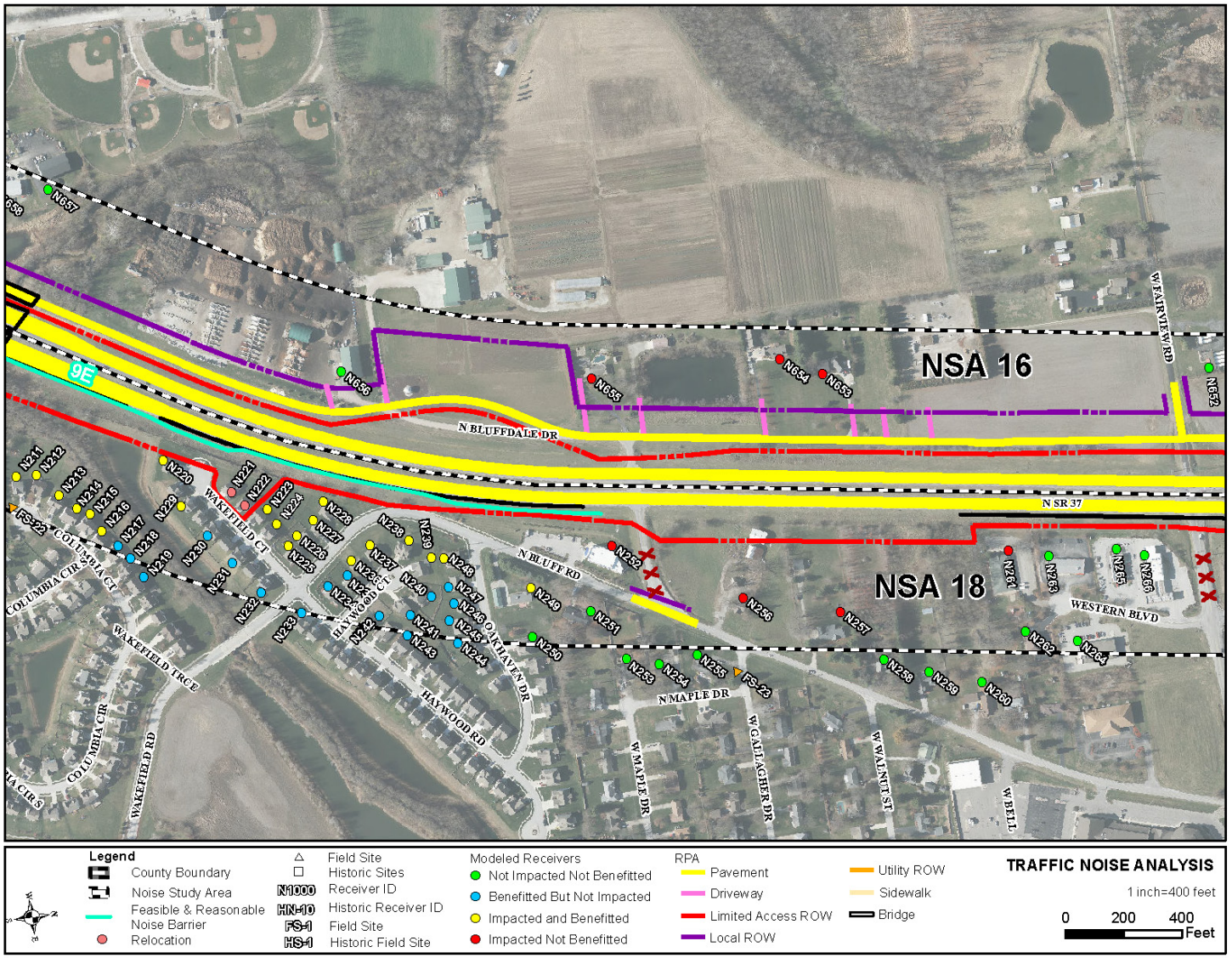

Figure 5.10-8: Reasonable and Feasible Noise Barriers, RPA Map 8

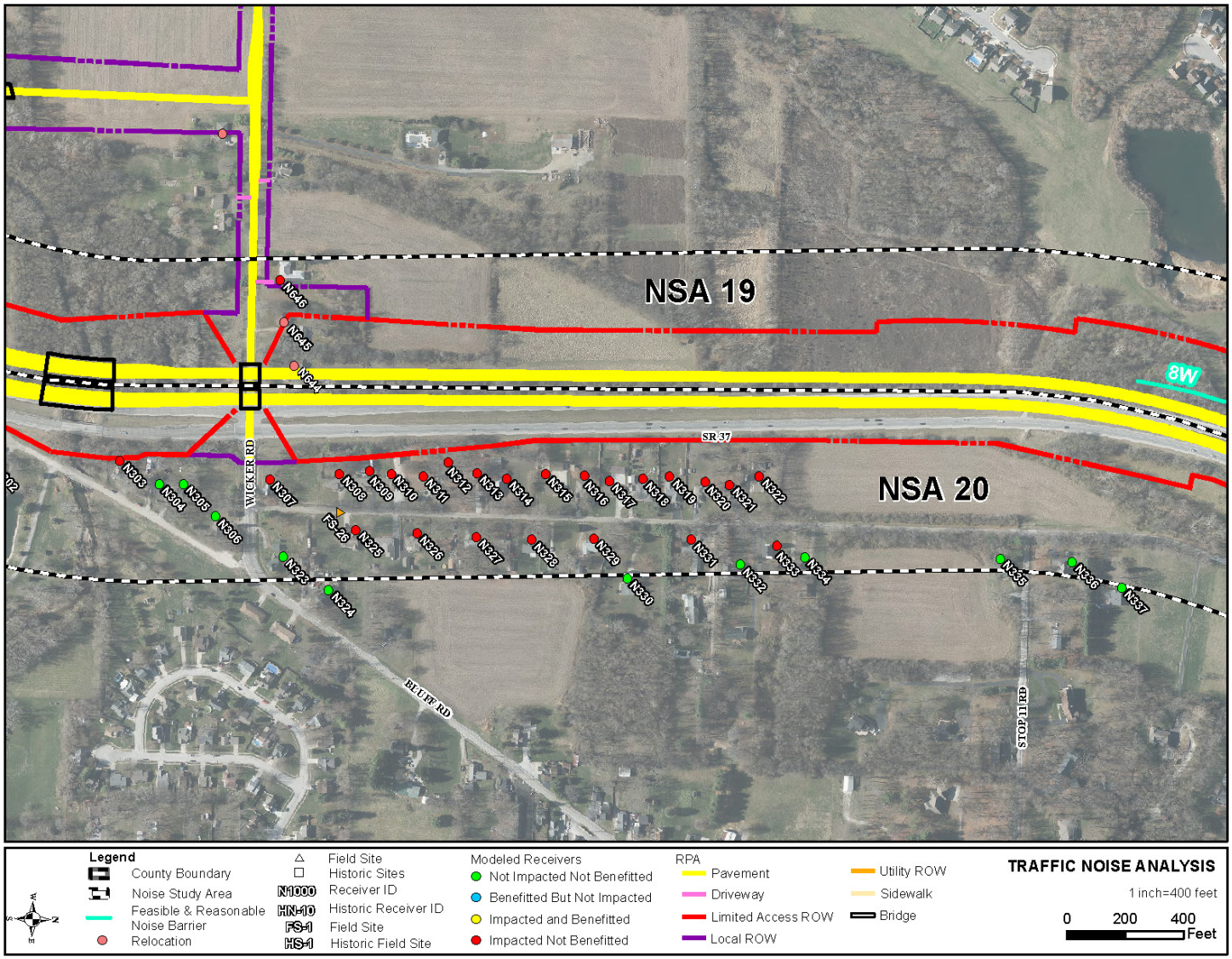

Figure 5.10-9: Feasible and Reasonable Noise Barriers, RPA Map 9

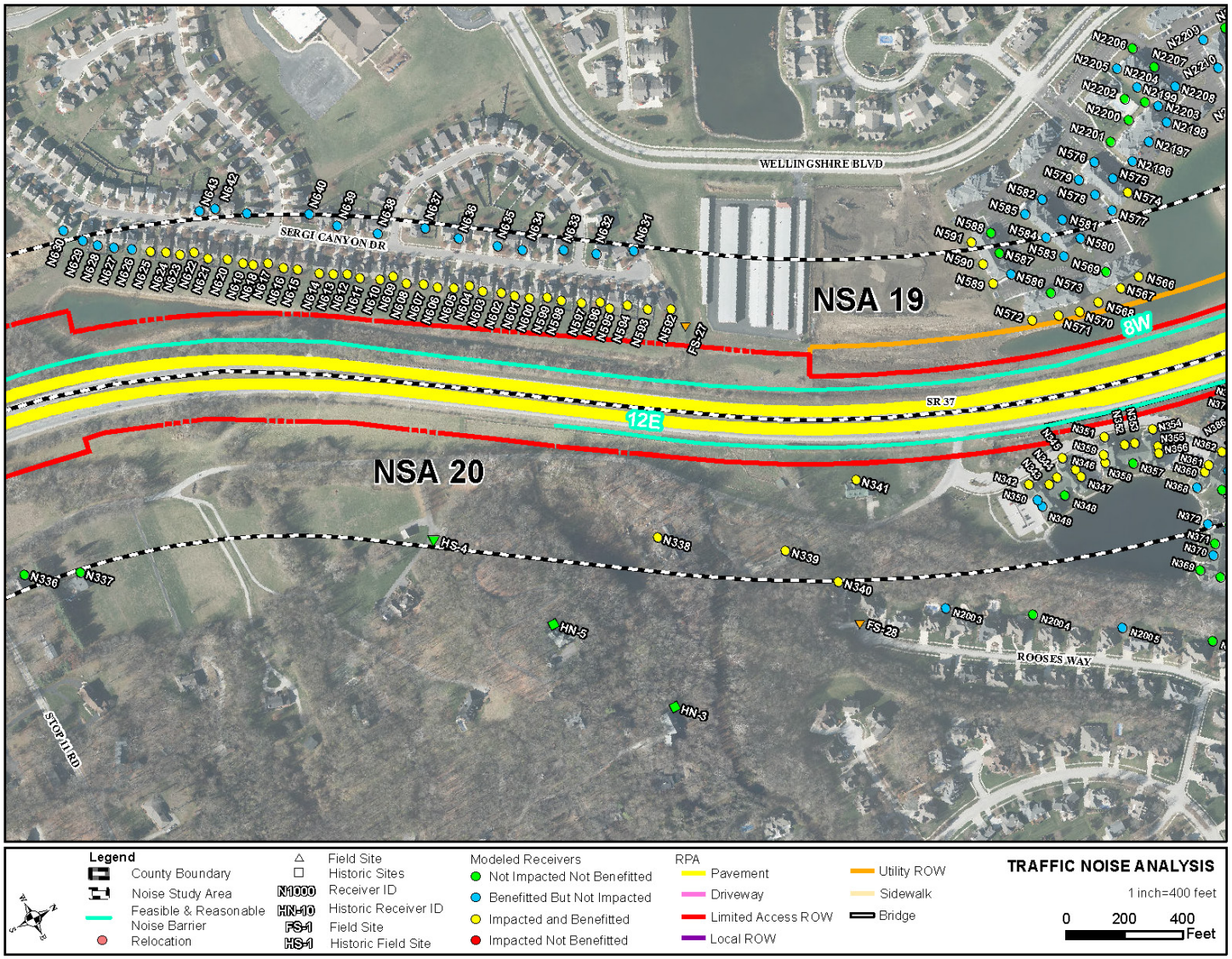

Figure 5.10-10: Feasible and Reasonable Noise Barriers, RPA Map 10

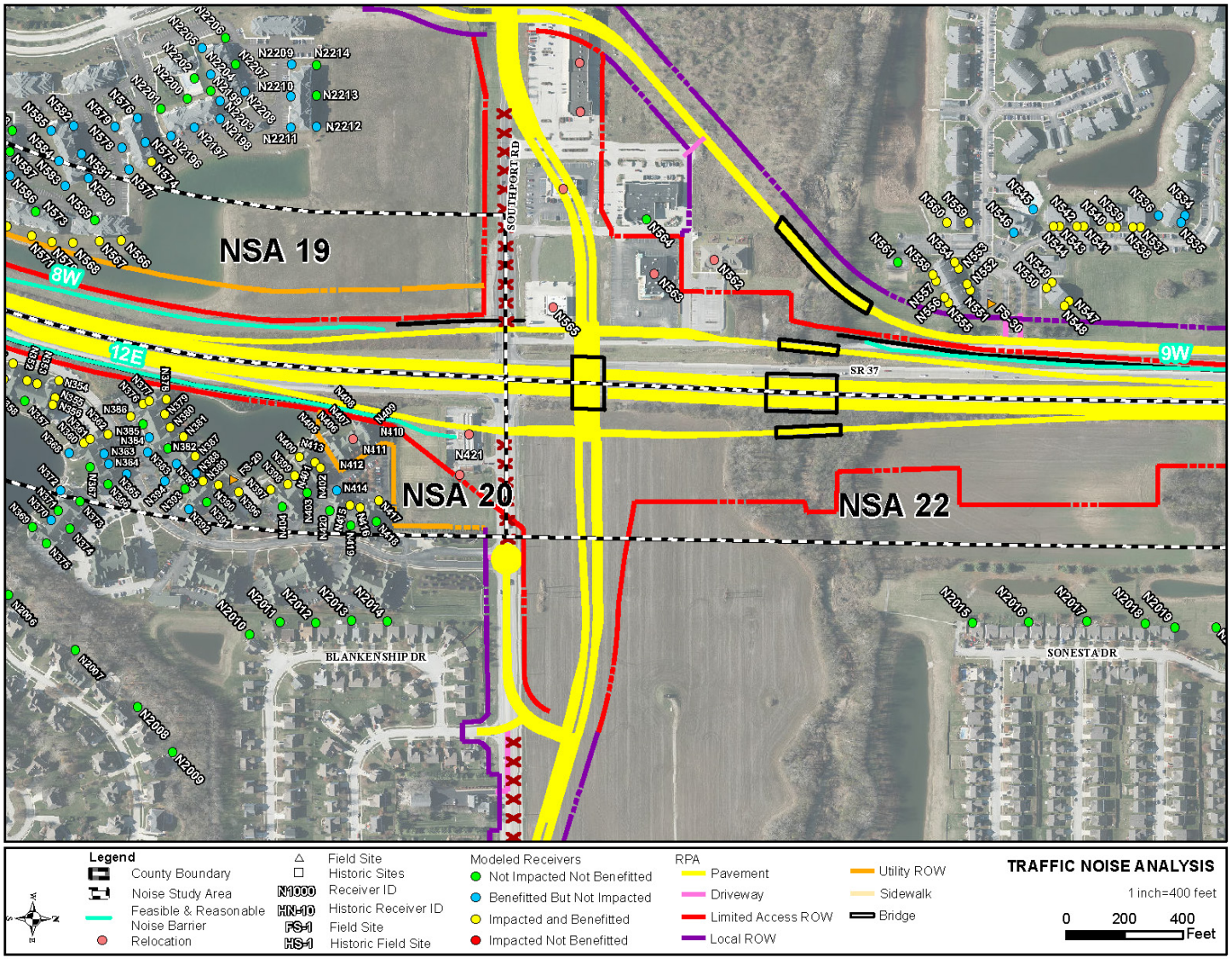

Figure 5.10-11: Feasible and Reasonable Noise Barriers, RPA Map 11

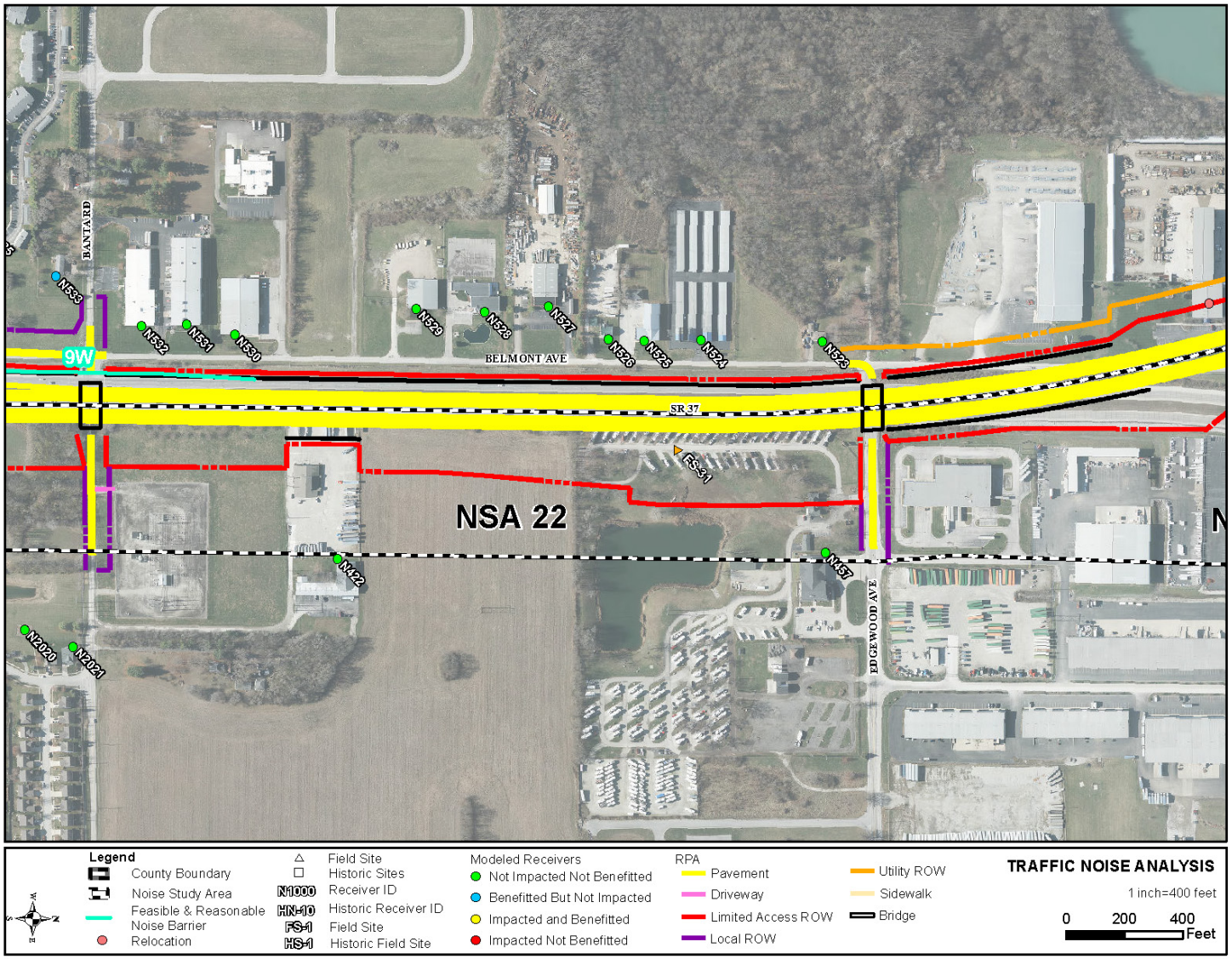

Figure 5.10-12: Feasible and Reasonable Noise Barriers, RPA Map 12

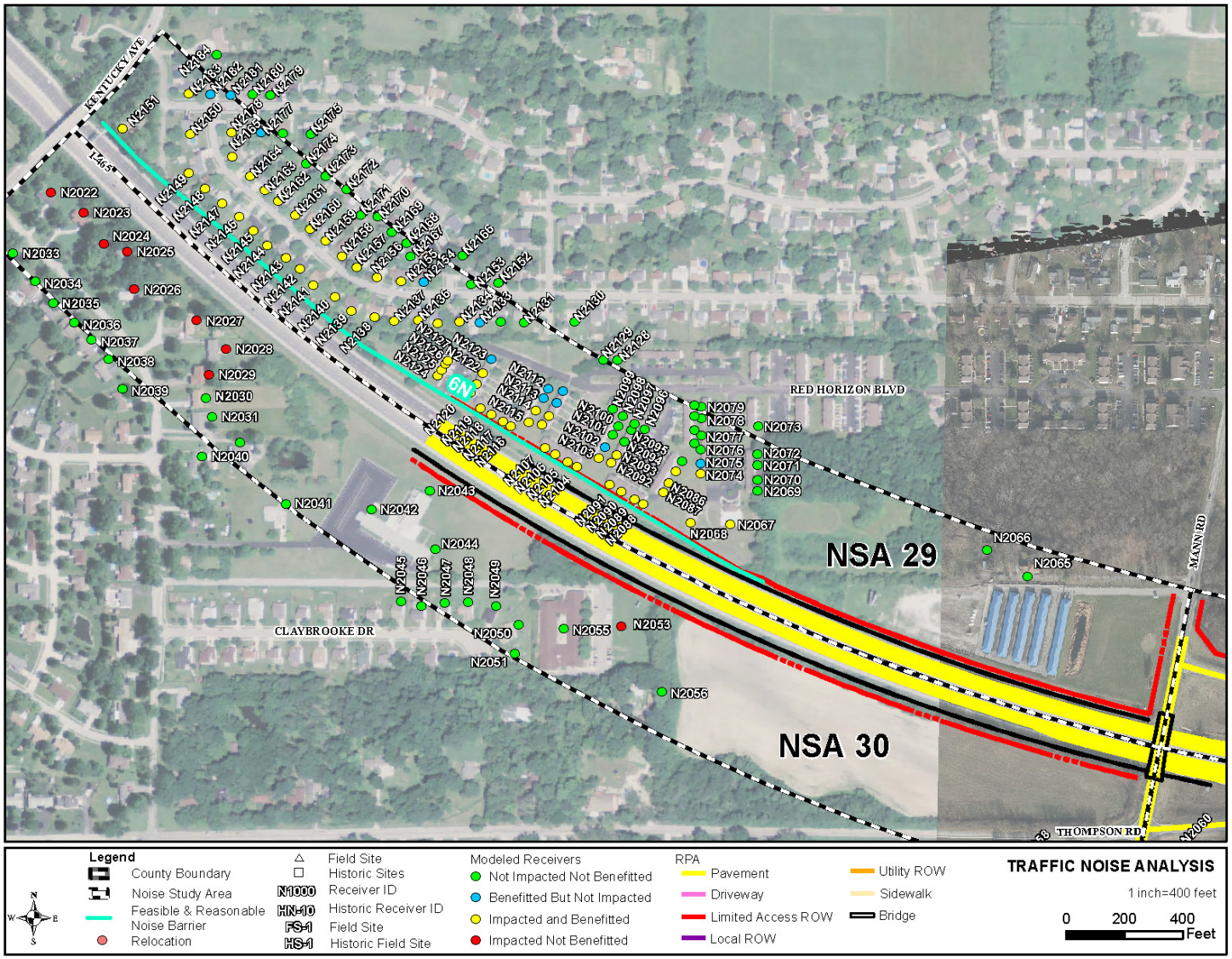

Figure 5.10-13: Feasible and Reasonable Noise Barriers, RPA Map 13

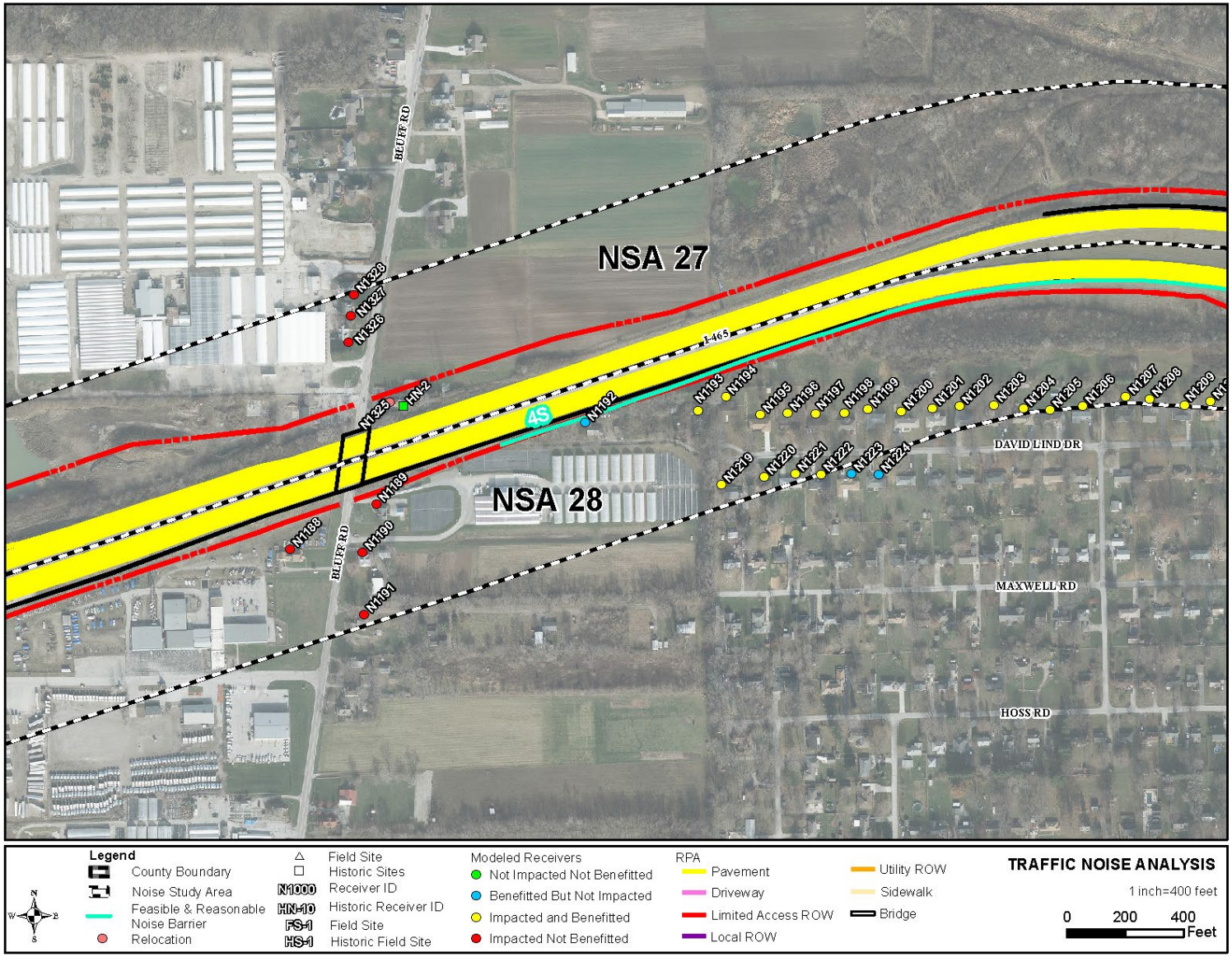

Figure 5.10-14: Feasible and Reasonable Noise Barriers, RPA Map 14