

12. COMPARATIVE SAFETY ANALYSIS

The purpose of the comparative safety analysis was to determine the safety impacts of reconfiguring the I-4 at Sand Lake Road interchange from an existing partial cloverleaf interchange (No-Build) to a diverging diamond interchange (DDI) (Build). To determine these impacts, a predicted crash frequency analysis was performed utilizing the Enhanced Interchange Safety Analysis Tool (ISATe) Build 06.10 – Modified to Include Present Worth Analysis. The ISATe analysis can be performed on three unique freeway features: freeway mainline, freeway ramps, and freeway ramp terminals. For purposes of the comparative analysis, only facilities with noted geometric differences between the No-Build and Build conditions were assessed. The following facilities/limits within the study’s area of influence were noted to be different and analyzed in ISATe for the No-Build and Build conditions:

- Freeway Ramps –
 - I-4 eastbound off ramp to Sand Lake Road;
 - I-4 eastbound on ramp from Sand Lake Road;
 - I-4 westbound off ramp to Sand Lake Road;
 - I-4 westbound loop on ramp from westbound Sand Lake Road (No-Build only);
 - I-4 westbound on ramp from eastbound Sand Lake Road (No-Build only);
 - I-4 westbound on ramp from Sand Lake Road (Build only); and
 - Connector-distributor ramp from westbound Sand Lake Road to Turkey Lake Road (Build only).

Limitations exist with the current Highway Safety Manual (HSM) methodologies and tools when it comes to quantitatively analyzing safety performance of freeways with buffer separated express lanes. Chapter 1 of the Enhanced Interchange Safety Analysis Tool (ISATe): User Manual notes that the “predictive method for freeways does not account for the influence of...freeways with limited access managed lanes that are buffer-separated from the general purpose lanes”. Thus, a qualitative safety analysis was performed for the I-4 mainline “Tube” concept in the study area as discussed in the **Freeway, Ramp, and Interchange** section.

The freeway ramp terminals at I-4 and Sand Lake Road were not analyzed in ISATe due to the unique No-Build and Build configurations. The conversion of a partial cloverleaf interchange to a DDI does not have Safety Performance Functions (SPFs) or Crash Modification Factors (CMFs), so no predicted safety analysis can be performed on the No-Build or Build interchange configuration. Per Section 1.6.3 of the November 2020 FDOT IARUG Safety Analysis Guidance, a qualitative assessment was performed in lieu of a quantitative safety analysis and is discussed in the **Freeway, Ramp, and Interchange** section.

In addition to the freeway/ramps/interchange, improvements were made at two intersections in the study’s area of influence. The FDOT’s Safety Performance for Intersection Control Evaluation (SPICE) tool was utilized to assess safety impacts for improvements at the Sand Lake Road and International Drive intersection. A qualitative analysis was performed at the Sand Lake Road and Turkey Lake Road intersection due to the unique configuration of removing the westbound left turn movement from the

intersection in the Build condition. The results of these analyses are discussed in the **Intersection** section. The opening year of the analysis was 2026 and the design year of the analysis was 2046.

12.1. Freeway, Ramp, and Interchange Analysis

12.1.1. Freeway Analysis

As discussed previously in this section, a qualitative assessment was performed for the I-4 mainline due to the limitations of the HSM methodologies and tools. At the beginning of the “Tube” concept north of Sand Lake Road, the merge condition created by the express lane is present in both the No-Build and Build conditions. The primary difference in the Build condition is the extension of the “Tube” express lane which will reduce the amount of traffic volume merging onto I-4 in this area. This reduction in merging traffic is anticipated to improve safety and reduce potential sideswipe crashes in the build condition. As discussed in **Section 11.2**, westbound mainline travel times are expected to be improved by approximately 5 to 56 percent in future analysis years with the Sand Lake Road interchange improvements and the express lane “Tube” concept. This should lead to a reduction in congestion related rear end crashes.

12.1.2. Ramp Analysis

Table 139 provides the results of the ISATe analysis for the I-4/Sand Lake Road interchange ramps. The results of the analysis show the proposed ramp improvements are predicted to experience approximately nine less crashes, which equates to over \$2 million in crash cost savings over the 20-year life cycle of the project.

Table 139: No-Build vs Build ISATe Predicted Crash Frequency Results

Scenario/ Feature	Predicted Fatal Crashes	Predicted Injury Crashes	Predicted Property Damage Only Crashes	Total Predicted Crashes	Total Present Value
No-Build – Ramps	2.5	97.2	147.0	246.8	\$17,870,000
Build – Ramps	2.1	97.9	155.3	255.3	\$15,810,000
Difference – Build minus No-Build	-0.4	0.7	8.2	8.6	(\$2,060,000)

Note: Some values in **Table 139** will not sum due to rounding from the ISATe output spreadsheets.

12.1.3. Interchange Analysis

As discussed previously in this section, a qualitative assessment was performed for the ramp terminals for the I-4 at Sand Lake Road interchange due to the unique configuration of both the No-Build and Build scenarios. The DDI research presented in National Cooperative Highway Research Program (NCHRP) Report 959 Diverging Diamond Interchange Information Guide Second Edition (2021) was utilized for this qualitative assessment. The following bullets outline the qualitative safety assessment of a DDI vs a partial cloverleaf interchange:

- Conflict Points –
 - The existing partial cloverleaf configuration has 15 total conflict points: 5 merging, 5 diverging, and 5 crossing.
 - The proposed DDI configuration has 14 total conflict points: 6 merging, 6 diverging, and 2 crossing.
 - While the DDI only has one less total conflict point, it has 3 less crossing conflict points. Crossing conflict points are typically locations where higher severity crashes are more likely to happen (like angle crashes). Thus, it would be expected the DDI would have less severe crashes than the diamond configuration of the partial cloverleaf interchange.
- Wrong-way maneuver concerns are more common at a diamond interchange, but the design of the DDI, mainly the channelization of movements, may decrease the likelihood of wrong-way maneuvers at freeway exit ramps.
- Lower speeds should reduce the total number of crashes and also reduce the number of severe injury crashes through the interchange area.

Based on the points noted above, the DDI is anticipated to reduce overall crashes, reduce the number of severe injury crashes, and potentially reduce wrong-way maneuver crashes through the I-4 and Sand Lake Road interchange area from a qualitative perspective.

12.2. Intersection Analysis

As discussed previously, the westbound left turn movement at the Sand Lake Road/Turkey Lake Road intersection is being removed in the Build condition. Because of this unique configuration, the SPICE tool cannot provide an accurate assessment of future predicted crashes thus a qualitative assessment was performed. At a typical four-leg signalized intersection, 32 conflict points are present (16 merging/diverging and 16 crossing) per Figure 72 in the FHWA Signalized Intersections Informational Guide. By removing a left turn movement, two merging/diverging and four crossing conflict points are removed. This reduces the conflict points to 14 merging/diverging and 12 crossing for a total of 26 conflict points in the Build condition instead of the 32 conflict points present in the No-Build condition. Because a left turn movement is being removed from the intersection, the Build condition intersection will see a lower traffic volume than in the No-Build condition. It is reasonable to assume the reduction in conflict points and in traffic volume at the Sand Lake Road/Turkey Lake Road intersection would lead to a reduction in crashes in the Build condition.

At the Sand Lake Road/International Drive intersection, construction is underway to six-lane Sand Lake Road east of International Drive. The future intersection will generally consist of:

- No-Build
 - Three through lanes will be present in the westbound direction through the intersection.
 - Two through lanes will be present in the eastbound direction on the eastbound approach, and the roadway will widen to three lanes east of the intersection.
- Build
 - In the Build scenario, a third through lane eastbound is added on the eastbound approach for consistency.

Based on the changes noted for each scenario, Sand Lake Road was analyzed as a 5-lane or fewer roadway in the No-Build scenario and as a six-lane or more roadway in the Build scenario. As shown in **Table 140**, crashes at the Sand Lake Road/International Drive intersection are predicted to decrease with the improved condition. While the analysis shows a decrease in crashes between the No-Build and Build scenarios, the analysis is using two different Safety Performance Functions (SPFs) due to the change from a five-lane or fewer roadway to a six-lane or more roadway. This is significant due to the AADT thresholds for those SPFs. The five-lane or fewer roadway has an upper AADT threshold of 67,700 for the major road and 33,400 for the minor road whereas the six-lane or more roadway has an upper AADT threshold of 137,600 for the major road and 68,400 for the minor road. The AADTs at the Sand Lake Road/International Drive intersection average 57,500 for the major road and 26,000 for the minor road in 2046, which is on the higher side for the five-lanes or fewer SPF but near the middle for the six-lane or more SPF. The varying AADT ranges between the SPFs is likely the reason why a decrease in crashes was observed between the No-Build and Build conditions.

Table 140: No-Build vs Build SPICE Predicted Crash Frequency Results

Scenario/ Feature	Predicted Fatal + Injury Crashes	Predicted Property Damage Only Crashes	Total Predicted Crashes	Total Present Value
Sand Lake Road and International Drive No-Build	303.5	975.8	1,279.2	\$63,156,436
Sand Lake Road and International Drive Build	262.0	753.6	1,015.6	\$54,801,864
<i>Difference – Build minus No-Build</i>	-41.5	-222.1	-263.6	(\$8,354,572)

Note: Some values in **Table 140** will not sum due to rounding from the SPICE output spreadsheets.

12.3. Comparative Safety Analysis Summary

The following bullets summarize the comparative safety analysis of the Build DDI versus the No-Build partial cloverleaf interchange:

- The Build condition is anticipated to improve safety conditions at the beginning of the “Tube” north of Sand Lake Road when compared to the No-Build condition from a qualitative perspective.
- The I-4 at Sand Lake Road ramp reconfigurations are predicted to reduce crashes and save over \$2 million in crash costs over the 20-year life cycle of the project.
- The DDI itself is anticipated to reduce overall crashes, reduce the number of severe injury crashes, and potentially reduce wrong-way maneuver crashes through the I-4 at Sand Lake Road interchange area from a qualitative perspective.
- It is anticipated that crashes would be reduced at the Sand Lake Road at Turkey Lake Road and Sand Lake Road at International Drive intersections under the Build configurations.

Appendix BB provides the results of the comparative safety analysis.