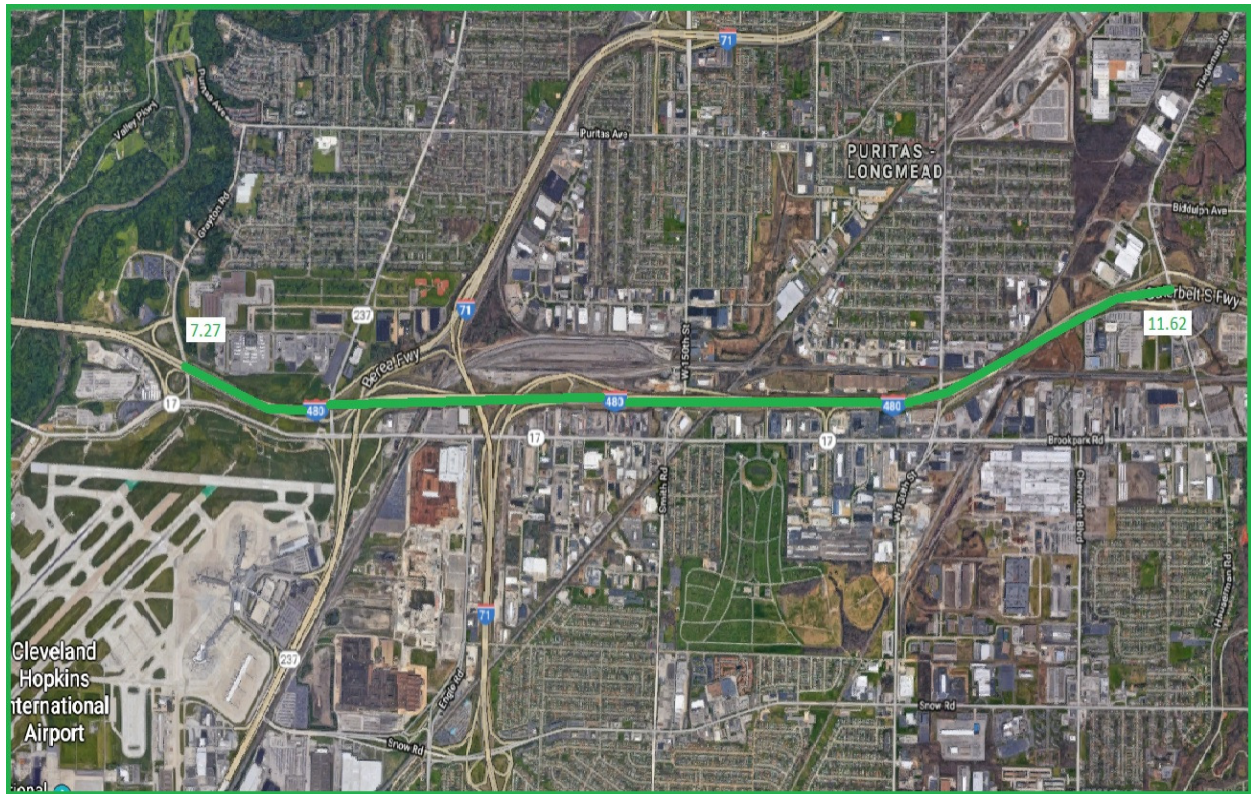




Ohio Department of Transportation, District 12 Traffic Operations Assessment Systems Tool



Anthony Toth, P.E. | December 2018

Cuyahoga IR 480, SLM 7.27 - 11.62
Grayton Road to Tiedeman Road
Urban Freeway TOAST numbers 27, 51, 52, 61
Functional Class 1 (Interstate)

Existing Conditions

Interstate 480 in western Cuyahoga County is an interstate urban freeway with relatively level terrain. The number of lanes along I-480 varies in this section (SLM 7.27-11.62) from a four to eight-lane freeway with 12-foot lanes and full shoulders within this section of the corridor. The number of lanes changes as there are drop lanes and add lanes to handle the traffic entering and exiting from both SR 237 and I-71. The pavement is asphalt with striped edge lines, lane lines, and raised pavement markers. The median of I-480 is a concrete barrier wall. The speed limit on this section of I-480 is 60 miles per hour.

This section of I-480 is an interstate to interstate interchange along with a State Route (Freeway) to interstate interchange and two ramp interchanges on the ends of the corridor all within about two miles. It is also the interchange that is used for Cleveland Hopkins International Airport and the rental car facilities in the area.

Travelling west, there is a drop lane and a decision lane to head south on I-71. Further west is a merge area. Traffic from I-71 northbound to I-480 westbound merges with traffic heading to SR 237 southbound and then must change lanes to continue on I-480 westbound. This right most lane becomes a drop lane to SR 237 southbound. The two remaining lanes continue west and join with I-71 southbound to I-480 westbound traffic as two add lanes. The last piece in this corridor is the weaving section (approximately 2500 feet), where I-480 westbound traffic must cross two lanes to exit at Grayton Road using a deceleration lane.

Travelling east, traffic from Grayton Road has an acceleration lane to merge with traffic on I-480. After the merge, traffic continuing west on I-480 has approximately 1000' to weave left before the two right lanes head to I-71. One is a drop lane and the other a decision lane. The decision lane ends in another approximately 800' before becoming two lanes of I-480 traffic through the interchange. Once east of the interchange, SR 237 northbound traffic has an add lane to I-480 and further east, I-71 has two lanes entering I-480 east. One is an inside merge and the other lane is an add lane.

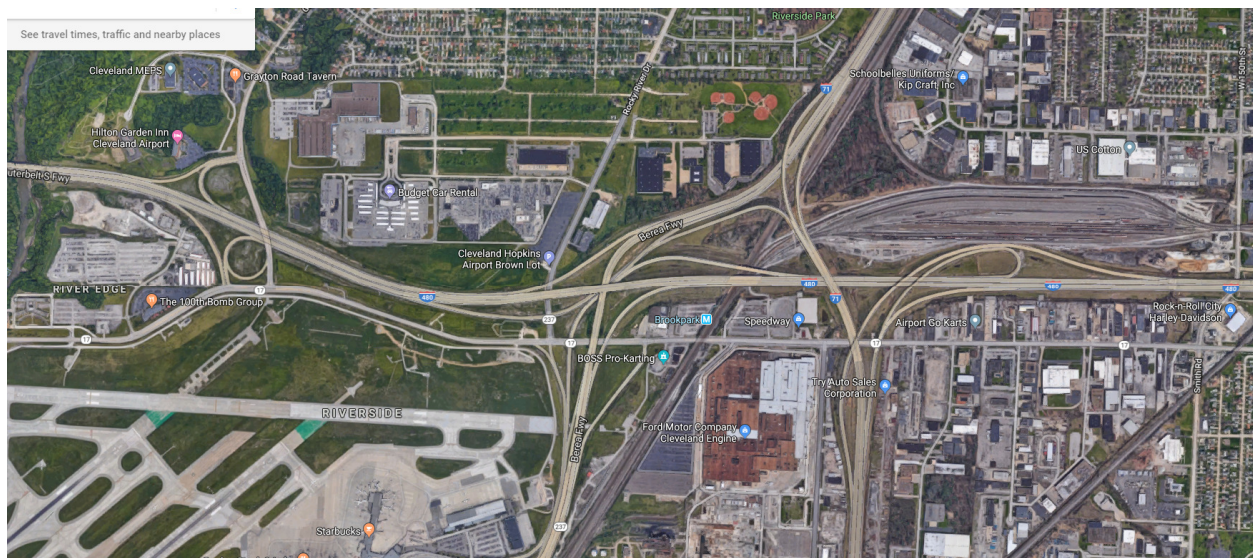


Figure 1. I-480 & SR 237, I-71 Interchange Area & I-480 and Grayton, W. 150th St. ramp interchanges

The traffic on this section of I-480 has had minimal growth over the past five years. However, it is still highly travelled with westbound traffic reaching near 60,000 vehicles per day and overall traffic reaching near 120,000 vehicles per day. Table 1 shows the westbound traffic on I-480 at different locations along the corridor. Table 2 shows the AADT on the five ramps that have traffic entering and exiting the corridor and the two weave areas.

Year	I-480 WB west of Grayton	I-480 WB between Grayton and I-71	I-480 WB between I-71 and SR 237 weave	I-480 WB between weave and I-71 SB exit	I-480 WB east of W. 150 th exit
	AADT	AADT	AADT	AADT	AADT
2018	59,922	-	-	37,553	-
2017	60,014	61,148	51,166	37,325	60,842
2016	58,199	59,740	50,562	37,285	60,230
2015	54,303	57,299	48,899	36,450	61,691
2014	55,241	-	-	35,339	-

Table 1. I-480 westbound AADT

Year	Ramp from I-480 WB to I-71 SB	Ramp from I-71NB to I-480 WB, entering weave section	Ramp from I-480 WB to SR 237 SB, exiting weave section	Ramp from I-71 SB to I-480 WB	Ramp from I-480 WB exit to Grayton Rd.
	AADT	AADT	AADT	AADT	AADT
2018	-	-	-	-	-
2017	15,359	13,841	8,429	18,411	9,678
2016	14,985	13,277	8,483	17,661	9,740
2015	16,394	12,449	8,025	16,425	8,907
2014	16,625	13,385	7,118	17,658	7,900

Table 2. Traffic entering and exiting I-480 corridor via ramps

Data Summary

When the 2018 TOAST (Traffic Operations Assessment Systems Tool) list was populated, data was used from Fiscal Year 2018, which is the period from July 1, 2017 – June 30, 2018. The data discussed below is generally from this time. The TOAST scores for these segments of I-480 are as follows:

Category	Metric	Units	Quantity	Score
Travel Time Performance	Free Flow Speed	percent	96.0%	80 / 80
Bottlenecks	Impact Factor	minute-miles / year	42,852	14 / 70
Incident Clearance	Clearance Time	minutes (average)	77	25 / 50
Secondary Crashes	Percent Secondary	percent	15.6%	8 / 40
Safety Performance	PSI Density	crashes / mile / year	0	30 / 30
Volume Per Lane	Number of Vehicles	vehicles / lane / day	20,625	2 / 20
Freight Corridors	Truck Percentage	percent	5.5%	16 / 20
Overall Score	Percent Total Score	percent	56.5%	175 / 310

Table 3. TOAST 2018 Scoring I-480 SLM 7.27 to 8.54 (D12 #61)

Category	Metric	Units	Quantity	Score
Travel Time Performance	Free Flow Speed	percent	95.2%	80 / 80
Bottlenecks	Impact Factor	minute-miles / year	41,596	14 / 70
Incident Clearance	Clearance Time	minutes (average)	77	25 / 50
Secondary Crashes	Percent Secondary	percent	15.6%	8 / 40
Safety Performance	PSI Density	crashes / mile / year	17	6 / 30
Volume Per Lane	Number of Vehicles	vehicles / lane / day	14,710	4 / 20
Freight Corridors	Truck Percentage	percent	4.5%	16 / 20
Overall Score	Percent Total Score	percent	49.4%	153 / 310

Table 4. TOAST 2018 Scoring I-480 SLM 8.54 to 10.00 (D12 #27)

Category	Metric	Units	Quantity	Score
Travel Time Performance	Free Flow Speed	percent	96.1%	80 / 80
Bottlenecks	Impact Factor	minute-miles / year	44,639	14 / 70
Incident Clearance	Clearance Time	minutes (average)	77	25 / 50
Secondary Crashes	Percent Secondary	percent	15.6%	8 / 40
Safety Performance	PSI Density	crashes / mile / year	0	30 / 30
Volume Per Lane	Number of Vehicles	vehicles / lane / day	17,109	2 / 20
Freight Corridors	Truck Percentage	percent	8.2%	12 / 20
Overall Score	Percent Total Score	percent	55.2%	171 / 310

Table 5. TOAST 2018 Scoring I-480 SLM 10.00 to 10.54 (D12 #52)

Category	Metric	Units	Quantity	Score
Travel Time Performance	Free Flow Speed	percent	97.8%	80 / 80
Bottlenecks	Impact Factor	minute-miles / year	47,918	14 / 70
Incident Clearance	Clearance Time	minutes (average)	77	25 / 50
Secondary Crashes	Percent Secondary	percent	15.6%	8 / 40
Safety Performance	PSI Density	crashes / mile / year	0	30 / 30
Volume Per Lane	Number of Vehicles	vehicles / lane / day	18,712	2 / 20
Freight Corridors	Truck Percentage	percent	8.3%	12 / 20
Overall Score	Percent Total Score	percent	55.2%	171 / 310

Table 6. TOAST 2018 Scoring I-480 SLM 10.54 to 11.62 (D12 #51)

Travel Time Performance: Travel time performance is a measure of the percentage of time a segment of roadway operated at or near the free-flow speed (generally the posted speed limit of the roadway). According to Inrix Analytics, I-480 operated at or near the free flow speed of 99.9 percent, high enough to gain a perfect score.

Bottlenecks: A bottleneck is defined as an occurrence when speeds drop to 65 percent of the free flow speed and cause at least a two-minute delay. The metric used to measure the impact of bottlenecks is called the Impact Factor, which is calculated by taking the sum of all bottlenecks that occurred throughout fiscal year 2018. The severity of a bottleneck is measured by multiplying how long a distance on the roadway a bottleneck impacted by the duration of the occurrence. This formula is used to calculate the Impact Factor, which is measured in minute-miles per year.

Incident Clearance: According to data obtained from law enforcement, incidents on I-480 took an average of 77 minutes per incident to clear.

Secondary Crashes: A secondary crash is defined as a crash that occurs as the result of a previous incident.

Safety Performance: The safety performance metric is the measure of potential for safety improvement in terms of crashes per year per mile. This is calculated using a formula that compares the study segment's crash history from 2013 – 2017 to similar roadway segments.

Volume Per Lane: The volumes per lane vary in this section of the corridor due to the interchange entrances and exits. The average volumes range from approximately 14,000 to 21,000 vehicles per lane per day in fiscal year 2018. This is a rather high number and the scores reflect that.

Freight Corridors: Over the past eight years, there has been a relatively constant 5-8% truck volume on this section of IR 71.

Countermeasures

The two TOAST categories that scored the worst within the study section of I-480 were Bottlenecks and Volume per Lane. These two categories lead to daily congestion and queueing that affect other interstates within the interchange area, specifically, I-71 northbound ramp to I-480 westbound. Section 8.54 to 10.00 is the worst of these four areas. It is the section from I-71 to W. 139th St. exit. The next two sections to the east (10.00 to 11.62, W. 139th St. to Tiedeman Rd.) will benefit from any improvements made to the worst section of the corridor.

Potential countermeasures to address the issues associated with this corridor are:

- Install dynamic speed feedback sign
- Performance Based Practical Design/repurpose lanes (narrow shoulders to add/connect through lanes)
- Convert inside/outside shoulder to hard running shoulder

Installing dynamic speed feedback signs would help the driver adjust their speeds. However, they may only ignore them until they actually see the slow traffic which would not really change the current conditions. Having faith in the signs is also an issue.

Using Performance Based Practical Design has led to studying the corridor for use of hard shoulder running. This practice was recently completed on the east side of I-480 along an eastbound stretch with success.

The study for westbound traffic congestion in this corridor is nearly finalized. Final determination needs to be completed as to the best possible way to use the shoulders going westbound in this section of I-480 along with addressing the drainage capacity and re-grading the crown of the bridges.

Below are schematic drawings of one scenario.



Figure 1. West end of the project, Grayton Rd. exit becomes a drop lane.



Figure 2. I-71 SB traffic continues to have two lanes to enter I-480 WB.

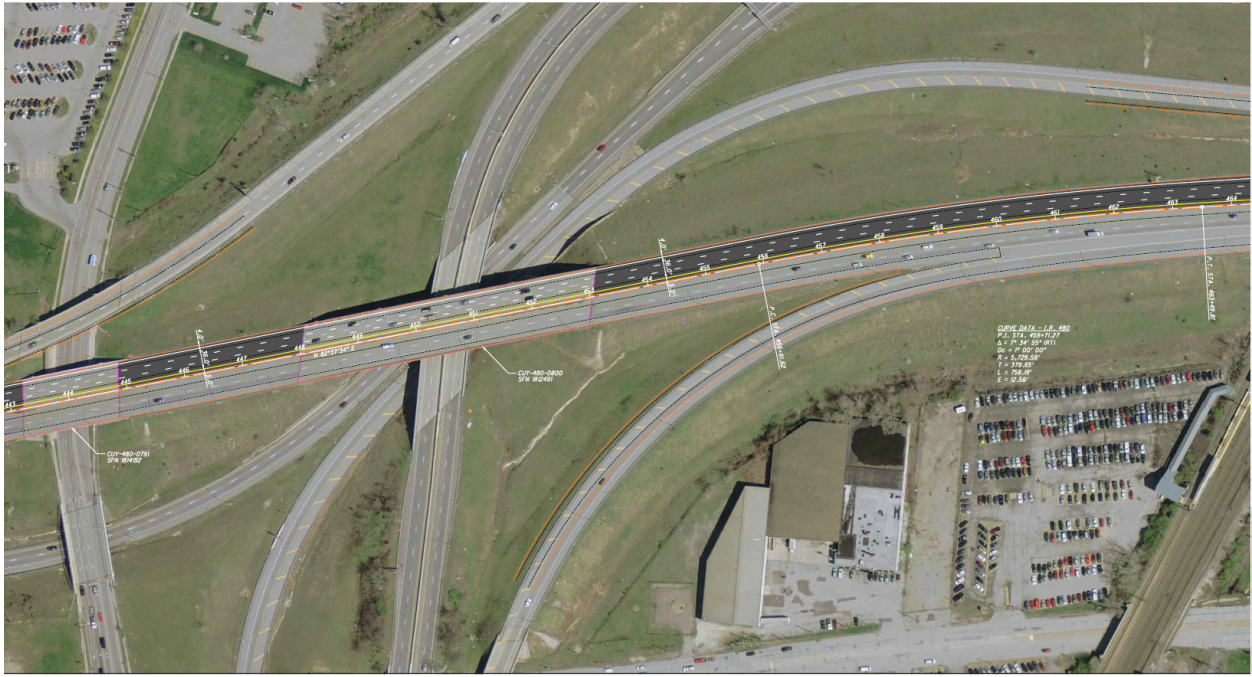


Figure 3. I-480 with three lanes WB. This section has 45' width scoped.



Figure 4. SR 237 continues to have a drop lane.



Figure 5. I-71 NB exit to I-480 WB becomes an auxiliary lane with a weave section rather than an acceleration lane with a merge.

Summary and Conclusions

This section of I-480 is not only used by local commuter traffic, but also by non-locals traveling to the airport and rental car facilities. There are weave areas, add lanes, and drop lanes all adding to the complexity of these interchanges. Given the geometry of the interchanges, the volumes of the vehicles using this corridor and the unfamiliar drivers, bottlenecks are created, especially during evening peak hours.

Looking at the possible countermeasures that will be useful, the following have been selected to address issues on this section of I-480:

- Convert part of inside and outside shoulders to hard running shoulders
- PBPD/repurpose lanes (narrow shoulders to add/connect through lanes)

While the study has not yet been finalized, preliminary findings show that it appears using part of the outside shoulder and part of the inside shoulder for hard shoulder running is a very viable countermeasure to alleviate the bottleneck issue. The conversion of a merge and drop lane for northbound 71 traffic to an auxiliary lane and weave area should help alleviate how the interchanges operate as well.

The study is far enough along to have a schematic on how to accomplish the changes. The construction costs for one of the most viable and extensive options is estimated roughly at \$3.5 - 4 million.