NORTH CAROLINA
Turnpike Authority

Maintenance Rating Program

Triangle Expressway

2018 First Quarter Report

1 S. Wilmington Street
Raleigh, NC 27601

Last Updated:
April 26, 2018

CONSULTANT CERTIFICATION OF COMPLETION

April 24, 2018

Dennis Jernigan, P.E.
Director of Highway Operations, NCTA
1 South Wilmington Street
Raleigh, NC 27601

NCTA Triangle Expressway Roadway Maintenance Performance Rating Program; Q1, 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.

Ken M. McEntire, PE
Principal

1100 Navaho Drive, Suite 125
Raleigh, NC 27609

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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 First Quarter Assessment of the Triangle Expressway.

The overall 2018 first quarter maintenance rating of the Triangle Expressway was 91.3, meeting the NCTA target rating of 90. As shown in ***Table 1***, only four of the five elements assessed achieved a rating greater than the target rating of 85.

Table 1: MRP Element Results for the 2018 First Quarter Assessment

Element	MRP Rating	Target Rating
Road Surface	98.5	85.0
Unpaved Shoulders and Ditches	97.8	85.0
Drainage	87.7	85.0
Roadside	92.2	85.0
Traffic Control Devices	83.8	85.0
Overall MRP Performance Rating	**91.3**	**90.0**

This report also provides a rolling rating of the latest four quarterly inspections of the Triangle Expressway. As presented in ***Table 2***, the rolling maintenance rating of the Triangle Expressway was 91.5.

Table 2: MRP Rolling Element Results

Element	Q2 2017 Rating	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Rolling Rating
Road Surface	100.0	98.1	98.9	98.5	98.8
Unpaved Shoulders and Ditches	95.5	100.0	97.9	97.8	98.0
Drainage	92.3	83.2	87.6	87.7	87.7
Roadside	87.4	90.4	92.5	92.2	90.8
Traffic Control Devices	88.5	85.2	82.4	83.8	84.8
Overall MRP Performance Rating	**92.7**	**90.9**	**91.1**	**91.3**	**91.5**

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.

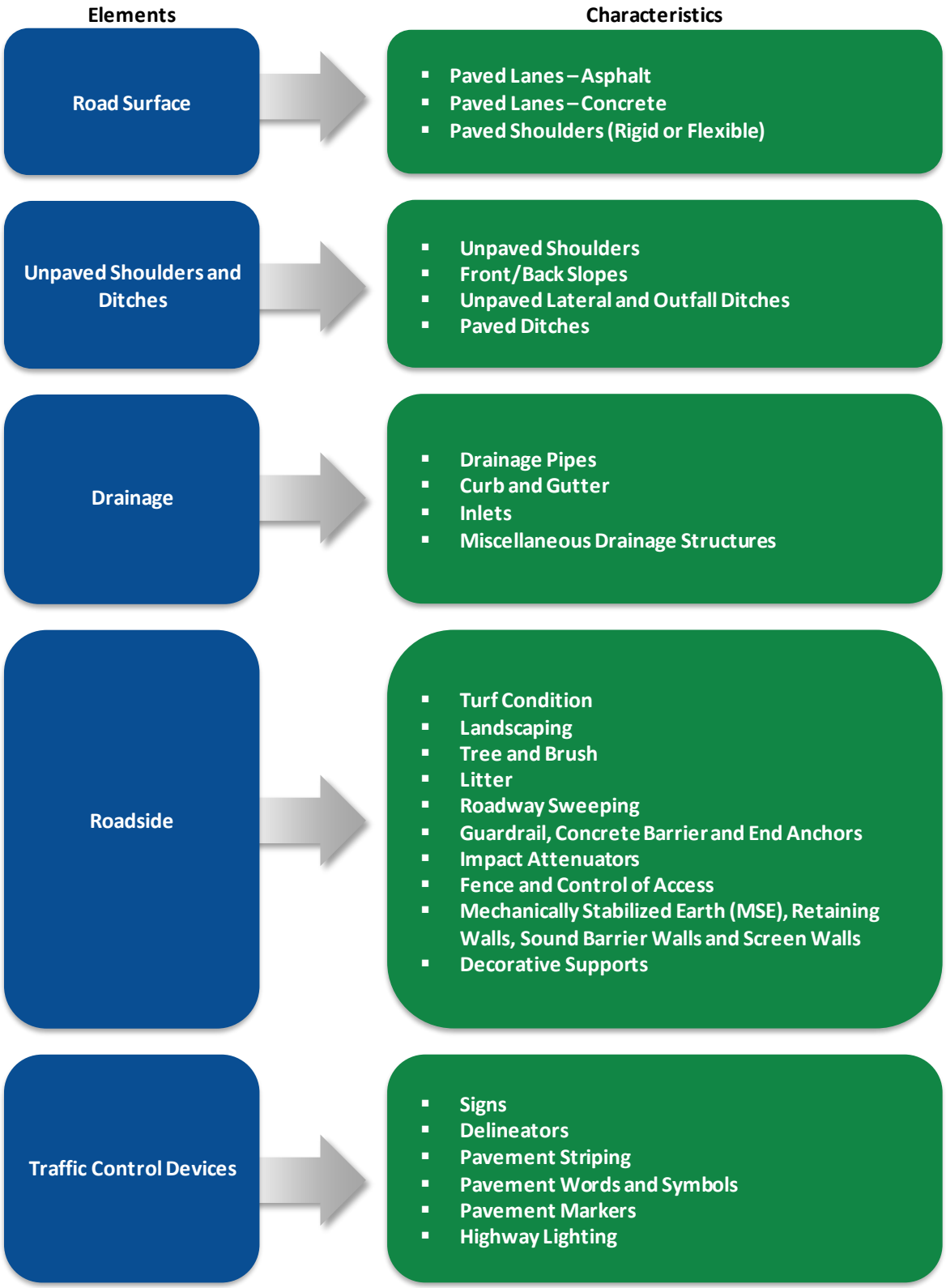
The NCTA performance standards, threshold criteria and maintenance rating program were developed through a collaborative effort by NCTA managers, NCDOT maintenance staff and consultants.

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



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:

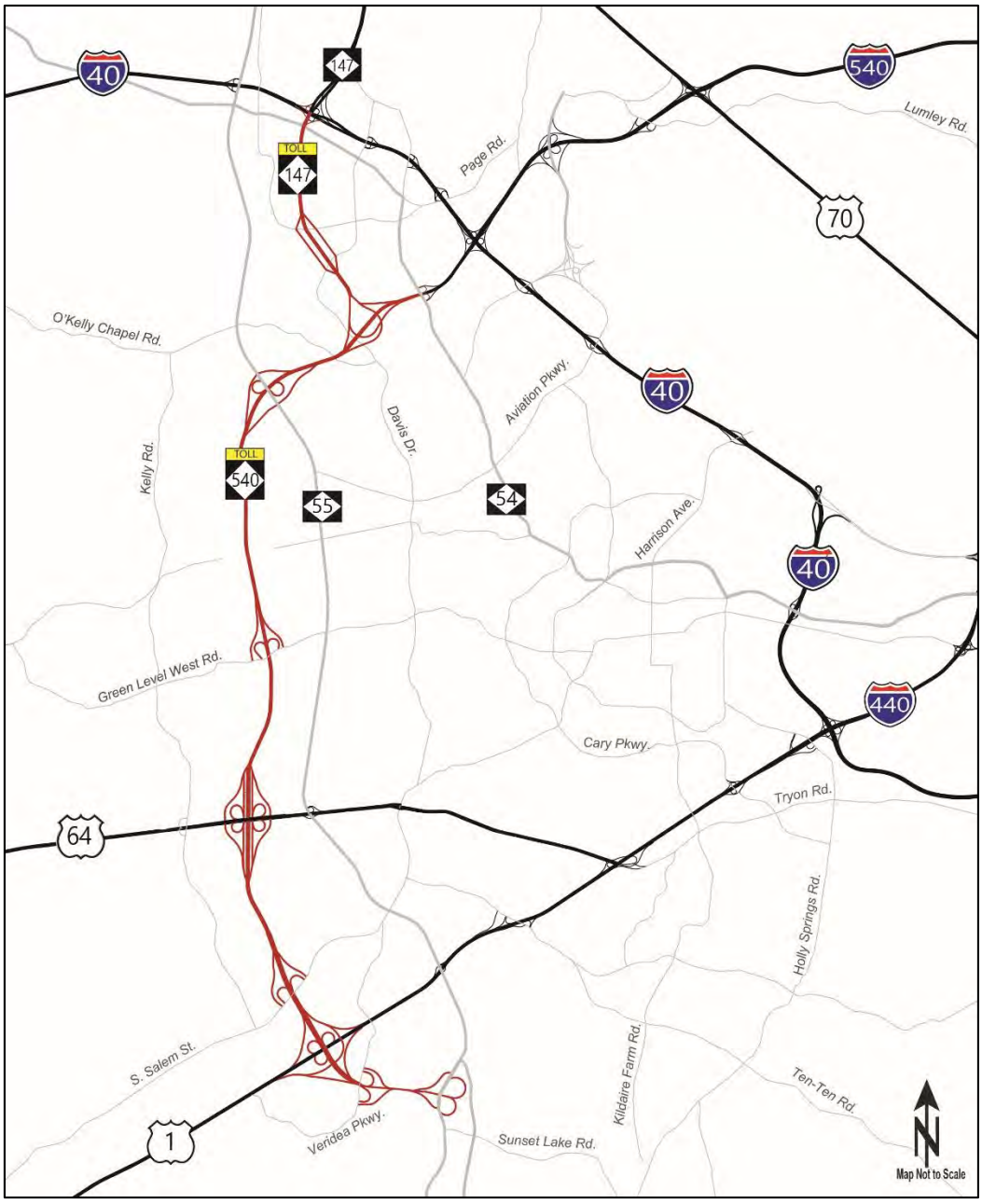
Road Surface =	**25%**
Unpaved Shoulders =	**13%**
Drainage =	**15%**
Roadside =	**17%**
Traffic Control Devices =	**30%**
Total	**100%**

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 NC-147 in Durham to the NC-55 Bypass near Holly Springs (***Figure 2***). It includes a one-mile segment on NC-540 extending north from the NC-540 / 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



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.

During this quarter, no assets were removed or added to the inventory. However, with the completion of the Access 540 Project, NCTA is working on adding to the inventory all new assets located in the Veridea Parkway interchange.

6.0 MRP First Quarter Assessment

6.1 Quarterly Results

The overall 2018 first quarter maintenance rating of the Triangle Expressway was 91.3, meeting NCTA's target overall rating of 90. Most elements assessed achieved ratings above the target rating of 85, except for Traffic Control Devices (83.8). Miscellaneous Drainage (59), Turf Condition (79), Pavement Striping/Marking (77), and Highway Lighting (68) are the characteristics that scored below the target rating of 80. It is important to note that these results are only representative of the first 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 first quarter MRP performance ratings for elements and characteristics are presented in ***Table 3*** and ***Table 4***, respectively.

Table 3: MRP Element Results for Q1 2018

Element	Q1 2018 MRP Rating
Road Surface	98.5
Unpaved Shoulders and Ditches	97.8
Drainage	87.7
Roadside	92.2
Traffic Control Devices	83.8
Overall MRP Performance Rating	**91.3**

Table 4: MRP Characteristic Results for Q1 2018						
Road Surface	**Sample Passed**	**Sample Total**	**Weighted Values**	**Actual Pts**	**Available Pts**	**Q1 Rating**
Paved Lanes Asphalt	19	20	9	171	180	95
Paved Lanes Concrete	24	24	9	216	216	100
Paved Shoulder	44	44	5	220	220	100
Element Total				**607**	**616**	**98.5**
Unpaved Shoulders and Ditches	**Sample Passed**	**Sample Total**	**Weighted Values**	**Actual Pts**	**Available Pts**	**Q1 Rating**
Unpaved Shoulder	43	44	9	387	396	98
Front/Back Slopes	43	44	6	258	264	98
Lateral and Outfall Ditches, Unpaved	43	44	6	258	264	98
Ditches, Paved	2	2	5	10	10	100
Element Total				**913**	**934**	**97.8**
Drainage	**Sample Passed**	**Sample Total**	**Weighted Values**	**Actual Pts**	**Available Pts**	**Q1 Rating**
Drainage Pipes	31	34	7	217	238	91
Curb and Gutter	26	29	6	156	174	90
Inlets	33	34	7	231	238	97
Misc. Drainage Structure	17	29	4	68	116	59
Element Total				**672**	**766**	**87.7**
Roadside	**Sample Passed**	**Sample Total**	**Weighted Values**	**Actual Pts**	**Available Pts**	**Q1 Rating**
Turf Condition	49	62	7	343	434	79
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	28	31	9	252	279	90
Impact Attenuators	9	9	9	81	81	100
Fence, Control Access	31	34	7	217	238	91
Retaining Walls and Sound Barrier Walls	14	16	5	70	80	88
Decorative Supports	23	25	5	115	125	92
Graffiti and Stain Removal	44	44	4	176	176	100
Element Total				**1874**	**2033**	**92.2**
Traffic Control Devices	**Sample Passed**	**Sample Total**	**Weighted Values**	**Actual Pts**	**Available Pts**	**Q1 Rating**
Signs	36	37	7	252	259	97
Delineators	42	42	3	126	126	100
Pavement Striping/Marking	34	44	8	272	352	77
Words and Symbols	28	31	7	196	217	90
Pavement Markers	37	44	9	333	396	84
Highway Lighting	34	50	6	204	300	68
Element Total				**1383**	**1650**	**83.8**

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

6.2 Analysis and Recommendations

Elements

During the first quarter, most elements exceeded NCTA's threshold criteria of 85 except for Traffic Control Devices (83.8). Road Surface (98.5) and Unpaved Shoulder/Ditches (97.8) continued to obtain ratings higher than 95, while Roadside (92.2) and Drainage (87.7) obtained ratings just above 90 and 85, respectively. These ratings are consistent with the ratings obtained during the fourth quarter of 2017. Recommendations are provided in the following section to help improve specific critical characteristic ratings and therefore improve some of the lower element ratings.

Characteristics

This quarter all but four characteristics, Miscellaneous Drainage Structure (59), Turf Condition (79), Pavement Striping/Marking (77), and Highway Lighting (68) 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***.

Miscellaneous Drainage (59 rating – 12 of the 29 assets failed). Out of the 12 miscellaneous drainage structures that did not pass the inspection, 9 were obstructed and 3 had missing rodent screens. Two of these structures are presented in ***Figure 3***.

Figure 3: Miscellaneous Drainage

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. Edge drains are a critical component of extending the life cycle of pavement as they provide a means for water to drain 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.

Turf Condition (79 rating – 13 of the 62 assets failed). All 13 turf areas that did not pass the inspection had bare ground conditions. Two of these turf areas are presented in ***Figure 4***.

Figure 4: Turf Areas

To continue to improve the Turf Condition rating, it is recommended that the maintenance provider continue with an aggressive schedule for seeding and fertilization cycles of bare ground areas during the spring and early summer. As part of their routine, the maintenance provider should closely monitor mowing heights during the 2018 mowing cycle pursuant to the NCTA Roadway and Facility Maintenance Standards V4, referenced below.

Turf Maintenance Program:

1) Roadside mowing should occur as often as necessary to always 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 poles, and ITS device poles.
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 as necessary.
    c. Fall:
        i. Apply post-emergence herbicides to select locations in accordance with the manufacturer's recommendations in August.
        ii. Bare ground areas shall be seeded in the fall as needed.

Turf Maintenance and Evaluation Standards:
Turf does not meet the maintenance standards when any of the following criteria is 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.

Pavement Striping/Marking (77 rating – 10 of the 44 assets failed). All 10 pavement striping/marking segments that did not pass the inspection had missing sections exceeding the minimum threshold requirement. Two of these segments are presented in ***Figure 5***.

Figure 5: Pavement Striping/Marking

To maintain a well-defined lane delineation throughout the Triangle Expressway, the maintenance provider should schedule pavement striping/marking replacement cycles in accordance with the *NCTA Roadway and Facility Maintenance Standards V4* (referenced below), and industry life-cycle specifications for the installed material.

Maintenance Program:

1) Pavement striping is observed daily and inspected every 4 months for compliance to the standard.
2) Worn or missing markings are evaluated for compliance annually, and generally are scheduled on a 3-5 year replacement cycle depending on the material.

Maintenance and Evaluation Standards:

Pavement Striping/Marking does not meet the maintenance standards when any of the following criteria is observed:

1) More than 10% of the length of any line is less than 5.4 inches wide.
2) More than 10% of each line is not visible at 160 feet during nighttime observation.
3) More than 10% of the length of any line is missing.
4) More than 10% of the length of any line is covered by soil, grass, or debris.

The original pavement striping/markings were installed along portions of Triangle Expressway over 5 years ago. Recognizing that the lifespan of epoxy paint is 3 to 5 years, NCTA has included in its capital budget and work schedule the replacement of pavement striping/markings with Polyurea, a long-life pavement marking material recommended in a 2015 cost-benefit analysis study by NCDOT. A pavement striping replacement contract for Toll NC-540 is scheduled to be awarded in May of 2018, and work is anticipated to be completed by the end of 2018.

Highway Lighting (68 rating – 16 of the 50 assets failed). Out of the 16 highway lights that did not pass inspection, 10 had functional damage and 6 had damaged parts. Two of these highway lights are presented in ***Figure 6***.

Figure 6: Highway Lighting

To increase this asset's rating, it is recommended that all non-functioning or damaged highway lights noted during the inspection be repaired and/or replaced in accordance with the *NCTA Roadway and Facility Maintenance Standards V4*, referenced below.

Highway Lighting Maintenance Program Standards:

1) Perform night patrol once a month, and identify any outages. A monthly "Lighting Outage Report" shall be submitted by the maintenance provider to the NCTA by the 30th of each month. All bulb outages must be replaced within 48 hours.
2) Perform cleaning of glassware at the same time as any routine maintenance function or diagnostic action is performed.
3) 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 is 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.
3) More than 10% of the poles are damaged or missing.
4) Rodent screen protection is not in place.

7.0 Current Rolling MRP Rating

The rolling maintenance rating of the Triangle Expressway was 91.5, exceeding NCTA's target overall rating of 90. Most element ratings exceeded the target rating of 85, except for Traffic Control Devices (84.8). Also, all but four characteristic ratings met or exceeded the target rating of 80. Ratings for Miscellaneous Drainage Structure, Turf Condition, Pavement Striping/Marking, and Highway Lighting were 70, 76, 79, and 68, respectively.

The cumulative rolling results are presented in ***Tables 5 and 6***. These results are a collection of the four quarterly inspections conducted throughout the year.

Table 5: MRP Rolling Element Results

Element	Q2 2017 Rating	Q3 2017 Rating	Q4 2017 Rating	Q1 2018 Rating	Rolling Rating
Road Surface	100.0	98.1	98.9	98.5	98.8
Unpaved Shoulders and Ditches	95.5	100.0	97.9	97.8	98.0
Drainage	92.3	83.2	87.6	87.7	87.7
Roadside	87.4	90.4	92.5	92.2	90.8
Traffic Control Devices	88.5	85.2	82.4	83.8	84.8
Overall MRP Performance Rating	**92.7**	**90.9**	**91.1**	**91.3**	**91.5**

Table 6: MRP Rolling Element Results					
Road Surface	**Q2 2017 Rating**	**Q3 2017 Rating**	**Q4 2017 Rating**	**Q1 2018 Rating**	**Rolling Rating**
Paved Lanes Asphalt	100	100	100	95	98
Paved Lanes Concrete	100	100	100	100	100
Paved Shoulder	100	95	97	100	98
Element Total	**100.0**	**98.1**	**98.9**	**98.5**	**98.8**
Unpaved Shoulders and Ditches	**Q2 2017 Rating**	**Q3 2017 Rating**	**Q4 2017 Rating**	**Q1 2018 Rating**	**Rolling Rating**
Unpaved Shoulder	92	100	97	98	97
Front/Back Slopes	100	100	100	98	99
Lateral and Outfall Ditches, Unpaved	100	100	97	98	99
Ditches, Paved	0	100	100	100	80
Element Total	**95.5**	**100.0**	**97.9**	**97.8**	**98.0**
Drainage	**Q2 2017 Rating**	**Q3 2017 Rating**	**Q4 2017 Rating**	**Q1 2018 Rating**	**Rolling Rating**
Drainage Pipes	100	97	94	91	96
Curb and Gutter	88	88	79	90	86
Inlets	97	74	94	97	90
Misc. Drainage Structure	72	71	74	59	70
Element Total	**92.3**	**83.2**	**87.6**	**87.7**	**87.7**
Roadside	**Q2 2017 Rating**	**Q3 2017 Rating**	**Q4 2017 Rating**	**Q1 2018 Rating**	**Rolling Rating**
Turf Condition	54	80	84	79	76
Landscaping	100	88	88	100	94
Trees and Brush	100	100	100	100	100
Litter	100	97	100	100	99
Roadway Sweeping	100	100	97	100	99
Guardrail, Concrete Barrier and End Anchors	97	94	100	90	95
Impact Attenuators	100	100	100	100	100
Fence, Control Access	93	87	90	91	90
Retaining Walls and Sound Barrier Walls	100	75	73	88	84
Decorative Supports	92	96	100	92	95
Graffiti and Stain Removal	96	100	100	100	99
Element Total	**87.4**	**90.4**	**92.5**	**92.2**	**90.8**
Traffic Control Devices	**Q2 2017 Rating**	**Q3 2017 Rating**	**Q4 2017 Rating**	**Q1 2018 Rating**	**Rolling Rating**
Signs	92	86	89	97	91
Delineators	100	94	80	100	94
Pavement Striping/Marking	88	87	68	77	79
Words and Symbols	97	93	90	90	93
Pavement Markers	88	95	97	84	91
Highway Lighting	78	60	68	68	68
Element Total	**88.5**	**85.2**	**82.4**	**83.8**	**84.8**

8.0 Green Level Historic District Signs

Four 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 four Green Level Historic District signs to conduct a visual inspection of each sign and ensure they are in good standing. During this quarter, the sign located at the intersection of Green Level Church Road and Green Level West Road was excluded from the inspection inventory due to its removal during the completion of a Town of Cary development project near the intersection. The three signs included in the inspection inventory were found to be in good condition, with the landscaped areas being well maintained. ***Figure 7*** shows two of these signs.

Figure 7: Green Level West Historic District Signs, Landscape Areas

9.0 Conclusion

This report presents the 2018 first quarter rating assessment of the Triangle Expressway. The NCTA's target ratings are 90 overall, 85 for elements, and 80 for characteristics. The first quarter 2018 overall rating was **91.3** and the rolling rating was **91.5**, both ratings met the target rating of 90.

Traffic Control Devices was the only element of five that did not meet the target rating for the first quarter and rolling assessment. This element obtained a rating of 83.8 for the quarterly assessment and 84.8 for the rolling assessment. In general, during the first quarter assessment all elements obtained scores consistent with previous quarter; there was not a significant variation of ratings from the fourth quarter 2017 assessment.

During the first quarter assessment, all but four characteristics met or exceeded the target rating of 80. These four characteristics are: Miscellaneous Drainage Structure (59), Turf Condition (79), Pavement Striping/Marking (77), and Highway Lighting (68). Similarly, during the cumulative rolling assessment these four characteristics did not meet the target rating of 80, obtaining a rating of 70, 76, 79, and 68, respectively.

To improve the ratings, it is recommended that the maintenance provider conduct routine patrols and maintenance of shoulder underdrains by removing any debris or overgrown vegetation that may impede the flow of water. It is also recommended that the maintenance provider repair and/or replace all defects in highway lights. Additionally, pavement striping/marking replacement cycles should be scheduled and completed as planned in the capital budget, and the bare areas seeding/fertilization program efforts should also continue during the spring and summer seasons to promote new turf growth.

This quarter, only three of the four Green Level Historic District sign locations were inspected due to the removal of one of the signs as part a Town of Cary development project near Green Level West Road. The three 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

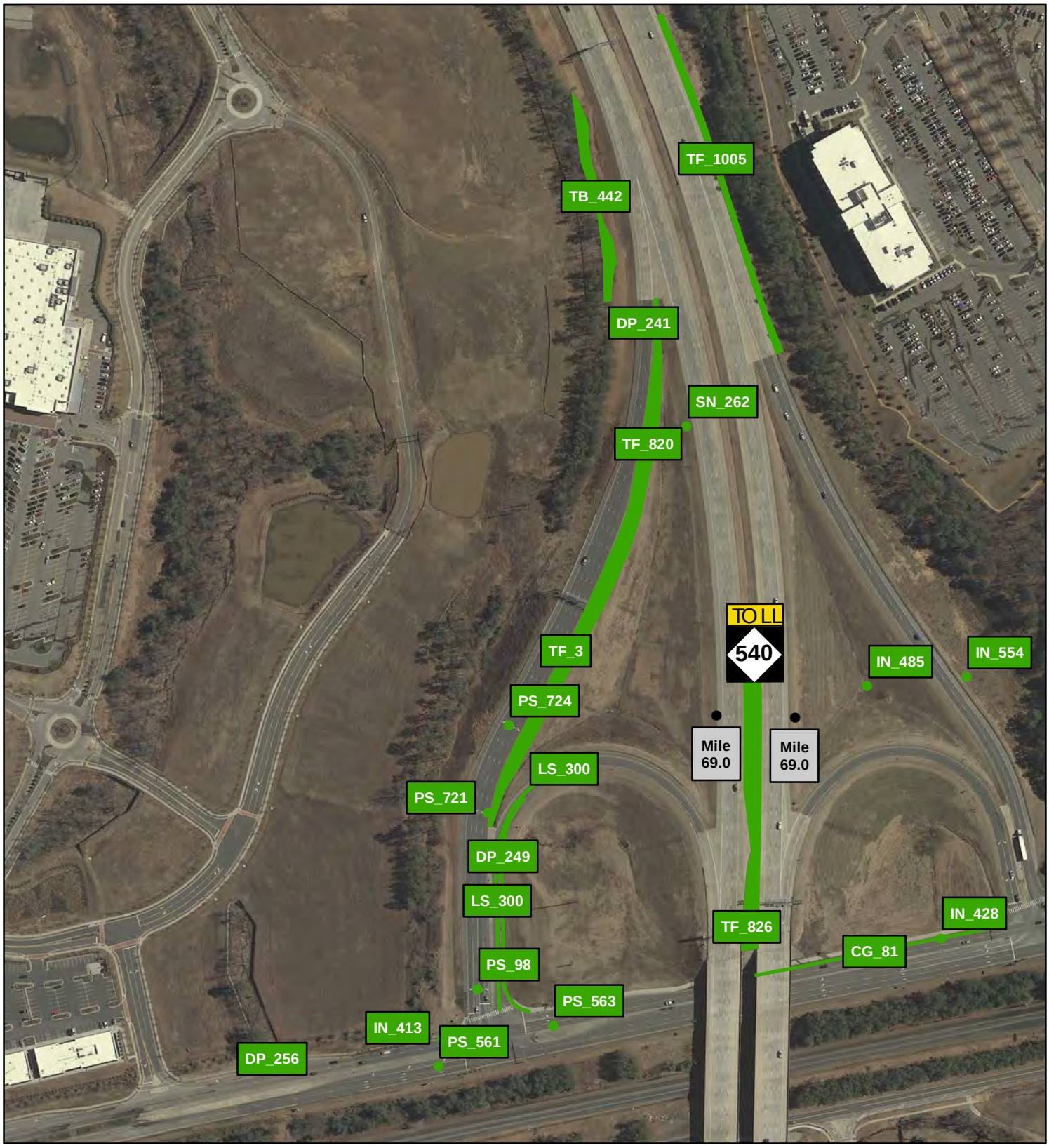
Triangle Expressway 2018 First Quarter Asset Assessment Locations

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations

Provided below are a series of maps outlining the assets that were a part of this quarter's sample and their corresponding result. 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. All assets and their respective prefixes are listed below:

- Guardrail, Concrete Barrier and End Anchors – BR
- Curb and Gutter – CG
- Decorative Supports – DS
- Drainage Pipes – DP
- Misc. Drainage Structures – MDP
- Fence and Control of Access – FN
- Graffiti - GF
- Highway Lighting – HL
- Impact Attenutators – IA
- Inlets – IN
- Landscaping – PB
- Linear Samples – LS
    - Paved Lanes – Asphalt
    - Paved Lanes – Concrete
    - Paved Shoulders
    - Unpaved Shoulders
    - Front/Back Slopes
    - Unpaved Lateral and Outfall Ditches
    - Litter
    - Roadway Sweeping
    - Pavement Striping/Markings
    - Pavement Markers
    - Delineators
- Paved Ditches – PD
- Pavement Words and Symbols – PS
- Signs – SN
- Tree and Brush – TB
- Turf Condition – TF
- MSE/Retaining Walls, Sound Barrier Walls, and Screen Walls – WL

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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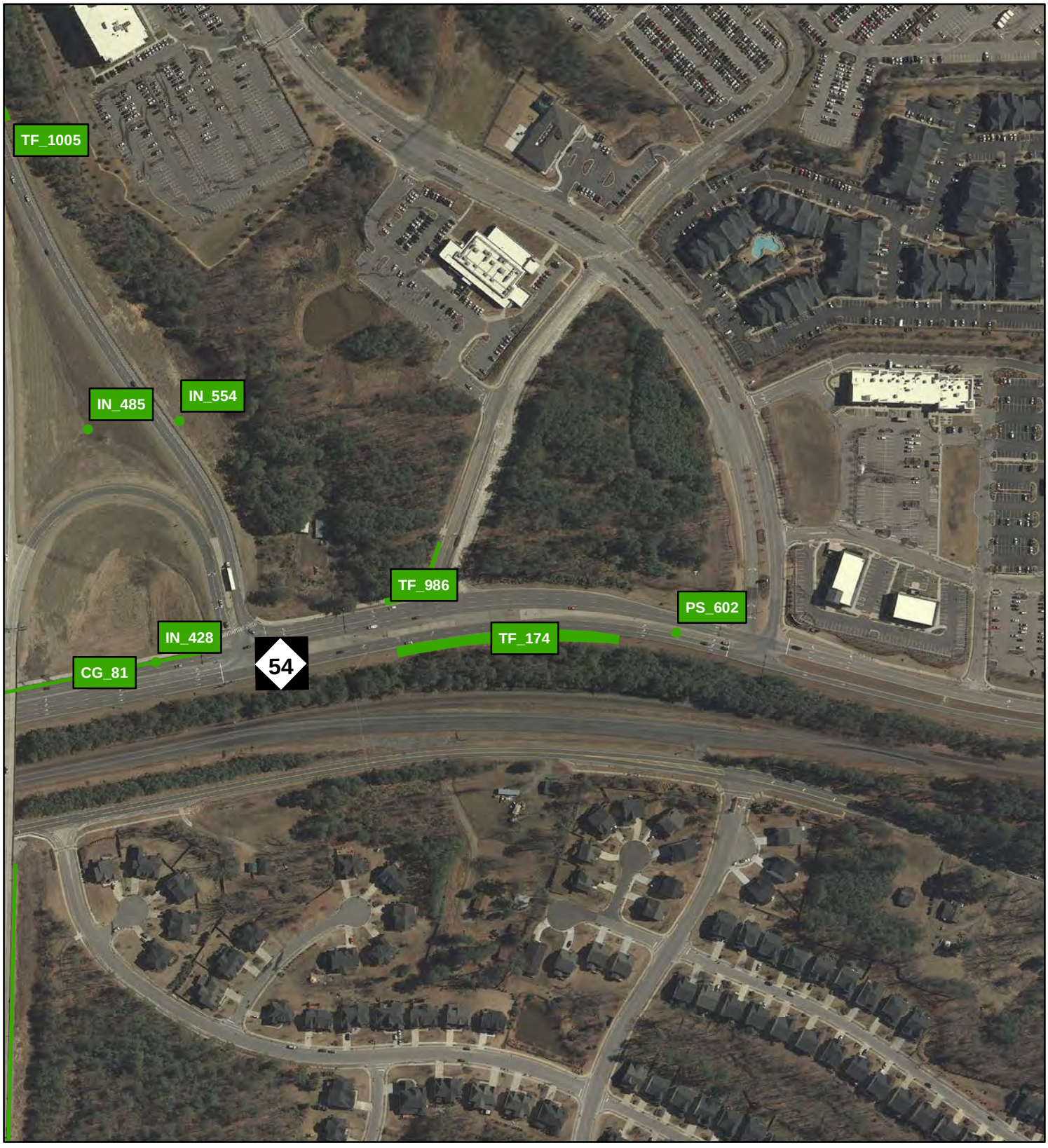
Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

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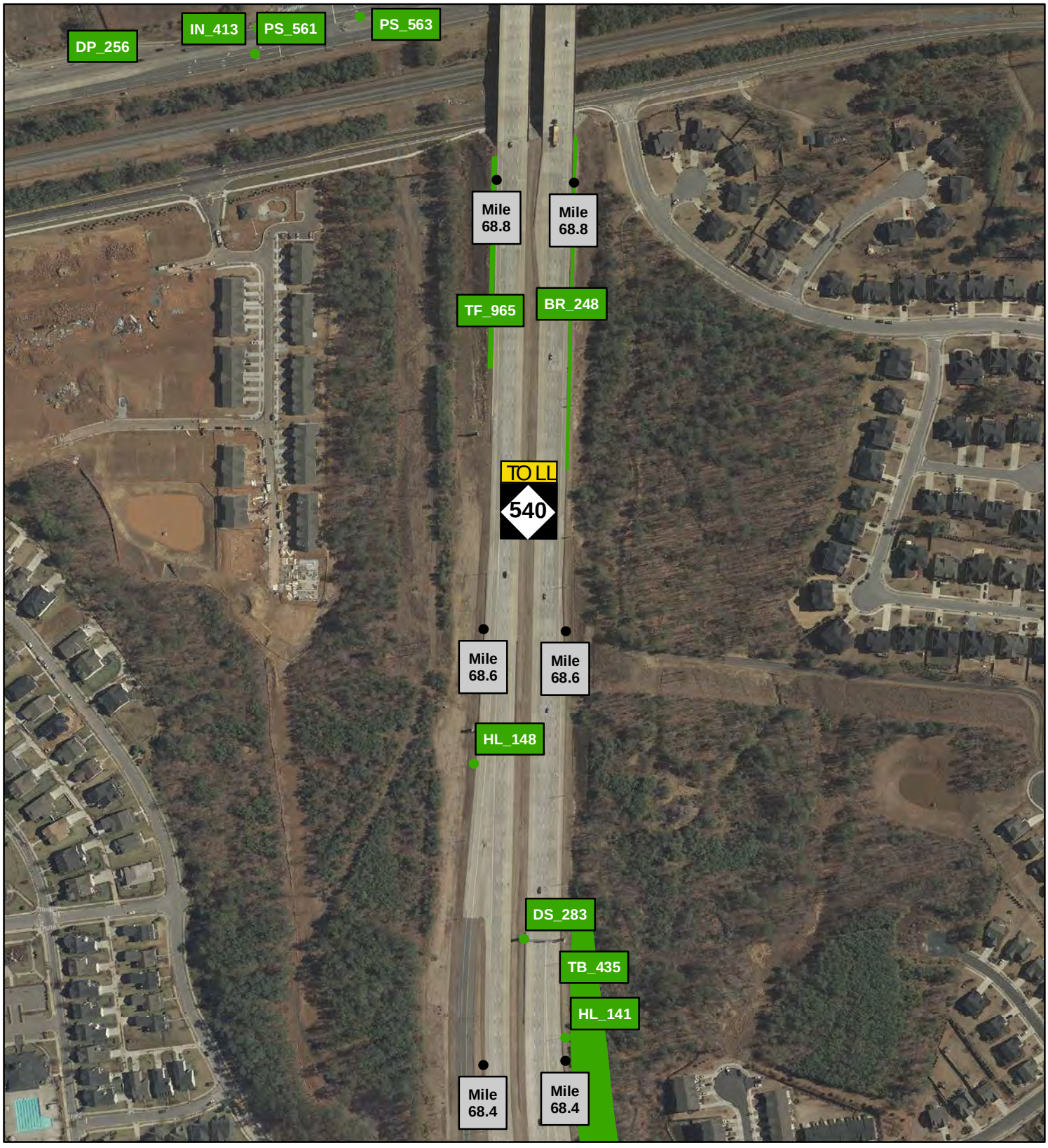

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Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

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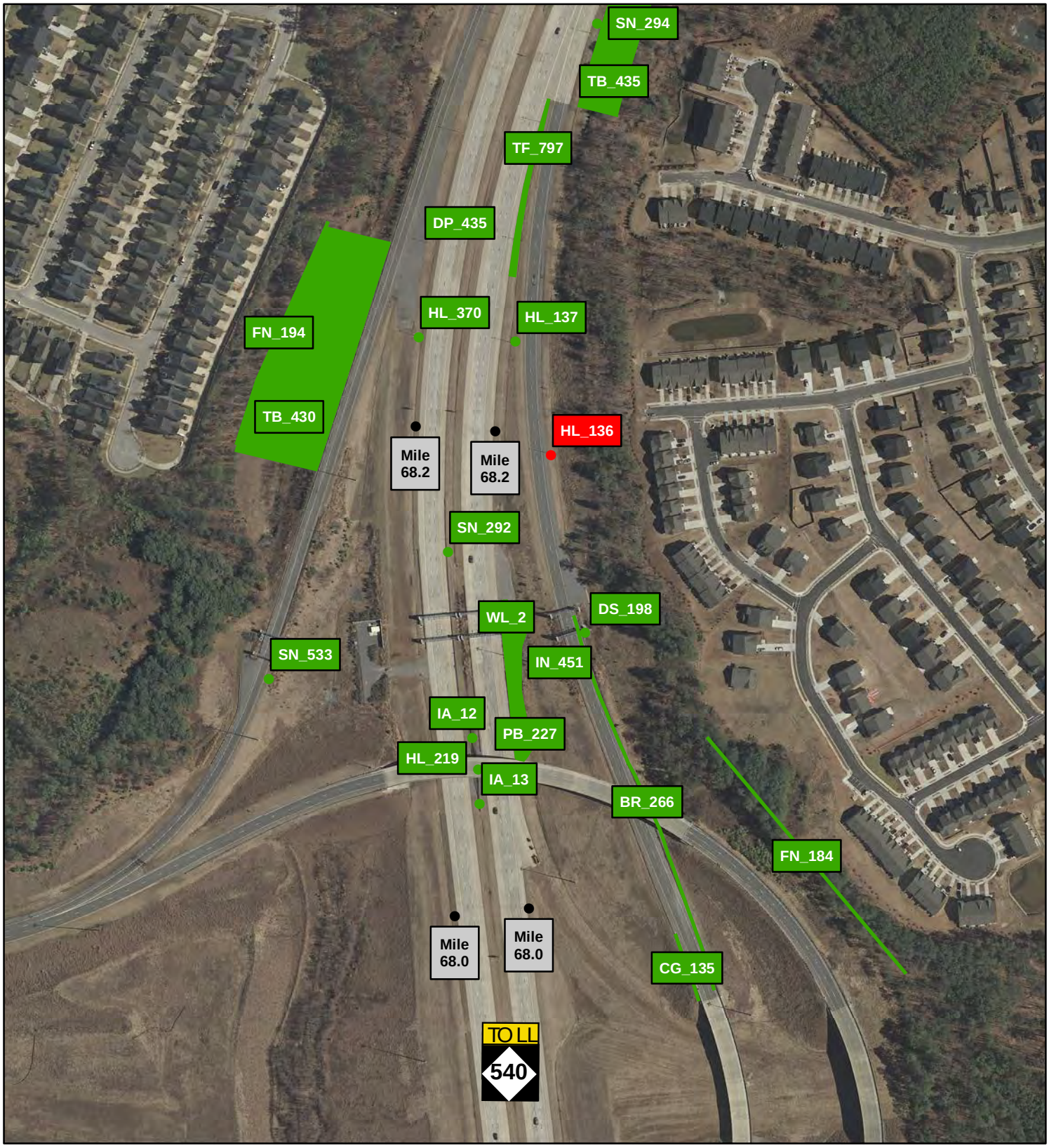


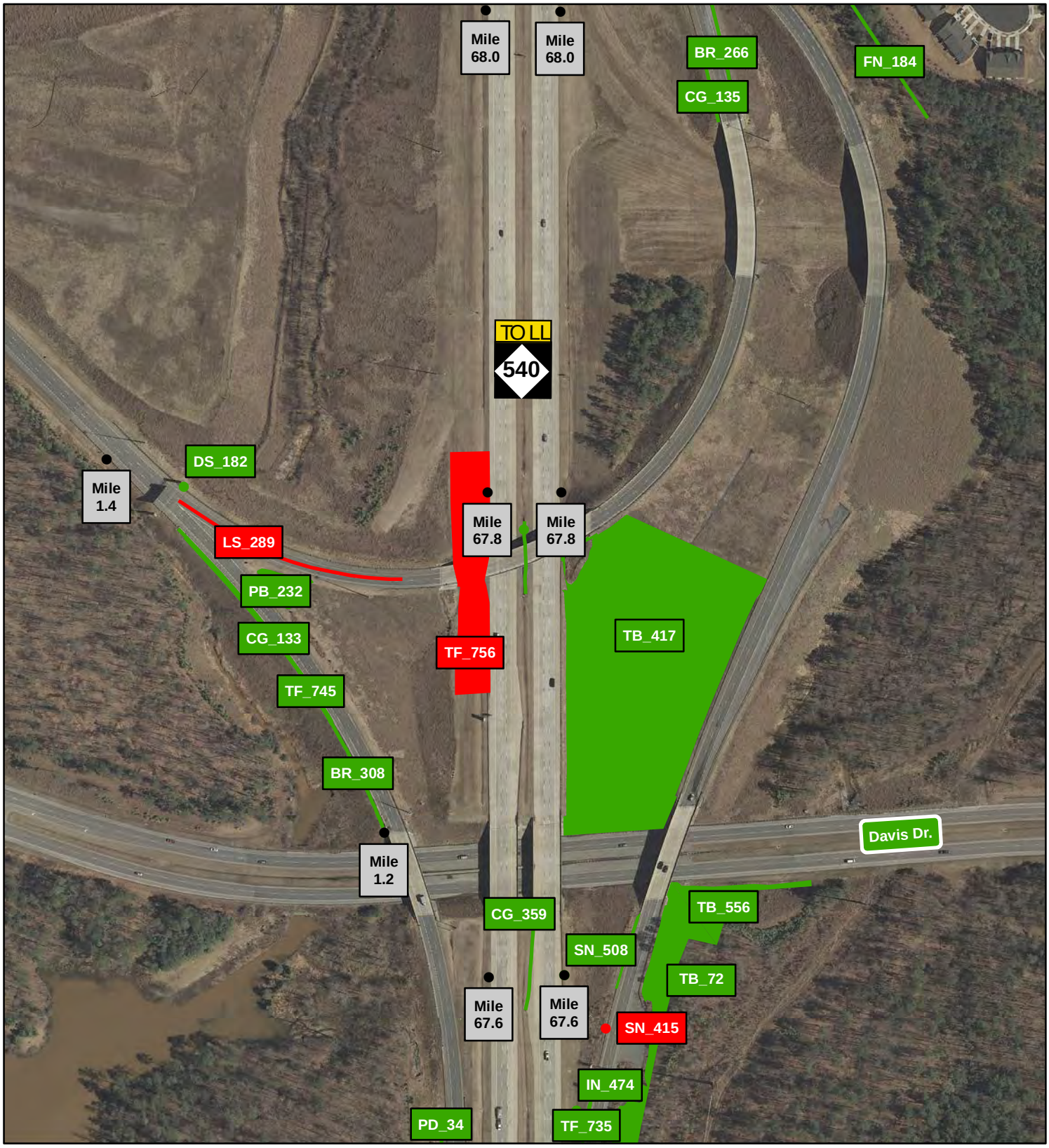
Legend

Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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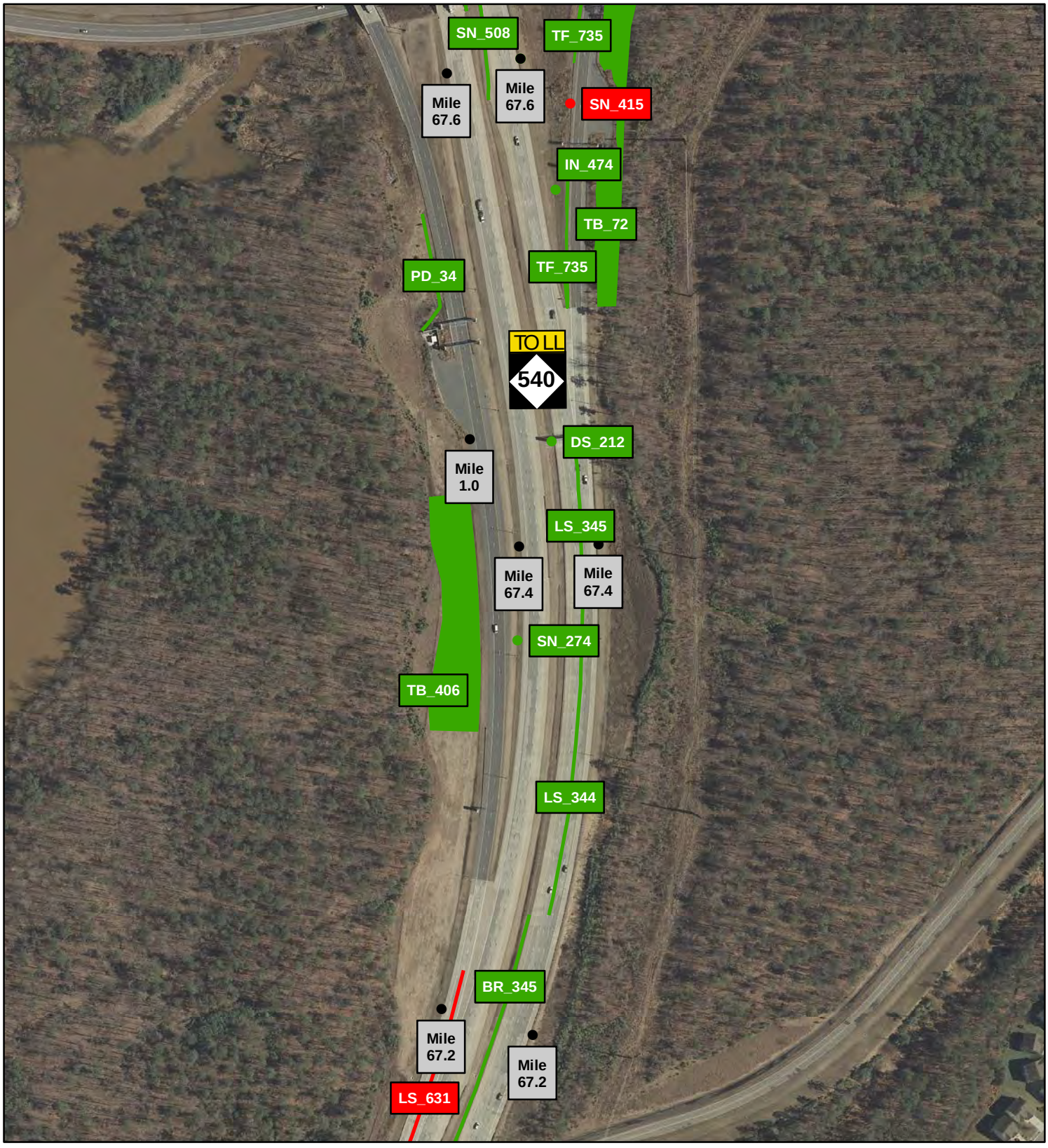
Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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NORTH CAROLINA Turnpike Authority

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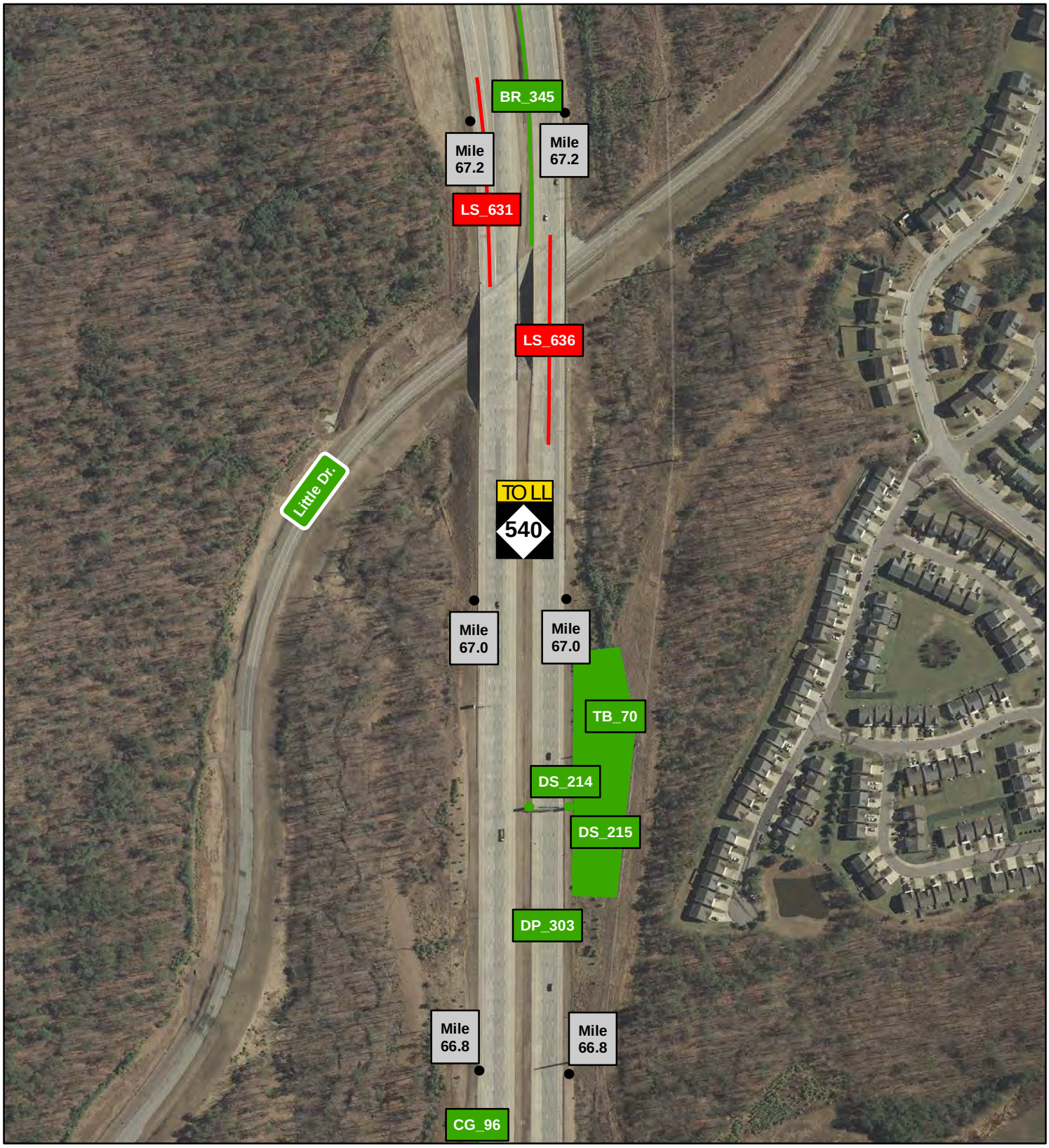

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NORTH CAROLINA Turnpike Authority

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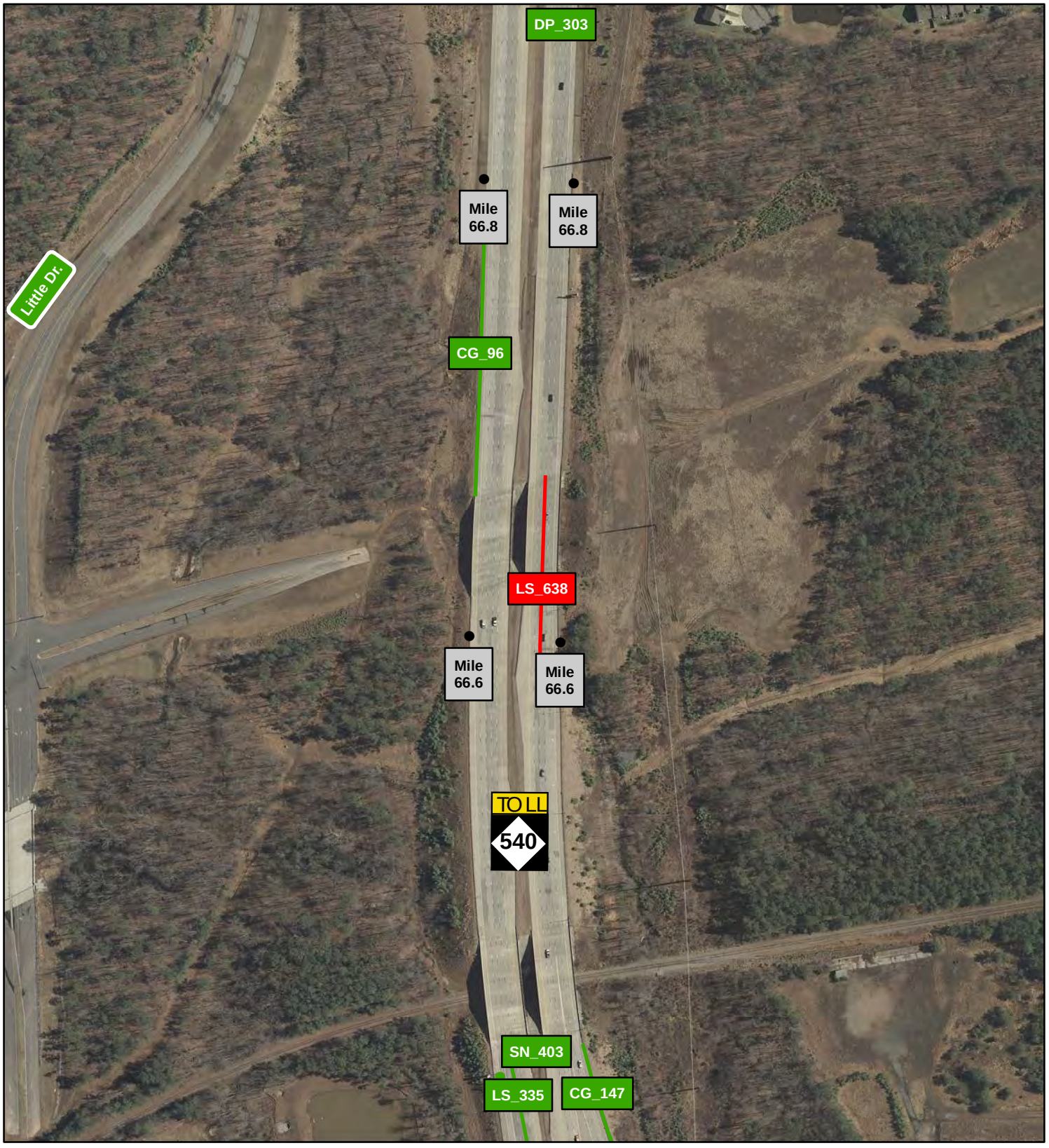

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NORTH CAROLINA Turnpike Authority

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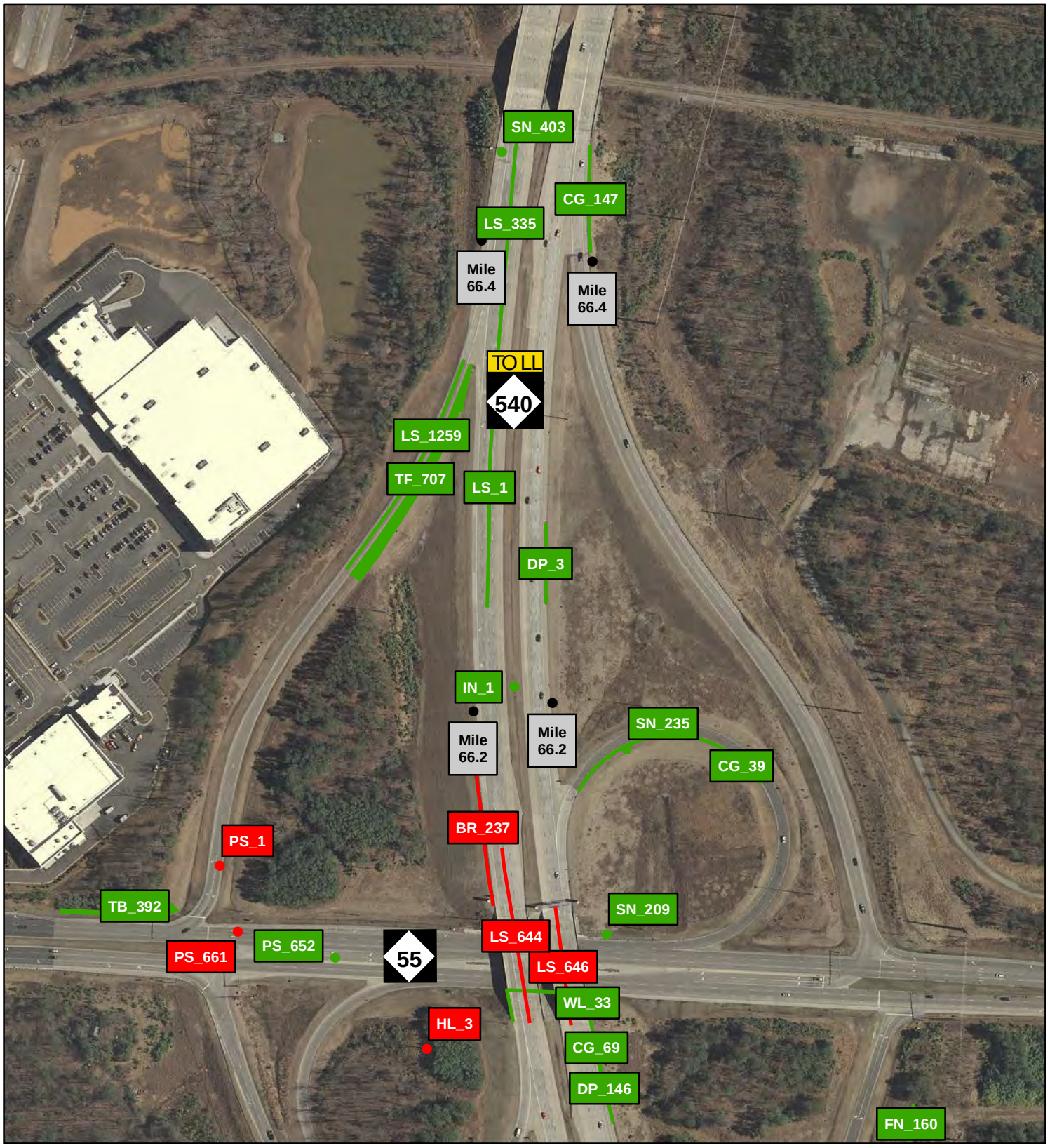

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NORTH CAROLINA Turnpike Authority

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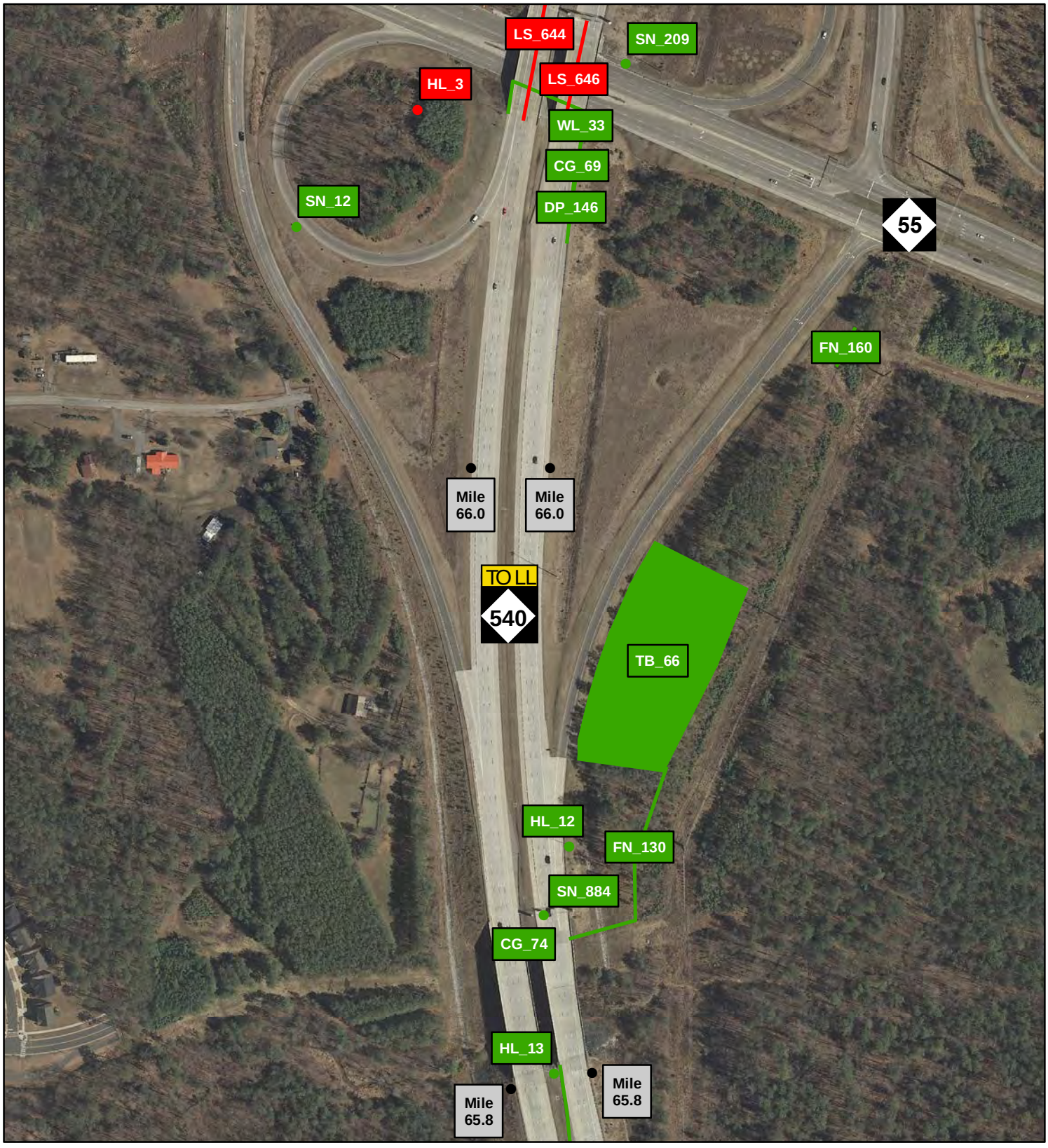

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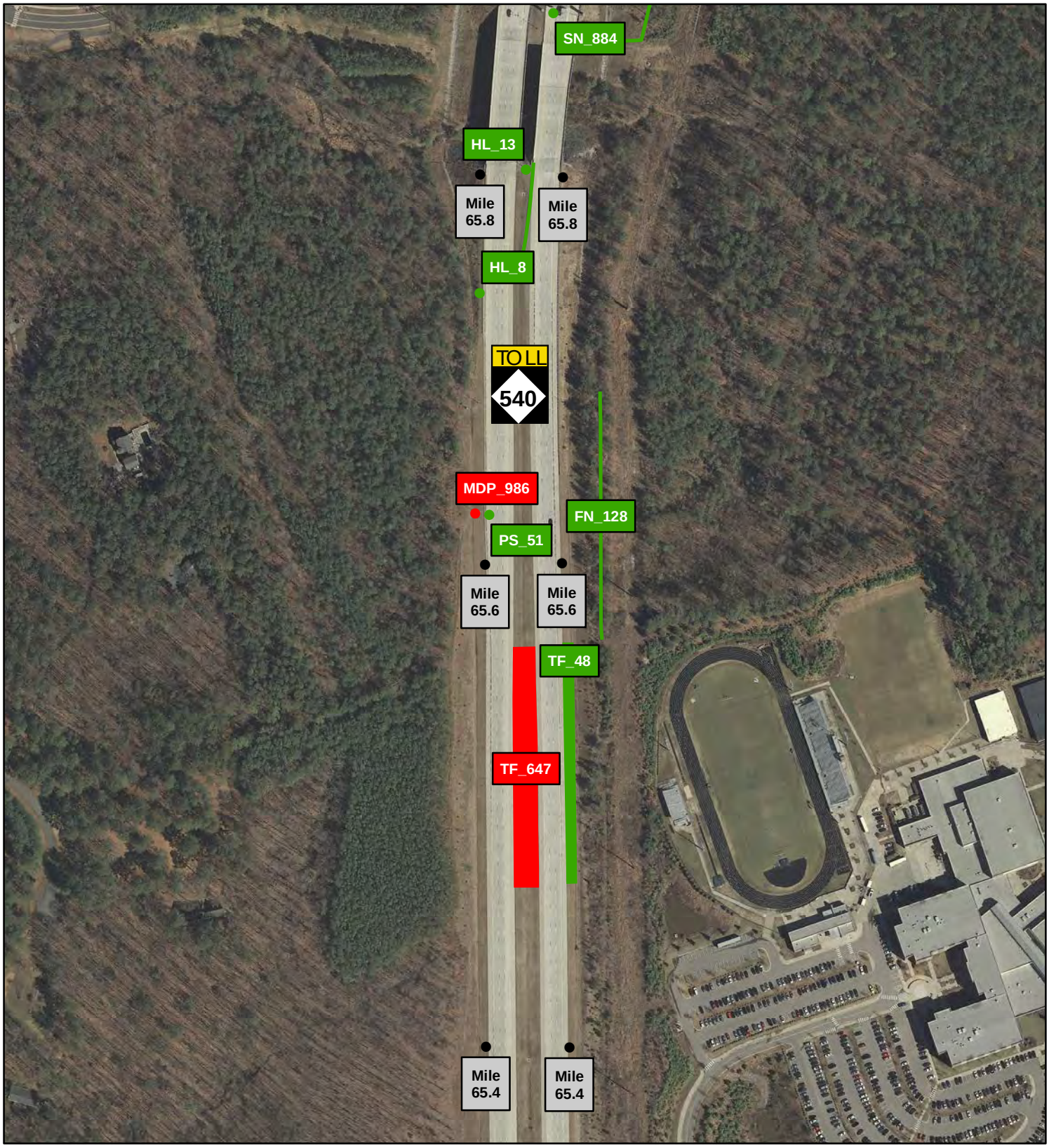

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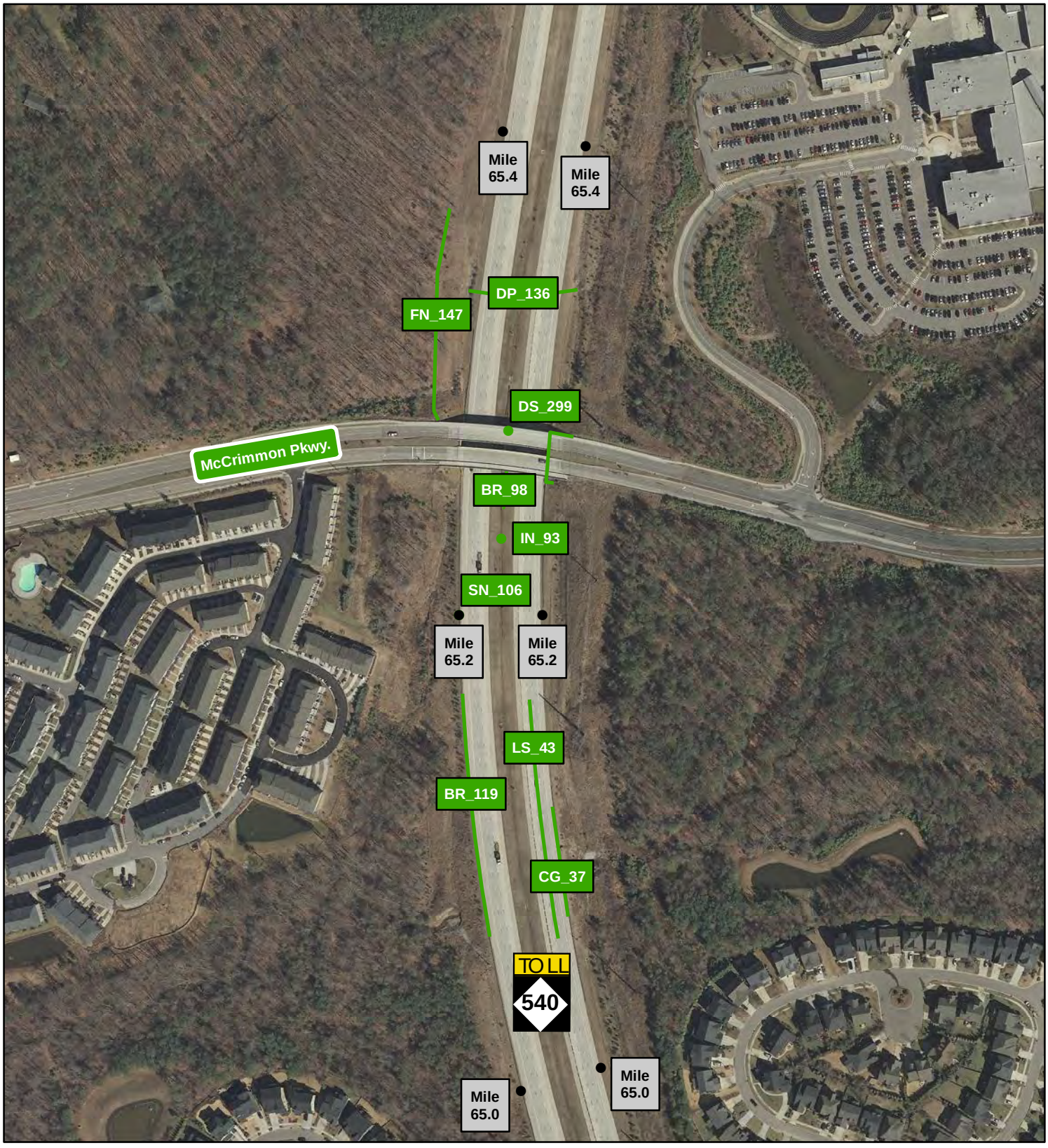

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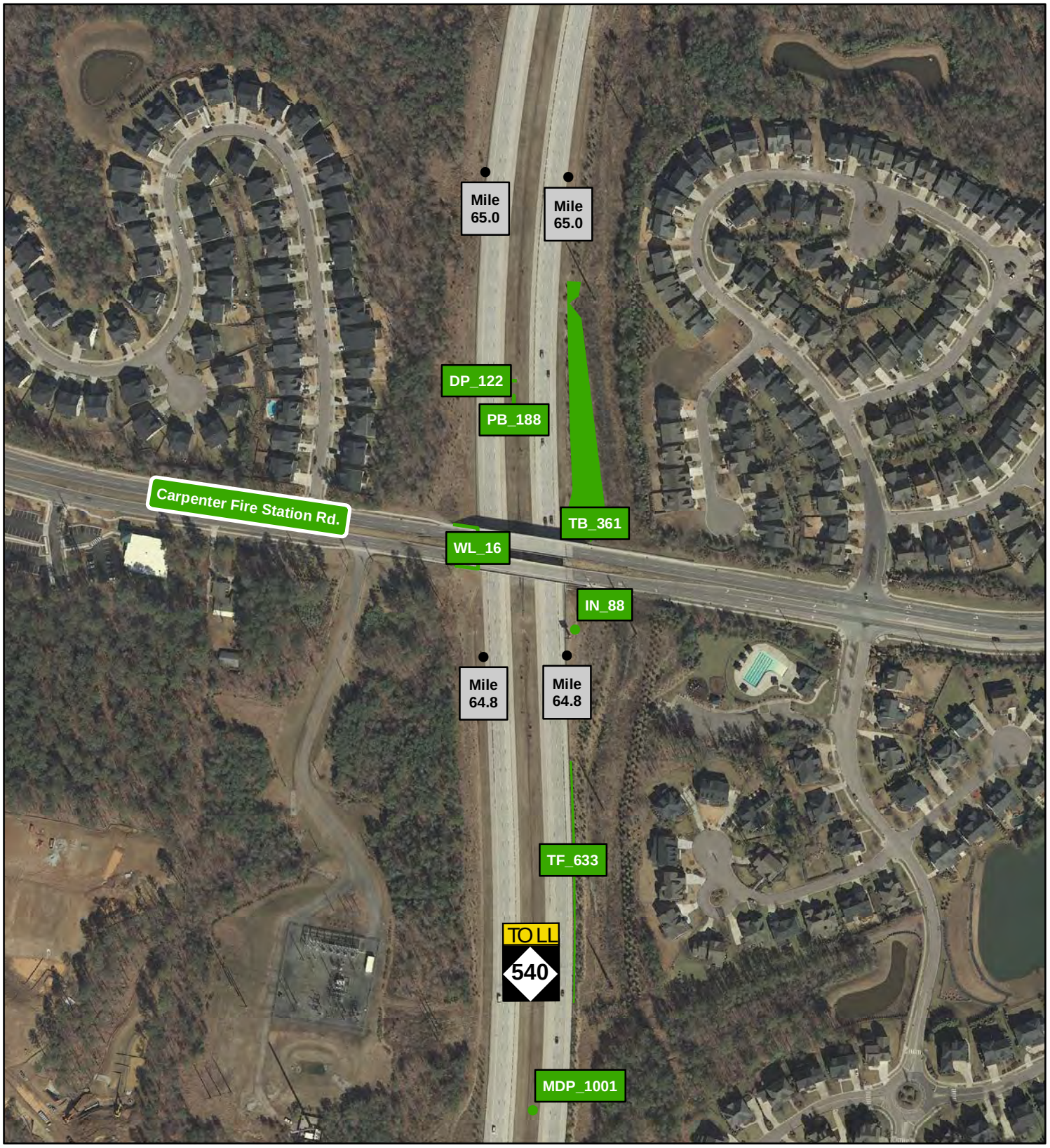

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NORTH CAROLINA Turnpike Authority

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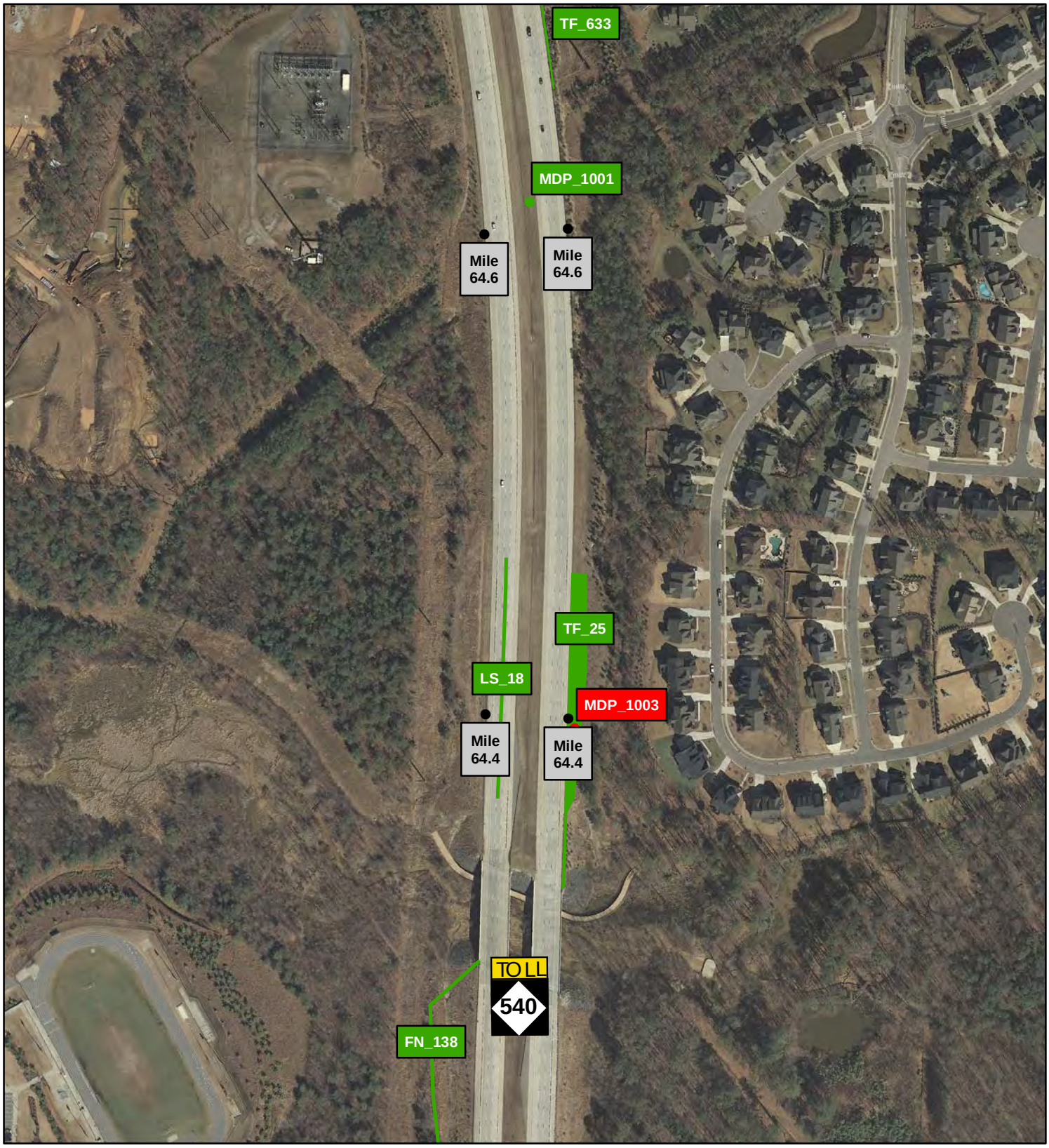

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NORTH CAROLINA Turnpike Authority

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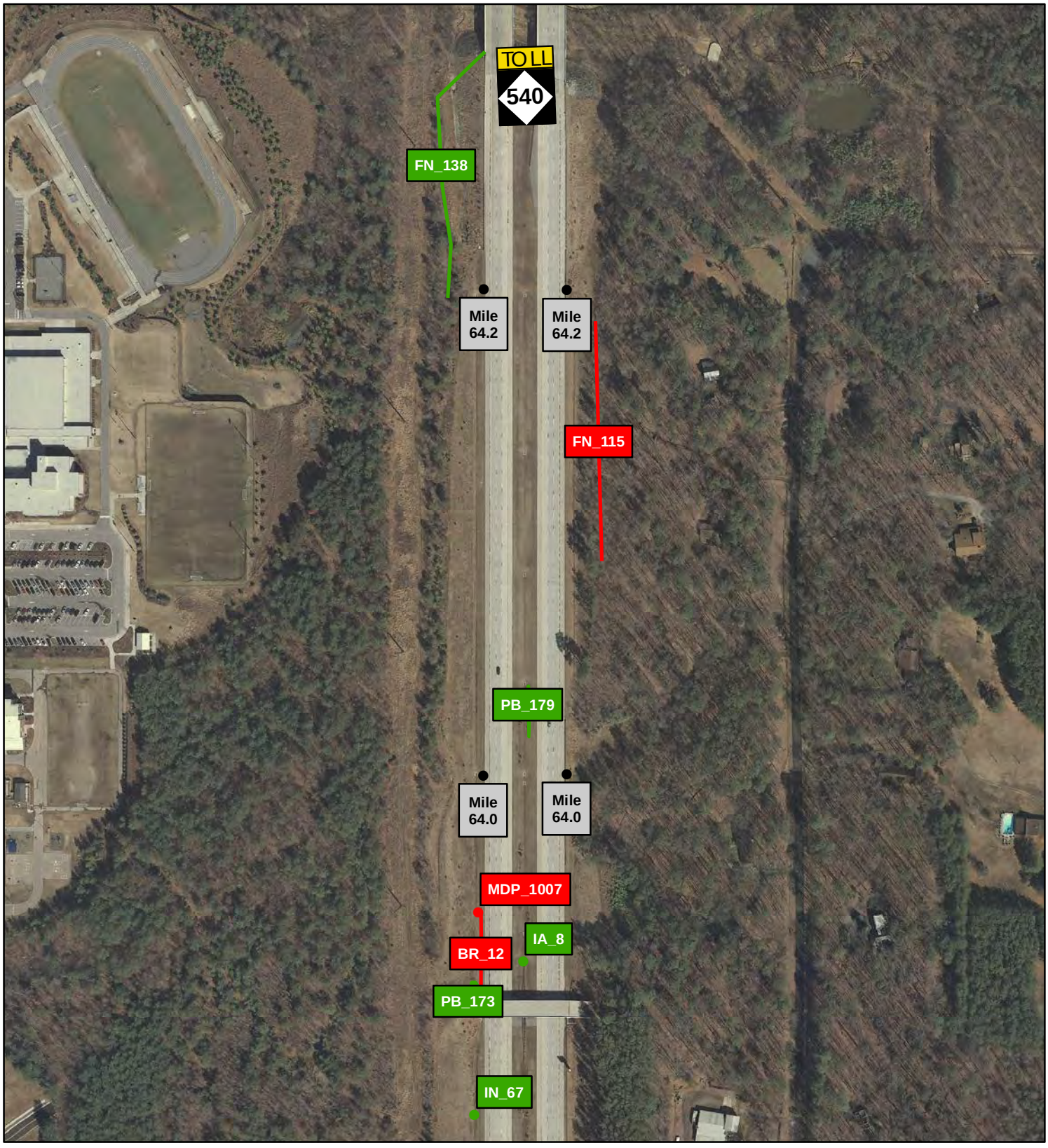

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NORTH CAROLINA Turnpike Authority

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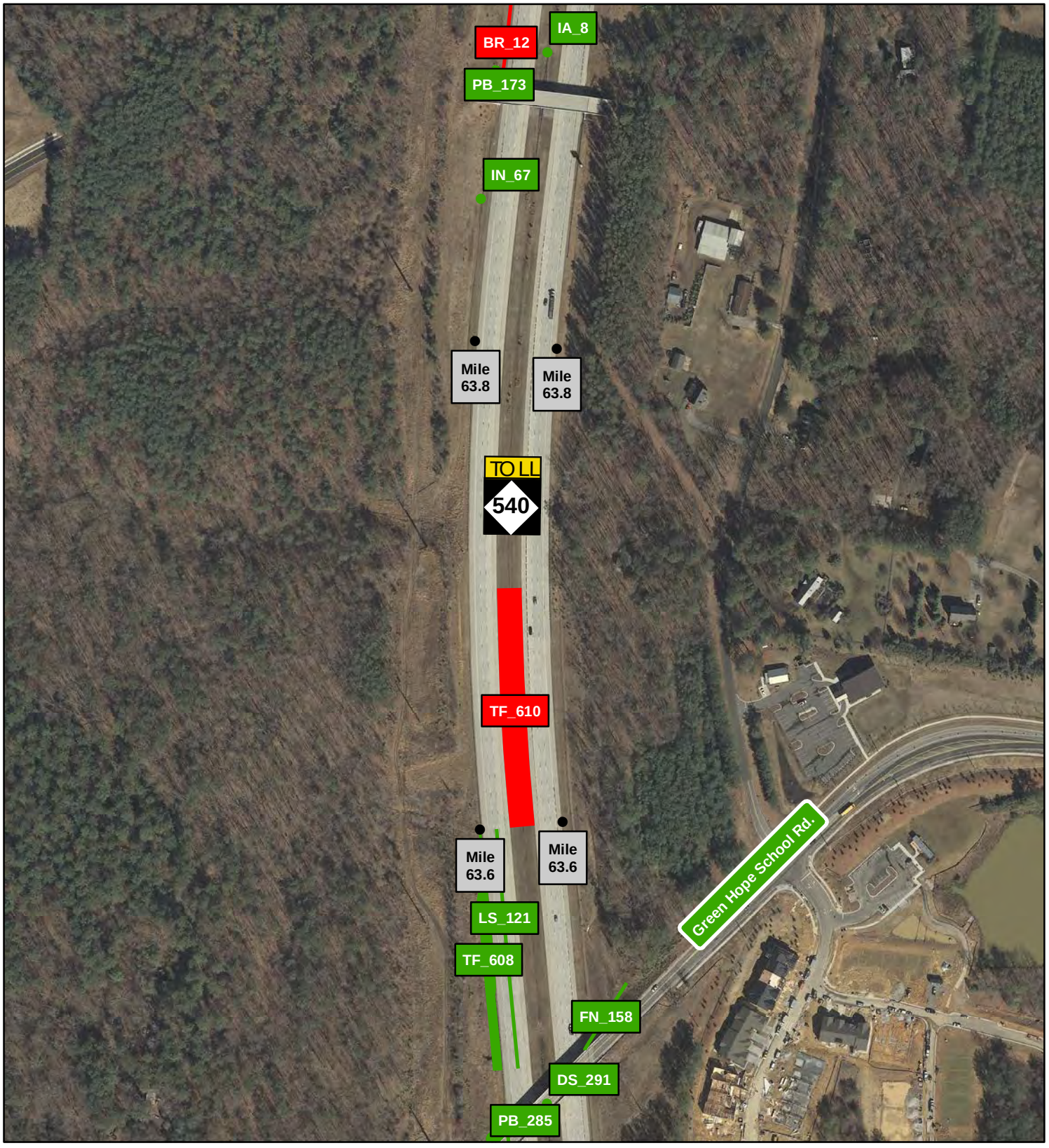

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Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations

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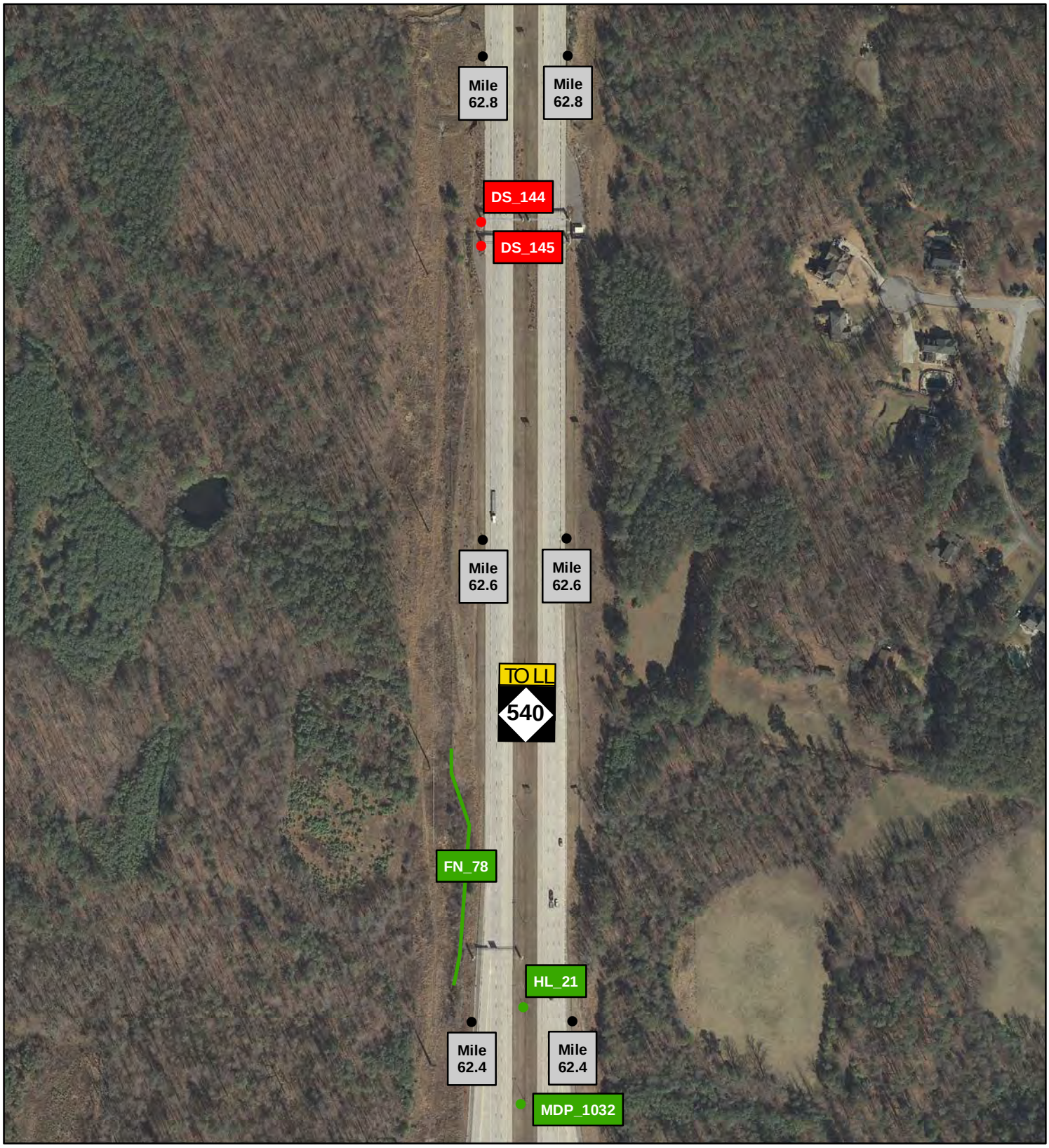

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NORTH CAROLINA Turnpike Authority

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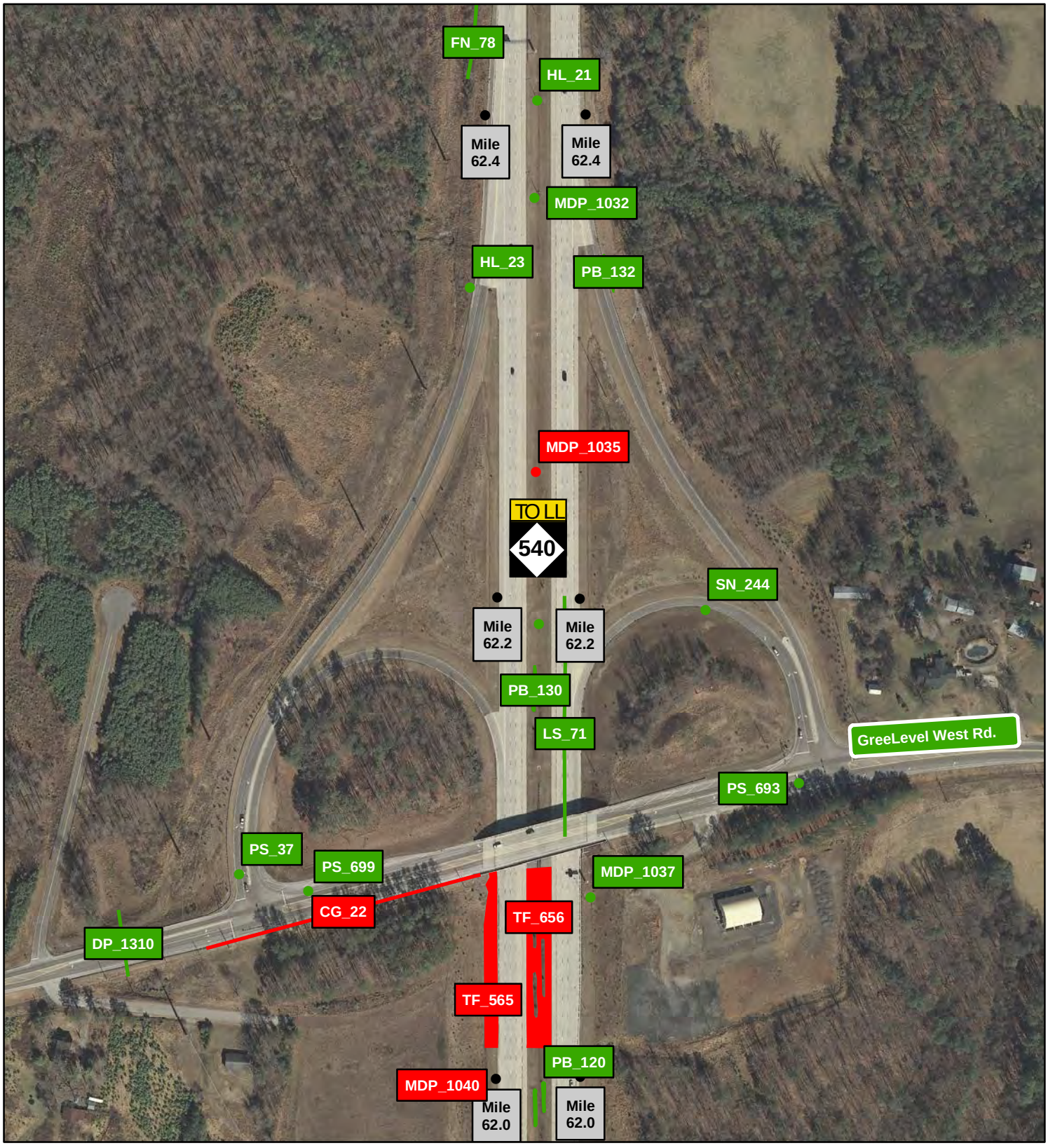

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NORTH CAROLINA Turnpike Authority

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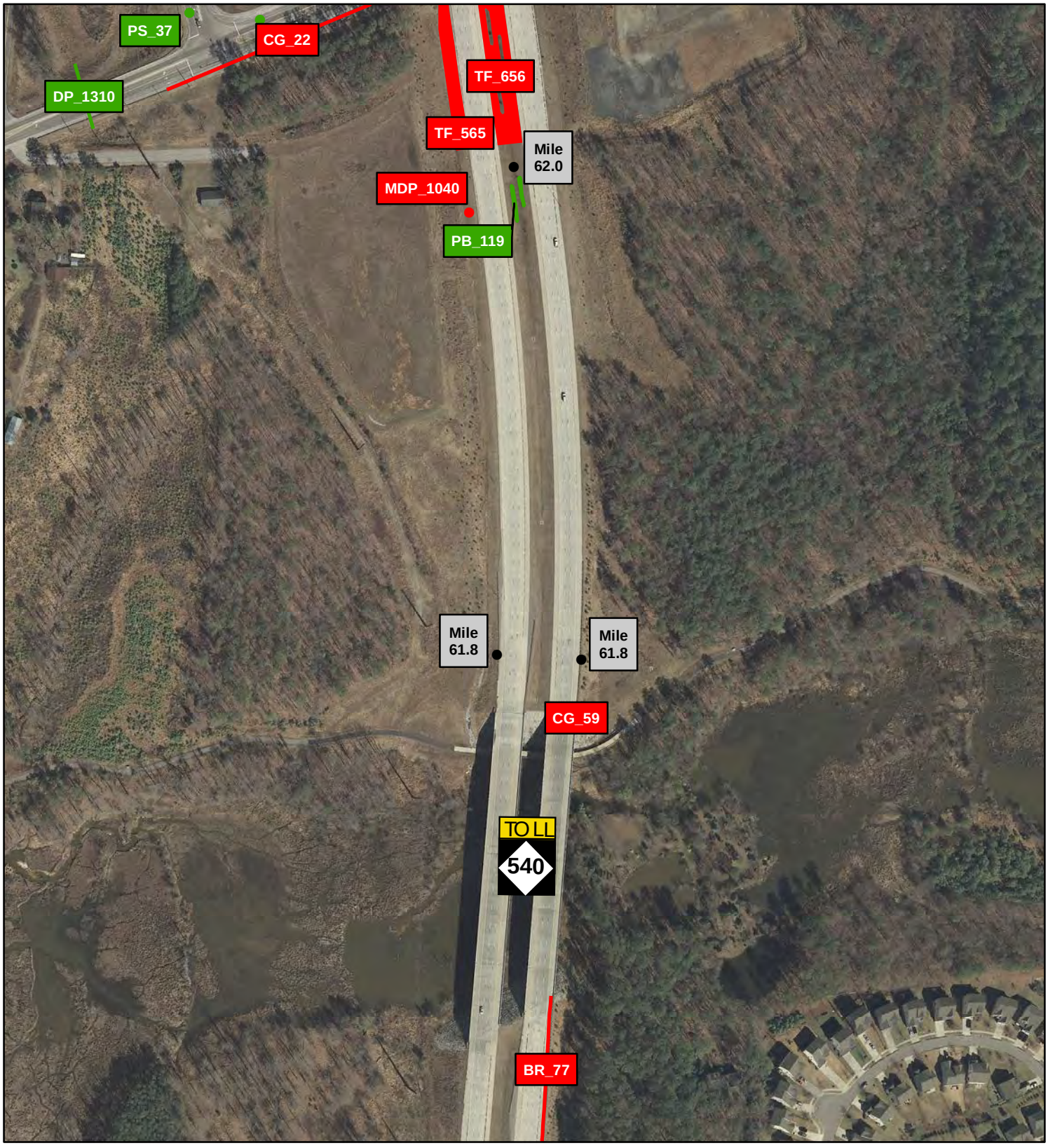

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Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

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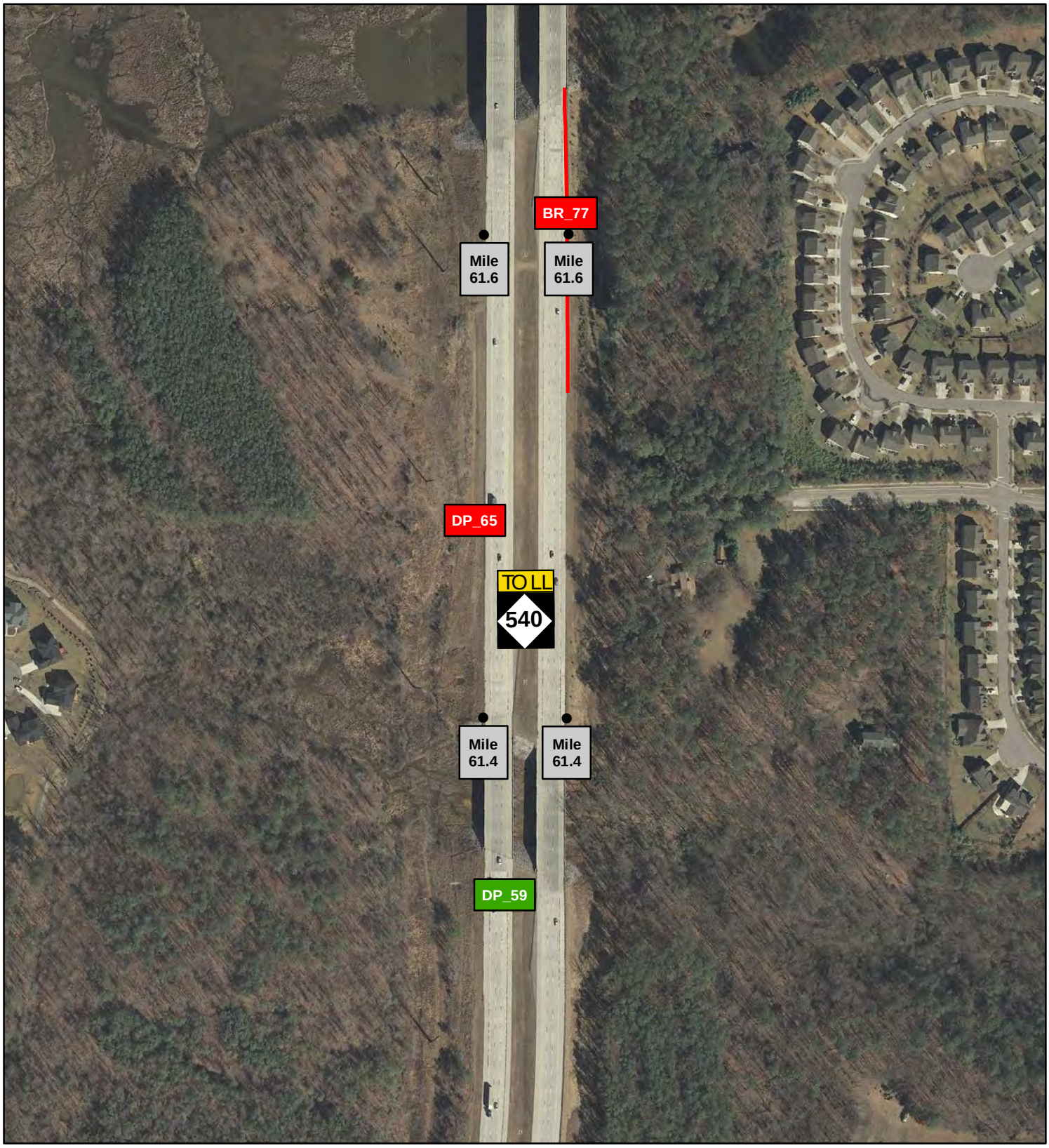
Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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Passing Asset

NORTH CAROLINA Turnpike Authority

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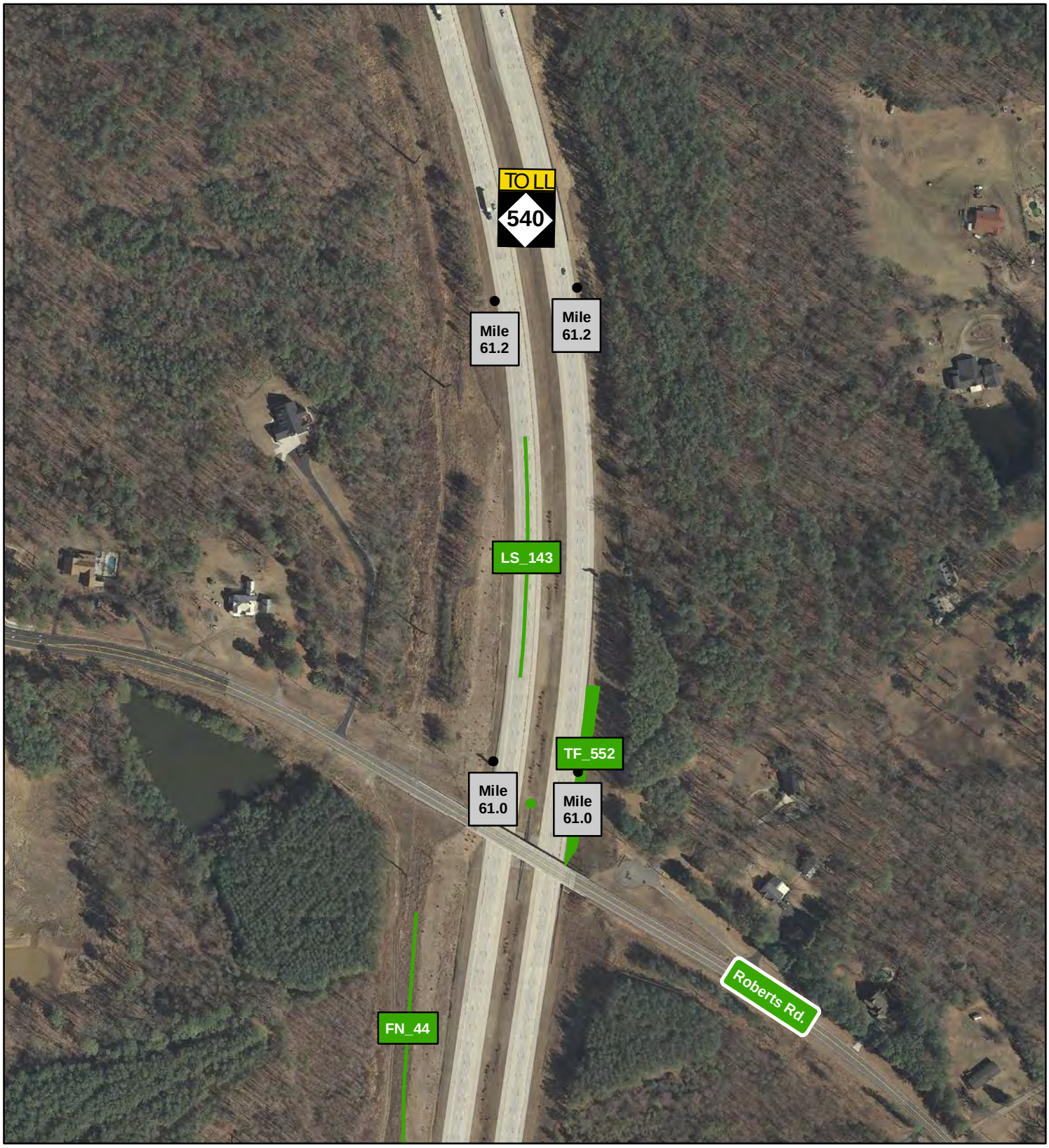

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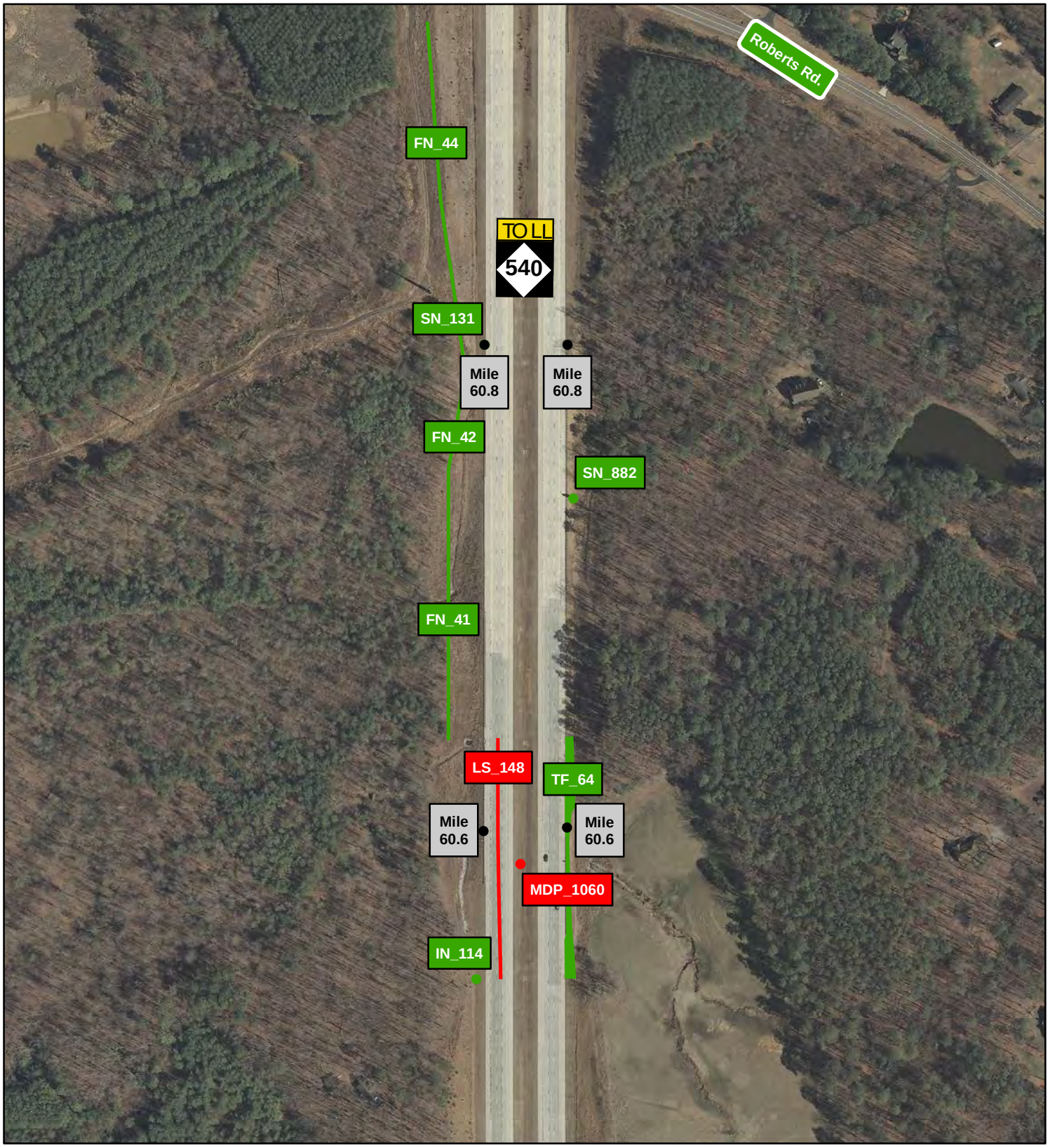
Passing Asset

NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations

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Passing Asset

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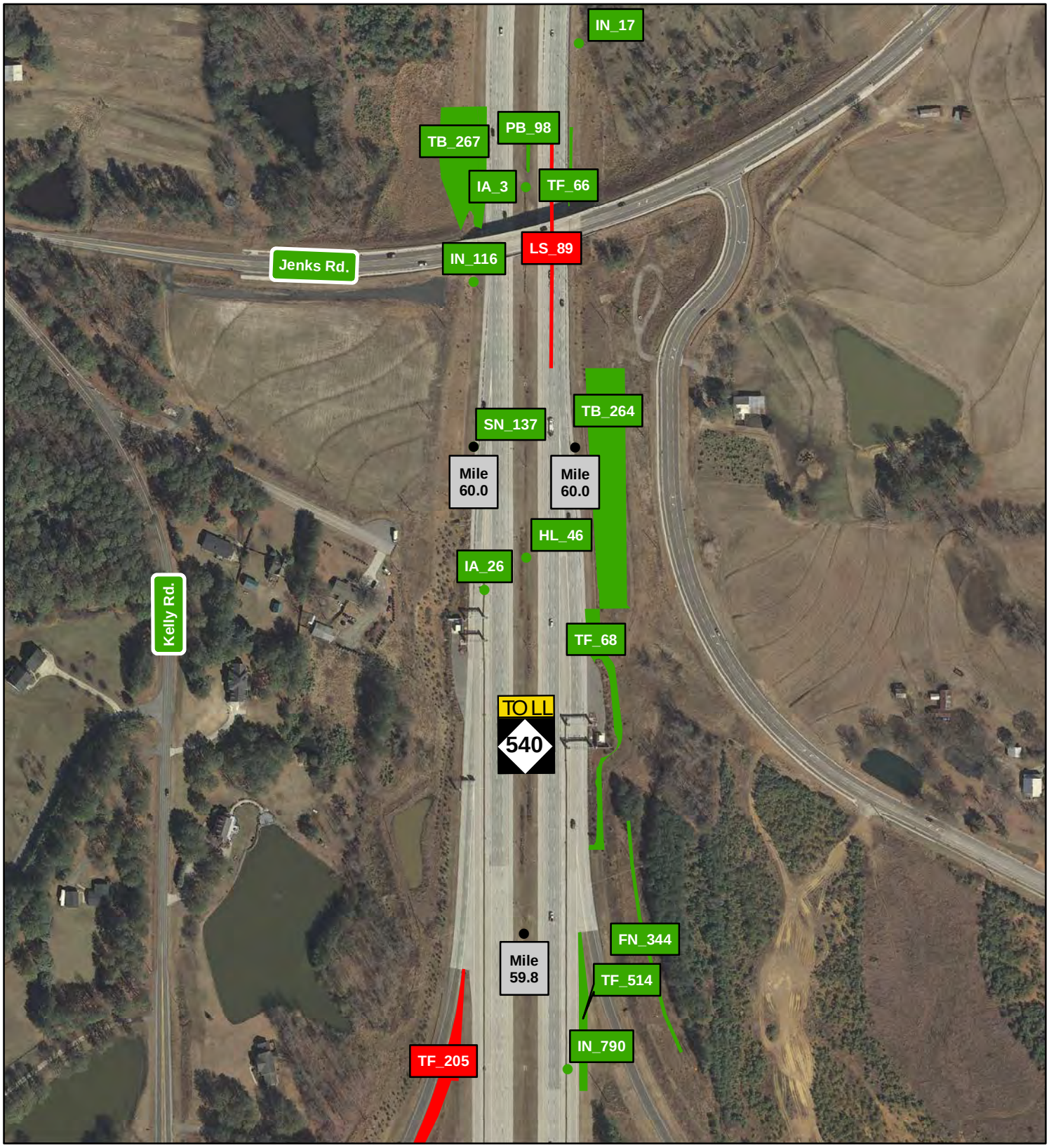

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NORTH CAROLINA Turnpike Authority

Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations

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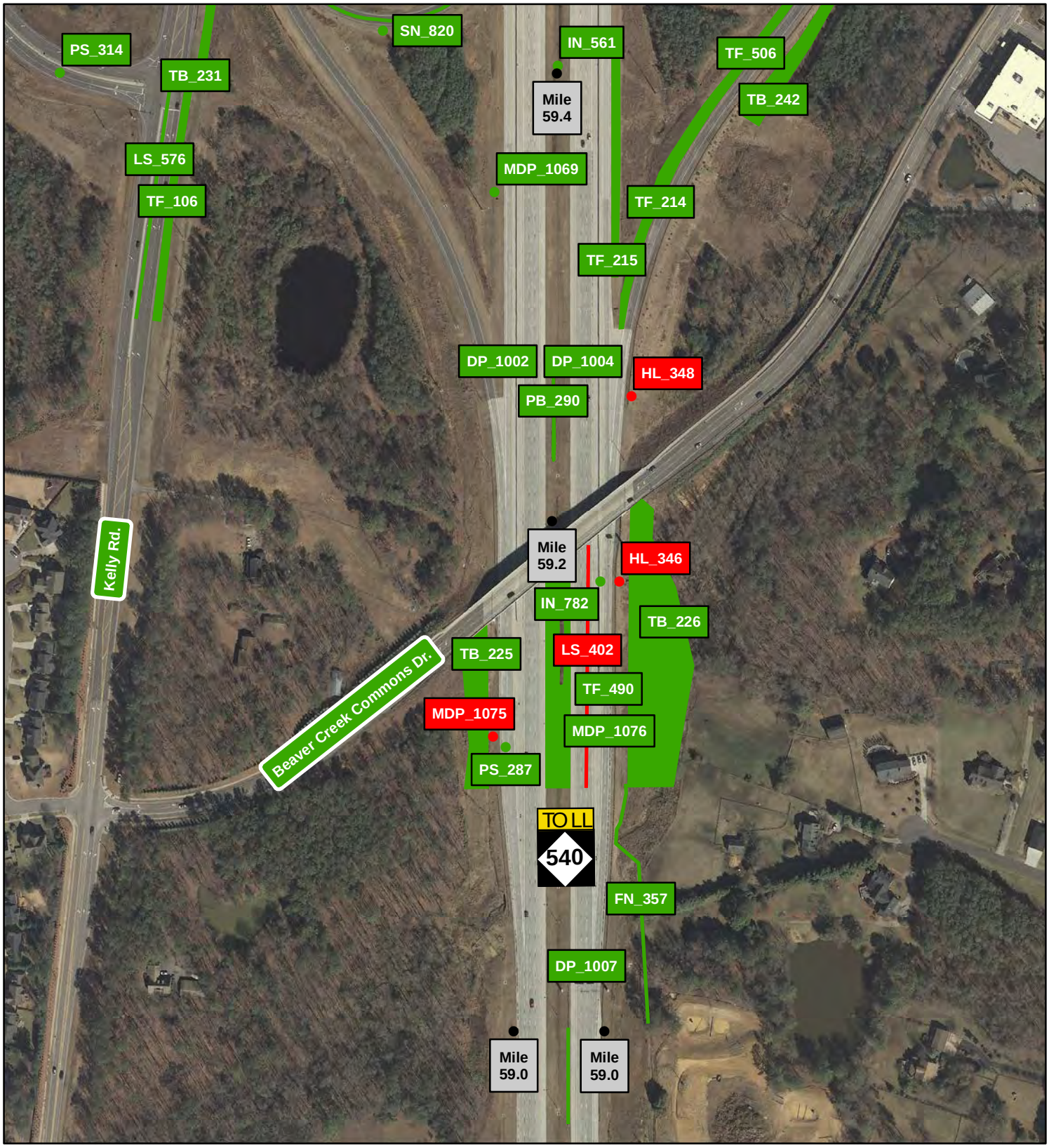

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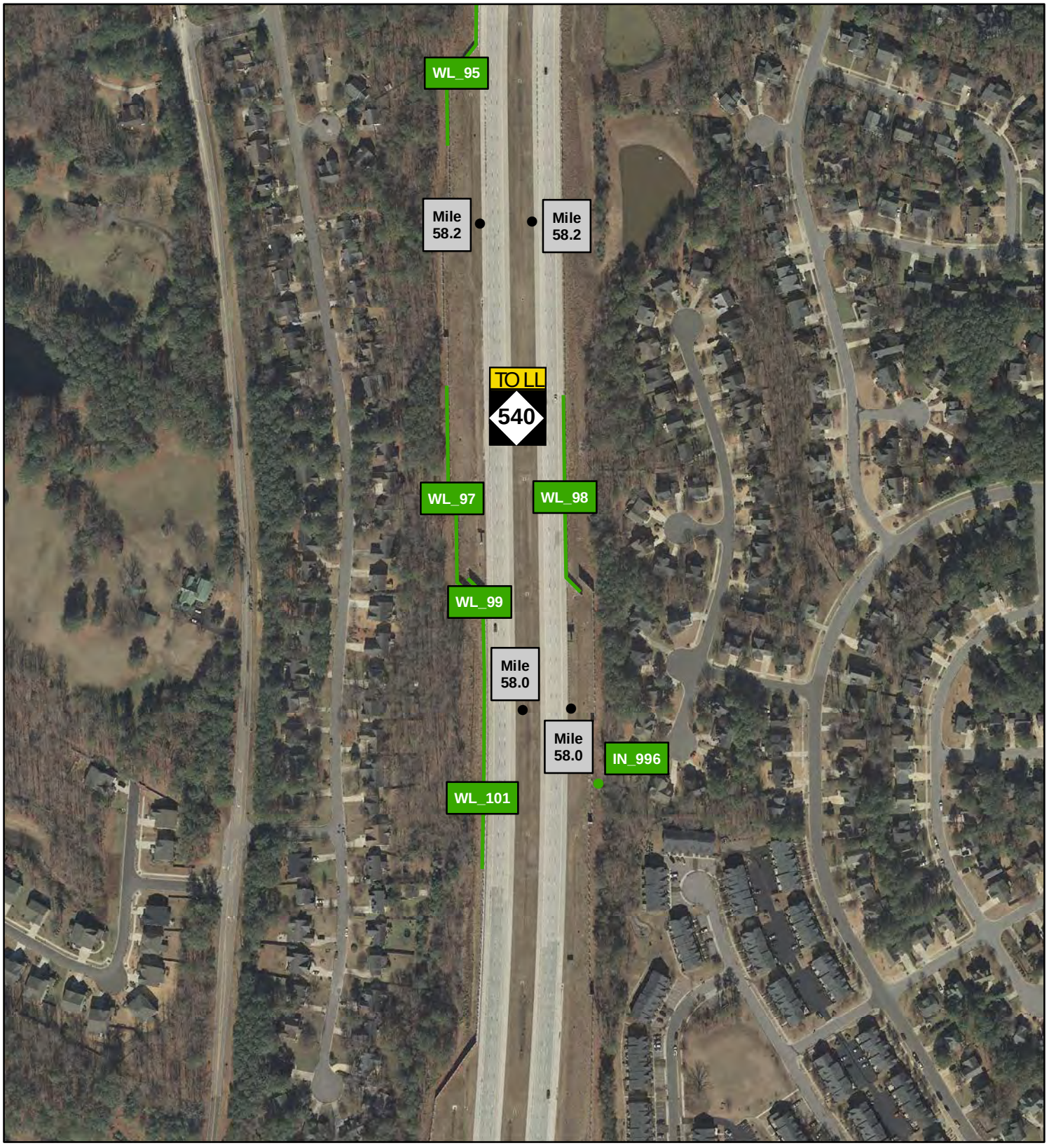

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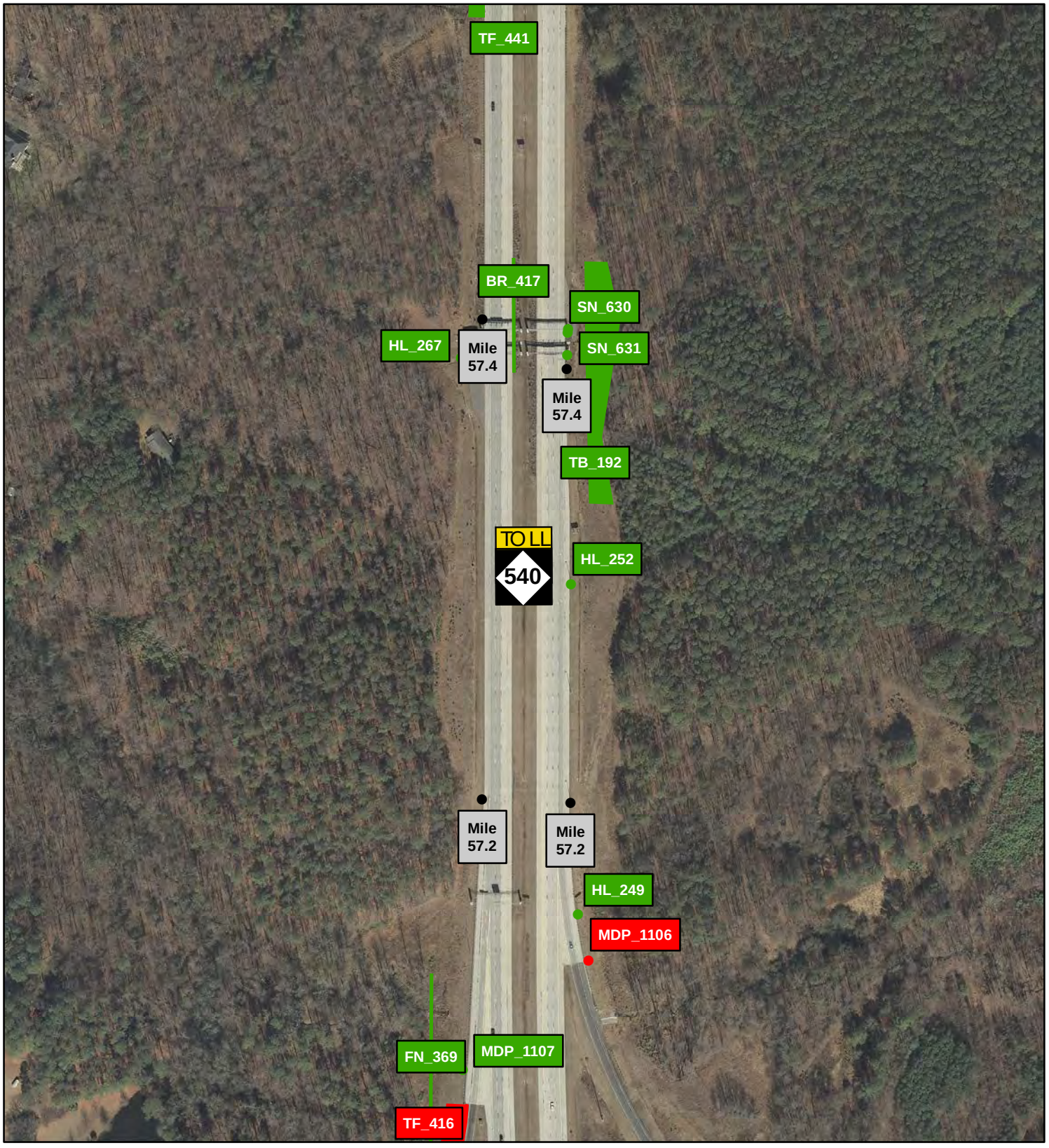

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NORTH CAROLINA Turnpike Authority

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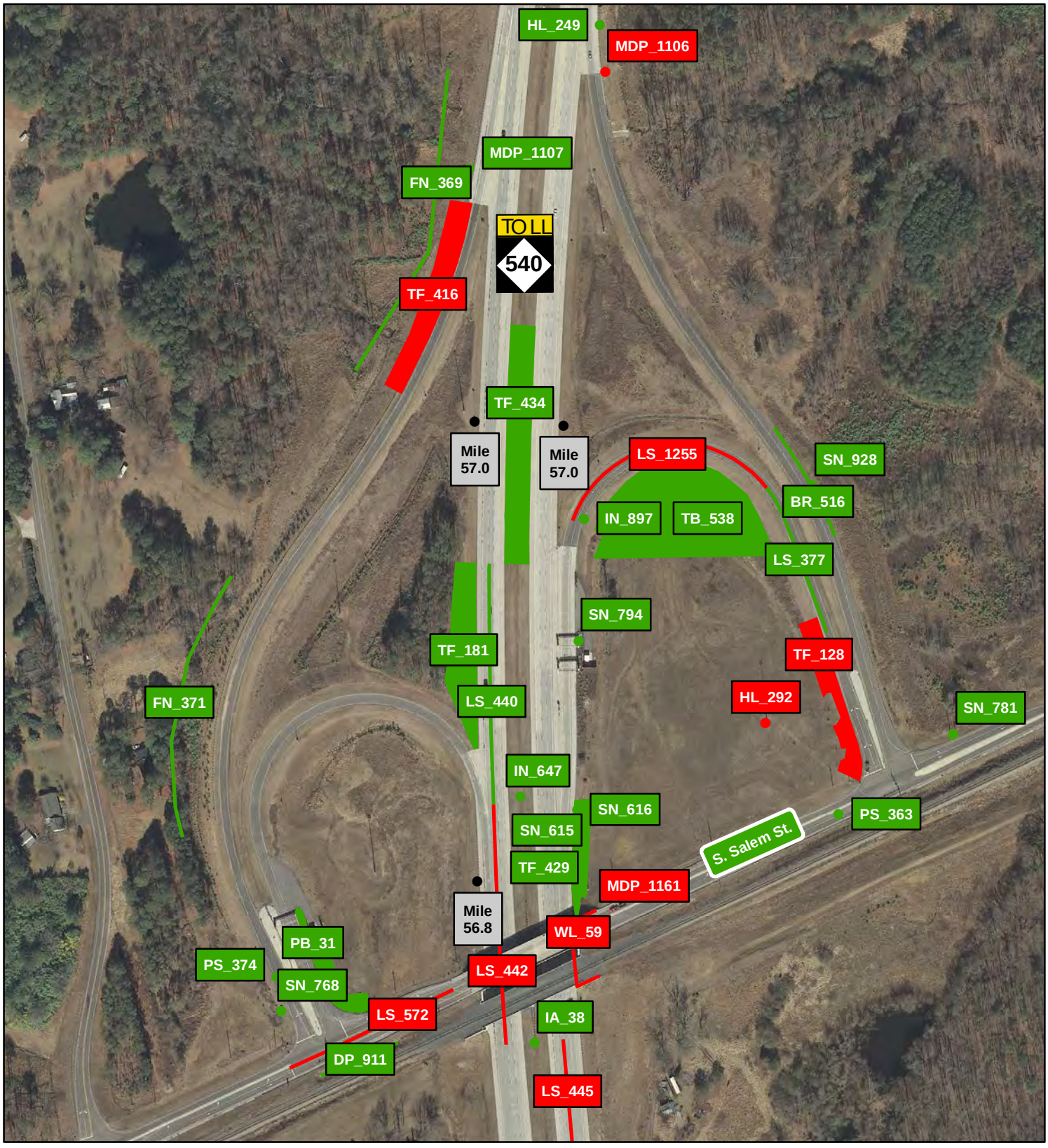

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NORTH CAROLINA Turnpike Authority

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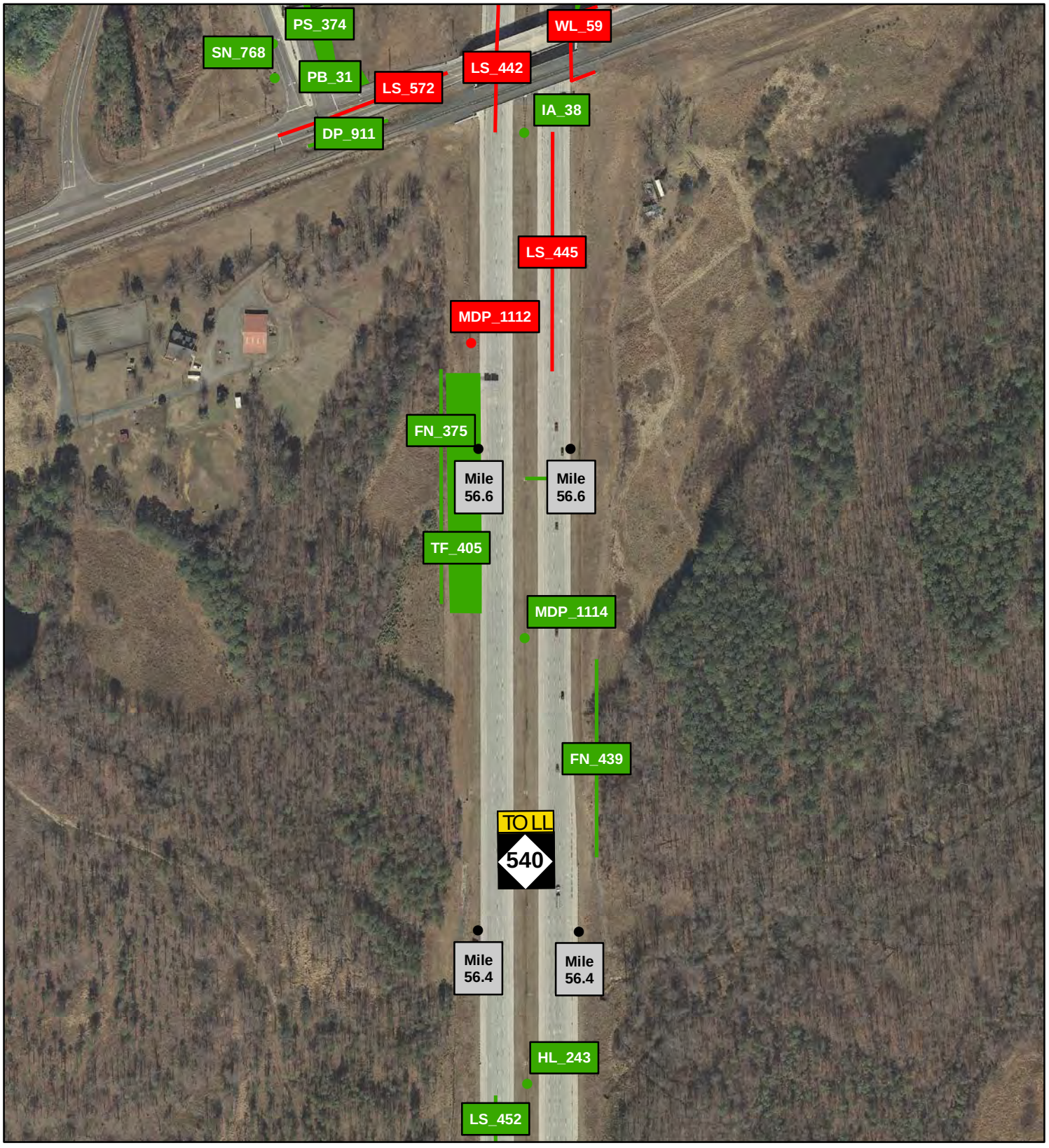

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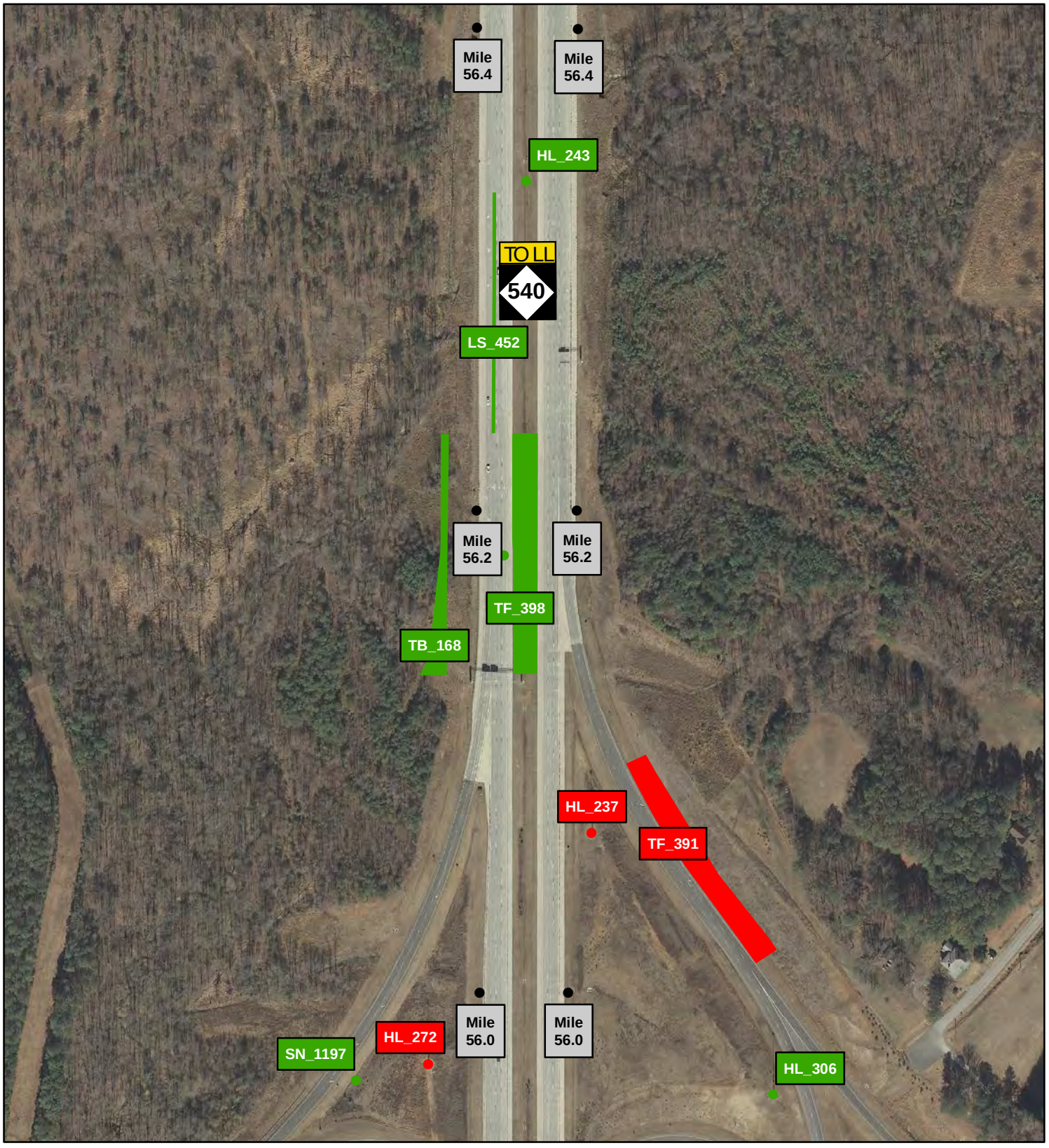

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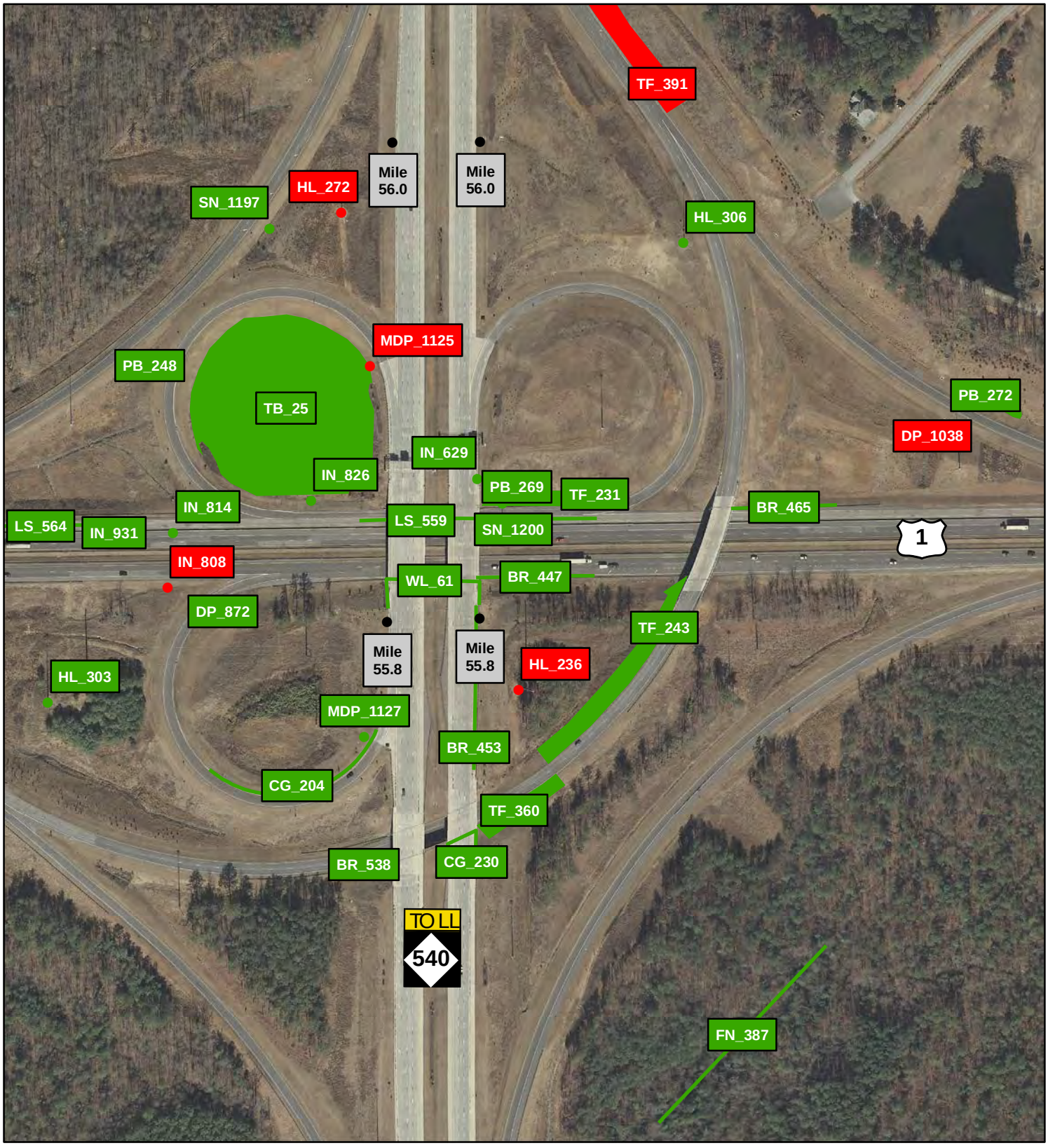

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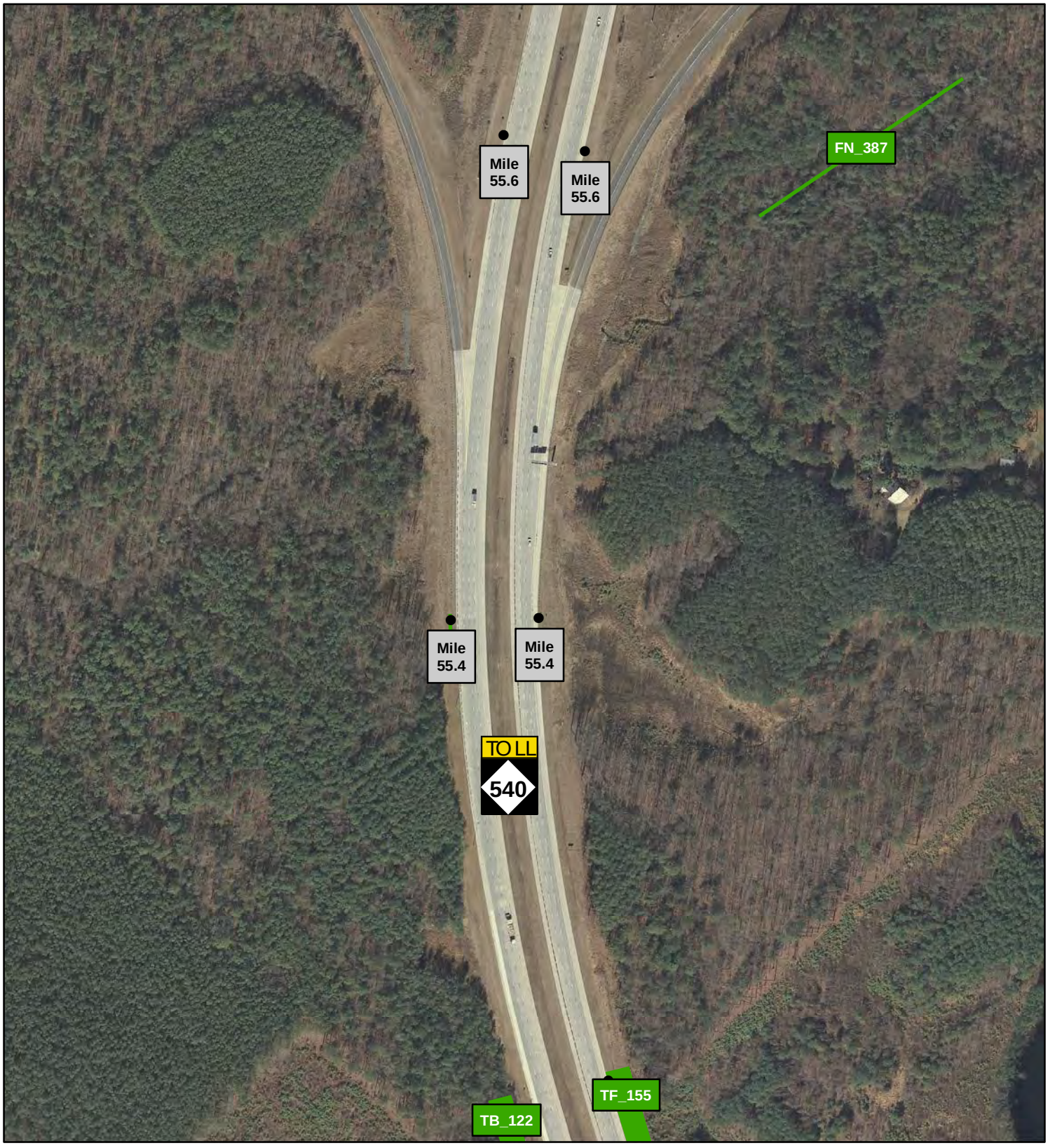

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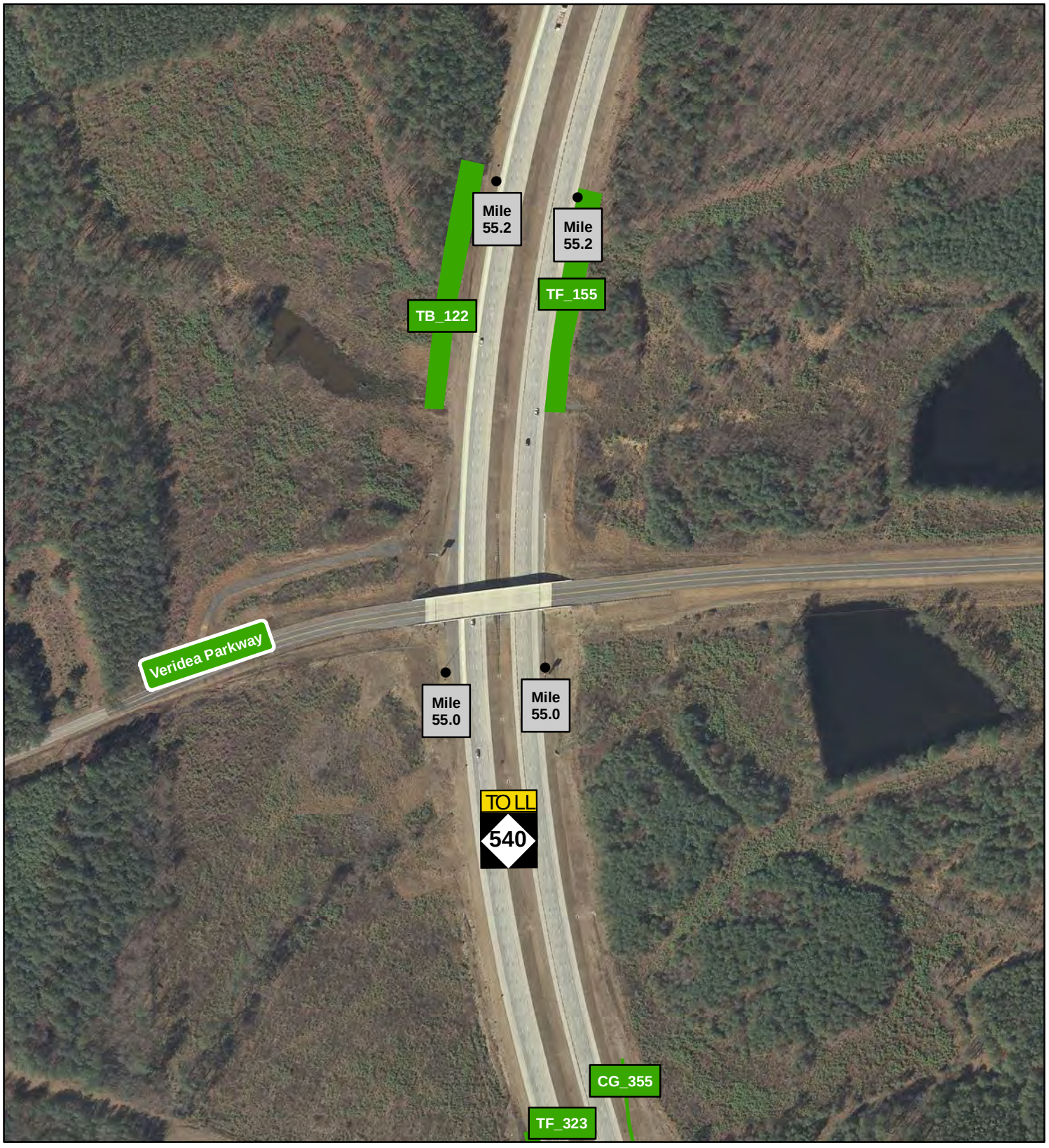

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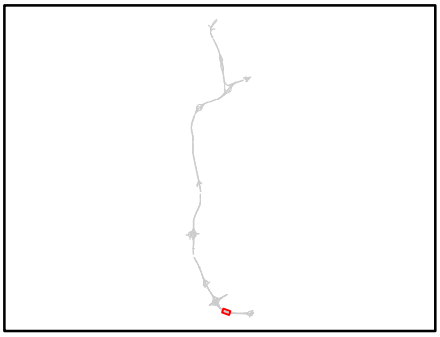

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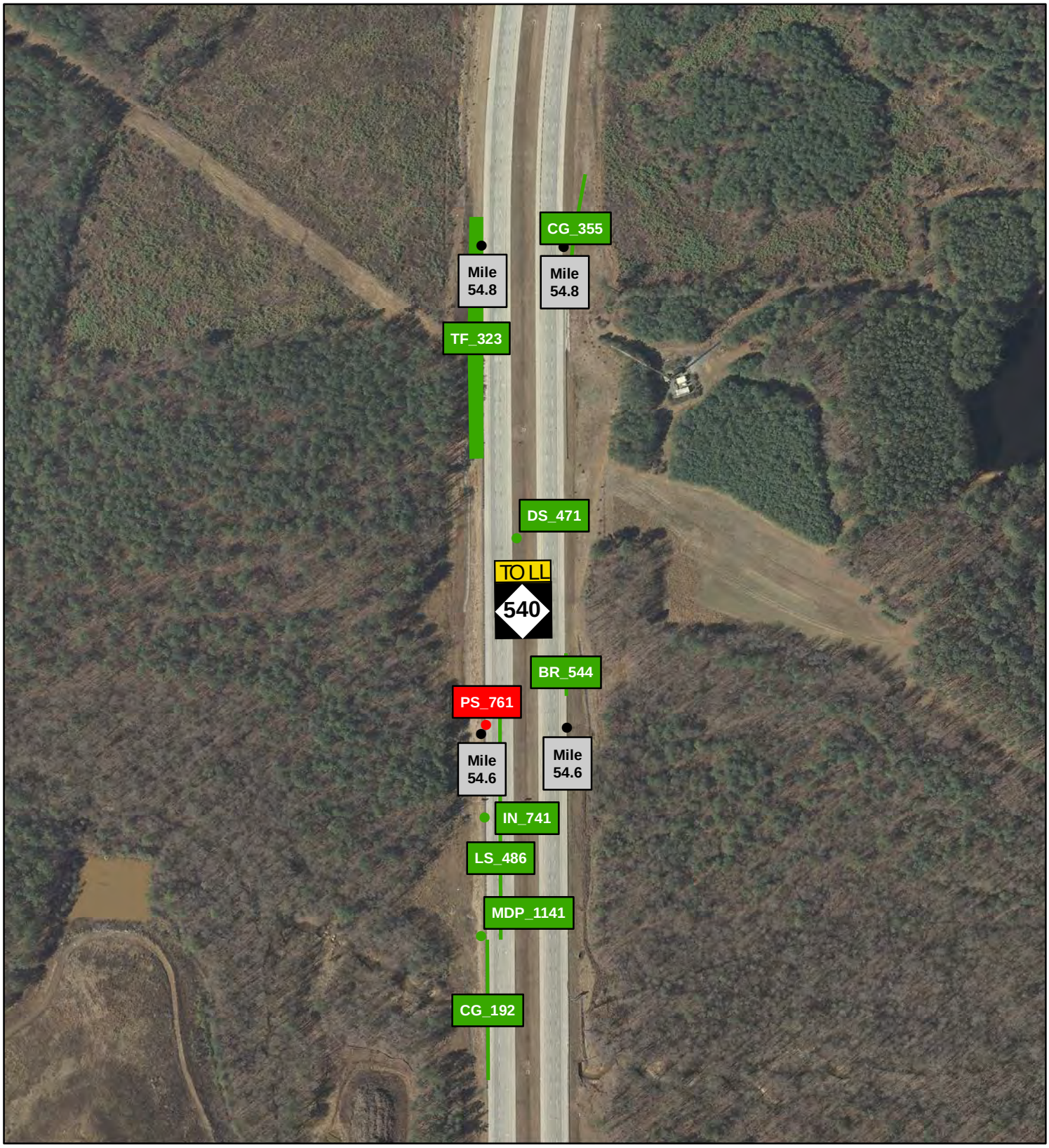

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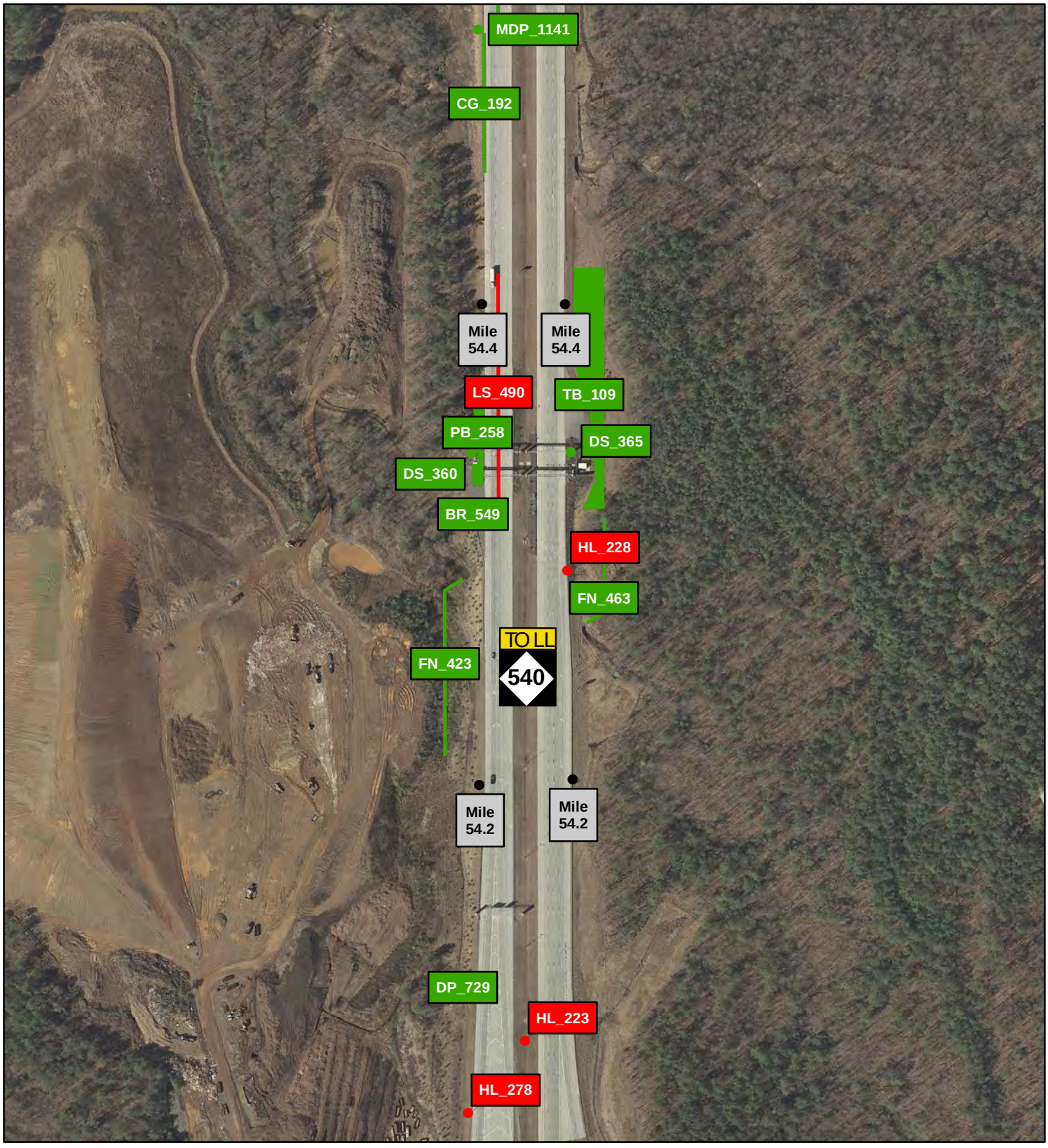

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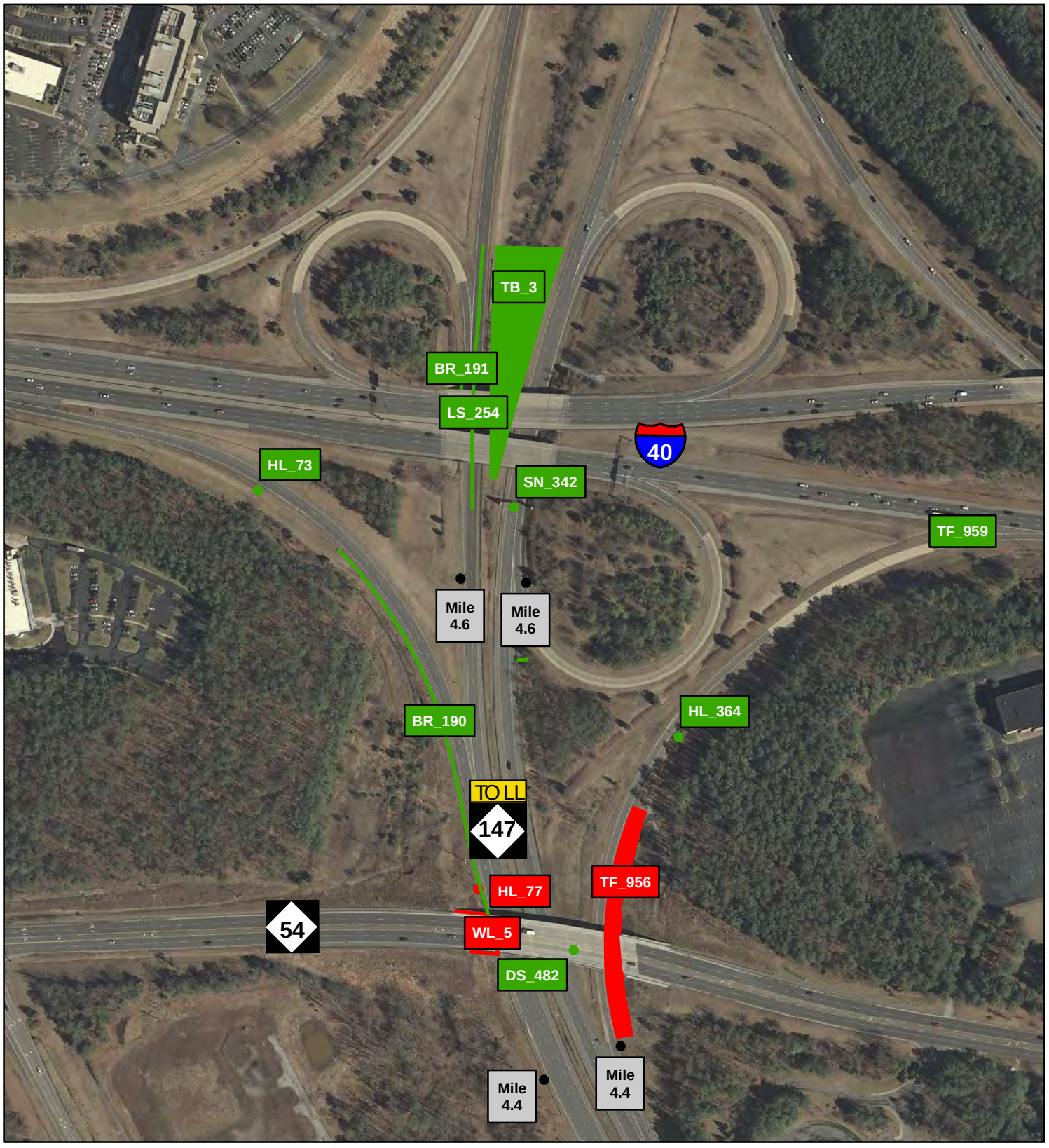

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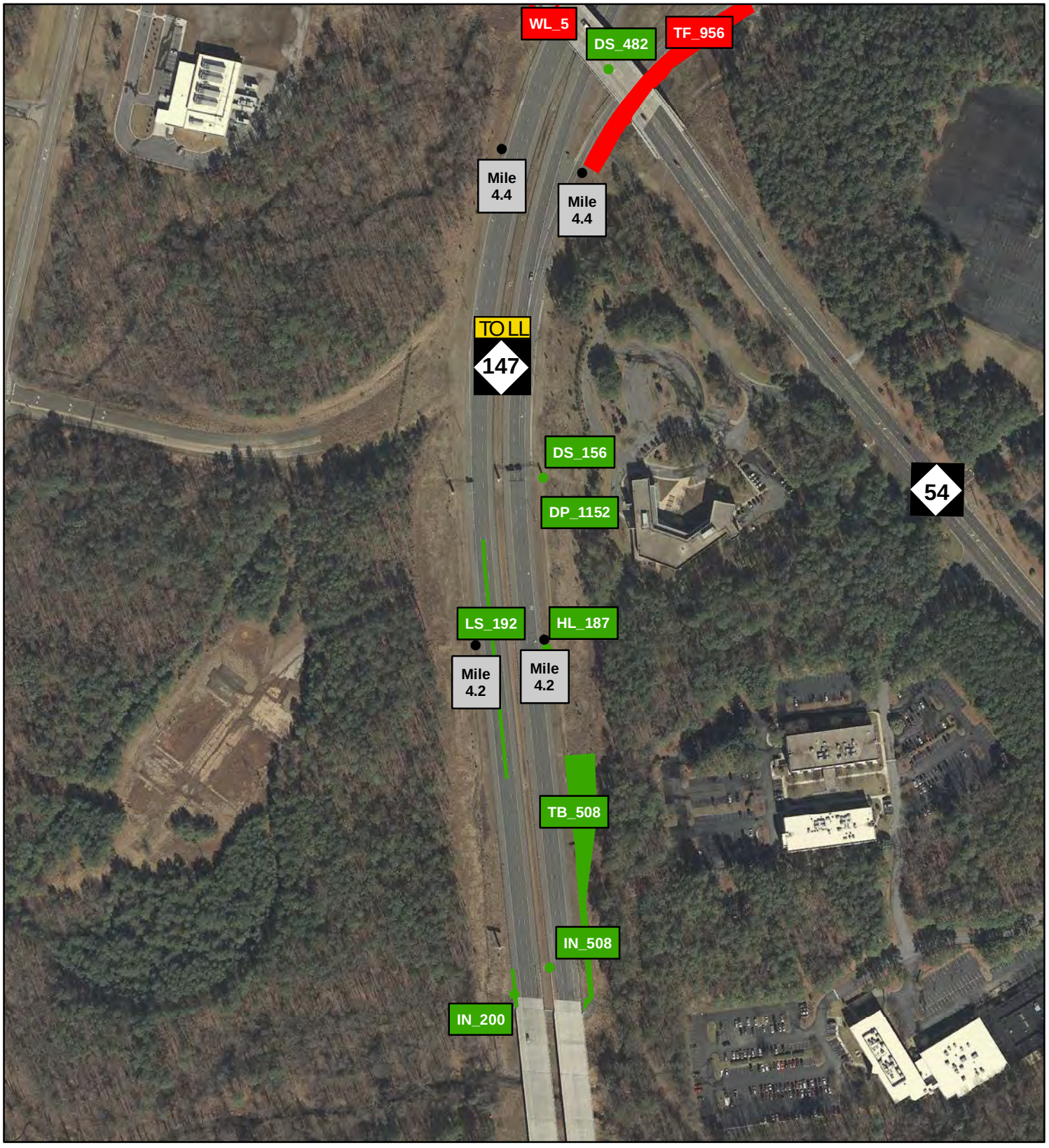

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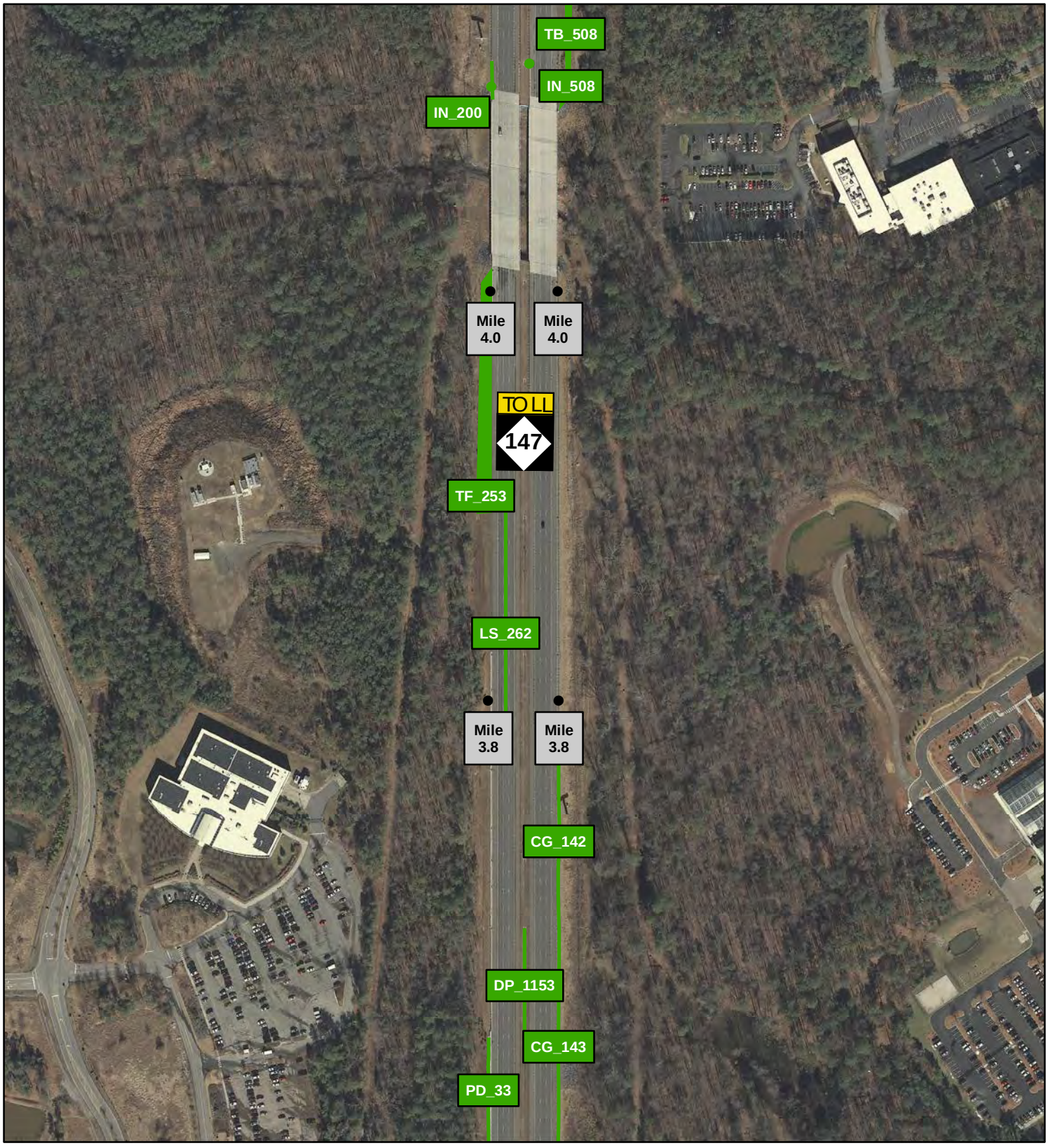

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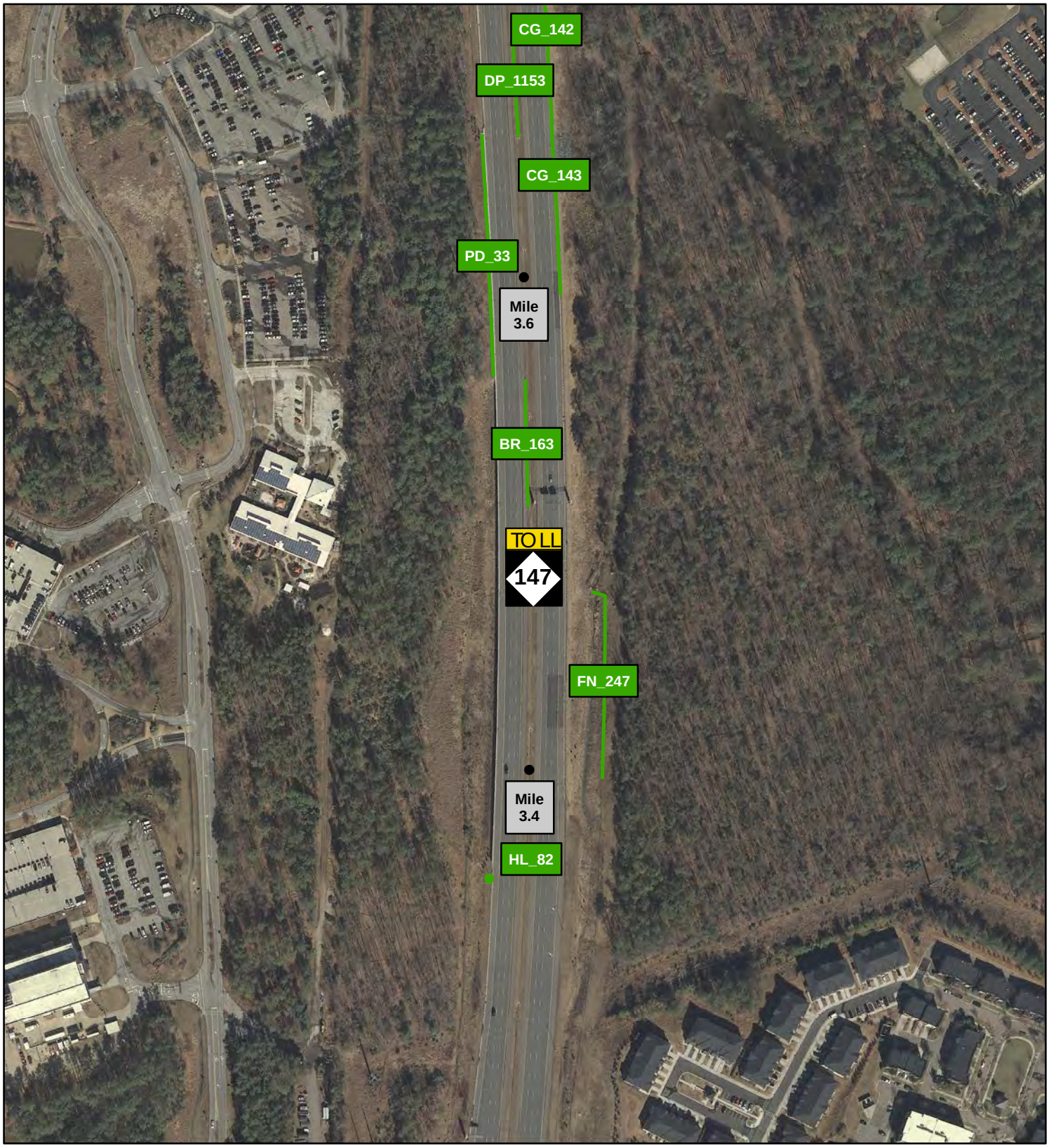

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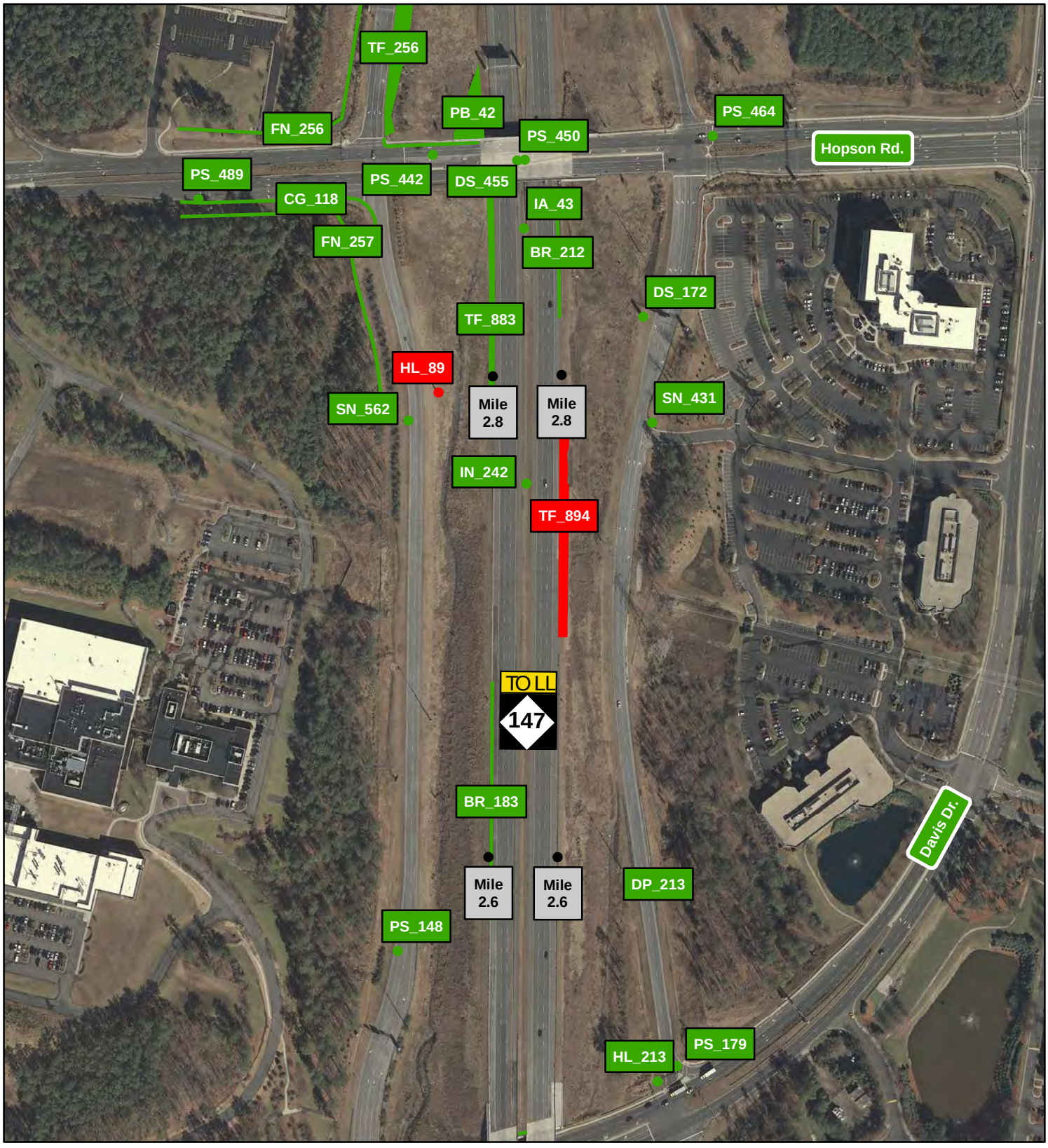

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Failing Asset

Passing Asset

NORTH CAROLINA Turnpike Authority

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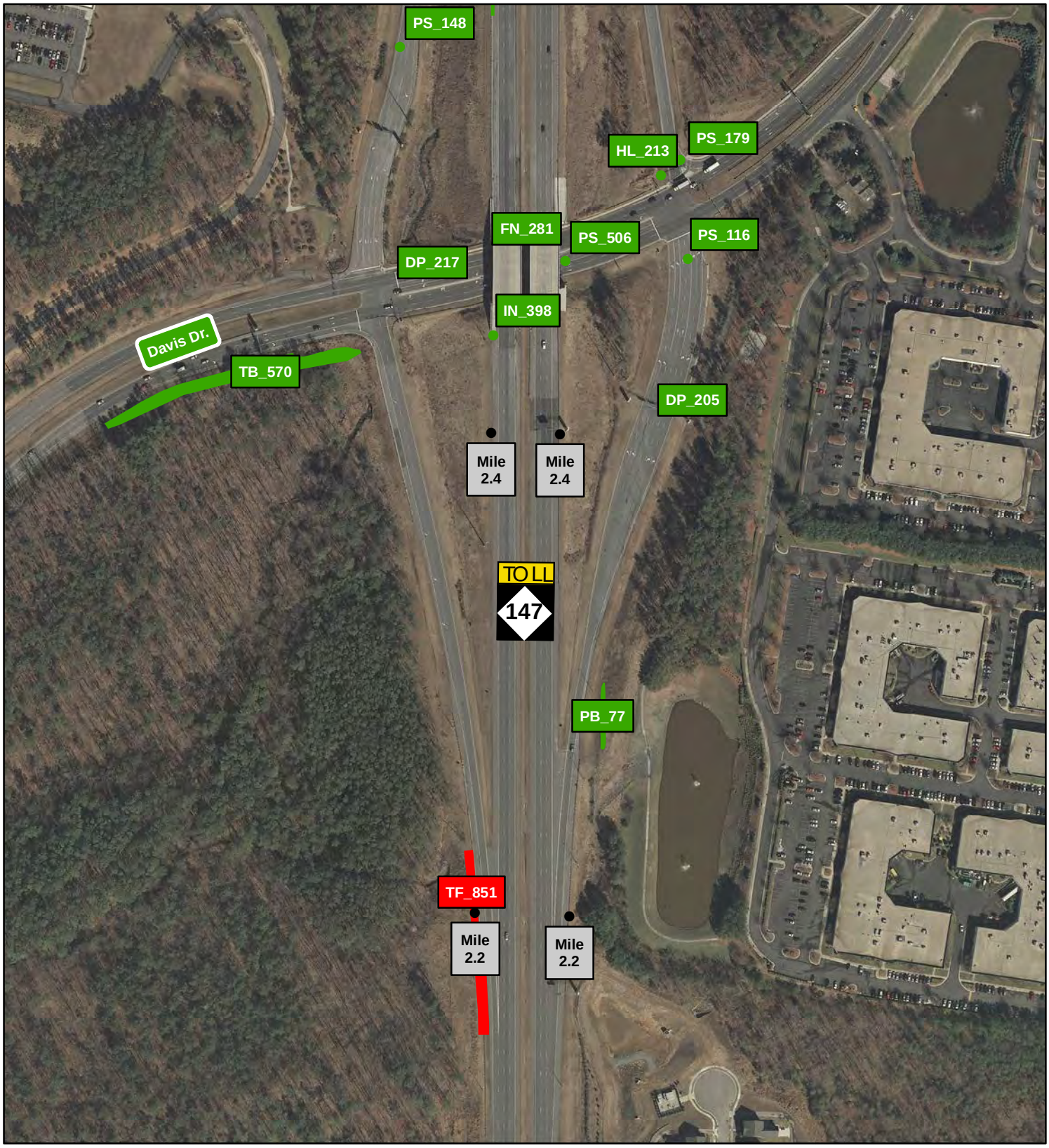
Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations



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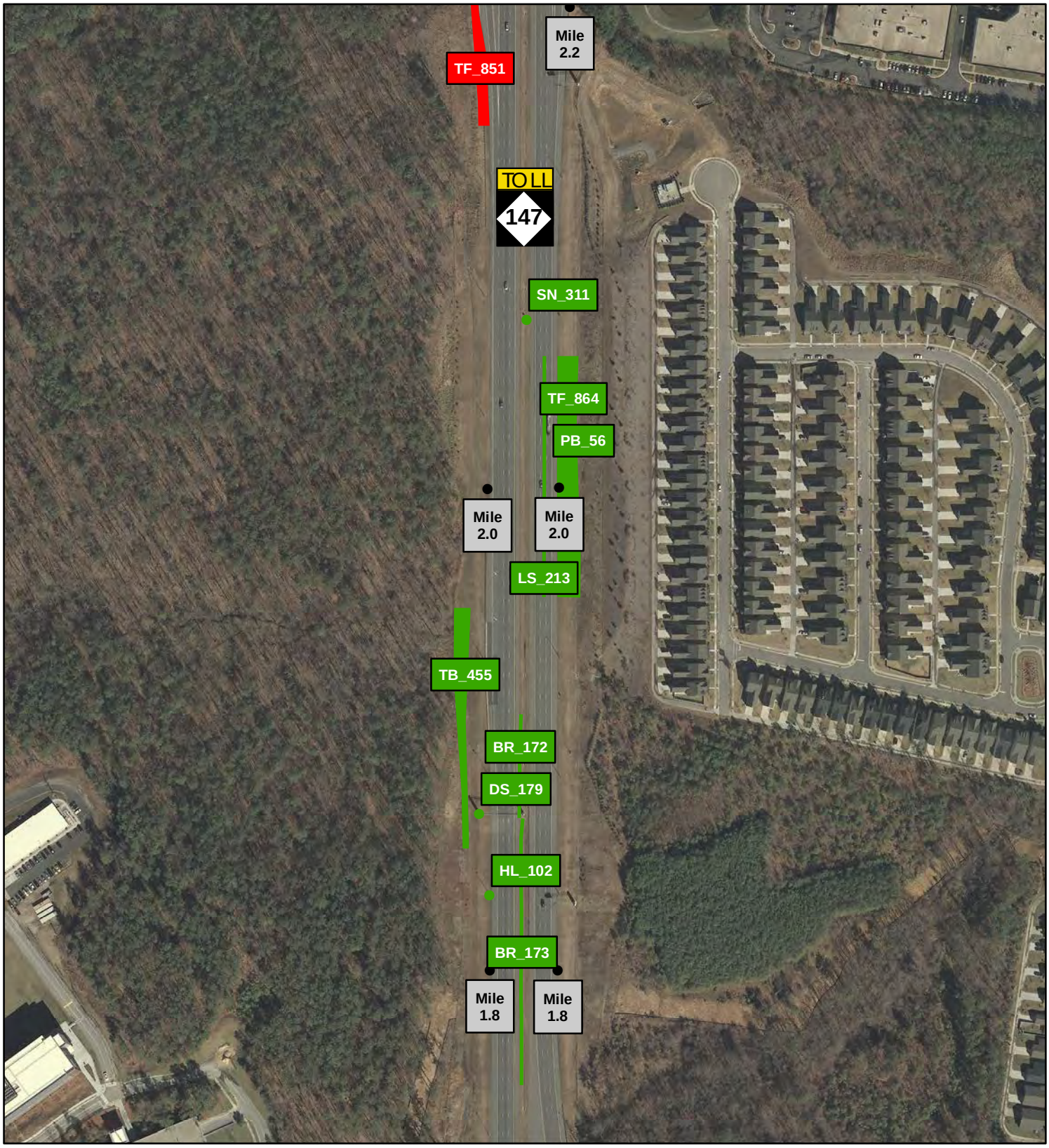

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Appendix A: Triangle Expressway 2018 First Quarter Asset Assessment Locations

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Passing Asset

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Appendix B

Triangle Expressway 2018 First Quarter Table Results of Assets Failing MRP

Appendix B: Triangle Expressway 2018 First 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. All assets and their respective prefixes are listed below:

The Inventory ID and GIS Reference Page number correspond to the maps provided in Appendix A, to allow for the quick location of particular asset failures. Photos of failures are provided when applicable.

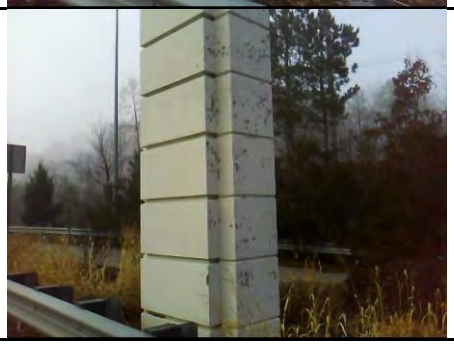
Guardrail, Concrete Barrier and End Anchors (BR)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Guardrail	BR_12	Functional Damage		A16, A17
2	Guardrail	BR_77	Functional Damage, Missing Parts		A22, A23
3	Guardrail	BR_237	Functional Damage, Missing Parts		A10

Curb and Gutter (CG)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Valley	CG_22	Material Accumulation		A21, A22
2	Valley	CG_59	Material Accumulation		A22
3	Valley	CG_283	Material Accumulation		A29

Decorative Supports (DS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Gantry Support	DS_144	Paint Scaling		A20
2	Gantry Support	DS_145	Paint Scaling		A20

Drainage Pipes (DP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Lateral Pipe	DP_65	Obstruction		A23
2	Cross Pipe	DP_989	Obstruction		A29
3	Cross Pipe	DP_1038	Obstruction		A40, A41

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Shoulder Drain	MDP_986	Missing Rodent Screen		A12
2	Shoulder Drain	MDP_1003	Obstruction		A15
3	Shoulder Drain	MDP_1007	Obstruction		A16
4	Shoulder Drain	MDP_1015	Missing Rodent Screen		A18

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Shoulder Drain	MDP_1035	Obstruction		A21
6	Shoulder Drain	MDP_1040	Obstruction		A21, A22
7	Shoulder Drain	MDP_1060	Obstruction		A25
8	Shoulder Drain	MDP_1075	Obstruction, Erosion		A30

Misc. Drainage Structure (MDP)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Shoulder Drain	MDP_1106	Obstruction		A35, A36
10	Shoulder Drain	MDP_1112	Obstruction		A37
11	Shoulder Drain	MDP_1125	Obstruction		A40
12	Shoulder Drain	MDP_1161	Missing Rodent Screen		A36

Fence and Control of Access (FN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Woven	FN_115	Fence Hole		A16
2	Woven	FN_326	Open Gate		A39
3	Woven	FN_409	Fence Hole		A47

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_3	Part Damage		A10, A11
2	Single Roadway	HL_77	Part Damage		A48
3	Single Roadway	HL_89	Functional Damage	Not Available for Nighttime Failure.	A53
4	Single Roadway	HL_136	Part Damage		A5
5	High Mast	HL_178	Functional Damage	Not Available for Nighttime Failure.	A52
6	Single Roadway	HL_179	Functional Damage	Not Available for Nighttime Failure.	A52
7	High Mast	HL_223	Functional Damage	Not Available for Nighttime Failure	A45, A46
8	High Mast	HL_228	Functional Damage	Not Available for Nighttime Failure	A45

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Single Roadway	HL_236	Part Damage		A40
10	High Mast	HL_237	Part Damage		A38
11	High Mast	HL_272	Part Damage		A38, A40
12	High Mast	HL_278	Functional Damage	Not Available for Nighttime Failure.	A45, A46, A47
13	High Mast	HL_292	Functional Damage, Missing Part		A36
14	High Mast	HL_334	Functional Damage	Not Available for Nighttime Failure.	A31
15	Single Roadway	HL_346	Functional Damage	Not Available for Nighttime Failure.	A30

Highway Lighting (HL)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
16	Double Roadway	HL_348	Functional Damage	Not Available for Nighttime Failure.	A30

Impact Attenuators (IA)

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

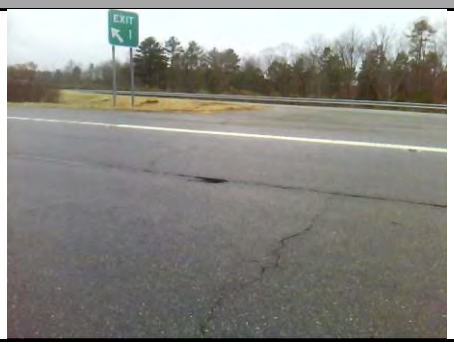
Inlets (IN)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Inlets	IN_808	Surface Damage		A39, A40

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
1	Asphalt	LS_289	Pothole		A6, A56

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
This asset did not produce any failures.					

Unpaved Shoulders (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_1249	Shoulder Drop Off		A46, A47

Front/Back Slopes (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_89	Slope		A26, A27

Unpaved Lateral and Outfall Ditches (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_547	Erosion		A41

Litter (LS)

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

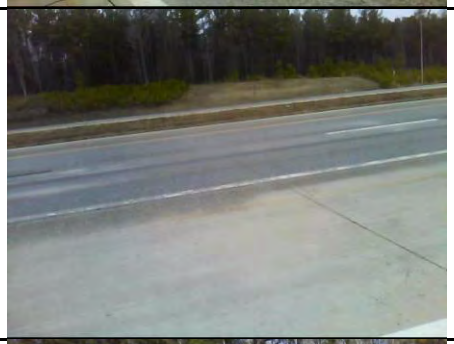
Roadway Sweeping (LS)

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

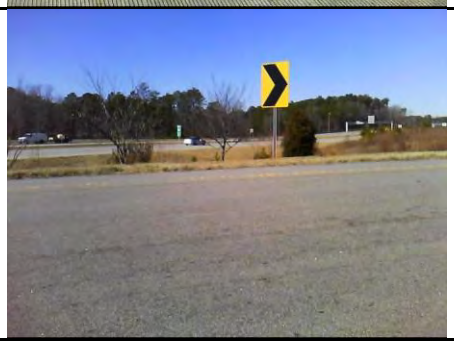
Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Concrete	LS_148	Line Missing		A25, A26
2	Asphalt	LS_289	Line Width		A6, A56
3	Concrete	LS_402	Line Missing		A30
4	Concrete	LS_442	Line Missing		A36, A37

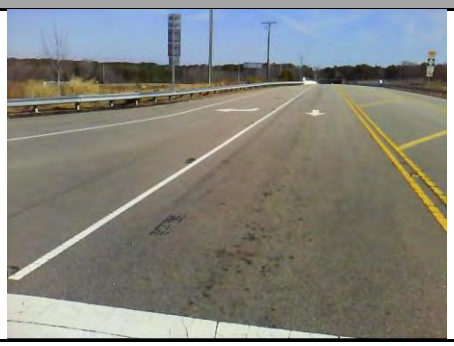
Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Concrete	LS_445	Line Missing		A36, A37
6	Concrete	LS_490	Line Width		A45
7	Asphalt	LS_547	Line Width		A41
8	Concrete	LS_1200	Line Missing		A28, A29

Pavement Striping (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
10	Concrete	LS_1220	Line Width		A32
9	Asphalt	LS_1255	Nighttime Visibility, Line Missing		A36

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	Asphalt	LS_572	Missing Markers		A36, A37
2	Asphalt	LS_631	Nighttime Reflectivity	Not Available for Nighttime Failure.	A7, A8
3	Concrete	LS_636	Missing Markers		A8
4	Concrete	LS_638	Missing Markers		A9
5	Concrete	LS_644	Missing Markers		A10, A11

Pavement Markers (LS)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
6	Concrete	LS_646	Missing Markers		A10, A11
7	Concrete	LS_1220	Missing Markers		A32

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
1	Right Turn	PS_1	Day Time Assessment		A10
2	Right Turn	PS_661	Nighttime Reflectivity	Not Available for Nighttime Failure.	A10
3	Merge Left	PS_761	Nighttime Reflectivity	Not Available for Nighttime Failure.	A44

Signs (SN)

#	Sign Type	Object ID	Failure Type	Photo	GIS Reference Page
1	One Way	SN_415	Leaning		A6, A7

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_128	Bare Ground		A36
2	Turf	TF_205	Bare Ground		A27, A28, A29
3	Turf	TF_220	Bare Ground		A28
4	Turf	TF_391	Bare Ground		A38, A40

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
5	Turf	TF_416	Bare Ground		A35, A36
6	Turf	TF_565	Bare Ground		A21, A22
7	Turf	TF_610	Bare Ground		A17
8	Turf	TF_647	Bare Ground		A12

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
9	Turf	TF_656	Bare Ground		A21, A22
10	Turf	TF_756	Bare Ground		A6
11	Turf	TF_851	Bare Ground		A54, A55
12	Turf	TF_894	Bare Ground		A53

Turf Condition (TF)

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
13	Turf	TF_956	Bare Ground		A48, A49

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

#	Material Type	Object ID	Failure Type	Photo	GIS Reference Page
1	MSE Wall	WL_5	Paint Scaling		A48, A49
2	MSE Wall	WL_59	Paint Scaling		A36, A37