

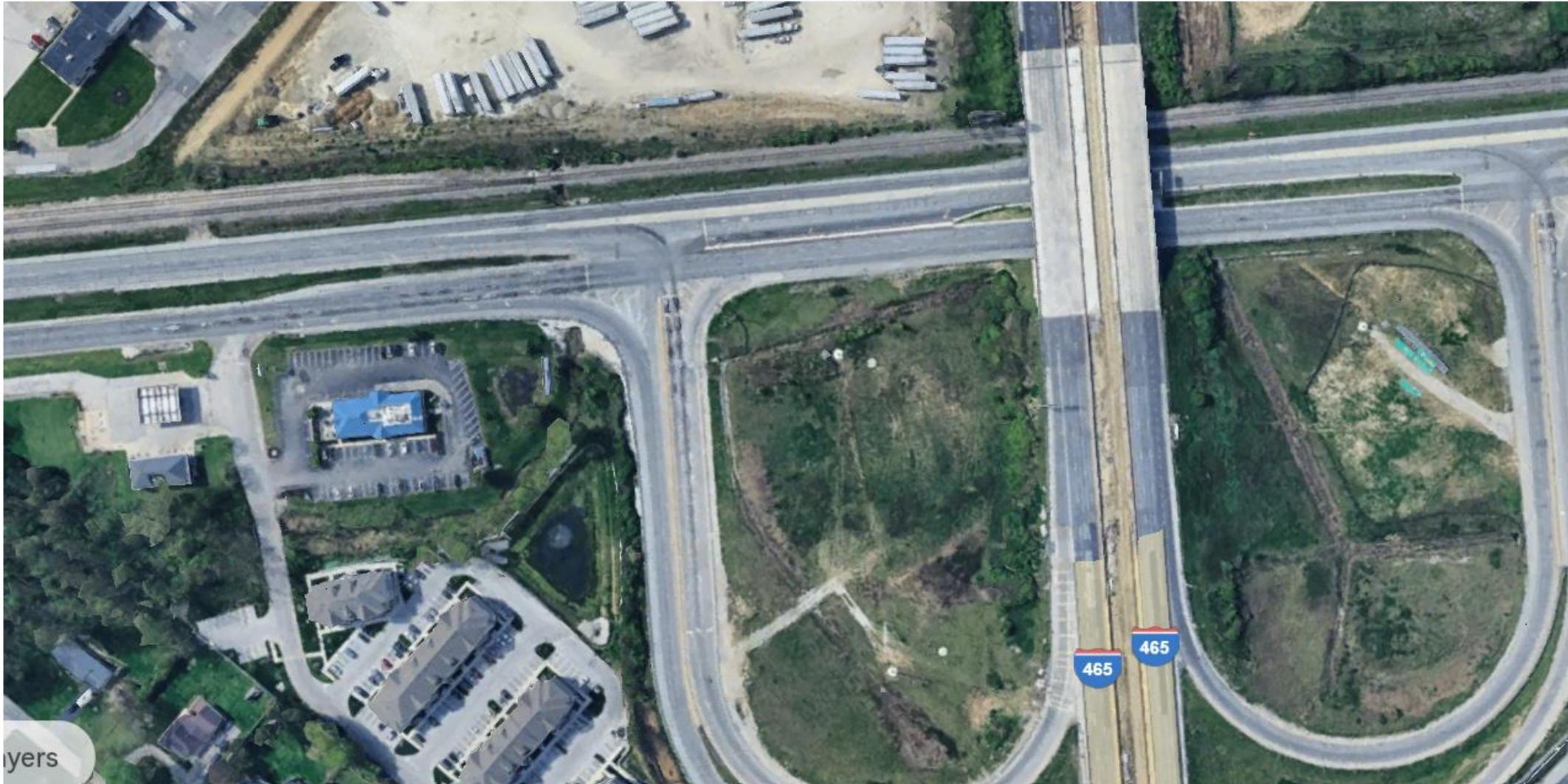
Preliminary Geometric Review for Non-conventional Intersections

Mark Orton-INDOT Road Review Supervisor

Preliminary Geometric Review Of RCI Intersections

- This process unofficially started in 2017 with the Corridor and Standards and Policy Divisions.
- There were new publications by FHWA on RCI intersections, RAB and DDI.
- The IDM Ch 46 Intersections was being rewritten at the time with focus on Reduced Conflict Intersections (RCI) specifically Roundabouts (RABS) and Restricted Crossing U-Turn Intersections (RCUTS). Many of the details that are used for the RCUTs today were developed at that time.
- Designers and district traffic engineers that were aware of the process requested preliminary of review of projects up to the time of the issuance of the Design Memo 24-11.

Continuous Flow "T" SR 67-I-465



INDOT Design Memo 24-11

- Preliminary Geometric Reviews
 - Why:
 - Initially RAB design had no standardization in the analysis.
 - INDOT allowed various software packages. (RODEL, ARCADY, HCS, CORSIM, SYNCHRO, etc)
 - No standardization in the default values for analysis.
 - This led to some Roundabouts being oversized with additional, lanes, by-pass lanes, and non-conventional geometry, etc.
 - Stage 1 plan submittal:
 - There were inconsistencies with truck aprons, approach alignments, circulating roadway widths, splitter island geometry, curb types etc.
 - Conflicting designs with respect to the Engineer's Report, Stage 1 plans and expectation of the District Traffic Engineer.
 - Caused significant issues which resulted in re-design, rescoping and resubmittal of Stage 1 plans. Affected project schedule and fees.

Preliminary Geometric Review Submittal

The designer (both in-house and outside) should provide the following:

1. 2D schematic detail sheet (Scale 1" = 20') (no profile grades or spot elevations required) on RAB layout including the following:
 - a. All dimension within RAB (circulating roadway width, all diameters, apron width, etc.)
 - b. Alignment data (no coordinates or degree of curve)
 - c. Typical sections of RAB and Approaches. (No pavement design required.)
 - d. Approach widths,
 - e. Entry angles
 - f. All radii identified for all approaches.
 - g. Path overlaps (Multilane RABS)
 - h. Island dimensions and offsets

Roundabout Submittal

2. Fastest path computations and schematics for Roundabouts
3. Engineer/Scoping Report
4. Verify LOS Analysis with the *State of Indiana Intersections Traffic Analysis Procedures*.
5. Current and future traffic volumes and design DHV for each movement (am, pm)
6. Design criteria for each approach (RAB is 4R Criteria)...road classification, design speed, design vehicle
7. Provide documentation of any constraints in the project design (driveways, utilities, schools, R/W, etc.) not identified in the Engineers Report.

The documents should be uploaded to ERMS to the Project Manager, District Traffic Engineer, Corridor Development, and Central Office review. It is preferred that the project manager setup the meeting since he has access to INDOT personnel calendars.

Roundabout Analysis

The Intersection Traffic Analysis Procedures

- Developed by Corridor Development in 2018 to define the analysis procedures for all traffic intersections. The document was updated in April of 2023.
- Provides methodologies, recommended software and procedures for intersection analysis.
- Provides the SIDRA default values for analysis.

SIDRA Analysis

- Use INDOT generated horizon year traffic data.
 - Do not submit an analysis where the software generates the growth.
- On the Roundabout TAB, for the **Environmental Factor** use 1.0 for the horizon year.
- The initial analysis should be a single lane roundabout. The increase in the number of circulating lanes and by-pass lanes should be incremental.
- Submit the following SIDRA analysis reports:
 - LOS Lane Schematic
 - Movement Summary
 - Roundabout Analysis



Preliminary Geometric Review Submittal for RCIs

- Items required for requesting a PGR
 - Engineer's /Scoping Report
 - Plan view (1"=20-ft scale) of the intersection with the following:
 - Preferably a roll plot so the sheets don't have to be pieced together
 - All travel lanes widths and turn lanes lengths delineated with tapers.
 - For RCUTs – existing median and shoulder widths dimensioned.
 - All existing drives and median crossovers within 500-ft of the project limits
 - Existing utilities and drainage facilities identified.
 - Existing R/W located and dimensioned.
 - Any unusual feature that may constrain the design or construction of the project (i.e. Bridge, etc.).
 - Proposed islands, median U-turn lane approaches.
 - Typical Sections
 - Wheel Paths of design vehicle for all movements.
 - Intersection sight distance computations.

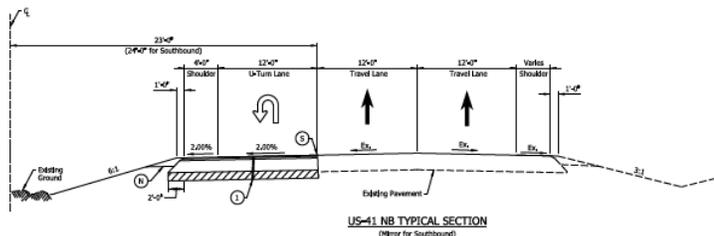
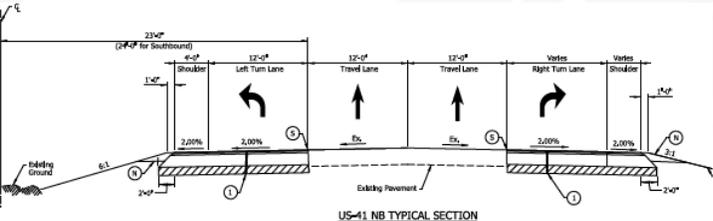
Intersection Types

- Non-conventional intersection types considered for review:
 - Roundabouts
 - Compact-roundabouts
 - Restricted Crossing U-Turn (RCUT)
(AKA as J-turn and Superstreet)
 - Median U-turn (MUT)
 - Boulevard-Left (Michigan Left)
 - Thru-Cut
 - Continuous flow Green “T”
 - Displaced Left-Turn Lane
 - Interchange Terminals

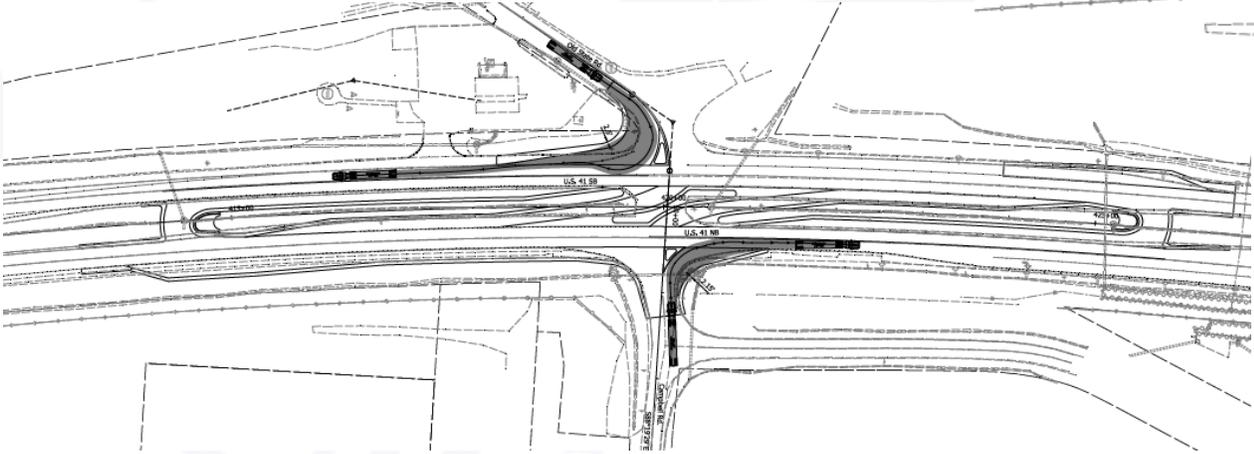
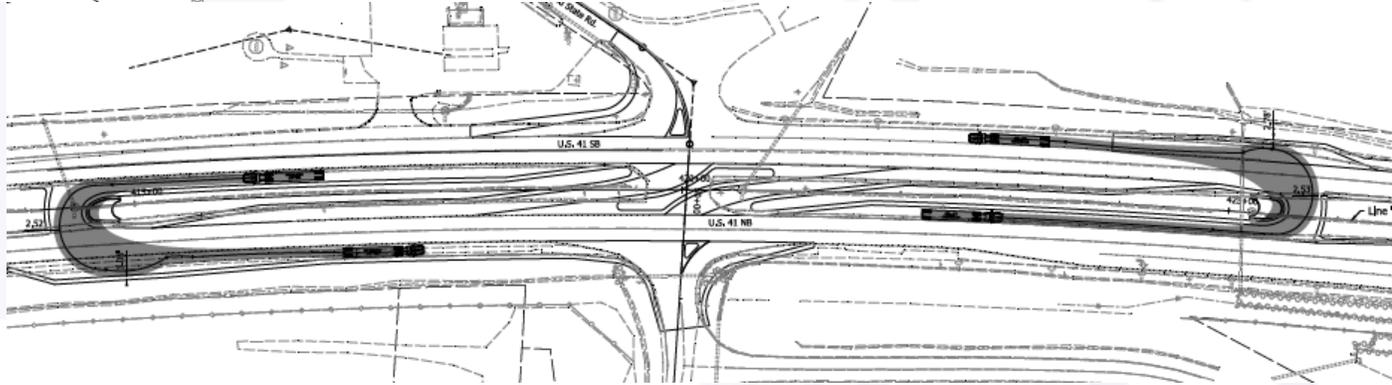
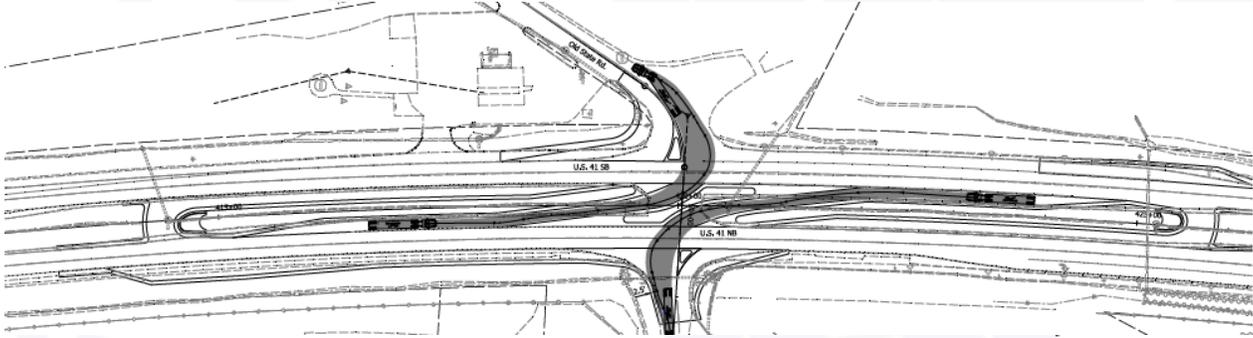
DDI

RAB

Typical RCUT Submission



Typical RCUT Submission



Roundabout Reviews

- Typical comments are the following:
 - The wheel path of the design vehicle should maintain a 2-ft offset from all curbing on the approaches and inside edge. The reason being is that truck drivers have only one shot getting in and out of the RAB...Designers have multiple opportunities to determine to optimal path for the vehicle.
 - Size of RAB. Since NCHRP 1043 has allowed reduction in the size of RAB, INDOT would like to see that optimized due to the rising costs.
 - Splitter islands in rural areas. Farm equipment being able to traverse through the approaches and RAB has led to requiring that the splitter islands be a Type “B” 4-inch sloping curb.
 - The Fastest path criteria used to be a concern, now it is a non-issue.

Roundabout Reviews

Typical Comments:

- Truck apron curb height being greater than 3" on single lane RABs. NCHRP Report 659, Guide for the Geometric Design of Driveways, Exhibit 3-5 provides vertical clearance for various vehicles.

Exhibit 3-5. Vehicle ground clearance dimensions.

| Design Vehicle | Rear Overhang (ft) | Wheelbase (ft) | Front Overhang (ft) | Ground Clearance for Rear Overhang (in) | Ground Clearance for Wheelbase (in) | Ground Clearance for Front Overhang (in) |
|----------------------------|--------------------|----------------|---------------------|---|-------------------------------------|--|
| Rear-Load Garbage Truck | 10.5 | 20 | -- | 14 | 12 | -- |
| Aerial Fire Truck | 12 | 20 | 7 | 10 | 9 | 11 |
| Pumper Fire Truck | 10 | 22 | 8 | 10 | 7 | 8 |
| Single-Unit Beverage Truck | 10 | 24 | -- | 8 | 6 | -- |
| Articulated Beverage Truck | -- | 30 | -- | -- | 10 | -- |
| Low-Boy Trailer <53 feet | -- | 38 | -- | -- | 5 | -- |
| Double-Drop Trailer | -- | 40 | -- | -- | 6 | -- |
| Car Carrier Trailer | 14 | 40 | -- | 6 | 4 | -- |
| Belly Dump Trailer | -- | 40 | -- | -- | 11 | -- |

Roundabout Reviews

Typical Comments:

- The designer needs to verify the SIDRA analysis if they did not develop the Engineer's /Scope Report.
 - Some reports have incorporated the **Design Life** in the **Site Demand & Sensitivity** tab to generate traffic for the horizon year. The Designers should use the horizon traffic generated from INDOT.
 - For each approach, make sure the appropriate lane control is used in the Lane Geometry tab. Specifically Tear Drop RAB...the connecting approaches between the RABs are “free-flow” not a “yield”.
 - Verify the default values from the Indiana Intersection Traffic Analysis Procedures Guide.

Roundabout Reviews

- Follow the scope of the Engineer's/Scoping Report. If the designer has issues or finds fault with the report, discuss with the scoping manager. If changes are necessary, the scoping manager should handle.
- PROWAG: Do not design a sidewalk in a project that does not connect to another sidewalk/trail/path. It will be deleted
- Multilane approaches: Design the approach that a truck can fit in one of the lanes via a painted median. The truck can encroach in adjacent lanes in the RAB.
- Do not allow private drives access a RAB in the circulating roadway.

Effects of Median Width on RCUTs

- A median width of 48-ft (measured from the left edge of turn lane) accommodates a W-62 to the outside shoulder of adequate width without a loon.
- Narrow medians reduce offset from mainline travel lanes and opposing left turn lanes,
- Median widths < 30-ft provide insufficient recovery space for errant vehicles raising the risk of head-on and sideswipe collisions. Accident rates on highways with 40-ft medians are 23% higher than those of 60-ft.
- Narrow medians can create drainage issues.
- High tension cable barrier systems can only be installed in medians greater than 36-ft wide. (IDM Section 49-5.01(04))

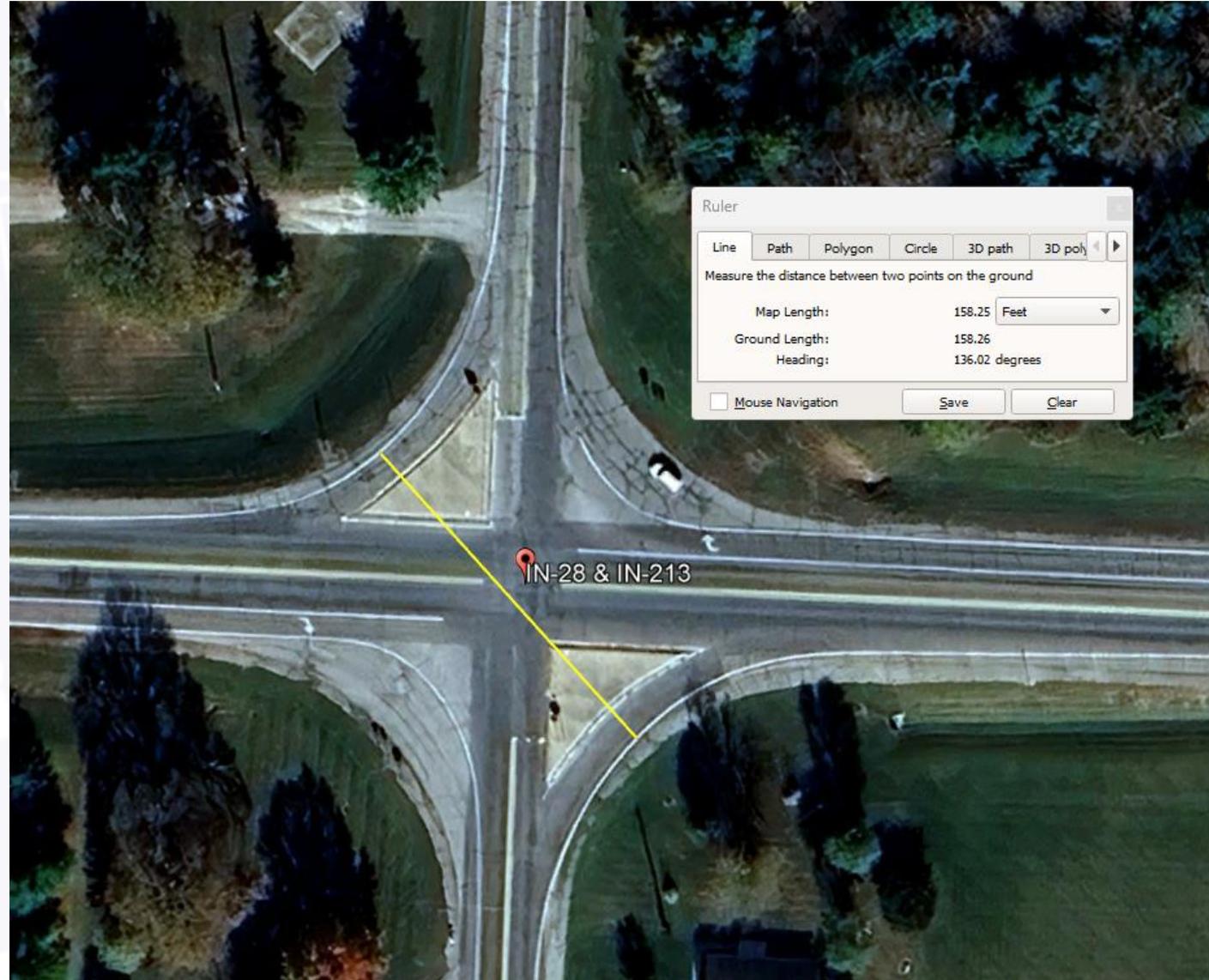
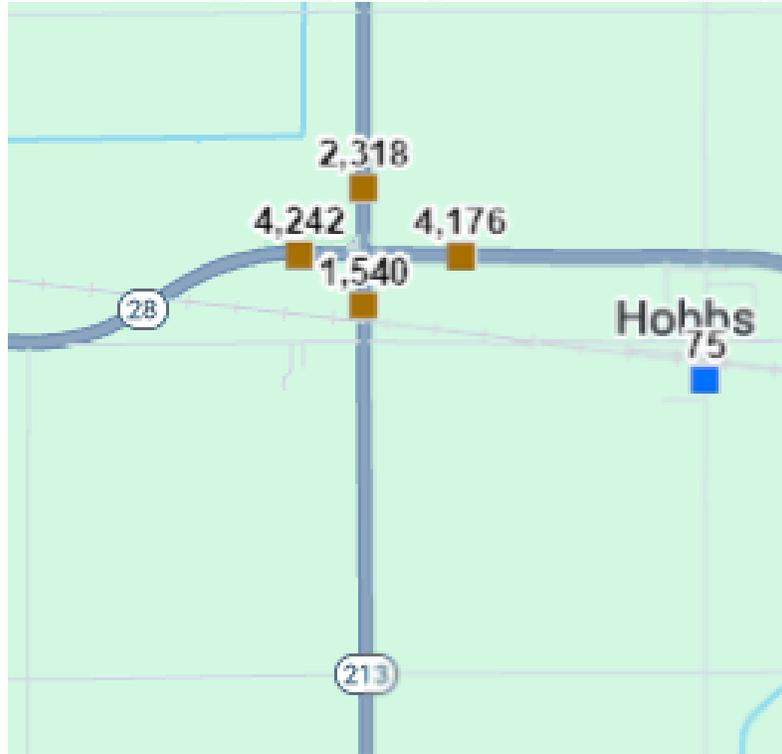
RCUT Median Treatments

- All facilities that are posted ≥ 50 mph, the medians shall have mountable curbs on the approaches and median.
- All curbing in the median should be offset a minimum of 4-ft from the thru travel lane.
- Guardrail should not be used in the median of an RCUT intersection unless there is a structure (bridge, sign foundation) that needs protection.
- The median ditch slopes should not be increased to discourage drivers from crossing the median.
- Existing median crossovers should not be located before a proposed median U-turn (MUT). Removing the crossover and extending the MUT beyond the crossover location should be a consideration.

Median U-Turn

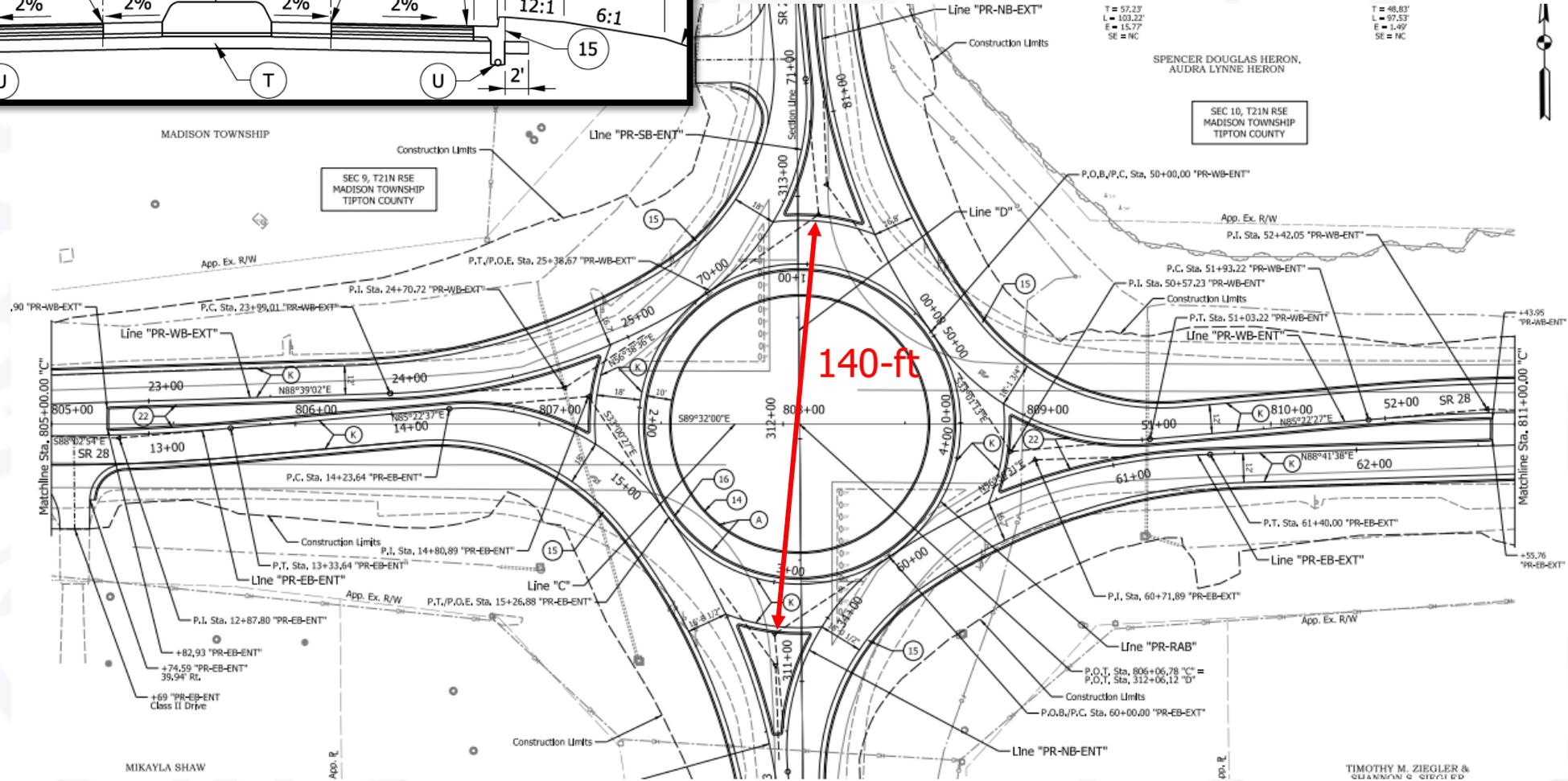
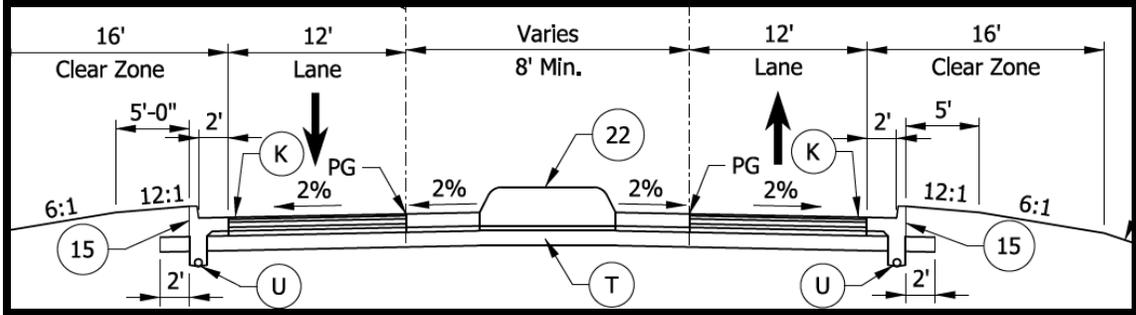


SR 28-SR 213 –Tipton County



SR 28-SR 213 –Tipton County

Stage 1 – Estimate \$4,948,389



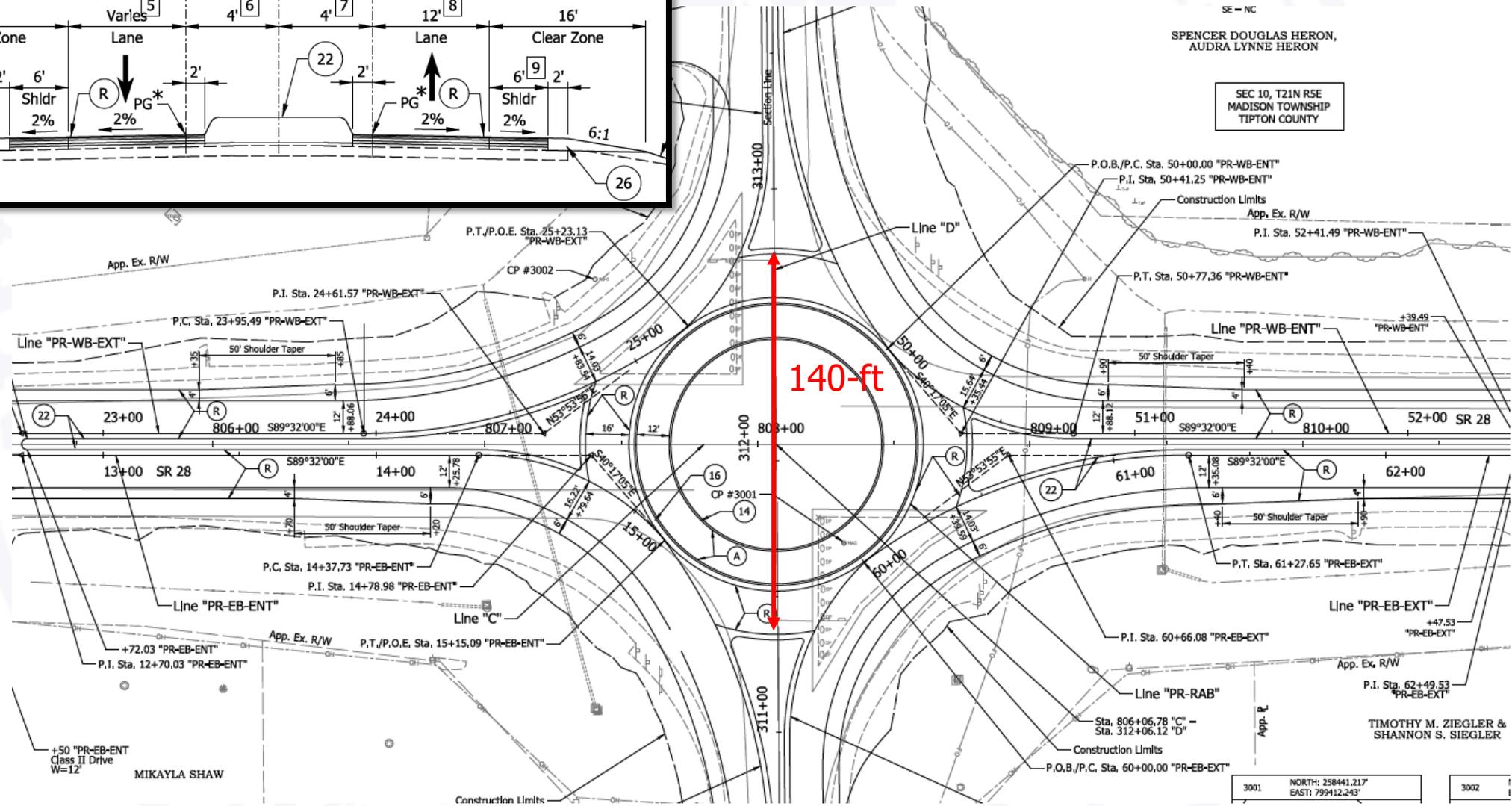
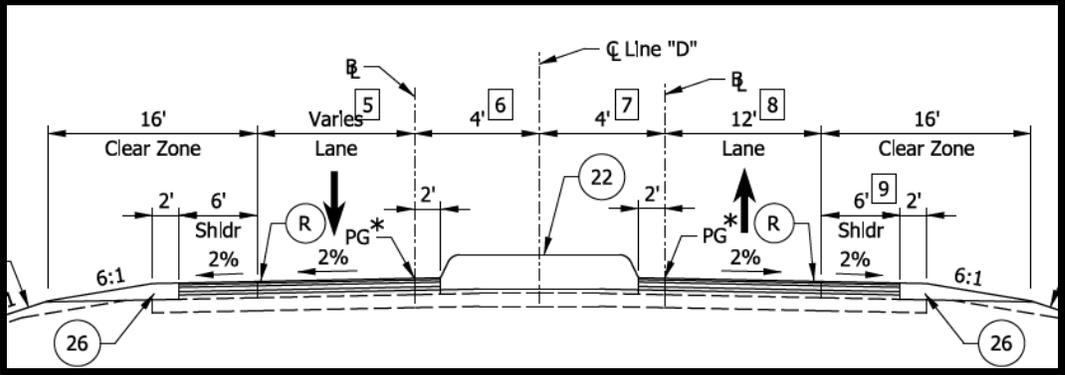
MIKAYLA SHAW

TIMOTHY M. ZIEGLER & ASSOCIATES



SR 28-SR 213 –Tipton County-Revised

Revised Stage 1 Estimate \$2,746,898

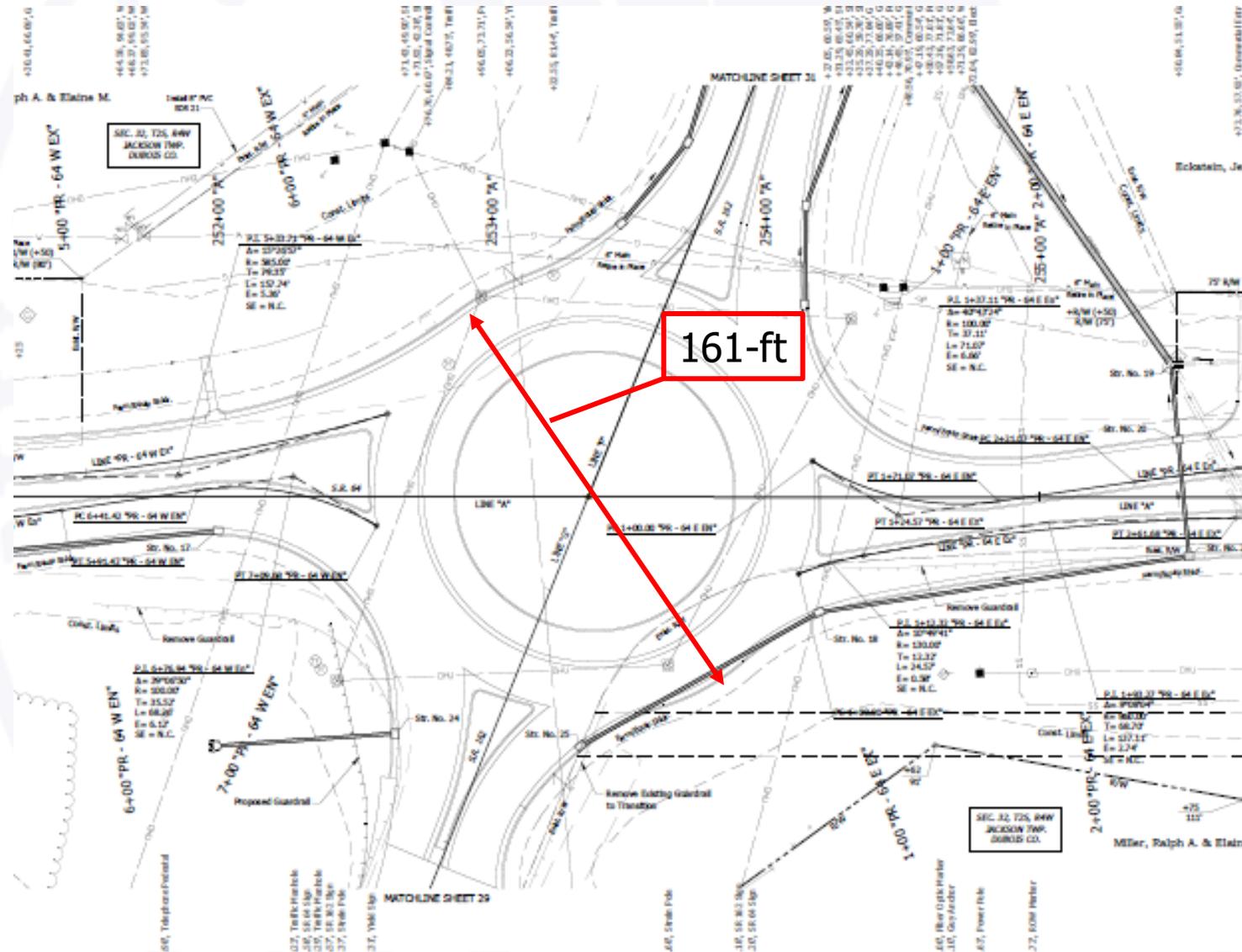


SE = NC
SPENCER DOUGLAS HERON,
AUDRA LYNNE HERON

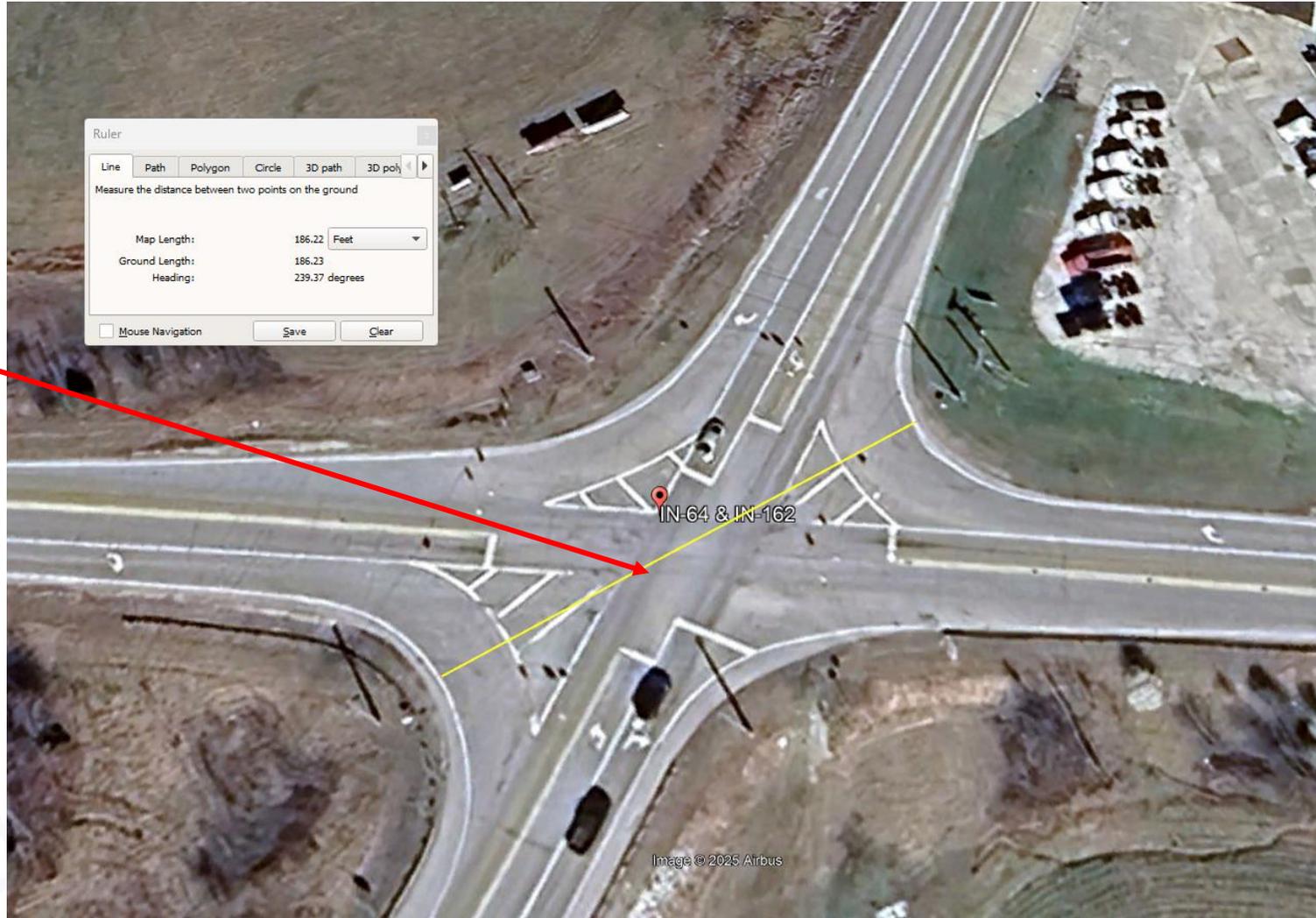
SEC 10, T21N R5E
MADISON TOWNSHIP
TIPTON COUNTY

SR 64 – SR 162 – Final Tracings

Engineer's Estimate - \$5.1 million



SR 64-SR 162 - RAB

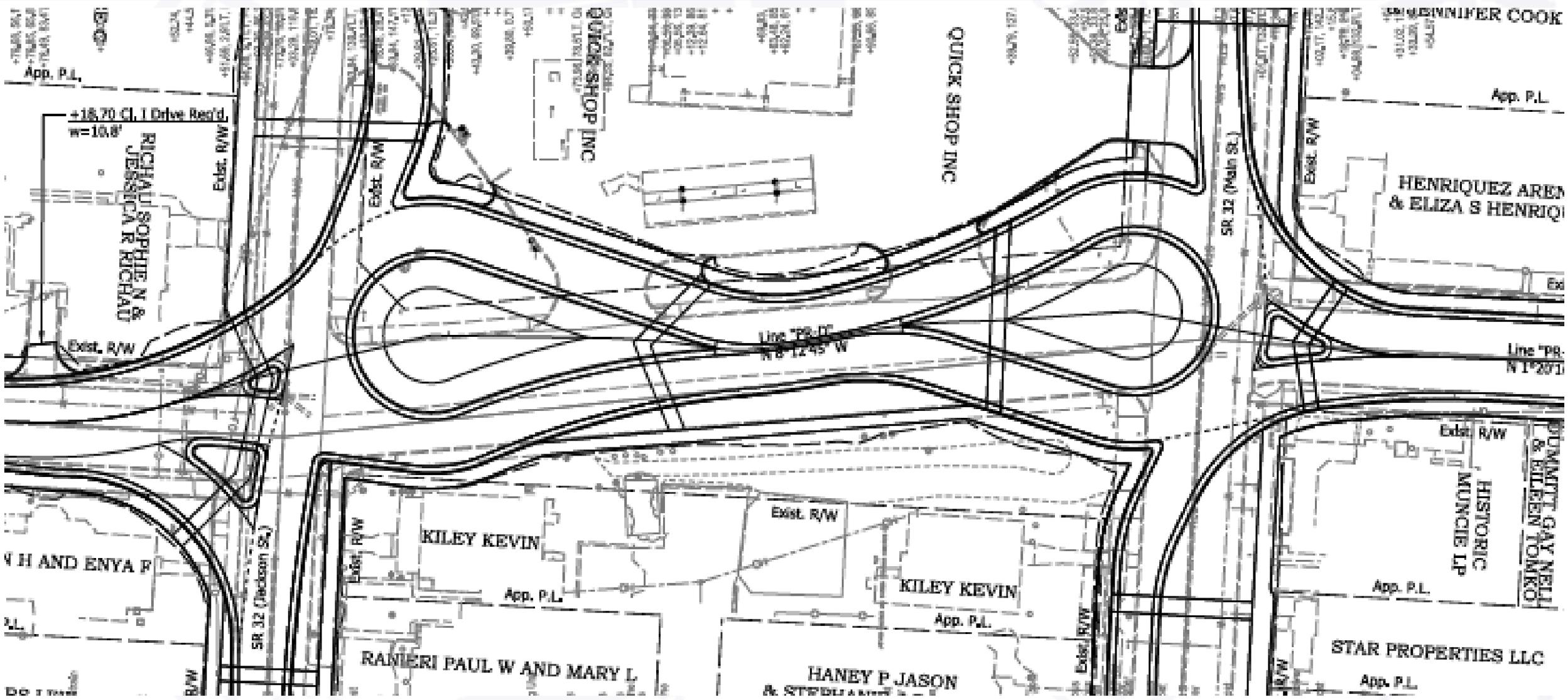


186-ft

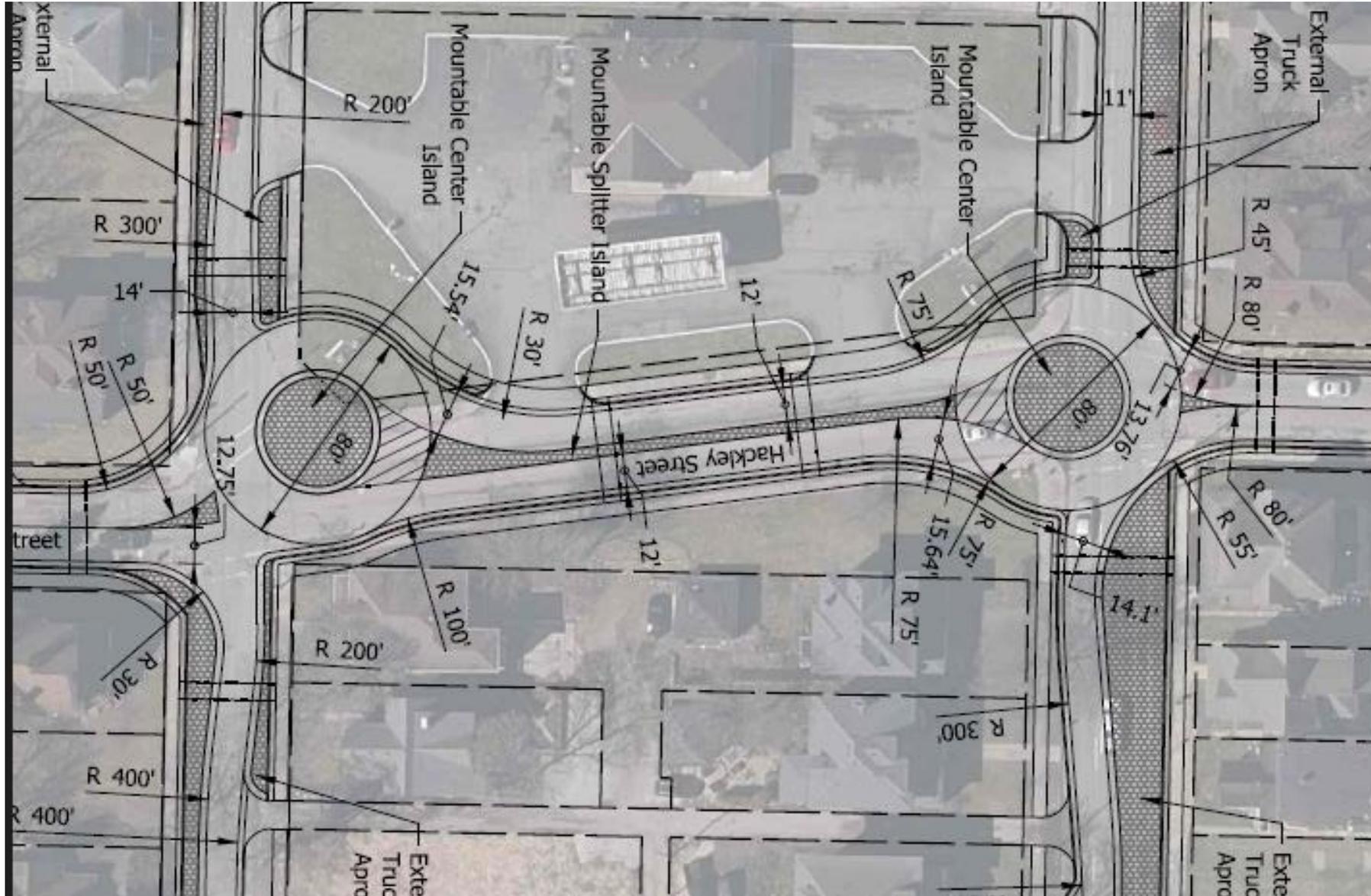
Compact RAB-Muncie-Hackley St – SR 32



Compact RAB-Muncie - Hackley St – SR 32



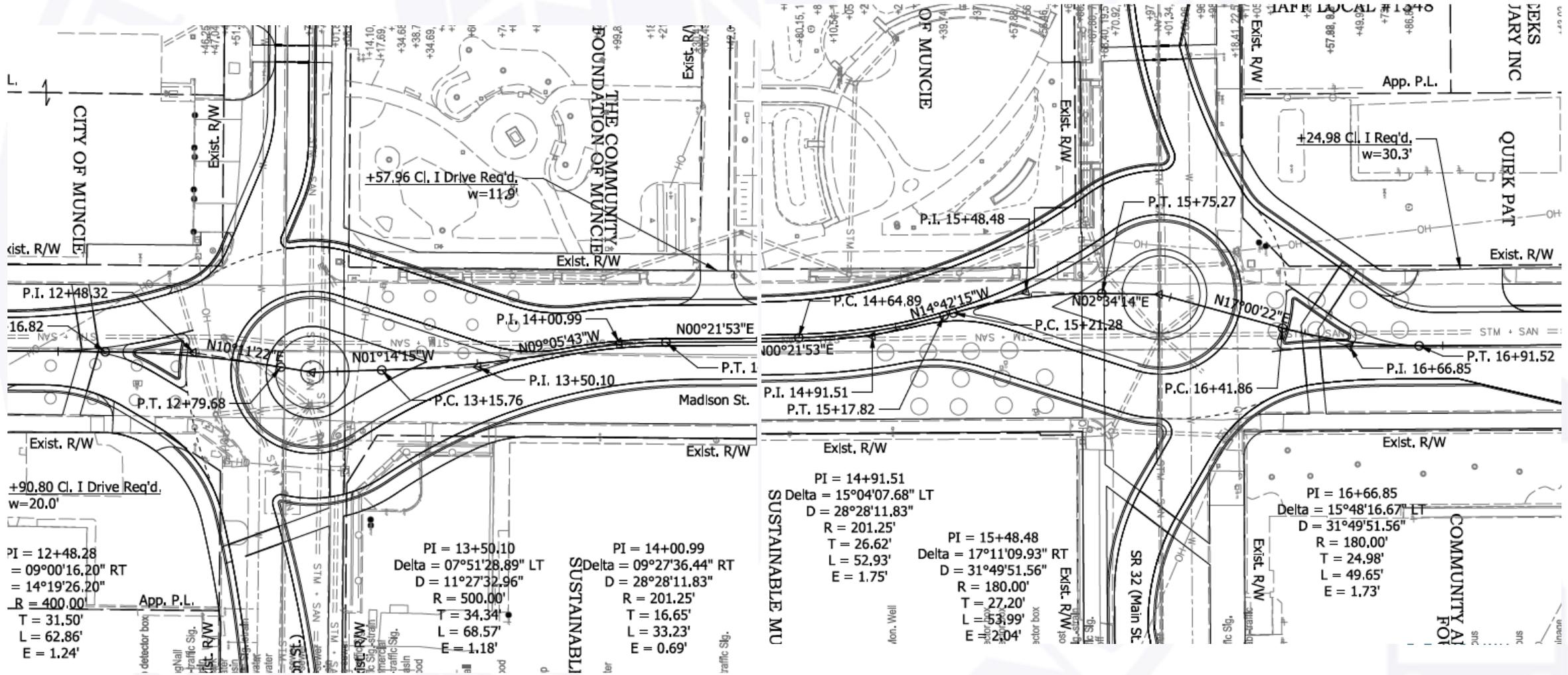
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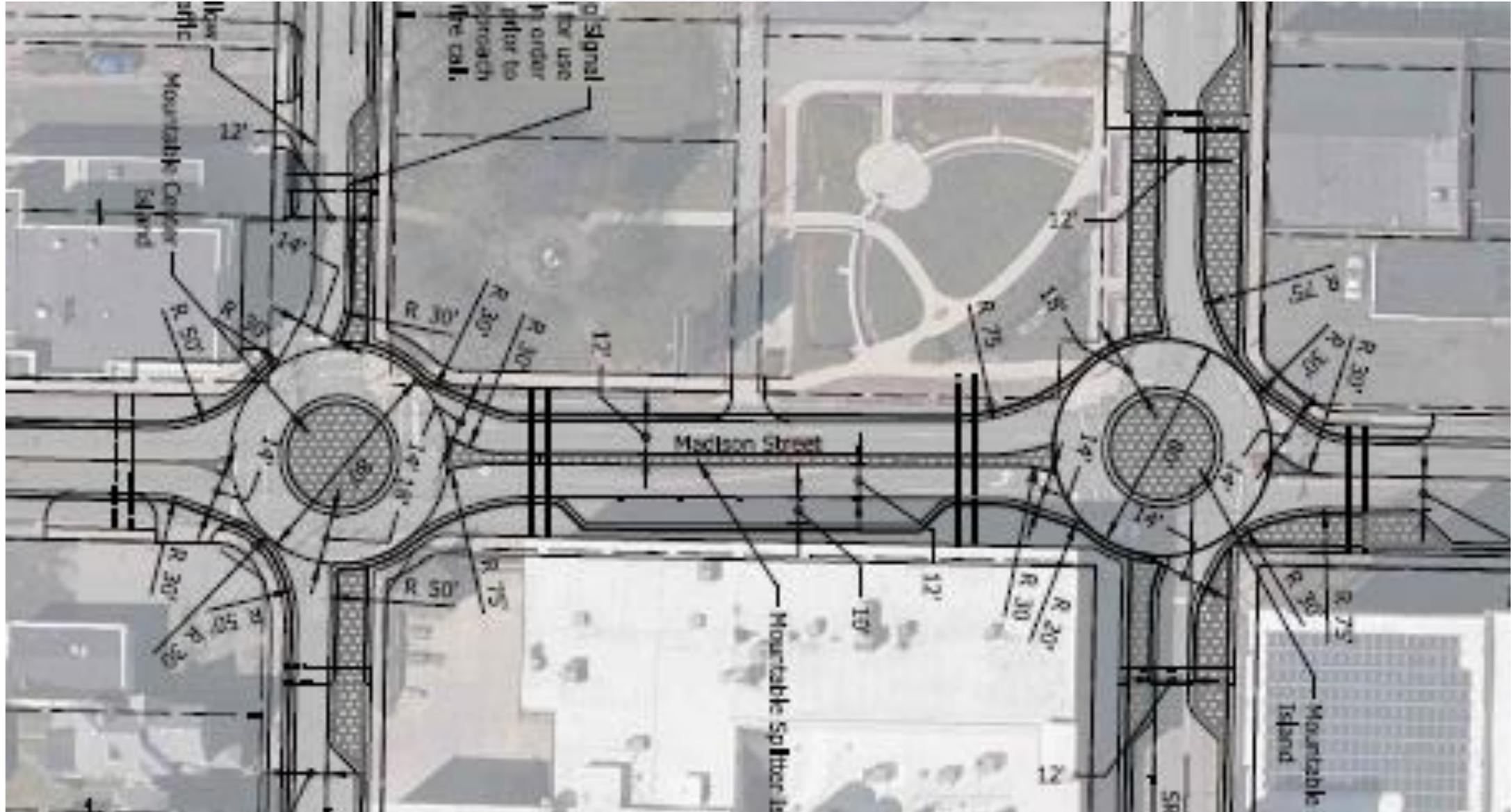
Compact RAB-Muncie –Madison St.–SR 32



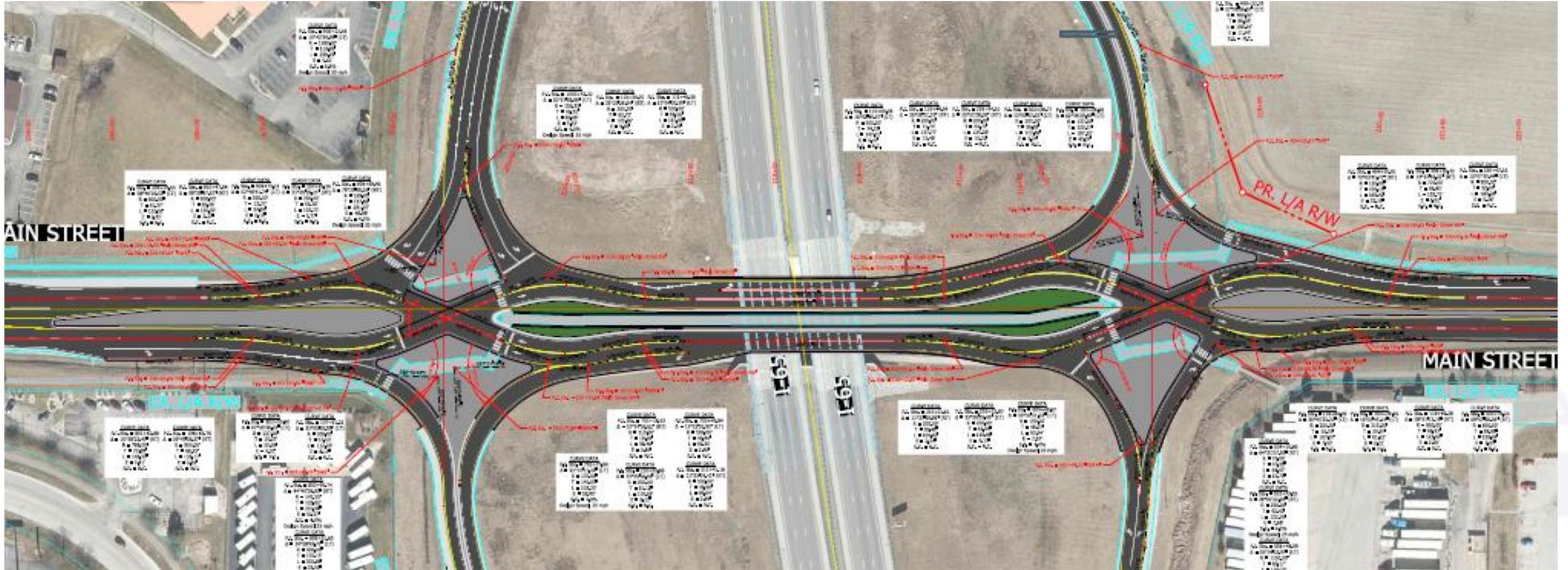
Compact RAB-Muncie –Madison St.–SR 32



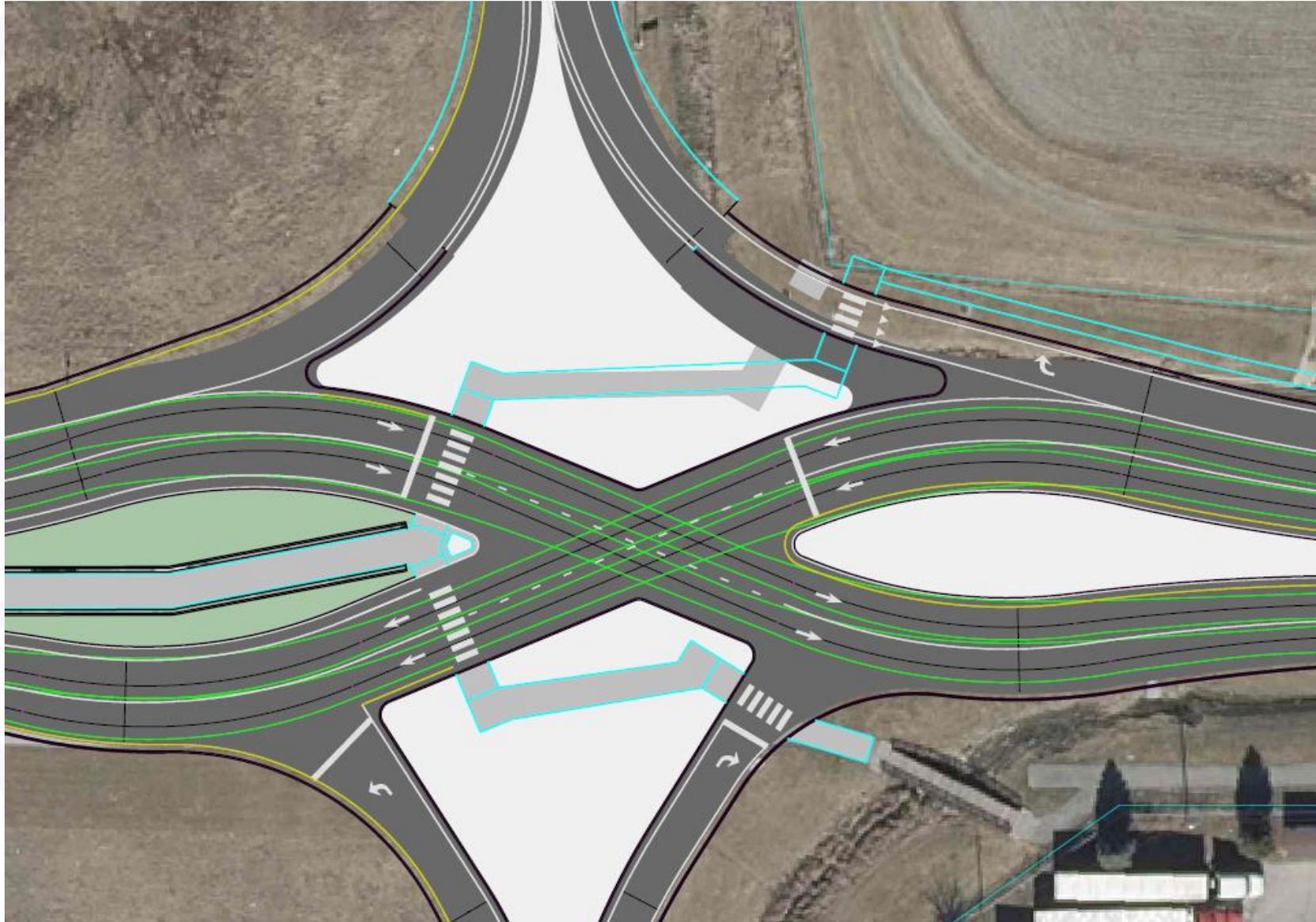
Compact RAB – Muncie-Madison St –SR 32



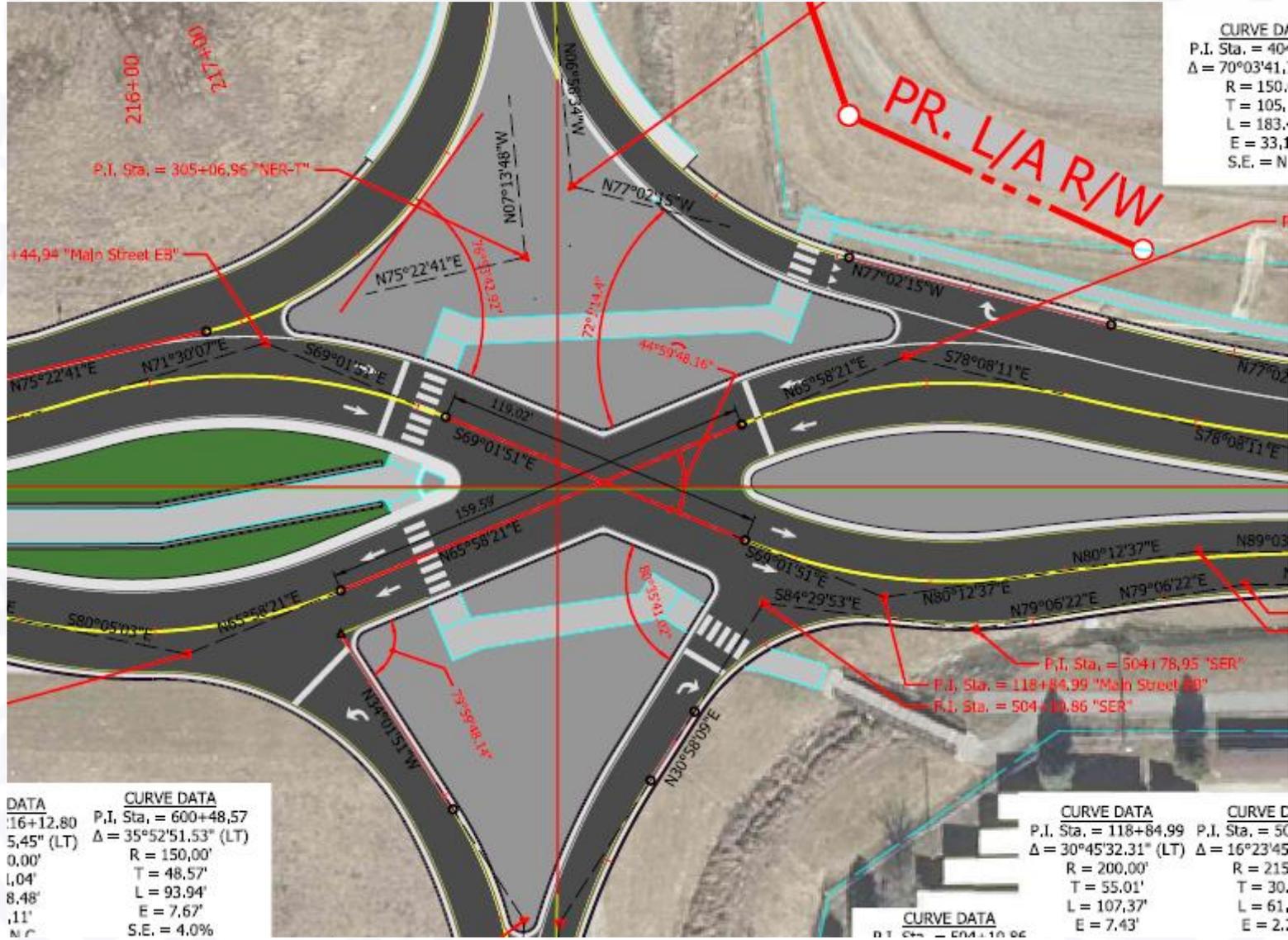
DDI Interchanges



DDI Wheel Paths



DDI Ramp Terminal



RCI Intersections Future Considerations

Costs of RCUTs have significantly increased in cost from just at a \$1 million a few years to close to \$3 million today.

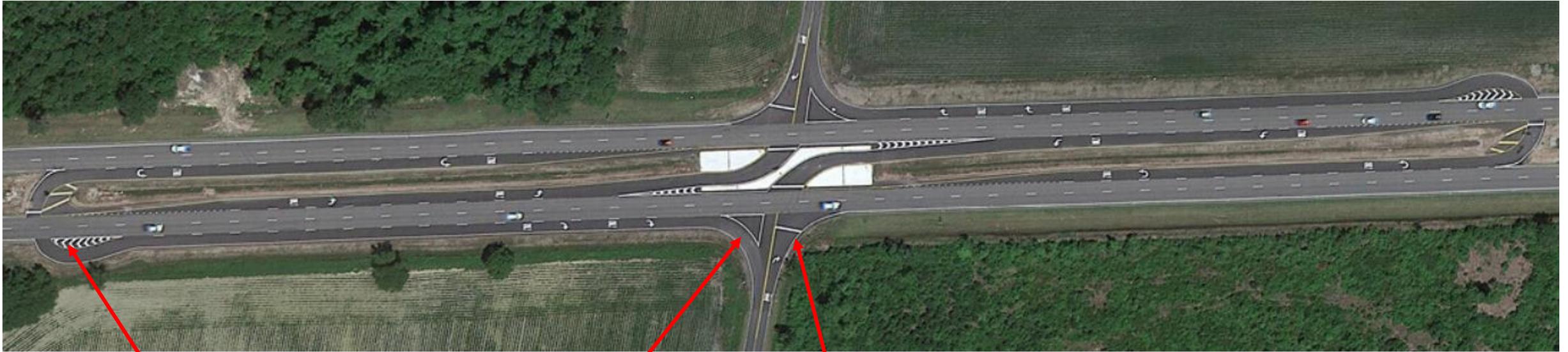
Considerations under evaluation internally to reduce costs:

- Reduction in turn lane length
- Reduction in pavement section for left turn lanes.
- Eliminate raised islands on the minor approaches.
- The need for right turn lanes on approaches...are they necessary?

Roundabouts have ballooned in costs significantly.

- Roundabouts become more efficient over time. Therefore, the horizon year LOS should be scrutinized to see if the traffic projections are realistic.

RCUT – Hwy 9-Liberty Church Road-S.C.



White chevrons at the Loons

No raised islands on approach.
Currently under discussions for
various projects.

The alignment of the minor approach is aligned
with mainline left approach...INDOT discourages
this type of alignment.

RCUT – Hwy 9-Liberty Church Road-S.C.



Use mountable islands
Very Limited Signage
One light pole



Scheduling a Meeting

- The Designer should upload the appropriate file to ERMs and notify the Project Manager (PM). The PM has access to all INDOT calendars and should schedule the PGR Meeting with but not limited to the following:
- Designer
- District Traffic Engineer
- Scoping Manager
- Nathan Shellhamer, Mobility
- Taylor Ruble, Safety
- Ben Smith, Highway Review
- Mark Orton, Highway Review

Calendars are very crowded for several of these individuals.

THE END

Thanks for Your Time

Mark Orton

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317-233-3840