

4.0 **STUDY EVALUATION & ANALYSES METHODOLOGY**

4.1 **Fermi Traffic Analysis & Modeling Scenarios**

The following represents the potential evaluation scenarios for consideration in this study during AM and PM Peak periods.

- **Existing Conditions (2009)**
- Existing Plant Outage Operations (2009)
- **Peak Construction Phase (2017)**
- Peak Construction Phase Outage (2017)
- **Peak Construction Phase (2017) with Improvement Mitigations**
- **Normal Plant Operations (2024)**
- Plant Outage Operations (2024)
- **Normal Plant Operations (2024) with Improvement Mitigations**
- Full Outage Operations (2024)

This study will focus evaluation and analyses upon the scenarios which represent a sustained average daily condition. The peak construction phase will occur over an extended period of at least 1 year, and will provide sustained daily conditions despite being only a temporary condition. The cases of outage operations are important for reference in that outages typically occur on an annual basis; however, outage conditions are encountered for an abbreviated period of approximately 1 month and do not represent a sustained average daily condition associated with Fermi operations.

4.2 **SEMCOG Planned Study Area Improvements**

In order to give proper evaluation of future traffic study year scenarios, MSG reviewed and incorporated any known improvements of relevance within the study area. The most notable and relevant such improvement involves the stretch of N. Dixie Hwy. between Grand Blvd. and Stony Creek, and from Stony Creek to Swan Creek. The table below summarizes the current projects as designated by the SEMCOG short-range (TIP) and long-range plan (RTP).

SEMCOG Programmed Improvements						
SEMCOG Project ID	Project Name	Project Limits	Proposed Work	Jurisdiction	Year	Cost (in 1,000s)
<u>RTP 1760</u>	Dixie Highway N	from Stony Creek to Swan Creek Road	Add center left turn lane	Monroe CRC	2010	16,932
<u>TIP 001813</u>	Dixie Highway N	from Grand Blvd to Stony Creek Road	Add center left turn lane	Monroe CRC	2010	987

MSG has served as the design engineer and consultant for the MCRC on recent N. Dixie Hwy. widening and reconstruction improvements, including the portion completed up to Stony Creek Road. In addition, MSG is currently serving as the MCRC design engineer and consultant for the widening of N. Dixie Hwy between Stony Creek and Pointe Aux Peaux Road. (Pointe Aux Peaux Road eastbound and westbound approaches have already been widened for center turn lanes, and the current design will connect with the existing 3-lane section west of Pointe Aux Peaux Road).

It is unclear when either the portion currently in design or the remainder of the RTP1760 N. Dixie Hwy. project will be programmed for funding within the SEMCOG TIP, and if they will be implemented prior to either the 2017 or 2020 study years considered with this project.

4.3 Analyses Evaluation and Criteria

The traffic analysis models developed for this study were evaluated for operational conditions using an array of recognized evaluation criteria and methods. MSG employed each of the following evaluation criteria/tools where applicable:

<u>Evaluation Tools</u>
<ul style="list-style-type: none"> • Traffic Analysis & Simulation Modeling • HCM Intersection Capacity Analyses <ul style="list-style-type: none"> • Vehicular Queuing and Storage • HCM Two-lane Roadway Segment Capacity Analyses • HCM Multi-lane Roadway Segment Capacity Analyses <ul style="list-style-type: none"> • Signal Warrant Analyses • Turn Lane Warrant Analyses • Crash History & Safety Analysis

These evaluation criteria/ tools were with reference to or as published by the:

- Transportation Research Board's (TRB) Highway Capacity Manual
- Michigan Department of Transportation (MDOT) Traffic & Safety Notes
- Michigan Manual of Uniform Traffic Control Devices (MMUTCD)
- MDOT Left-Turn Phasing Signal Guidelines

4.3.1 Modeling and Simulation

MSG employed industry leading software through Trafficware's Synchro and SimTraffic packages to develop dynamic analysis and simulation models of the Fermi project study area. The package utilizes methodologies consistent with Highway Capacity Manual (HCM) theory as established by the Transportation Research Board (TRB), and is widely accepted by public agencies.

MSG built and calibrated ten (10) traffic model/simulations in support of these evaluations.

<u>Traffic Analysis & Simulation Models</u>
<ul style="list-style-type: none"> • Existing Conditions (2009) • Peak Construction Phase (2017) • Normal Plant Operations (2024) • Peak Construction Phase (2017) with Improvement Mitigations • Normal Plant Operations (2024) with Improvement Mitigations

The calibration of each model accounted for customized Fermi study area characteristics including:

- Signalized Controls (Ex. Phasing & Timing Permit Data)
- Un-signalized Controls
- Existing Lane Use/ Configuration
- Known (SEMCOG TIP) Programmed Improvement(s)

- Peak Hour Factors
- Heavy Vehicle Percentages
- Posted Speed Limits
- Two-Way Left Turn Lanes (TWLT's)
- Turn Lane Storage Lengths & Tapers

4.3.2 HCM Intersection Capacity Analyses

Signalized and un-signalized intersection capacity analyses were conducted in accordance with the methodologies established by the *Transportation Board (TRB)*, *Highway Capacity Manual*. This is an industry-wide accepted traffic engineering analysis of the operational efficiency experienced at an intersection and its approaching roadway(s). Letter grades (A through F) representing the HCM definition for Level of Service (LOS) were determined to identify the quality of traffic flow and driver experience on the facilities in terms of average delay experienced. Tables below summarize the HCM LOS criteria.

HCM Level of Service Criteria at Signalized Intersections			
LOS	Delay/Vehicle (Seconds)	Description	
A	≤ 10	Little or no delay, few vehicles stopped at intersection	Acceptable
B	> 10 and ≤ 20	Short traffic delays, progression is still good	Acceptable
C	> 20 and ≤ 35	Average traffic delays, many vehicles go through intersection without stopping, but significant amount are stopped	Acceptable
D	> 35 and ≤ 55	Long traffic delays, unfavorable progression, more vehicles stopped at intersection, individual cycles may fail	Acceptable (Marginal)
E	> 55 and ≤ 80	Very long traffic delays, individual cycles frequently fail	Moderately Deficient
F	> 80	Extreme traffic delays, over-saturation	Deficient

HCM Level of Service Criteria at Un-signalized Intersections			
LOS	Delay/Vehicle (Seconds)	Description	
A	10.0 or less	Primarily Free Flow	Acceptable
B	10.1 to 15.0	Reasonably Free Flow	Acceptable
C	15.1 to 25.0	Stable Flow	Acceptable
D	25.1 to 35.0	Marginal Congestion	Acceptable (Marginal)
E	35.1 to 50.0	Unstable Congestion	Moderately Deficient
F	Greater than 50.0	Very Congested	Deficient

4.3.3 Vehicular Queuing and Storage

Highway capacity analyses provide a good indicator of whether there is ample capacity for the traffic demand volume (i.e. enough lanes to service the volume of traffic); however, in certain instances there can be ample capacity yet insufficient storage capacity for the associated vehicular queuing. MSG reviewed the length of vehicular queuing (stacking) versus available storage to address this. This entailed review of analysis reports for queue length, and simulation model inspection.

4.3.4 Signal Warrant Analyses

At un-signalized locations where analyses identified deficiencies which suggest a potential need for signalization (i.e. excessive stop-control delay, queuing, etc.), signal warrant analyses were conducted in accordance with the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). The results are presented to identify those warrants satisfied at the location and support any recommendation for or against signalization.

4.3.5 Turn Lane Warrants

Where operational deficiency or vehicular queuing analyses suggested potential need for lane additions, left and right turn lane warrants were evaluated in accordance with MDOT Traffic & Safety Notes. MDOT provides separate left and right turn lane warrants and allow for calibration to both 2-lane and 4-lane roadways as well as varying speed limits. The figures below provide a graphical excerpt of the left and right turn lane warrants provided in associated MDOT Traffic & Safety Note.

FIGURE 26 MDOT Traffic & Safety Note 604a: Traffic Volume Guidelines for Right Turn Lanes & Tapers

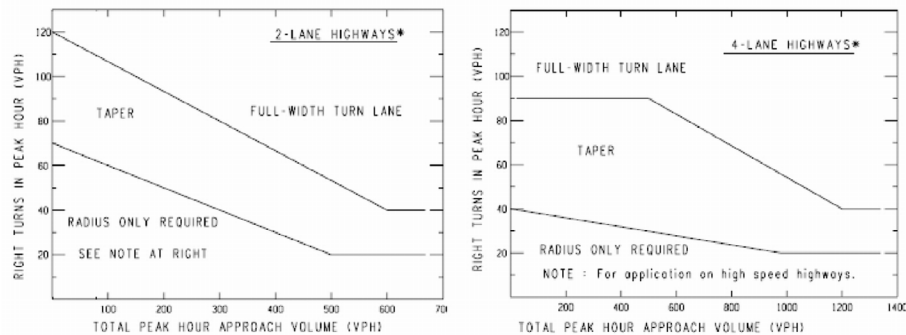
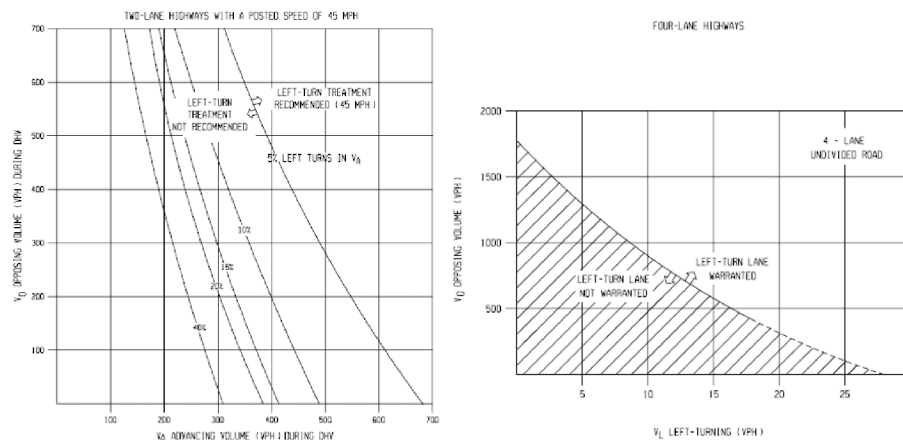


FIGURE 27 MDOT Traffic & Safety Note 605a: Traffic Volume Guidelines for Left-Turn Lanes and Passing Flares at Un-signalized Intersections



4.3.6 MDOT Left-turn Phasing Signal Guidelines

Where signal phasing additions or optimization changes suggested improvement, MSG considered need/ justification consistent with the *MDOT Left-Turn Phasing Signal Guidelines*. The guidelines in part indicate evaluation for a left turn phase requires satisfaction of one of the following conditions.

MDOT Left-Turn Phase Criteria

1. *The left-turn peak hour volume exceeds 90 vehicles per hour for streets with a posted speed less than 50 mph, or*
2. *the product of opposing through hourly volume (VHP) and left-turn hourly volumes (VHP) exceeds 50,000, if there is one opposing lane or 100,000, if there are two opposing lanes, or*
3. *A crash pattern is evident at the intersection which could be correctable with left turn phasing*

5.0 CRASH HISTORY & SAFETY ANALYSIS

Crash history and analyses can provide valuable insight into the operational and safety conditions of roadway and intersection facilities. In some cases there can be direct correlation between a crash history, any identifiable safety deficiencies, and operational conditions found in analyses. In others, crash conditions may have no direct correlation or appear to be random. Regardless, it is important to review any crash history available to best understand all the conditions for any given location. MSG researched available crash history data published by SEMCOG within the study area. Data for the years of 2004-2008 was readily available, and is provided in **Appendix F**. A summary of this crash history is provided below.

Study Area Crash Data Summary (2004-2008)											
Intersection	Crashes By Severity			Total	Crashes by Type						
	Fatal	Level ABC	PDO		Single Vehicle	Head On	Head left	Angle	Rear End	Side Swipe	Other
N. Dixie Hwy. & I-75 NB Ramps	0	4	19	23	3	0	0	8	8	4	0
N. Dixie Hwy. & I-75 SB Ramps	0	5	23	28	1	0	3	8	14	2	0
Nadeau Road & I-75 NB Ramps	0	1	6	7	1	1	0	3	2	0	0
Nadeau Road & I-75 SB Ramps	0	6	15	21	3	0	0	7	10	1	0
Swan Creek Road & I-75 NB Ramps	0	2	7	9	3	0	0	3	3	0	0
Swan Creek Road & I-75 SB Ramps	0	6	27	33	10	0	0	11	6	3	3
N. Dixie Highway & Stony Creek	0	2	4	6	1	1	1	1	2	0	0
N. Dixie Highway & Pointe Aux Peaux	0	3	12	15	5	2	0	2	5	1	0
N. Dixie Highway & Leroux Road	0	2	5	7	6	1	0	0	0	0	0
N. Dixie Highway & Enrico Fermi Drive	2	2	2	6	4	0	0	1	1	0	0
N. Dixie Highway & Post Road	0	2	7	9	4	0	0	3	0	1	1
Leroux Road & Toll Road	0	0	0	0	0	0	0	0	0	0	0
Enrico Fermi & Leroux Road	0	0	0	0	0	0	0	0	0	0	0
Totals	2	35	127	164	41	5	4	47	51	12	4
Severity: Fatal - a crash which resulted in at least one fatality A-level - a crash in which the worst injury incurred was an A-level (incapacitating) injury. B-level - a crash in which the worst injury incurred was a B-level (non-incapacitating) injury. C-level - a crash in which the worst injury incurred was a C-level (possible) injury. PDO - a crash which resulted in property damage only (no injuries).					Crash Type: Uncoded - crash type was coded improperly or not coded; Single veh. - a single vehicle crash Head-on - a head-on crash Head-left - a head-on/left-turn crash Angle - an angle crash; Rear-end - a rear end crash Rear-left - a rear-end/left-turn crash Rear-right - a rear-end/right-turn crash Swipe-same - a sideswipe/same direction crash Swipe-opp. - a sideswipe/opposite direction crash Other - other or unknown crash type						

FIGURE 28 Intersection Crash History by Severity (2004-2008)

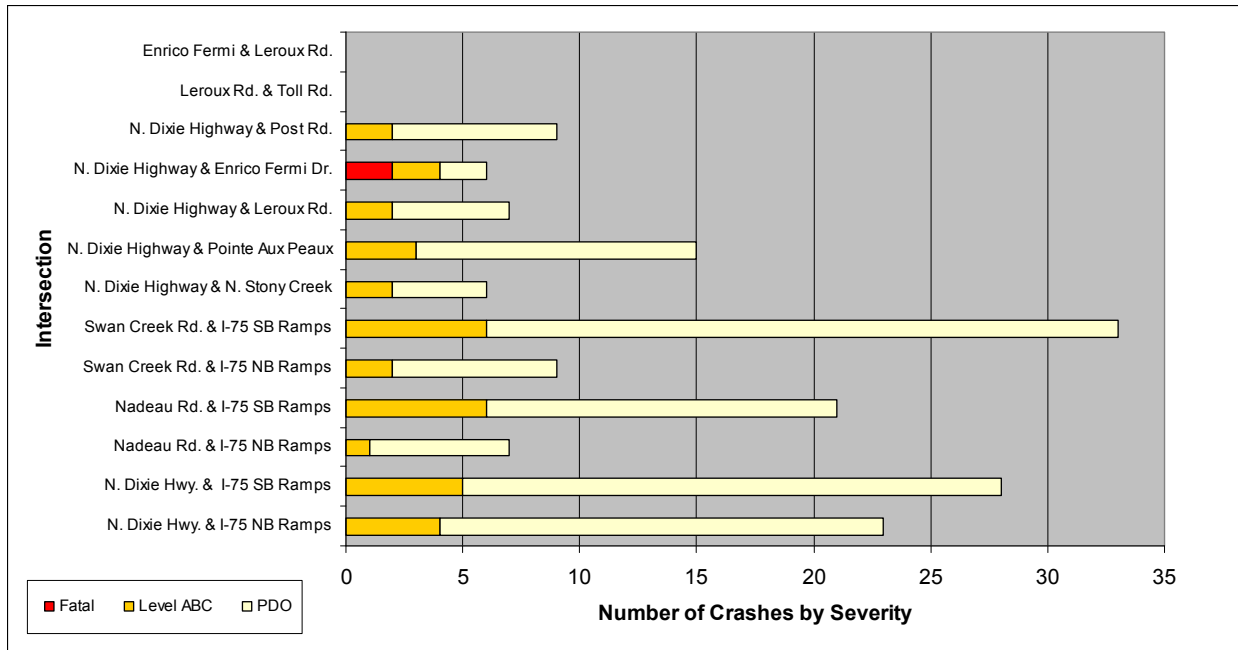
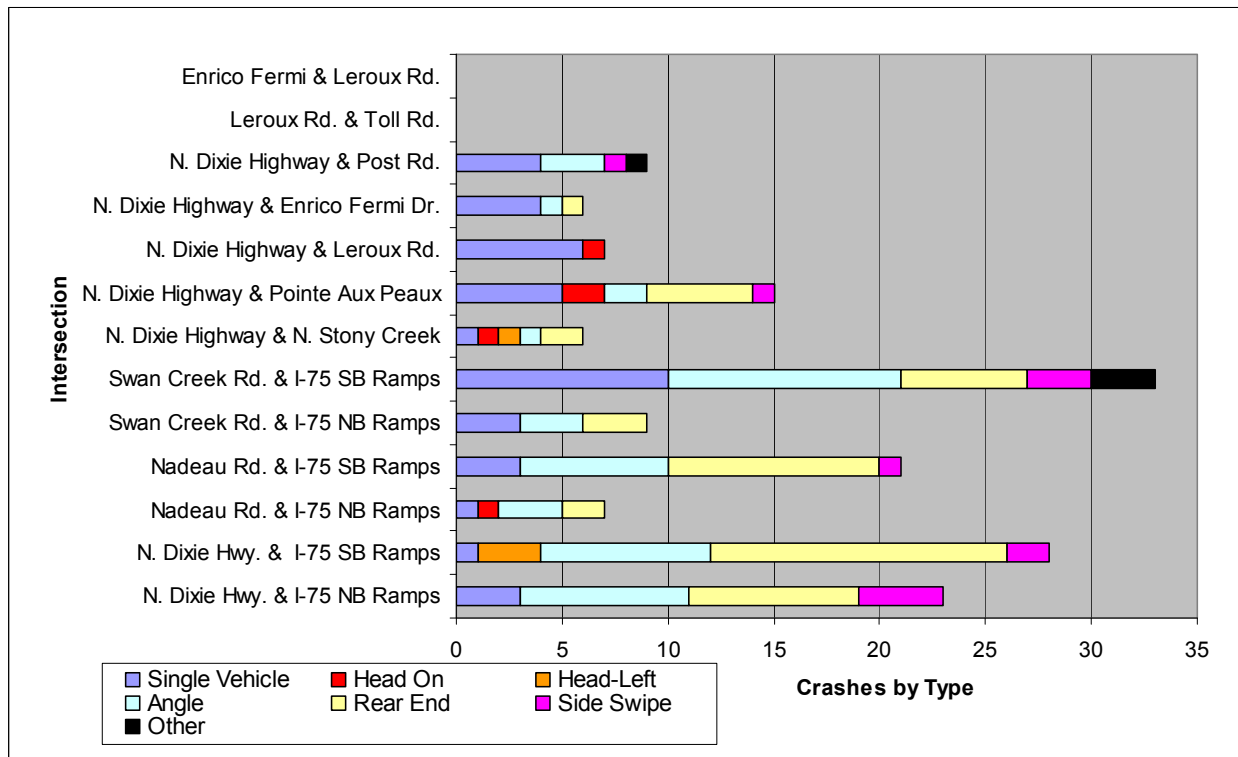


FIGURE 29 Intersection Crash History by Type (2004-2008)



The results of the crash analysis provides for the following conclusions:

- All intersections had an average of less than 7 crashes per year with the highest occurrence involving I-75 & Swan Creek Road with nearly 6.6 crashes per year (33 crashes over the 5 year study period)
- Most of the crashes, 77%, were low severity (PDO – Property Damage Only)
- Two fatal crashes occurred at the N. Dixie Highway and Enrico Fermi Drive intersections. The first fatal in 2004 involved an impaired driver (alcohol and drugs) and icy roads. This was a single car road departure crash. The second crash in 2005 involved two cars and slushy roads.
- 25% of the crashes were single vehicle crashes and normally involved a road departure.
- Of the 51 rear end crashes, 38 (74%) occurred at the five signalized intersections. Signalized intersections typical note high occurrences of rear crashes.

6.0 OPERATIONAL ANALYSES FINDINGS

As presented in Section 4.0, MSG built and calibrated a series of traffic analysis and simulation models for the AM and PM Peak study traffic analysis scenarios/years including:

- **Existing Conditions (2009)**
- **Peak Construction Phase (2017)**
- **Normal Plant Operations (2020)**

The above models were utilized to conduct detailed HCM intersection operational analysis. Detailed reports are provided in the form of HCM Signalized and Un-signalized Intersection Capacity Analysis Reports presented by **Appendix G**. In addition to the determined HCM LOS and delay, the reports include a host of other input and analysis data such as volumes, lane configurations, heavy vehicles, lane storage lengths, vehicular queuing (back-ups), and a measure of demand volume to available lane capacity (V/C ratio).

A more consolidated and general summary of the intersection levels of service (LOS), vehicular delay, and other operationally noteworthy observations regarding each intersection, peak hour, and scenario was compiled by MSG from the HCM reports. This is presented in the following three (3) sections and tables as a summary of operational analysis for the above scenarios. The Existing (2009) conditions provide a baseline comparison of current study area conditions by which the Peak Construction Phase (2017) and Normal Plant Operations (2020) can be reviewed and evaluated. The initial models (as above) and HCM analysis conducted by MSG did not assume the implementation of any improvements to current roadway or traffic control facilities. Section 7.0 provides additional assessment for what existing and projected deficiencies or impacts the HCM analyses indicate to exist.

6.1 Existing Conditions (2009)

HCM Levels of Service – Existing 2009					
Intersection/ Approach LOS (Delay – sec/veh.)		Existing 2009 AM Peak		Existing 2009 PM Peak	
		LOS(Delay)	Operational Notes	LOS(Delay)	Operational Notes
NB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (4.4)	• Operates well with sufficient lane capacity and reasonable delays maximized for progressive Dixie flow	A (5.0)	• Operates comparable to AM Peak with sufficient lane capacity and reasonable delays maximized for Dixie flow
	WB Dixie	A (4.9)		A (5.0)	
	NB Ramp	C (25.6)	• EBLT of 165 vph acceptable with permissive LT phasing	C (25.6)	• EBLT of 175 vph acceptable with permissive LT phasing
Signalized Intersection		A (8.9)		A (8.4)	
SB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (4.1)	• Operates well with sufficient lane capacity and reasonable delays maximized for progressive Dixie flow	A (4.9)	• Operates comparable with sufficient lane capacity and reasonable delays maximized for progressive Dixie flow
	WB Dixie	A (3.8)		A (5.3)	
	SB Ramp	C (26.8)	• WBLT of 136 vph acceptable with permissive LT phasing	C (26.2)	• WBLT of 192 vph acceptable with permissive LT phasing
Signalized Intersection		A (9.3)		A (9.5)	
NB I-75 Ramps & Nadeau Road	WB Nadeua	Free	• Nadeau EB LT volume of 302 vph relies on relatively low opposing WB volume of 150 vph.	Free	• Nadeau EB LT volume of 296 vph relies on relatively low opposing WB volume of 153 vph. • NB Ramp LT failing under stop-control; however only 62 vph keeps queuing reasonable.
	EB Nadeau Thru/ LT	A (8.6)		A (5.5)	
	NB Ramp (LT)	F (50.9)	F (115.8)		
	NB Ramp RT	Free	Free		
Un-Signalized Intersection		N/A		N/A	
SB I-75 Ramps & Nadeau Road	EB Nadeau	A (7.8)	• Signal control services well with minimal delay to any movement • SB Ramp RT of 214 vph and EB thru of 301 vph related to commercial travel center.	A (9.1)	• Signal control services well with minimal delay to any movement • SB Ramp RT of 311 vph and EB thru of 382 vph related to commercial travel center.
	WB Nadeau	A (6.5)		A (7.6)	
	SB Ramp	A (8.4)		B (10.5)	
Signalized Intersection		A (7.7)		B (12.0)	
NB I-75 Ramps & Swan Creek Road	SEB Swan Creek	Free	• Intersection traffic influenced by Meijer distribution center to SE • NWB LT of 169 vph lacks exclusive turn lane and is potentially susceptible to SEB thru/RT traffic increases • NB Ramp LT volume is small (21 vph), but delayed by gaps available with stop-control. (NB RT of 115 vph)	Free	• Intersection traffic influenced by Meijer distribution center to SE • NWB LT of 202 vph lacks exclusive turn lane and is potentially susceptible to SEB thru/RT traffic increases • NB Ramp LT volume is moderate (44 vph), but delayed by gaps available with stop-control. (NB RT of 158 vph)
	NWB Swan Creek	A (4.5)		A (5.7)	
	NB Ramp LT	D (26.4)		E (41.3)	
	NB Ramp RT	B (11.1)		B (11.9)	
Un-Signalized Intersection		N/A		N/A	
SB I-75 Ramps & Swan Creek Road	SEB	A (0.0)	• NWB LT of 122 vph lacks exclusive turn lane and is potentially susceptible to SEB thru/RT traffic increases • NB/SB approaches experience reasonable delay, but sufficiency stop-control subject to any increased traffic	A (0.2)	• NWB LT of 133 vph lacks exclusive turn lane and is potentially susceptible to SEB thru/RT traffic increases • NB/SB approaches near capacity under stop-control. (NB LT of 165 vph produces 8-10 vehicle queue.)
	NWB	A (4.0)		A (4.0)	
	SB Ramp (NB Approach)	C (16.1)		E (36.4)	
	SB	C (20.4)		D (27.9)	
Un-Signalized Intersection		N/A		N/A	

Stoney Creek Road & N. Dixie Hwy.	NB Dixie	A (6.1)	• T-intersection stop-control presently adequate. • Notable RT from (100 vph) and NB LT (176 vph) to Stoney Creek. Both lack exclusive turn lanes.	A (2.2)	• T-intersection stop-control presently adequate. • Notable RT from (99 vph) and NB LT (51 vph) into Stoney Creek. Both lack exclusive turn lanes.
	SB Dixie	Free		Free	
	EB Stoney Crrreek	C (17.8)		C (19.8)	
Un-Signalized Intersection		N/A		N/A	
Pointe Aux Peaux Road & N. Dixie Hwy.	NEB Dixie	B (14.9)	• Signalized control yields minimal delay (LOS A or B) for all intersection movements and approaches. • NEB/ SWB Dixie LT movement volumes <10 vph, and exclusive turn lanes are provided with additional capacity.	B (12.8)	• Signalized control yields minimal delay for nearly all intersection movements and approaches, except the highest volume SWB approach (423 vph – LOS C). • NEB/ SWB Dixie LT movement volumes remain <50 vph, and exclusive turn lanes are provided with additional capacity.
	SWB Dixie	A (9.6)		C (24.7)	
	SEB Marshall Field	A (8.4)		A (8.4)	
	NWB Pointe Aux Peaux	B (11.5)		B (10.3)	
Signalized Intersection		B (12.7)		B (18.4)	
Leroux Road & N. Dixie Hwy.	NB Dixie	Free	• Leroux is localized side road serving minimal Dixie traffic. • Acute angle with Dixie makes it susceptible to safety concerns (i.e. sight distance) as any traffic to/from Dixie increases.	Free	• Same as AM Peak • Higher directional traffic from SB Dixie is more compounded with acute angle intersection.
	SB Dixie	A (0.3)		A (0.0)	
	SWB Leroux	B (12.0)		B (14.7)	
Un-Signalized Intersection		N/A		N/A	
Toll Road & Leroux Road	NE/ SW Leroux Road	Free	• Highly local traffic intersection serving minimal traffic.	Free	• Highly local traffic intersection serving minimal traffic.
	NW Toll Road	A (8.6)		A (8.8)	
Un-Signalized Intersection		N/A		N/A	
Enrico Fermi Drive & N. Dixie Hwy.	NB Dixie	A (3.6)	• PRIMARY FERMI ACCESS • Fermi outbound < 25 vph allowing signal priority for higher demand inbound traffic from Dixie. • 277 vph NB RT – no RT lane. • 189 vph SB LT – no LT lane.	A (10.0)	• PRIMARY FERMI ACCESS • Signal control adequately serves outbound Fermi demand without excessive disruption to N. Dixie Hwy. • 227 vph WB LT • 161 vph WB RT
	SB Dixie	A (4.9)		B (10.9)	
	WB Enrico Fermi	C (21.2)		B (14.1)	
Signalized Intersection		A (4.7)		B (12.4)	
Enrico Fermi Drive & Leroux Road	SE/ NW Enrico Fermi	Free	• Leroux produces very little conflicting cross-traffic with Enrico Fermi, and stop-control is adequate.	Free	• Leroux produces very little conflicting cross-traffic with Enrico Fermi, and stop-control is adequate.
	NE Leroux	B (13.5)		B (13.3)	
	SW Leroux	A (0.0)		B (12.4)	
Un-Signalized Intersection		N/A		N/A	
Post Road & N. Dixie Hwy.	NB Dixie	A (0.7)	• Two-way stop-control is sufficient for the minor volume demands from EB Post (< 90 vph) and WB Post (< 30 vph) • LT's to Post from Dixie are minimal (<10 vph), growth is not accommodated by exclusive lanes.	A (1.2)	• Two-way stop-control is sufficient for the minor volume demands from EB Post (< 60 vph) and WB Post (<25 vph) • LT's to Post from Dixie are minimal (<30 vph), growth is not accommodated by exclusive lanes.
	SB Dixie	A (0.2)		A (0.5)	
	EB Post	C (15.9)		C (18.1)	
	WB Post	B (13.3)		B (14.6)	
Un-Signalized Intersection		N/A		N/A	

6.2 Peak Construction Phase (2017)

HCM Levels of Service – 2017 Peak Construction					
Intersection/ Approach LOS (Delay – sec/veh.)		2017 Peak Construction AM Peak		2017 Peak Construction PM Peak	
		LOS(Delay)	Operational Notes	LOS(Delay)	Operational Notes
NB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (7.9)	• Heavy NB RT from I-75 ramp (increased to 526 vph) • NB RT movement degrades from LOS C (25.1) in existing to LOS F (90.0).	**B (18.9)	• WB thru traffic increase over existing is major (1041 vph)
	WB Dixie	A (8.5)		A (6.4)	• **Although EB approach LOS B, EBLT movement of 186 vph is no longer accommodated by permissive LT phasing (LOS E)
	NB Ramp	F (80.6)		C (25.8)	
Signalized Intersection		C (33.7)		B (13.6)	
SB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (4.5)	• Comparable overall operations to Existing 2009 • WBLT of 177 vph still accommodated by permissive LT phasing	A (5.8)	• WB approach impacted by WB LT traffic increases
	WB Dixie	A (4.7)		F (106.9)	• WB LT of 535 vph is not accommodated by permissive phasing.
	SB Ramp	C (26.4)		C (27.6)	
Signalized Intersection		A (9.3)		E (63.4)	
NB I-75 Ramps & Nadeau Road	WB Nadeua	Free	• NB Ramp LT failed under existing 2009 stop-control. • Additional Nadeau traffic intensifies vehicle delay; however only 58 vph keeps queuing reasonable (~5 veh.)	Free	• NB Ramp LT failed under existing 2009 stop-control. • Additional Nadeau traffic intensifies vehicle delay; however only 62 vph keeps queuing reasonable (~7 veh.)
	EB Nadeau Thru/ LT	A (8.9)		A (9.6)	
	NB Ramp (LT)	F (83.6)		F (253.0)	
	NB Ramp RT	Free		Free	
Un-Signalized Intersection		N/A		N/A	
SB I-75 Ramps & Nadeau Road	EB Nadeau	A (9.4)	• Signal control continues to service demand volumes well with minimal delay and all movements at LOS A/B • Only marginal delay increases are observed for Fermi traffic	A (9.6)	• Signal control continues to service demand volumes well with minimal delay and all movements at LOS A/B • Only marginal delay increases are observed for Fermi traffic
	WB Nadeau	A (7.9)		A (7.9)	
	SB Ramp	B (10.4)		B (10.8)	
Signalized Intersection		A (9.6)		B (12.0)	
NB I-75 Ramps & Swan Creek Road	SEB Swan Creek	Free	• NWB LT of 217 vph lacks exclusive turn lane, but maintains acceptable LOS for the NWB thru/LT movement • NB Ramp LT volume remains small (23 vph), but fails due to inadequate gaps. • NB RT increased to 225 vph and approaches capacity.	Free	• NWB LT of 334 vph lacks exclusive turn lane, but maintains acceptable LOS B for the NWB thru/LT movement • NB Ramp LT (47 vph) fails due to inadequate gaps from Swan Creek traffic, but moderate volume of the movement keeps queuing to ~7 vehicles
	NWB Swan Creek	A (8.3)		B (10.3)	
	NB Ramp LT	F (70.0)		F (535.9)	
	NB Ramp RT	D (34.3)		B (12.9)	
Un-Signalized Intersection		N/A		N/A	
SB I-75 Ramps & Newport Road	SEB Newport	A (0.0)	• Largest Fermi traffic increase projected is SB exit ramp (NB approach) to 323 vph, but adequate approach LOS C is maintained. • SB approach (minor volumes) struggle for gaps and suffer failure delays.	A (0.2)	• NWB and NWB LT traffic is increased by Fermi • 235 vph NWB LT is from shared lane with thru traffic (215 vph) • NB/SB approaches well exceed capacity under stop-control. (NB LT of 175 vph produces 30+ vehicle queue.)
	NWB Newport	A (4.4)		A (5.5)	
	SB Ramp (NB Approach)	C (18.8)		F (387.2)	
	SB	F (67.0)		F (65.7)	
Un-Signalized Intersection		N/A		N/A	

Stoney Creek Road & N. Dixie Hwy.	NB Dixie	B (10.5)	<ul style="list-style-type: none">Stop-controlled 106 vph RT from Stoney Creek fails due to Dixie traffic increases and lack of exclusive left/ right turn lanes.	A (4.8)	<ul style="list-style-type: none">Stop-controlled 106 vph RT from Stoney Creek fails due to Dixie traffic increases and lack of exclusive left/ right turn lanes.
	SB Dixie	Free		Free	
	EB Stoney Ccreek	F (337.3)		F (231.0)	
Un-Signalized Intersection		N/A		N/A	
Pointe Aux Peaux Road & N. Dixie Hwy.	NEB Dixie	F (419.5)	<ul style="list-style-type: none">NEB Dixie (inbound) thru traffic increased significantly to 1012 vph	B (16.6)	<ul style="list-style-type: none">SWB Dixie (outbound) thru traffic increased significantly to 1068 vph
	SWB Dixie	B (11.0)		F (510.1)	
	SEB Marshall Field	A (8.6)	<ul style="list-style-type: none">Signal timing, phasing, and lane capacity need necessary to accommodate large volume of Fermi construction traffic.	A (8.6)	<ul style="list-style-type: none">Signal timing, phasing, and lane capacity need necessary to accommodate large volume of Fermi construction traffic.
	NWB Pointe Aux Peaux	B (11.8)		B (10.4)	
Signalized Intersection		F (275.1)		F (354.0)	
Leroux Road & N. Dixie Hwy.	NB Dixie	Free	<ul style="list-style-type: none">Leroux is localized side road serving minimal Dixie traffic, but high volume on Dixie reduces sufficient gaps.Increased delay poses more concern for safety of acute intersection geometry.	Free	<ul style="list-style-type: none">Leroux is localized side road serving minimal Dixie traffic, but high volume on Dixie reduces sufficient gaps.Increased delay poses more concern for safety of acute intersection geometry.
	SB Dixie	A (0.4)		A (0.0)	
	SWB Leroux	E (37.0)		F (38.7)	
Un-Signalized Intersection		N/A		N/A	
Toll Road & Leroux Road	NE/ SW Leroux Road	Free	<ul style="list-style-type: none">Highly local traffic intersection serving minimal traffic.	Free	<ul style="list-style-type: none">Highly local traffic intersection serving minimal traffic.
	NW Toll Road	A (8.7)		A (8.8)	
Un-Signalized Intersection		N/A		N/A	
Enrico Fermi Drive & N. Dixie Hwy.	NB Dixie	F (88.3)	<ul style="list-style-type: none">Inbound Fermi traffic demand: 1033 NB RT; 714 SB LTExisting access completely insufficient to accommodate Fermi 2 operations and Fermi 3 contractor population.Major intersection upgrade	B (13.5)	<ul style="list-style-type: none">Outbound Fermi traffic demand: 924 WB LT; 714 WB RTExisting access completely insufficient to accommodate Fermi 2 operations and Fermi 3 contractor population.Major intersection upgrade.
	SB Dixie	F (2062.0)		C (24.7)	
	WB Enrico Fermi	B (14.1)		F (434.5)	
Signalized Intersection		F (753.1)		F (334.0)	
Enrico Fermi Drive & Leroux Road	SE/ NW Enrico Fermi	Free	<ul style="list-style-type: none">Leroux produces very little conflicting cross-traffic with Enrico Fermi; however, any cross-traffic will suffer significant delay.	Free	<ul style="list-style-type: none">Leroux produces very little conflicting cross-traffic with Enrico Fermi; however, any cross-traffic will suffer significant delay.
	NE Leroux	F (121.1)		F (171.0)	
	SW Leroux	A (0.0)		F (84.9)	
Un-Signalized Intersection		N/A		N/A	
Post Road & N. Dixie Hwy.	NB Dixie	A (1.1)	<ul style="list-style-type: none">Adequacy of two-way stop control (Post) is tested by SB Dixie traffic (740 vph) during peak construction period.	A (1.4)	<ul style="list-style-type: none">Adequacy of two-way stop control (Post) is tested by SB Dixie traffic (726 vph) during peak construction period.
	SB Dixie	A (0.3)		A (0.7)	
	EB Post	F (162.5)	<ul style="list-style-type: none">Lane capacity or traffic control revisions to be considered.	F (91.5)	<ul style="list-style-type: none">Lane capacity or traffic control revisions to be considered.
	WB Post	F (57.1)		E (40.3)	
Un-Signalized Intersection		N/A		N/A	

6.3 Normal Plant Operations (2020)

HCM Levels of Service – 2020 Normal Plant Operations			
Intersection/ Approach LOS (Delay – sec/veh.)		2020 Normal Plant AM Peak - LOS/Delay	2020 Normal Plant PM Peak - LOS/Delay
NB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (4.9)	A (7.2)
	WB Dixie	A (5.5)	A (5.5)
	NB Ramp	C (25.1)	C (25.6)
Signalized Intersection		B (10.3)	A (9.3)
SB I-75 Ramps & N. Dixie Hwy	EB Dixie	A (4.4)	A (5.6)
	WB Dixie	A (4.1)	B (10.4)
	SB Ramp	C (26.4)	C (27.2)
Signalized Intersection		A (9.2)	B (12.0)
NB I-75 Ramps & Nadeau Road	WB Nadeua	Free	Free
	EB Nadeau Thru/ LT	A (6.7)	A (5.5)
	NB Ramp (LT)	F (80.0)	F (115.8)
	NB Ramp RT	Free	Free
Un-Signalized Intersection		N/A	N/A
SB I-75 Ramps & Nadeau Road	EB Nadeau	A (6.9)	A (9.1)
	WB Nadeau	A (5.9)	A (7.6)
	SB Ramp	B (10.8)	B (10.5)
Signalized Intersection		A (8.2)	A (9.3)
NB I-75 Ramps & Swan Creek Road	SEB Swan Creek	Free	Free
	NWB Swan Creek	A (5.7)	A (5.2)
	NB Ramp LT	D (32.7)	E (41.9)
	NB Ramp RT	B (14.0)	B (12.4)
Un-Signalized Intersection		N/A	N/A
SB I-75 Ramps & Newport Road	SEB Newport	A (0.0)	A (0.4)
	NWB Newport	A (4.2)	A (4.5)
	SB Ramp (NB Approach)	C (17.4)	E (41.0)
	SB	D (28.2)	F (180.4)
Un-Signalized Intersection		N/A	N/A

Stoney Creek Road & N. Dixie Hwy.	NB Dixie	A (7.7)	A (3.8)
	SB Dixie	Free	Free
	EB Stoney Creek	E (36.2)	E (43.5)
Un-Signalized Intersection		N/A	N/A
Pointe Aux Peaux Road & N. Dixie Hwy.	NEB Dixie	F (80.1)	B (14.0)
	SWB Dixie	A (9.8)	F (163.7)
	SEB Marshall Field	A (8.5)	A (8.4)
	NWB Pointe Aux Peaux	B (11.7)	B (10.5)
Signalized Intersection		D (51.4)	F (102.1)
Leroux Road & N. Dixie Hwy.	NB Dixie	Free	Free
	SB Dixie	A (0.3)	A (0.0)
	SWB Leroux	C (16.6)	C (21.6)
Un-Signalized Intersection		N/A	N/A
Toll Road & Leroux Road	NE/ SW Leroux Road	Free	Free
	NW Toll Road	A (8.7)	A (8.8)
Un-Signalized Intersection		N/A	N/A
Enrico Fermi Drive & N. Dixie Hwy.	NB Dixie	A (7.2)	B (12.1)
	SB Dixie	F (279.1)	B (13.4)
	WB Enrico Fermi	B (18.8)	F (71.3)
Signalized Intersection		F (107.3)	D (52.6)
Enrico Fermi Drive & Leroux Road	SE/ NW Enrico Fermi	Free	Free
	NE Leroux	C (23.2)	C (23.6)
	SW Leroux	A (0.0)	C (19.6)
Un-Signalized Intersection		N/A	N/A
Post Road & N. Dixie Hwy.	NB Dixie	A (0.8)	A (1.1)
	SB Dixie	A (0.2)	A (0.6)
	EB Post	D (27.4)	D (22.3)
	WB Post	C (18.5)	C (19.6)
Un-Signalized Intersection		N/A	N/A

7.0 IMPACTS & DEFICIENCIES EVALUATION

The Existing (2009), Peak Construction (2017), and Normal Plant Operations (2020) operational analyses, presented in the preceding sections 6.1, 6.2, and 6.3, highlight intersections or traffic movements within the study area which either exhibit:

1. Acceptable pre-existing operational conditions, but deficiencies incurred during the temporary Peak Construction (2017) phase, then a return to acceptable conditions during the permanent Normal Plant Operations (2020) condition. OR
2. Acceptable pre-existing operational conditions, deficiencies incurred during both the temporary Peak Construction (2017) phase and permanent Normal Plant Operations (2020) condition. OR
3. Pre-existing operational deficiencies under current conditions not including the Fermi 3 expansion continued in more severity for both future study scenarios. OR
4. Pre-existing operational deficiencies under current conditions continued in more severity by the temporary Peak Construction Phase (2017), but for which the permanent Normal Plant Operations (2020) have marginal degrading influence.

In general, both site traffic generation assessment and operational traffic analysis of this study has shown the temporary Peak Construction (2017) phase will serve as the critical influencing period. The 2017 peak construction period is, however, a temporary condition, albeit for an estimated year duration. Regardless, normal highway improvements are based on a design life of 20 years. The level of roadway improvement should be evaluated in light of the relatively short term duration of the peak construction in comparison to the normal life cycle of a roadway improvement. With that understood it is important to consider the relative perspectives of temporary deficiencies and impacts anticipated during the Peak Construction (2017) phase with pre-existing conditions and what can be anticipated for permanent Normal Plant Operations planned to commence by 2020.

The table below identifies impact by existing (or pre-existing) condition, a product of the 2017 peak construction period and a result of the 2020 Fermi 3 operations. The highest level of concern would be given to impacts that sustain through the 2020 Fermi 3 operations as these could be considered long term conditions. Impacts related only to construction operations should consider operational measures to better distribute or reduce the AM and PM peak hour traffic. These measures would include strictly enforces construction shift staggering and bussing of contractors from remote locations.

Summary of Impacts & Deficiencies				
Intersection	Deficiency	2009	2017	2020
I-75 & N. Dixie Hwy NB On/Off (east ramps)	Northbound I-75 Ramp Left-Turn to westbound N Dixie Hwy.		X	
	Eastbound N. Dixie Hwy Left-Turn to Northbound I-75		X	
I-75 & N. Dixie Hwy SB On/Off (west ramps)	Westbound N. Dixie Hwy Left-Turn to Southbound I-75		X	
I-75 & Nadeau NB On/Off (east ramps)	Northbound I-75 Ramp (East) Left-Turn to westbound Nadeau Road	X	X	X
I-75 & Swan Creek NB On/Off (east ramps)	Northbound I-75 (East) Ramp Left-Turn to westbound Swan Creek Road	X	X	X
I-75 & Swan Creek SB On/Off (west ramps)	Southbound I-75 (West) Ramp Approach @ Swan Creek Road	X	X	X
N. Dixie Hwy & Stoney Creek Road	Eastbound Stoney Creek Road Approach to Dixie Hwy.		X	X
N. Dixie Hwy & Pointe Aux Peaux Rd	N. Dixie Hwy. through movements @ Pointe Aux Peaux Road		X	X
N. Dixie Hwy & Leroux Road	Leroux Road approach @ N. Dixie Hwy.		X	
N. Dixie Hwy & Enrico Fermi Dr	Enrico Fermi Drive & N. Dixie Hwy. (Overall Fermi access)		X	X
N. Dixie Hwy & Leroux Rd	Leroux Road approaches to Enrico Fermi Drive		X	
N. Dixie Hwy & Post Rd	Post Road approaches to N. Dixie Hwy.		X	

Improvement scenarios will be assessed to address areas with deficient operations. Some basic philosophies of the improvement scenarios include:

- Impacts related to the peak construction phase only should be assessed to determine if stringent shift staggering during the peak period would mitigate the impact. The peak construction period is expected to involve 1 to 2 years. Expenditure of roadway improvements for a short interim period and that would not be necessary post construction might be avoidable through stringent shift staggering.
- Although transportation planning would suggest, as identified in Section 4.3.2, that a level of service D or better is acceptable, lower levels of service that result from a short term construction operation can be tolerated as a short term condition provided that safety concerns do not result. Generally a LOS E or even a high level F can be tolerated for many facilities for a short term construction period. The level of impact for the short term construction period should also be weighted in light of any recommendation for improvement.
- Recommendations for road improvements will require approval of the Michigan Department of Transportation (MDOT) for intersections involving the I-75 interchanges and the Monroe County Road Commission (MCRC) for all other roads and intersections. Since the study years are well off to the future (2017 and 2020) and based on projected traffic, these agencies will not likely commit to the improvement until closer to the target date.

The following tables provide a summary of impacts (based on level of service of the critical movement) and improvement options.

AM Peak Unsatisfactory Operations Summary					
Intersection	Approach/ Movement	Existing 2009	Peak Construction (2017)	Fermi 3 Operations (2020)	Potential Improvement Considerations
NB I-75 Ramps & N. Dixie Hwy	Northbound Ramp Left-turn	C (25.6)	F (80.6)	C (25.8)	<input type="checkbox"/> Signal timing/ phasing Modification (Construction phase only impact)
NB I-75 Ramps & Nadeau Road	Northbound Ramp Left-turn	F (50.9)	F (83.6)	F (80.0)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use Modification
NB I-75 Ramps & Swan Creek Road	Northbound Ramp Left-turn	D (26.4)	F (70.0)	D (32.7)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use Modification (Construction phase only impact)
SB I-75 Ramps & Swan Creek Road	Southbound Approach	C (20.4)	F (67.0)	D (28.2)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use Modification (Construction phase only impact)
Stoney Creek Road & N. Dixie Hwy.	Eastbound Stoney Creek	C (17.8)	F (337.3)	E (36.2) (Note: Borderline LOS D condition)	<input type="checkbox"/> Signalization <input type="checkbox"/> EB Stoney Creek Left/Right Turn Lane(s) (Construction phase only impact)
Pointe Aux Peaux Road & N. Dixie Hwy.	Northeast-bound N. Dixie Hwy.	B (14.9)	F (337.3)	F (80.1)	<input type="checkbox"/> Signal timing/ phasing optimization
	Southwest-bound N. Dixie Hwy.	A (9.6)	B (11.0)	A (9.8)	
Leroux Road & N. Dixie Hwy.	Southwest-bound Leroux Road	B (12.0)	E (37.0)	C (16.6)	<input type="checkbox"/> Left-turn Restriction (Construction phase only impact)
Enrico Fermi Drive & N. Dixie Hwy.	Northbound N. Dixie Hwy.	A (3.6)	F (88.3)	A (7.2)	<input type="checkbox"/> Signal timing/ phasing optimization <input type="checkbox"/> NB/SB Dixie Turn Lanes <input type="checkbox"/> Additional Access Point <input type="checkbox"/> WB Lane Use/ Storage
	Southbound N. Dixie Hwy.	A (4.9)	F (2062.0)	F (279.1)	
	Westbound Enrico Fermi Drive	C (21.2)	B (14.1)	B (18.8)	
Enrico Fermi Drive & Leroux Road	Northeast-bound Leroux Road	B (13.5)	F (121.1)	C (23.2)	<input type="checkbox"/> Warning Signage <input type="checkbox"/> Temporary Closure (Construction phase only impact)
Post Road & N. Dixie Hwy.	Eastbound Post	C (15.9)	F (162.5)	D (27.4)	Signalization (Construction phase only impact)
	Westbound Post	B (13.3)	F (57.1)	C (18.5)	

PM Peak Unsatisfactory Operations Summary					
Intersection	Approach/ Movement	Existing 2009	Peak Construction (2017)	Fermi 3 Operations (2020)	Potential Improvement
NB I-75 Ramps & N. Dixie Hwy	Eastbound Left-turn	A (7.6)	E (55.2)	B (14.5)	<input type="checkbox"/> Signal timing/ phasing optimization <input type="checkbox"/> EB LT Phase (Construction phase only impact)
SB I-75 Ramps & N. Dixie Hwy	Westbound Approach (LT)	A (8.0)	F (106.9)	C (20.5)	<input type="checkbox"/> Signal timing/ phasing optimization <input type="checkbox"/> WB LT Phase (Construction phase only impact)
NB I-75 Ramps & Nadeau Road	Northbound Ramp LT	F (115.8)	F (253.0)	F (115.8)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use Modification
NB I-75 Ramps & Swan Creek Road	Northbound Ramp LT	E (41.3)	F (535.9)	E (41.9)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use
SB I-75 Ramps & Swan Creek Road	Southbound I-75 Ramp (NB Approach)	E (36.4)	F (387.2)	F (180.4)	<input type="checkbox"/> Signalization <input type="checkbox"/> Lane Use
	SB Approach	D (27.9)	F (65.7)	E (41.0)	
Stoney Creek Road & N. Dixie Hwy.	EB Stoney Creek	C (19.8)	F (231.0)	E (43.5)	<input type="checkbox"/> Signalization <input type="checkbox"/> EB Stoney Creek Left/Right Turn Lane(s)
Pointe Aux Peaux Road & N. Dixie Hwy.	NEB Dixie	B (12.8)	B (16.6)	B (14.0)	<input type="checkbox"/> Signal timing/ phasing optimization
	SWB Dixie	C (24.7)	F (510.1)	F (163.7)	
Leroux Road & N. Dixie Hwy.	SWB Leroux	B (14.7)	F (58.7)	C (21.6)	<input type="checkbox"/> Left-turn Restriction (Construction phase only impact)
Enrico Fermi Drive & N. Dixie Hwy.	NB Dixie	A (10.0)	B (13.5)	B (12.1)	<input type="checkbox"/> Signal timing/ phasing optimization <input type="checkbox"/> NB/SB Dixie Turn Lanes <input type="checkbox"/> Additional Access Point <input type="checkbox"/> WB Lane Use/ Storage
	SB Dixie	B (10.9)	C (24.7)	B (13.4)	
	WB Enrico Fermi	B (14.1)	F (434.5)	E (71.3)	
Enrico Fermi Drive & Leroux	NE Leroux	B (13.3)	F (171.0)	C (23.6)	<input type="checkbox"/> Warning Signage <input type="checkbox"/> Temporary Closure?? (Construction phase only impact)
	SW Leroux	B (12.4)	F (84.9)	C (19.6)	
Post Road & N. Dixie Hwy.	EB Post	C (18.1)	F (91.5)	D (28.3)	<input type="checkbox"/> Signalization (Construction phase only impact)
	WB Post	B (14.6)	E (40.0)	C (19.6)	