



NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2018 Fourth Quarter and Annual Report

1 S. Wilmington Street
Raleigh, NC 27601



Last Updated:
January 9, 2019

CONSULTANT CERTIFICATION OF COMPLETION

January 3, 2019

Dennis Jernigan, P.E.
Director of Highway Operations, NCTA
1 South Wilmington Street
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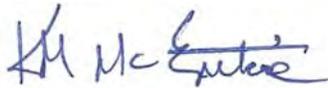
NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q4, FY 2018 Rating

This is to certify that I, Ken M. McEntire, PE am an authorized official representative of the company The Kercher Group, Inc., which is a subconsultant to HNTB North Carolina, P.C. Collaboratively; we are working as the Triangle Expressway Roadway and Facility Maintenance Performance Rating Program Consultants.

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been independently performed in accordance with, and in conformity to, the *NCTA Roadway and Facility Maintenance Performance Standards*.

Sincerely,

The Kercher Group, Inc.

A handwritten signature in blue ink that reads "Ken M. McEntire". The signature is written in a cursive style with a large initial "K" and "M".

Ken M. McEntire, PE
Principal

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1.0 EXECUTIVE SUMMARY

The North Carolina Turnpike Authority (NCTA) Maintenance Rating Program (MRP) is a maintenance evaluation program for roadway features and toll facilities on the NCTA system. This report presents results from the 2018 Fourth Quarter Assessment of the Triangle Expressway.

The overall 2018 fourth quarter maintenance rating of the Triangle Expressway was 96.6, meeting the NCTA target rating of 90. As shown in **Table 1**, all five elements assessed achieved a rating greater than the target rating of 85.

Table 1: MRP Element Results for the 2018 Fourth Quarter Assessment		
Element	MRP Rating	Target Rating
Road Surface	99.2	85.0
Unpaved Shoulders and Ditches	99.0	85.0
Drainage	92.8	85.0
Roadside	97.1	85.0
Traffic Control Devices	95.1	85.0
Overall MRP Performance Rating	96.6	90.0

This report also provides a summary and analysis of the 2018 Annual Assessment of the Triangle Expressway, which considers the results of all four quarterly inspections conducted in 2018 during the months February, May, August, and November. The summation of these results produces the annual rating, which is a statistically valid representation of the assets’ conditions with a 95% confidence level in statistical sampling.

The overall 2018 annual maintenance rating of the Triangle Expressway was 94.7, which is above the NCTA target rating of 90. As shown in **Table 2**, all annual element ratings were also above the target rating of 85.

Table 2: MRP Element Results for the 2018 Annual Assessment					
Element	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Q4 2018 Rating	Annual Rating
Road Surface	98.5	99.2	99.2	99.2	99.0
Unpaved Shoulders and Ditches	97.8	96.8	97.1	99.0	97.7
Drainage	87.7	97.3	96.1	92.8	93.5
Roadside	92.2	91.3	94.9	97.1	93.9
Traffic Control Devices	83.8	91.1 ¹	94.6 ¹	95.1	90.9 ²
Overall MRP Performance Rating	91.3	94.8	96.4	96.6	94.7

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes the second and third quarter ratings for characteristics listed above.

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In addition, the report provides findings of the Green Level Historic District signs inspection. This quarter, all three signs inspected were found to be in good physical condition, and the landscaped areas around the signs were maintained in accordance with NCTA MRP standards.

2.0 INTRODUCTION

The NCTA MRP is a comprehensive planning, measuring, and managing process that provides a means for communicating to managers, stakeholders and customers the impacts of policy and budget decisions on program service delivery.

Using outcome-based performance measures and the service level scale (0 through 100), the inspection results are rated against established thresholds criteria. The program analysis is accomplished using sampling procedures that capture the level of service being provided for individual assets. The evaluation procedure is based on the establishment of threshold conditions that quantify the maximum defect allowed on assets. Over time, the results can be charted to identify work needs and subsequent necessary actions.

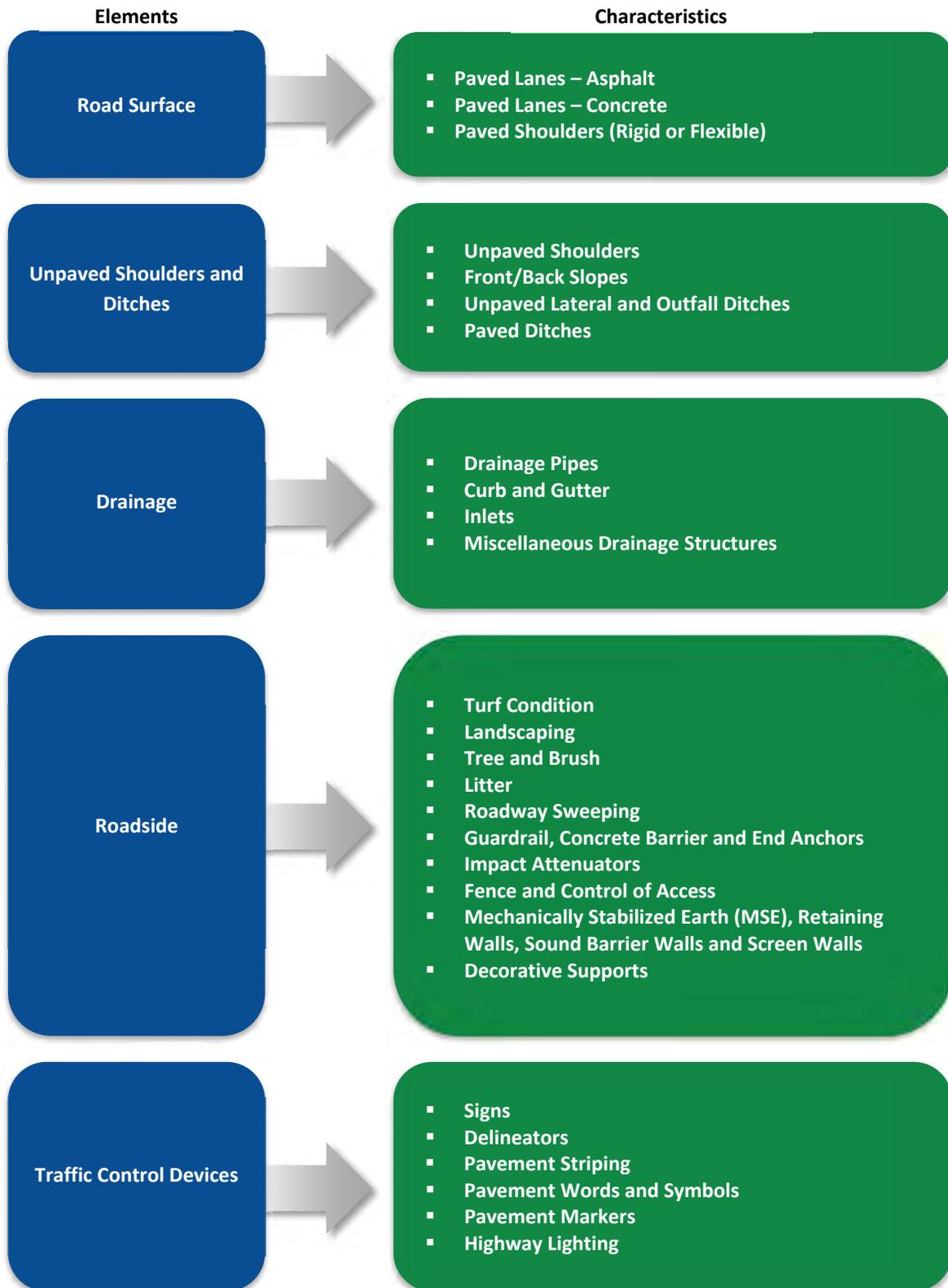
The NCTA performance standards, threshold criteria, and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff, and consultants.

Using field survey information, a maintenance matrix can be developed to show the ties between maintenance activities and the characteristics of various roadway features. The purpose of this evaluation is to provide information that can be used to schedule and prioritize routine maintenance activities and provide uniform maintenance conditions that meet established objectives.

3.0 MRP PROCEDURE

Per the *NCTA Roadway and Facility Maintenance Performance Standards V4*, roadway assets or characteristics on NCTA facilities have been grouped into elements. These elements and corresponding characteristics can be seen in **Figure 1**:

Figure 1: Maintenance Elements and Characteristics



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A weighting system has been established to identify the importance of each element and characteristic. This system consists of two weighting factors: one that accounts for the importance of individual characteristics within a given maintenance element (1-9), and one that accounts for the importance of the maintenance elements to the total rating (by % of score). This two-factor system reveals deficiencies among characteristics and elements.

The program analysis is accomplished using statistically valid, random sampling procedures that capture the level of service for individual characteristics with a 95% confidence level in sampling. The sample characteristics selected are evaluated during quarterly inspections, which are performed during the months of February, May, August, and November to account for dynamic changes in assets during the various seasons. The evaluation process is completed using electronic data collection tablets and is based on established threshold conditions described in the *NCTA Roadway and Facility Maintenance Standards V4*. Those characteristics that meet or exceed the threshold are coded as PASSING; those that do not meet the threshold are coded as NOT PASSING.

When the evaluation process is completed, the number of PASSING samples and total sample are multiplied by the weighted values (1-9) to determine the actual and possible rating points for characteristics and elements. MRP ratings for elements and characteristics are then calculated as the ratio of the actual rating points to possible rating points. The MRP ratings represent the maintenance level of service currently being provided, as they define the percent of characteristics and elements that meet the maintenance condition standard. For instance, an MRP rating of 83 signifies that 83 percent of the inspected elements/characteristics met the standard.

The overall MRP rating is determined by calculating the sum of the elements ratings multiplied by the following weighted factors:

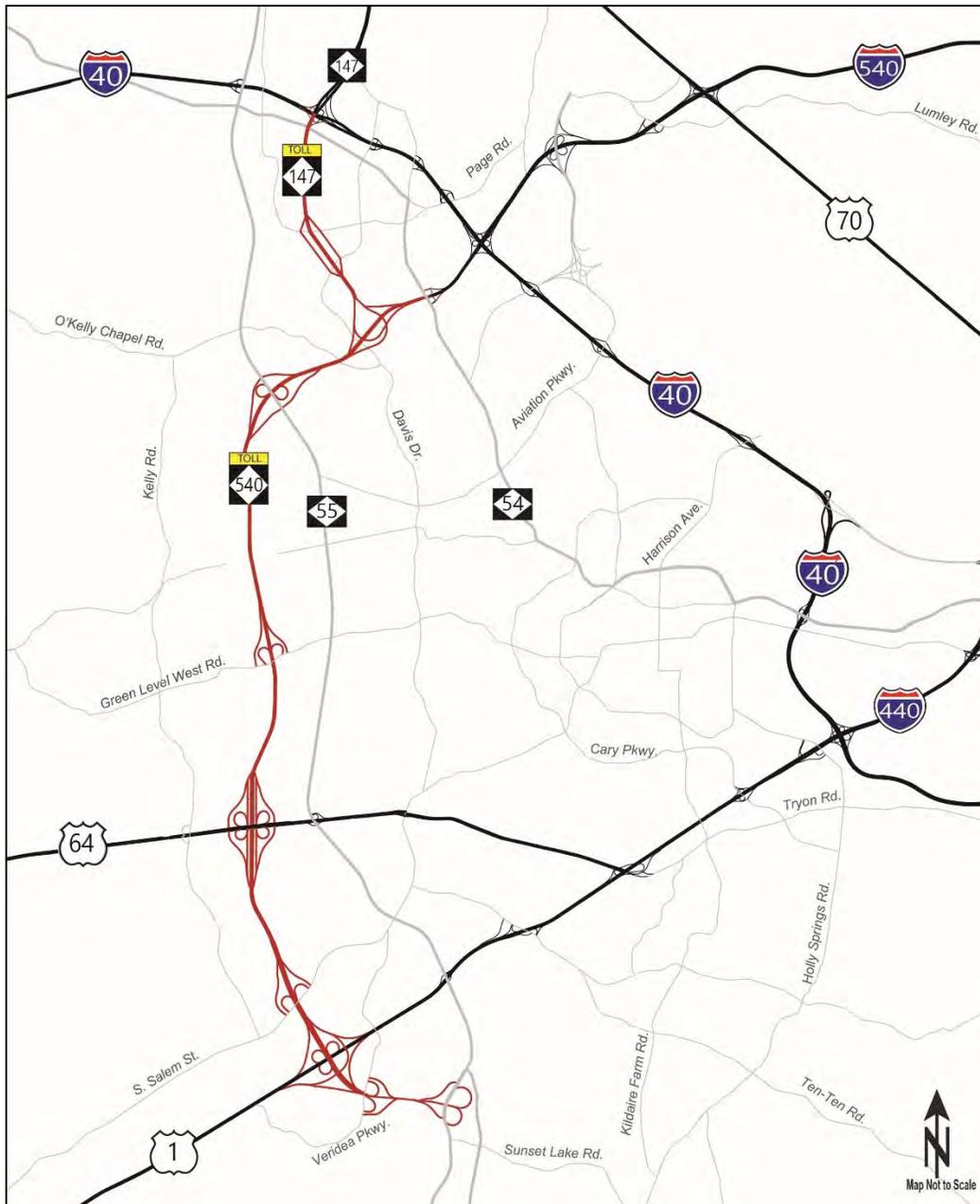
Road Surface =	25%
Unpaved Shoulders =	13%
Drainage =	15%
Roadside =	17%
Traffic Control Devices =	30%
<hr/>	
Total	100%

The NCTA's overall target rating is 90, with elements scoring 85 or higher, and characteristics 80 or higher. In addition to quarterly ratings, the cumulative rolling annual rating is calculated each quarter. This rating is obtained by adding the ratings of the latest four quarterly inspections to compensate for the likelihood of uneven sample sizes.

4.0 TRIANGLE EXPRESSWAY DESCRIPTION

The Triangle Expressway extends for approximately 18.8 miles from the interchange of I-40 and Toll NC-147 in Durham to the NC-55 Bypass near Holly Springs (**Figure 2**). It includes a one-mile segment on Toll NC-540 extending north from the Toll NC-540 / Toll NC-147 interchange to the NC-54 interchange. The Triangle Expressway consists of eleven interchanges and twenty all-electronic toll collection zones.

Figure 2: Triangle Expressway Map



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5.0 TRIANGLE EXPRESSWAY ASSET INVENTORY UPDATE

Through normal day-to-day maintenance activities and the construction of special projects, roadside assets are continuously being added or modified on the roadway. NCTA coordinates closely with NCDOT Division 5 Maintenance and conducts routine field visits to maintain an accurate asset inventory and ensure the validity of the MRP survey.

During this quarter assets on Toll NC 540 North from Green Level West Road to Carpenter Fire Station Road were removed from the inventory due to the Morrisville Parkway Interchange construction project. Also, NCTA added to the inventory all new assets located in the Veridea Parkway interchange in March 2018. **Table 3 presents** the updated number of assets that are currently available for inspections.

Table 3: Asset Inventory		
Assets	Total Inventory	2018 Eligible Inventory
Barriers	588	569
Curb and Gutter	243	241
Decorative Supports	279	277
Drainage	1172	1158
Misc. Drainage	170	163
Fences	435	418
Highway Lighting	397	397
Impact Attenuators	45	45
Inlets	1053	1042
Linear Segments	694	678
Plant Beds	266	261
Paved Ditches	2	2
Pavement Symbols	617	488
Signs	1101	1091
Tree and Brush	564	549
Turf	1009	994
Walls	84	81

6.0 MRP FOURTH QUARTER ASSESSMENT

6.1 Quarterly Results

The overall 2018 fourth quarter maintenance rating of the Triangle Expressway was 96.6, meeting NCTA's target overall rating of 90. All elements assessed achieved ratings above the target rating of 85 established for element groups. Miscellaneous Drainage (65) is the characteristic that scored below the target rating of 80.

It is important to note that these results are only representative of the fourth quarter sample, one of the four surveys to provide an intermediate snapshot of seasonal conditions. Therefore, they are not a statistically valid representation of the assets; only the total of all four quarterly inspections, reported at the end of each calendar year, provides a 95% confidence level in statistical sampling. The fourth quarter MRP performance ratings for elements and characteristics are presented in **Table 4** and **Table 5**, respectively.

Table 4: MRP Element Results for Q4 2018	
Element	Q4 2018 MRP Rating
Road Surface	99.2
Unpaved Shoulders and Ditches	99.0
Drainage	92.8
Roadside	97.1
Traffic Control Devices	95.1
Overall MRP Performance Rating	96.6

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Table 5: MRP Characteristic Results for Q4 2018

Road Surface	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q4 Rating
Paved Lanes Asphalt	17	17	9	153	153	100
Paved Lanes Concrete	27	27	9	243	243	100
Paved Shoulder	43	44	5	215	220	98
Element Total				611	616	99.2
Unpaved Shoulders and Ditches	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q4 Rating
Unpaved Shoulder	43	44	9	387	396	98
Front/Back Slopes	44	44	6	264	264	100
Lateral and Outfall Ditches, Unpaved	44	44	6	264	264	100
Ditches, Paved	2	2	5	10	10	100
Element Total				925	934	99.0
Drainage	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q4 Rating
Drainage Pipes	36	36	7	252	252	100
Curb and Gutter	29	30	6	174	180	97
Inlets	33	34	7	231	238	97
Misc. Drainage Structure	20	31	4	80	124	65
Element Total				737	794	92.8
Roadside	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q4 Rating
Turf Condition	56	62	7	392	434	90
Landscaping	25	25	4	100	100	100
Trees and Brush	31	31	4	124	124	100
Litter	44	44	4	176	176	100
Roadway Sweeping	44	44	5	220	220	100
Guardrail, Concrete Barrier and End Anchors	31	31	9	279	279	100
Impact Attenuators	11	11	9	99	99	100
Fence, Control Access	35	37	7	245	259	95
Retaining Walls and Sound Barrier Walls	16	16	5	80	80	100
Decorative Supports	26	27	5	130	135	96
Graffiti and Stain Removal	44	44	4	176	176	100
Element Total				2021	2082	97.1
Traffic Control Devices	Sample Passed	Sample Total	Weighted Values	Actual Pts	Available Pts	Q4 Rating
Signs	36	37	7	252	259	97
Delineators	44	44	3	132	132	100
Pavement Striping/Marking	43	44	8	344	352	98
Words and Symbols	31	31	7	217	217	100
Pavement Markers	40	44	9	360	396	91
Highway Lighting	45	50	6	270	300	90
Element Total				1575	1656	95.1

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Additionally, **Appendix A** includes maps that present the location of all assets assessed during the fourth quarter. **Appendix B** includes a list of the individual assets that did not achieve their target ratings.

6.2 Analysis and Recommendations

Elements

During the fourth quarter, all elements exceeded NCTA's threshold criteria of 85. Road Surface (99.2) and Unpaved Shoulder/Ditches (99.0) continued to obtain ratings higher than 95. All other elements exceeded a score of 90 this quarter. Roadside (97.1) was the element that experienced the most significant increase in rating compared to the previous quarter. The rating for this element was 2.2 points higher than the third quarter rating. The increase is the result of improved Turf Condition (90), Landscaping (100), and Guardrail (100) ratings.

In contrast, Drainage (92.8) experienced the most significant decrease in rating compared to the previous quarter. The rating for this element was 3.3 points lower than the third quarter rating. The decrease was predominately due to lower ratings for Miscellaneous Drainage (65), which could be attributed to the heavy rainfall from storms during the fall months.

Traffic Control Devices (95.1) experienced an increase of 11.3 points compared to first quarter ratings. The restriping project, which improved the condition of pavement striping, characters, symbols, and markers on concrete surfaces, was completed earlier this fall. The rating of Pavement Striping (98), Pavement Characters and Symbols (100), and Pavement Marker (91) characteristics resumed this quarter.

Recommendations to improve specific critical characteristic ratings are provided in the following sections.

Characteristics

This quarter all but one characteristic, Miscellaneous Drainage Structure (65), met the NCTA target threshold criteria of 80. A description of the characteristics' conditions and future work planning recommendations are provided below. Pictures of all characteristic failures are included in **Appendix B**.

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Miscellaneous Drainage (65 rating – 11 of the 31 assets did not pass): Out of the 11 miscellaneous drainage structures that did not pass inspection, 2 were obstructed and 9 had a missing or damaged screen at the outlet. Two of the miscellaneous drainage structures (shoulder underdrains) that did not pass inspection are presented in **Figure 3**.

Figure 3: Miscellaneous Drainage Inspection Results Sample



In accordance with *NCTA Roadway and Facility Maintenance Standards V4*, referenced below, the maintenance provider shall plan annual cleaning of these drainage features to remove any debris or overgrown vegetation. It is also recommended that the maintenance provider continue to follow the routine patrol schedule and repair any erosion or soil buildup problems along the ditch line near the outlets. Given the subsurface Triassic soil conditions encountered on this project, the edge drain system is a critical component of maintaining the design life of pavements as it provides a conduit to channel water away from the subgrade and base.

Miscellaneous Drainage Maintenance Program Standards:

- 1) Miscellaneous Drainage Structures shall be inspected during routine patrols.
- 2) Clear all outlets to edge drains annually.
- 3) Schedule cleanouts and repairs during inspections.

Miscellaneous Drainage Evaluation Standards:

Miscellaneous Drainage Structures do not meet the maintenance standards when any of the following criteria is observed:

- 1) More than 50% of the structure (length and depth) is obstructed or blocked.
- 2) End protection has deteriorations, erosions, washouts or buildups adversely affecting the natural flow of water.

To avoid affecting the natural flow of water near the drainage features and reducing the design life of pavement performance, it is recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage. Appropriate grading of the ditch line may be necessary to provide positive flow.

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7.0 MRP ANNUAL 2018 ASSESSMENT

7.1 Annual Results

The 2018 annual maintenance rating of the Triangle Expressway was 94.7, exceeding NCTA’s target overall rating of 90. All element ratings exceeded the target rating of 85. Also, all but one characteristic rating met or exceeded the target rating of 80. Ratings for Miscellaneous Drainage Structure was 75.

The 2018 results are presented in **Tables 6 and 7**. These results are a collection of the four quarterly inspections conducted throughout the year.

Table 6: MRP Element Results for 2018					
Element	Q1 2018 Rating	Q2 2018 Rating	Q3 2018 Rating	Q4 2018 Rating	Annual Rating
Road Surface	98.5	99.2	99.2	99.2	99.0
Unpaved Shoulders and Ditches	97.8	96.8	97.1	99.0	97.7
Drainage	87.7	97.3	96.1	92.8	93.5
Roadside	92.2	91.3	94.9	97.1	93.9
Traffic Control Devices	83.8	91.1 ¹	94.6 ¹	95.1	90.9 ²
Overall MRP Performance Rating	91.3	94.8¹	96.4¹	96.6	94.7²

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes the second and third quarter ratings for characteristics listed above.

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Table 7: MRP Rolling Element Results					
Road Surface	Q1 2018 RATING	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	ROLLING RATING
Paved Lanes Asphalt	95	100	100	100	99
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	100	98	98	98	98
Element Total	98.5	99.2	99.2	99.2	99.0
Unpaved Shoulders and Ditches	Q1 2018 RATING	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	ROLLING RATING
Unpaved Shoulder	98	95	93	98	96
Front/Back Slopes	98	95	100	100	98
Lateral and Outfall Ditches, Unpaved	98	100	100	100	99
Ditches, Paved	100	100	100	100	100
Element Total	97.8	96.8	97.1	99.0	97.7
Drainage	Q1 2018 RATING	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	ROLLING RATING
Drainage Pipes	91	100	100	100	98
Curb and Gutter	90	97	97	97	95
Inlets	97	97	100	97	98
Misc. Drainage Structure	59	94	81	65	75
Element Total	87.7	97.3	96.1	92.8	93.5
Roadside	Q1 2018 RATING	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	ROLLING RATING
Turf Condition	79	69	85	90	81
Landscaping	100	96	96	100	98
Trees and Brush	100	100	100	100	100
Litter	100	100	100	100	100
Roadway Sweeping	100	100	100	100	100
Guardrail, Concrete Barrier and End Anchors	90	97	94	100	95
Impact Attenuators	100	100	100	100	100
Fence, Control Access	91	94	94	95	93
Retaining Walls and Sound Barrier Walls	88	94	94	100	94
Decorative Supports	92	89	100	96	94
Graffiti and Stain Removal	100	100	100	100	100
Element Total	92.2	91.3	94.9	97.1	93.9
Traffic Control Devices	Q1 2018 RATING	Q2 2018 RATING	Q3 2018 RATING	Q4 2018 RATING	ROLLING RATING
Signs	97	97	100	97	98
Delineators	100	95	89	100	96
Pavement Striping/Marking	77	100 ¹	94 ¹	98	90 ¹
Words and Symbols	90	90 ¹	100 ¹	100	95 ¹
Pavement Markers	84	95 ¹	100 ¹	91	90 ¹
Highway Lighting	68	78	86 ²	90 ²	81 ²
Element Total	83.8	91.1¹	94.6³	95.1²	90.9³

¹ Excludes pavement striping, characters, symbols, and markers on concrete pavement surfaces.

² Excludes nighttime functionality as a metric for Highway Lighting.

³ Excludes Pavement Striping, Pavement Characters and Symbols, Pavement Markers, and Highway Lighting functionality characteristics.

7.2 Analysis and Recommendations

Based on the combined results of all four quarterly inspections conducted in 2018, all elements exceeded NCTA's threshold criteria of 85. In addition, all but one of the characteristics did not meet the target threshold criteria of 80. This characteristic was Miscellaneous Drainage Structure (75). Miscellaneous Drainage obtained a low rating less than 80 in two of the four quarters. Turf Condition (81) and Highway Lighting (81) were both above the characteristic threshold criteria of 80 due to the higher ratings achieved in the third and fourth quarters. Although overall the Pavement Markers scored (90) above the target rating, it is noted that the markers along Toll 147 have reached their serviceable life (3 years) and the entire pavement marker segment is failing to achieve appropriate nighttime reflectivity. It is recommended that these markers be replaced in the spring of 2019.

To increase the rating obtained for miscellaneous drainage structures and meet NCTA's threshold criteria, it is recommended that the maintenance provider follow the maintenance recommendations provided in **Section 6**. Additionally, to continue to meet NCTA's threshold criteria for turf and highway lighting, it is recommended for the maintenance provider to continue to follow the maintenance program and standards presented in the *NCTA Roadway and Facility Maintenance Standards V4*, referenced below.

Turf Condition

Maintenance Program:

- 1) Roadside mowing should occur as often as necessary to conform to the evaluation standard. Mowing shall be in accordance with the NCTA approved mowing patterns and must not exceed the mowing lines identified by the approved stakes. These stakes are identified with a 15 inch white top. The maintenance provider shall review and confirm clarity to the NCTA (in writing) for strict adherence to the approved mowing pattern prior to each mowing season.
- 2) Turf grass shall be cut to a height of six inches (6) with a maximum tolerance of two (2) inches plus or minus.
- 3) Maintain roadway mowing 5 feet behind guardrail, unless otherwise specified by landscaping stakes.
- 4) Where landscaping has been established, or around the natural enhancement areas, mowing shall conform to the established contours with smooth flowing transitions.
- 5) Roadside trimming shall occur around all traffic appurtenances including, but not limited to guardrail, sign posts, light standards, and ITS devices.
- 6) Chemical applications:
 - a. Winter:
 - i. Apply limestone.
 - ii. Apply fertilizer.
 - b. Spring:
 - i. Apply pre- and post-emergent broadleaf weed control in accordance with the manufacturer's recommendations in April.
 - ii. Bare ground areas shall be scheduled for seeding in as necessary.

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- c. Fall:
 - i. Apply post-emergence herbicides to select locations in accordance to the manufactures recommendations in August.
 - ii. Bare ground areas shall be seeded in the fall as needed.

Maintenance and Evaluation Standards:

Turf does not meet the maintenance standards when any of the following criteria are observed:

- 1) More than 25% of the undesirable vegetation is present within the mowing limits of the area.
- 2) Noxious weeds present.
- 3) More than 50 cumulative SF of bare ground is present in the turf evaluation area.

Highway Lighting

Highway Lighting Maintenance Program Standards:

- 1) Perform night patrol once a month, and identify any outages to be submitted by the maintenance provider. LED maintenance and replacement will occur under the responsibility of the Council of State contract for the next 15 years.
- 2) Replace any light poles damaged by traffic within 5 days or within 14 days if any foundations need pouring.

Highway Lighting Maintenance and Evaluation Standards:

Highway and Sign Lighting do not meet the maintenance standards when any of the following criteria are observed:

- 1) Any electrical inspection plate, access panel cover, exposed electrical wire, or pull box cover are not properly secured in place.
- 2) More than 10% of the total luminaries are not functioning during nighttime observation. (This criterion is not being evaluated while NCTA highway lighting system is under the Council of State contract)
- 3) More than 10% of the poles are damaged or missing.
- 4) Rodent screen protection is not in place.

8.0 GREEN LEVEL HISTORIC DISTRICT SIGNS

The three Green Level Historic District signs and surrounding landscaped areas were installed as part of the Triangle Expressway construction project. Currently, NCDOT is maintaining the Green Level Historic District Signs and the Town of Cary is providing maintenance to the landscaped areas surrounding these signs.

8.1 Analysis and Recommendations

As part of each quarterly inspection, an assessment team visits the three Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. The three signs included in the inspection inventory were found to be in good condition, with the landscaped areas being well maintained. **Figure 4** shows these signs.

Figure 4: Green Level West Historic District Signs, Landscape Areas



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9.0 CONCLUSION

This report presents the 2018 fourth quarter and annual rating assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements, and 80 for characteristics. The fourth quarter 2017 overall rating was 96.6 and the annual rating was 94.7, both ratings met the target rating of 90.

All element ratings were above the target ratings for the quarter and annual assessment. Drainage (92.8) was the only element to experience a decrease in rating compared to the previous quarter. Road Surface (99.2) rating remained constant, Unpaved Shoulders and Ditches (99.0) rating increased by 1.9 points, Roadside (97.1) rating increased by 2.2 points, Traffic Control Devices rating increased by 0.5 points.

During the fourth quarter assessment, all but one characteristic met or exceeded the target rating of 80. This characteristic was Miscellaneous Drainage (65). Similarly, during the annual assessment Miscellaneous Drainage (75) did not meet the target rating of 80.

To improve the ratings, it is recommended that the maintenance provider conduct routine patrols of shoulder underdrains, in addition to periodically removing any debris or overgrown vegetation that may impede the flow of water. It is also recommended that outlet elevations be checked against the outflow ditch elevations to ensure positive drainage and prevent drain outlets from backing up with water. Applicable grading of the ditch line may be necessary to provide positive flow.

To continue to improve upon characteristic ratings that have scored a rating below 80 this year, it is recommended that the maintenance provider address wall paint scaling issues. Scheduling for this repair within the annual work plan would alleviate further deterioration and maintain the facility's intended aesthetics. Also, bare areas seeding/fertilization program efforts should also continue during the spring and summer seasons to promote new turf growth.

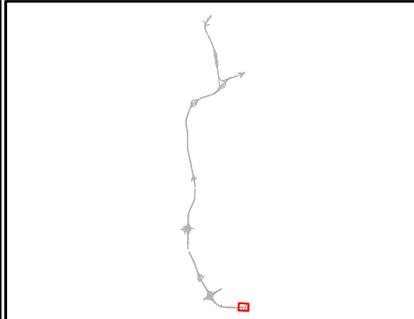
This quarter, the three Green Level Historic District signs inspected were found to be in good standing condition. Additionally, the landscaped areas surrounding the signs were found to be well maintained.

Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

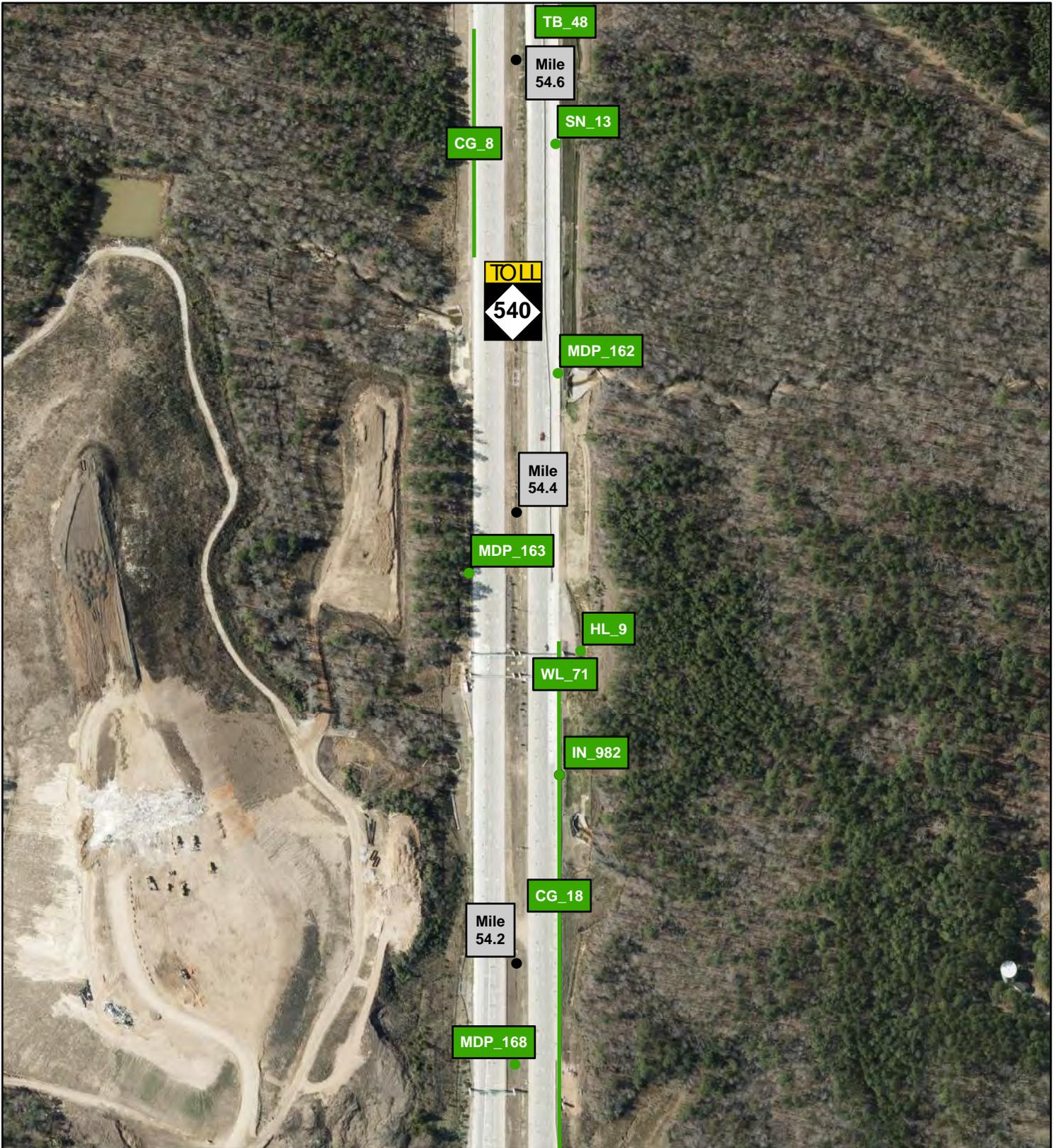


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

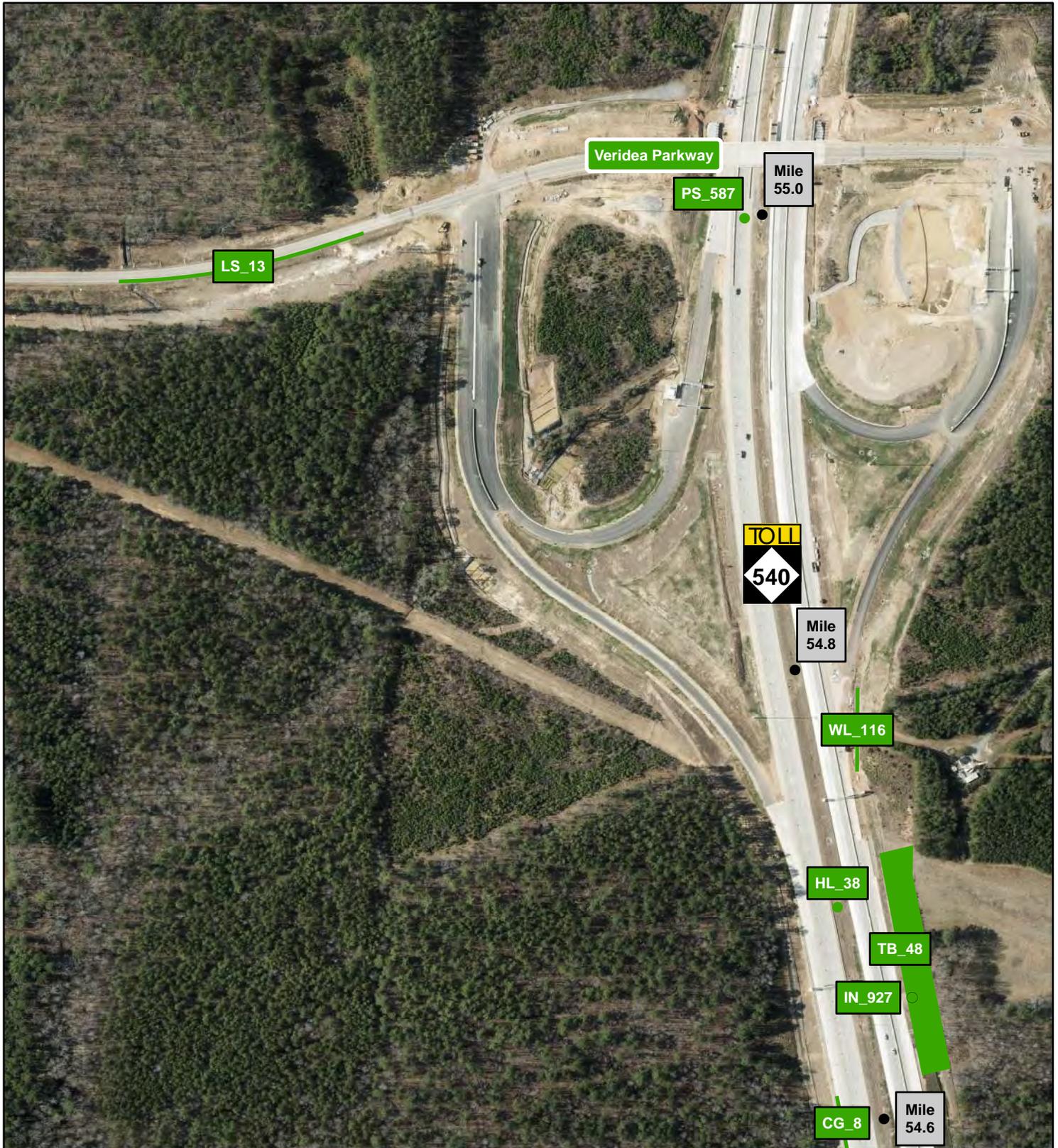


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

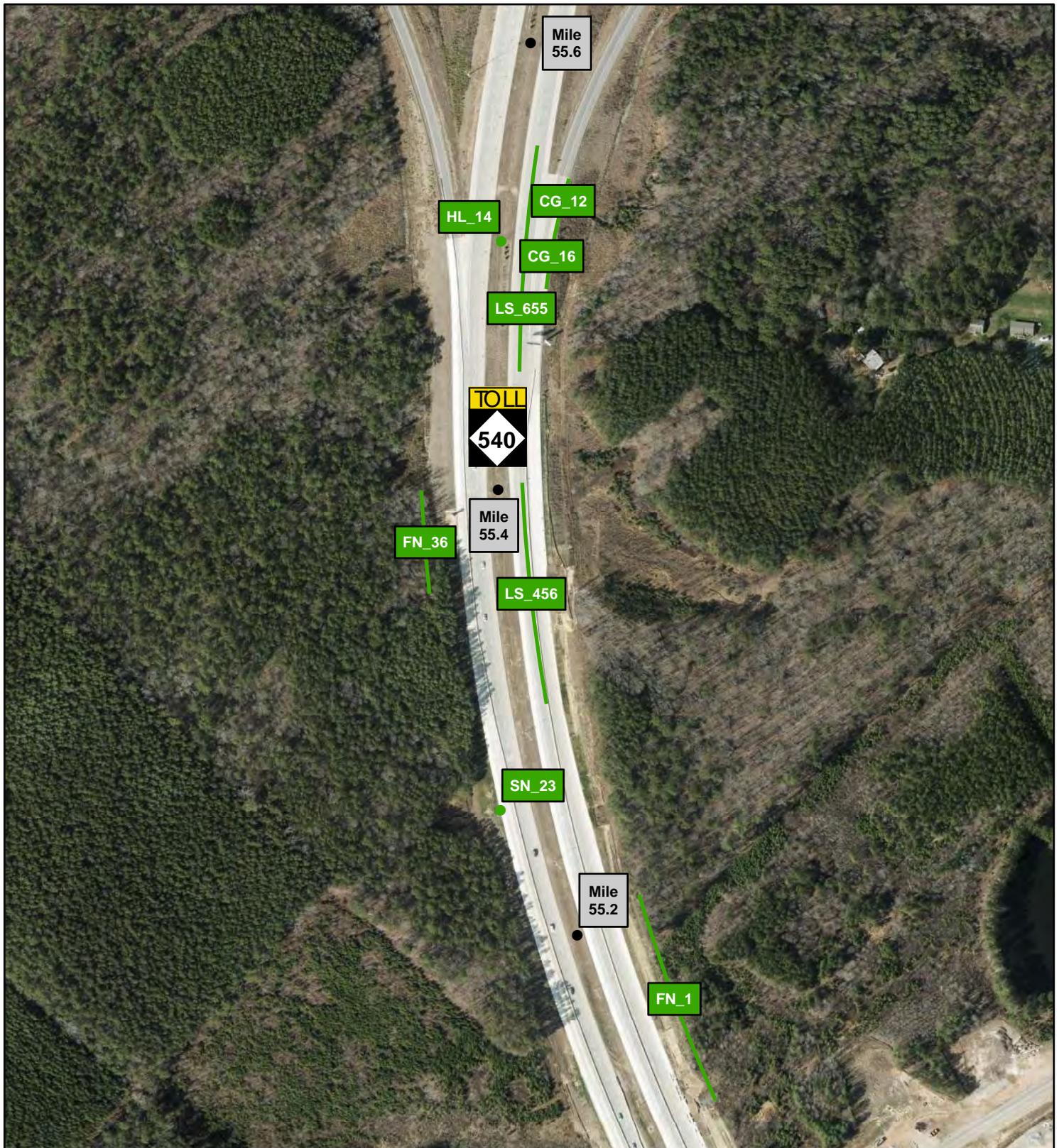


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

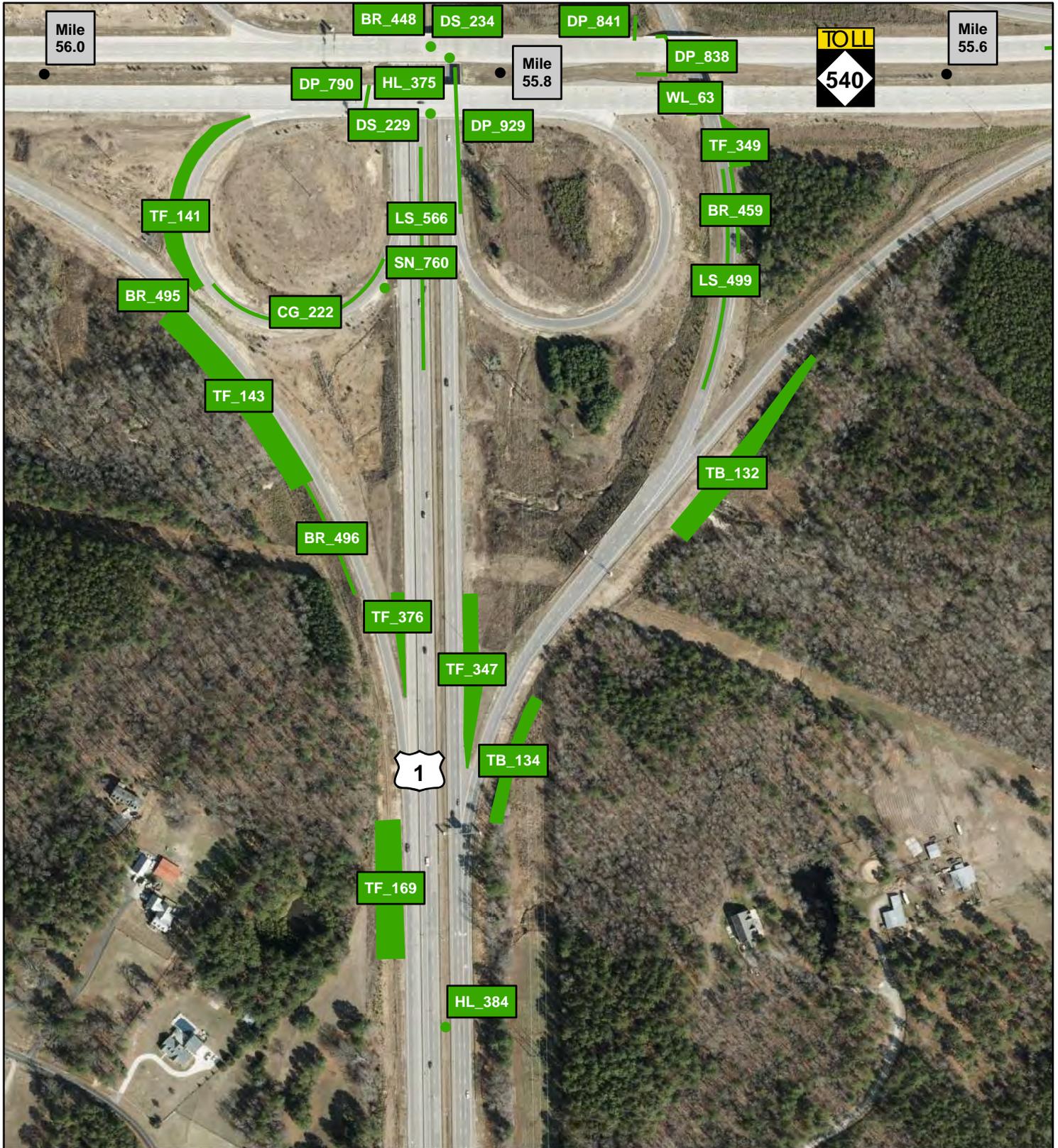


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

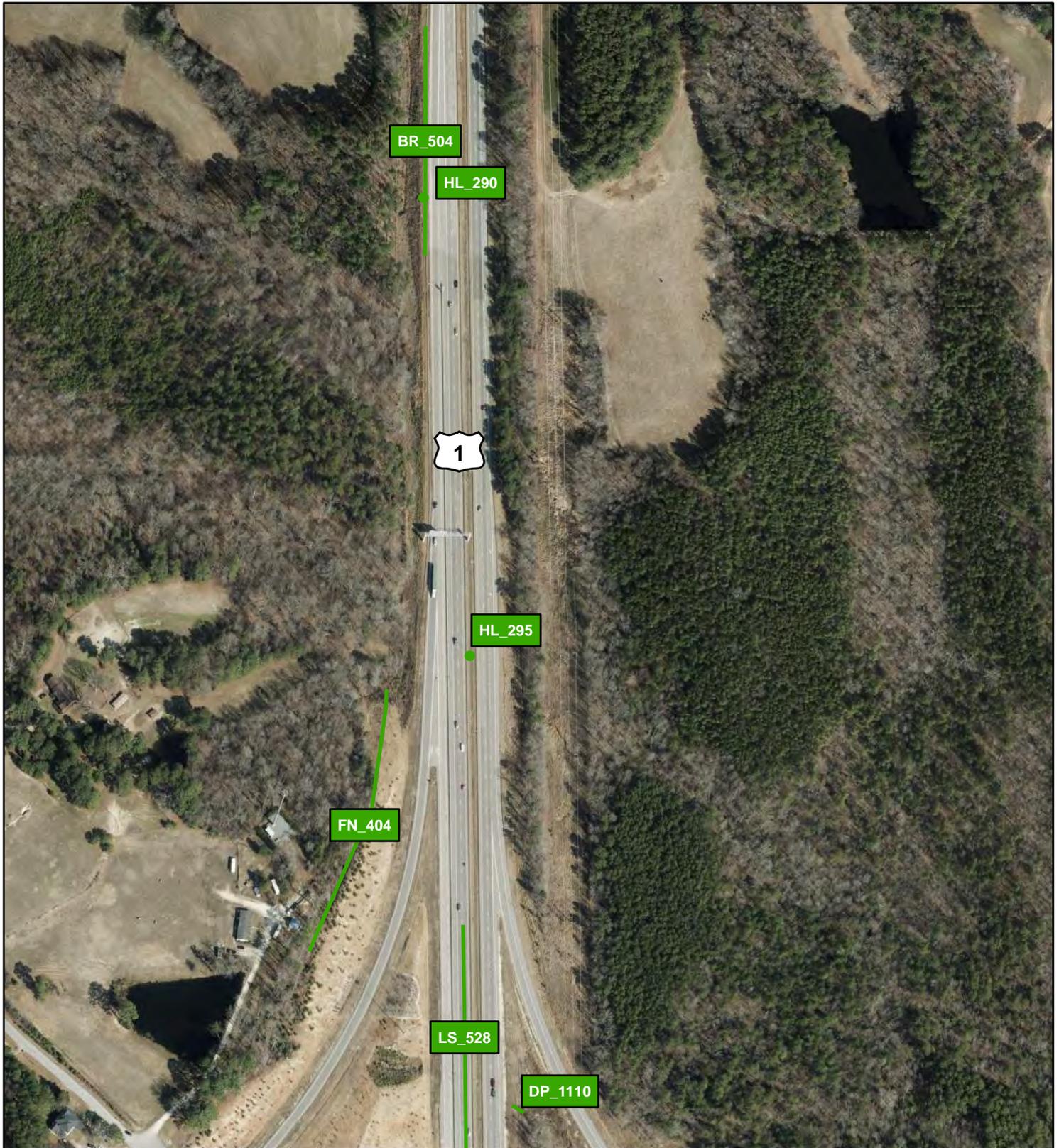


Legend

- Failing Asset
- Passing Asset

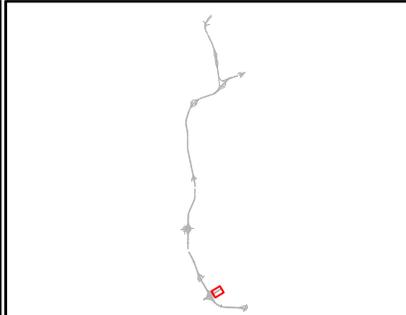


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

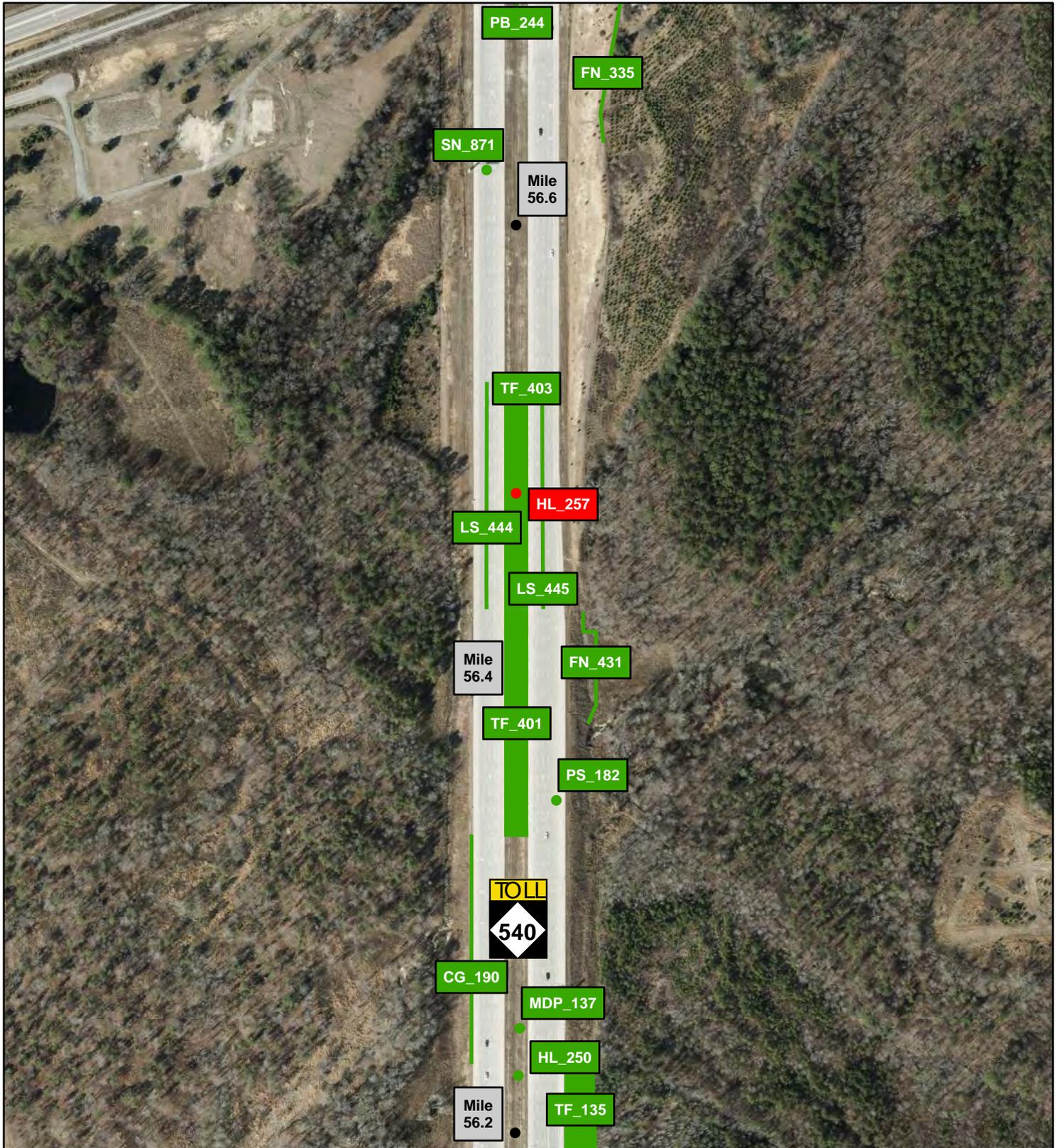


Legend

-  Failing Asset
-  Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

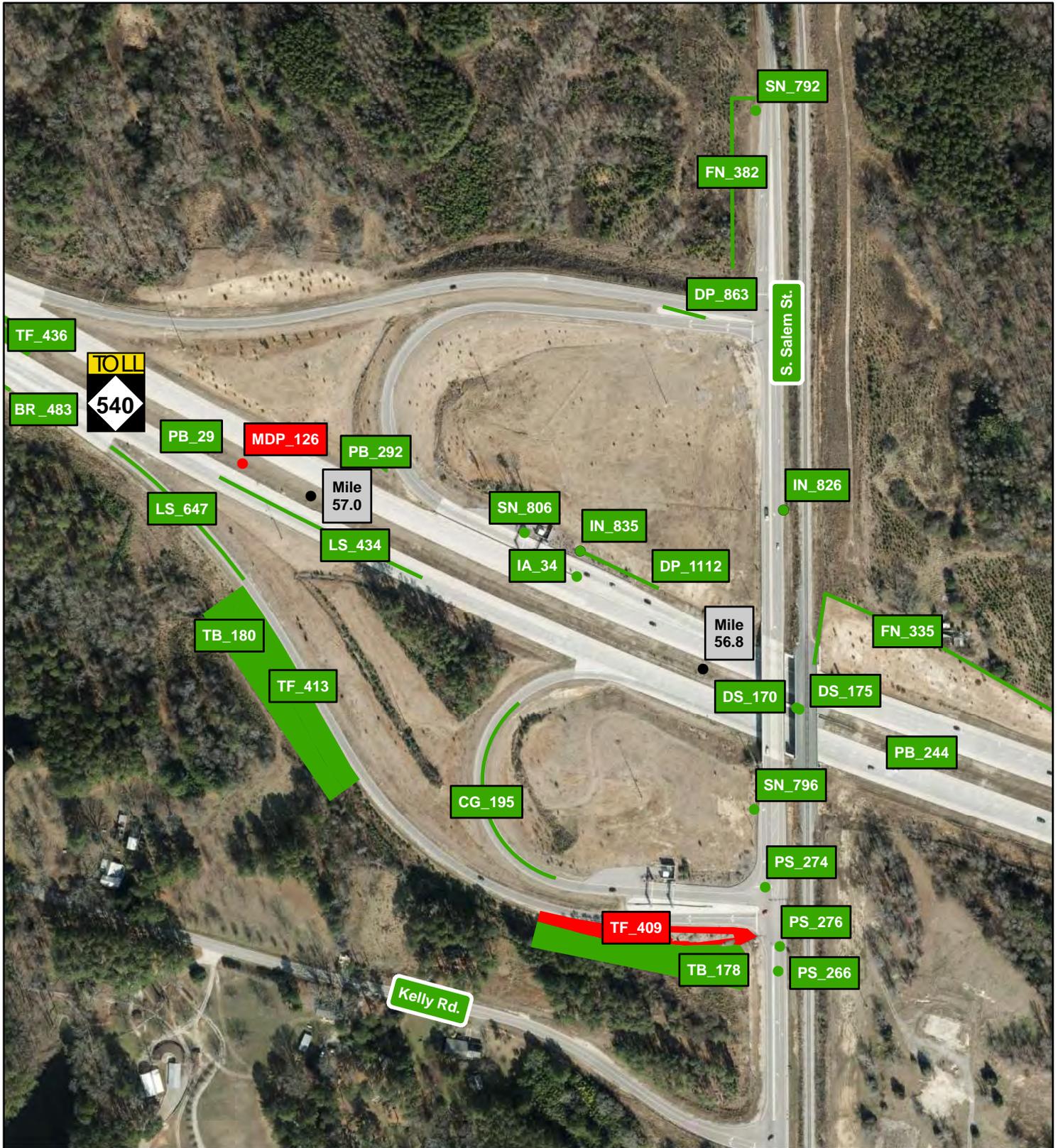


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

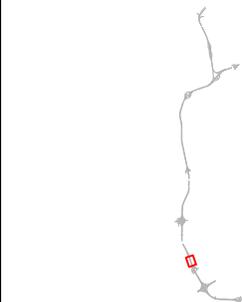


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

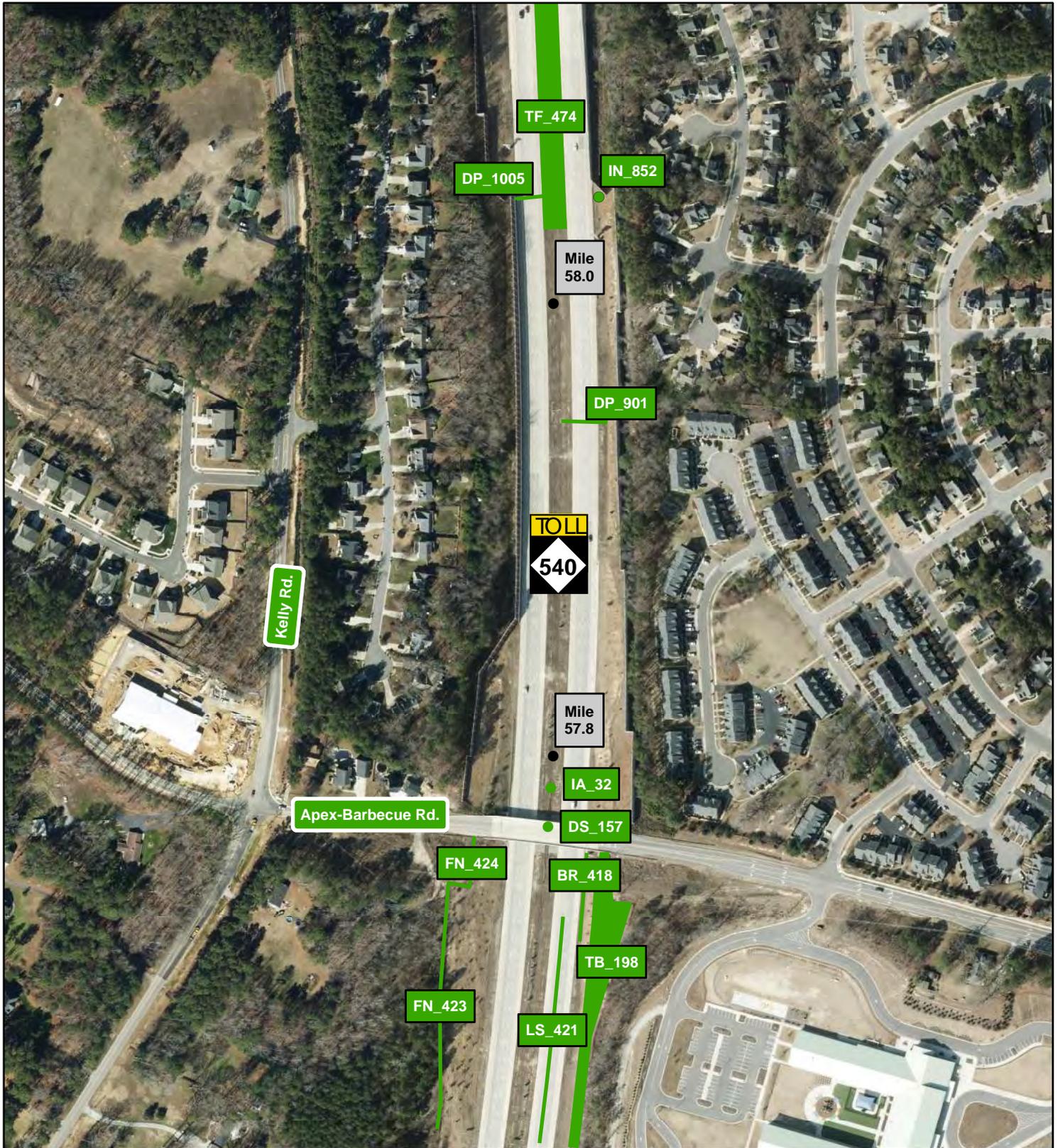


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

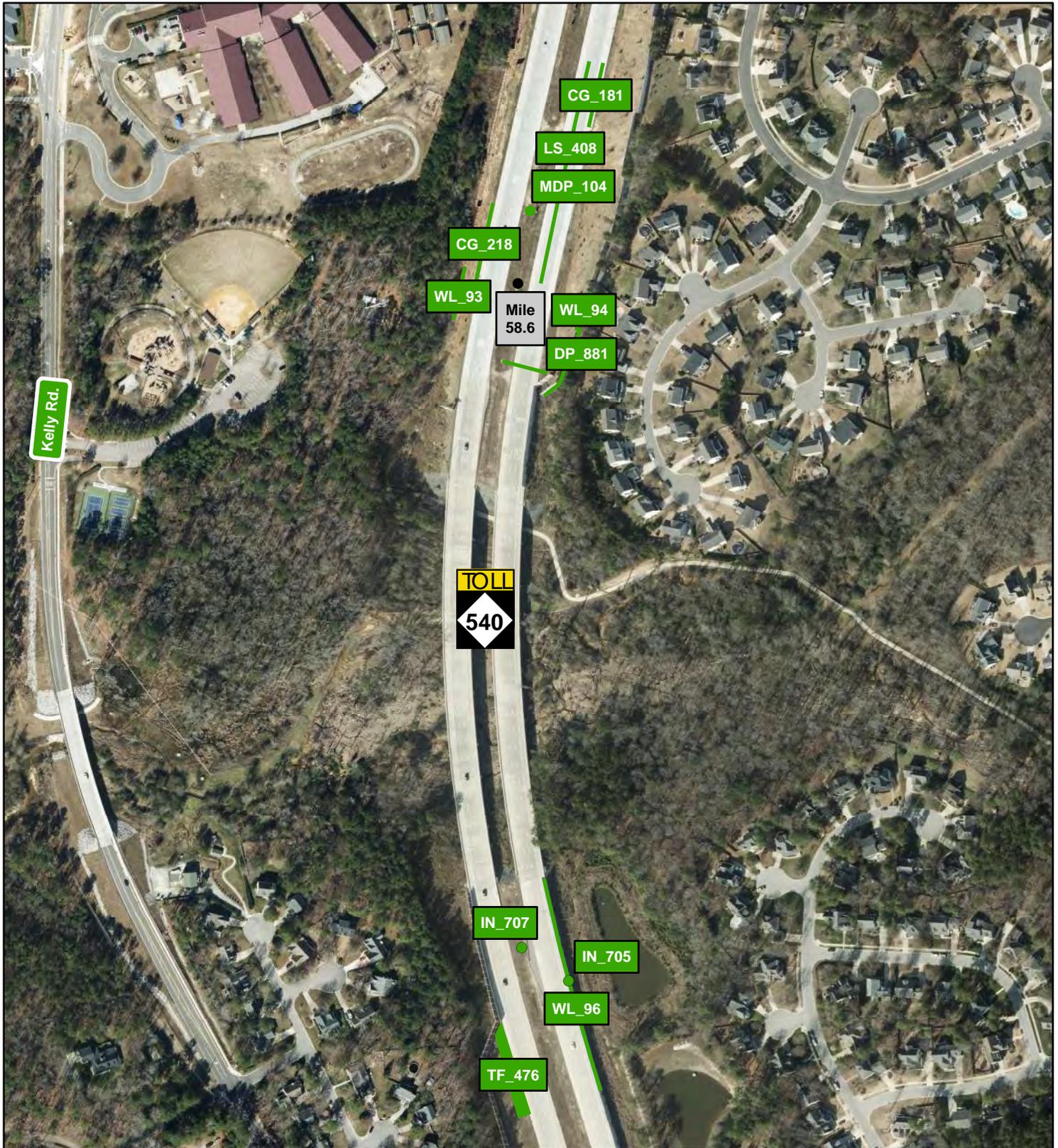


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

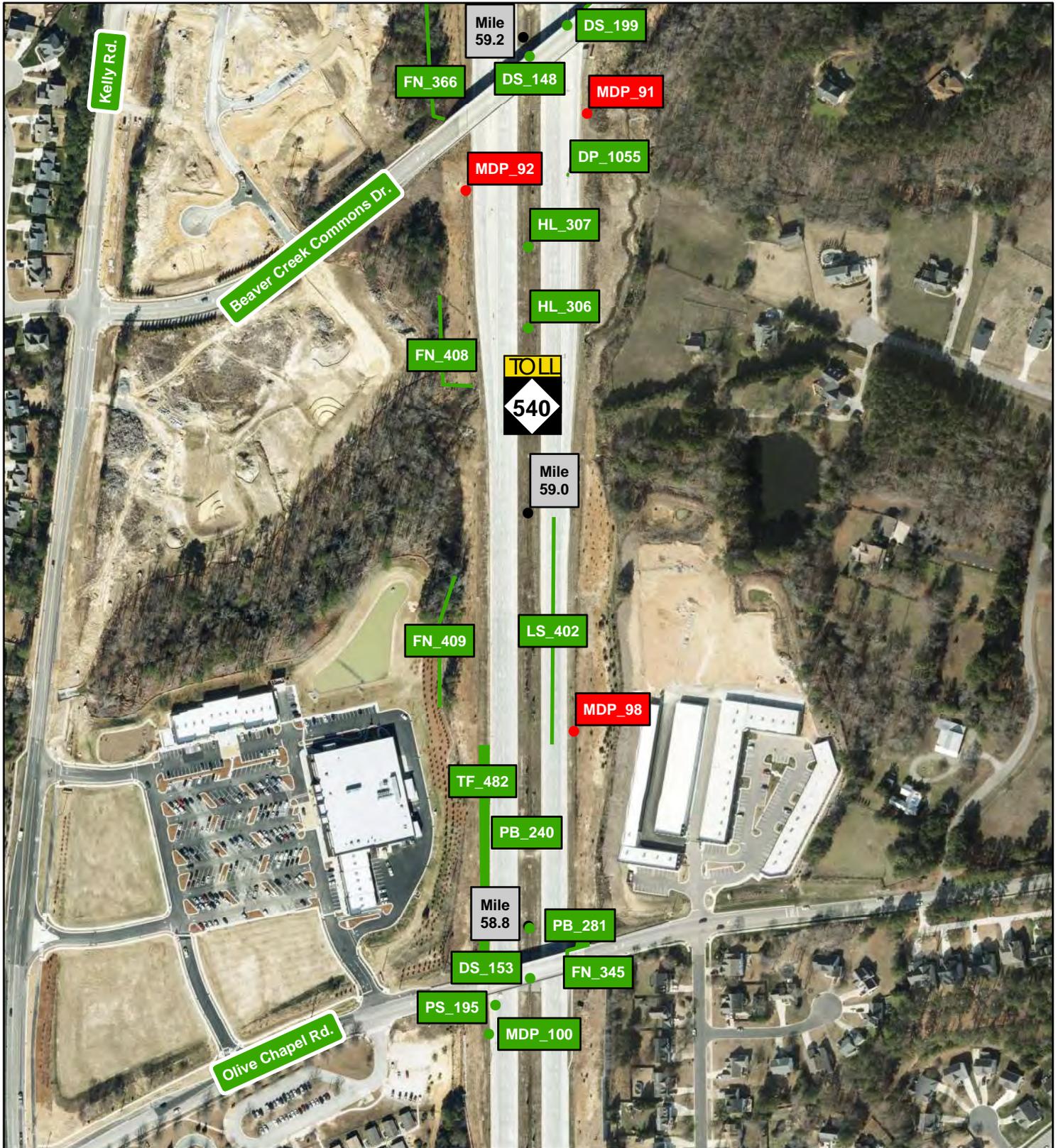


Legend

-  Failing Asset
-  Passing Asset

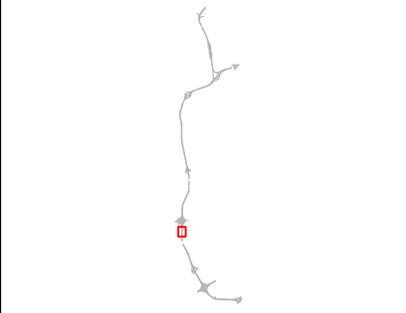


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

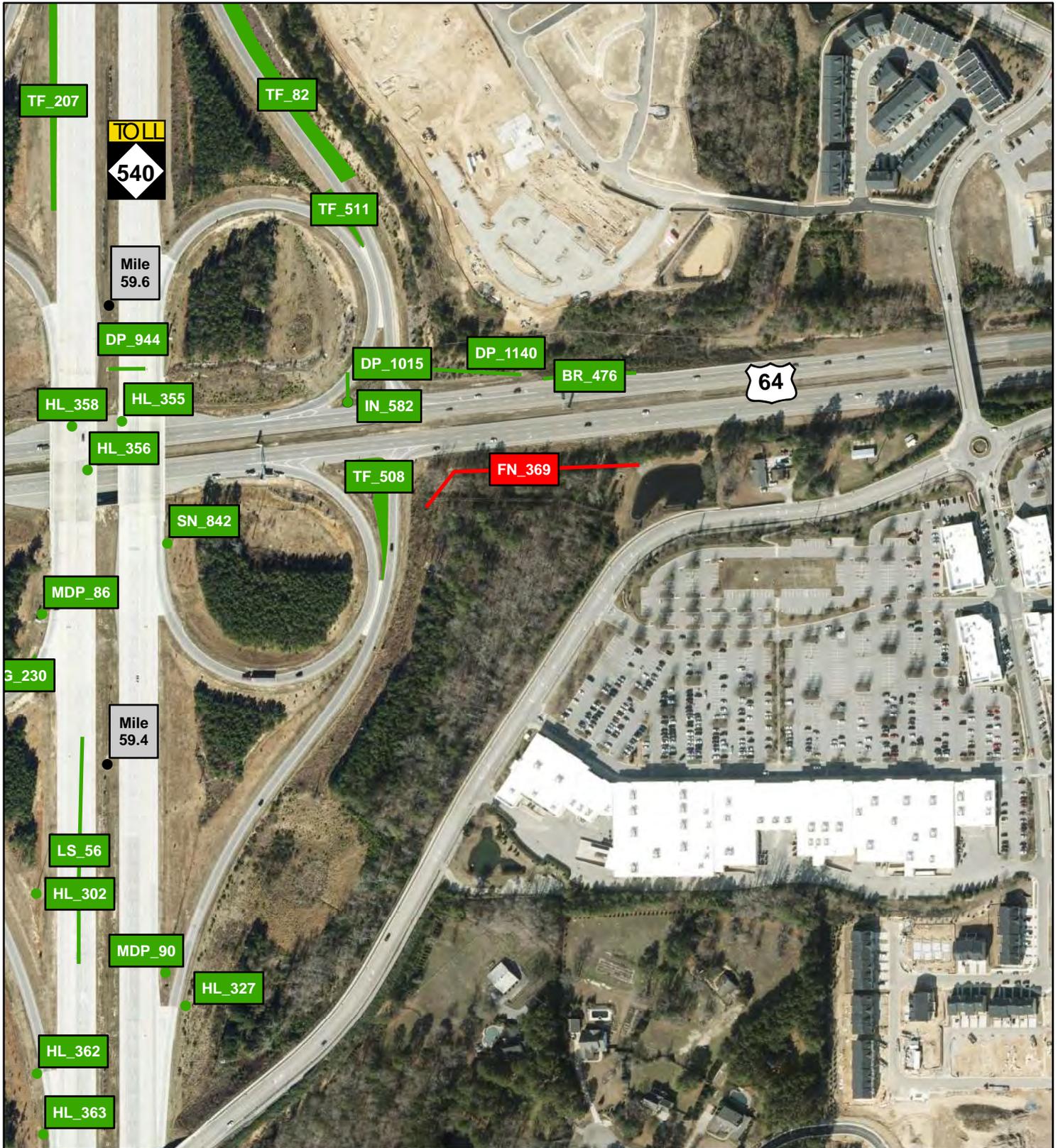


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

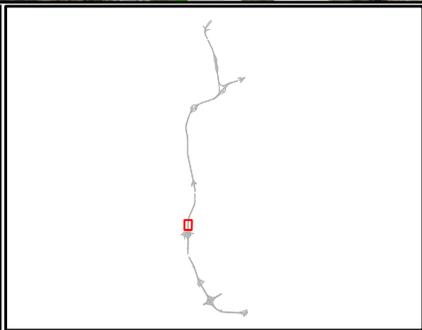


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

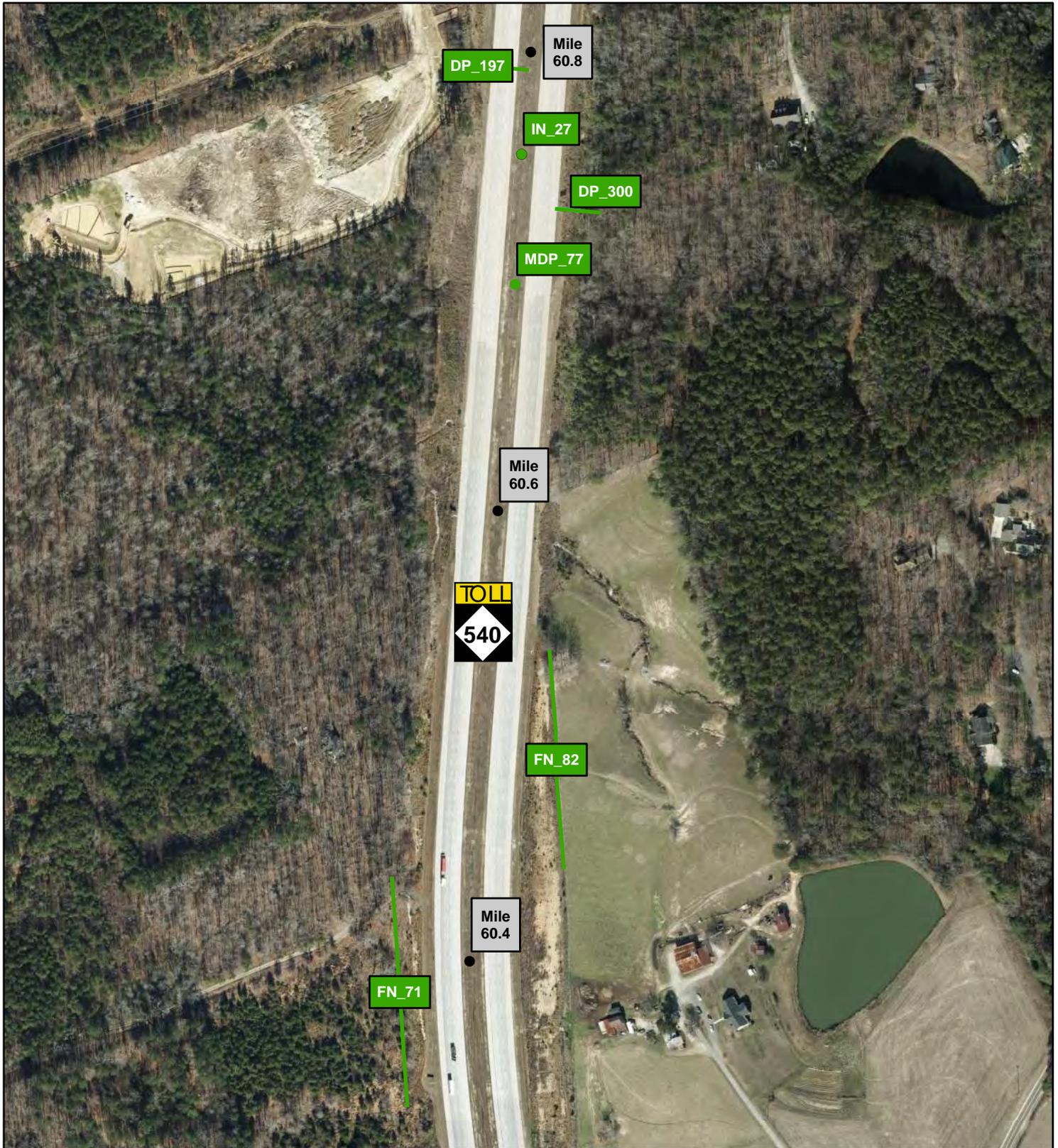




NORTH CAROLINA
Turnpike Authority

A16

Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

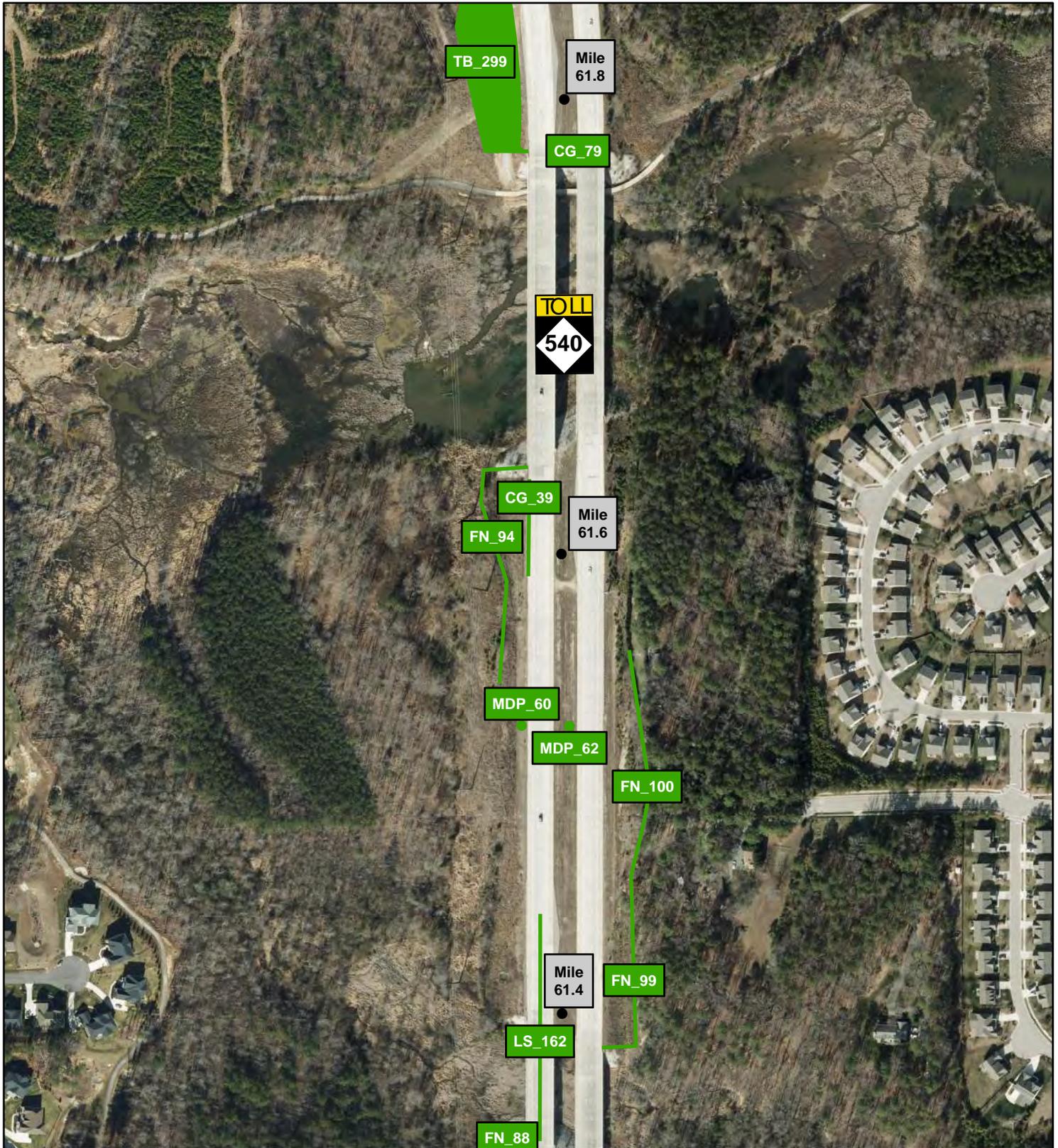


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

-  Failing Asset
-  Passing Asset

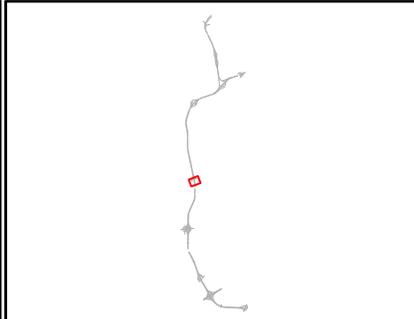


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

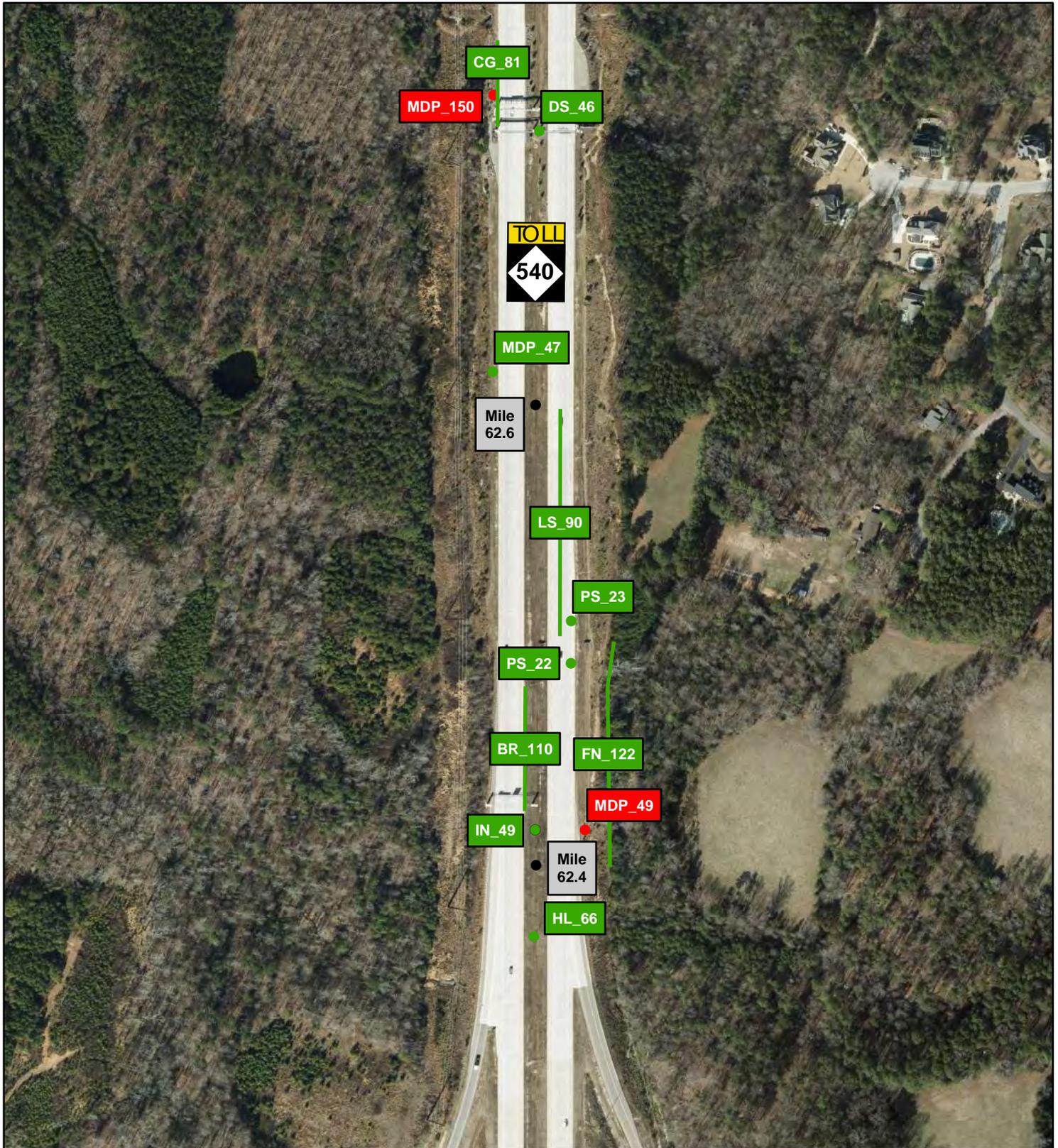


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

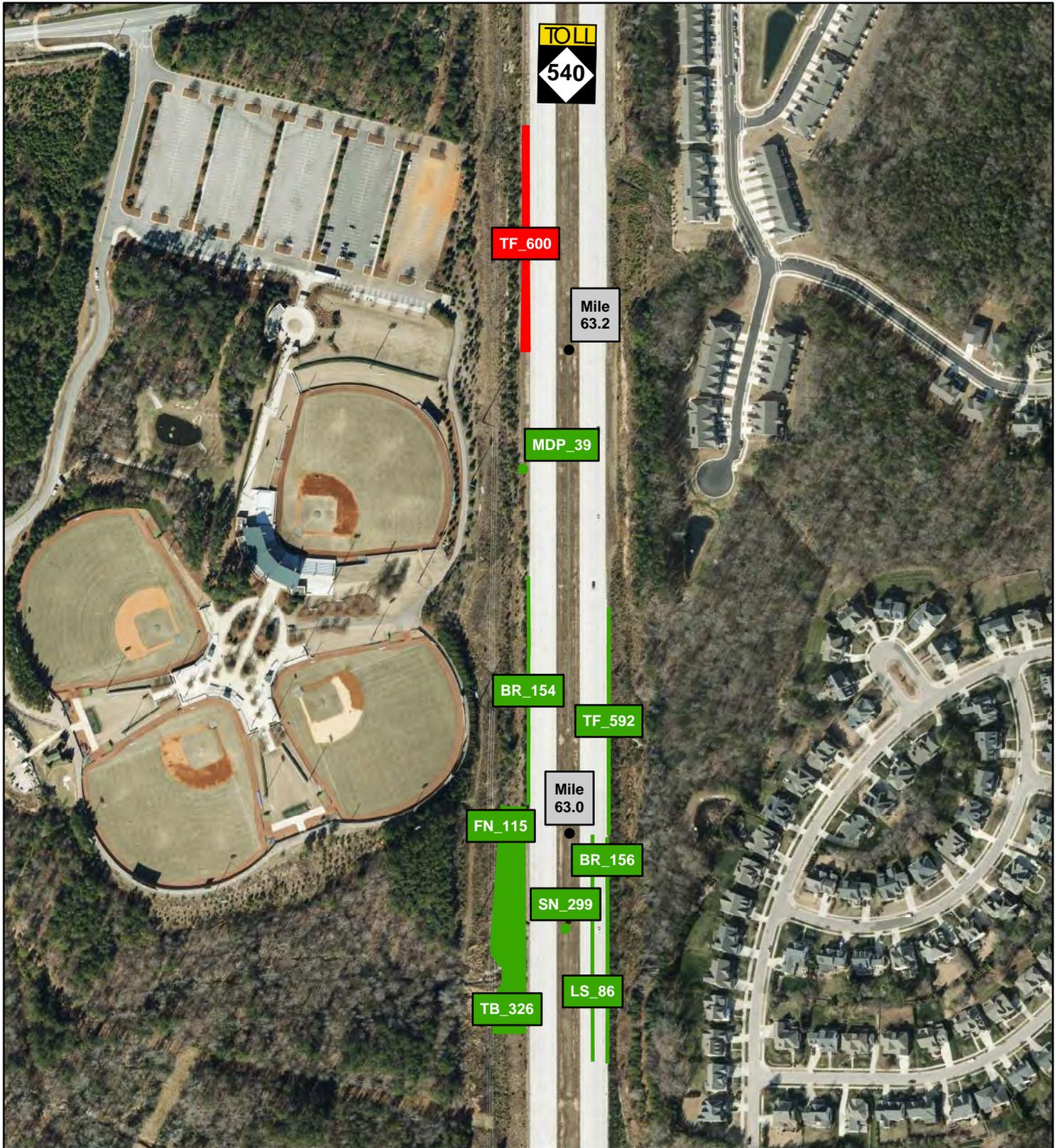


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

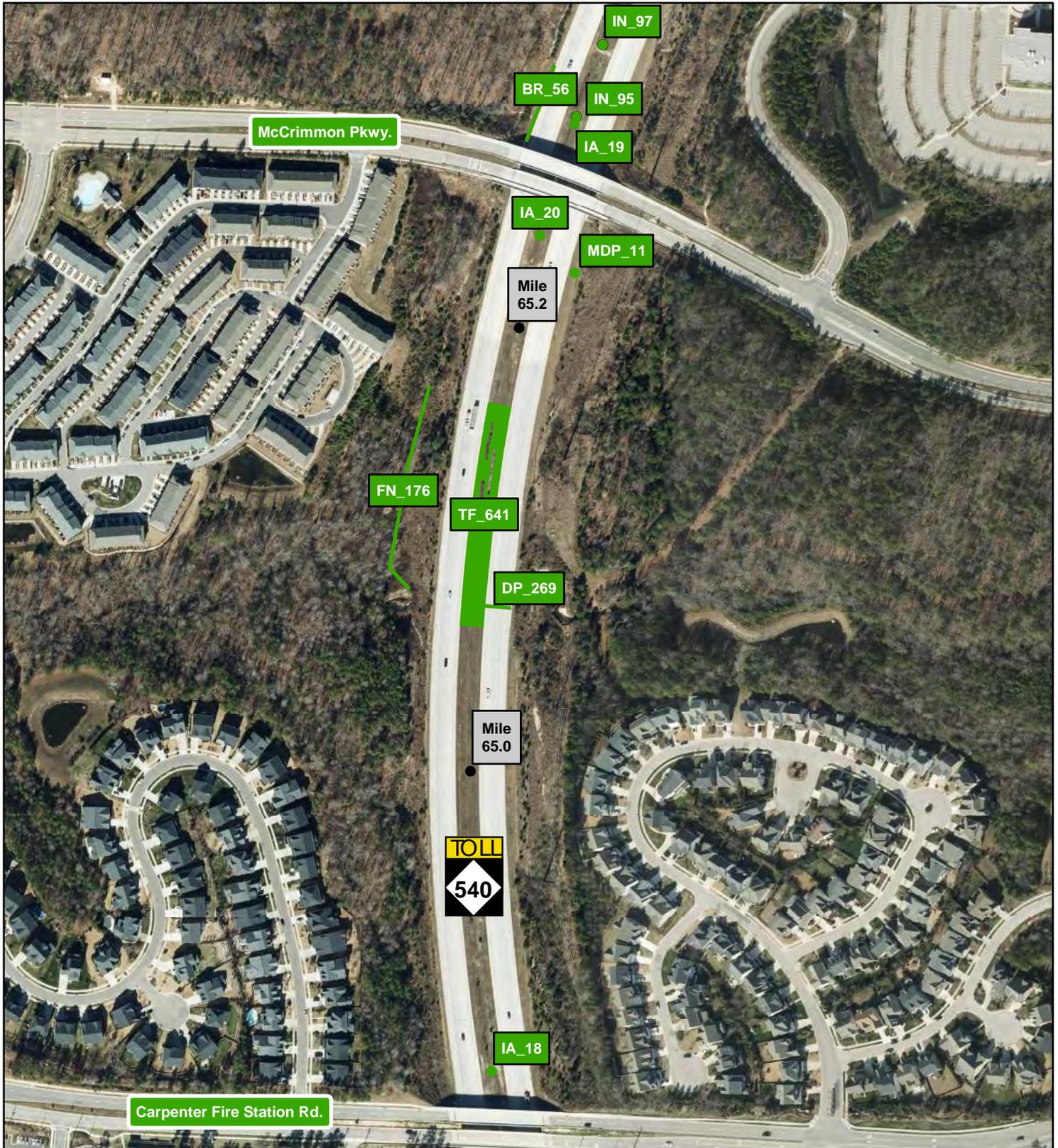


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

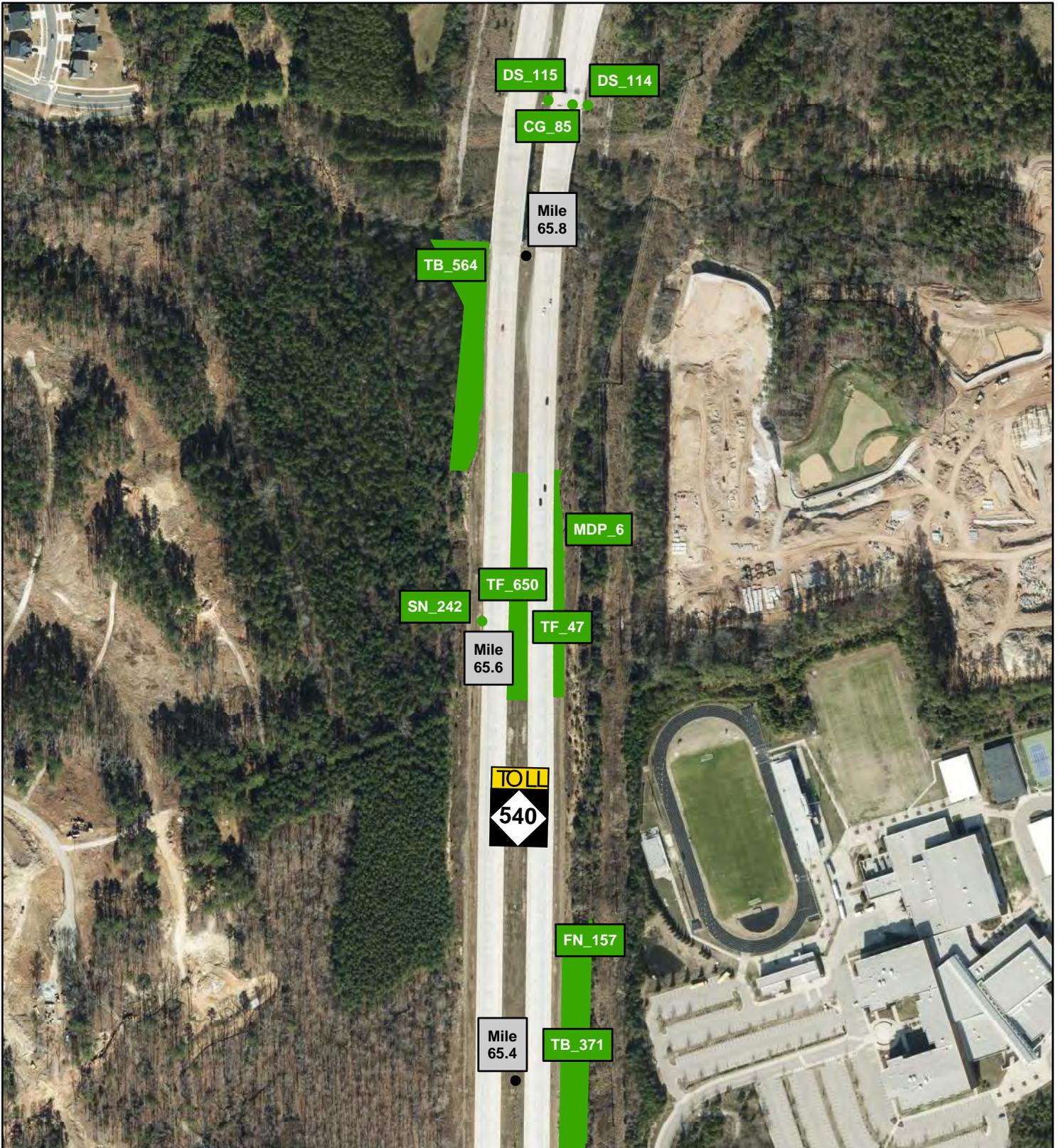


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

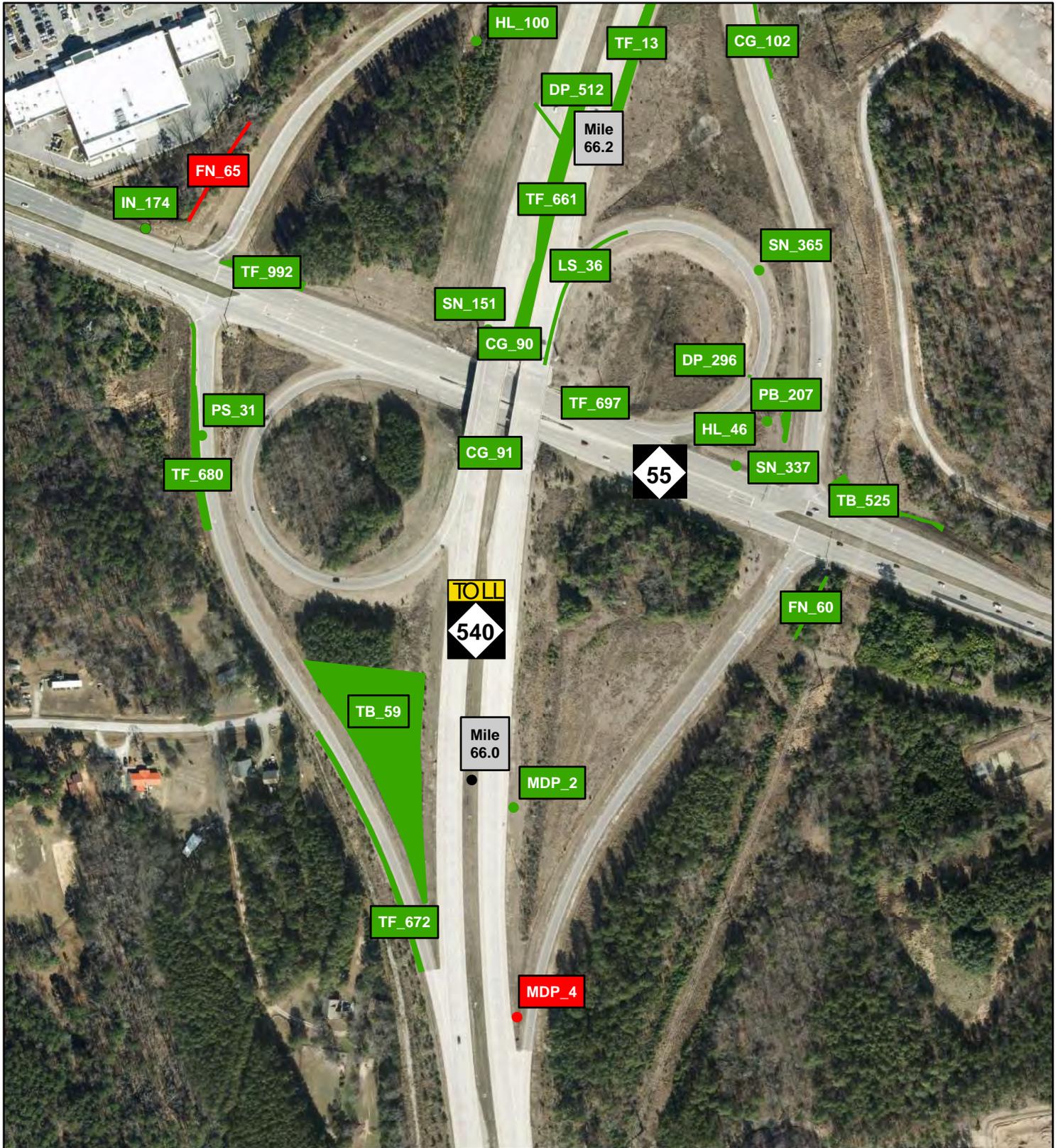


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

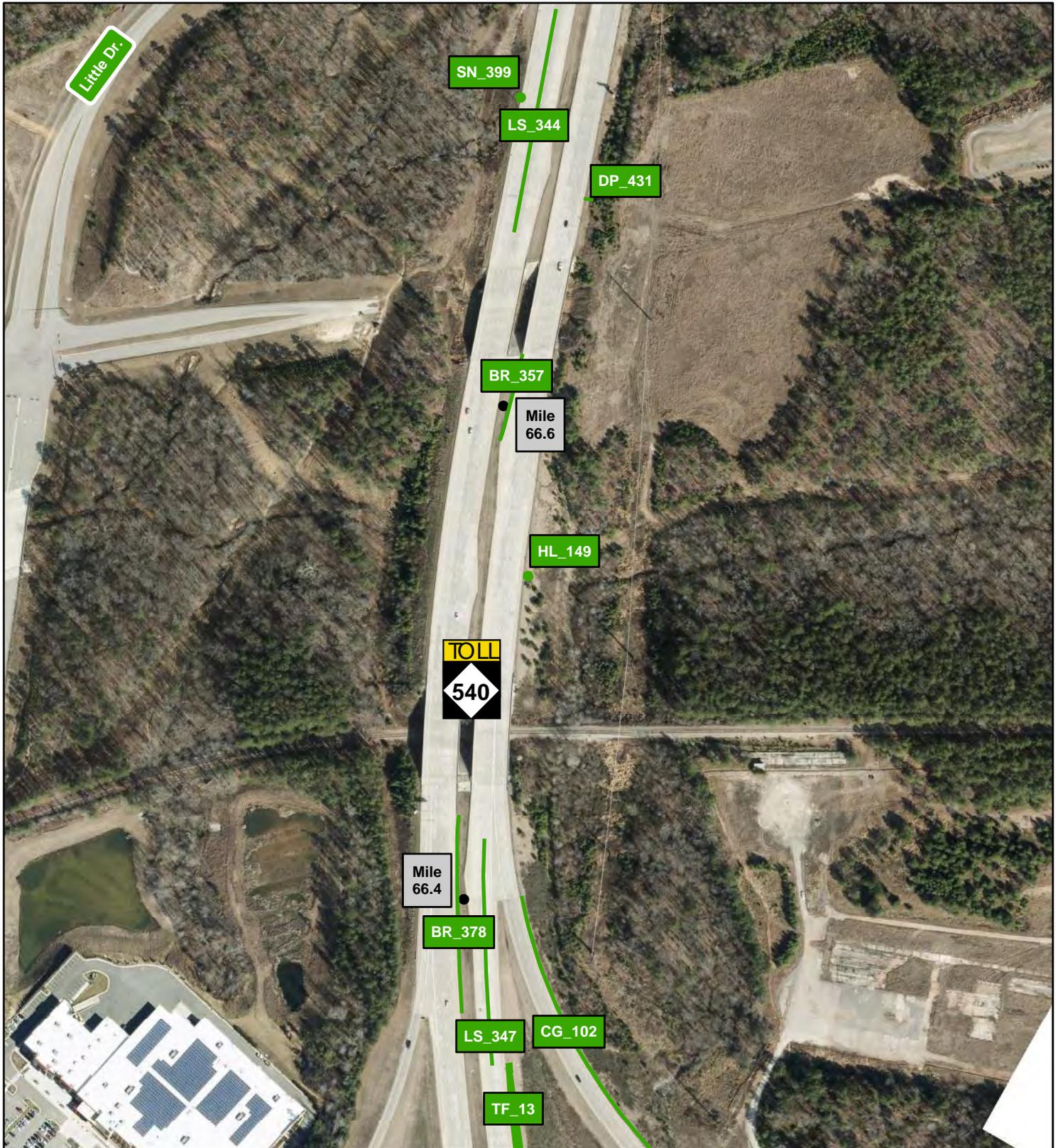


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

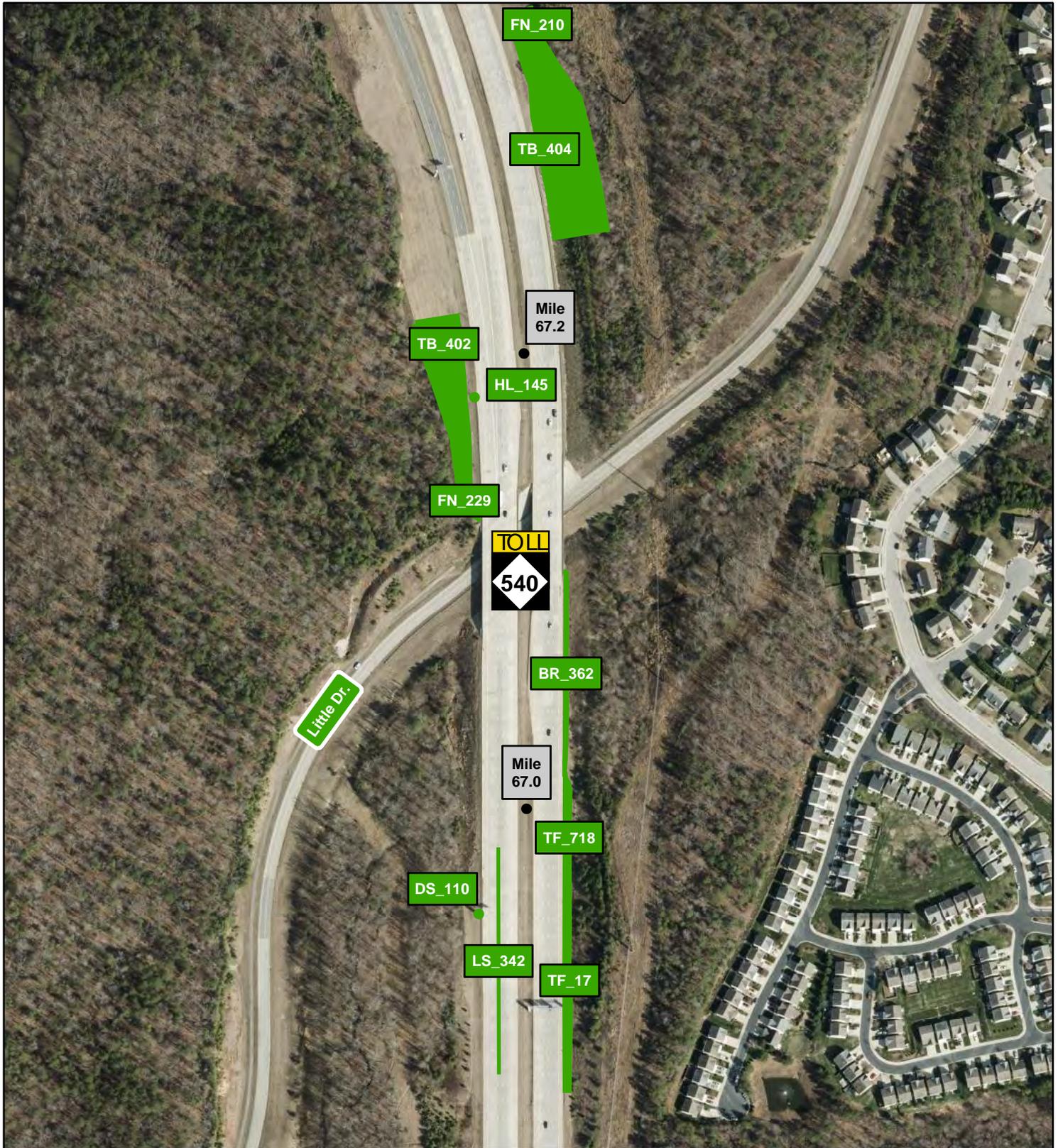


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

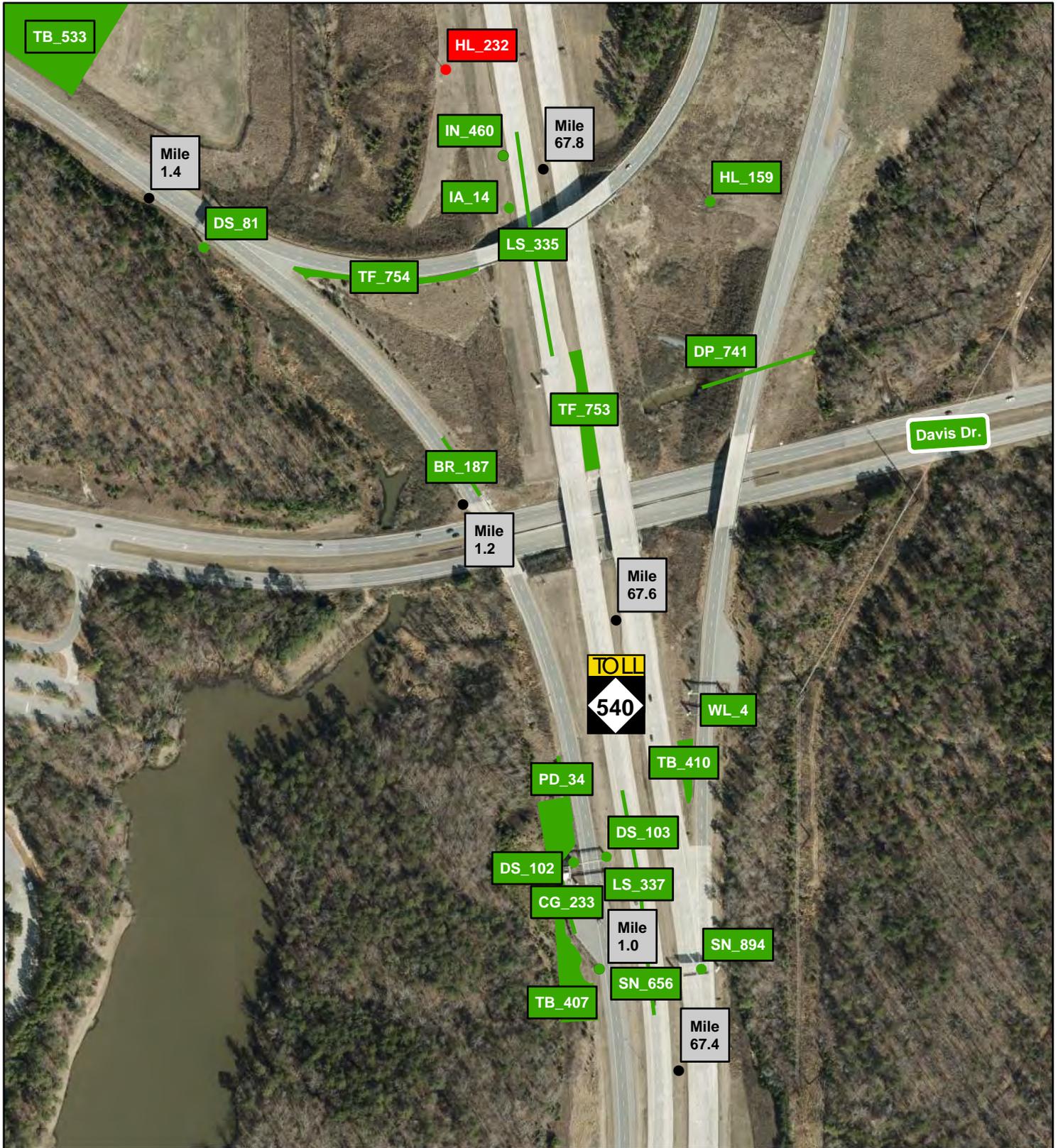


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

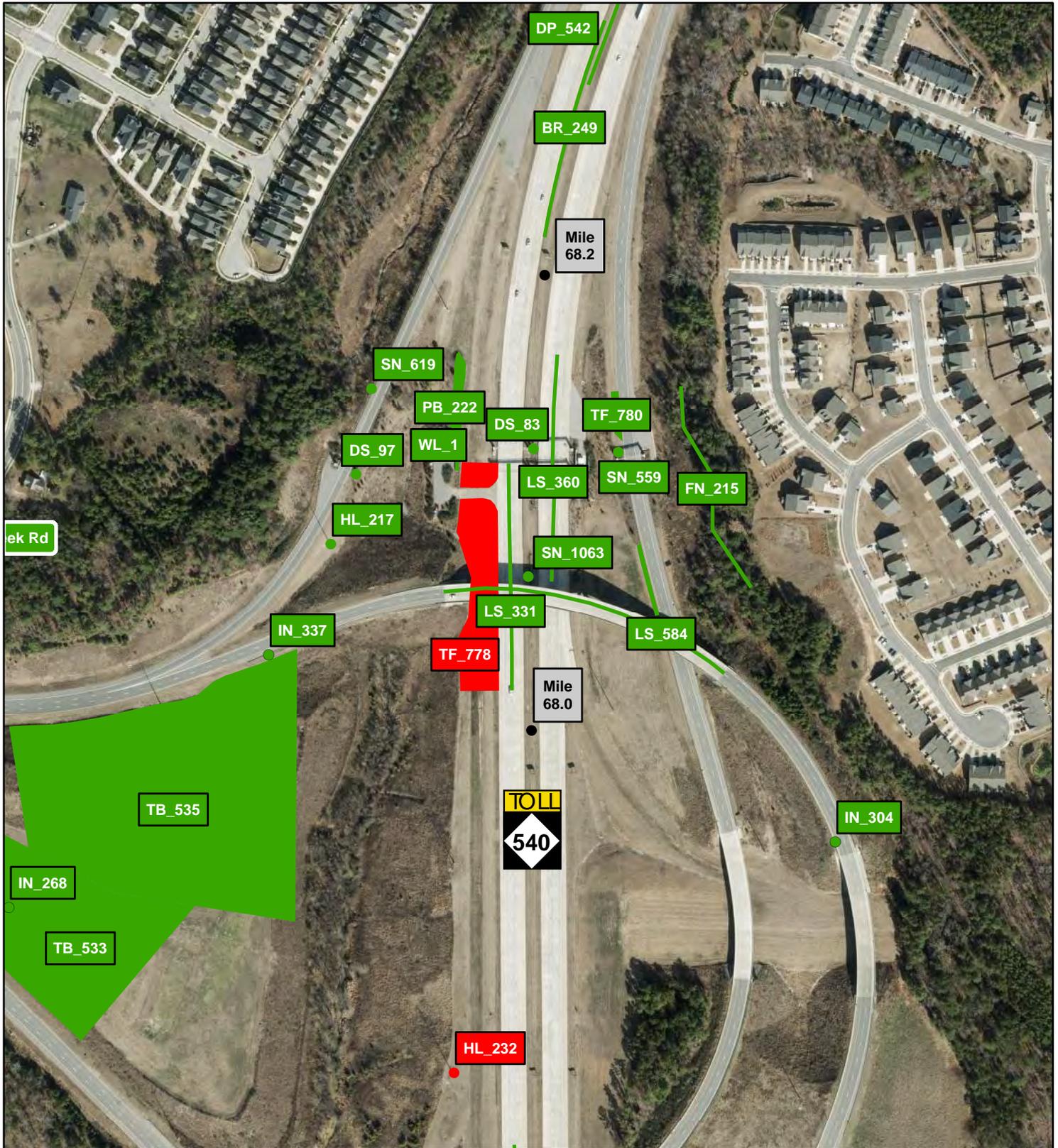


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

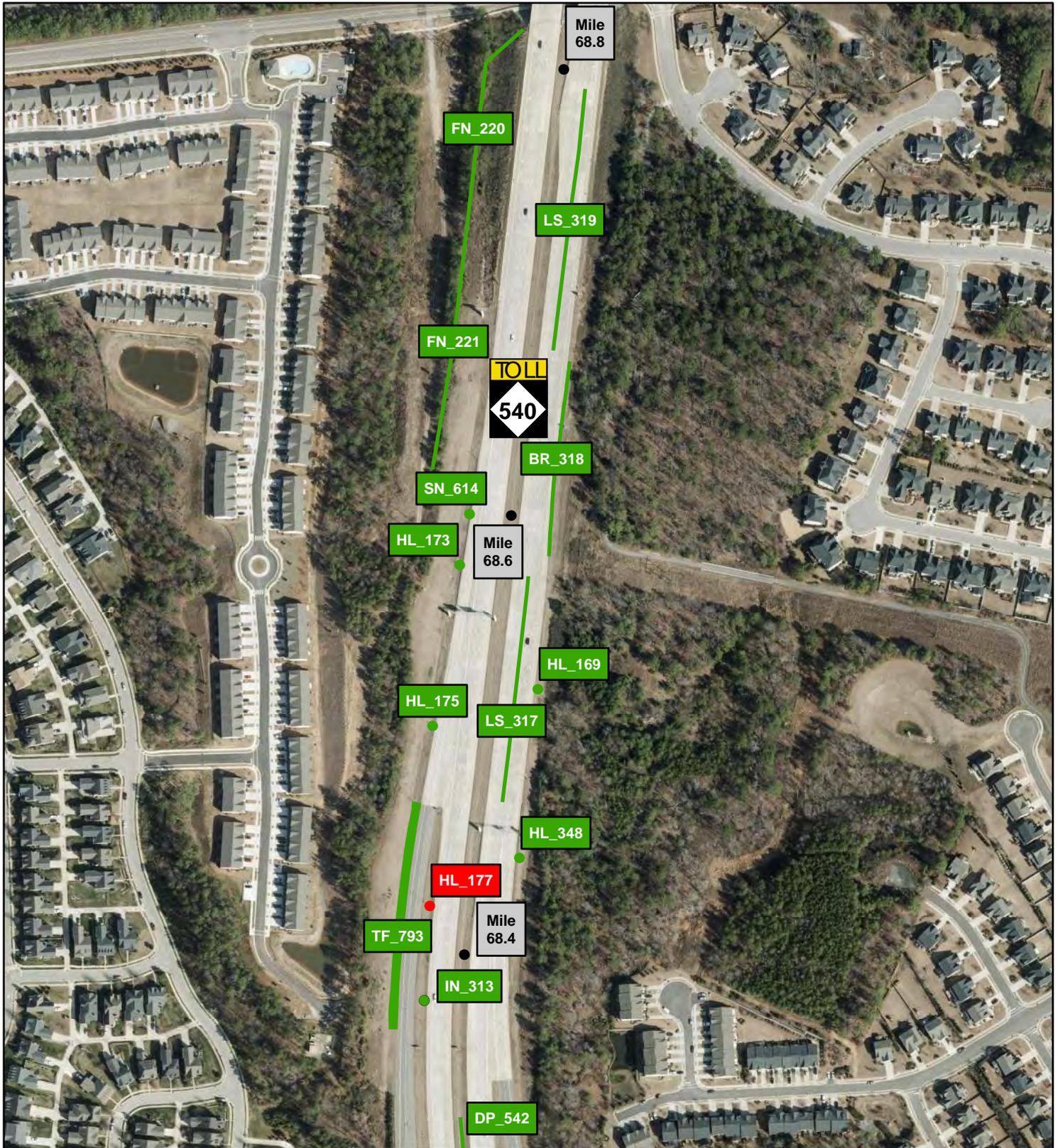


Legend

- Failing Asset
- Passing Asset

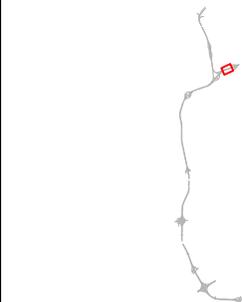


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset

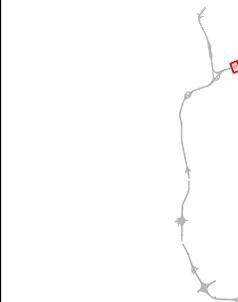


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

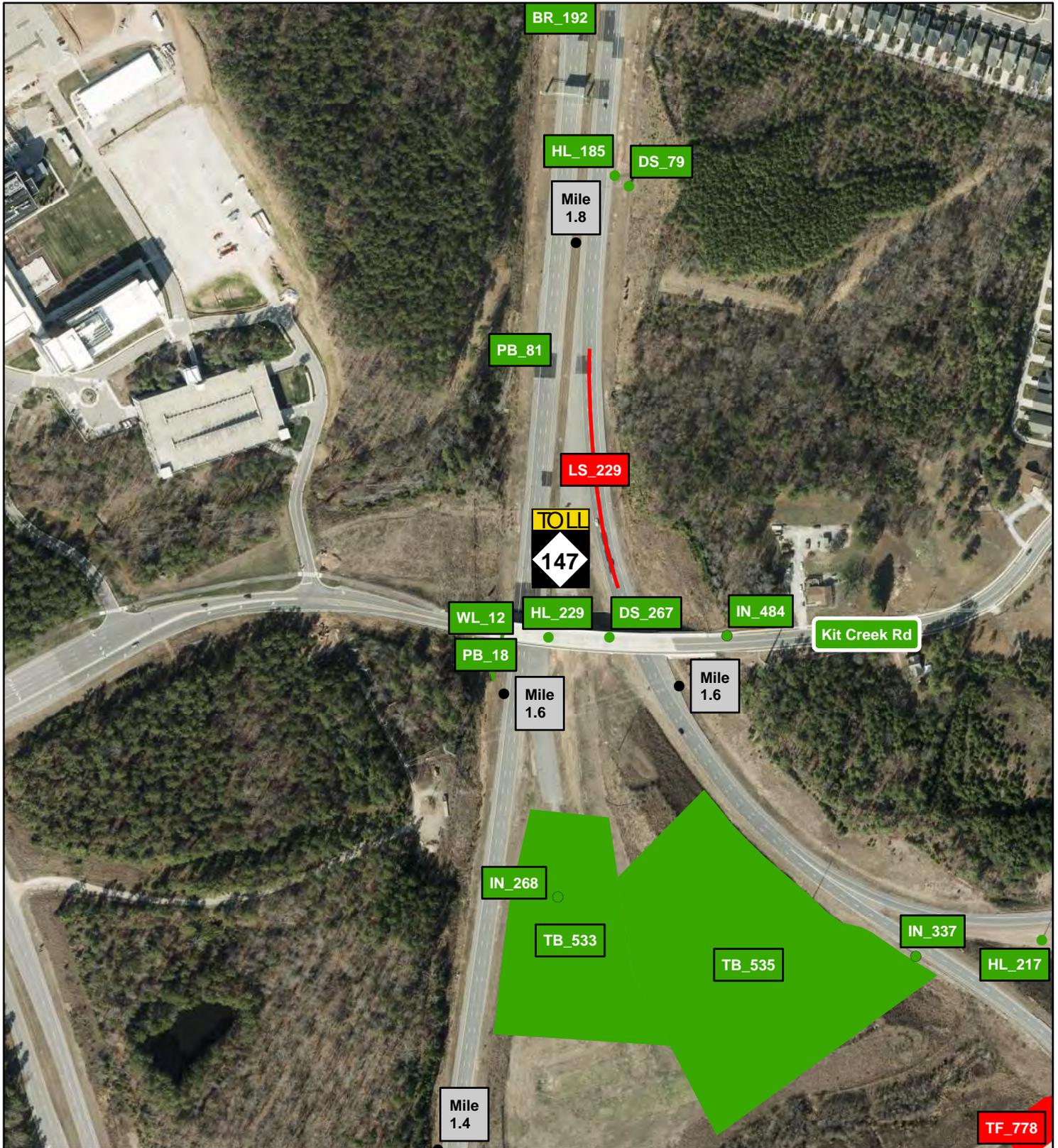


Legend

- Failing Asset
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Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

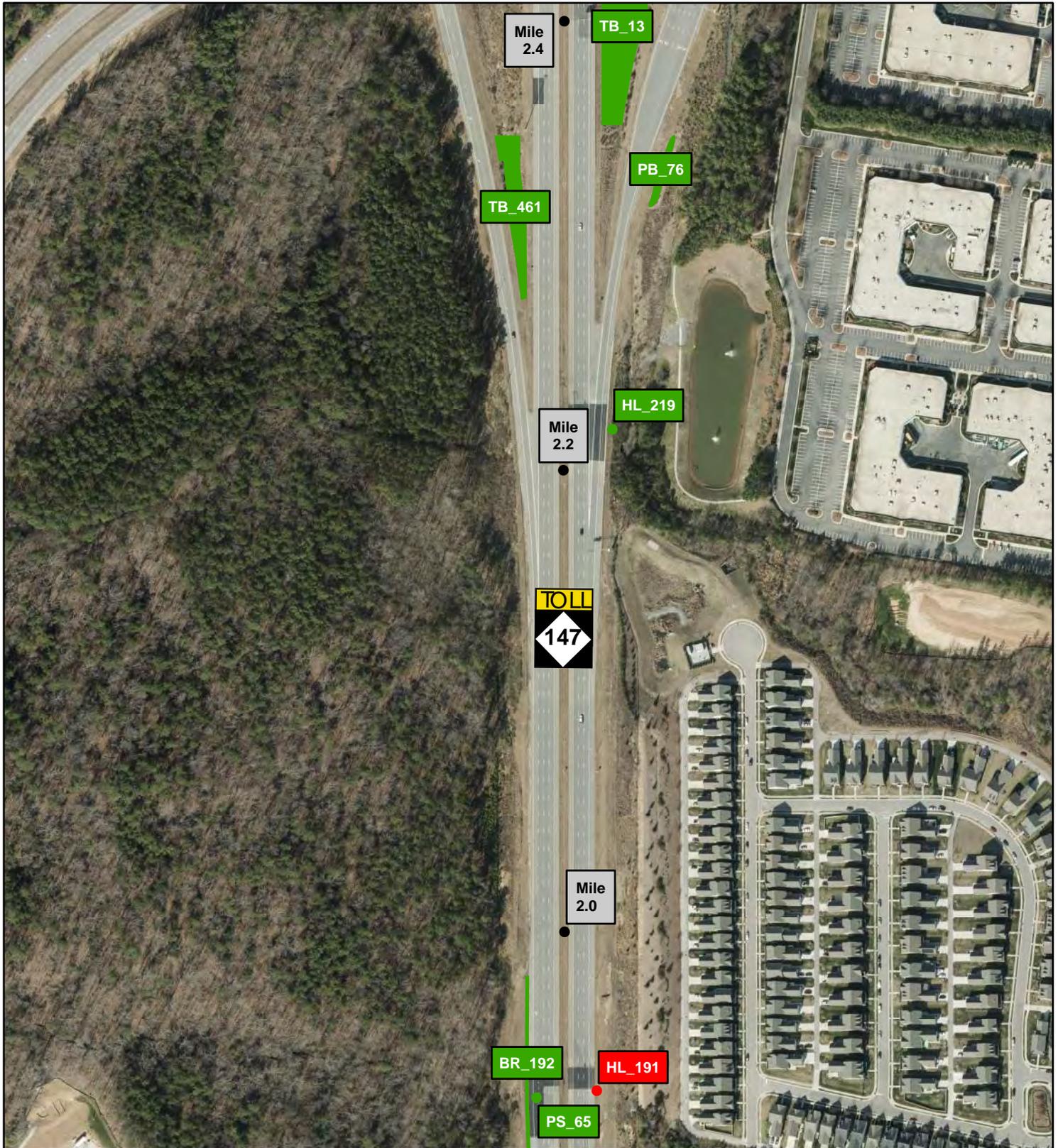


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

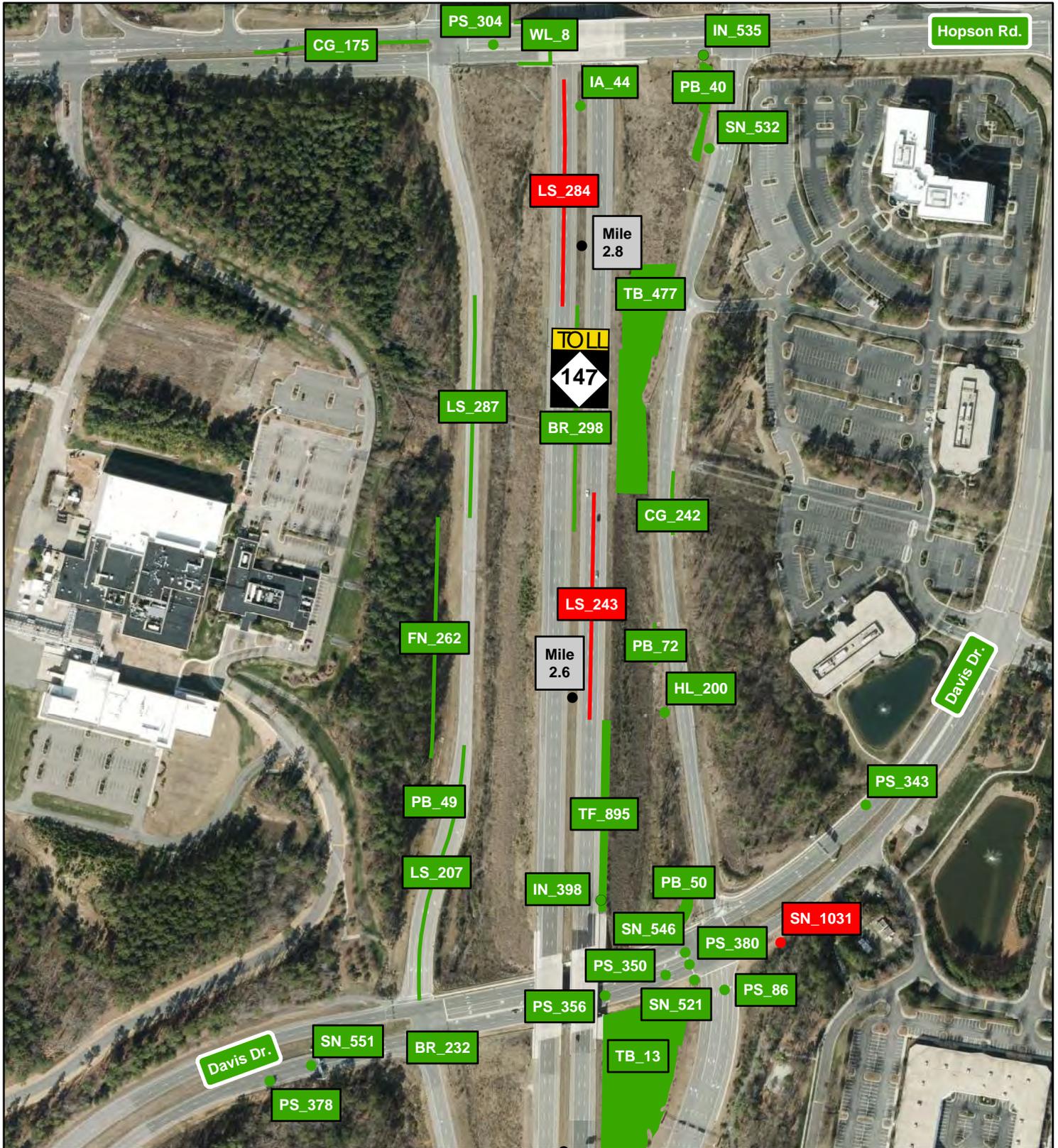


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

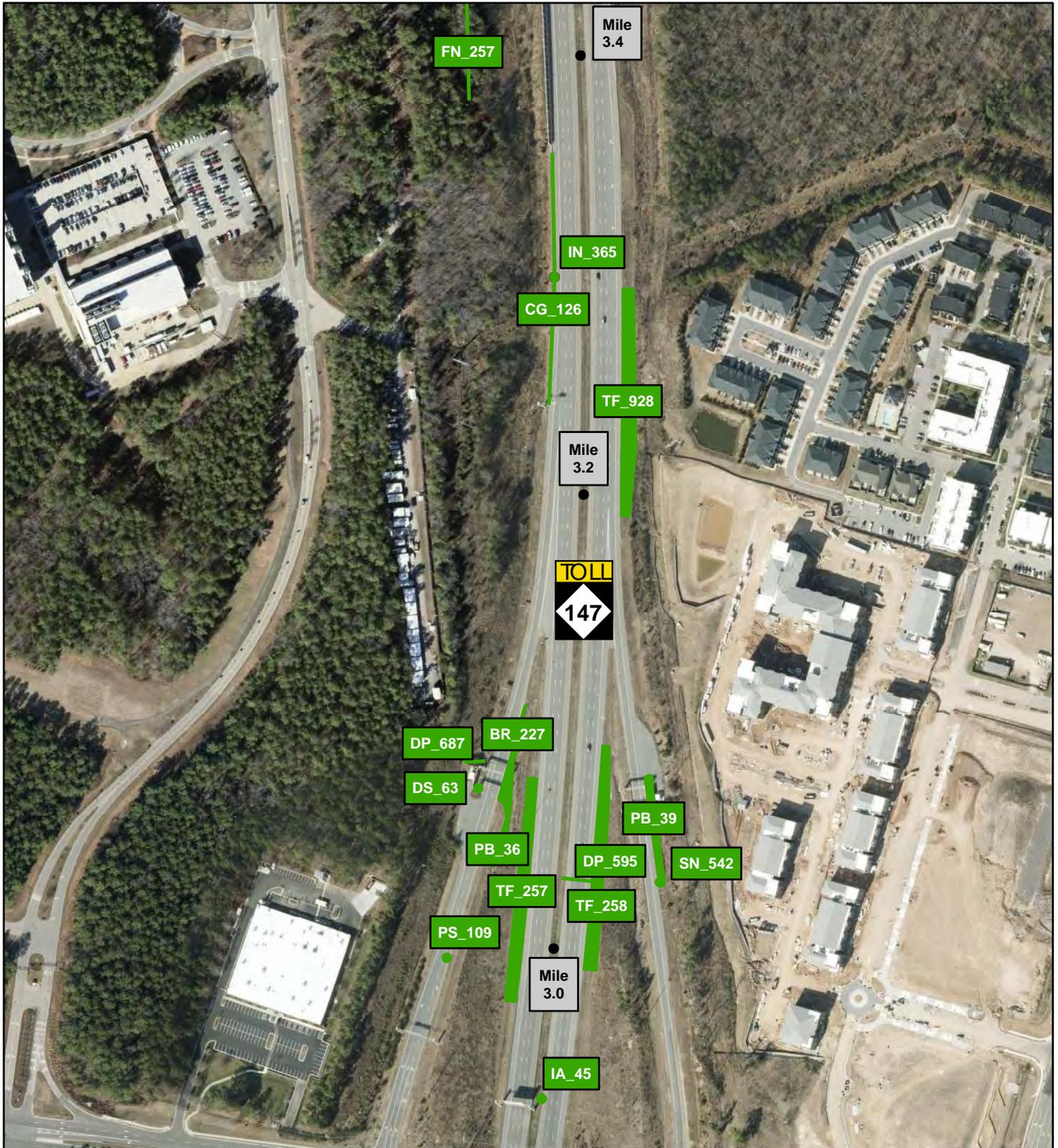


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

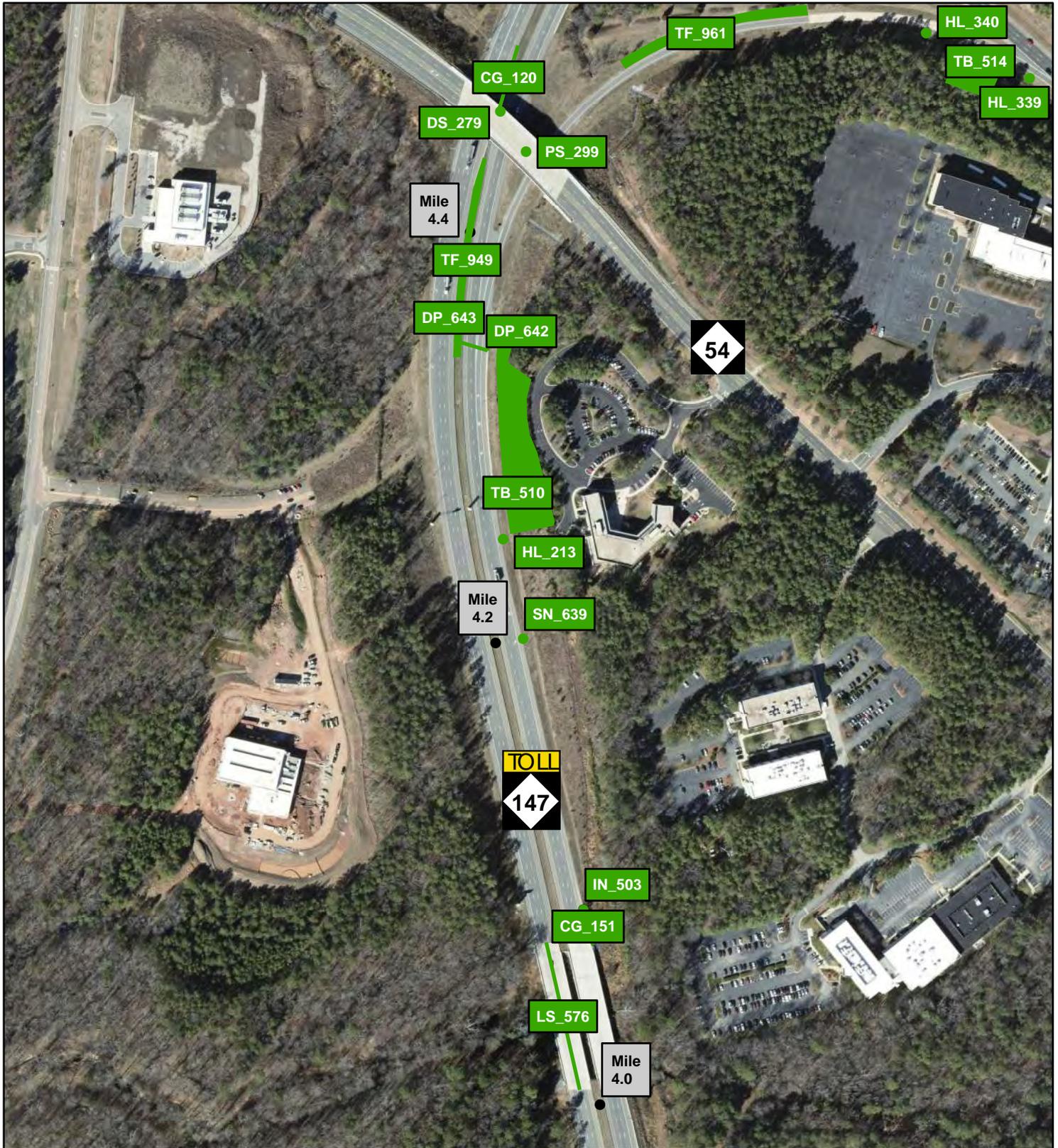


Legend

- Failing Asset
- Passing Asset



Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations

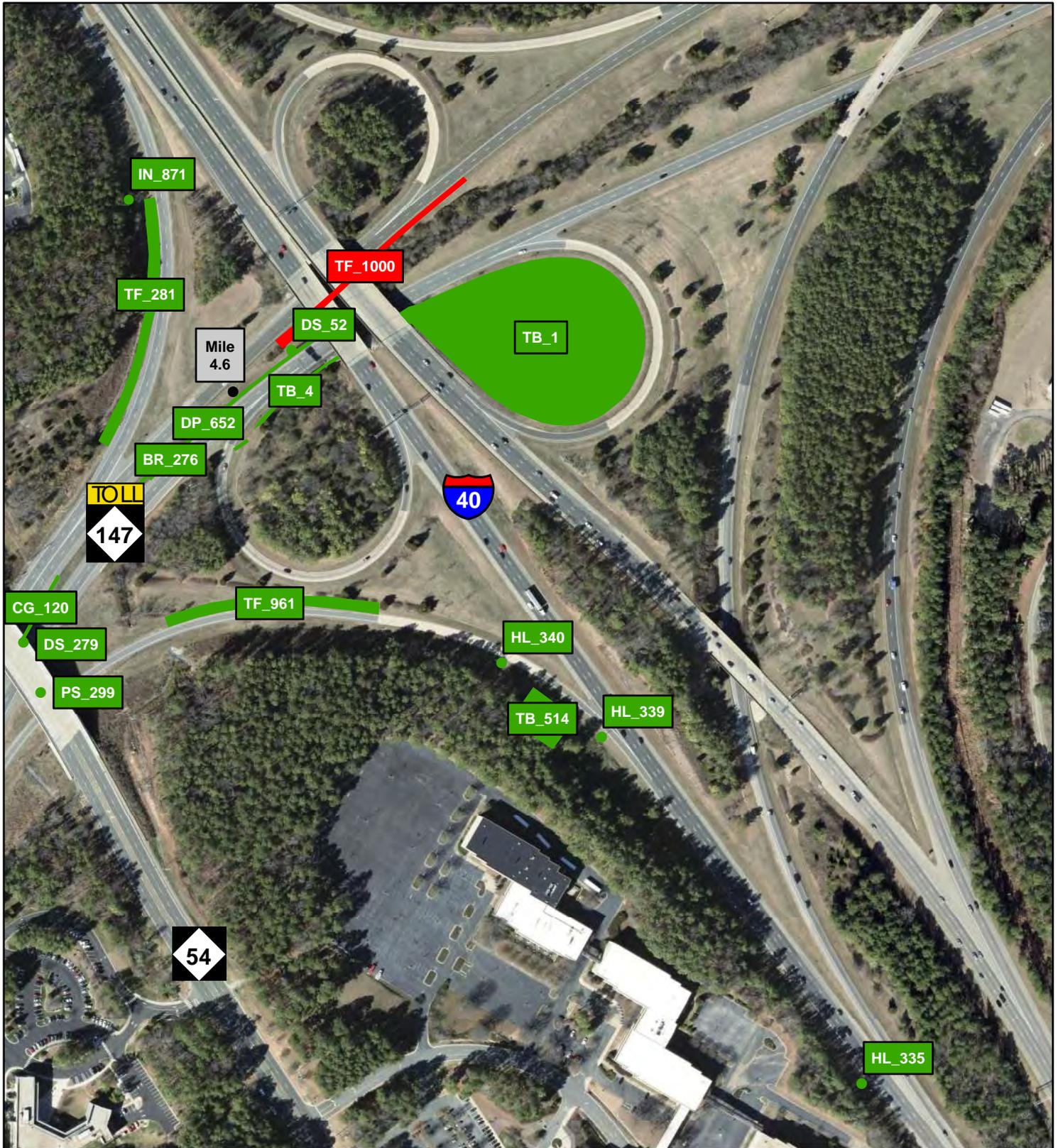


Legend

- Failing Asset
- Passing Asset

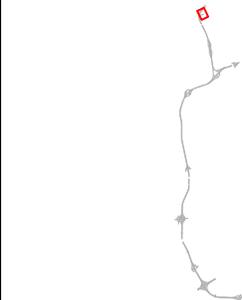


Appendix A: Triangle Expressway 2018 Fourth Quarter Asset Assessment Locations



Legend

- Failing Asset
- Passing Asset



Appendix B

Triangle Expressway 2018 Fourth Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2018 Fourth Quarter Table Results of Assets Failing MRP

Provided below are a series of tables outlining the existing failures that occurred throughout the facility. Assets are defined by an Inventory ID, which is a unique identifier given to each individual asset. The components that make up the Inventory ID are an asset specific prefix along with a number, such as LS_1. The Inventory ID and GIS Reference Page number correspond to the provided map packets and allow for quick location of particular asset failures. Photos of failures were provided when applicable.

All assets and their respective prefixes are listed below:

Guardrail, Concrete Barrier and End Anchors (BR).....	1
Curb and Gutter (CG)	2
Decorative Supports (DS).....	3
Drainage Pipes (DP).....	4
Misc. Drainage Structure (MDP)	5
Fence and Control of Access (FN)	8
Graffiti (GR)	9
Highway Lighting (HL)	10
Impact Attenuators (IA)	12
Inlets (IN).....	13
Landscaping (PB)	14
Paved Lanes – Asphalt (LS).....	15
Paved Lanes – Concrete (LS)	15
Paved Shoulders (LS).....	15
Unpaved Shoulders (LS)	16
Front/Back Slopes (LS)	17
Unpaved Lateral and Outfall Ditches (LS)	17
Litter (LS)	17
Roadway Sweeping (LS)	17
Pavement Striping (LS).....	18
Pavement Markers (LS).....	19
Delineators (LS).....	20
Paved Ditches (PD).....	21
Pavement Words and Symbols (PS).....	22
Signs (SN)	23
Tree and Brush (TB)	24
Turf Condition (TF).....	25
MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)1.....	27

Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Curb and Gutter	CG_97	Obstruction		A31

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Overhead Sign Support	DS_167	Scaling		A10

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_4	Obstruction & Missing Rodent Screen		A25
2	Shoulder Drain	MDP_49	Missing Rodent Screen		A21
3	Shoulder Drain	MDP_59	Obstruction & Missing Rodent Screen		A20
4	Shoulder Drain	MDP_74	Missing Rodent Screen		A18

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_91	Missing Rodent Screen		A13
6	Shoulder Drain	MDP_92	Missing Rodent Screen		A13
7	Shoulder Drain	MDP_98	Obstruction & Missing Rodent Screen		A13
8	Shoulder Drain	MDP_116	Missing Rodent Screen		A10

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Shoulder Drain	MDP_119	Missing Rodent Screen		A10
10	Shoulder Drain	MDP_126	Missing Rodent Screen		A9
11	Shoulder Drain	MDP_150	Obstruction & Missing Rodent Screen		A21

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_65	Hole Height		A25
2	Woven	FN_369	Fence Height		A15

Graffiti (GR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Single Roadway	HL_20	Part Damage		A1
2	Double Roadway	HL_177	Part Damage		A30
3	Single Roadway	HL_191	Part Damage		A33
4	High Mast	HL_232	Part Damage		A28, A29

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Single Roadway	HL_257	Part Damage		A8

Impact Attenuators (IA)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Inlets (IN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Inlet	IN_980	Obstruction		A1

Landscaping (PB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Lanes – Asphalt (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Lanes – Concrete (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_243	Joint Separation		A34

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_369	Shoulder Drop-Off		A1

Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Unpaved Lateral and Outfall Ditches (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Litter (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Roadway Sweeping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_275	Line Missing	 A photograph taken from a vehicle's perspective looking down a road. The road is asphalt. On the right side of the road, there is a concrete curb and a storm drain. A white line is missing on the asphalt surface near the curb. A white van is visible in the distance on the left side of the road. The sky is clear and blue.	A36

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_229	Nighttime Reflectivity	Not Available for Nighttime Failure	A32
2	Asphalt	LS_243	Nighttime Reflectivity	Not Available for Nighttime Failure	A34
3	Asphalt	LS_275	Nighttime Reflectivity	Not Available for Nighttime Failure	A36
4	Asphalt	LS_284	Nighttime Reflectivity	Not Available for Nighttime Failure	A34

Delineators (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Paved Ditches (PD)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Pavement Words and Symbols (PS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Wrong Way	SN_1031	Leaning & Surface Damage		A34

Tree and Brush (TB)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
This asset did not produce any failures.					

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Turf	TF_409	Bare Ground		A9
2	Turf	TF_460	Bare Ground		A1
3	Turf	TF_600	Bare Ground		A22
4	Turf	TF_778	Bare Ground		A29, A32

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_813	Bare Ground		A31
6	Turf	TF_1000	Bare Ground		A38

MSE/Retaining Walls, Sound Barrier Walls and Screen Walls (WL)1

#	Material Type	Object ID	Failure Type	Photo6	GIS Reference Page
This asset did not produce any failures.					