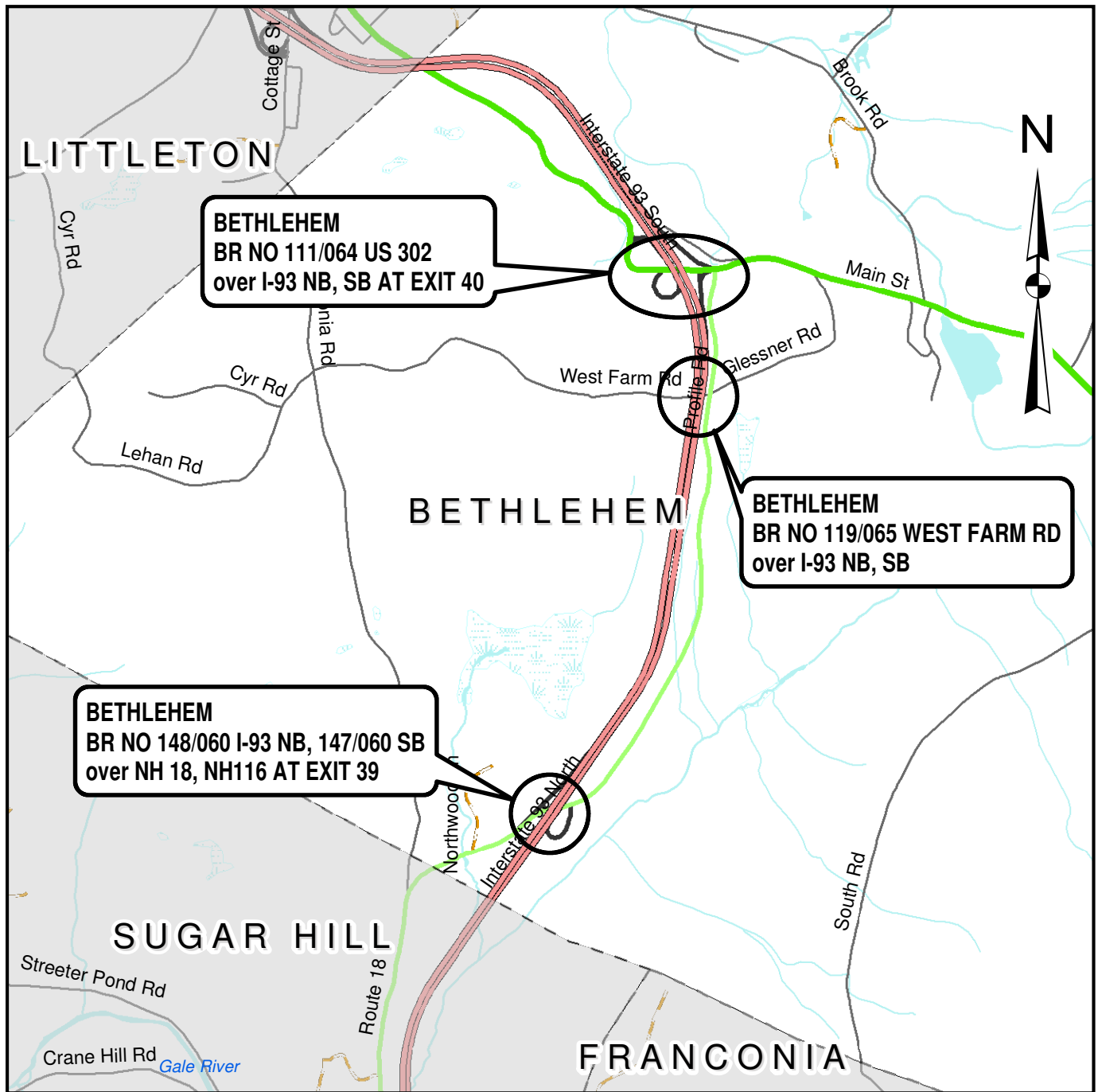


# Bethlehem 43330 - I-93 Bridge Painting



1 1/2 0 1 2 Miles

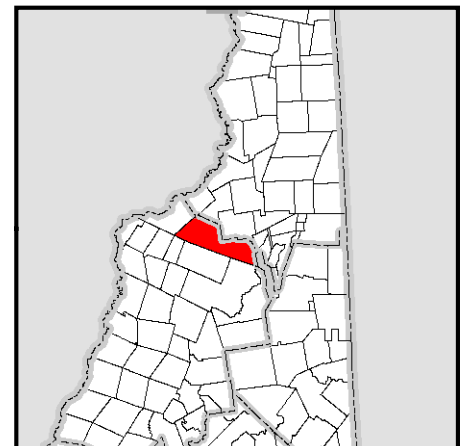
## LEGEND

- Streams
- Water Bodies
- US Routes
- State Routes
- Interstates
- Local Roads
- Town Boundary

New Hampshire  
**DOT**  
Department of Transportation

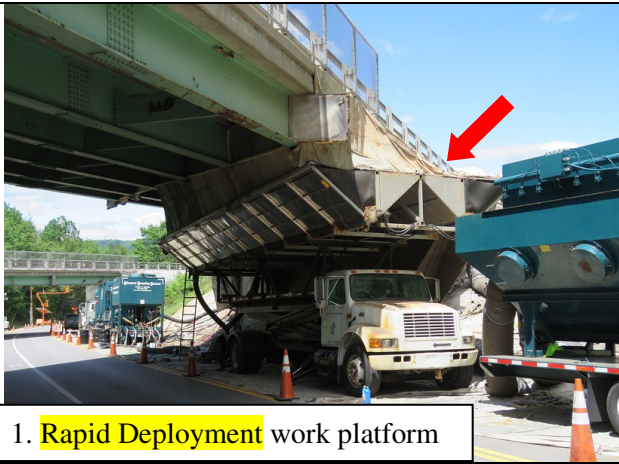
State #: 43330  
Federal #: N/A

**LOCATION MAP**

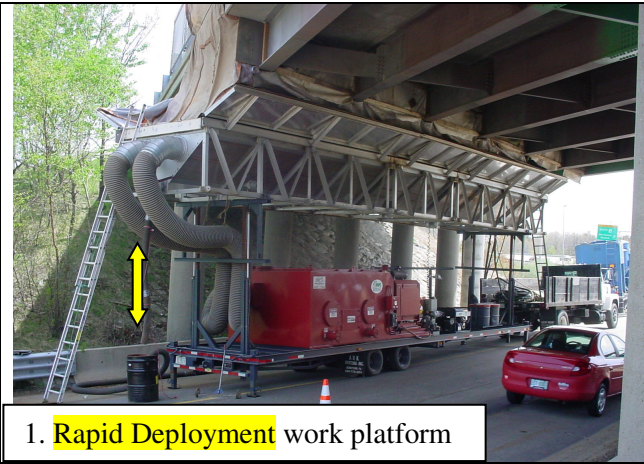




## BRIDGE PAINTING EQUIPMENT- FIVE ESSENTIAL UNITS



1. Rapid Deployment work platform



1. Rapid Deployment work platform



2. Blast grit recycler, and 3. Compressors



2. Blast grit recycler / hazardous waste drums



4. Dust collector w HEPA air filters



4. Dust collector w HEPA air filters



5. Paint equipment box truck



5. Paint equipment, cans, hoses, mixers, sprayers



## BRIDGE PAINTING SAMPLES – **FOUR SETUP TYPES**

(The question at every bridge site is how best to place the five essential units.)



**Type 1-** Interstate Bridge - Interstate roadway is open  
over Local Road - Equipment on local road- **clears out daily**



**Type 2-** Interstate Bridge - Interstate roadway is open  
over Local Road - Equipment on local road - **stays 24/7** (w traffic signals)



**Type 3-** Local Road Bridge - Equipment on bridge - **stays 24/7** (w barrier, barrels, or traffic signals)  
over Interstate - **Rapid deployment** unit on Interstate- **clears out daily**



**Type 4-** Any Bridge - **Equipment on bridge** - **stays 24/7** (w barrier, barrels, or traffic signals)  
over River or RR -



**43330 Bundle 8 / Site 1 / Bethlehem** I-93 NB, SB over **NH 18**, NH 116 at Exit 39 (MM 119.26)**Site 1**

at Exit 39

Br No 148/060 NB, 147/060 SB

I-93 over NH 18, NH 116

I-93 Traffic: 2,531 NB / 2,523 SB vpd (2020)

I-93 Speed / NH 18: 70 mph / 40 mph

I-93 Travel width NB/SB 8-12-12-10 (2 lanes)

plus lane for NB on-ramp

I-93 NB On Ramp Traffic: 146 vpd (2020)

I-93 SB Off-Ramp Traffic 219 vpd (2020)

NH 18 Traffic: 946 vpd (2020)

NH 18 Travel width 4-12-12-4 ft (2 lanes)

NH 18 Pavement width 32'-0"

Bridge width (o-o on NH18): 192 ft

NB/SB each 1-span bridge, L=57.5 ft (on skew)

Proposed Work

- NH 18 Use truck-mounted rapid deployment unit in lane-closure work zone (stay 24/7).
- Locate support vehicles on NH 18 (stay 24/7)
- Work one half of bridge, then switch sides.

Traffic

- No impact to I-93 traffic.
- NH 18 maintain one lane of alternating two-way traffic with traffic signals (24/7).

Timeframe for lane closures:

- NH 18 Permitted 24/7 from April 1 to Dec 1.

Duration:

Overall duration NH 18 lane closures: 6-8 wks

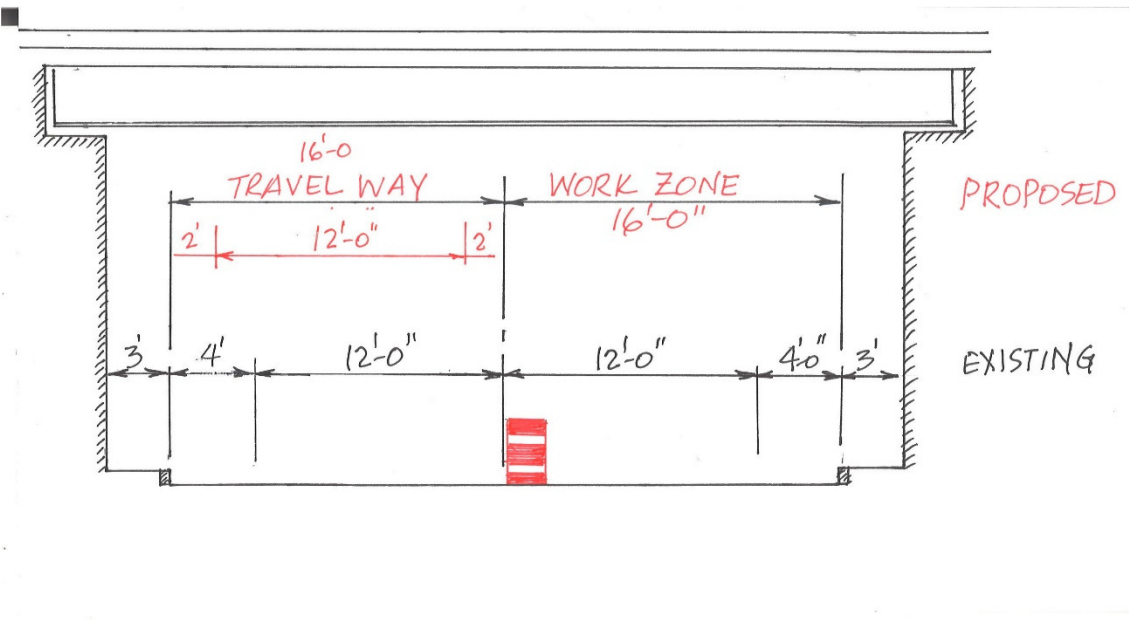




43330 Bundle 8 / Site 1 / Bethlehem I-93 NB, SB over NH 18, NH 116 at Exit 39 (MM 119.26)



NH 18 (Looking NB)



Exit 39 NB On-Ramp

NH 18 (Looking SB)





Steve Babalis, P.E.  
Project Manager

Hi Jerry,

Here is a summary of the preliminary traffic control results we have for Bundle 9, site 2, and all of Bundle 8. In short, traffic volumes at all of the sites are generally low and well within the capacity of the existing roadway and traffic control conditions. The key factor is providing safe and practical traffic control.

For generating I-93 design volumes, two continuous counters were utilized and were adjusted by ramp ATR counts. All of the traffic data was procured NHDOT transportation data management system website. Traffic data was modified to represent peak month conditions and was adjusted to 2022. 2020 data was not used due to the influence of Covid. Peak conditions were evaluated with the assumption that if the operations are reasonable during those conditions, then they will be acceptable during off peak times, and if found that they are not acceptable, then the appropriate TCP duration windows would be determined.

## BUNDLE 8

### Site 1 – Route 18 at I-93 Overpass at Exit 39

Site 1 proposes using alternating one-way traffic control along Route 18 underneath the I-93 overpass. Traffic volumes along Route 18 and Exit 39 were procured from ATR counts conducted on Rte 18 in May 2016, and ATR counts of the ramps in October 2017.

Due to the proximity of the ramps to the work zone, it is recommended the SB off-ramp approach is incorporated into the alternating one-way temporary signal system. It is assumed the eastern limit of the alternating one way is bounded by Exit 39 on-ramp. By incorporating the off-ramp into the signal system, the resulting TCP signal phasing would be increased into a 3 phase system with the ramp being provided their own protected signal phase preceding the Rte 18 eastbound phase. Traffic modeling indicates that the temporary signal will operate during peak hours with acceptable delays and queuing.

			Queue (95th %) ft
AM Peak	LOS	Delay (s)	
Rte 18 Eastbound	C	24	105
Rte 18 Westbound	C	34.2	77
Exit 39 Off Ramp	C	25.9	46

			Queue (95th %) ft
PM Peak	LOS	Delay (s)	
Rte 18 Eastbound	C	23	112
Rte 18 Westbound	C	29.3	113
Exit 39 Off Ramp	C	33.6	43



**43330 Bundle 8 / Site 2 / Bethlehem West Farm Road over I-93 NB, SB (MM 120.64)**

Sample:

**Site 2**

between Exits 39-40

Br No 119/065 West Farm Rd over I-93 NB,SB

I-93 Traffic: 4,313 NB / 3,757 SB vpd (2020)

I-93 Travel width 4-12-12-10 (2 lanes)

I-93 Speed /W Farm Rd): 70 mph / 40 mph

W Farm Rd Traffic: 148 vpd (2020)

W Farm Rd Travel width 1.5-12-12-1.5 (2 lanes)

W Farm Rd Pave width 27 ft

5-span bridge length: 244 ft

**Proposed Work**

-I-93 use truck-mounted rapid deployment for work over I-93 travel lanes (spans 2, 4) in daily temporary lane-closure work zone. Clear lanes at the end of work shift

-Spans 1,3,5- use suspended platforms (24/7)

-Support units on overpass EB Rt. lane (24/7)

**Lane closures:**

-I-93 NB, SB lane closures are restricted for 8-10 wks for period Apr 1-Dec 1. Daytime work.

-W. Farm Rd lane closure permitted 24/7.

-W. Farm Rd maintain one lane alternating two-way traffic with traffic signals

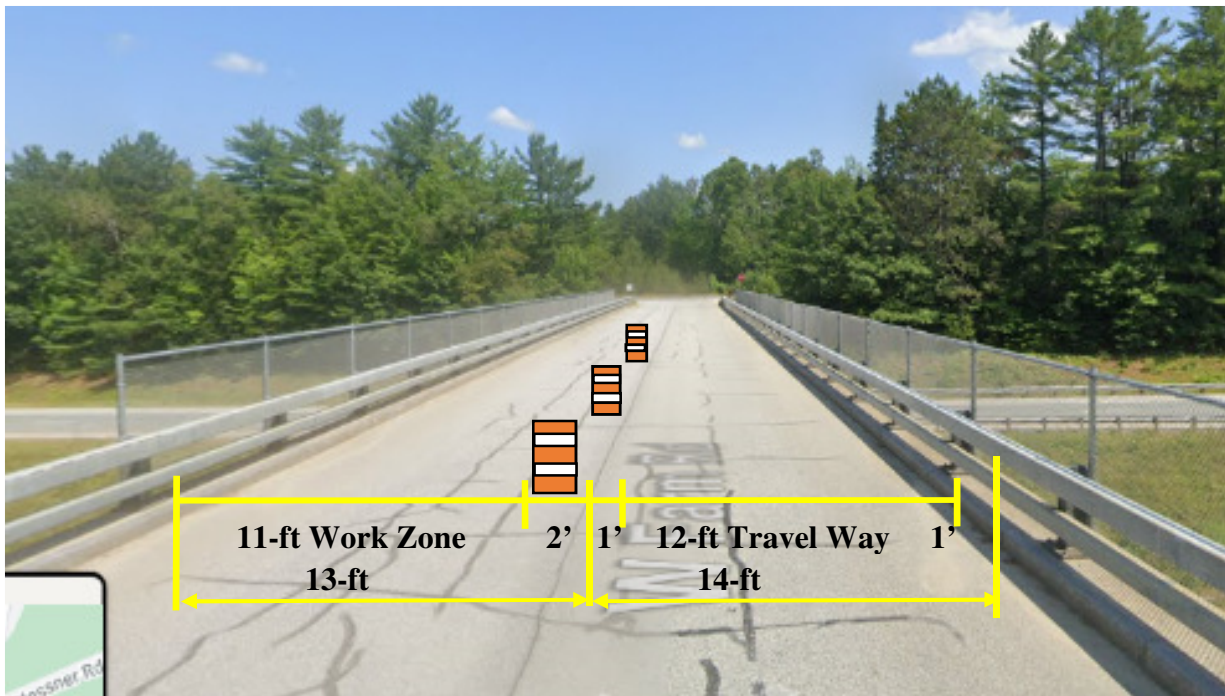
**Channel traffic:**

Use drums, cones, flaggers, officers, attenuator

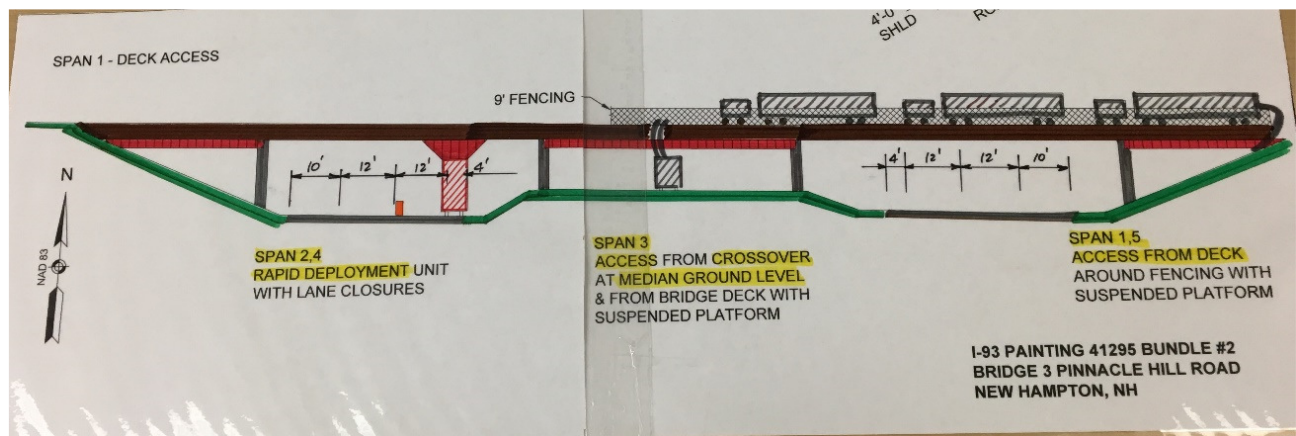
Rapid Deployment on Interstate- (per shift)  
Support vehicles on local road overpass- (24/7)



43330 Bundle 8 / Site 2 / Bethlehem West Farm Road over I-93 NB, SB (MM 120.64)



West Farm Road – Bridge Deck



Overpass over Interstate 93 – Concept of Equipment Placement  
(sample sketch from a different bridge- details similar)





Steve Babalis, P.E.  
Project Manager

## Site 2

### West Farm Road over I-93

Site 2 proposes using **alternating one-way traffic on West Farm Rd** and temporary lane closures on I-93. The existing bridge is located approximately 70 ft from Route 18 intersection with West Farm Road. ATR traffic counts were conducted on West Farm Road in 2011, 2014, 2017, and 2020 with average daily volumes ranging from 200 to 400 vehicles. Considering the low traffic volumes, volumes range, and small snapshot of time those counts were conducted, the 2014 May counts, which were the highest was used for the traffic analysis to best represent the worst case scenario. Those volumes were grown to 2022 and adjusted to peak month conditions.

The **key concern for West Farm Road** is related to the **proximity to Route 18** and the possibility of queues spilling back into the intersection. To understand this risk, two alternatives were evaluated:

- Alternative 1 - which uses a work zone equivalent to the length of the bridge [Normal case-JZ]  
Alternative 2 - which has a work zone of approximately 400 feet [‘Worst’ case-JZ]

Alternative 1	LOS	Delay (s)	Queue (95th %) ft
Eastbound	B	15.4	48
Westbound	B	16	54

Alternative 2	LOS	Delay (s)	Queue (95th %) ft
Eastbound	C	20.9	50
Westbound	C	21.8	60

The analysis shows that the **risk is low for queuing to spill back into Route 18**. The traffic volumes used in this analysis are conservative based on the history of the road.

## I-93

Temporary **daytime** lane closures are proposed on I-93. The continuous counter by the Vermont border shows that the traffic volumes of I-93 along this section don’t mirror the same peak time influxes that occur on the southern segments of I-93 related to the heavy northbound Friday volumes and heavy southbound Sunday volumes.

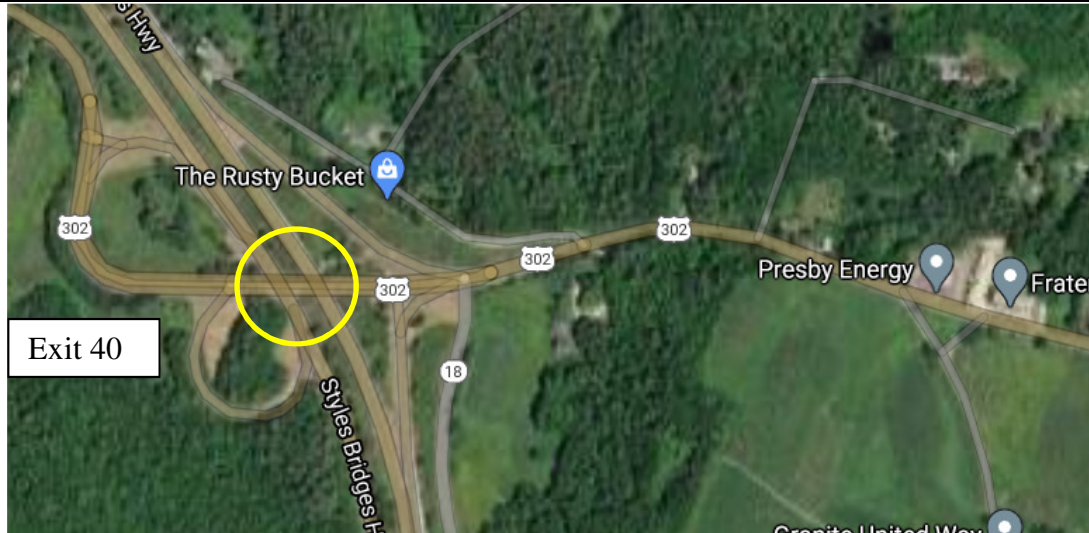
I-93 Northbound	Traffic Volume	LOS
Existing	652	A
Temporary Lane Drop		B

I-93 Southbound	Traffic Volume	LOS
Existing	445	A
Temporary Lane Drop		A

The analysis shows that I-93 traffic operations will only experience a minimal impact due to reducing a travel lane.



43330 Bundle 8 / Site 3 / Bethlehem US 302, NH 18 over I-93 NB, SB at Exit 40 (MM 121.04)



**Site 3** at Exit 40

Br No 111/064 US 302 over I-93 NB, SB  
 I-93 Traffic 4,313 NB / 3,757 SB vpd (2020)  
 I-93 Travel width 4-12-12-10 (2 lanes)  
 I-93 Speed / US 302: 70 mph / 40 mph  
 US 302 Traffic: 2,698 vpd (2020)  
 US 302 Travel width (three 12-ft lanes) = 36 ft  
 US 302 Shoulders: 5'-ft  
 US 302 Pavement width 46 ft  
 Bridge width (out-to-out): 49.5 ft  
 5-span bridge: 44 / 67 / 74 / 59.75 / 38 = 288 ft

Channel traffic:

-Use drums, cones, flaggers, officers, attenuator  
 -Concrete barrier for 24/7 overpass EB right lane closure with attenuator both ends  
 -Add stop sign on SB Exit 40E Off-Ramp at US 302 EB.

Rapid Deployment on Interstate- (per shift)  
 Support vehicles on overpass (24/7)

Proposed Work

-I-93 use truck-mounted rapid deployment for work over I-93 travel lanes (spans 2, 4) in daily temporary lane-closure work zone.  
 -I-93 clear lanes at the end of the work shift.  
 -spans 1,3,5- suspended platforms (stays 24/7)  
 -Support units on overpass EB Rt. lane (24/7)

Traffic

-I-93 maintain one lane / reduce speed to 60 mph  
 -Overpass- maintain one lane WB and one EB.  
 -Overpass- work zone reduce speed to 30 mph

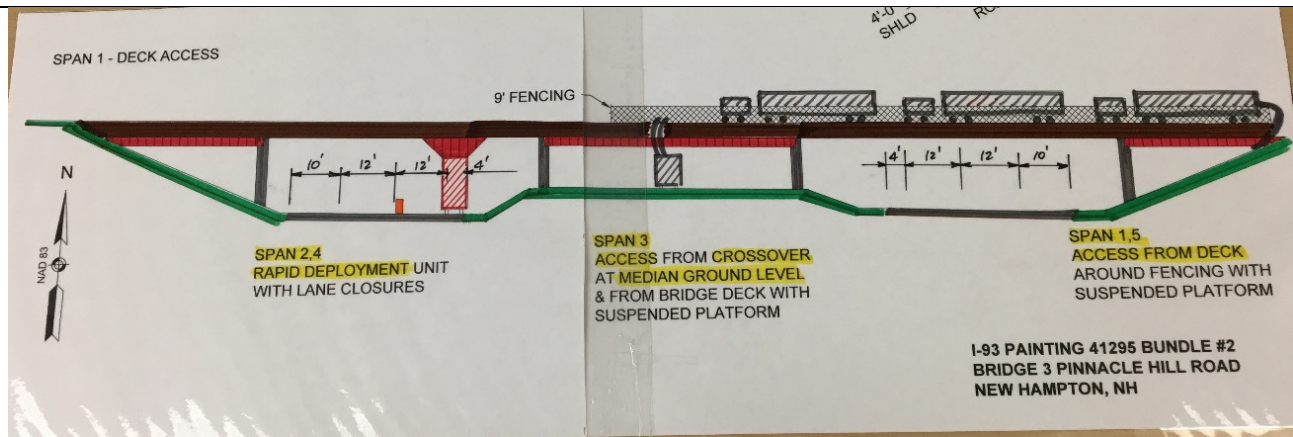
I-93 lane closures:

-I-93 NB, SB lane closures in day time hours for 8-10 wks during period Apr 1-Dec 1:  
 -Close SB On-Ramp during closure of SB lanes (ramp weave & slow-speed) at SB Exit 40 and detour 1.6 miles on I-93 NB to Exit 41 to reverse direction via I-93 SB.  
 -Close SB Off-ramp during closure of SB lanes (ramp weave & slow-speed) at SB Exit 40 and detour 1.8 miles on I-93 SB to Exit 39 via I-93 SB, NB back to Exit 40 (but not during Site 1 Exit 39 NH 18 lane-closure work.)

43330 Bundle 8 / Site 3 / Bethlehem US 302, NH 18 over I-93 NB, SB at Exit 40 (MM 121.04)



US 302 Overpass over I-93 at Exit 40 (NB)

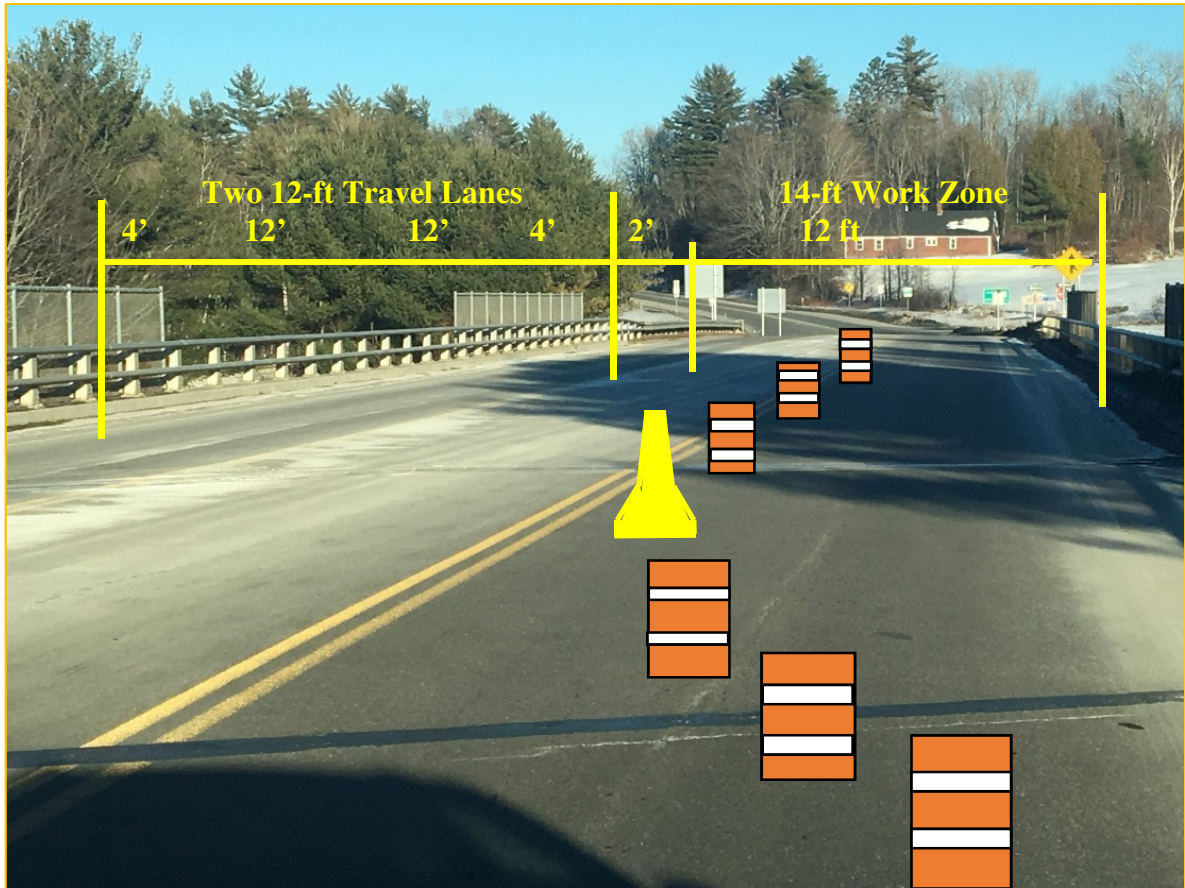


Concept of Equipment Placement (similar bridge)



Sample Example from a similar bridge





Note: Traffic Barrels are drawn but furnish with Portable Concrete Barrier)

NH 302 Overpass (looking EB)



3 High-speed lane

2 Slow-speed lane

1 Ramp weave lane

I-93 SB at Exit 40  
(Off Ramp immediately after bridge)



Steve Babalis, P.E.  
Project Manager

### Site 3 – US 302 over I-93 at Exit 40

Hi Jerry,

Site 3 proposes shifting traffic on US 302 towards the north to create a work zone on the southern half of the bridge while maintaining two-way traffic. The TCP also proposes **daytime** lane closures on I-93, with the southbound Exit 40 off-ramp being closed and detoured when the slow travel lane and weaving lane are closed. A similar TCP for US 302 for bridge deck work [JZ- in 2018] as seen on google ortho-imagery.

I evaluated Site 3 I-93 traffic operations for **daytime** closure, and **it is anticipated to operate acceptably**. See the table below.

I-93 Northbound	Design Hour	Traffic Volume	LOS
Existing	3 PM - 4 PM	575	A
Temporary Lane Drop			B

I-93 Southbound	Design Hour	Traffic Volume	LOS
Existing	3 PM - 4 PM	657	A
Temporary Lane Drop			B

The key challenge related to temporary lane closures on I-93 at Exit 40 is related to **how to accommodate the southbound ramps**. The existing condition consists of two loop ramps that utilize a short weaving lane under Route 302. This places the ramp gores in close proximity of the bridge making temporary access during lane closures challenging. The current TCP calls for closing the southbound off-ramp during the lane closures on the western side of I-93 southbound but does still allow the Exit 40 on-ramp to access I-93. There is approximately 540 feet of separation between the controlling curve on the on-ramp to the bridge. This will **not allow** for sufficient acceleration length to be provided in the temporary condition. Two **alternatives** are available:

1. Change the **on ramp** **from yield to stop** controlled with the appropriate marking and signing during lane closures on the western side of I-93 (See MUTCD 6H-44 which is attached)
2. Temporary close the **on ramp** and **detour** traffic **to Exit 41** located 1.6 miles to the west.

[**Proposal** (JZ) - After discussions with Steve, the proposal for I-93 **SB ramps** is summarized as follows: When I-93 SB ramp weave lane, and slow-speed lane are closed for rapid deployment, temporarily **close the SB on-ramp** and **detour** traffic 1.6 miles **to Exit 41** via I-93 NB; and temporarily **close the SB off-ramp** and detour traffic via I-93 SB 1.8 miles **to Exit 39** and return via I-93 NB to Exit 40 (but not during Site 1 Exit 39 work. **Advance signing** is recommended on I-93 SB prior to Exit 41 for US 302 EB.]

### Impact to Exit 41

I also evaluated the impact the temporary closure of Exit 40 on-ramp would have on the greater network with vehicles being detoured to Exit 41. The detour has its greatest impact on the intersection of Cottage St and



Route 302 just north of Exit 41. I was able to generate some rough intersection volumes using nearby ATR counts on US 302 and Cottage St. See the operations summary below.

### **Intersection US 302 & Cottage St**

<b>Existing Condition</b>					
	Movement	LOS	V/C	Delay (s)	Queue 95% (veh)
Cottage St/US 302 Southbound	Left	A	0.104	9.1	0.3
US 302 WB	Left/Right	D	0.612	32.8	3.8
<b>During TCP</b>					
Cottage St/US 302 Southbound	Left	A	0.104	9.1	0.3
US 302 WB	Left/Right	F	0.825	57.1	6.8

The proposed detour is anticipated to add 40 left-turning vehicles during the Weekday PM peak hour from US 302 to Cottage St. It is expected the additional turning traffic will add delay to the intersection. The analysis showed during peak month and hour conditions, the intersection likely operates around LOS D. The TCP will reduce the operations to LOS F. In the context of temporary traffic control conditions, the additional delay is acceptable.

A recommendation for time frame limitations for the Site 3 traffic control is that the closure and detour for the Exit 40 off-ramp from I-93 to US 302 should not coincide with the implementation of Site 1 traffic control that will be controlled with alternating one-way signals.

**Nighttime work** (although night work is not proposed).]

I-93 Northbound	Design Hour	Traffic Volume	LOS
Existing	9PM - 10 PM	197	A
Temporary Lane Drop			A

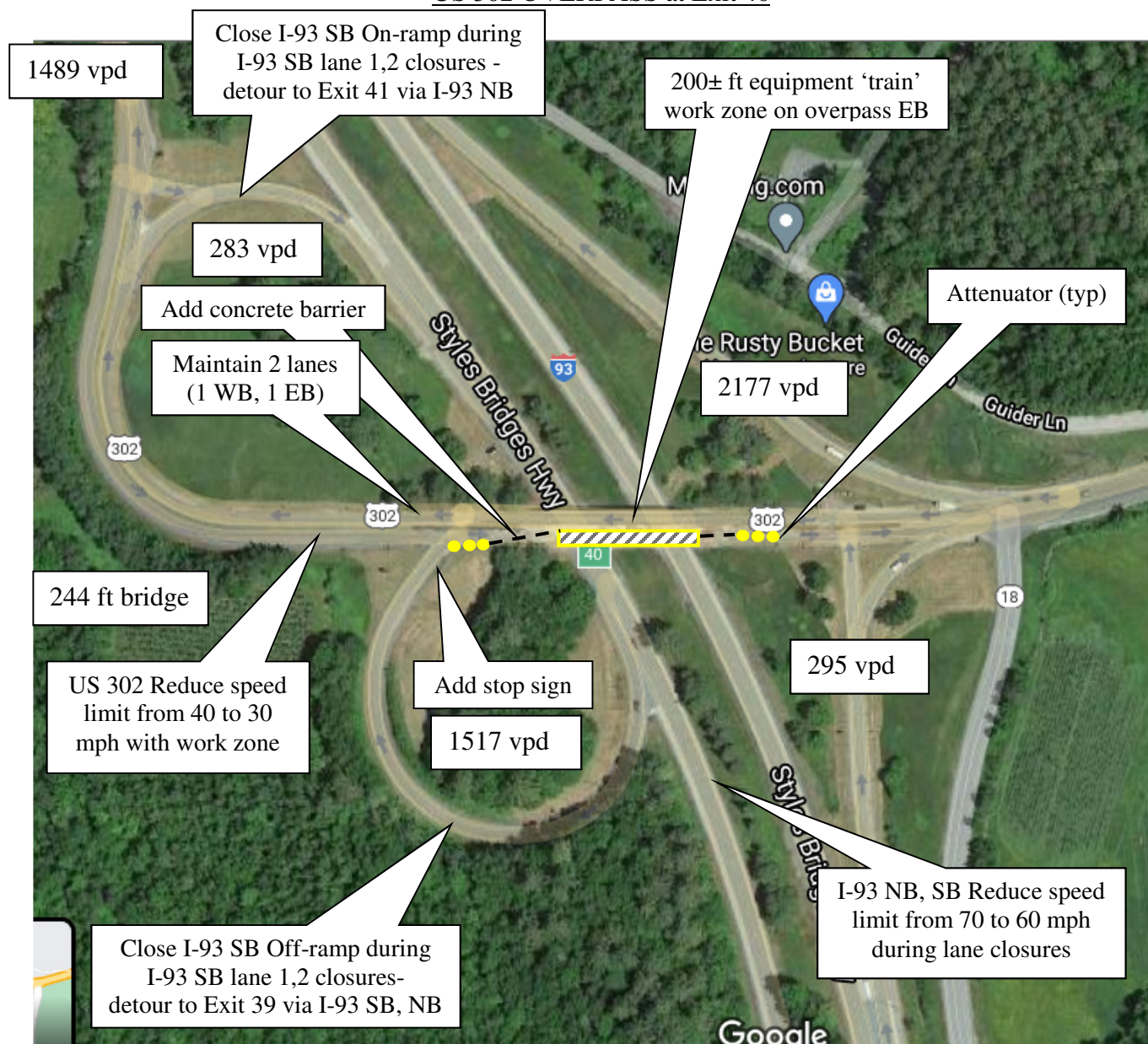
I-93 Southbound	Design Hour	Traffic Volume	LOS
Existing	9PM - 10 PM	215	A
Temporary Lane Drop			A

Both alternatives (1, 2) are viable [for night work]. There is ample sight distance along I-93 southbound, which is a prerequisite if insufficient acceleration distance is available. Temporary closure of the southbound on-ramp will likely impact less than 50 vehicles during the evening closure.

The traffic analysis shows that lane closures during **nighttime** hours will have a minimal impact on traffic operations.

**43330** Bundle 8 / Site 3 / Bethlehem US 302, NH 18 over I-93 NB, SB at Exit 40 (MM 121.04)

US 302 OVERPASS at Exit 40



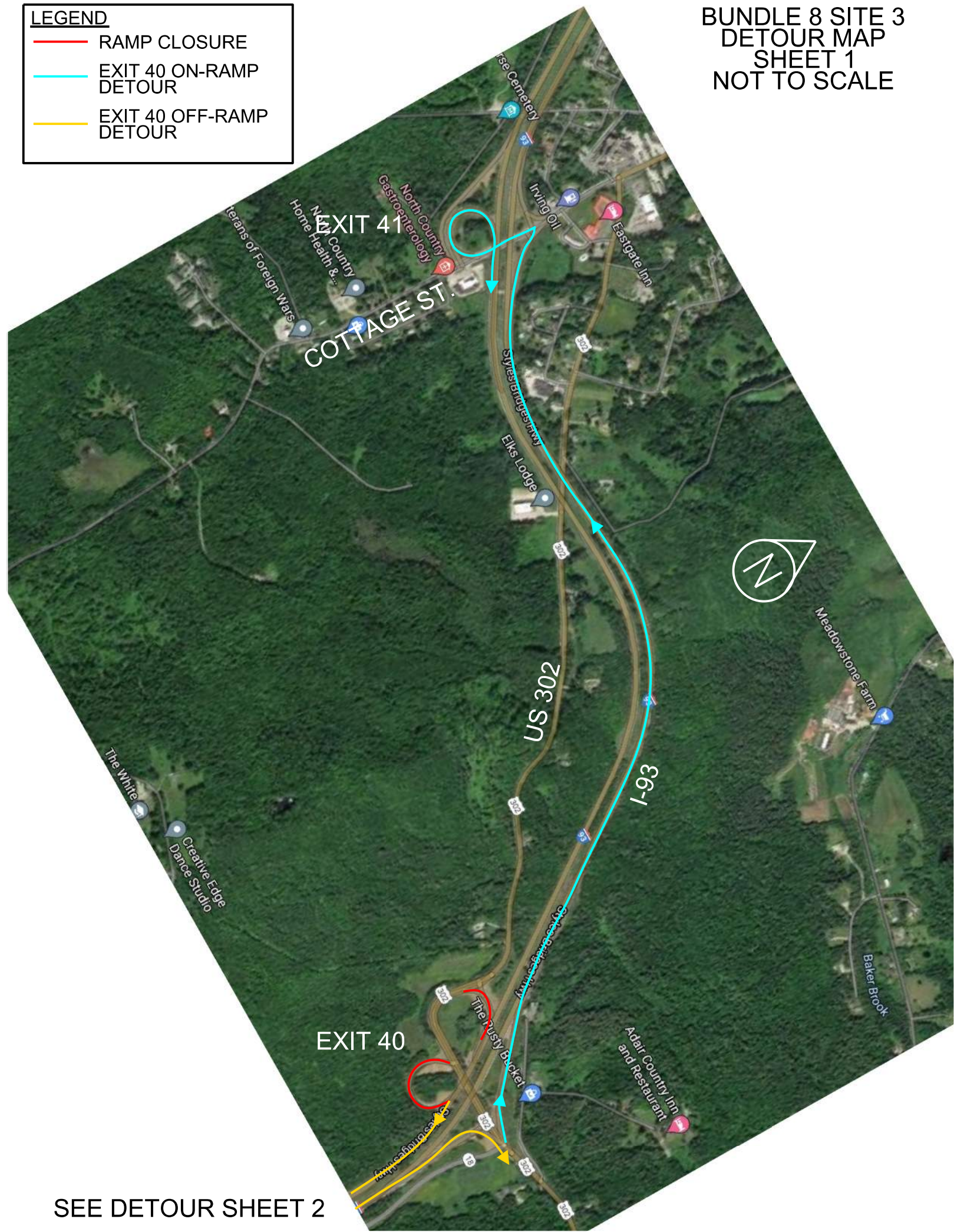
US 302 over I-93 at Exit 40



**LEGEND**

- RAMP CLOSURE
- EXIT 40 ON-RAMP DETOUR
- EXIT 40 OFF-RAMP DETOUR

BUNDLE 8 SITE 3  
DETOUR MAP  
SHEET 1  
NOT TO SCALE



SEE DETOUR SHEET 2



SEE DETOUR SHEET 1



EXIT 40

302

US 302

93

The Rocks  
Estate

I-93

18




93

NH 18

EXIT 39

BUNDLE 8 SITE 3  
DETOUR MAP  
SHEET 2  
NOT TO SCALE

**LEGEND**

-  RAMP CLOSURE
-  EXIT 40 ON-RAMP  
DETOUR
-  EXIT 40 OFF-RAMP  
DETOUR