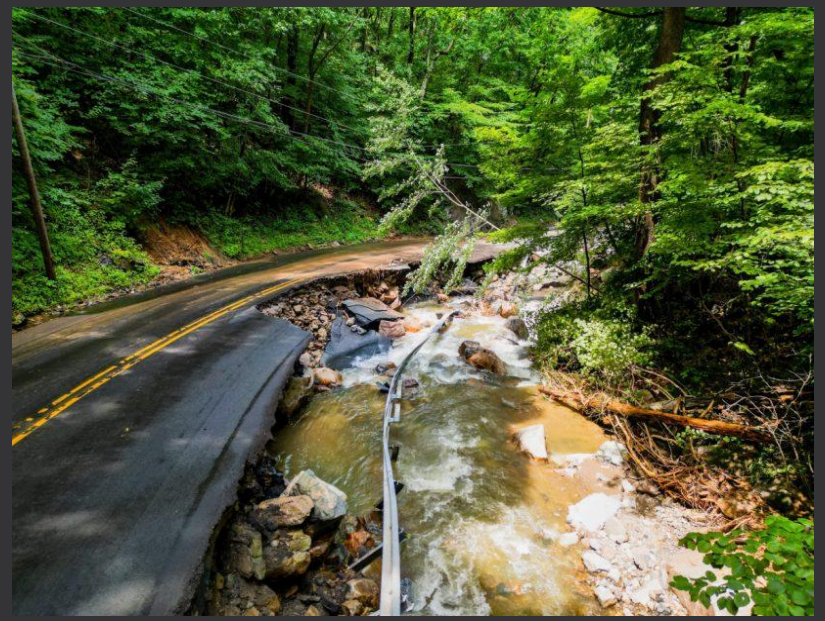
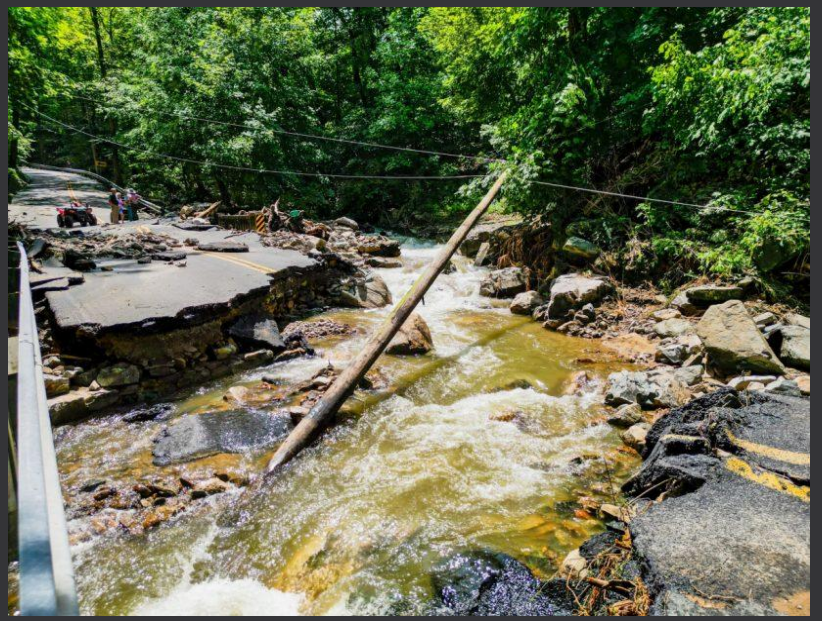
Repair and Rehabilitation of County Route 626

in White Township, NJ





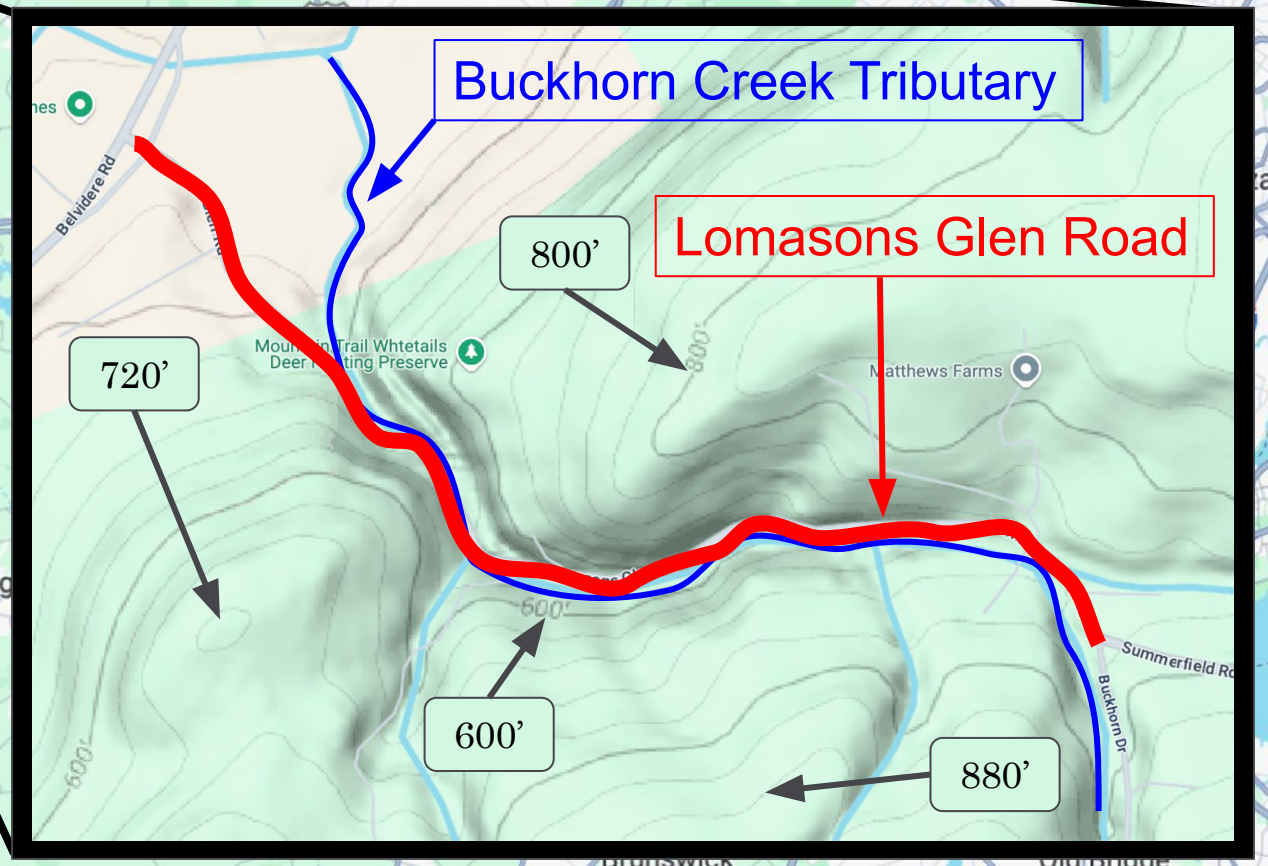
Team Members: Louis Turner (Team Leader), Michael Harrison, Daniel Geissler, and Tony Gonzalez

Advisors: Dr. Michael Horst and Dr. Thomas Brennan

Problem Statement and Background

- County Road Route 626 in White Township
- Bridge No. 23073, over Buckhorn Creek Tributary
- Original embankments upstream reinforced with concrete retaining walls
- Superstructure/substructure remained intact during storm event
- Roadway closure since 2022

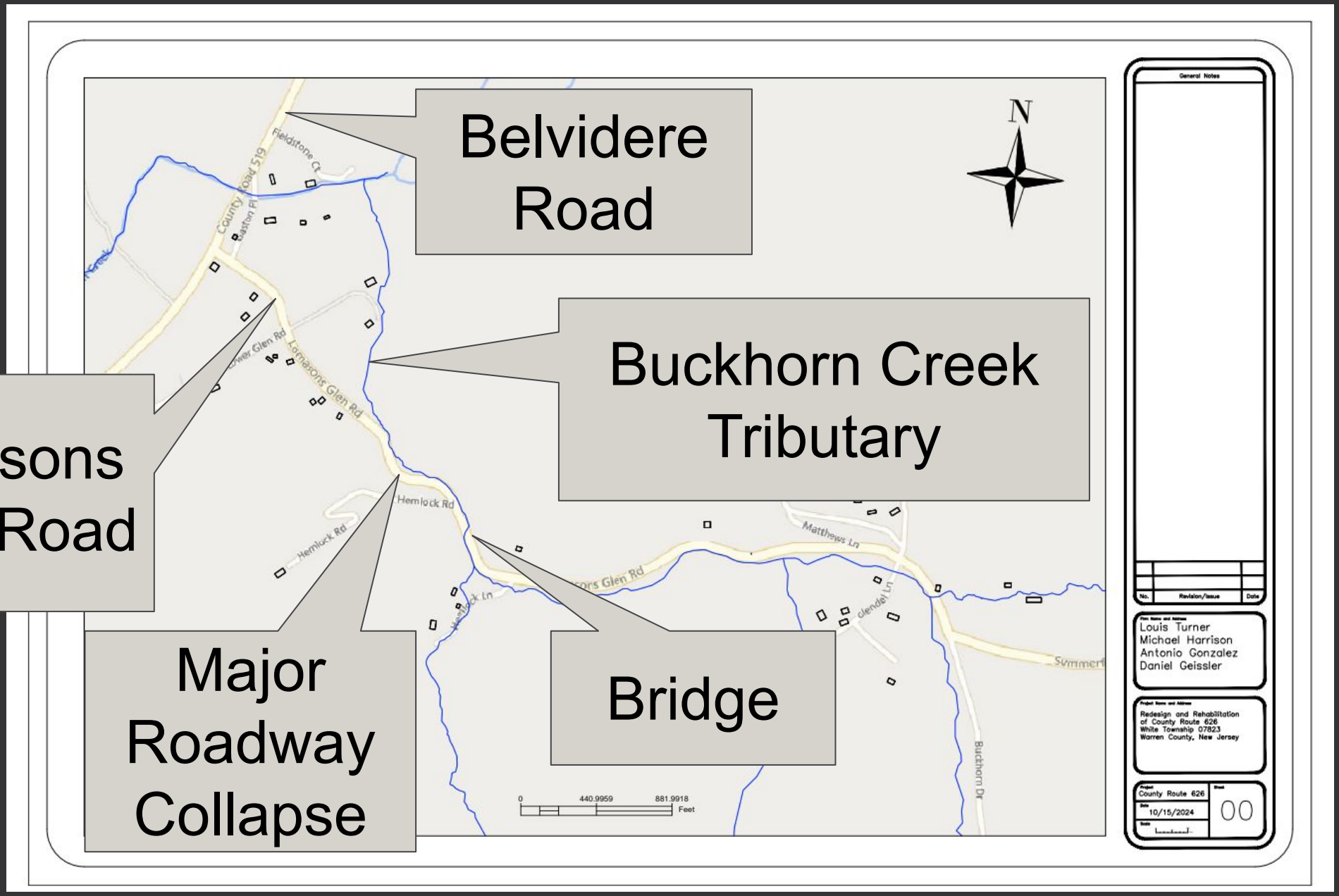
Site Location



Lomasons Glen Road

- 1.15 miles long with a 1,360 feet elevation change.
- 200-300 foot elevation change from mountain top to roadway.

Site Plan Overview



Applicable Standards, Specifications, and Codes

- NJDOT Roadway Design Manual
- Manual on Uniform Traffic Control Devices Version 11 (MUTCD)
- ITE Trip Generation Manual

Modern Engineering Tools

- Water Resources
  - Softwares: USGS Streamstats, NWS PFDS, HEC-RAS
    - Watershed Area, HEC-RAS
- Transportation
  - Softwares: Synchro, Microsoft Excel

- AutoCAD Civil 3D Imperial
  - Drafting, Drawings, and Design

Realistic Constraints

- Economic - Project Cost
- Environmental & Sustainability
  - Renewable Resources, Low Energy, and Maintenance
- Constructability (QA/VE)
  - Roundabouts
- Ethical & Legal
  - State, County, & Township Regulations
- Social & Political

Hydraulic Design Requirements

- Bridge Design:
  - Rectangular Bridge
  - Open-Bottom Natural Bridge
- Embankment Design:
  - Sloped Levee Walls or Gabion Basket

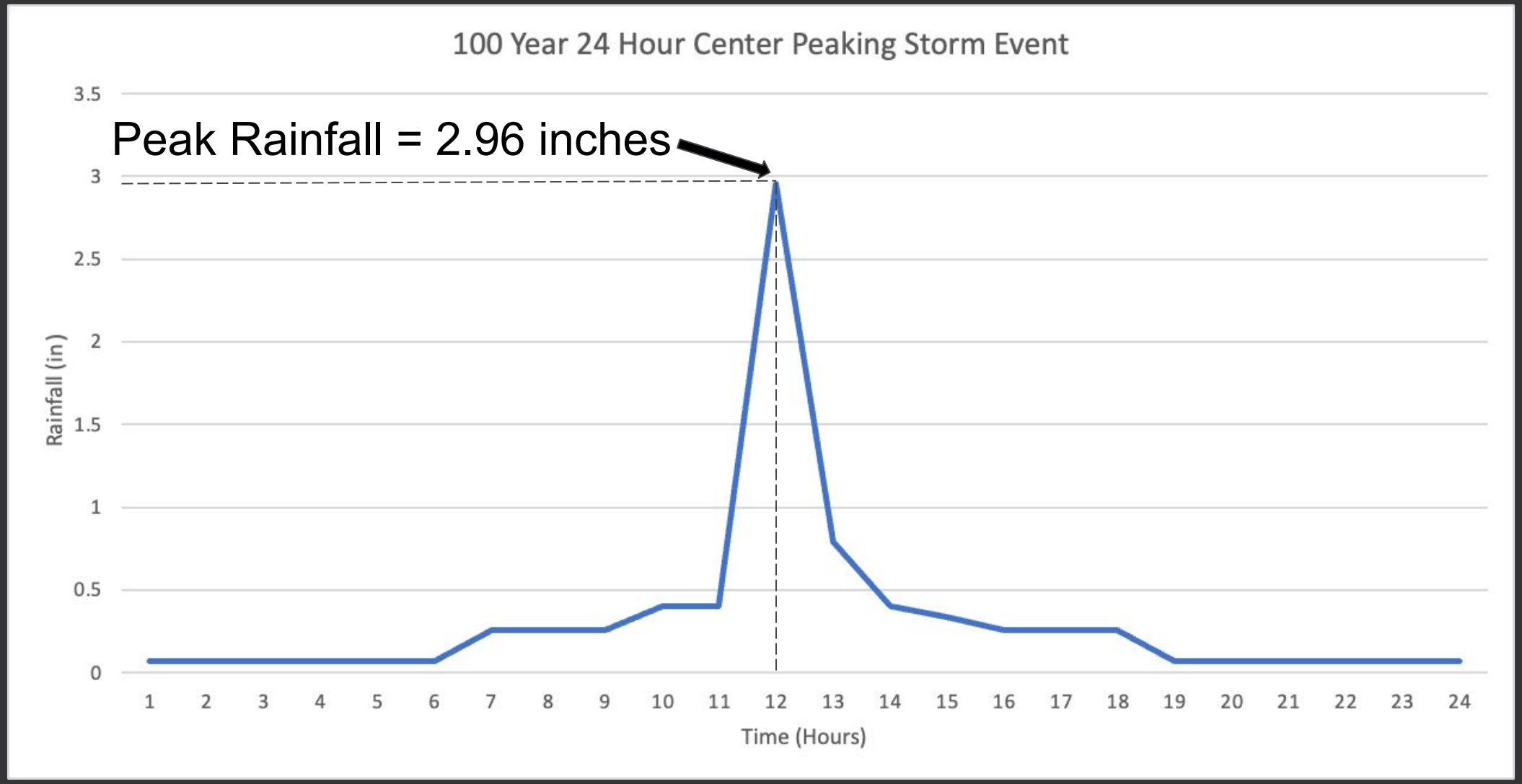
Design Constraints (Water Resources)

Delineated Watershed Area
- 1.32 square miles

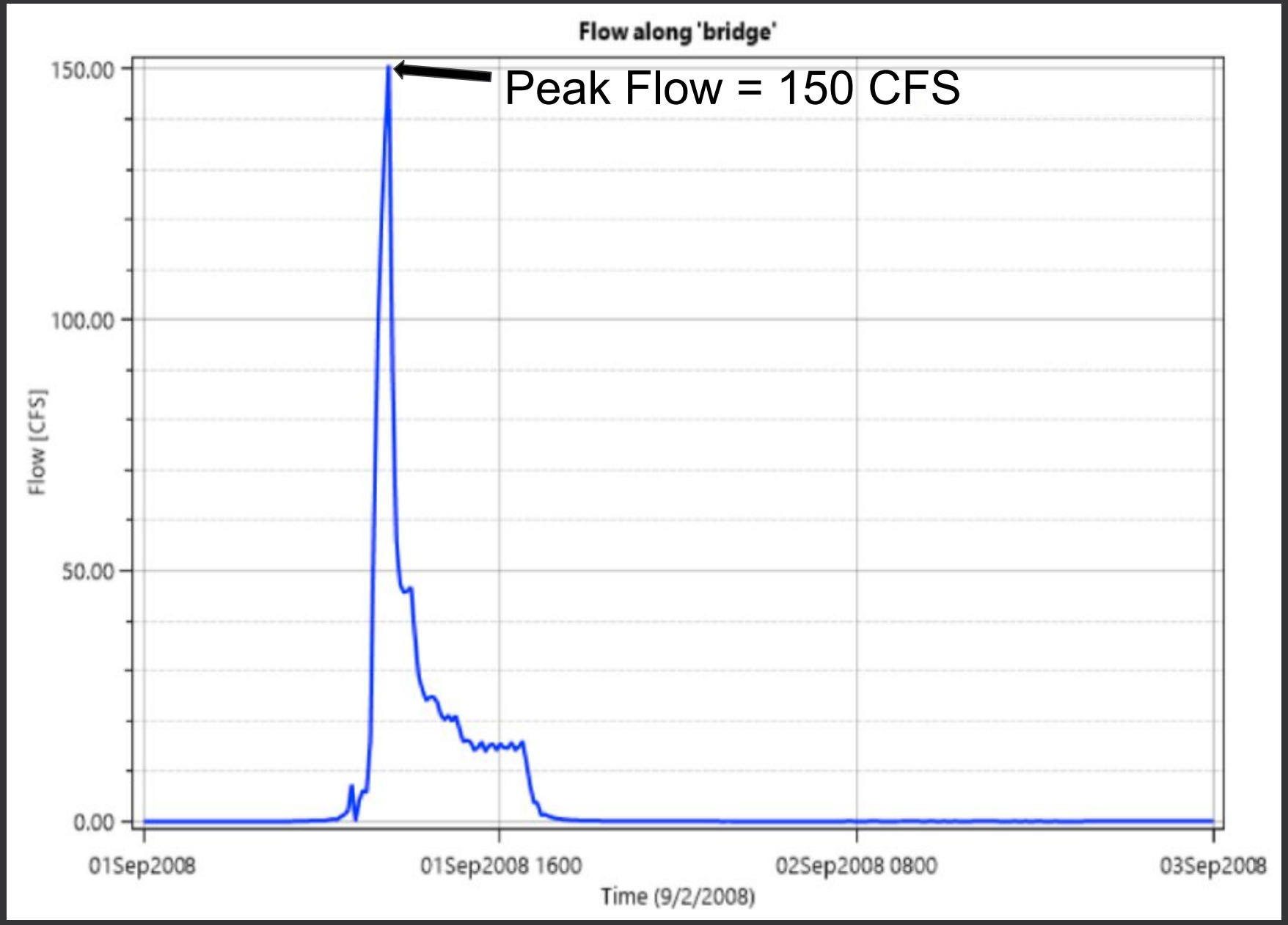
Average Land Slope
- 21.52%

Lomasons Glen Road

Rainfall Data

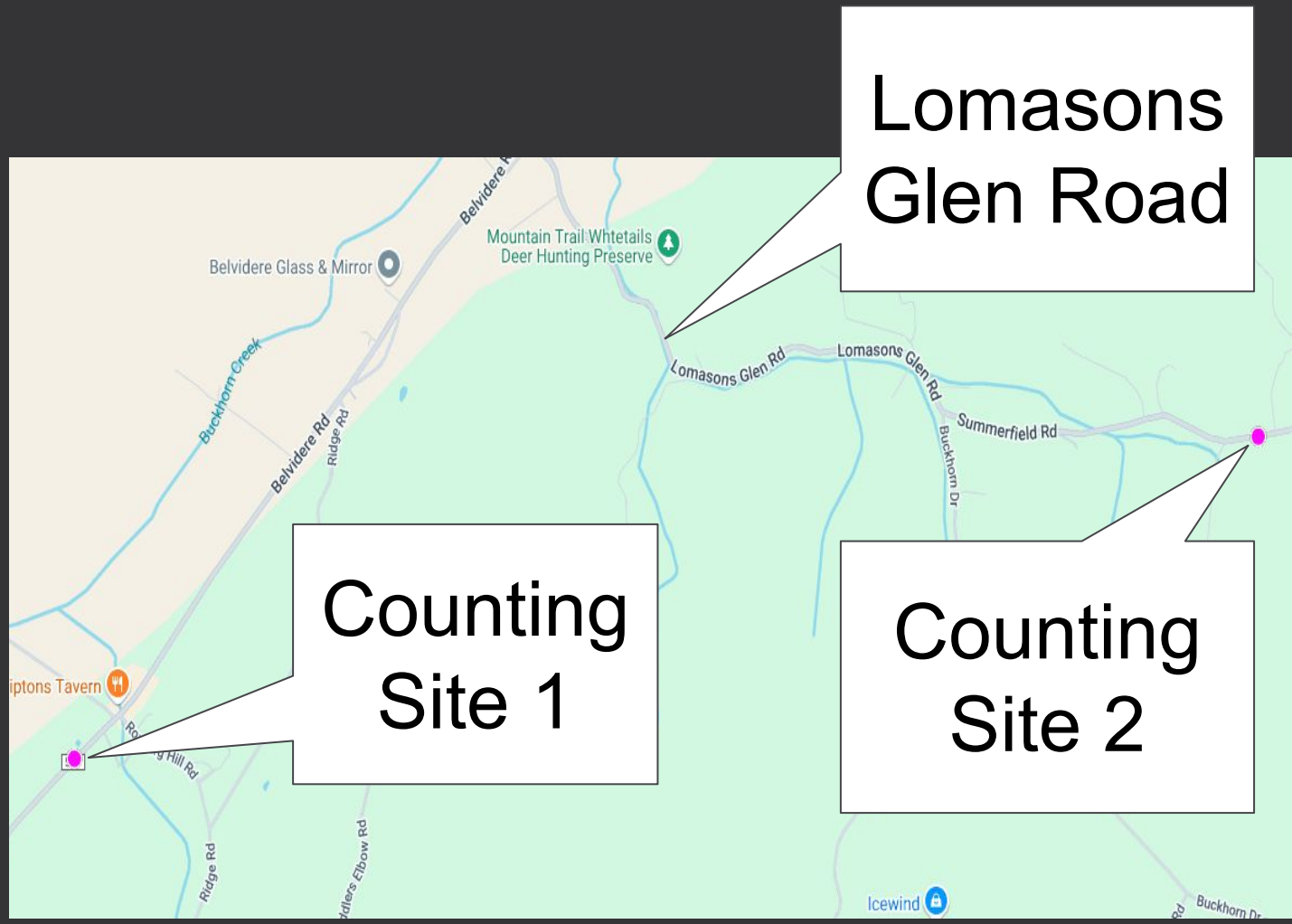


Hydrograph

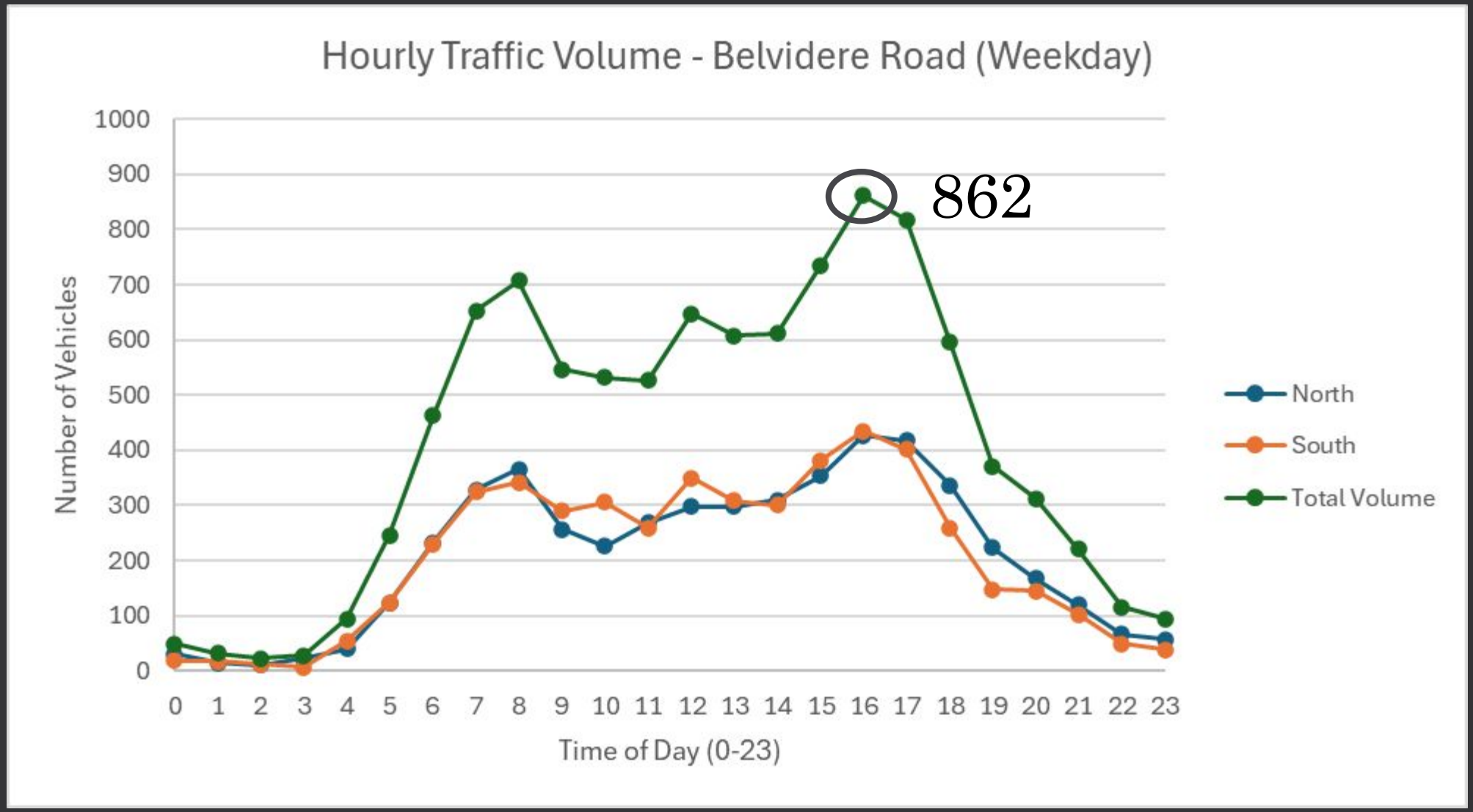

Flow along 'bridge'
Peak Flow = 150 CFS
150.00
100.00
50.00
0.00
Flow [CFS]
01Sep2008
01Sep2008 1600
02Sep2008 0800
03Sep2008
Time (9/2/2008)

Design Constraints (Transportation)

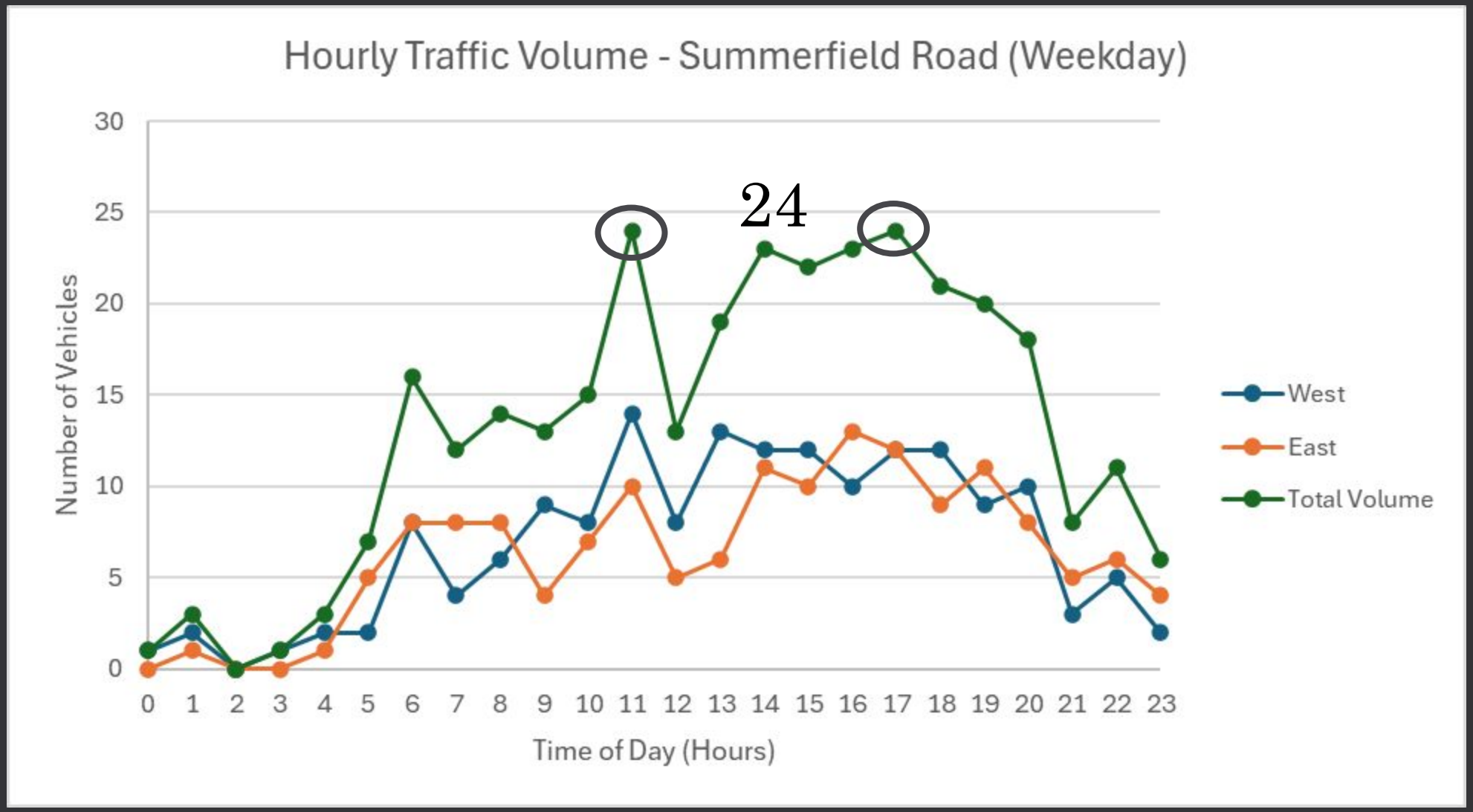
- NJDOT Traffic Counting Sites
- 862 Peak Traffic Hour Vehicles at Site 1
- 24 Peak Traffic Hour Vehicles at Site 2



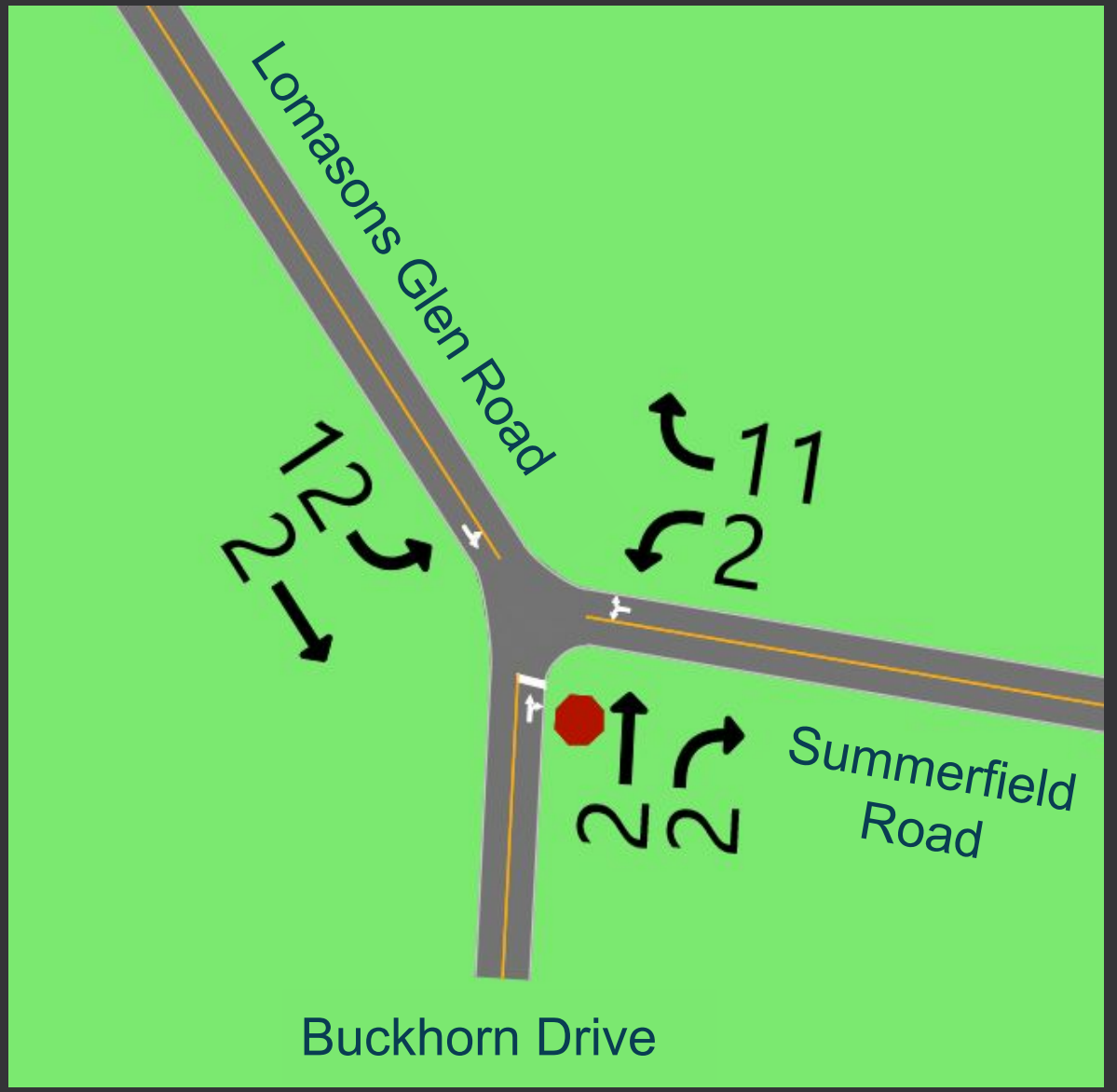
Traffic Count Graph: Belvidere Road (Site 1)



Traffic Count Graph: Summerfield Road (Site 2)



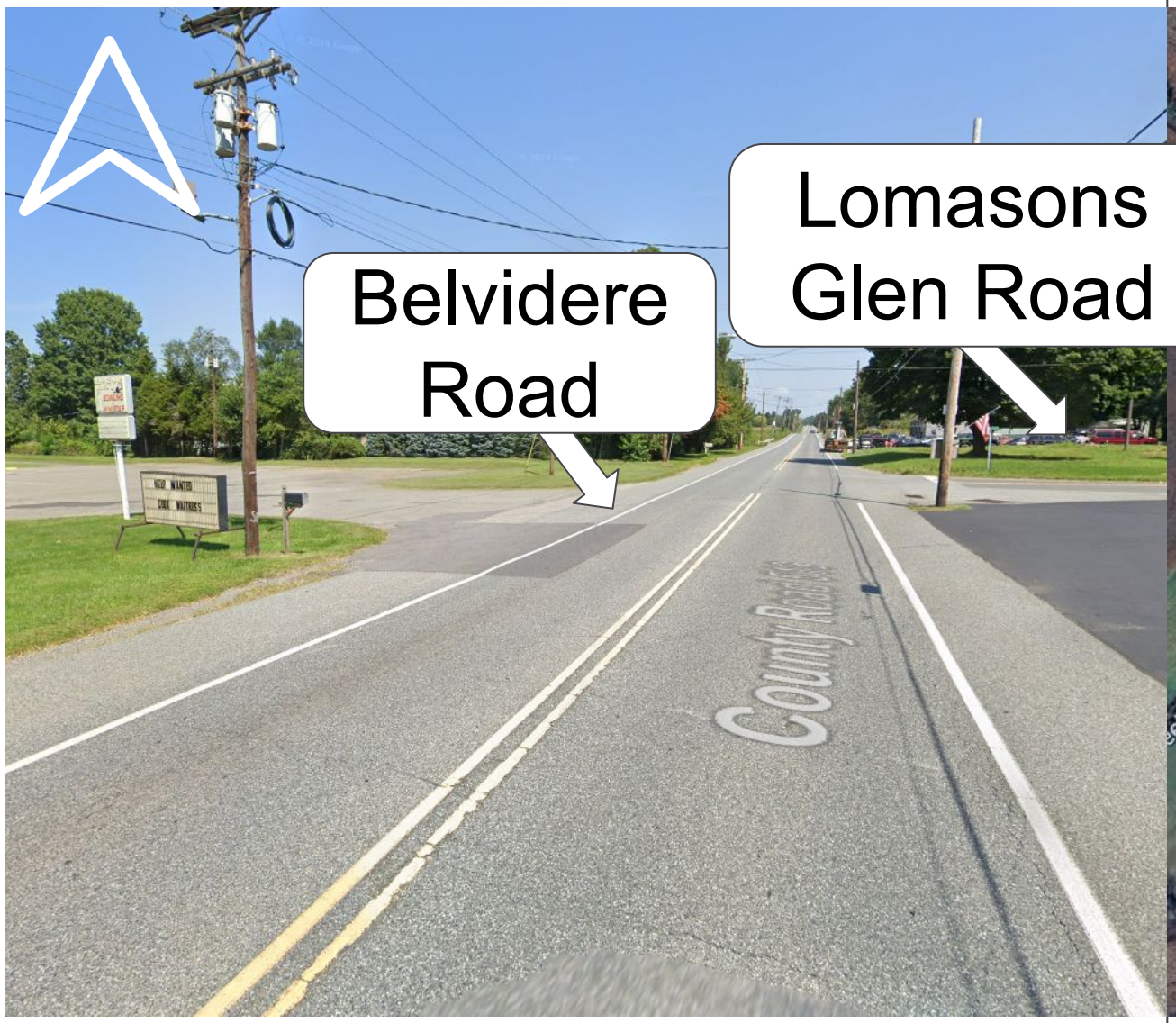
Synchro Model Existing Condition

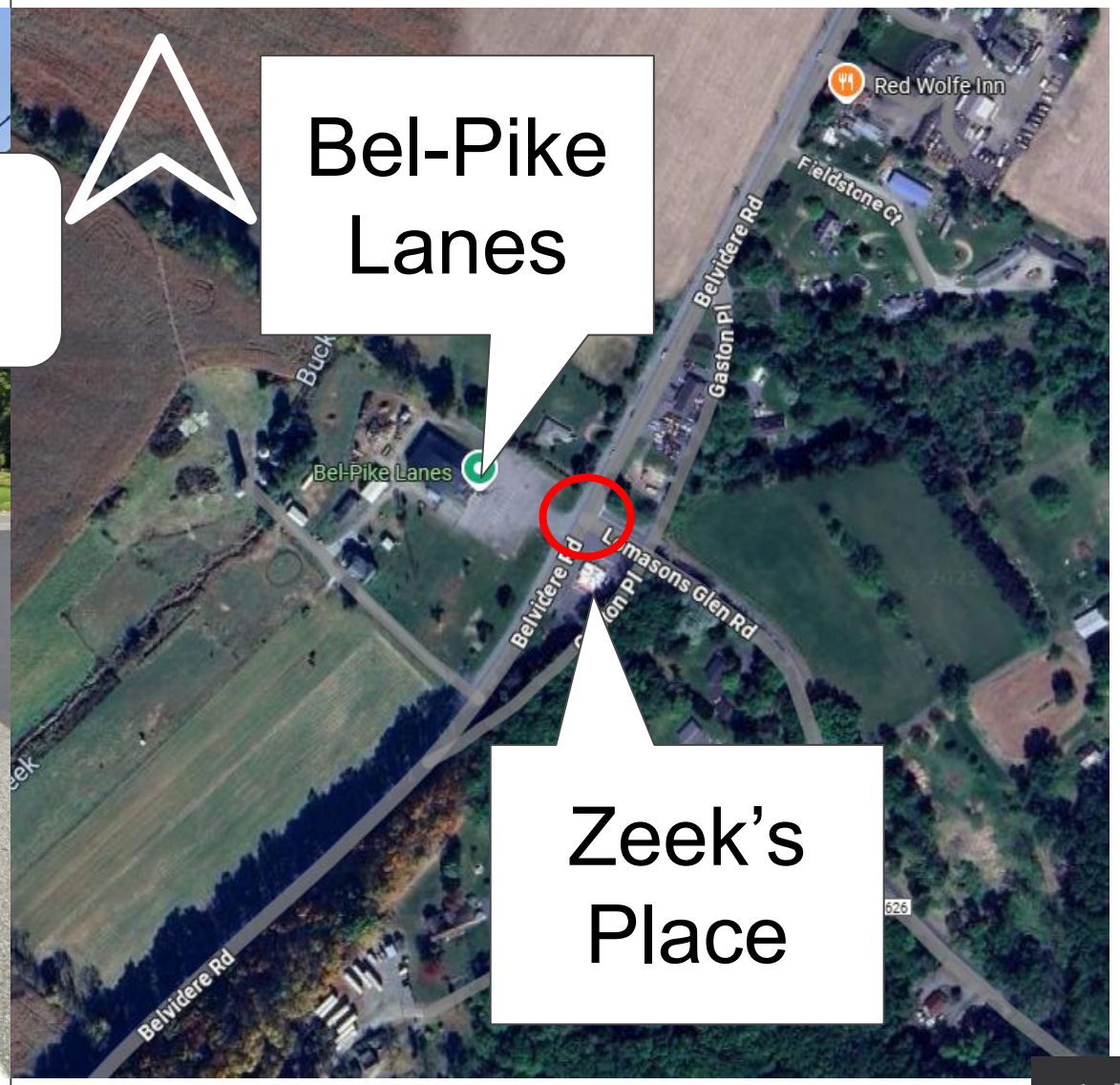


Geometric Design Constraint

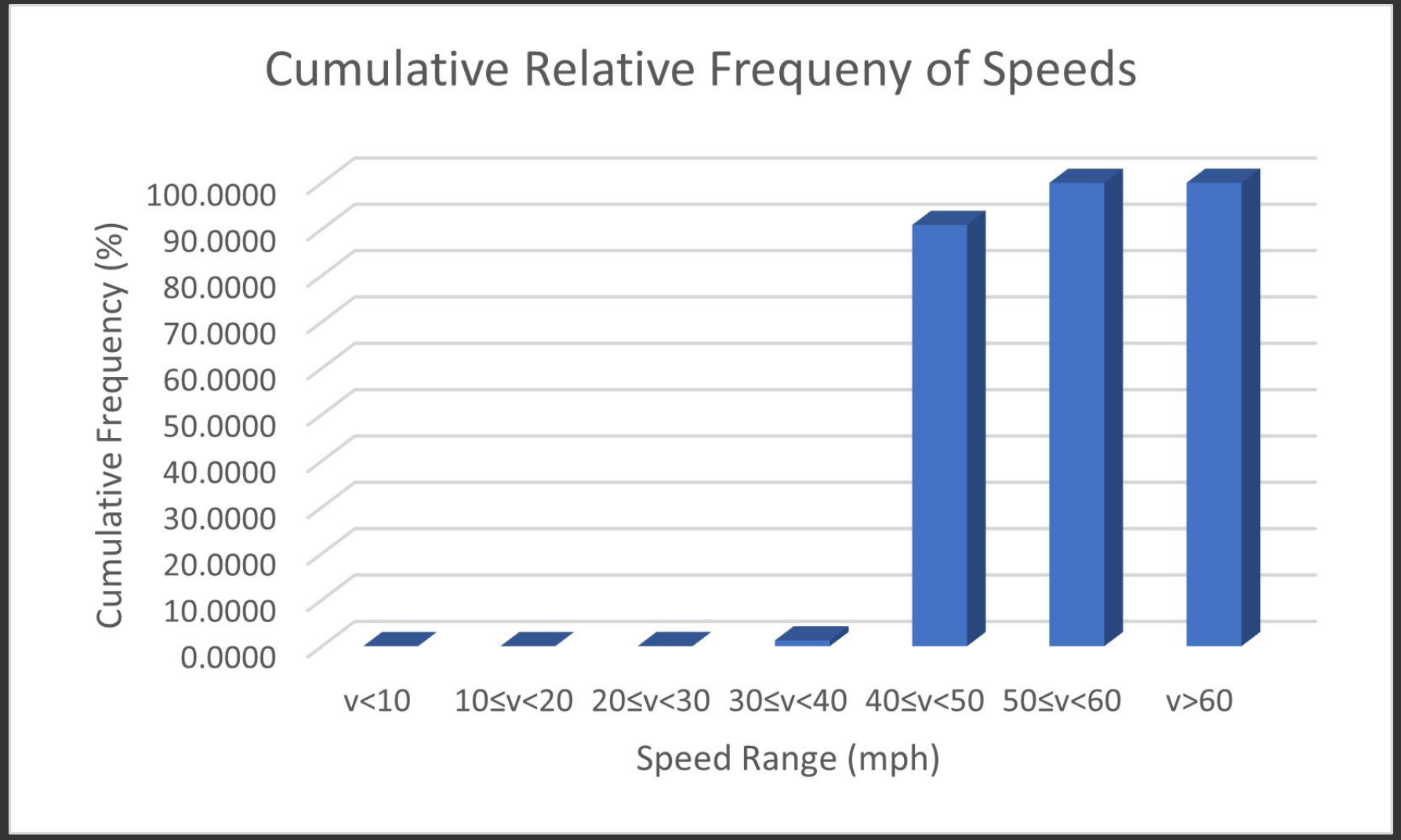
- Pedestrian and Bicyclist Signage

Intersection of Lomasons Glen Road and Belvidere Road



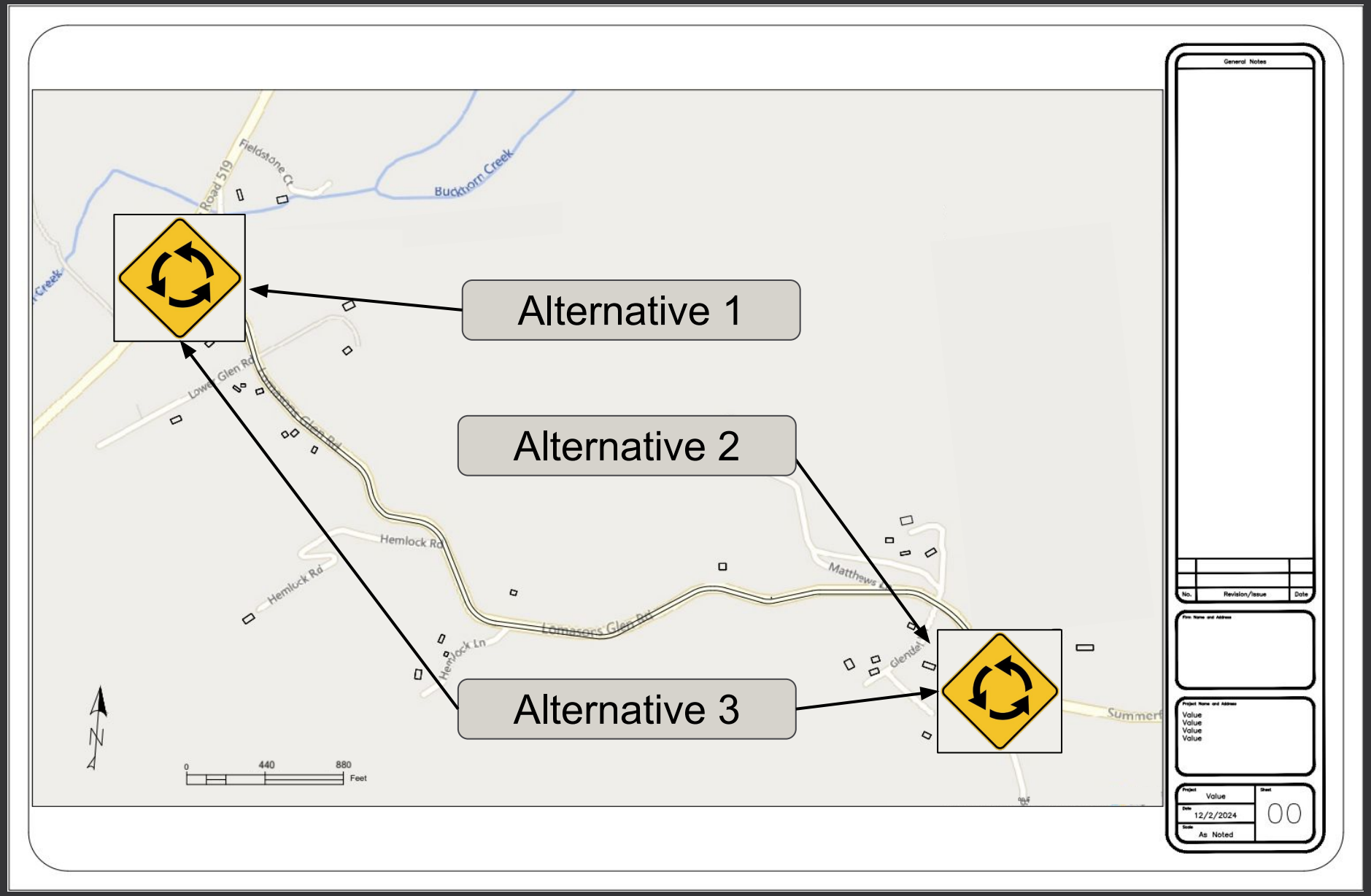


Belvidere Road Speed Data



Intersection of Summerfield Road, Lomasons Glen Road, and Buckhorn Drive

Roundabout Locations



Transportation Design Selection Matrices

Traffic Design					
Type	Constraints	Weight	Belvidere Rd. & Lomasons Glen	Buckhorn Roundabout	Both Intersections
Ethical	Safety	5	2	1	3
Environmental	Resources	4	2	3	2
Economical	Cost	3	2	3	2
Sustainable	Construction	2	2	2	1
	Total		28	30	31

Design Selection

Scour Prevention					
Type	**Constraints**	**Weight**	**Levee**	**Gabion**	**RipRap**
Environmental	**Floodplain Management**	**4**	3	2	2
Economical	**Cost**	**3**	2	3	2
Sustainability	**Recycling of Materials**	**5**	2	2	2
Constructability	**Ease of Construction**	**2**	2	2	3
	Total		**38**	**31**	**30**

Culvert / Bridge Design					
Type	**Constraints**	**Weight**	**Natural Bottom Bridge**	**Box Culvert**	**Pipe Arch**
Water Resources Design	**Stream Stability / Design Flood**	**5**	3	2	3
Environmental	**Water Quality/Ecological Safety**	**4**	3	3	2
Economical	**Cost**	**3**	2	2	1
Constuction	**Land Use / Construction Practices**	**2**	3	2	3
	Total		**37**	**31**	**29**

Hydraulic Design Methodology

- Delineated watershed area using Streamstats
- Utilized HEC-RAS to model a 100-year storm event
- Modeled the peak flow of the river in HEC-RAS
- Developed a detailed river system in HEC-RAS
- Simulated hydraulic flow using HEC-RAS 2-D Unsteady Flow Analysis.

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

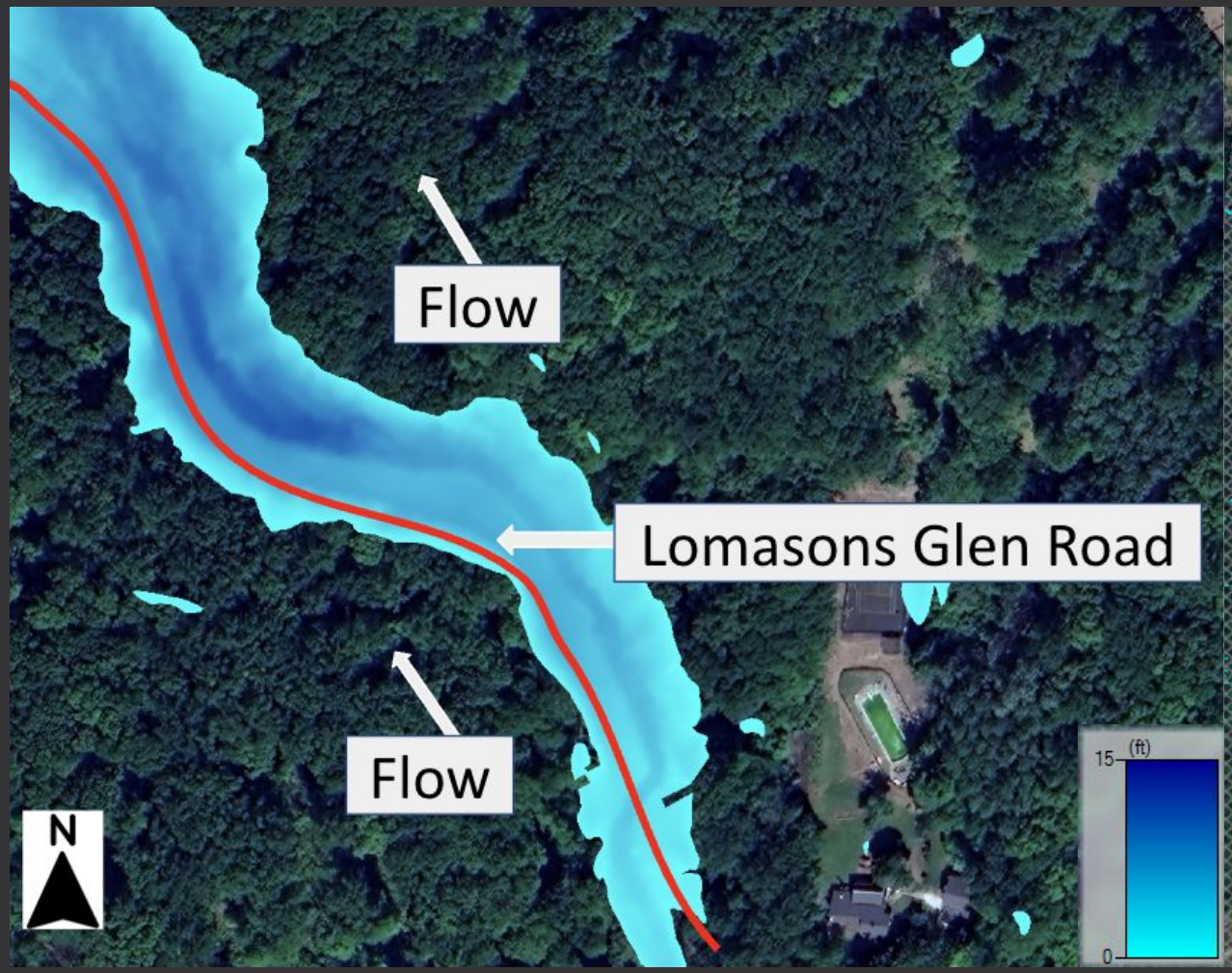
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.323 (0.289-0.360)	0.386 (0.346-0.430)	0.460 (0.411-0.512)	0.517 (0.460-0.574)	0.591 (0.522-0.655)	0.649 (0.570-0.720)	0.711 (0.620-0.791)	0.780 (0.673-0.869)	0.873 (0.743-0.977)	0.952 (0.800-1.07)
10-min	0.515 (0.462-0.574)	0.616 (0.553-0.687)	0.733 (0.655-0.816)	0.821 (0.732-0.912)	0.936 (0.828-1.04)	1.03 (0.902-1.14)	1.12 (0.980-1.25)	1.23 (1.06-1.37)	1.37 (1.17-1.53)	1.49 (1.25-1.68)
15-min	0.643 (0.576-0.716)	0.772 (0.693-0.861)	0.925 (0.827-1.03)	1.04 (0.924-1.15)	1.18 (1.05-1.31)	1.30 (1.14-1.44)	1.42 (1.24-1.58)	1.54 (1.33-1.72)	1.72 (1.46-1.92)	1.86 (1.56-2.10)
30-min	0.877 (0.786-0.978)	1.06 (0.954-1.19)	1.31 (1.17-1.46)	1.50 (1.33-1.66)	1.74 (1.54-1.94)	1.94 (1.71-2.16)	2.16 (1.88-2.40)	2.39 (2.06-2.66)	2.72 (2.31-3.04)	2.99 (2.51-3.37)
60-min	1.09 (0.978-1.22)	1.33 (1.19-1.48)	1.67 (1.50-1.86)	1.94 (1.73-2.16)	2.32 (2.05-2.57)	2.63 (2.31-2.92)	2.96 (2.58-3.29)	3.33 (2.88-3.71)	3.88 (3.30-4.34)	4.35 (3.65-4.90)
2-hr	1.32 (1.19-1.47)	1.61 (1.45-1.78)	2.02 (1.82-2.25)	2.36 (2.11-2.62)	2.85 (2.54-3.16)	3.28 (2.90-3.63)	3.75 (3.29-4.15)	4.28 (3.72-4.75)	5.10 (4.35-5.69)	5.82 (4.89-6.53)
3-hr	1.48 (1.33-1.64)	1.79 (1.61-1.99)	2.23 (2.01-2.48)	2.60 (2.33-2.88)	3.13 (2.79-3.46)	3.58 (3.17-3.97)	4.09 (3.59-4.54)	4.66 (4.05-5.18)	5.54 (4.73-6.18)	6.30 (5.31-7.08)
6-hr	1.90 (1.72-2.11)	2.29 (2.08-2.55)	2.83 (2.57-3.15)	3.29 (2.97-3.65)	3.98 (3.56-4.41)	4.59 (4.07-5.08)	5.28 (4.62-5.84)	6.06 (5.24-6.72)	7.27 (6.18-8.10)	8.35 (6.99-9.34)
12-hr	2.36 (2.14-2.63)	2.85 (2.58-3.17)	3.55 (3.21-3.94)	4.16 (3.74-4.61)	5.07 (4.51-5.61)	5.89 (5.19-6.51)	6.82 (5.94-7.54)	7.90 (6.79-8.75)	9.58 (8.07-10.7)	11.1 (9.18-12.4)
24-hr	2.76 (2.56-2.98)	3.31 (3.08-3.59)	4.15 (3.85-4.48)	4.85 (4.48-5.23)	5.87 (5.40-6.32)	6.74 (6.16-7.25)	7.70 (6.98-8.27)	8.74 (7.86-9.38)	10.3 (9.14-11.0)	11.6 (10.2-12.5)
2-day	3.24 (3.00-3.52)	3.91 (3.63-4.25)	4.89 (4.53-5.32)	5.70 (5.27-6.18)	6.87 (6.31-7.43)	7.84 (7.17-8.47)	8.90 (8.08-9.60)	10.0 (9.05-10.8)	11.7 (10.4-12.6)	13.1 (11.6-14.1)
3-day	3.40 (3.17-3.68)	4.10 (3.82-4.43)	5.12 (4.76-5.53)	5.96 (5.52-6.42)	7.16 (6.61-7.71)	8.17 (7.50-8.78)	9.25 (8.45-9.94)	10.4 (9.46-11.2)	12.1 (10.9-13.0)	13.6 (12.1-14.6)
4-day	3.57 (3.34-3.84)	4.30 (4.01-4.62)	5.35 (4.99-5.75)	6.21 (5.78-6.67)	7.45 (6.91-7.98)	8.49 (7.84-9.09)	9.61 (8.82-10.3)	10.8 (9.87-11.6)	12.6 (11.3-13.5)	14.0 (12.6-15.0)
7-day	4.21 (3.94-4.51)	5.05 (4.72-5.41)	6.22 (5.81-6.66)	7.20 (6.71-7.69)	8.60 (7.99-9.18)	9.78 (9.05-10.4)	11.0 (10.2-11.8)	12.4 (11.3-13.2)	14.4 (13.0-15.4)	16.0 (14.4-17.1)
10-day	4.87 (4.57-5.20)	5.81 (5.45-6.20)	7.07 (6.62-7.54)	8.08 (7.56-8.61)	9.52 (8.88-10.1)	10.7 (9.94-11.4)	11.9 (11.0-12.7)	13.2 (12.2-14.1)	15.1 (13.8-16.1)	16.6 (15.0-17.7)
20-day	6.55 (6.19-6.94)	7.76 (7.34-8.22)	9.23 (8.72-9.78)	10.4 (9.81-11.0)	12.0 (11.3-12.7)	13.3 (12.4-14.0)	14.6 (13.6-15.4)	15.9 (14.8-16.8)	17.7 (16.4-18.8)	19.2 (17.6-20.4)
30-day	8.17 (7.74-8.61)	9.63 (9.12-10.1)	11.2 (10.6-11.8)	12.4 (11.8-13.1)	14.1 (13.3-14.8)	15.3 (14.5-16.2)	16.6 (15.6-17.5)	17.9 (16.7-18.9)	19.6 (18.2-20.7)	20.9 (19.4-22.1)
45-day	10.4 (9.89-10.9)	12.2 (11.6-12.8)	14.0 (13.3-14.7)	15.3 (14.6-16.1)	17.1 (16.3-18.0)	18.4 (17.5-19.4)	19.7 (18.7-20.7)	20.9 (19.8-22.1)	22.5 (21.2-23.8)	23.7 (22.3-25.1)
60-day	12.5 (11.9-13.1)	14.6 (13.9-15.3)	16.6 (15.8-17.4)	18.1 (17.3-19.0)	20.1 (19.1-21.1)	21.5 (20.5-22.6)	22.9 (21.7-24.0)	24.2 (22.9-25.4)	25.9 (24.4-27.2)	27.1 (25.5-28.6)

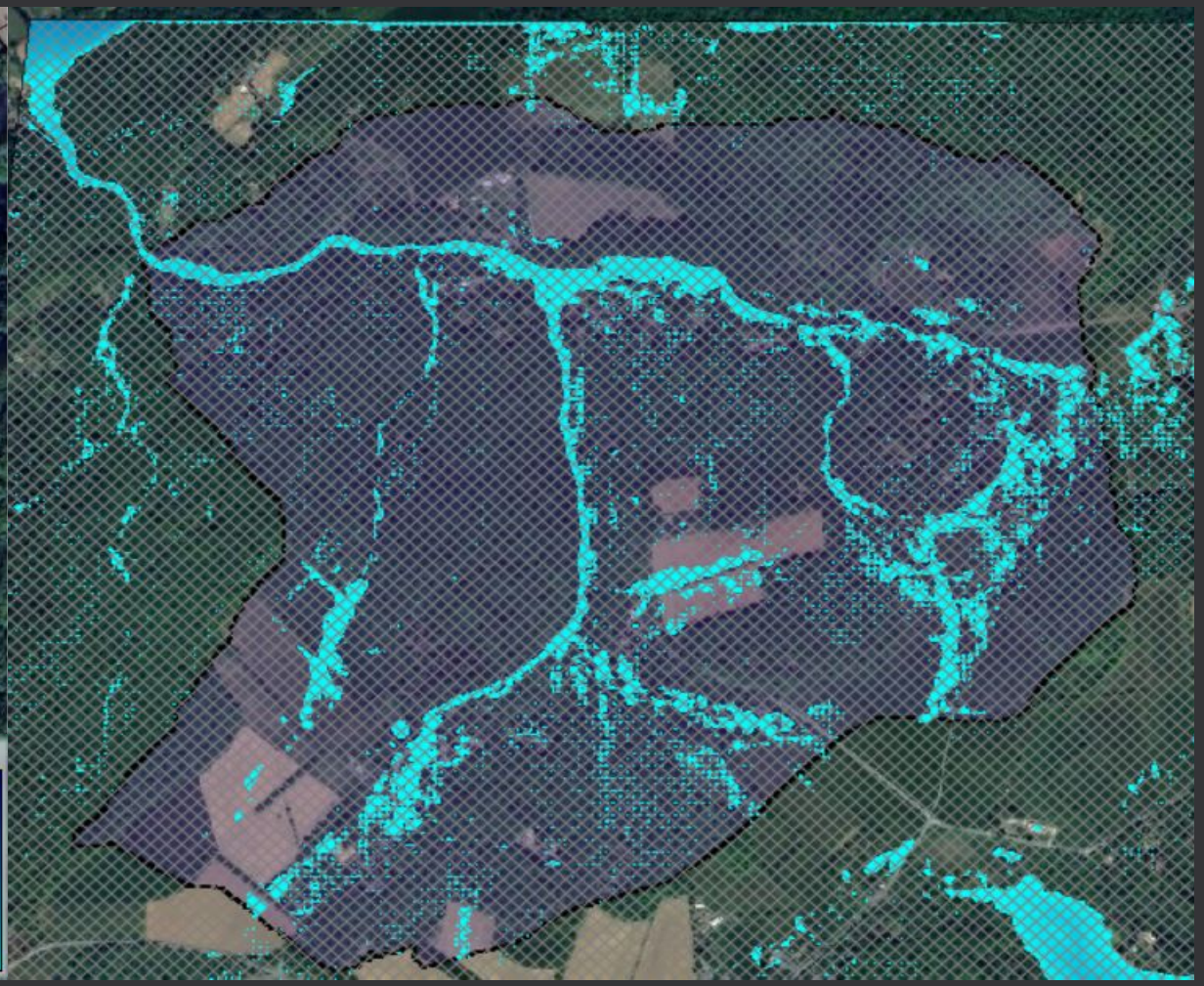
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

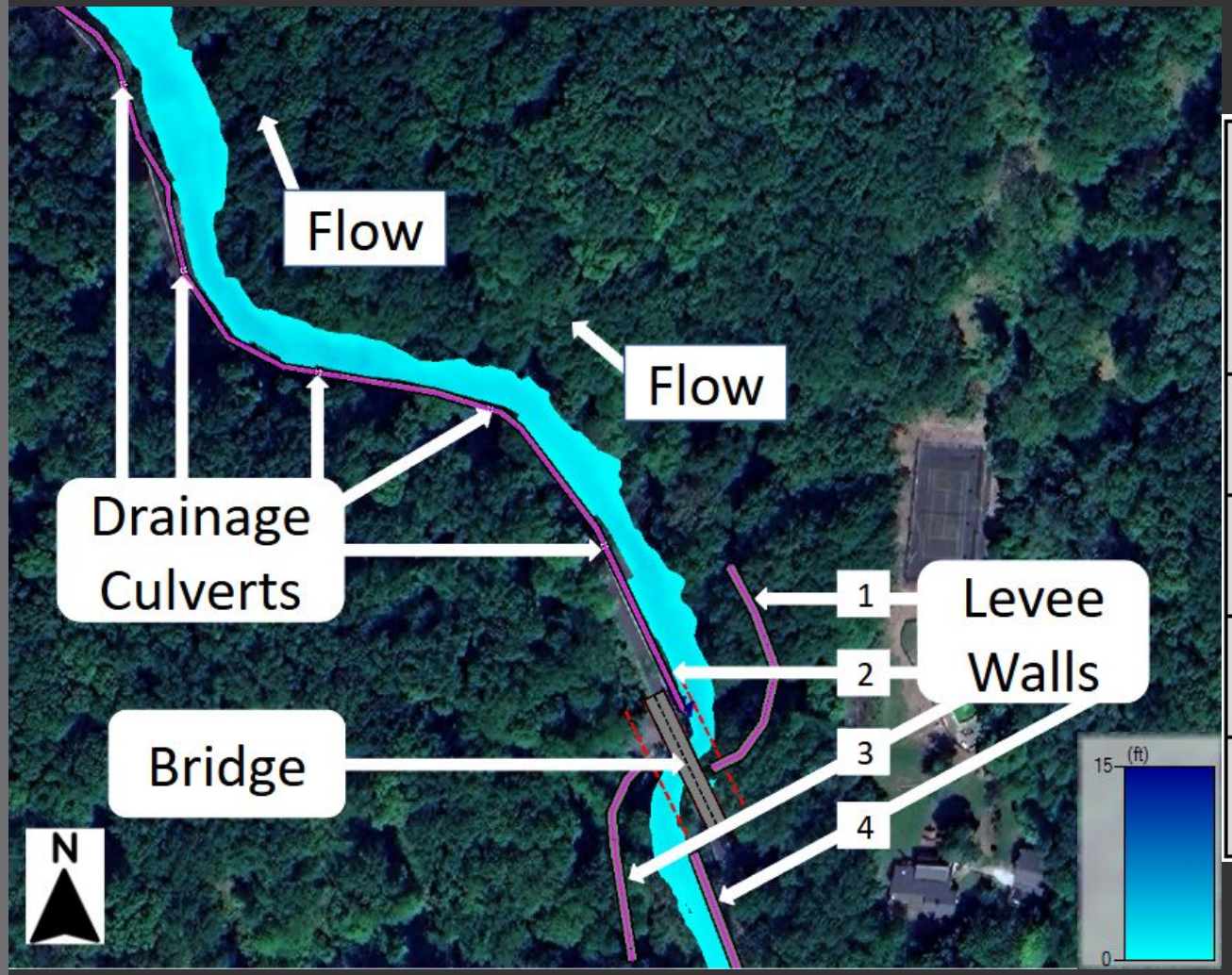
Please refer to NOAA Atlas 14 document for more information.

Existing Floodplain of a 100-Year Storm Event



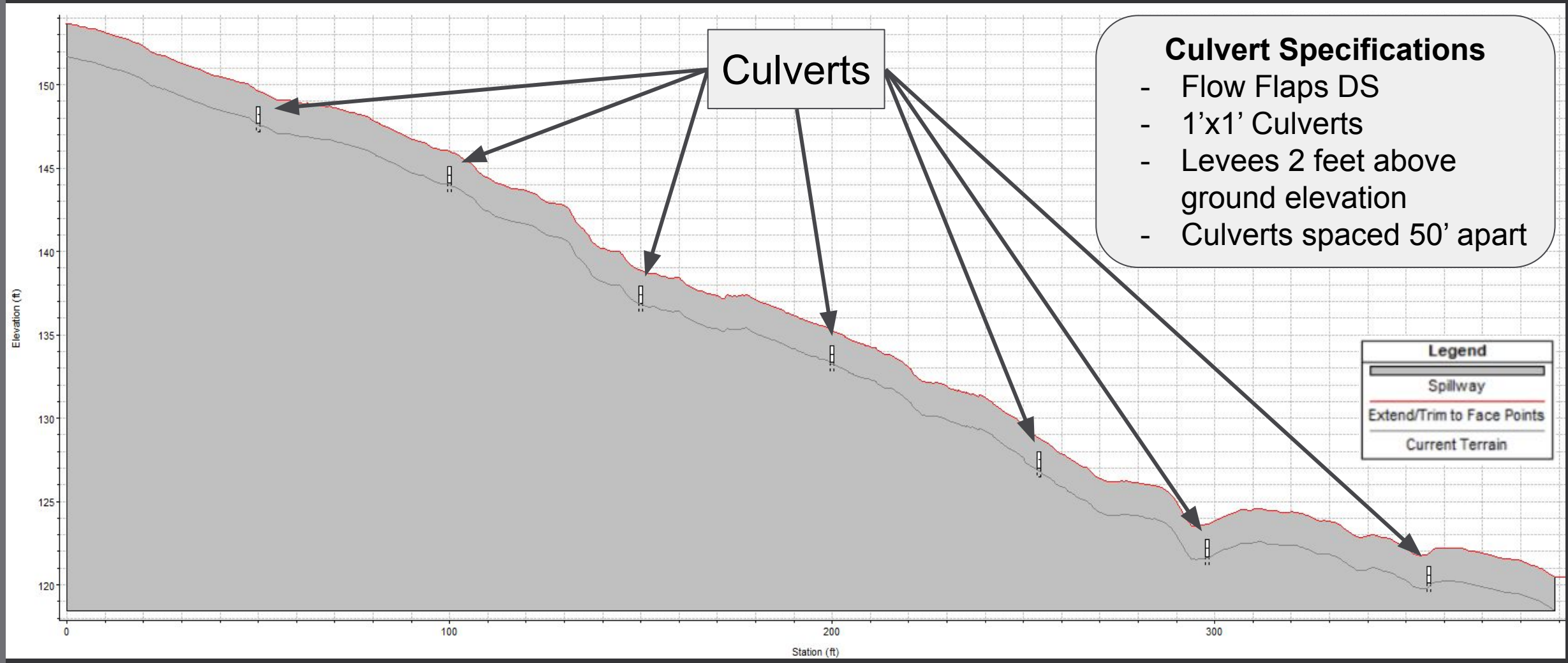


Modified Floodplain of a 100-Year Storm Event

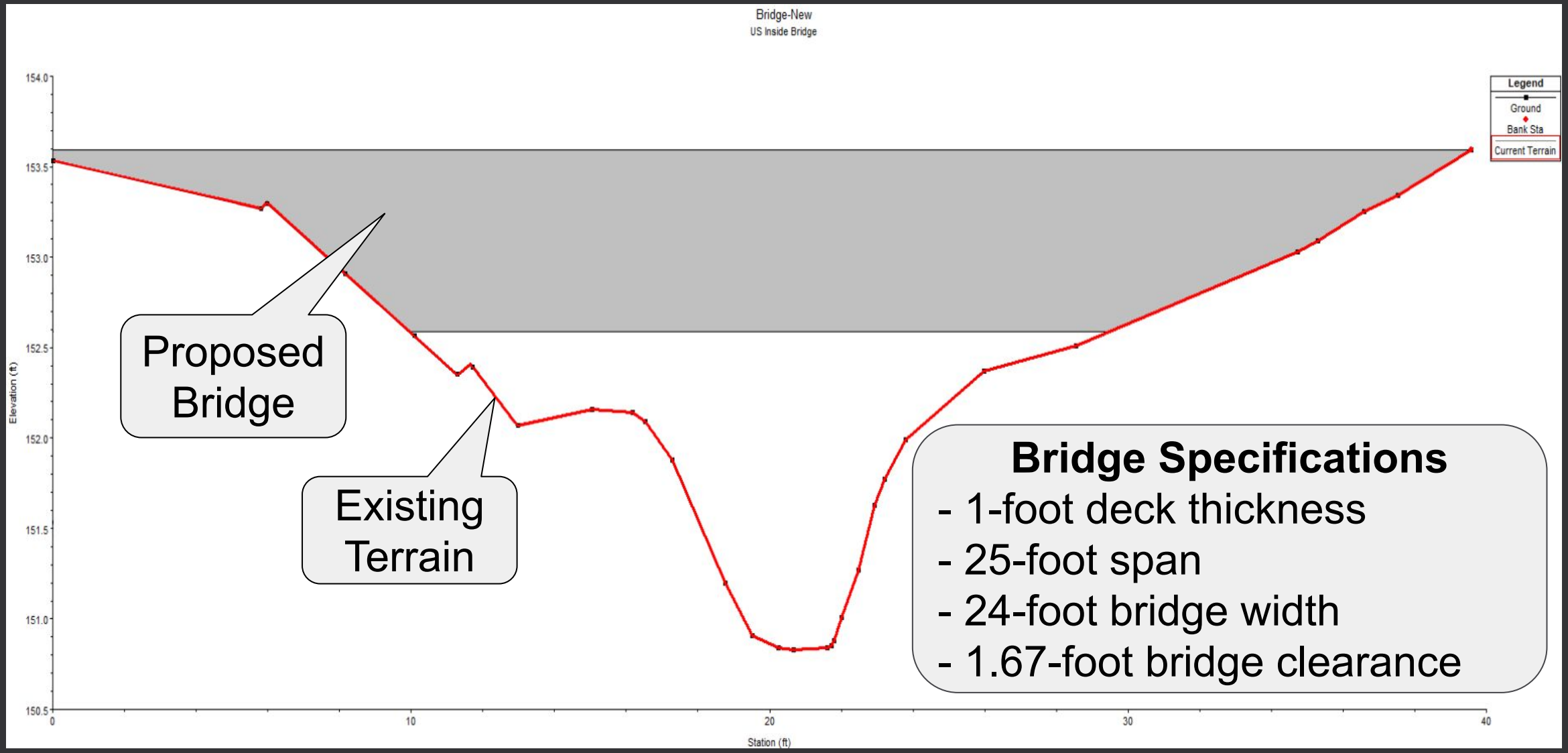


Levee Wall	Total Length (ft)	Upstream Elevation (ft)	Downstream Elevation (ft)
1	70	153.80	151.70
2	390	151.70	118.50
3	60	165.50	153.30
4	160	157.90	153.80

Cross Section of Levee



Cross Section of Proposed Bridge



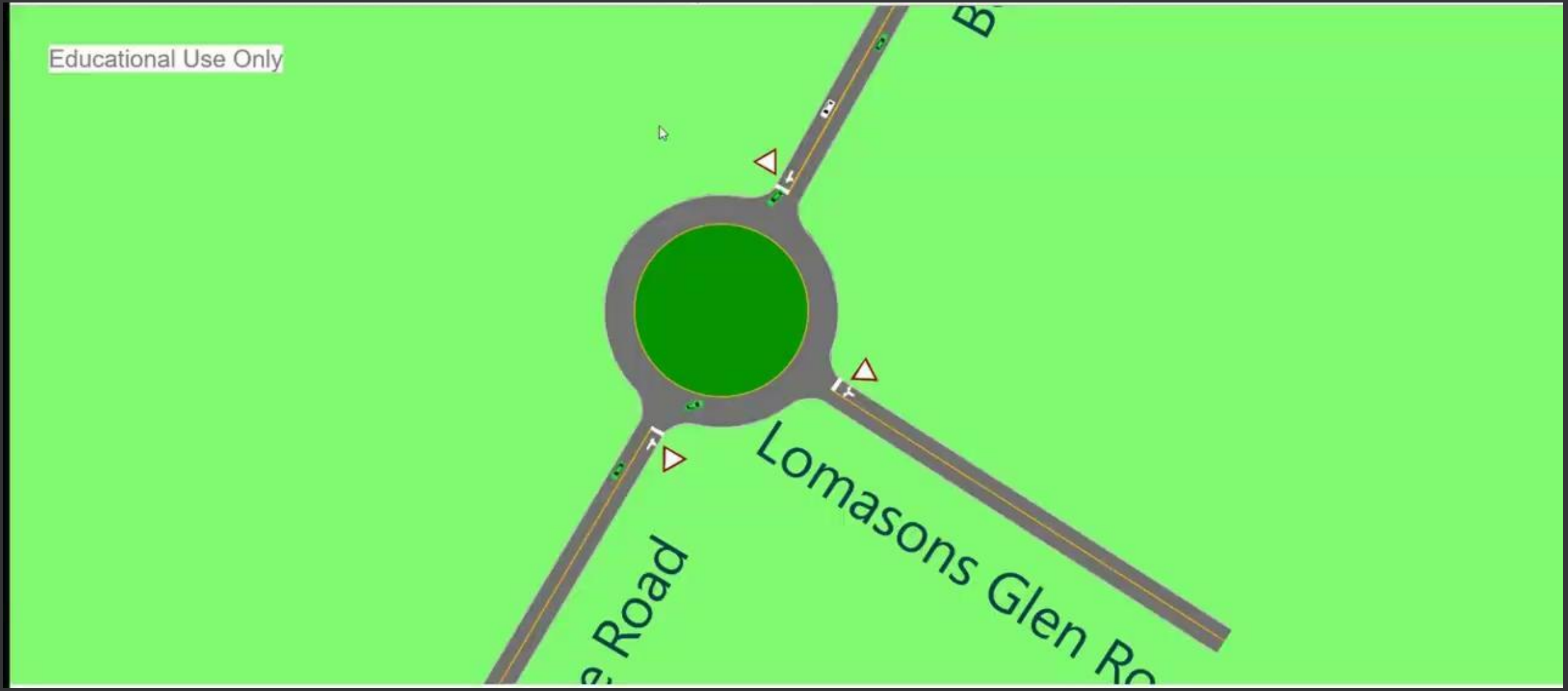
Transportation Design Methodology

- Obtaining Tax Maps (GIS)
- Roundabout Style Consideration
- Synchro
- CAD Drafting
- Consider Signage

Belvidere Road & Lomasons Glen Road

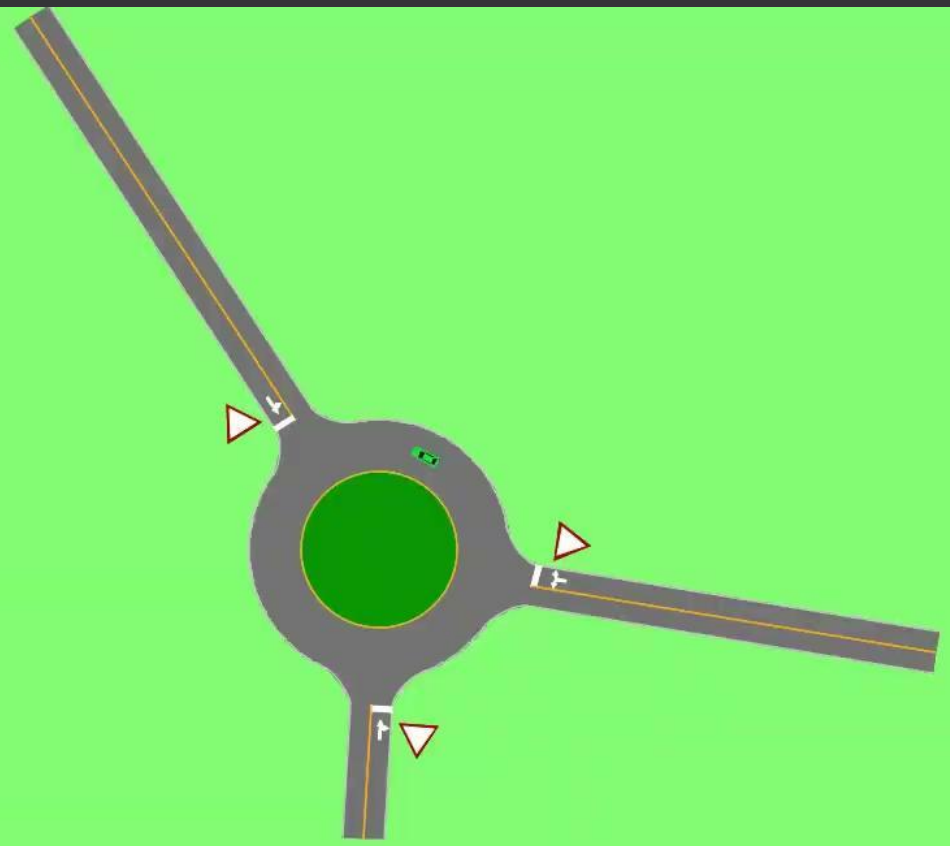
Lomasons Glen Road, Summerfield Road, & Buckhorn Drive

Roundabout 1 Proposed Traffic Model

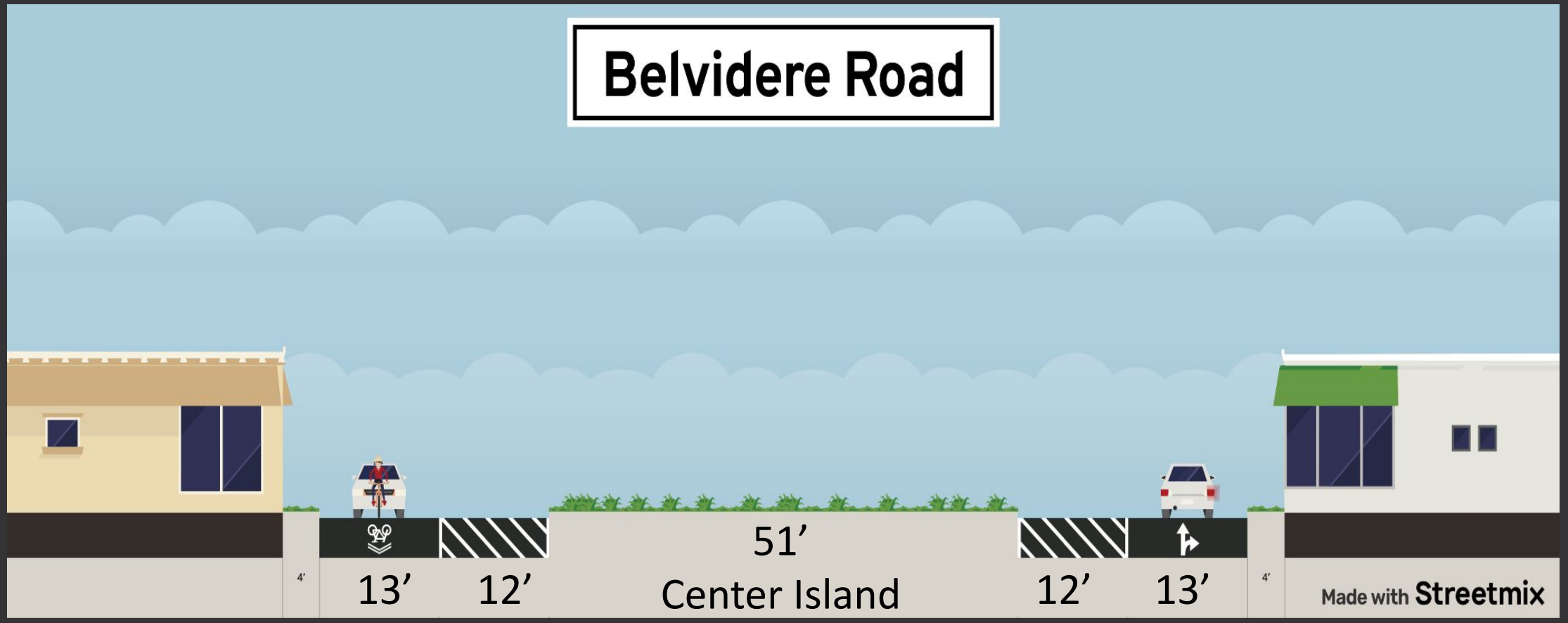


Roundabout 2 Proposed Traffic Model

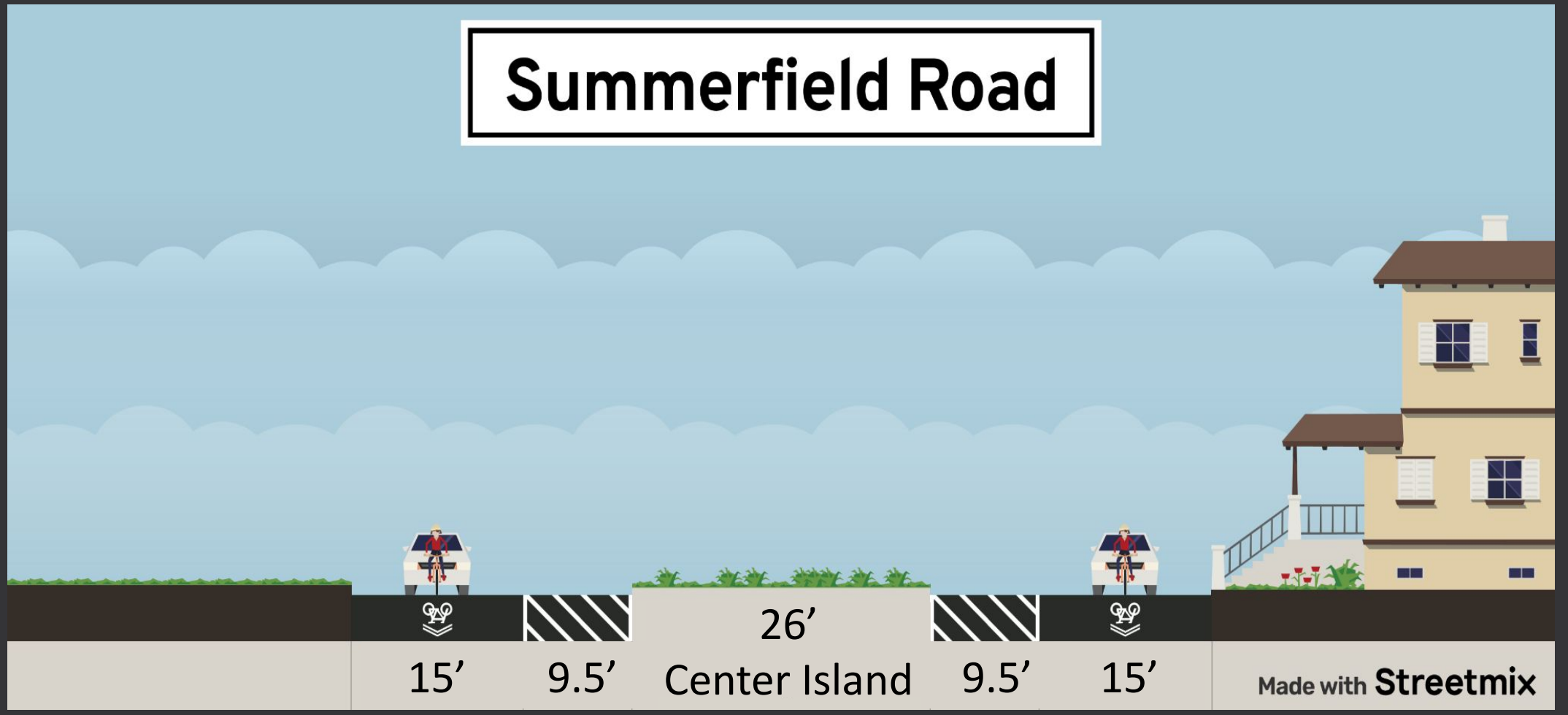
Educational Use Only



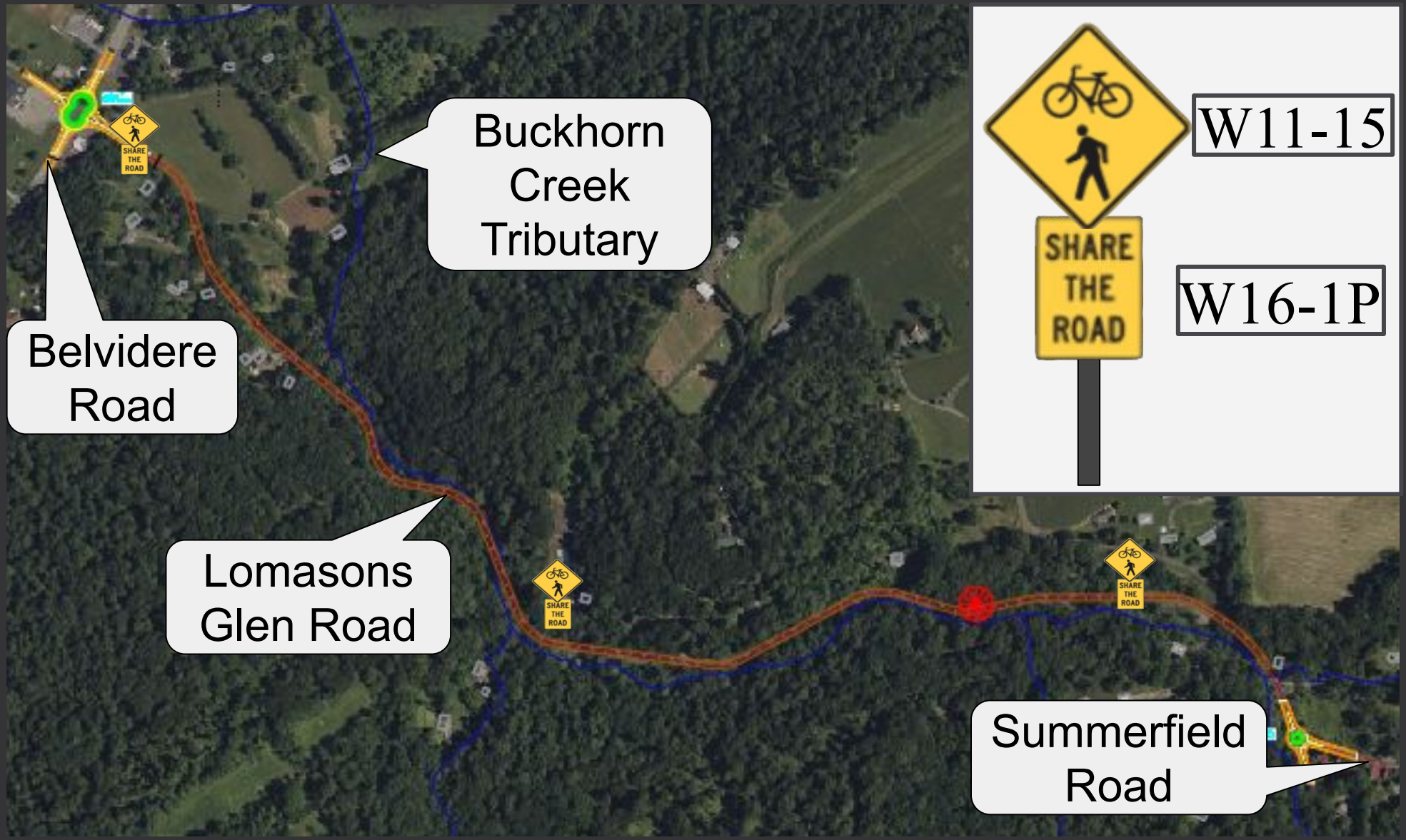
Roundabout 1 Cross Section (Belvidere Road)



Roundabout 2 Cross Section (Summerfield Road)



Signage


Buckhorn Creek Tributary
Belvidere Road
Lomasons Glen Road
Summerfield Road
SHARE THE ROAD
W11-15
SHARE THE ROAD
W16-1P

Fall 2025 Budget

Fall						
Task	Dr. Horst	Dr. Brennan	Louis Turner	Michael Harrison	Antonio Gonzalez	Daniel Geissler
	Water Resources Director	Transportation Director	Project Engineer/Team Leader	Project Engineer	Project Engineer	Project Engineer
	Academic Advisor	Academic Advisor	Level II Engineer	Level I Engineer	Level I Engineer	Level I Engineer
Site Visit	0	0	2	0	0	0
Research	15	10	20	20	20	20
Proposal Presentation	1	1	5	5	5	5
Plan Drafting	0	1	1	1	2	3
Alt Design Research	0	0	4	4	4	4
Constraint Analysis	1	1	2	2	2	2
Quarterly Report	1	1	3	3	3	3
Engineering Services Presentation	1	1	2	3	2	2
Engineering Services Report	1	1	4	4	4	4
Total Hours	20	16	43	42	42	43
Hourly Rate	$80.00	$80.00	$35.00	$30.00	$30.00	$30.00
Salaries	$1,600.00	$1,280.00	$1,505.00	$1,260.00	$1,260.00	$1,290.00

Wages Cost		$8,195.00
Overhead	150%	$12,292.50
Fixed Fee	10%	$2,048.75
Direct Cost		$0.00
Total		$23,000

Spring 2025 Budget

Spring						
Task	Dr. Horst	Dr. Brennan	Louis Turner	Michael Harrison	Antonio Gonzalez	Daniel Geissler
	Water Resources Director	Transportation Director	Project Engineer/Team Leader	Project Engineer	Project Engineer	Project Engineer
	Academic Advisor	Academic Advisor	Team Leader	Team Member	Team Member	Team Member
Site Visit	0	0	2	0	0	0
Research	8	8	20	18	18	20
Design Work	0	0	16	14	14	12
Poster Presentation	0	0	8	9	9	10
Quarterly Report	1	1	12	11	11	10
Abstract	1	2	2	2	2	2
Final Presentation	0	0	10	10	10	10
Final Report	4	4	8	8	8	8
Total Hours	9	9	78	72	72	72
Hourly Rate	80	80	35	30	30	30
Salaries	720	720	2730	2160	2160	2160

Wages Cost		$10,650.00
Overhead	150%	$15,975.00
Fixed Fee	10%	$2,662.50
Direct Cost		$0.00
Total		$29,000

Construction Cost Estimate

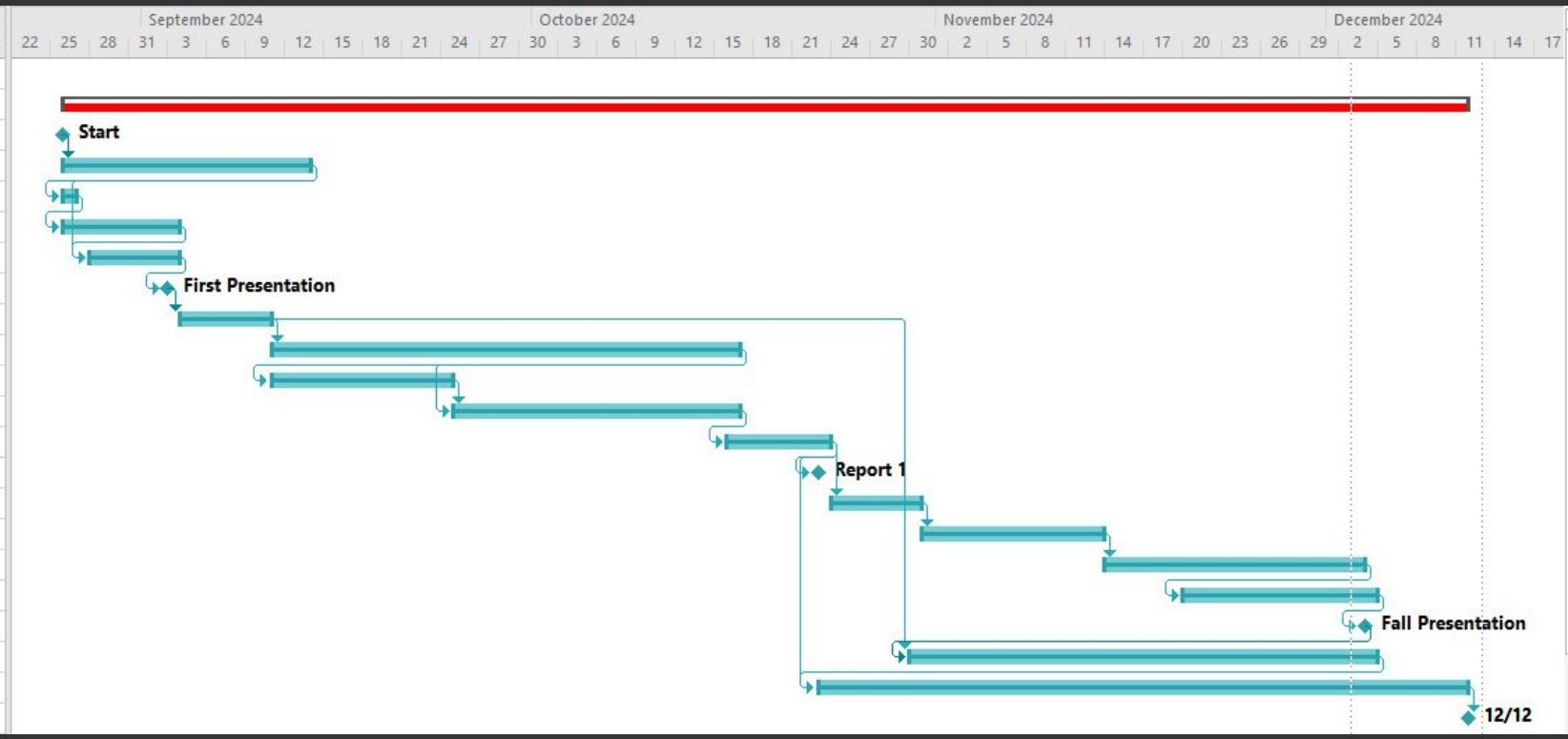
Construction Cost Estimate			
Work Item	**Unit Cost ($)**	**Quantity**	**Total Cost ($)**
Site Work			
Peanut RAB - Asphalt Paving	$5.00	5969 SF	$29,845.00
Circular RAB - Asphalt Paving	$5.00	3887 SF	$19,435.00
Roadway - Asphalt Paving	$5.00	72000 SF	$360,000.00
Roadway - Traffic Control Setup	LS	1	$12,000.00
Levee Walls - Precast Wall Panels	$130.00	750 LF	$97,500.00
Levee Walls - Footings & Compacted Base	$50.00	750 SF	$37,500.00
Levee Walls - Crane Rental (10 days)	$2,000.00	10 Days	$20,000.00
Bridge - Precast Modular Units	$160.00	2 EA	$96,000.00
Bridge - Abutment Excavation & Formwork	LS	1 EA	$18,000.00
Bridge - Crane Rental (5 days)	$2,500.00	5 Days	$12,500.00
CAT AP555F Asphalt Paver (40 days)	$1,500.00	40 Days	$60,000.00
CAT CB64 Roller (40 days)	$1,000.00	40 Days	$40,000.00
Dump Trucks (80 days)	$600.00	80 Days	$48,000.00
Hydraulic Crane (Walls + Bridge)	LS	1	$32,500.00

	Crew Members	Hourly Pay	Weekly Hours	Days	Labor Cost
Levee Walls - Labor Crew	4	$45	8	10	$14,400
Bridge - Labor Crew	5	$55	8	5	$11,000
Paving Crew	5	$50	8	21	$42,000
Wall Crew	4	$45	8	10	$14,400
Bridge Crew	3	$55	8	5	$6,600
Earthwork Crew	4	$45	8	21	$30,240
				Total Labor Cost	$118,640

Earthwork			
Peanut RAB - Subbase & Compaction	$2.25	5969 SF	$13,430.00
Circular RAB - Minor Excavation	$1.50	3887 SF	$5,830.00
Circular RAB - Subbase & Compaction	$2.25	3887 SF	$8,746.00
Roadway - Subgrade Stabilization	$2.25	72000 SF	$162,000.00
Bridge - Abutment Excavation & Formwork	LS	1 EA	$18,000.00
CAT 320 Excavator (60 days)	$800.00	60 Days	$48,000.00
CAT D6 Bulldozer (40 days)	$900.00	40 Days	$36,000.00
Total Labor Cost	LS	1	$118,640.00
	TOTAL PROJECT COST		$1,293,926.00
	Contingency (20%)		$258,785.20
	GRAND TOTAL (with Contingency)		$1,552,711.00

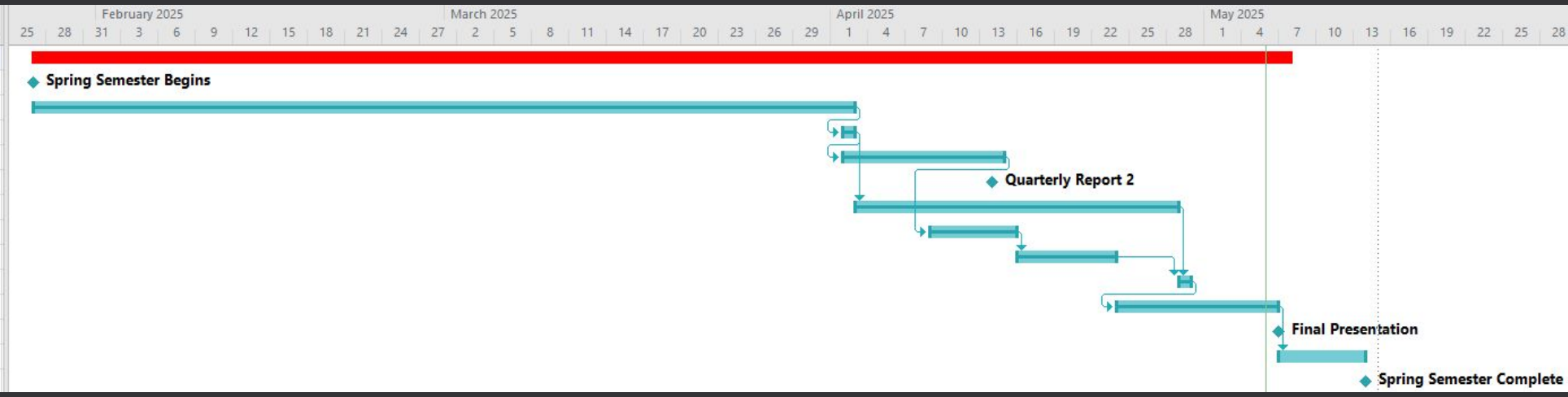
Fall 2025 Semester Gantt Chart

Task Name	Duration	Start	Finish
Total Project			
Fall Semester	**78 days**	**Mon 8/26/24**	**Wed 12/11/24**
Start	0 days	Mon 8/26/24	Mon 8/26/24
Research	15 days	Mon 8/26/24	Fri 9/13/24
Site Visit	1 day	Mon 8/26/24	Mon 8/26/24
Site Location Plans	7 days	Mon 8/26/24	Tue 9/3/24
Problem Statement & Background Presentation	5 days	Wed 8/28/24	Tue 9/3/24
First Presentation	0 days	Tue 9/3/24	Tue 9/3/24
Initial Website	5 days	Wed 9/4/24	Tue 9/10/24
Alternative Design Research	26 days	Wed 9/11/24	Wed 10/16/24
Realistic & Design Constraint Analysis	10 days	Wed 9/11/24	Tue 9/24/24
Alternative Designs & Constraints Presentation	16 days	Wed 9/25/24	Wed 10/16/24
Quarterly Report #1	6 days	Wed 10/16/24	Wed 10/23/24
Report 1	0 days	Wed 10/23/24	Wed 10/23/24
Optimal Design Selection	5 days	Thu 10/24/24	Wed 10/30/24
Abstract	10 days	Thu 10/31/24	Wed 11/13/24
Estimate of Engineering Costs & Schedule	14 days	Thu 11/14/24	Tue 12/3/24
Engineering Services Proposal Presentation	11 days	Wed 11/20/24	Wed 12/4/24
Fall Presentation	0 days	Wed 12/4/24	Wed 12/4/24
Final Website	26 days	Wed 10/30/24	Wed 12/4/24
Final Fall Report	36 days	Wed 10/23/24	Wed 12/11/24
Fall Semester Complete	0 days	Thu 12/12/24	Thu 12/12/24



Spring 2025 Semester Gantt Chart

Task Name	Duration	Start	Finish
Sring Semester	**73 days**	**Mon 1/27/25**	**Wed 5/7/25**
Spring Semester Begins	0 days	Mon 1/27/25	Mon 1/27/25
Finish Design	48 days	Mon 1/27/25	Wed 4/2/25
Poster Presentation	1 day	Wed 4/2/25	Wed 4/2/25
Quarterly Report #2	9 days	Wed 4/2/25	Mon 4/14/25
Quarterly Report 2	0 days	Mon 4/14/25	Mon 4/14/25
Finish Poster	18 days	Thu 4/3/25	Mon 4/28/25
Draft Abstract	5 days	Wed 4/9/25	Tue 4/15/25
Final Abstract	6 days	Wed 4/16/25	Wed 4/23/25
COSA	1 day	Tue 4/29/25	Tue 4/29/25
Final Presentation	9 days	Thu 4/24/25	Tue 5/6/25
Final Presentation	0 days	Wed 5/7/25	Wed 5/7/25
Final Report	5 days	Wed 5/7/25	Tue 5/13/25
Spring Semester Complete	0 days	Wed 5/14/25	Wed 5/14/25



Thank you.

Questions?