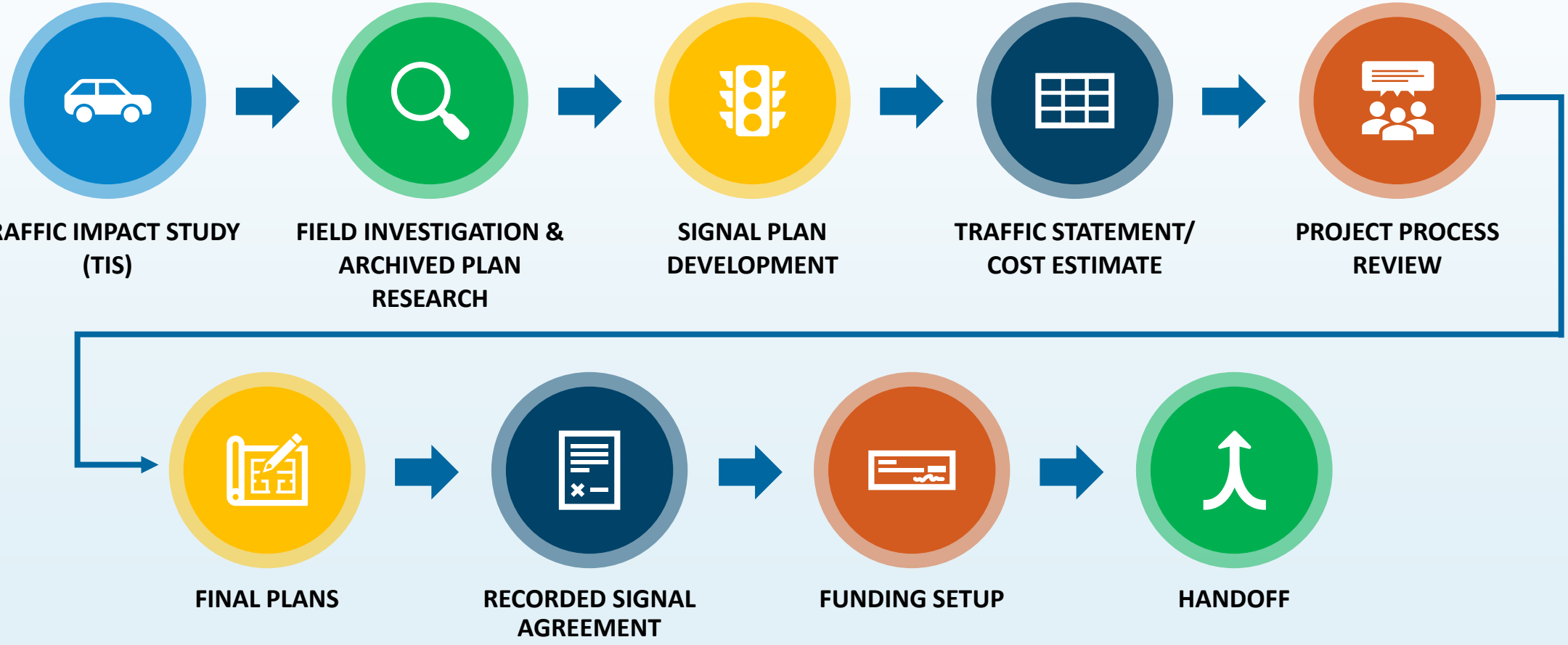
Signal Design Process & Common Errors

Sean Humphrey, P.E. – Traffic Reviewer, Consultant
October 25, 2022

Traffic Signal Design Process



TRAFFIC IMPACT STUDY (TIS)

- "A study conducted during the development approval process to determine the impacts that traffic generated by the proposed development will have on the surrounding street network and the improvement needed to the transportation system in order to mitigate those impacts." *(Section 1.8, DCM).*

- A Final TIS or TOA Review Letter is created from the study which outlines the traffic impacts that may be caused by the construction or improvement of a development, and provides recommendations for development entrances including:
  - Lane configuration/assignments
  - Signal phasing/operations
  - Bicycle and pedestrian improvements
  - Scope of signal improvement work

Common Errors

- Forgetting to incorporate TIS recommendations
- Not providing justification for modifying or omitting TIS recommendations

FIELD INVESTIGATION & ARCHIVED PLAN RESEARCH

- Record existing intersection features that will impact signal design
  - Signal equipment placement, condition, etc.
  - Overhead and underground utilities
  - Signing and pavement markings
  - Pedestrian facilities
  - ITMS equipment
  - Right-of-way
- Measure approach slopes and take photos of approach speed limits for signal timesheet preparation

FIELD INVESTIGATION

Common Error

Overlooking major utility conflicts


Overhead utility heights


Horizontal utility clearance


Drainage inlets


Underground utility conflicts

SIGNAL PLAN DEVELOPMENT

- Determine and identify locations of existing signal equipment
- Propose new signal design considering right-of-way, clear zone, lateral offset, utility constraints, etc.
- Complete signal phasing diagram and applicable signal equipment schedules

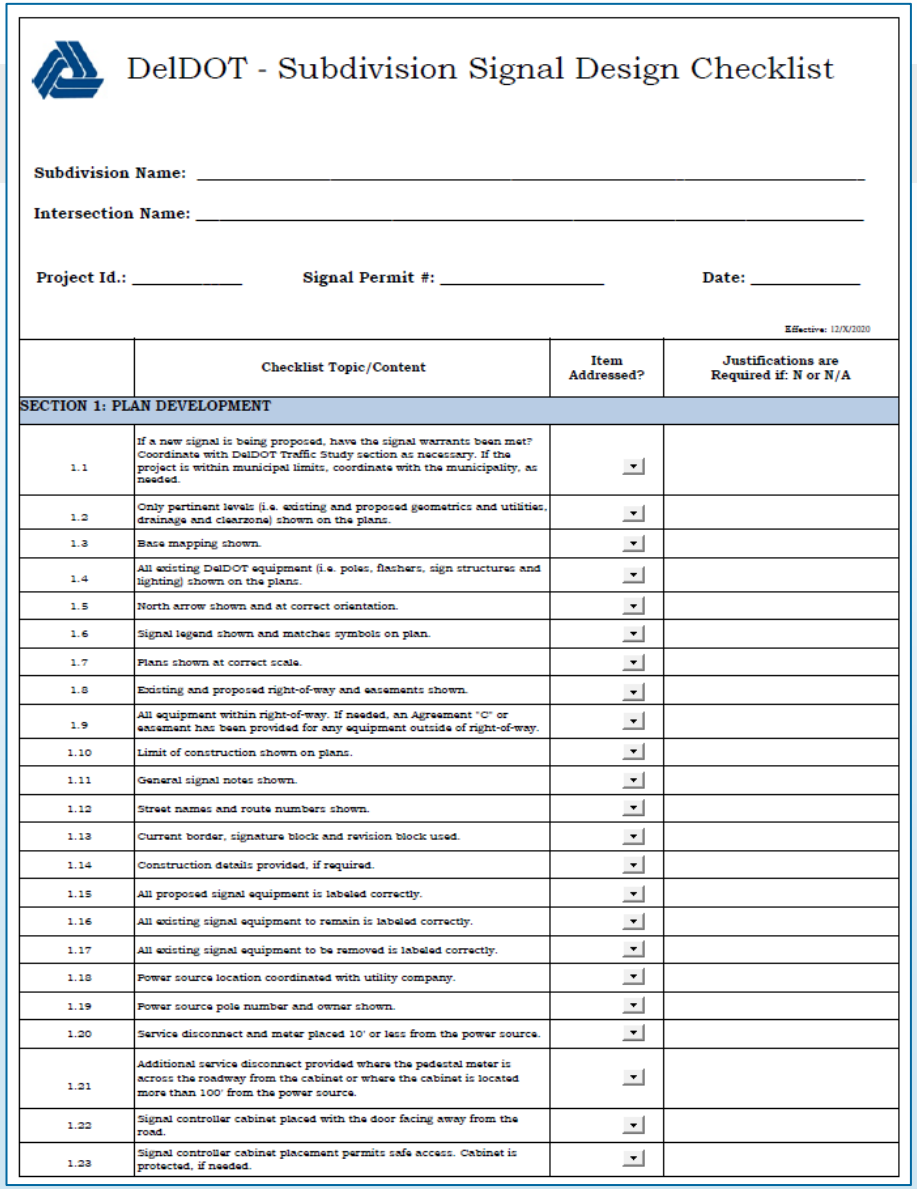
SIGNAL PLAN DEVELOPMENT

Common Error

Not using the **Signal Design Checklist**

(found on the Development Coordination website, under Checklists)

- Provides designers with all basic elements needed for a complete signal plan
- Self-check to ensure no steps have been skipped



DelDOT - Subdivision Signal Design Checklist

Subdivision Name: _____

Intersection Name: _____

Project Id.: _____ **Signal Permit #:** _____ **Date:** _____

Effective: 12/X/2020

	Checklist Topic/Content	Item Addressed?	Justifications are Required if: N or N/A
SECTION 1: PLAN DEVELOPMENT			
1.1	If a new signal is being proposed, have the signal warrants been met? Coordinate with DelDOT Traffic Study section as necessary. If the project is within municipal limits, coordinate with the municipality, as needed.		
1.2	Only pertinent levels (i.e. existing and proposed geometrics and utilities, drainage and clearzone) shown on the plans.		
1.3	Base mapping shown.		
1.4	All existing DelDOT equipment (i.e. poles, flashers, sign structures and lighting) shown on the plans.		
1.5	North arrow shown and at correct orientation.		
1.6	Signal legend shown and matches symbols on plan.		
1.7	Plans shown at correct scale.		
1.8	Existing and proposed right-of-way and easements shown.		
1.9	All equipment within right-of-way. If needed, an Agreement "O" or easement has been provided for any equipment outside of right-of-way.		
1.10	Limit of construction shown on plans.		
1.11	General signal notes shown.		
1.12	Street names and route numbers shown.		
1.13	Current border, signature block and revision block used.		
1.14	Construction details provided, if required.		
1.15	All proposed signal equipment is labeled correctly.		
1.16	All existing signal equipment to remain is labeled correctly.		
1.17	All existing signal equipment to be removed is labeled correctly.		
1.18	Power source location coordinated with utility company.		
1.19	Power source pole number and owner shown.		
1.20	Service disconnect and meter placed 10' or less from the power source.		
1.21	Additional service disconnect provided where the pedestal meter is across the roadway from the cabinet or where the cabinet is located more than 100' from the power source.		
1.22	Signal controller cabinet placed with the door facing away from the road.		
1.23	Signal controller cabinet placement permits safe access. Cabinet is protected, if needed.		

SIGNAL PLAN DEVELOPMENT

Common Error

Forgetting to consider clear zone and lateral offset

- See **"Clear Zone & Lateral Offset Application Discussion"** on DelDOT Design Resource Center for more information

Lateral Offset (or Horizonal Clearance)		
Speed Limit	≤ 45 mph	> 45 mph
Minimum lateral offset	2 ft	2ft
Desirable lateral offset	6 ft	10 ft

DelDOT's Traffic Design Manual (2015) – Chapter IV.C.1.c(1)

Clear Zone

Table IV-3
Clear Zone Distances (in feet from edge of traveled way)

Design Speed (MPH)	Design ADT	Backslopes			Foreslopes		
		1V:3H	1V:5H to 1V:4H	1V:6H or Flatter	1V:6H or Flatter	1V:5H to 1V:4H	1V:3H
40 or Less	Under 750	7 - 10	7 - 10	7 - 10	7 - 10	7 - 10	(2)
	750-1500	12 - 14	12 - 14	12 - 14	10 - 12	12 - 14	(2)
	1500-6000	14 - 16	14 - 16	14 - 16	12 - 14	14 - 16	(2)
	Over 6000	16 - 18	16 - 18	16 - 18	14 - 16	16 - 18	(2)
45 - 50	Under 750	8 - 10	8 - 10	10 - 12	10 - 12	12 - 14	(2)
	750-1500	10 - 12	12 - 14	14 - 16	14 - 16	16 - 20	(2)
	1500-6000	12 - 14	14 - 16	16 - 18	16 - 18	20 - 26	(2)
	Over 6000	14 - 16	18 - 20	20 - 22	20 - 22	24 - 28	(2)
55	Under 750	8 - 10	10 - 12	10 - 12	12 - 14	14 - 18	(2)
	750-1500	10 - 12	14 - 16	16 - 18	16 - 18	20 - 24	(2)
	1500-6000	14 - 16	16 - 18	20 - 22	20 - 22	24 - 30	(2)
	Over 6000	16 - 18	20 - 22	22 - 24	22 - 24	26 - 32 (1)	(2)
60	Under 750	10 - 12	12 - 14	14 - 16	16 - 18	20 - 24	(2)
	750-1500	12 - 14	16 - 18	20 - 22	20 - 24	26 - 32 (1)	(2)
	1500-6000	14 - 18	18 - 22	24 - 26	26 - 30	32 - 40 (1)	(2)
	Over 6000	20 - 22	24 - 26	26 - 28	30 - 32 (1)	36 - 44 (1)	(2)
65 - 70	Under 750	10 - 12	14 - 16	14 - 16	18 - 20	20 - 26	(2)
	750-1500	12 - 16	18 - 20	20 - 22	24 - 26	28 - 36 (1)	(2)
	1500-6000	16 - 20	22 - 24	26 - 28	28 - 32 (1)	34 - 42 (1)	(2)
	Over 6000	22 - 24	26 - 30	28 - 30	30 - 34 (1)	38 - 46 (1)	(2)

SIGNAL PLAN DEVELOPMENT

Common Error

Providing inadequate pedestrian facilities per DelDOT's ***Traffic Design Directive 2019-1***

- Provide crossings across all intersection approaches where appropriate
- Where crossings are deemed infeasible or undesirable, provide supporting documentation to DelDOT's Traffic Section for review and approval

SIGNAL PLAN DEVELOPMENT

Other Common Errors

- Incorrect CADD standards
- Forgetting soil boring requests
- Failing to verify mast arm loading
- Incorrect signal head numbering
- Incorrect NEMA phasing
- Failing to address all review comments
- Forgetting to submit timesheet package with signal plans
- Attempting to submit items for review outside of PDCA
- Developing signal plans only for impacted approached, rather than entire intersection
- Forgetting to provide CADD files with final signal plan for signature

TRAFFIC STATEMENT/COST ESTIMATE

- MS Excel spreadsheet to be completed by the designer using a template, which is used to determine cost of proposed traffic signal and associated equipment
- The template includes a tab describing how each section is intended to be completed
- To be submitted with signal plan for review prior to approval of signal

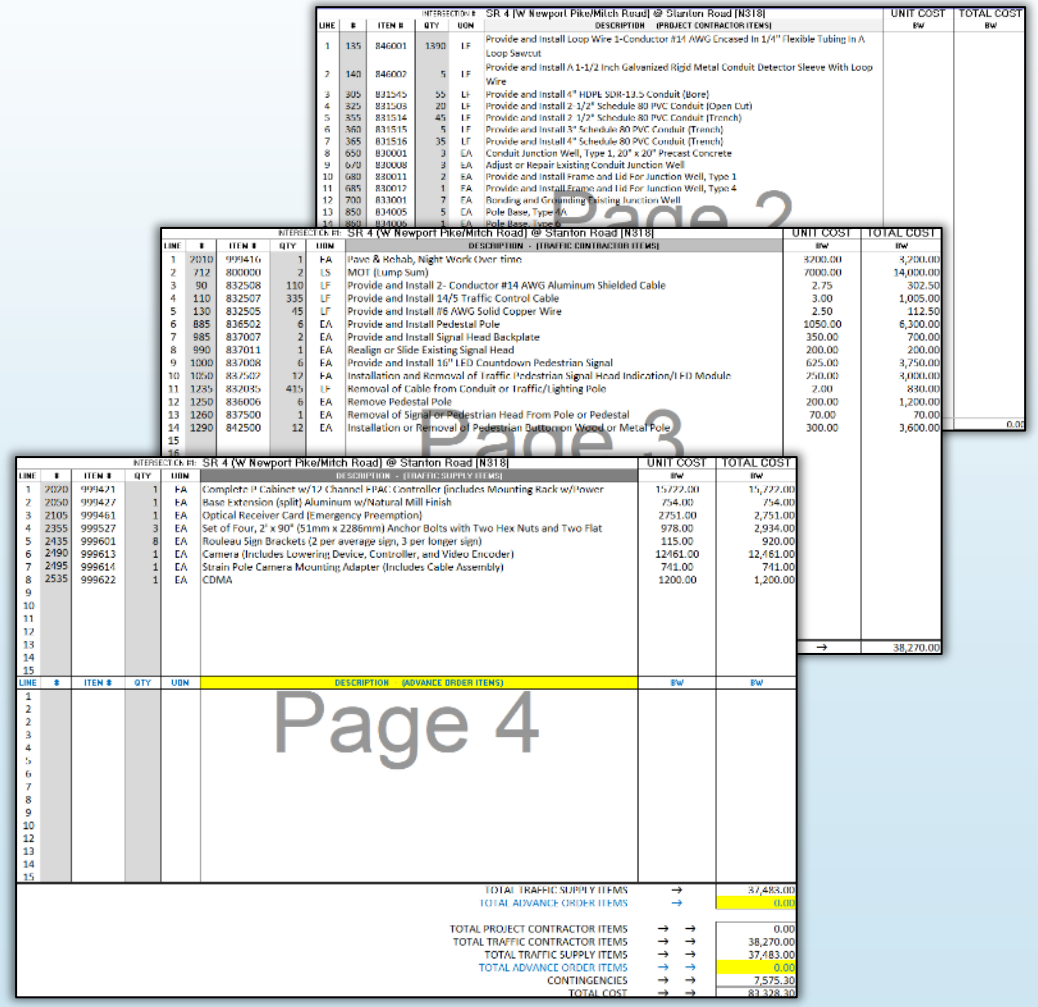
TRAFFIC STATEMENT/COST ESTIMATE

Common Error

Placing signal items under incorrect sections

- Project Contractor Items – all **underground** equipment
- Traffic Contractor Items – all **aboveground** signal equipment, and associated cables
- Traffic Supply Items – all **900 section** items
  - Advance Order Items – all steel poles and mast arms

    (can only be ordered after execution of signal agreement and final plans)



TRAFFIC STATEMENT/COST ESTIMATE

Common Errors

- Using an outdated traffic statement template
  - Latest pricing needs to be verified to ensure accuracy of cost estimate
- Forgetting to include quotes for special order items with the final traffic statement, i.e., fisheye cameras, ITMS
- Not selecting highest cost contractor for final cost estimate

PROJECT PROCESS REVIEW

- A review period during which designers submit signal plans and cost estimate to DelDOT for review by DelDOT Signal Construction/Maintenance, Traffic Design/Safety/Studies, TMC, OIT, and other sections as needed

- Project Process review is a required step to ensure constructability, operational compliance, and maintenance feasibility prior to plan approval for installation by Chief of Traffic Engineering

PROJECT PROCESS REVIEW

Common Errors

- Overlooking Project Process review period in project schedule
- Not addressing all comments made during Project Process review
- Attempting to bypass Project Process review

FINAL SIGNAL PLANS

- The final form of signal plans which has incorporated or resolved all previous comments provided throughout the review process
- Plans must contain signature and seal before it can be approved for installation by Chief Traffic Engineer

Common Errors

- Forgetting to provide signature and seal on final plans
- Not submitting final traffic statement and updated timesheet package with final signal plans

RECORDED SIGNAL AGREEMENT

- An agreement allowing DelDOT right of entry onto property to install, operate, and maintain new traffic signals and ITMS devices or modification of existing signal equipment
- Required to be executed in order to request funding

Common Error

- Overlooking TIS recommendation to enter into signal agreement
- Waiting until the last minute to start the process of drafting a signal agreement

FUNDING SETUP

- A draft concurrence letter is sent to Finance along with the final cost estimate and signal agreement to request funding from the developer for installation of the signal

Common Errors

- Forgetting to include all applicable traffic statement tabs in final cost estimate sent to Finance
- Excluding maintenance fee from final estimate
- Not realizing that it may take up to a month between reception of signed concurrence letter/check and issuance of a project number

HANDOFF

- The final step in the signal design process, in which finalized signal design documents are distributed to all appropriate parties for signal installation

Common Errors

- Failing to confirm funding approval prior to handing off project
- Forgetting to include all necessary parties in signal handoff email
- Forgetting to send all materials identified on Handoff Form

NEXT STEPS

- Prior to the start of construction, the developer's contractor shall contact signal construction to coordinate scheduling and installation of signal

- Field changes that occur during construction of signal require a redline plan outlining all intended modifications to the original approved signal plan

Wait…

Questions