

I. Introduction

The Transportation Advisory Committee (TAC) of the Northeast Ohio Areawide Coordinating Agency (NOACA) is being asked to recommend approval of the Nagel Interchange project for inclusion on the NOACA TIP. Several public meetings have been held and studies have been prepared over the course of project development beginning in 2004. The purpose of this document is to distill the findings of these materials and provide the most current information for NOACA's use in evaluating the project. This document will:

- Summarize “no build” traffic conditions (i.e. the need for the project)
- Explain the resulting “build” traffic conditions if the project is constructed
- Discuss the design concept for the project and what improvements are included to the local road system
- Explain the project's funding strategy
- Discuss the project's relation to bicycle and pedestrian facilities and transit
- Explain the project's potential environmental impacts

II. “No Build” Traffic Conditions/Project Need

Previous Studies

The Avon I-90 Access Study was commissioned in 2004 by the City of Avon to evaluate the adequacy of access to I-90 and evaluate alternatives for addressing identified deficiencies. In addition, this study documented operational deficiencies of the existing roadway network bounded by Detroit Road (SR 254) to the south, Chester Road/Just Imagine Drive and Clemens Road to the north, SR 83 to the west and Crocker Road to the east, including the existing interchanges of SR 83 and Crocker Road with I-90.

The Avon I-90 Access Planning Study, dated April 14, 2006, compared the traffic impacts of maintaining the current access (No Build) at SR 83, upgrading the existing SR 83 interchange, and building a new interchange to I-90 at four different locations in Lorain County between Jaycox Road and Crocker Road. A copy of the 2006 Planning Study Report is available on the NOACA website. Due to the limitations of the traffic data available at that time, the planning study was used only to identify the differences among the options and was not intended to be a quantitative analyses of the actual traffic anticipated in the study area.

The study identified two basic needs for the proposed project: 1.) provide adequate access to I-90, and 2.) support growth consistent with existing land use plans. The study identified the Crocker Road and SR 83 interchange areas as high congestion locations within the study area. The capacity of the current interchange areas is not adequate for the anticipated future traffic patterns. The existing spacing between the two interchanges in or near the City of Avon at SR 83 and Crocker Road is 3.7 miles, which is in drastic contrast with the interchange spacing of the neighboring interchanges. The three interchanges on either side of the SR 83 interchange have the following spacing:

1. Lorain Blvd (SR 57) to Detroit Road (SR 254) 2.45 miles
2. Detroit Rd (SR 254) to Colorado Ave (SR 611) ... 2.96 miles
3. Colorado Ave (SR 611) to SR 83 1.94 miles
4. SR 83 to Crocker Rd 3.70 miles
5. Crocker Rd to Columbia Rd (SR 252) 0.62 miles
6. Columbia Rd (SR 252) to Clague Rd 1.37 miles
7. Clague Rd to Detroit Rd (SR 254) 0.88 miles

Within the area, many of the surrounding communities have already experienced major growth. With a large amount of vacant land along its northern border, the City of Avon is beginning to experience major growth and needs similar access to I-90, which is presently enjoyed by the neighboring communities. As noted earlier, a critical component of the Purpose and Need was to provide adequate access to I-90 to retain and allow for the expansion of existing major employers, such as Henkel Consumer Adhesives, which depends upon efficient freeway access. To meet these needs, the Planning Study recommended pursuing a new interchange at the Nagel Road location.

As part of the Planning Study process, the study team communicated with developers and current employers in the City to project how the study area might develop. From that feedback, the team identified potential land uses and development sizes. Based on this information, the City of Avon expects that roughly 220 acres in study area will be developed with industrial space, office space, a medical center and supporting commercial development. Existing zoning within the study area north of I-90 is office/manufacturing. The City of Avon accepted commercial overlay zoning for part of the industrial area to allow for potential mixed-use development plans. South of I-90, the existing zoning is residential, with some commercial at the intersection of Nagel Road and Detroit Road.

TranSystems prepared the original Planning Study Report using traffic data compiled from traffic counts collected between 2000 and 2004 and adjusted for the design year using the Northeast Ohio Areawide Coordinating Agency's (NOACA) Travel Demand Model (TDM) as updated and released in 2005. The information originally used for the analyses does not include an increase in traffic associated with development anticipated within the study area that is above NOACA's base model projections, particularly in the industrial and office zones north of I-90. In an effort to meet the Interchange Justification Study requirements of ODOT and FHWA, TranSystems worked with NOACA and ODOT's Office of Technical Services to prepare traffic projections that include this anticipated growth. Using information provided by the City of Avon, TranSystems and NOACA, ODOT developed 2010 (Opening Year) and 2030 (Design Year) certified traffic for the Interchange Justification Study. These updated volumes are used for the discussion below of the traffic needs associated with the project.

Purpose and Need

The purpose of the project is to: 1.) provide improved access to I-90, and 2.) support growth consistent with existing land use plans. A draft Purpose and Need document has been prepared and is currently in review with ODOT. A copy of the draft document is available on the NOACA website. Below is a summary of the issues.

Both interchanges serving the industrial area of the City of Avon, as well as some arterial intersections adjacent to these interchanges, have capacity issues with expected traffic conditions in 2030. At the SR 83 interchange, the ramp terminals will operate at LOS F, while the intersections immediately north and south of the interchange will operate at LOS D. At the Crocker Road interchange, the westbound ramp terminal will operate at LOS F in the PM peak, and the intersection immediately north of the interchange will operate at LOS F during both the AM and PM peak. The eastbound ramp terminal and the intersection immediately south of the interchange will operate at LOS D.

The City of Avon desires to meet the needs of existing business and residents, and to provide the necessary transportation infrastructure to better manage future growth in these areas. According to census information, the City experienced a high residential growth rate between 1990 and 2000. Avon leads northeast Ohio in new housing units, with a 76.95% increase in housing units from 1990 to 2000. In contrast, only 25% of the industrial zoned land in Avon has been developed. At the rate the region is growing, additional industrial and service expansion is expected in order to support the residential population. The City recognizes that the current infrastructure is unlikely to be able to support the anticipated demand created by development of the industrial area. Because of this, they are planning to provide adequate infrastructure in a timely manner.

The primary area for industrial growth is north of I-90 between the SR 83 and Crocker Road interchanges. Vehicles from the industrial area desiring to go eastbound on I-90 must travel 1.7 miles westbound on Chester Road, pass

through several signalized intersections and make at least two left turns in order to access I-90 at the congested SR 83 interchange. Other available routes under existing conditions involve traveling local streets in circuitous routes to reach the Crocker Road interchange 2.0 miles to the east. The City of Westlake has rejected suggestions to connect Avon's industrial area to Clemens Road in order to provide a more direct connection to the Crocker Road interchange. Since the intersections of Clemens & Crocker Roads and the I-90 westbound ramp & Crocker Road are both failing, adding additional traffic from Avon's industrial area would only make a bad situation worse. Development of the industrial area requires appropriate access to I-90 in order to maintain appropriate service to existing, expanding industries and new business investments while minimizing the effect on residential areas.

Existing Conditions

State Route 83. SR 83 is a 4-lane, limited access facility, divided with a grass median between Detroit Road and Chester Road. Its Functional Classification is an Urban Minor Arterial. Located approximately 1,500 feet north of Detroit Road, the interchange with I-90 is a standard diamond with 2-lane exit ramps and 1-lane entrance ramps. The ramp intersections are signalized and control all movements to and from the interstate. SR 83 is carried over I-90 by two bridges. The southbound bridge is three lanes wide to accommodate the southbound left turn lane at the eastbound ramp intersection. The northbound bridge is two lanes wide, carrying the two through lanes. An 80-foot long northbound left turn lane to the westbound entrance ramp develops outside the bridge limits. There is approximately 730 feet between the ramp intersections. SR 83 intersects Chester Road approximately 550 feet north of the SR 83 & westbound ramp intersection. The State Route turns east on Chester Road for 620 feet, to the intersection of Chester & Center Road, where it turns onto Center Road and continues north to the City of Avon Lake. Recently, the City of Avon built a road extension opposite SR 83 at the western intersection with Chester Road to provide an alternative route from SR 83 to Center Road. This "bypass" of Chester Road is not the official State Route, but provides congestion relief for vehicles traveling north on SR 83. As part of the Chester Road "bypass", the City built a Park-and-Ride lot on property adjacent to the road that is owned by the City. Lorain County transit serves this Park-and-Ride lot with an express bus that connects to Cleveland RTA facilities.

The I-90 interchange area of State Route 83 has been rapidly developing with commercial properties, including a Wal-Mart, a Best Buy, service stations with convenience markets, and a high-turnover sit-down restaurant on the north side of I-90. A Lowe's home improvement store is scheduled to open on SR 83 north of Chester Road in the near future. South of I-90, two retail centers opened on Detroit Road on either side of SR 83; one is 80,000 square feet and one is 840,000 square feet of retail space. The City of Avon (estimated population 12,000) requires developers to make improvements to the public street system in order to mitigate the traffic impacts of their development, which is why the intersections adjacent to the SR 83 interchange will operate at LOS D in the Design Year. In addition to serving the recent commercial developments in the corridor, SR 83 provides access to the City of Avon Lake (estimated population 20,000) to the north of I-90 and residential areas on the west side of the City of Avon.

Nagel Road. Nagel Road is a 2-lane road that runs north/south within and beyond the study area. Its Functional Classification is listed as an Urban Collector, and it is part of the grid street system identified in the City of Avon's Thoroughfare Plan. The intersections of Nagel Road & Avon Road and Nagel Road & Chester Road are currently stop-controlled. South of Detroit Road, Nagel Road provides access to residential subdivisions, while north of Detroit Road it serves the industrial-zoned area of Avon and provides access to the City of Avon Lake. Nagel Road can be accessed from I-90 using the SR 83 interchange via either Detroit Road or Chester Road. In addition, it can be accessed from the Crocker Road interchange via Detroit Road, Clemens Road/Bradley Road/Avon Road, or Clemens Road/Bradley Road/ Walker Road.

Crocker Road & I-90 Interchange. The Crocker Road & I-90 interchange is located in the City of Westlake (estimated population 32,000), Cuyahoga County. Crocker Road between Detroit Road and I-90 is an Urban

Principal Arterial (Non-Freeway) while north of I-90 it is an Urban Minor Arterial. It provides access to commercial, industrial and residential areas on the west side of Westlake. In addition, it provides access to the City of Bay Village (estimated population 16,000). The interchange is a modified standard diamond; the southbound Crocker to eastbound I-90 access is a loop ramp, and the northbound Crocker to eastbound I-90 access is a diagonal ramp. The two eastbound entrance ramps merge together on a Collector-Distributor lane that is separated from the mainline by a concrete barrier, which then merges onto I-90 in a single lane. Both the eastbound and westbound ramp intersections are signalized, but the southbound to eastbound ramp is a slip ramp that does not pass through the traffic signal. Crocker Road carries two through lanes in each direction in the interchange area, and at the westbound ramp it has a northbound left turn lane. The eastbound exit ramp is two lanes wide. The westbound exit ramp has an exclusive right turn lane, a combined right/left turn lane and an exclusive left turn lane. All entrance ramps are single lanes. The intersection of Crocker Road & Clemens Road is located roughly 300 feet north of the westbound ramp intersection.

Interstate 90. Throughout most of the study area, Interstate 90 has three lanes in each direction. It adds/drops the third lane at the SR 611 interchange, between the exit and entrance ramps. There is a grass median for the entire length of the interstate in the study area.

Traffic Volumes

ODOT's Office of Technical Services prepared certified traffic volumes, using traffic counts collected by TranSystems and TDM runs prepared by NOACA. NOACA adjusted their TDM for the IJS to include development in Avon's industrial area that was not originally included in their base model. The No Build volumes include trip generations for 220 acres of land along Nagel Road north of I-90. The Build volumes include the same trip generations as the No Build, plus an additional 100 acres of commercial development in a "halo" area around the proposed Nagel interchange. Copies of the certified traffic are available on the NOACA website.

Opening Year for the study is 2010, with a Design Year of 2030. Design Year traffic analyses are provided for the No Build condition, Upgrade Existing SR 83 condition, and Build Nagel interchange condition.

Traffic Analyses

Level-of-Service (LOS) is a quality measuring tool for the operations of several different roadway types, features or controls. The Highway Capacity Manual (HCM), published by the Transportation Research Board, is the standard of care for roadway operations analysis and level-of-service determination. The level-of-service is computed as the result of multivariable logic and numeric equations in the form of a worksheet. The variables account for geometric and traffic conditions that dictate capacity and represent the flows that exist and/or are anticipated in the future. These variables typically include speed, delay, traffic volume, lane geometrics, etc.

There are six level-of-service grades that represent all of the possible operating conditions; these levels range from LOS A, representing optimum operation, to LOS F, representing congested or unstable flow. For freeway elements, each grade is represented by a range of vehicular density values for each segment of freeway or ramp merge/diverge area. Intersection LOS is represented by a range of the average amount of delay experienced by vehicles traveling through the intersection. ODOT states that LOS C is the goal for interchange improvements. LOS E and LOS F are commonly considered at capacity or over capacity, respectively.

McTrans, a federally sponsored transportation software group, developed a package titled Highway Capacity Software. HCS+ (version 5.21) is a software package that has incorporated many of the analyses included in the current HCM. The software follows the same method for level-of-service computation as the HCM, and therefore is typically considered acceptable for LOS analysis. Table 1 gives the density ranges for freeway analyses. Table 2 lists the delay ranges for signalized and unsignalized intersection analyses.

Table 1 - LOS Criteria for Freeways

Level-of-Service	Freeway Segment Density (pc/mi/ln)	Weaving Segment Density (pc/mi/ln)	Ramp Junction Density (pc/mi/ln)
A	0 - 11	≤ 10	≤ 10
B	> 11 - 18	> 10 - 20	> 10 - 20
C	> 18 - 26	> 20 - 28	> 20 - 28
D	> 26 - 35	> 28 - 35	> 28 - 35
E	> 35 - 45	> 35 - 43	> 35
F	> 45	> 43	Demand Exceeds Capacity

Table 2 - LOS Criteria for Intersections

Level of Service	Delay (sec/veh)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	>10 - 20	>10 - 15
C	>20 - 35	>15 - 25
D	>35 - 55	>25 - 35
E	>55 - 80	>35 - 50
F	>80	>50

In addition to using HCS+ to determine delay and LOS for the signalized intersections, TranSystems used Synchro/SimTraffic to identify signal coordination concerns and verify lane configurations on SR 83 and the proposed Nagel Road corridor. Synchro is a macroscopic traffic software program that analyzes intersection capacity for a network of signalized intersections. SimTraffic is a microscopic simulation model that helps to illustrate the full impact of queuing and blocking. TranSystems first analyzed proposed intersection configurations in HCS+, then reviewed and modified them as needed using Synchro/SimTraffic, and finally re-analyzed the modifications in HCS+ to determine the actual delay and LOS for the intersections.

No Build

Intersections: TranSystems performed analyses for all the major intersections in the study area in an effort to determine how the local street system affects the traffic’s ability to access the freeway. Table 3 summarizes the results of the No Build HCS intersection analyses.

As Table 3 indicates, the primary locations of congestion will occur around the ramp intersections in the interchange areas. The intersection of Nagel & Chester will also fail under No Build conditions (with or without construction of a traffic signal), because of the concentration of traffic in the proposed development location; however, the City typically makes developers mitigate those impacts. In addition to the ramp intersection LOS problems, the intersection of Crocker Road & Clemens Road fails substantially.

The high amount of delay at the ramp intersections at all three interchanges indicates that these intersections are constraining the volume of traffic that can enter I-90 during the peak periods. A closer look at the lane movement volume to capacity (v/c) ratios for these intersections gives a better indication of how much traffic is being permitted onto the freeway in relation to the demand volume. Table 4 shows the critical demand volumes and v/c ratios, and the volume of traffic that would actually enter I-90.

Table 3 – 2030 No Build Intersection Capacity Results

Location	AM Design Hour		PM Design Hour	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
SR 611 & I-90 WB	C	27.2	D	36.1
SR 611 & I-90 EB	F	81.4	E	56.7
SR 83 & Chester (east)	C	23.0	C	33.2
SR 83 & Chester (west)	C	33.8	D	42.1
SR 83 & I-90 WB	D	52.0	F	124.6
SR 83 & I-90 EB	F	153.8	E	66.8
SR 83 & Detroit	D	40.3	D	42.4
Jaycox & Chester	B	17.7	C	24.0
Jaycox & Detroit	B	12.2	B	14.9
Nagel & Chester	F	296.2	F	432.8
Nagel & Detroit	B	18.9	D	40.3
Crocker & Clemens	F	137.3	F	156.8
Crocker & I-90 WB	D	48.4	F	141.2
Crocker & I-90 EB	D	54.7	D	36.2
Crocker & Detroit	D	40.3	D	52.3
Unsignalized intersections				
Nagel & Chester	F	339.37	F	614.77
Nagel & Avon	F (WB)	112.6 (WB)	F (WB)	389.5 (WB)

Table 4 – 2030 No Build Entrance Ramp Permitted Volumes

Direction	Entrance Ramp	From North		From South		Total	
		Demand Volume	v/c ratio	Demand Volume	v/c ratio	Demand Volume	Permitted Volume
AM DHV							
Eastbound	SR 611	850	1.13	390	1.10	1240	1107
Eastbound	SR 83	590	1.42	810	1.32	1400	1029
Eastbound	Crocker	750	< 1.00	1030	1.12	1780	1670
Westbound	Crocker	220	1.03	390	1.13	610	559
Westbound	SR 83	370	1.05	300	1.16	670	611
PM DHV							
Eastbound	SR 611	550	1.03	210	1.05	760	734
Eastbound	SR 83	510	1.19	380	1.11	890	771
Eastbound	Crocker	590	< 1.00	620	1.04	1210	1186
Westbound	Crocker	380	1.22	530	1.51	910	662
Westbound	SR 83	470	1.26	300	1.53	770	569

A comparison of the demand volumes to the permitted volumes illustrates the access problem, particularly at the SR 83 and Crocker Road interchanges. In the AM Design Hour, only 1029 vehicles enter Eastbound I-90 at SR 83 because the ramp intersection is over capacity. At Crocker Road, only 1107 vehicles enter Eastbound I-90 for the same reason. Those vehicles represent *85% of the total demand volume* trying to enter EB I-90 at these two interchanges during the AM Design Hour. In the PM Design Hour, only 662 vehicles enter Westbound I-90 at Crocker Road, and only 569 vehicles enter Westbound I-90 at SR 83; this represents *73% of the total demand volume* trying to enter WB I-90 at these two interchanges during the PM Design Hour. These examples are the worst access concerns; the SR 611 eastbound entrance ramp experiences similar access constraints, as do the non-peak directions at SR 83 and Crocker Road. In addition to illustrating the access problems for the City of Avon, the constrained volumes were used to calculate the freeway segment volumes throughout the study area, which in turn were used to calculate the freeway segment and ramp merge/diverge area densities and LOS.

Freeways: TranSystems analyzed the freeway segments in the study area to determine how I-90 will function under current conditions in the Design Year. Table 5 summarizes the results of the No Build Freeway analyses.

Within the study area, I-90 is functioning at better-than-acceptable LOS, particularly for an urban area. Part of the reason for this is because not all of the traffic is able to access the freeway; on the other hand, the LOS B and C shown for almost every freeway segment indicates that there is substantial reserve capacity available on the freeway.

Table 5 – 2030 No Build Freeway Capacity Results

Segment	AM Design Hour		PM Design Hour	
	LOS	Density (pcpmpf)	LOS	Density (pcpmpf)
EB I-90 SR 254 to SR 611	C	22.5	C	19.8
EB I-90 SR 611 to SR 83	C	18.7	B	14.6
EB I-90 SR 83 to Crocker	C	20.7	B	14.8
EB I-90 Crocker to SR 252	C	25.8	B	16.9
WB I-90 SR 252 to Crocker	B	14.4	D	31.6
WB I-90 Crocker to SR 83	B	11.5	C	23.0
WB I-90 SR 83 to SR 611	B	11.5	C	21.0
WB I-90 SR 611 to SR 254	B	14.4	D	27.7

Ramps: TranSystems analyzed the ramp merge and diverge areas under current conditions in the Design Year. Table 6 summarizes the results of the No Build Ramp merge and diverge analyses.

The only ramp merge area that is experiencing a capacity problem is the Crocker Road westbound exit ramp, which has a density just above the minimum LOS E threshold. Otherwise, the merge and diverge areas operate at or above acceptable LOS.

Table 6 – 2030 No Build Ramp Merge & Diverge Capacity Results

Ramp	AM Design Hour		PM Design Hour	
	LOS	Density (pcpmpl)	LOS	Density (pcpmpl)
SR 611 EB entrance	C	24.4	B	19.3
SR 611 EB exit	C	27.6	C	24.5
SR 611 WB entrance	B	19.3	D	32.3
SR 611 WB exit	B	16.6	C	25.9
SR 83 EB entrance	C	24.9	B	18.3
SR 83 EB exit	C	23.4	B	19.3
SR 83 WB entrance	B	14.5	C	22.1
SR 83 WB exit	B	15.7	D	28.4
Crocker EB entrance	D	30.2	B	19.9
Crocker EB exit	C	25.3	B	19.3
Crocker WB entrance	B	14.9	C	26.0
Crocker WB exit	C	20.1	E	35.1

III. “Build” Traffic Conditions

Build Nagel Interchange

Intersections: The proposed Nagel interchange incorporates the intersection with Avon Road into the eastbound I-90 ramp intersection. The eastbound exit ramp consists of two left turn lanes, one through lane and one right turn lane, while the entrance ramp will be a single lane. Avon Road consists of one left turn lane, one through lane and one right turn lane. Northbound Nagel Road consists of one left turn lane, one exclusive through lane and one combined through/right turn lane. Southbound Nagel Road consists of one left turn lane, two through lanes and one right turn lane. South of the Avon Road/eastbound I-90 ramp intersection, Nagel Road tapers to one lane in each direction.

At the proposed westbound I-90 ramp intersection, Nagel Road has two through lanes in each direction. In addition, there will be dual northbound left turn lanes and dual southbound right turn lanes; as a result, the westbound entrance ramp is two lanes wide, but tapers to one lane before the acceleration lane. The westbound exit ramp has one left turn lane and two right turn lanes.

Nagel Road continues to carry two through lanes in each direction at the Chester Road intersection. In addition, both directions have one left turn lane and one right turn lane. Eastbound Chester Road has one left turn lane, one through lane and one right turn lane. Westbound Chester Road has two left turn lanes, one through lane and one right turn lane. North of the Chester Road intersection, Nagel Road tapers to one lane in each direction.

The final intersection on the Nagel Road corridor that requires improvements as a result of the proposed interchange is Nagel Road & Detroit Road. This intersection, while located 3,500 feet south of the interchange area, is affected by traffic pattern changes created by the new interchange. It currently has one through lane and one left turn on each approach; TranSystems recommends adding eastbound and westbound right turn lanes to minimize congestion on Detroit Road and provide LOS D in the Design Year. Opening Year traffic operates at LOS B (delay of 13.2 sec/veh in the AM Design Hour; 14.0 sec/veh in the PM Design Hour) without any improvements, so these recommendations will be incorporated in the future.

The improvements needed at SR 83 to obtain LOS D in the Build Nagel interchange scenario include:

- Widening the segment of SR 83 between Chester Road and the westbound ramp to accommodate three southbound through lanes and one southbound right turn lane, and realign the northbound left turn lane so that it is opposite the left turn lane directly across Chester Road. The through lane widening and left turn lane realignment can be accomplished in the grass median area. One of the southbound through lanes will flow into the southbound left turn lane on the downstream segment of SR 83.
- Widening the westbound exit ramp from two lanes to three: one left turn lane, one combine left/right turn lane and one right turn lane.
- Widen the northbound SR 83 bridge over I-90 to accommodate three lanes: one left turn lane and two through lanes.
- Add a northbound right turn slip ramp at the eastbound ramp intersection.
- Widen the eastbound exit ramp from two lanes to four lanes: two right turn lanes and two left turn lane.
- Widen the eastbound entrance ramp to two lanes to permit free movement from the northbound right turn ramp. Taper back to a single lane prior to the acceleration lane.

Table 7 summarizes the results of the Build Nagel interchange HCS intersection analyses.

Table 7 – 2030 Build Nagel Interchange Intersection Capacity Results

Location	AM Design Hour		PM Design Hour	
	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)
SR 611 & I-90 WB	C	26.5	C	32.8
SR 611 & I-90 EB	E	73.7	D	45.6
SR 83 & Chester (east)	C	23.6	C	27.9
SR 83 & Chester (west)	C	31.9	D	37.0
SR 83 & I-90 WB	C	26.9	D	37.1
SR 83 & I-90 EB	C	28.9	C	29.0
SR 83 & Detroit	D	37.2	D	39.4
Jaycox & Chester	B	19.1	C	32.9
Jaycox & Detroit	B	12.8	C	21.6
Nagel & Chester	C	30.6	D	38.9
Nagel & I-90 WB	C	28.4	C	33.9
Nagel & Avon/I-90 EB	C	33.9	C	30.0
Nagel & Detroit	B	13.0	D	44.8
Crocker & Clemens	E	72.3	E	67.3
Crocker & I-90 WB	D	35.8	F	118.0
Crocker & I-90 EB	C	32.9	C	23.6
Crocker & Detroit	D	35.9	D	45.5

Adding a new interchange at Nagel Road helps draw traffic from the SR 611, SR 83 and Crocker Road interchanges. While the SR 611 & I-90 eastbound intersection still operates below acceptable LOS in the AM Design Hour, it improves from LOS F to LOS E. The same result happens at the Crocker Road & Clemens Road intersection for both peak periods. In the PM Design Hour, the SR 611 & I-90 eastbound ramp intersection improves from LOS E to LOS D. Also, while the Crocker & I-90 westbound ramp intersection is still at LOS F, the delay is reduced by 23.2 sec/vehicle to 118.0 sec/vehicle. Finally, the Crocker & I-90 eastbound ramp intersection improves from LOS D to LOS C in this scenario. Overall, most intersections experience at least a reduction in delay if not an improvement in LOS.

The change in LOS at the adjacent interchange ramp intersections indicates that the constraint conditions have also changed. As part of the improvements to SR 83, traffic flows are unconstrained at those ramps. Table 8 shows the critical volumes and v/c ratios, and the volume of traffic that would actually enter I-90.

Table 8 indicates a substantial improvement for vehicles trying to access I-90, particularly in the off-peak direction where traffic is unconstrained in this option. In the AM Design Hour, 1,460 vehicles at SR 83, 290 vehicles at Nagel Road and 1,700 vehicles at Crocker Road access eastbound I-90; this represents more than 99% of the total eastbound demand volume at those interchanges. In the PM Design Hour, 642 vehicles at Crocker Road, 970 vehicles at Nagel Road and 630 vehicles at SR 83 enter westbound I-90. This represents 94% of the total westbound demand volume at those interchanges.

Table 8 – 2030 Build Nagel Entrance Ramp Permitted Volumes

Direction	Entrance Ramp	From North		From South		Total	
		Demand Volume	v/c ratio	Demand Volume	v/c ratio	Demand Volume	Permitted Volume
AM DHV							
Eastbound	SR 611	830	1.12	390	1.05	1220	1112
Eastbound	SR 83	630	< 1.00	830	< 1.00	1460	1460
Eastbound	Crocker	700	< 1.00	1030	1.03	1730	1700
Westbound	Crocker	170	< 1.00	350	< 1.00	520	520
Westbound	SR 83	310	< 1.00	240	< 1.00	550	550
PM DHV							
Eastbound	SR 611	540	< 1.00	200	< 1.00	740	740
Eastbound	SR 83	560	< 1.00	400	< 1.00	960	960
Eastbound	Crocker	560	< 1.00	620	< 1.00	1180	1180
Westbound	Crocker	290	1.19	490	1.23	780	642
Westbound	SR 83	390	< 1.00	240	< 1.00	630	630

Freeways: TranSystems analyzed the freeway segments with the revised constraint conditions, to determine how I-90 will function with a new Nagel Road interchange and an upgraded SR 83 interchange in the Design Year. Table 9 summarizes the results of the Upgrade SR 83 Freeway analyses.

Table 9 – 2030 Build Nagel Interchange Freeway Capacity Results

Segment	AM Design Hour		PM Design Hour	
	LOS	Density (pcpmp)	LOS	Density (pcpmp)
EB I-90 SR 254 to SR 611	C	23.0	C	19.6
EB I-90 SR 611 to SR 83	C	19.1	B	14.6
EB I-90 SR 83 to Nagel	C	24.2	B	16.5
EB I-90 Nagel to Crocker	C	21.8	B	15.2
EB I-90 Crocker to SR 252	D	28.4	B	18.0
WB I-90 SR 252 to Crocker	B	15.0	D	30.9
WB I-90 Crocker to Nagel	B	11.9	C	22.5
WB I-90 Nagel to SR 83	B	12.8	C	24.9
WB I-90 SR 83 to SR 611	B	12.0	C	21.2
WB I-90 SR 611 to SR 254	B	15.3	D	31.6

While there are minor increases in the actual density experienced on some of the freeway segments as a result of adding the new interchange, there is only one segment that experiences a reduction of LOS. In the AM Design Hour, eastbound I-90 between Crocker Road and SR 252 goes from LOS C to LOS D; this is similar to the degradation experienced with the Upgrade Existing SR 83 option and is an acceptable LOS based on new or reconstructed roadways in the “Guide For Selection of Minimum Design Levels of Service” and the reference sections in Exhibit 301-1E of ODOT’s Location and Design Manual. As with the Upgrade Existing SR 83 option, these results demonstrate that I-90 can handle the increased traffic volumes without improperly impacting the freeway operations.

Ramps: TranSystems analyzed the ramp merge and diverge areas under Build Nagel interchange conditions in the Design Year. Table 10 summarizes the results of the Build Nagel interchange Ramp analyses.

Table 10 – 2030 Build Nagel Interchange Ramp Merge/Diverge Capacity Results

Ramp	AM Design Hour		PM Design Hour	
	LOS	Density (pcpmpl)	LOS	Density (pcpmpl)
SR 611 EB entrance	C	24.8	B	19.3
SR 611 EB exit	D	28.2	C	24.2
SR 611 WB entrance	C	20.2	D	34.9
SR 611 WB exit	B	17.2	C	27.3
SR 83 EB entrance	D	29.3	C	20.6
SR 83 EB exit	C	23.6	B	18.9
SR 83 WB entrance	B	14.8	C	23.8
SR 83 WB exit	B	17.3	D	30.0
Nagel EB entrance	C	23.4	B	17.4
Nagel EB exit	C	25.6	B	18.4
Nagel WB entrance	B	15.5	C	27.9
Nagel WB exit	B	13.0	C	24.0
Crocker EB entrance	D	31.5	C	20.9
Crocker EB exit	C	26.0	B	19.5
Crocker WB entrance	B	15.1	C	25.5
Crocker WB exit	C	20.7	D	34.9

A few entrance ramps experience reduced LOS; however none of the ramps drop below LOS D. Most of the ramps operate at LOS C or B. In addition, the Crocker Road westbound exit ramp improved from LOS E to LOS D under the Build Nagel interchange option.

Conclusions

The current interchange infrastructure serving the City of Avon industrial area is not sufficient to support the expected growth and traffic demand of that area. The primary interchanges that serve the industrial area will experience significant congestion around the ramp intersections in the Design Year, which constrains the volume of traffic able to access I-90. Under No Build conditions, only 85% of the AM eastbound demand volume entering I-90 at the SR 83 and Crocker Road interchanges will be able to access the interstate, while only 73% of the PM westbound demand volume will access I-90. In addition, the existing interchange spacing of 3.7 miles requires circuitous travel patterns for vehicles entering or exiting the industrial area. The No Build freeway capacity analyses indicate that there is substantial reserve capacity available on the freeway segments and most ramp merge/diverge areas, meaning that I-90 can accommodate additional traffic if it can access the interstate.

Adding a new interchange at Nagel Road helps draw traffic from all three existing interchanges in the study area. The SR 83 ramp intersections still require improvements to operate at LOS D, so this work is included in the Build Nagel interchange option. The SR 611 & I-90 EB ramp improves from LOS F to LOS E, as does the Crocker Road & Clemens Road intersection. The Crocker Road & I-90 WB ramp intersection still experiences LOS F, but delay is reduced by 23.2 sec/veh. Overall, the addition of a new interchange in the City of Avon significantly reduces constraints on the traffic trying to access I-90. In the AM Design Hour, 99% of the eastbound traffic demand volume is permitted to enter I-90 at the SR 83, Nagel Road and Crocker Road interchanges. In the PM Design Hour, 94% of the westbound traffic demand volume is permitted to enter I-90 at those locations. Adding a new interchange also

eliminates the circuitous routes that industrial area traffic would otherwise have to use. Only one freeway segment experiences reduced LOS, but it is still within the acceptable range of LOS D. A few entrance ramps at adjacent interchanges experience reduced LOS; however none drop below LOS D. Finally, the Crocker Road westbound exit ramp improves from LOS E to LOS D under the Build Nagel interchange option.

IV. Design Concept

Based on the results of the traffic analysis, the City of Avon is pursuing the Build Nagel Road Interchange option, including improving the SR 83 & I-90 interchange, for improving access to I-90 for the City of Avon. This option includes building the new interchange at Nagel Road, improving the intersection of Nagel Road & Chester Road, improving the intersection of Nagel Road & Detroit Road, and improving the SR 83 & I-90 ramp intersections as described in the analysis above. These improvements will be staged based on need and available funding, but will be accomplished in the following order:

1. Construct new Nagel Road interchange and Nagel Road & Chester Road intersection improvements (Opening Year 2010).
2. Improve SR 83 & I-90 ramp intersections (anticipated Opening Year 2020).
3. Improve Nagel Road & Detroit Road intersection (anticipated Opening Year 2020).

Should funding and need for the SR 83 & I-90 interchange improvements occur earlier than 2020, the City of Avon will implement those improvements more quickly.

V. Project Funding

TranSystems prepared construction cost estimates for the Build Nagel interchange (including improving SR 83 to LOS D). These estimates are planning level and will be refined as the project continues to develop. They are construction costs only and do not include Right-of-Way acquisition, engineering, inspection or utility relocation costs. Estimates assume construction in 2010 and include a 29.5% inflation rate and 30% contingency. The Nagel interchange is estimated to cost \$19,751,051 while the associated SR 83 improvements are estimated at \$2,164,372 for a project total of \$21,915,423.

At this time, there is no funding to upgrade existing interchanges, as NOACA and ODOT have committed their funding to other priorities. Any project would have to compete with other projects statewide to obtain funding from the Transportation Review Advisory Council (TRAC). On the other hand, the City of Avon has negotiated with developers in the Nagel Road area to identify funding for building the Nagel interchange; they have committed to a formula of 1/3 provided by City capital improvement funds, 1/3 provided by the private developer and 1/3 obtained from Tax Increment Financing (TIF) from the industrial zoned land. In addition, the City has agreed to arrange funding to construct the additional improvements at SR 83 after the Nagel interchange is built, based on available TIF monies. They have committed to making those improvements the second priority of infrastructure improvements, immediately following the Nagel Road interchange.

VI. Bicycle/Pedestrian and Transit Issues

As part of the NOACA planning review process, the project is being reviewed by committees focused on bicycle and pedestrian access and on transit issues. Following is a summary of the current status of this coordination.

Bicycle/Pedestrian

The City of Avon met with the BAC to discuss bicycle and pedestrian accommodations in the City of Avon and those contemplated as a part of the Nagel Interchange project. The City reported that pedestrian accommodations were planned for the project, including sidewalks within the project limits on both sides of Nagel Road north and south of I-90, as well as a sidewalk on the east side through the interchange area crossing I-90. Bicycle crossing of I-90 is shown on the City's plan for the Jaycox overpass. Jaycox Road is preferred over the Nagel Road location in order to reduce bicycle/vehicular conflicts. The BAC expressed concerns that the timeframe for improving the Jaycox crossing was uncertain and requested that the City consider including a bicycle lane or shared use path as a part of the interchange project.

The City directed the project team to evaluate including a shared use path as a part of the project. The project team is currently developing a concept with input on standards from ODOT. The additional costs, operations, safety and property impacts will be evaluated prior to a decision on this issue.

Transit

The project team met with the transit committee to discuss transit issues for the project area. The project team noted that a park-and-ride facility was recently constructed by the City of Avon at the SR 83 interchange, including shelter. The lot is served by Lorain County Transit which provides an express bus (route #70) to the Westlake park and ride lot that is served by GCRTA, located between Clague and Columbia Roads north of I-90 along Sperry Road. Since there is adequate capacity at this new lot and it is located in close proximity, no additional park-and-ride is planned for the Nagel Interchange.

The transit committee expressed concerns about the ability of transit to access future development sites within the City of Avon. No site plans have been submitted for City review for any sites as of this time, so there is no information available. However, the City will consider whether to incorporate comments on transit accessibility into future site plan reviews in this area.

VII. Environmental Overview

Coordination with NOACA's TRANSWAC is scheduled for July 25, 2007. TranSystems is currently in the process of coordinating environmental documentation through ODOT for the proposed interchange. Field studies completed include Noise Analysis, Air Quality Analysis, Phase I Cultural Resources Survey, Level 1 Ecological Survey Report and Environmental Site Assessment Screening Report. Phase 1 Environmental Site Assessments are currently under way for seven locations. The following summarizes the extent of environmental work completed to date.

Noise Analysis

A traffic noise analysis was performed to identify and estimate the potential traffic noise impacts associated with the project. The noise analysis for this project was conducted in accordance with the Code of Federal Regulations (CFR), Title 23, Part 772, and the U.S. Department of Transportation, Federal Highway Administration (FHWA), *Highway Traffic Noise Analysis and Abatement Policy and Guidance* (FHWA, 1995). The project was further conducted in accordance with the ODOT noise policy pertaining to *Standard Procedure for Analysis and Abatement of Highway Traffic Noise* (ODOT, 2005). Existing year 2005 noise levels and noise levels for design year 2030 No Build and Build alternatives were modeled using the FHWA Traffic Noise Model (TNM) Version 2.5 (FHWA, 1998).

For the SR 83 area, noise sensitive areas identified in the vicinity of the interchange include residential receptors located on Center Road and on Chester Road west of SR 83. A total of six noise sensitive receptor sites evaluated for noise impact as part of this investigation were predicted to experience traffic noise levels above the acceptable threshold. A noise barrier analysis was performed for receptor sites impacted by this alternative to determine if the construction of a noise barrier wall would be a reasonable and feasible measure in abating design year Build traffic noise levels. The level of noise reduction that this noise barrier wall could provide would meet the ODOT feasibility criterion; however, at a total cost of \$385,068 dollars the barrier would cost \$64,178 per benefited receptor. At a cost of greater than \$35,000 per benefited receptor, the barrier does not meet the ODOT reasonable criterion. A noise barrier wall at this location is not a feasible and reasonable noise abatement measure and will not be incorporated into the project.

For the Nagel interchange area, noise sensitive areas identified in the vicinity of the proposed interchange include two isolated residential structures located adjacent to and just south of I-90, east of Nagel Road and north of Avon Road. There is a group of four residential structures located on the south side of Avon Road east of Nagel Road. Two isolated residential structures are located on the south side of Just Imagine Road just north of I-90. As part of the project, the Nagel Road/Detroit Road intersection will also be improved with the addition right turn queue lanes. A group of six residential structures are located on the west side of Nagel Road just north of Detroit Road. A total of four noise sensitive receptor sites evaluated for noise impact as part of this investigation were predicted to experience traffic noise levels above acceptable threshold.

A noise barrier analysis was performed for receptor sites impacted by the Nagel interchange to determine if the construction of a noise barrier wall would be a reasonable and feasible measure in abating design year Build traffic noise levels at the two residential dwellings located immediately south of I-90 and east of Nagle Road. The level of noise reduction that this noise barrier wall could provide would meet the ODOT feasibility criterion; however, the barrier would cost \$41,252 per benefited receptor. At a cost of greater than \$35,000 per benefited receptor, the barrier does not meet the ODOT reasonable criterion. A noise barrier wall at this location is not a feasible and reasonable noise abatement measure and will not be incorporated into the project. A noise barrier analysis was also performed to determine if the construction of a noise barrier wall would be a reasonable and feasible measure in abating design year Build alternative traffic noise levels at the two residential dwellings located immediately north of I-90 on Just Imagine Drive. This barrier would provide a maximum noise reduction of 2.5 dB at receptor site 2-4 consisting of two residential dwelling units. By not achieving the minimum noise reduction of 5 dB, the noise barrier

does not meet the ODOT feasible criterion. A noise barrier wall at this location is not a not a feasible and reasonable noise abatement measure and will not be incorporated into the project.

Air Quality Analysis

The ODOT Technical Guidance for Analysis of Mobile Source Air Toxics (TG-POL-01-06) dated August 1, 2006 is based on the FHWA Interim Guidance on Air Toxic Analysis in NEPA Documents (February 3, 2006). To address Mobile Source Air Toxics (MSAT), projects are divided into four categories depending on the proposed project's potential for meaningful MSAT effects. This project fits the category having Low Potential MSAT Effects. Projects having a low potential for meaningful MSAT effects require the preparation of a qualitative MSAT air quality analysis.

For the Nagel Interchange, it is expected there would be reduced MSAT emissions in the immediate area of the project, relative to the No Build Alternative, due to the reduced VMT associated with more direct routing, and due to EPA's MSAT reduction programs. In comparing various project alternatives, MSAT levels could be higher in some locations than others, but current tools and science are not adequate to quantify them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

Cultural Resources

In July 2006, TranSystems contracted The Mannik & Smith Group, Inc. to conduct a Phase I cultural resources reconnaissance survey for the proposed Build Nagel interchange. The purpose of the survey was to identify cultural resources in the project area and evaluate the effect of the project on the properties that meet the criteria for listing in the National Register of Historic Places, in conformance with federal laws and regulations.

A literature and data review was completed in July of 2006. The study area for archaeological resources was 2.5 miles and the study area for history/architecture resources was 1.2 miles. Within those areas, the literature review identified five archaeological sites listed in the Ohio Archaeological Inventory, five properties listed in the Ohio Historic Inventory and one architectural resource listed in the National Register of Historic Places. Two cultural resource management surveys have been conducted within the 1.2-mile study area. No structures within the project area are listed on the Ohio Historic Bridge Inventory.

Fieldwork was conducted in August and December of 2006. Aboveground reconnaissance identified 18 properties within the survey area over 50 years of age, including one previously recorded site: Holy Trinity Church, located on the southwest corner of Nagel Road and Detroit Road. Those resources were individually photographed and recorded in a History/Architecture Resources Table. The archaeological field crew conducted systematic surface survey at a 10-meter interval and a shovel test survey at a 15-meter interval, dependant on ground surface visibility. No archaeological sites were identified through Phase I investigations.

Based on field observations and research, one previously recorded history/architecture property within the survey area, Holy Trinity Church, is recommended eligible for listing in the National Register of Historic Places under Criterion A and C on the basis of its architectural and cultural significance. In addition, one property at 33495 Detroit Road is recommended for additional Phase II study to clarify its historical associations with the Nagel family, who were prominent early pioneers in the area. No other aboveground resources appear to meet the eligibility requirements for listing in the NRHP.

The proposed I-90 interchange will have no effect on archaeological resources. No impacts to historic buildings are expected; however some work is anticipated at the Nagel/Detroit intersection adjacent to the Holy Trinity church. As design details become available, the specific effects of the proposed interchange on historic properties will be determined.

Ecological Resources

Ecological field investigations for the study area were conducted in October 2006, April 2007 and May 2007. The aquatic, terrestrial and wetland habitats, as well as endangered species, were examined according to the ODOT *Ecological Manual, 2005*.

The anticipated ecological resource impacts in the SR 83 area are as follows:

- Aquatic Resources – No stream impacts are anticipated because there are no open streams within the proposed project limits.
- Wetland – Impacts include 0.01 acres of one Category 1 wetland.
- Endangered species – No endangered species are likely to be impacted by the proposed improvements. Fifteen trees were identified in the study area as meeting the definition of suitable roosting trees for the Indiana bat; none were considered suitable maternity roosting habitat trees. In addition, none are expected to be affected by the project because they all lie outside of the construction limits. The proposed project area is in the Northeast Indiana Bat Management Unit.

In addition to the potential impacts at SR 83, the anticipated ecological resource impacts for the Build Nagel Road interchange option are as follows:

- Aquatic resources – A maximum of 82 linear feet of impact to one stream and 28 linear feet of impact to a second stream are possible. Impacts, if necessary, would be limited to portions of three sided box culvert extensions below the ordinary high water mark.
- Wetland – Proposed, unavoidable impacts, including those to jurisdictional ditches, total 3.037 acres. A total of 1.547 acres are Category 1 wetlands whereas the remaining 1.490 acres are comprised of Category 2 wetlands.
- Terrestrial – Impacts total 56.1 acres, including 35.2 acres to residential/commercial/disturbed land, 8.5 acres to mixed deciduous forest, 7.3 acres to agriculture fields and 2.1 acres of scrub-shrub habitat.
- Endangered species – No known listed species will be impacted as a result of the proposed project. An estimated 6,163 trees would be removed as part of this project, seven of which exhibited characteristics for non-isolated Indiana bat roosting habitat. No trees within the construction limits exhibited maternity roosting tree characteristics. The proposed project area is in the Northeast Indiana Bat Management Unit.

Environmental Site Assessment

Based on the information collected during the environmental site assessment screening, a Phase I Environmental Site Assessment was recommended for sites of concern. ODOT Office of Environmental Services concurred that the following sites warrant further investigation:

- Acclaim Auto Sales, 33599 Detroit Road
- Avon Bearings Corp, 1500 Lear Nagle
- Avon Bearings (second facility) 1500 Nagle Road
- Westlake Auto Body, 1370 Nagle Road
- Adoh N Supply, 1270 Nagle Road
- East Avon Center, 33552 Detroit Road
- Auto Salvage Yard, 33173 Just Imagine Drive

No further investigation is recommended for the remaining suspect sites located in or near the project due to their relative distance to the study area and no ROW required.