TO: FDOT
FROM: HDR, Inc.
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PROJECT: St Johns River Crossing
FPID No: 208225-3-21-01
Clay, Duval, and St. Johns Counties; Florida

1. Introduction

The Florida Department of Transportation (FDOT) identified the need for an improved highway corridor and bridge crossing in the area of the St. Johns River between Clay and St. Johns Counties. The St. Johns River Crossing Project is an effort to decide the best solution, while trying to minimize the adverse effects that solution might have on the communities and the environment in the two counties.

Three goals were established to guide the FDOT in developing potential solutions to existing transportation problems in the project area (further defined below):

- Provide additional capacity to improve current and future transportation network deficiencies
- Promote and support employment and economic development
- Improve efficacy of emergency evacuation

These goals were then consolidated into a statement of purpose to be used to evaluate alternatives and identify the one that would best serve the area's transportation needs:

To address population growth and resulting traffic by providing additional capacity that meets the area's transportation, economic, employment and safety needs while avoiding, minimizing, and/or mitigating effects on the affected communities and the environment.

Rapid population growth in the project area has resulted in additional traffic and congestion on local roads, a situation that is expected to worsen in the future. Providing additional capacity to improve current and future transportation network deficiencies in the near term would help alleviate the congestion while providing access for residents to local employment centers, thus promoting and supporting economic development. Perhaps most important, an improved crossing of the St. Johns River would result in more efficient emergency evacuation, thus potentially saving lives.

As shown below in ***Table 1-1***, in addition to the No Build Alternative, there are ten Build Alternatives currently under consideration, each with different lengths and construction cost estimates.

Table 1: **Project Alternatives Characteristics**

Alternative	Estimated Construction Cost	Length of Alternative (miles)	Estimated Average Daily Trips (2030)*	Estimated Total Trips per Year (2030)
Purple	$1.29 billion	26	33,225	12,127,125
Black	$1.67 billion	36	34,375	12,546,875
Pink 1	$1.26 billion	31	36,855	13,451,909
Pink 2	$1.28 billion	31	36,855	13,451,909
Brown 1	$1.46 billion	34	30,410	11,099,650
Brown 2	$1.45 billion	34	30,410	11,099,650
Orange 1	$1.55 billion	33	30,270	11,048,550
Orange 2	$1.56 billion	33	30,270	11,048,550
Green 1	$1.36 billion	31	36,773	13,422,045
Green 2	$1.36 billion	31	36,773	13,422,045
No Build	$0	32**	39,548	14,435,059

* Source: *St. Johns River Crossing Turning Movement Study* (Wilbur Smith, May 2008)
**Note: Determined using existing road network and existing Shands Bridge crossing

2. Methodology

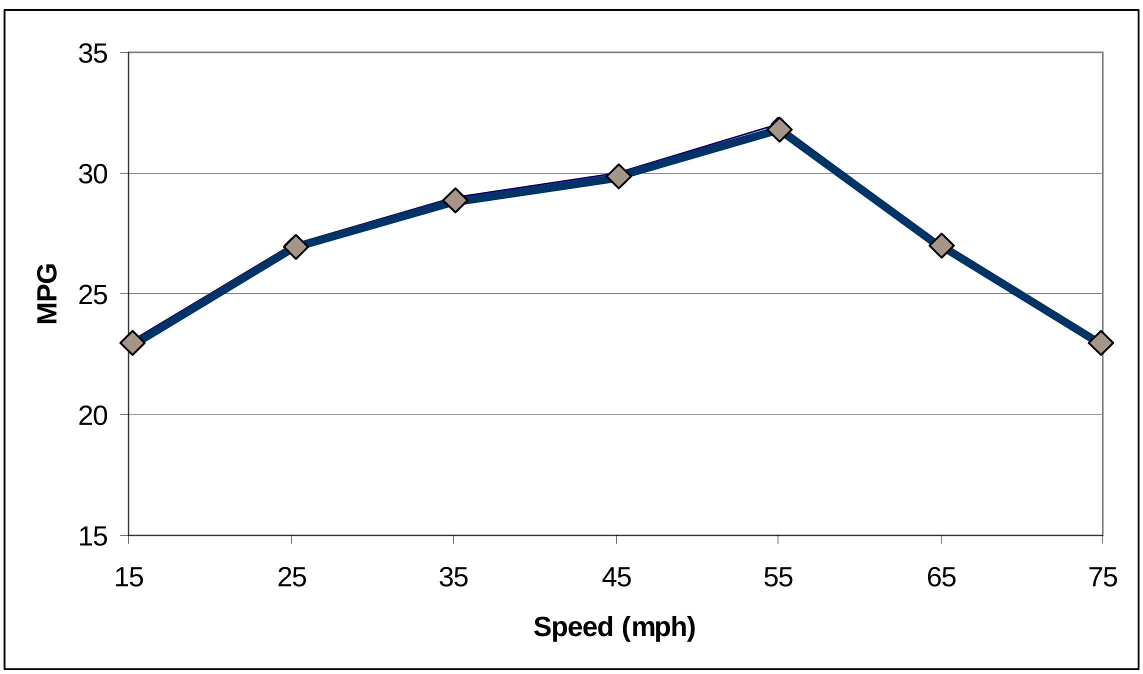
As the price of petroleum skyrocketed during the first six months of 2008, energy once again became a controversial issue and an important topic for environmental documents. Agency and public reviewers are keenly interested in energy and the effects of project construction and operation on the demand for energy. As interest in this element of the environment increases, environmental professionals are updating their analytical tools to ensure that they are using current energy consumption factors and formulas. As of this writing (June 2008) all of the analytical tools are not yet up-to-date and some older tools are still in use.

Energy is consumed during the construction and operation of transportation facilities. Energy is used during construction to manufacture materials and transit vehicles, transport materials, and operate construction machinery. Operational energy consumption includes fuel consumed by public and privately-operated vehicles using the facility. Traffic congestion increases travel times, extends the duration of the peak commute period, and results in decreased fuel efficiency and higher fuel consumption.

Construction energy consumption would include energy expended by machinery and equipment during construction of the St. Johns River Crossing Project. To determine energy consumption, projected construction costs were converted to energy consumption based on the procedures described in the United States Department of Transportation (USDOT) *Energy Requirements for Transportation Systems* (USDOT, 1980). The factor used to estimate energy consumption during construction was determined with the California Transportation Department (CALTRANS) 1983 urban freeway widening formula. The estimation of construction costs was then based on information provided by the FDOT.

Energy consumption rates for vehicles operating on the roadway can be differentiated by comparing changes in traffic operations, as measured by vehicle miles traveled (VMT) and changes in traffic speed throughout the study area. Fuel consumption is proportional to travel speed, and it decreases as speed increases up to about 55 miles per hour **(*Figure 1*)**. Fuel consumption generally increases as speed increases above that point (CCAP, 2005; USDOT, 1980). Total fuel consumption is also affected by the fuel efficiency of vehicles, traffic flows, surface conditions, and roadway geometry. Average speed in the corridor is estimated to be 60 miles per hour for each of the alternatives, including the No Build. Energy consumption for the alternatives will, therefore, not vary because of average vehicle speed.

Figure 1: **Average Passenger Vehicle Fuel Consumption**



MPG = miles per Gallon
mph = miles per hour

Fuel consumption (gallons per vehicle) also depends on the fuel efficiency or fuel usage rate of each vehicle. In 2005, passenger cars traveled an average of 22.9 miles per gallon (mpg). Vans, pickup trucks, and sport utility vehicles traveled an average of 16.2 mpg, and heavy-duty trucks had an average fuel rate of 5.8 mpg (USDOT 2006). Based on the percentage of each type of vehicle currently on the road, the average fuel rate for all vehicles was 19.2 mpg.

Energy is measured in British thermal units (BTUs) because it is a standard unit of measure regardless of fuel type (i.e., diesel fuel or gasoline). Because of the small size of a single BTU, typical descriptions are reported in million BTUs. For example, one gallon of gasoline equals 0.13 million BTUs. Operational energy consumption is estimated by calculating the fuel consumed by vehicles traveling through the project area on a daily basis. Fuel consumed is calculated by determining the VMT for the project area and dividing by the amount of fuel consumed per mile for a given speed. Because speed is expected to be the same for each of the alternatives, this factor has been dropped from the calculation. Fuel consumption, or mpg, is derived from 2005 averages for passenger vehicles, light trucks, and heavy-duty trucks and weighted by the percentage of each type of vehicle currently on public roadways.

The length of each corridor alternative is shown above in ***Table 1***. Under the No Build Alternative, vehicles are expected to travel either to the north over the Buckman Bridge or south across the Shands Bridge to reach the same endpoints as for the alternatives. The estimates of average daily trips and total annual trips are based on data from the *St. Johns River Crossing Project Turning Movement Study*, Series A figures (Wilbur Smith May 2008).

3. Affected Environment

Depending upon the alternative, the St. Johns River Crossing Project would extend approximately 25 to 33 miles from State Road 21 to Interstate 95. The project area is experiencing rapid growth and the additional traffic is causing congestion of local roads. Growth and the associated traffic congestion are expected to continue in the future. The area consists of suburban and rural land uses and rapid growth is increasing population density and travel demand. Energy consumption in the project area is increasing with population growth.

4. Environmental Consequences

The St. Johns Corridor project team evaluated construction and operational energy consumption that will occur with the ten Build Alternatives and the No Build Alternative.

4.1 Build Alternatives

4.1.1 Construction Energy Consumption

Energy would be consumed to manufacture materials, transport those materials, and operate the construction machinery and equipment. The energy consumed in completing the project would be proportional to the cost or size of the project.

Based on the CALTRANS (CALTRANS, 1983) urban freeway widening formula, energy consumption during construction is about 8.8 million BTUs per thousand dollars of construction costs. Using this factor, construction of the St. Johns River Crossing Project was projected to consume between 11,127,515 and 14,664,277 million BTUs of energy, depending upon the alternative chosen. Construction costs and energy consumption are presented for each alternative in ***Table 2*** below.

Table 2: **Energy Consumption during Construction**

Alternative	Estimated Construction Cost	Energy Consumption During Construction (Millions of Btus)
Purple	$1.29 billion	11,369,046
Black	$1.67 billion	14,664,277
Pink 1	$1.26 billion	11,127,515
Pink 2	$1.28 billion	11,227,191
Brown 1	$1.46 billion	12,850,146
Brown 2	$1.45 billion	12,949,822
Orange 1	$1.55 billion	13,668,194
Orange 2	$1.56 billion	13,734,505
Green 1	$1.36 billion	11,945,563
Green 2	$1.36 billion	12,011,874
No Build	$0	0

4.1.2 Operational Energy Consumption

Operational energy consumption was estimated by calculating the fuel consumed by vehicles traveling through the project area on a daily basis, as was noted in ***Table 1***. Fuel consumed was calculated using an average of 19.2 mpg for the design year of 2030. These calculations do not include several factors such as idling conditions or roadway characteristics (i.e. variations in grade) that may also affect fuel consumption. Traffic is forecasted to increase in the St. Johns corridor study area whether the project is constructed or not. The St. Johns River Crossing Project would provide additional capacity resulting in improved operational conditions, faster travel speeds, and vehicles spending less time in stop-and-go conditions.

As ***Table 3*** illustrates, total annual fuel consumption in 2030 would range 15.7 million gallons for the Purple Alternative and 24.1 million gallons for the No Build Alternative. If built, the St. Johns River Crossing Project will result in a fuel savings of between 2.9 million gallons for the Pink 1 and 2 Alternatives to 8.3 million gallons for the Purple Alternative. Each of the Build Alternatives would reduce annual fuel consumption, compared with the No Build Alternative.

By comparing the amount of fuel required to construct each of the proposed Build Alternatives ***(Table 2)*** with the Estimated Energy Savings per Year (and converting each to similar units of measurement) it is possible to estimate the Energy Payback Period for the project. The Energy Payback Period for each of the Build Alternatives is shown in ***Table 3*** below and ranges from 10.5 years for the Purple Alternative to a maximum of 29.1 years for the Pink 2 Alternative.

Table 3: **Estimated Energy Consumption During Operation**

Alternative	Length of Alternative (Miles)	Estimated Average Daily Trips (2030)[1]	Total Trips per Year	Total Miles Traveled	Energy Consumption per Year (gallons)[2]	Estimated Energy Savings per Year (gallons)	Energy payback (in years)
Purple	26	33,225	12,127,125	315,305,250	15,727,365	8,331,066	10.5
Black	36	34,375	12,546,875	451,687,500	16,565,796	7,492,635	15.1
Pink 1	31	36,855	13,451,909	417,009,182	21,088,670	2,969,761	28.8
Pink 2	31	36,855	13,451,909	417,009,182	21,088,670	2,969,761	29.1
Brown 1	34	30,410	11,099,650	377,388,100	19,077,523	4,980,908	19.8
Brown 2	34	30,410	11,099,650	377,388,100	19,077,523	4,980,908	20.0
Orange 1	33	30,270	11,048,550	364,602,150	18,471,795	5,586,637	18.8
Orange 2	33	30,270	11,048,550	364,602,150	18,471,795	5,586,637	18.9
Green 1	31	36,773	13,422,045	416,083,409	20,622,414	3,436,017	26.7
Green 2	31	36,773	13,422,045	416,083,409	20,622,414	3,436,017	26.9
No Build	32	39,548	14,435,059	556,855,503	24,058,431	0	NA

[1] Source: *St. Johns River Crossing Project Turning Movement Study* (Wilbur Smith 2008)

[2] One gallon of gasoline has 130,000 Btus

In the future, new technologies such as fuel cells or electric/gasoline hybrid cars are expected to become more popular with consumers and over time may help reduce the consumption of fuel. Also, tolling the alternatives could be used to moderate travel along the St. Johns River Crossing Project and help control energy consumption.

4.2 No Build Alternative

4.2.1 Construction Energy Consumption

Routine maintenance would be conducted, and minor safety improvements would be constructed, as required. This includes short-term minor construction activities that are necessary for continued operation of existing transportation facilities. Energy consumption from such minor construction activities would be minor.

4.2.2 Operational Energy Consumption

The No Build Alternative is FDOT's continued routine maintenance that consists of short-term minor construction necessary for continued operation of the existing routes and minor safety improvements, as required within the project area. For the No Build Alternative, fuel consumed was calculated using an average of 19.2 mpg for the design year of the Build Alternatives (2030) and the Shands Bridge as the alternative route.

Capacity of this section of St. Johns River corridor would not be increased and the new bridge over the St. Johns River would not be constructed. The existing corridors would be required to handle all increases in vehicle traffic and roadway performance is likely to decrease over time. Traffic using the local roadways is likely to experience reduced fuel efficiencies which would result in more energy consumption. Under the No Build Alternative, vehicles would consume about 24.1 million gallons of fuel each year traveling this section of the St. Johns River Corridor and other routes in 2030.

5. Proposed Mitigation

No specific mitigation is proposed because the St. Johns River Crossing Project is not expected to affect the regional energy supplies. The St. Johns River Crossing Project will not result in any unavoidable adverse effects.

6. References

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