MEMORANDUM

TO:	Kelly Crowe, Steve McAlearney; City of Key West
FROM:	Peng Zhu, Jose Rodriguez, Bryan Wilson; KCI Technologies
DATE:	April 15, 2021
SUBJECT:	Findings of City of Key West One-Way Street Conversion Feasibility Study Phase 1 - Elizabeth St. and Greene St.

To support community development and tourist activities, the City of Key West initiated a one-way street conversion feasibility study with purposes of improving safety and livability while minimizing impacts to street connectivity, traffic operations, and business and resident activities. Phase 1 of the study focused on Elizabeth Street between Caroline and Greene Streets, and Greene Street between Elizabeth and Simonton Streets, as shown in **Figure 1** below. This area experiences a high degree of delivery truck activities, frequent on-street parking, and heavy tourist pedestrian and bicycle activities.

Figure 1. Phase 1 Study Corridor

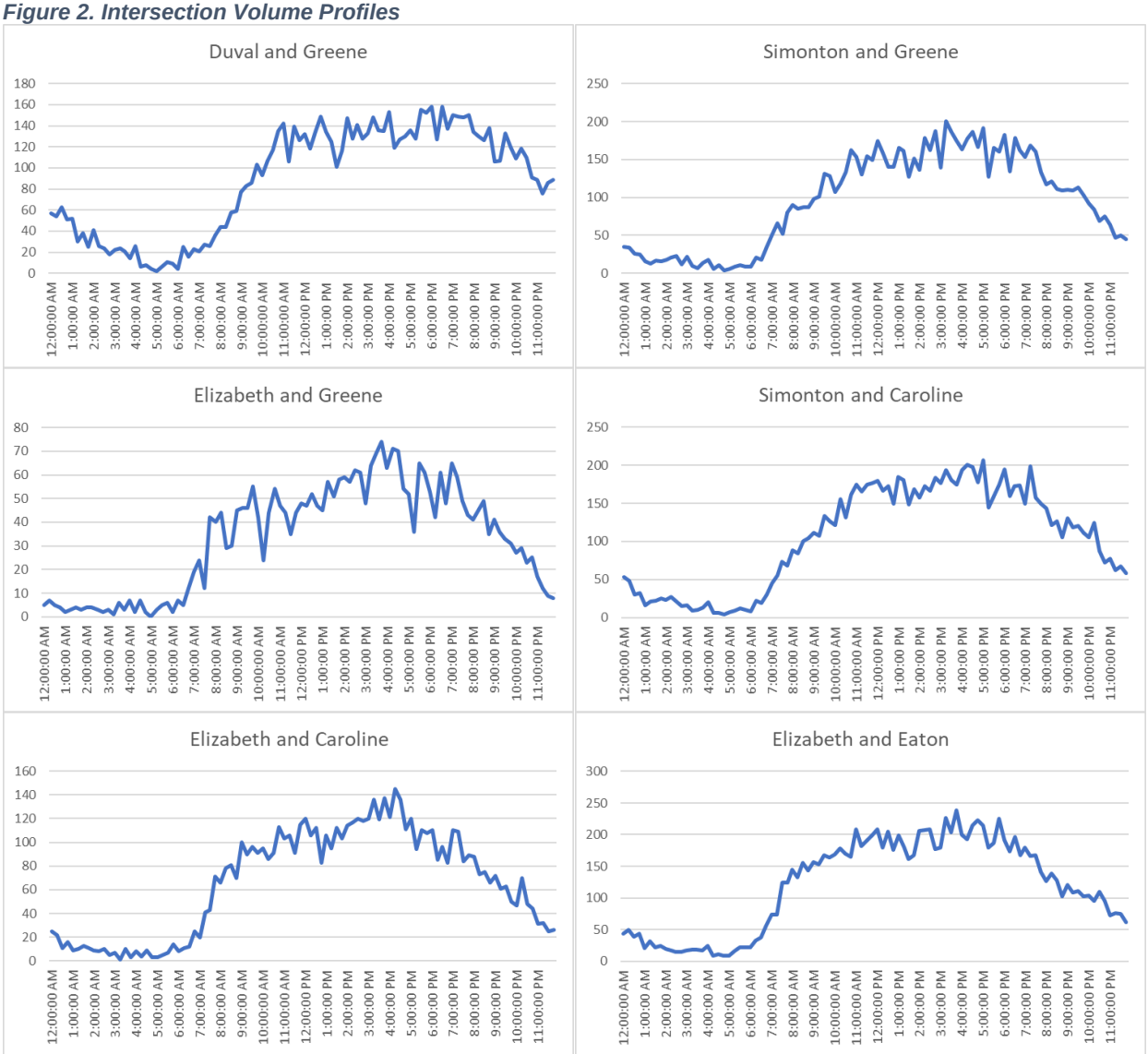
KCI, Technologies, Inc. (KCI) has conducted plans reviews and data gathering to identify recently completed, on-going, and planned projects. Review findings were documented in the **Technical Memorandum: *Existing Plans and Data Review Summary***, dated January 2021.

The feasibility of one-way conversion was evaluated based on three criteria: traffic operations, safety, and accessibility. For traffic operations, roadway link capacity and intersection level of service (LOS) were analyzed. For traffic safety, historical crash analysis and predictive method using crash modification factors were applied. For accessibility, we looked at costs in terms of travel time and travel distance changes as the result of the one-way conversion.

Traffic Data Collection

Field data collection at six intersections along and adjacent to the study segment were conducted on Friday, February 19 and Saturday, February 20, 2021 **Figure 2** below shows total intersection volumes by time-of-day. Instead of typical AM and PM peak hours, the study area experienced mid-day and afternoon/evening peaks.

Figure 2. Intersection Volume Profiles



Traffic Operations

Figure 3 shows existing conditions ADT along the study segment and adjacent roadways. Based on the data, northbound Elizabeth Street to westbound Greene Street (counterclockwise) has higher traffic volumes than the other direction (clockwise). Based on traffic volumes and FDOT Q/LOS methodology[1], roadway segment LOS were determined as shown in **Figure 4**. All roadway segments operate under acceptable LOS (City of Key West LOS standard is "D"). Existing Conditions ADT and LOS are also summarized in **Table** 1.

Figure 3. ADT - Existing Conditions

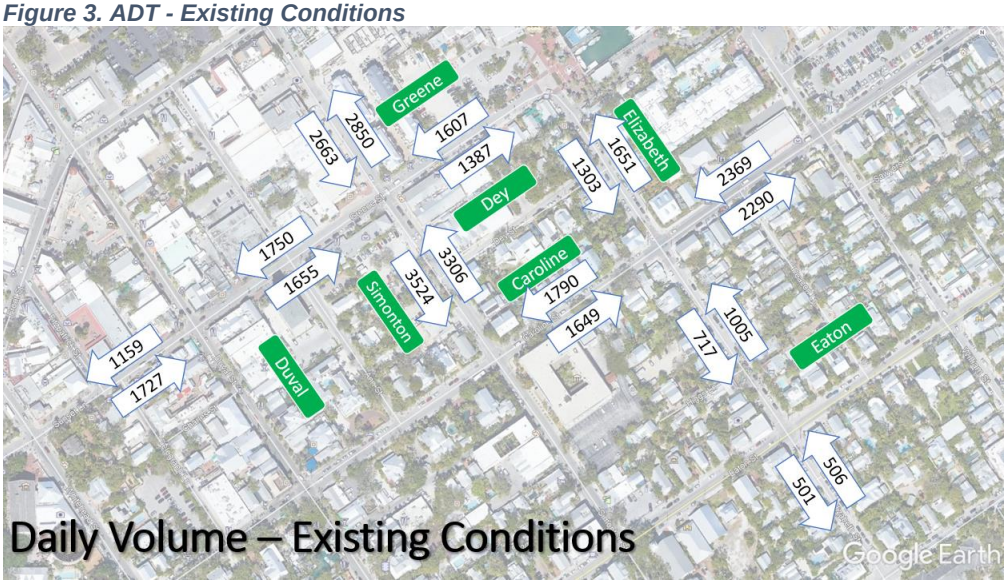


Figure 4. Roadway Segment LOS - Existing Conditions

[1] Florida Department of Transportation (FDOT) 2020 Quality/Level of Service (Q/LOS) Handbook, June 2020.

Table 1. Roadway Segment ADT and LOS - Existing Conditions

Street	Segment	ADT	Lanes	LOS*
Green St	West of Duval	2,886	2	C
Green St	Between Duval and Simonton	3,405	2	C
Green St	Between Simonton and Elizabeth	2,994	2	C
Caroline St	Between Simonton and Elizabeth	3,439	2	C
Caroline St	East of Elizabeth	4,659	2	C
Simonton St	North of Greene	5,513	2	D
Simonton St	Between Greene and Caroline	6,830	2	D
Elizabeth St	Between Greene and Caroline	2,954	2	C
Elizabeth St	Between Caroline and Eaton	1,722	2	C
Elizabeth St	South of Eaton	1,007	2	C

* LOS based on 2020 FDOT Q/LOS Handbook Generalized Service Volume Tables.

Figure 5 and **Figure 6** show traffic volumes and segment LOS, respectively, after one-way conversion. Segment LOS will still be acceptable. We applied a conservative approach assuming all traffic along eastbound Greene Street to southbound Elizabeth Street would reroute to southbound Simonton Street and Eastbound Caroline Street. In fact, traffic would be spread onto a wider network with less impact to the individual links. ADT and LOS with one-way conversion are also summarized in **Table 2**.

Figure 5. ADT – One-Way Conversion

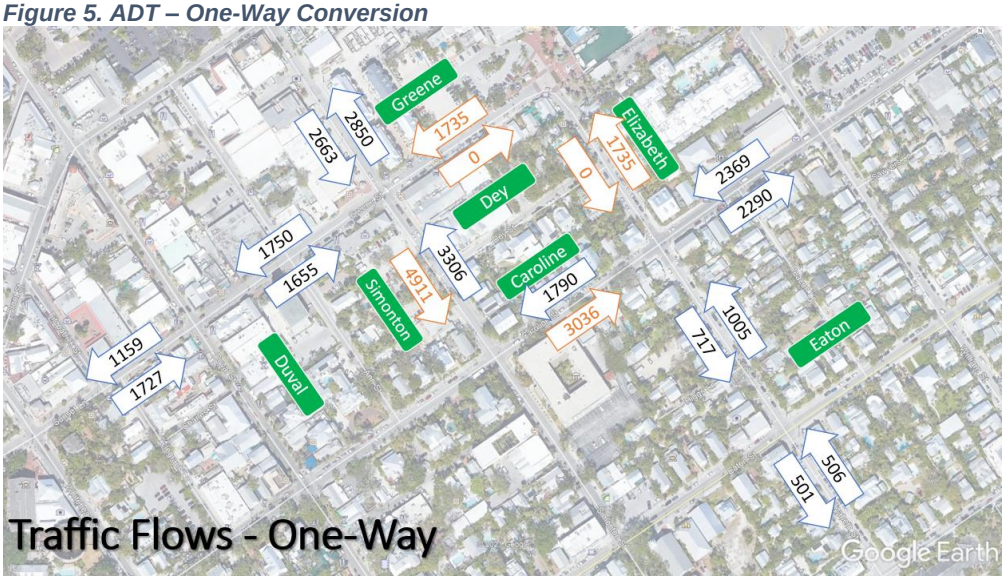


Figure 6. Roadway Segment LOS - One-Way Conversion

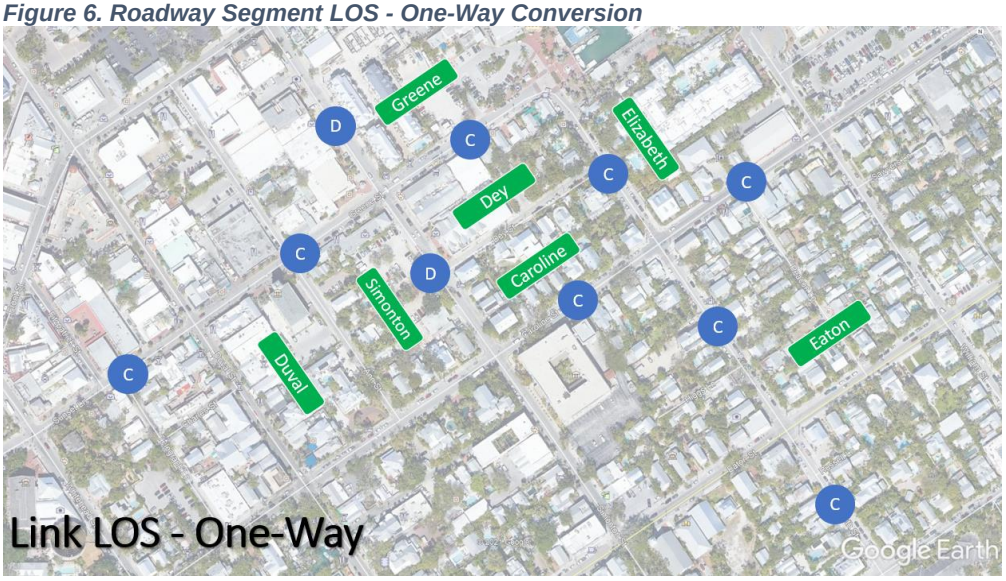


Table 2. Roadway Segment ADT and LOS – One-Way Conversion

Street	Segment	ADT	Lanes	LOS*
Green St	West of Duval	2,886	2	C
Green St	Between Duval and Simonton	3,405	2	C
Green St	Between Simonton and Elizabeth	1,735	1	C
Caroline St	Between Simonton and Elizabeth	4,826	2	C
Caroline St	East of Elizabeth	4,659	2	C
Simonton St	North of Greene	5,513	2	D
Simonton St	Between Greene and Caroline	8,217	2	D
Elizabeth St	Between Greene and Caroline	1,735	1	C
Elizabeth St	Between Caroline and Eaton	1,722	2	C
Elizabeth St	South of Eaton	1,007	2	C

* LOS based on 2020 FDOT Q/LOS Handbook Generalized Service Volume Tables

Similarly, **Figure 7** and **Figure 8** summarize the intersection LOS (based on Synchro analysis) under existing conditions and one-way conversion, respectively. Results from both mid-day peak and afternoon/evening peak are shown in the two figures. All study intersections LOS are acceptable.

Figure 7. Intersection LOS - Existing Conditions

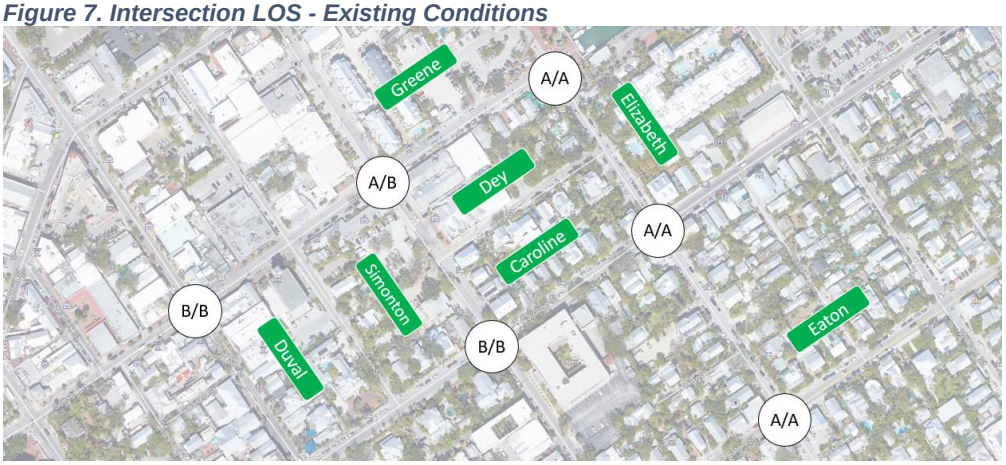


Figure 8. Intersection LOS - One-Way Conversion

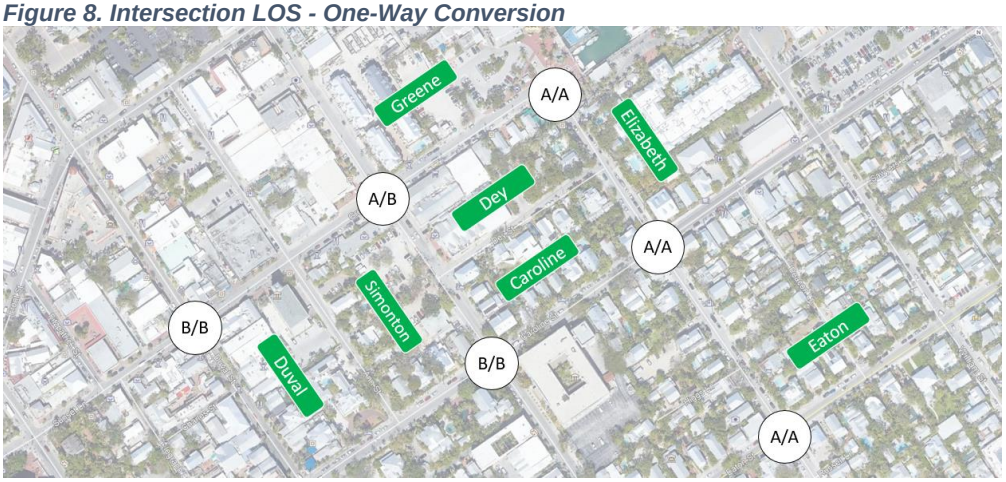


Table 3. Intersection Level of Service and Delay – Existing Conditions VS. One-Way Conversion

Intersection	Existing LOS (Peak1/Peak2)	Delay (sec)	One-Way LOS	Delay (sec)
Greene @ Duval	B/B	10.3/11.9	B/B	10.3/11.9
Greene @ Simonton	A/B	9.8/10.7	A/B	9.6/10.4
Greene @ Elizabeth	A/A	7.7/7.9	A/A	8.0/8.1
Caroline @ Simonton	B/B	11.9/13.0	B/B	13.3/19.1
Caroline @ Elizabeth	A/A	5.8/8.0	A/A	3.4/4.4
Eaton @ Elizabeth	A/A	3.0/4.2	A/A	3.4/4.2

Safety

A total of 45 crashes were reported within the study area between 2017 and 2020. Results of the crash analysis are presented in this report with figures and tables showing crash-related factors including crash locations, crash types, crash occurrence by year, month, and time of day, and contributing circumstances. **Table 4** presents the distribution of the crashes by year and month from January 2017 through December 2020. **Figure 9** summarizes the crashes by hour of day grouped by three-hour increments.

Table 4. Crashes by Year and Month

Month	2017	2018	2019	2020	Number of Crashes	Percent of Total Crashes
January	2	2	1	1	6	13.3%
February	1	1	0	1	3	6.7%
March	2	1	2	1	6	13.3%
April	2	0	2	0	4	8.9%
May	0	2	0	0	2	4.4%
June	0	0	2	0	2	4.4%
July	1	1	2	1	5	11.1%
August	2	0	0	0	2	4.4%
September	0	1	2	0	3	6.7%
October	0	2	1	0	3	6.7%
November	0	2	2	1	5	11.1%
December	2	0	1	1	4	8.9%
Total Crashes	12	12	15	6	45	100.0%
Percent of Total	26.7%	26.7%	33.3%	13.3%	100.0%	

Figure 9. Crashes by Time of Day

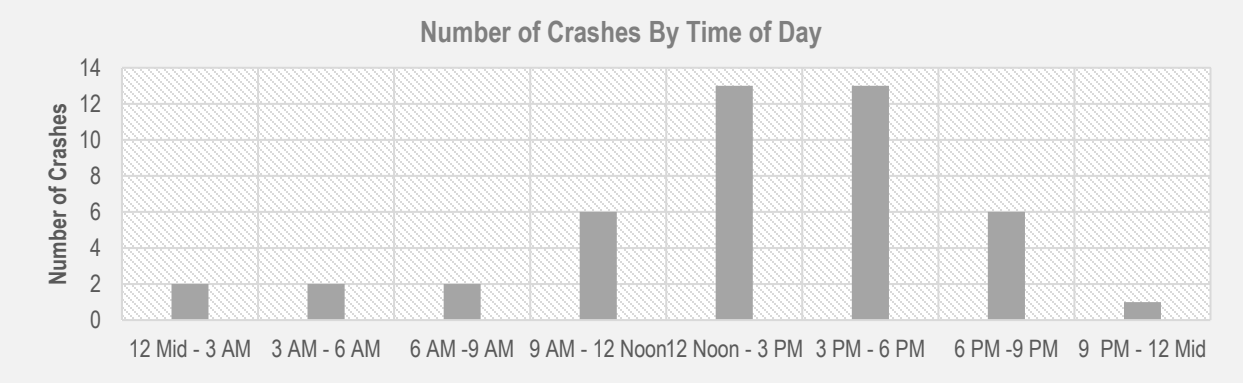


Figure 10 through **Figure 13** illustrate the types, dates, and locations of the crashes that occurred along the study segment from 2017 to 2020.

Figure 10. 2017 Crashes

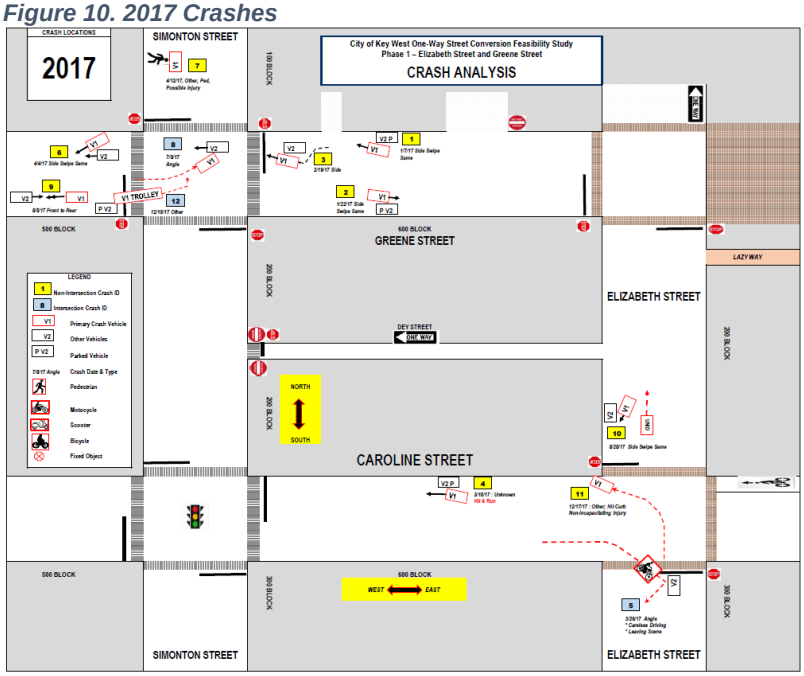


Figure 11. 2018 Crashes

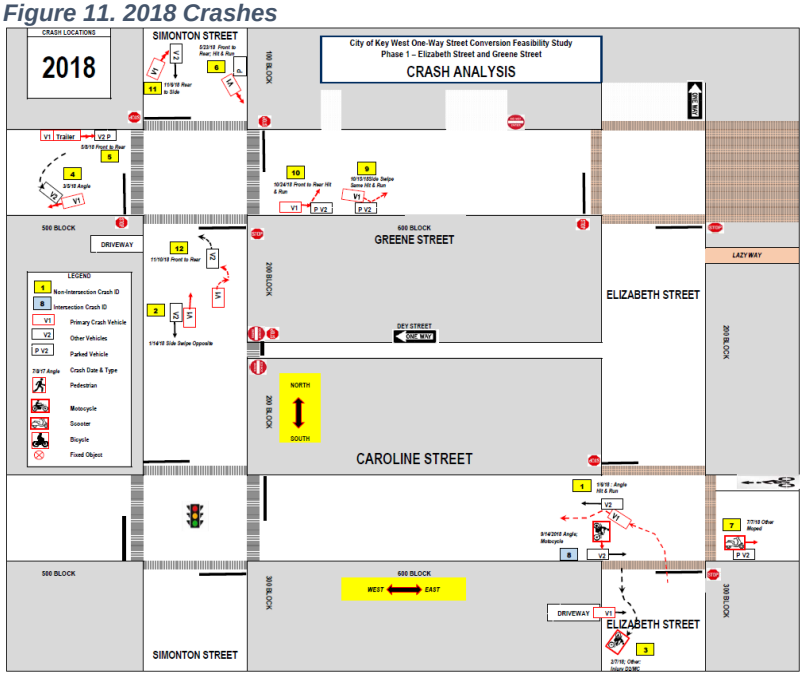


Figure 12. 2019 Crashes

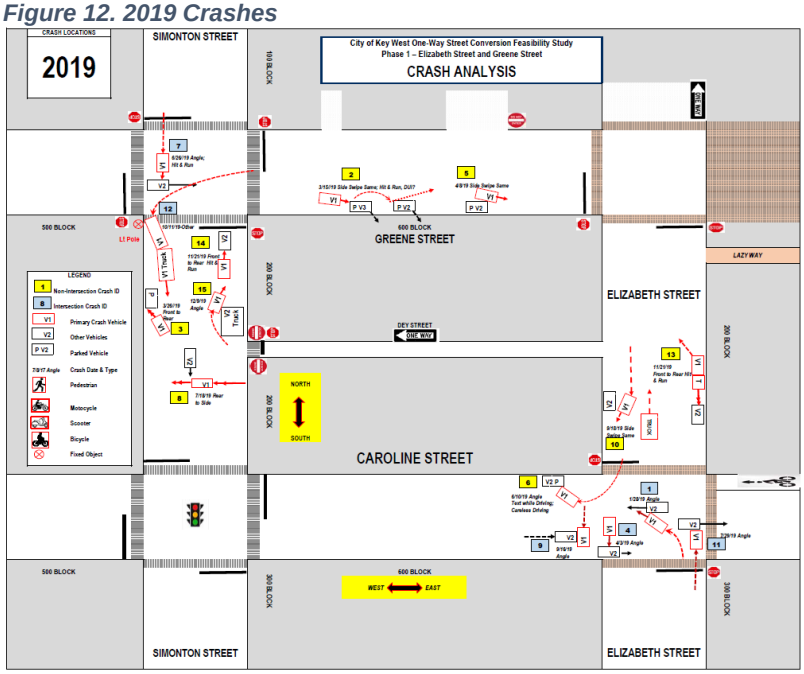


Figure 13. 2020 Crashes

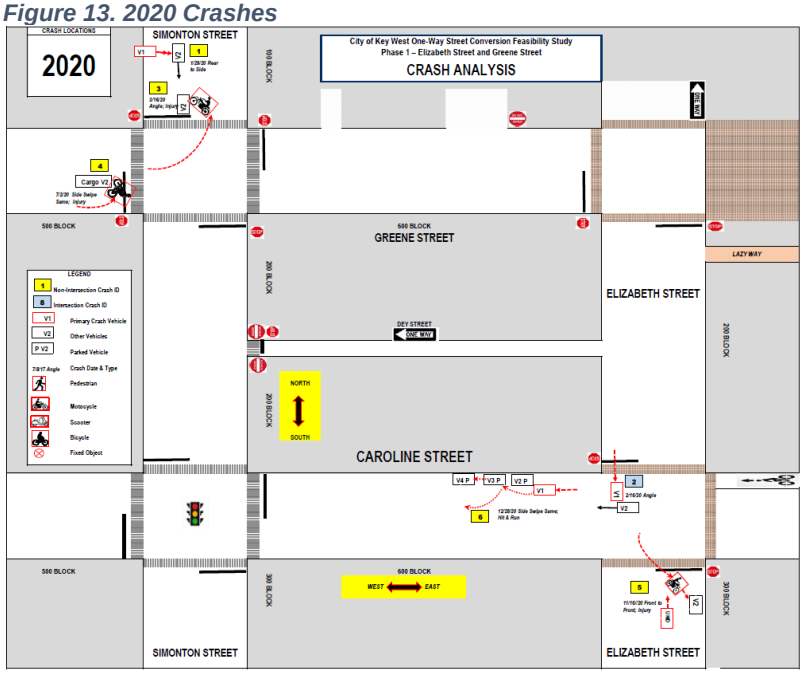


Table 5 presents the primary contributing factors for each type of crash. The top contributing factor for Angle crashes is Failing to Yield Way; for Side-Swipe Same Direction it is Careless Driving; and for Front to Rear crashes, it is Improper Backing. Overall, the top four contributing circumstances are Careless driving (13 crashes, 28.9 percent), Improper Backing (8 crashes, 17.8 percent), Failed to Yield Way (6 crashes, 13.3 percent), and Failure to Keep in Proper Lane (5 crashes, 11.1 percent).

Table 5. Contributing Factors

Crash Type	Contributing Circumstances	Number of Crashes
Angle (14 Crashes)	Failed to Yield Way	6
	Careless Driving	3
	No Contributing Action	2
	Driving too Fast	1
	Failure to Keep in Proper Lane	1
	Other	1
Side-Swipe Same Direction (12 Crashes)	Careless Driving	5
	Failure to Keep in Proper Lane	3
	Improper Passing	2
	No Contributing Action	1
	Other	1
Front to Rear (8 Crashes)	Improper Backing	5
	Careless Driving	2
	Followed too Closely	1
Other (5 Crashes)	Other factors not identified	2
	Careless Driving	1
	Oversteering	1
	No Contributing Action	1
Rear to Side (3 Crashes)	Improper Backing	3
Front to Front (1 Crash)	Failure to Keep in Proper Lane	1
Sideswipe Opposite Direction	Careless Driving	1
Unknown Type	Careless Driving	1

Table 6 presents the crash types, frequencies, and percentages. The top three crash types are 14 (31.1 percent) *Angle* crashes, 12 (26.7 percent) *Same Direction Side Swipe* crashes, and 8 (17.8 percent) *Front-to-Rear* crashes. *Rear-to-Side* crashes totaled 5 (11.1 percent) while other crashes make up the remaining 13.3 percent.

Table 6. Crashes by Types

Crash Type	2017	2018	2019	2020	# of Crashes	% of Crashes
Angle	2	3	7	2	14	31.1%
Same Direction Sideswipe	6	1	3	2	12	26.7%
Front to Rear	1	4	3	0	8	17.8%
Other	2	2	1	0	5	11.1%
Rear to Side	0	1	1	1	3	6.7%
Head-on	0	0	0	1	1	2.2%
Opposite Direction Sideswipe	0	1	0	0	1	2.2%
Unknown	1	0	0	0	1	2.2%
Total Crashes	12	12	15	6	45	100.0%

Other notable crash analysis findings include the following:

- A total of 23 parked vehicles were involved in 19 of the crashes. Seven of the crashes involving parked vehicles occurred along Green Street between Elizabeth and Simonton Street. Three of the crashes involving parked cars occurred along Elizabeth Street between Greene and Caroline Street. In two of the three crashes, the drivers indicated that they had to swerve/veer to the right to avoid an oncoming truck, striking a parked vehicle;
- Motorcycles were involved in 7 (15.6 percent) crashes;
- Only one of the reported 45 crashes involved a pedestrian (on Simonton Street north of Greene Street). No injury was reported;
- No crashes involving bicycles were reported during the four-year analysis period;
- Only 2 crashes involved fixed objects – one was a curb and the other a light pole.
- There were no fatal crashes;
- Six crashes resulted in injuries and/or potential injuries (one injury per crash). Four of the injured were motorcyclists;
- One crash involved a tourist trolley bus at the intersection of Simonton and Greene Street;
- There were 10 hit-and-run crashes reported, six of which involved parked vehicles;
- There were no reported DUI involved crashes; however, there is one case where an inebriated suspect following a vehicle involved in a hit-and-run crash on Greene Street was questioned.

Based on FHWA's Crash Modification Factors Clearinghouse, the segment is expected to receive a Cost Modification Factor of 0.53 as the result of one-way conversion, which is equivalent to a

3-crashes-per-year reduction.

Accessibility

Traffic on northbound Elizabeth Street and westbound Greene Street will not be impacted by the one-way conversion. Therefore, we focused on identifying and redirecting eastbound Greene Street and southbound Elizabeth Street vehicular trips terminating somewhere along the study segment. These trips will require longer routes to reach their destinations. We applied three methods to estimate such traffic:

1) Southbound Elizabeth Street outbound traffic minus eastbound Greene Street inbound traffic;
2) 10% of all eastbound to southbound traffic; and
3) Estimation based on available parking spaces.

As a result of the three methods, about 140 vehicles a day will need to take a 0.3-mile longer route with a travel time of 2.0 minutes. Increased travels are calculated as 42 (140*0.3) vehicle-mile-traveled and 4.7 (140*2/60) vehicle-hour-traveled, equivalent to $160 in monetary value[2].

Key Takeaways

A list of key takeaways from the feasibility evaluation are provided below:

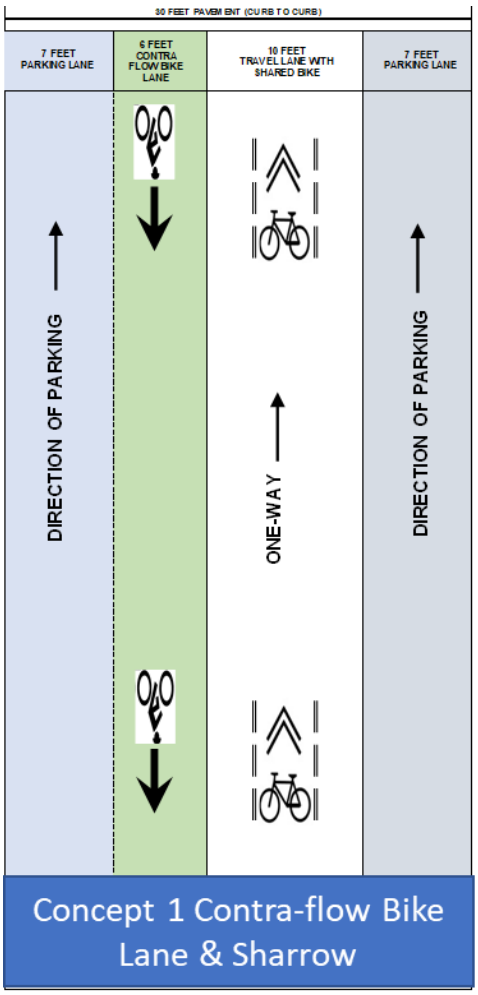
- The study segment has relatively low street and intersection volumes;
- Roadway and intersections analyses indicated that there are no concerns in roadway capacity and intersection operations;
- Traffic operational impacts from the diversions resulting from the one-way conversion is minimal.
- The study segment experiences relatively low crash severity, potentially related with low speed, narrow streets, and drivers' expectation of high multimodal activities; and.
- Expected safety benefits from the one-way conversion is a reduction of about 3 crashes per year along the study segment.

2 Vehicle per mile cost based on IRS standard of $0.56/mile, travel time values based on South East Florida Road and Transit User Cost Calculator (2014 update)

Potential Concepts

Five potential concepts are provided below, together with their Pros/Cons and ease of implementation.

Concept 1: Contra-Flow Bike Lane & Sharrow



Pros:

- Easy to implement
- Maintains existing parking spaces
- Maintains loading zones

Cons:

- Westbound/southbound bicycle will be contra-flow
- No exclusive northbound/eastbound bicycle lane

Ease of implementation: ♦ ♦ ♦ ♦ ♦

Concept 2: Curbside Contra-Flow Bike Lane & Sharrow

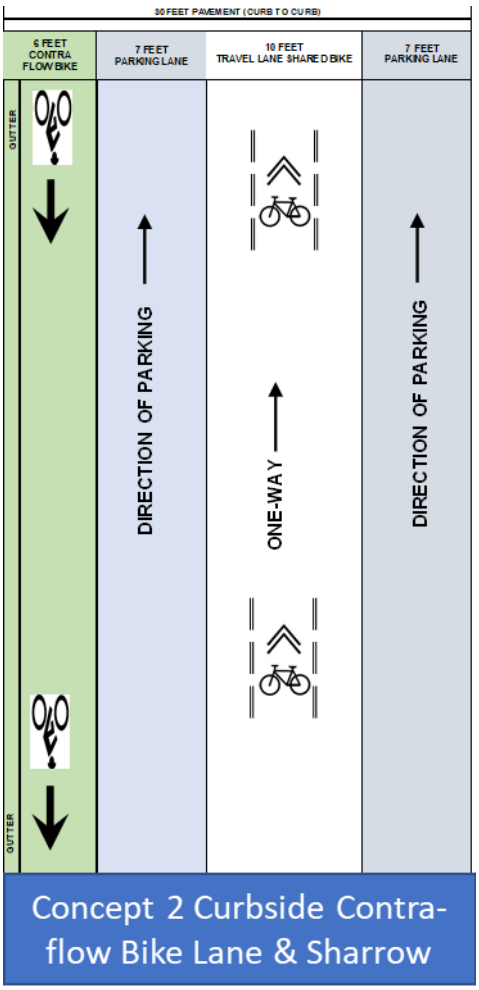
<u>Pros</u>:

- Easy to implement
- Maintains existing parking spaces
- Maintains loading zones
- Westbound/southbound bicycle traffic is separated from vehicular traffic by parking

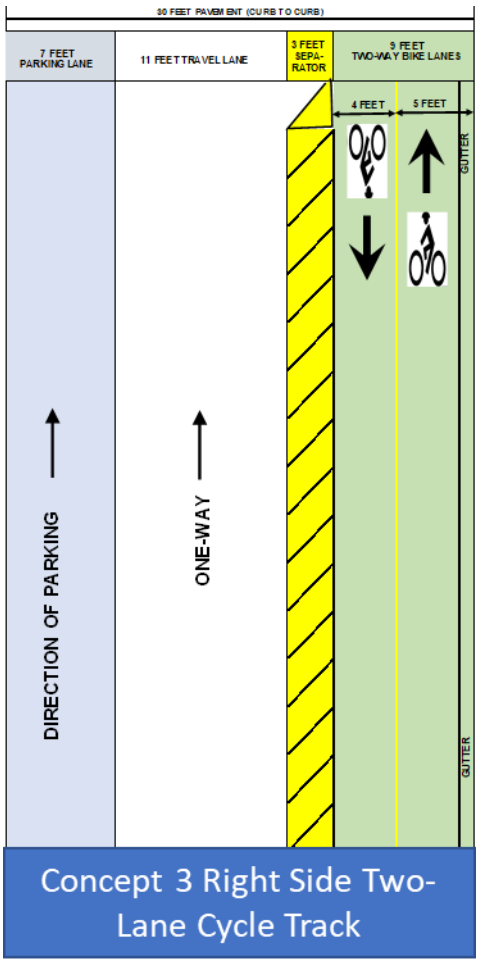
<u>Cons</u>:

- Westbound/southbound bicycle lane will be contra-flow
- No exclusive northbound/eastbound bicycle lane
- May not be sufficient to handle emergency vehicles

<u>Ease of implementation</u>: ♦ ♦ ♦ ♦ ♦



Concept 3: Right Side Two-Lane Cycle Track



Pros:

- Exclusive bike lanes for both directions
- Provides separation between bikes and vehicles

Cons:

- Loss of parking on one side
- Westbound/southbound bicycle lane will be contra-flow

Ease of implementation: ♦ ♦ ♦ ♦

Concept 4: Left Side Two-Lane Cycle Track

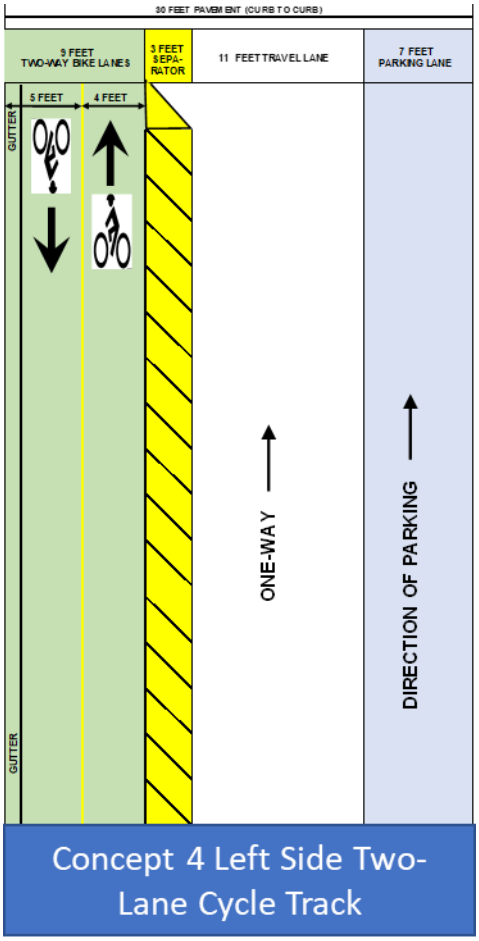
Pros:

- Exclusive bike lanes for both directions
- No contra-flow conflicts
- Provides separation between bikes and vehicles

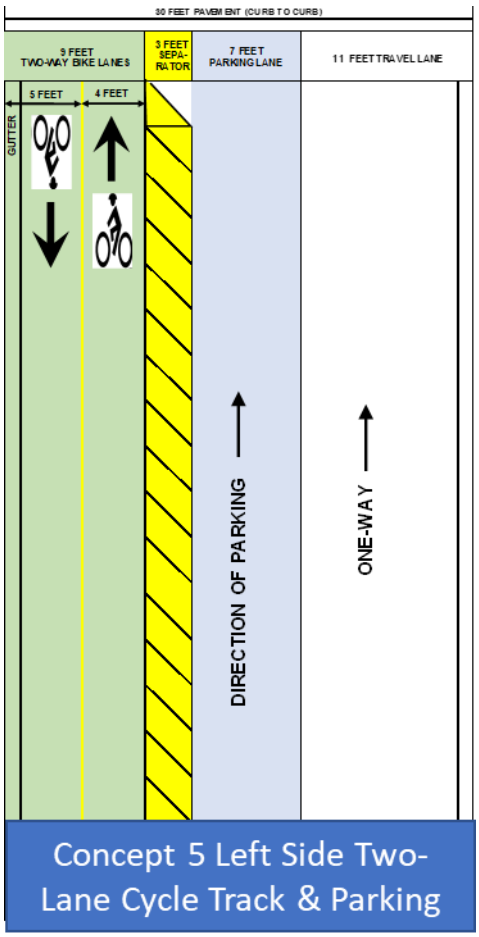
Cons:

- Loss of parking on one side
- May not be preferred by business owners along Greene Street.

Ease of implementation: ♦ ♦ ♦ ♦



Concept 5: Left Side Two-Lane Cycle Track and Parking



Pros:

- Exclusive bike lanes for both directions
- No contra-flow
- Provides separation between bikes and vehicles

Cons:

- Loss of parking on one side
- Parking at street center
- May not be sufficient to handle emergency vehicles

Ease of implementation: ♦ ♦ ♦