US-40 WIDENING

Civil Engineering Capstone Spring 2025

UVU CIVIL ENGINEERING

UDOT Keeping Utah Moving

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Project Scope

The US-40 Widening Capstone Project is geared towards designing to enhance roadway safety, efficiency of traffic, and compliance with current UDOT standards. Given the high volume of truck traffic, key improvements include the addition of a Two-Way Left-Turn Lane (TWLTL) specifically for semi-trucks and large vehicles, widened shoulders, and extended acceleration lanes to meet regulatory requirements. These upgrades will improve traffic flow, reduce congestion, and enhance overall safety for both passenger and commercial vehicles.

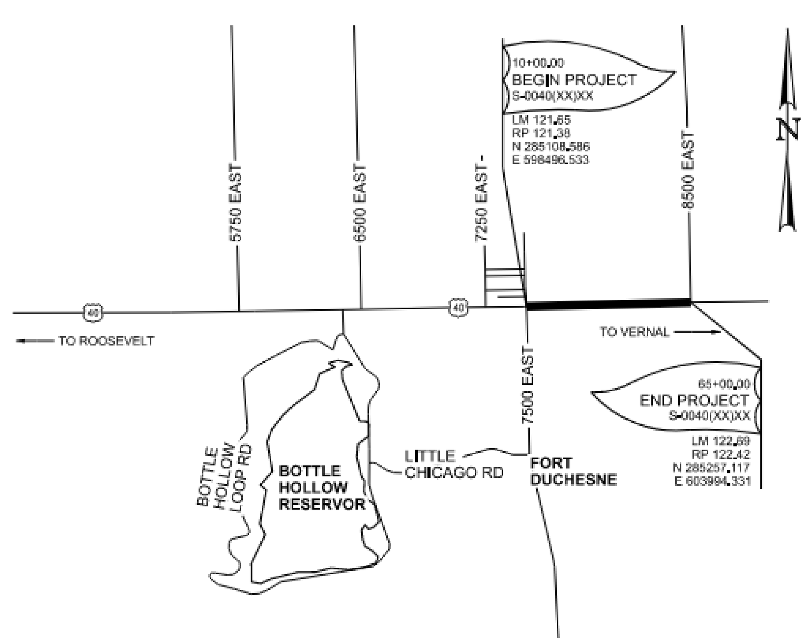


Figure 1. Project Location

Three design alternatives are considered and evaluated for this project. A matrix and a thorough scoring system is provided to support all the possible alternatives. The final design will adhere to UDOT standards.

Project Impacts

Pros
- More foot-traffic that would benefit local businesses
- Homes in the area may increase in value
- Materials used in project is sourced from local suppliers to reduce greenhouse gases
- The TWLTL will make maneuvering driveways easier and safer

Cons
- Emissions generated due to complex task of relocating utilities and presence of heavy machinery
- Native ground disturbance that could impact local vegetation
- Native American land and way of life might significantly change as time passes due to increased traffic

Design Requirements

Figure 1 below shows 14 different design requirements that were considered for the final design of the project as requested by UDOT. Each requirement below has references to different standards and specifications used to determine the appropriate design requirements.

ROADWAY NAME US-40

ROADWAY CHARACTERISTICS AND TRAFFIC DATA

Functional Class	Rural Arterial		Pavement Type	HMA/PCCP	
Design Vehicle	Interstate Semi (WB-67)		Terrain	Level	
Latest Year	2025	AADT= 7800	Latest Truck %	39%	
Design Year	2045	AADT= 10140	Projected Truck %	39%	
Posted Speed	60	mph	Design Speed	65	mph
No. of Lanes (Typ)	3		Curb & Gutter (Typ)	Type B1	
Pavement Width (Typ)	12	ft	Park Strip Width (Typ)	N/A	ft
Shoulder Width (Typ)	12	ft	Sidewalk Width (Typ)	4	ft

Comments
Aerial survey was conducted for this project. The 2024 Design Year AADT growth rateis projected to be 30%.

Refer to the Document Priority Section in the Introduction of the Roadway Design Manual for Design Criteria Order of Precedence

FHWA Controlling Criteria		Existing	UDOT Standard	Proposed/ Used	Design Exception	References	Date of Decision, Comments
Design Speed (mph)	Speed	60 mph	65 mph	65 mph	Not Required	**RDM** 3.3.1; **GB** 2-21:27, 6-2:3 (T. 6-1), 6-13:14, 7-3, 7-36, 8-2, **GB** (T. 3.1 SSD)	Determined by Concept Team
Design Loading Structural Capacity	Design Loading	HS-20	HL-93	HL-93	Not Required	**GB** 6-7:8 (T. 6-6), 6-20, 7-9, 50:51, 8-5	HS-20 for existing; HL-93 for new construction
Lane Width (ft)	Mainline	12 ft	12 ft	12 ft	Not Required	**DM** 4.1; **GB** 4-9:10, 6-16, 7-6:7 (T. 7-3), 7-15, 39:40, 8-3:4	Based on DM 4.1 Standards
	Med/TWLTL	12ft	14ft	14ft			
	LT/RT Turn	12ft	12ft	12ft			
	Climb/Pass	12ft	12ft	12ft			
Shoulder Width (ft)	Outside	4ft to 8ft	12 ft	12 ft	Not Required	**DM** 4.1; **GB** 4-12:13, 6-6 (T. 6-5), 7-6:7 (T. 7-3), 7-16, 40, 8-3:4, 18	Barrier shy is the distance adjacent to the barrier and should never be reduced below 2 ft.
	Inside	Not Evaluated	Not Evaluated	Not Evaluated			
	Barrier Shy	6ft	6ft	6ft			
Horizontal Curve Radius (ft)	Min Radii (Super)	Not Evaluated	Not Evaluated	Not Evaluated	Not Required	**RDM** 3.3; **GB** 3-33:35 (T. 3-7), 42 (T. 3-8), 43 (T. 3-9)(Any Facility)	No curves present
Superelevation Rate (%)	e_{max}	Not Evaluated	6%	Not Evaluated	Not Required	**RDM** 3.3; **GB** 3-31:33, 3-42 (T. 3-8), 3-43:44 (T. 3-9), 3-78:79 (T. 3-20), 4-32:33, 6-4,15, 7-6, 20 (F. 7-3, F. 7-4), 7-38, **RDM** 3.3.3	No curves present
Maximum Grade (%)	Max Grade	<3%	<5%	2.0%	Not Required	**RDM** 3.4.2; GB 3-130, 5-3:4 (T. 5-2), 5-15, 6-4 (T. 6-2), 6-14 (T. 6-7), 7-5:6 (T. 7-2), 7-37:38 (T. 7-4a), 8-4:5 (T. 8-1), 8-4:5 (T. 8-1), **GB (T. 7-2)**	Roadway is fairly level
Cross Slope (%)	Cross Slope	2.0%	1.5% to 2%	2.0%	Not Required	**RDM** 3.3.8, 4.2.2; **GB** 3-21:33, 4-2:7 (T. 4-1), 4-13:14, 6-4,15, 7-6, 15:16, 38:39, **RDM** 3-2	Roadway varies but this slope is common from center to edge
Stopping-Sight Distance (ft)	Min	570 ft	645 ft	645 ft	Not Required	**RDM** 3.2; **GB** 3-2:9 (T. 3-1:2, F. 3-14), 3-113:119, 6-4:5 (T. 6-3:4), 6-15, 7-4:5 (T. 7-1), 7-37, **GB** (T. 6-3 SSD), 6-5	Roadway is fairly level
Vertical Clearance* (ft)	Min	16 ft	16.5 ft over road, 23.83 ft over rail, 17.5 ft ped over rd	16.5 ft	Not Required	**DM** 4.2; **GB** 6-8, 20, 7-9, 51, 8-4	* Notify FHWA of any changes to Vertical Clearance on the National Highway System
UDOT Design Documentation		**Existing**	**UDOT Standard**	**Proposed/ Used**		**References**	**Date of Decision, Comments**
Lateral Offset to Obstruction (ft)	Min	8 ft	4 ft on tangents/ 6 ft on curves	12 ft		**RDM** 4.6.2; **RDG** 10-3; **GB** 4-18, 6-8:9, 21:22, 7-8, 49:50 **GB** 5.3.4.2, 5-23	Curbed roadways within 600 feet of 7500 E intersection, rest of roadway is without curb.
Vertical Alignment (K-value)	Sag Curve Min. K	Not Evaluated	157	157		**GB** Crest 3-155:157 (T. 3-34:35), Sag 3-161 (T. 3-36); **MOI** 7-56:59, **GB** (T. 5-8)	
	Crest Min. K	Not Evaluated	193	193			
Clear Zone (ft)	Design CZ	Not Evaluated	38-46 ft	42 ft		**RDM** 4.6, **RDG** 3-6 (figure 3.2), 3-8; **GB** 4-17, 5-10, 23, 6-8, 21, 7-8, 49, **GB** 5-10, **RSDG** (T. 3-1), 3-2	Design Clear Zone and Max Required Clear Zone are different values. Foreslope of 4:1 used
	Max Req'd CZ	Not Evaluated	46 ft	46 ft			
Intersection Sight Distance (ft)	Case D	No Change	625 ft	No Change		**GB** 9-28:54, **GB** (T. 9-7:11) 9-46:50	Casue B1 with a combination truck
	Case, B	Not Evaluated	1315 ft	1315 ft			

Figure 2. Project Design Certification (UVU Civil Capstone 2024-25 Group 2, 2024)

Alternatives

Design Matrix US-40 TWLTL		Design Alternatives					
		North		South		Middle	
Criteria	Importance Factor (IP) (1-5)	Score (1-10)	Score * (IP)	Score (1-10)	Score * (IP)	Score (1-10)	Score * (IP)
Cost	5	8	40	4	20	5	25
Safety	5	6	30	5	25	5	25
Public Involvement	3	7	21	6	18	5	15
Right of Way	5	7	35	4	20	5	25
Utility Impacts	4	6	24	4	16	7	28
Time Duration of Project	5	6	30	4	20	3	15
Environmental	3	5	15	5	15	5	15
	TOTAL SCORE	195		134		148	

Table 1: Design Matrix (UVU Civil Capstone 2024-25 Group 2, 2024)

The leading alternative is to widen the roadway to the north based on the design matrix. There are two existing concrete abutments north of the existing bridge where a new bridge can be constructed. This alternative is one that reduces material costs, labor costs, and time duration for the project the most.

Additionally, the assumed right-of-way fence on the north side is approximately 50 feet from the existing edge of the pavement. This meant that this alternative has the lowest impact when moving utility poles. There is less property owned by residents which should result in less inconveniences. There is also more area for workers to maneuver.

Final Design

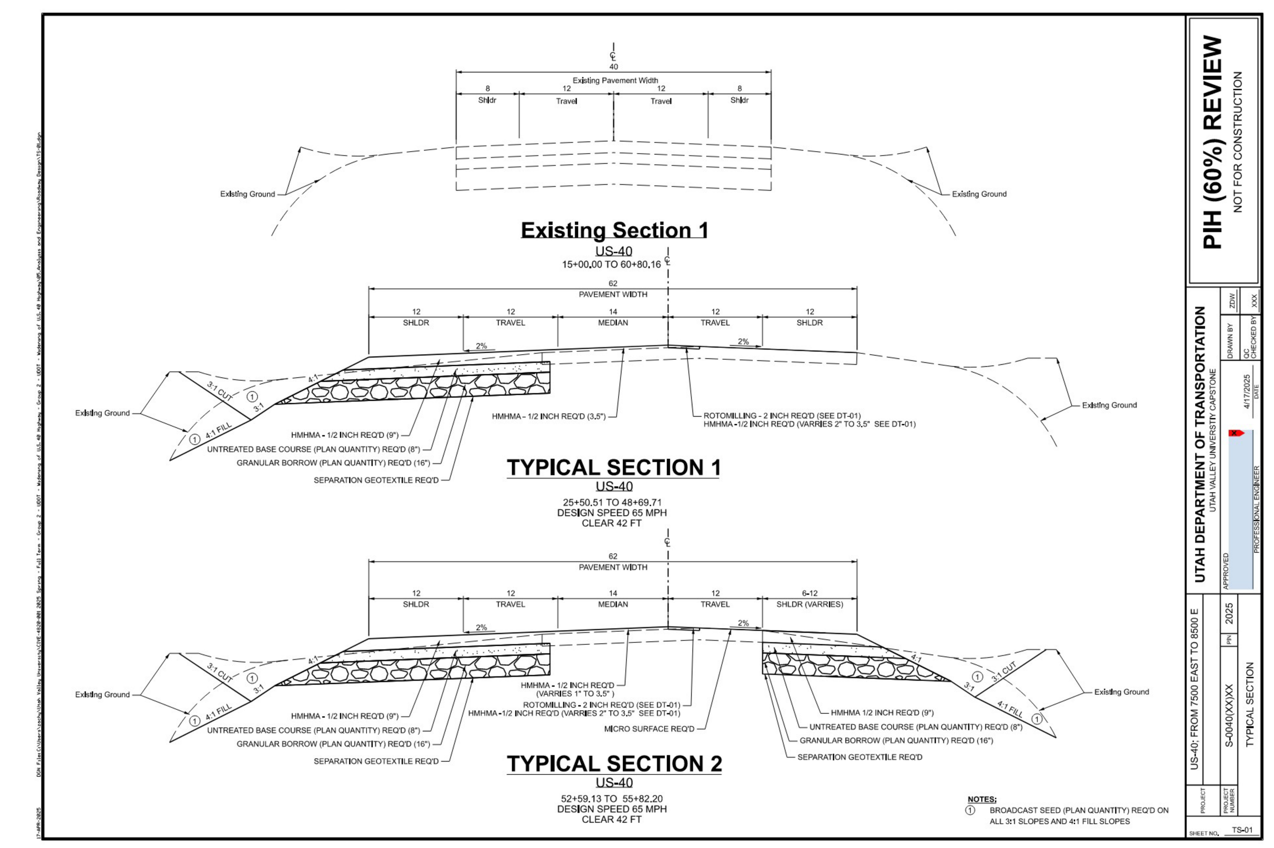


Figure 3. Typical Section 1 (UVU Civil Capstone 2024-25 Group 2, 2025)

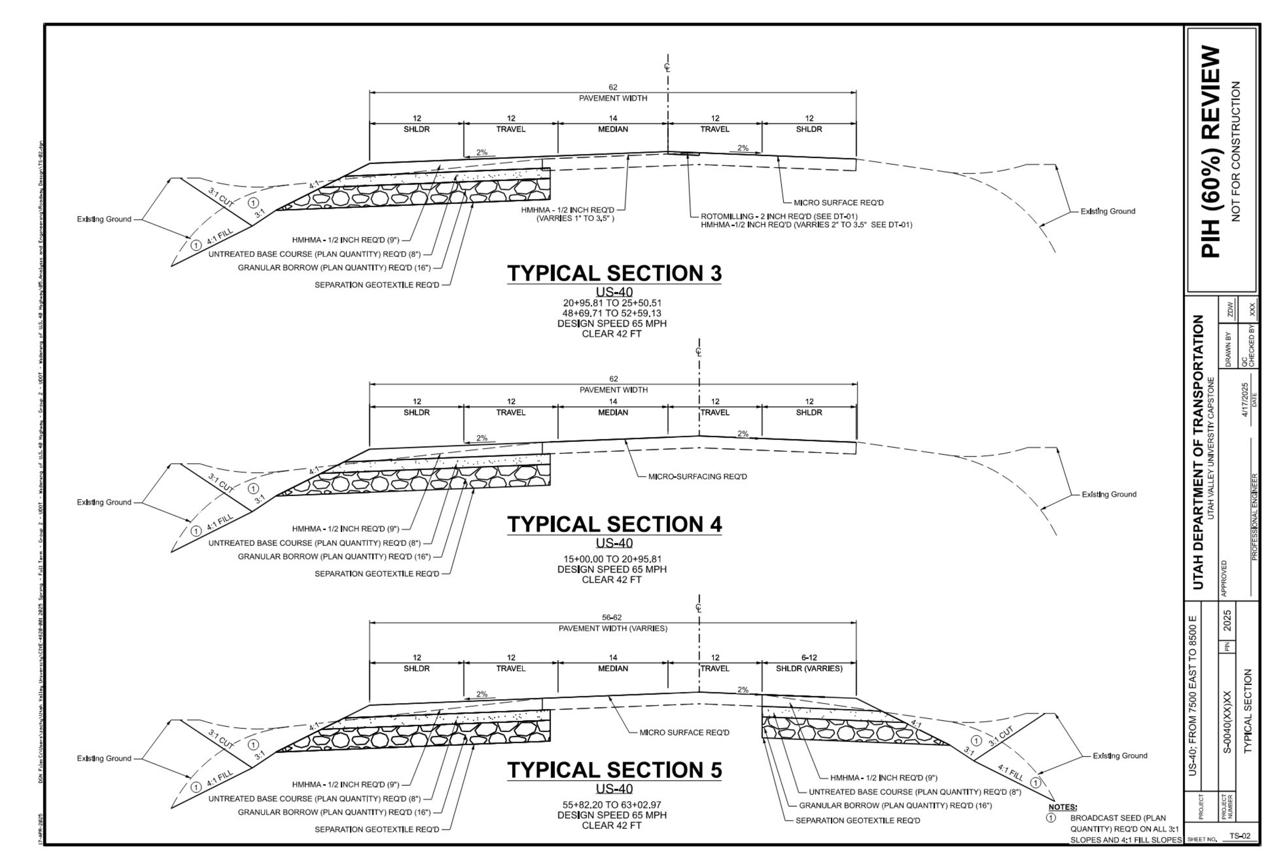


Figure 4. Typical Section 2 (UVU Civil Capstone 2024-25 Group 2, 2025)

Figures 3 and 4 show the typical sections of the final design for the widening of US-40. As shown a 14' TWLTL has been added along with 12' shoulders.

Cost Estimate

The estimated total cost of this project is $10.4 million. This value was determined using UDOT standard bid items and unit prices. A contingency was added because the project is at a 60% design

References and Resources

UDOT Standard Drawings and Specifications.
AASHTO Roadway Design Guide.
Roadside design guide.
MUTCD.
OpenRoads Designer