

LOCATION HYDRAULICS REPORT

Florida Department of Transportation

District Five

SR 535 PD&E Study

Limits of Project: From US 192 to North of SR 536/World Center Drive

Orange and Osceola Counties, Florida

Financial Management Number: 437174-2

ETDM Number: 14325

Date: August 2024

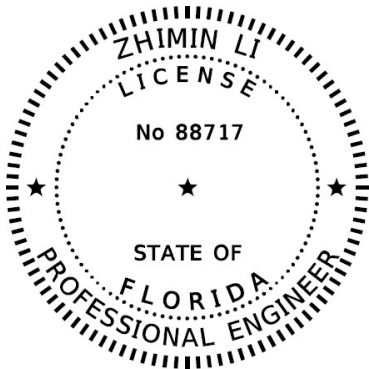
The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022 and executed by the Federal Highway Administration and FDOT.

PROFESSIONAL ENGINEERING CERTIFICATE

I hereby certify that I am a registered professional engineer in the State of Florida practicing with BCC Engineering LLC, a corporation, authorized to operate as an engineering business by the State of Florida, and that I have reviewed or approved the evaluation, findings, opinions, conclusions, or technical advice hereby reported for:

Project: SR 535 PD&E from US 192 to North of SR 536/World Center Drive
FM Number: 437174-2
Location: Osceola and Orange County, Florida
Client: FDOT District Five

This PD&E Location Hydraulics Report includes a summary of data collection efforts and engineering analysis for this SR 535 project. I acknowledge that the procedures and references used to develop the results contained in this report are standard to the professional practice of transportation engineering and planning as applied through professional judgment and experience.



Name: Zhimin Li, P.E.
P.E. Number 88717
Date August 5, 2024

This item has been electronically signed and sealed by Zhimin Li, P.E. on August 5, 2024 using a digital signature. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Executive Summary

SR 535 is a four-lane divided minor arterial facility located within unincorporated Osceola and Orange Counties in Central Florida. SR 535 is known as Vineland Road in Osceola County and Kissimmee-Vineland Road in Orange County. The project limits extend approximately 2.35 miles from the US 192 intersection in Osceola County to just north of the SR 536 intersection in Orange County. The purpose of the project is to accommodate future projected traffic demand and improve safety. The need for the project is based on addressing future transportation demand and safety concerns.

The project is within the jurisdiction of MetroPlan Orlando. The MetroPlan Orlando 2045 Cost Feasible Plan (CFP) includes widening of SR 535 from US 192 in Osceola County to SR 536 in Orange County in years 2031 to 2035 (construction). The SR 535 improvements are funded for design in the Florida Department of Transportation (FDOT) 2024-2029 Five-Year Work Program and MetroPlan Orlando 2023-2028 Transportation Improvement Program (TIP). This project was screened in the Efficient Transportation Decision Making (ETDM) system as ETDM #14325.

'No-Build' and Construction ('Build') Alternatives were evaluated during the study. The build alternative consists of widening SR 535 from four to six lanes. The study evaluated a range of typical section and intersection alternatives including inside widening and outside widening of the existing roadway. The build alternative analysis included the evaluation of open and closed stormwater drainage conveyance systems together with the evaluation of pond site locations. The study also evaluated Transportation System Management and Operations (TSMO) and multimodal improvements.

The Preferred Alternative consists of inside widening from four to six lanes with a shared use path along both sides and intersection improvements. The Preferred Alternative has a design speed of 45-miles per hour (mph) and consists of full reconstruction with the additional lanes constructed towards the median. The typical section consists of three (3) 11-foot travel lanes in each direction separated by a 32-foot to 47-foot median with a 14-foot shared use path on the west side and a 12-foot shared use path on the east side of the roadway. The Preferred Alternative will be constructed within the existing right-of-way width of 200-feet to 224-feet. Swales with ditch bottom inlets in conjunction with flume inlets at the curb line will be provided for drainage conveyance.

The Preferred Alternative will also implement intersection improvements including the following innovative intersection concepts.

- Polynesian Isle Boulevard Partial Median U-Turn (PMUT): Implementation of the PMUT involves the removal of northbound and southbound direct left turn movements from SR 535 to Polynesian Isle Boulevard and the addition of signalized U-turns at the existing median openings located just north and south of the intersection along SR 535 to accommodate vehicles wishing to travel east or west on Polynesian Isle Boulevard.
- International Drive Partial Displaced Left Turn (PDLT). Implementation of the PDLT involves the removal of direct eastbound and westbound left turns from International Drive at SR 535 with the displaced left turns installed on both legs International Drive. The

northbound and southbound left turn movements for SR 535 continue to take place at the main intersection.

- SR 536 (World Center Drive) Partial Displaced Left Turn (PDLT). Implementation of the PDLT involves the removal and replacement of direct northbound and southbound left turns from SR 535 at SR 536 with the displaced left turns installed on both legs of SR 535. The eastbound and westbound left turn movements for the SR 536/World Center Drive continue to take place at the main intersection.

Protection of floodplains and floodways is required by Executive Order 11988: Floodplain Management, USDOT Order 5650.2, Floodplain Management and Protection, and Federal-Aid Policy Guidance on Location and Hydraulic Design of Encroachment on Flood Plains, 23 CFR Part 650A. The intent of these regulations is to avoid or minimize highway and land use development encroachments that reduce storage and increase water surface elevations within base floodplains. Where encroachment is unavoidable, the regulations require FDOT to take appropriate measures to minimize impacts. The LHR identifies and evaluates these impacts.

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRMs) for the study area. The relevant FIRM panel numbers are 12095C0585F and 12095C0605F for Orange County, Florida dated September 25, 2009, and 12097C0055G for Osceola County, Florida dated June 18, 2013.

There are no floodplains in the vicinity of the project within the Osceola County limits. There is a floodplain located on the west side of SR 535 between the Osceola/Orange County line and SR 536 within the Orange County limits, which is designated as Zone A (no base flood elevations determined). The floodplain through this area is traversed by International Drive and SR 417, which creates 3 distinct sections (identified as Floodplain 1, 2 and 3), although the floodplains are hydraulically connected.

There are no regulatory floodways within the project limits.

Five cross drains have been identified under SR 535 and SR 536 within the project limits as shown on **Table ES-1**.

Table ES-1: Cross Drain Summary

County	Road	Station	Location (Milepost)	Cross Drain Size and Type
Osceola	SR 535	1521+30	0.600	2-30" RCP
Osceola	SR 535	1544+00	1.037	2-24" RCP
Orange	SR 535	1570+00	0.382	1-24" RCP
Orange	SR 536	1599+00 LT	1.694	1-3'x8' CBC
Orange	SR 536	1609+50 LT	1.920	1-36" RCP

Project improvements will result in longitudinal and transverse impacts to the 100-year floodplain. Longitudinal impacts are anticipated from encroaching into the floodplain areas due to the proposed roadway improvements, as well as from a stormwater pond berm. SR 535 does not bisect the floodplain but is instead on the upstream fringe of the mapped floodplain. Transverse impacts are anticipated from the extension or replacement of the existing cross drains. A summary of the floodplain impacts is summarized in **Table ES-2**.

Table ES-2: Base Flood Elevations and Floodplain Impacts

Floodplain ID	Station Range	Base Flood Elevation	Floodplain Impacts (ac-ft)
1	1582+00 to 1600+00	95	4.82
2	1569+00 to 1582+00	91	1.78
3	1550+00 to 1569+00	89.5	2.29
Total			8.89

Since the three impact locations are hydraulically connected and within close proximity of each other, it was determined that the impacts from the three locations could be combined for developing compensation options. Equivalent storage was checked to ensure impacts at the lower elevations could be accommodated at each floodplain compensation site. Five floodplain compensation (FPC) sites have been developed as part of this analysis. All FPC sites analyzed will provide sufficient storage to mitigate floodplain impacts. A summary of the floodplain compensation volume provided for all alternatives is provided in **Table ES-3**.

Table ES-3 Floodplain Compensation Alternatives

FPC Site	Station	Offset	Floodplain Compensation Provided (ac-ft)
1	1586+00	Rt	14.45
2	1581+00	Rt	19.74
3	1575+00	Rt	19.74
4	1572+00	Lt	10.08
5	1566+00	Rt	12.75

All FPC sites analyzed will provide the requisite storage to offset floodplain impacts. As part of this analysis a comparison matrix was developed to determine which location would be the preferred alternative. Based on this preliminary analysis, FPC Site 1 is the recommended alternative.

The floodplain is located in a low density, urbanized area, and the encroachments are classified as "minimal". Minimal encroachments on a floodplain occur when there is a floodplain involvement but the impacts on human life, transportation facilities, and natural and beneficial floodplain values are not significant and can be resolved with minimal efforts. Normally, these minimal efforts to address the impacts will consist of applying the Department's drainage design standards and following the South Florida Water Management District (SFWMD) procedures to achieve the results that will not increase or significantly change the flood elevations and/or limits.

This project will make every effort to minimize the floodplain impacts resulting from the placement of fill. The maximum allowable roadway embankment slope will be used within the floodplain area to minimize the floodplain impacts, and floodplain compensation will be utilized in the stormwater ponds and roadside ditches where possible.

There is no change in flood "risk" associated with this project. The encroachments will not have a significant potential for interruption or termination of transportation facilities needed for emergency vehicles or used as an evacuation route. In addition, no significant adverse impacts on natural and beneficial floodplain values are anticipated and no significant impacts to highway users are expected.

All proposed cross drains will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase. Thus, there will be no significant adverse impacts on natural and beneficial floodplain values. It has been determined, through consultation with local, state, and federal water resources and floodplain management agencies that there is no regulatory floodway involvement on the project and that the project will not support base floodplain development that is incompatible with the existing floodplain management program.

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1.0 Introduction

In November 2017, the Florida Department of Transportation (FDOT) District Five (D-5) completed a Corridor Planning Study (CPS) to evaluate State Road 535 (SR 535) from US 192 in Osceola County to I-4 in Orange County. The purpose of the CPS was to identify specific problem areas along the corridor and evaluate multimodal alternatives that will be carried forward into future phases of project development in order to optimize the operations of the existing facility. Improvements identified as a result of the CPS included widening from four to six lanes, TSMO and multimodal improvements, and intersection improvements (including innovative intersection designs).

This Location Hydraulics Report (PSR) was prepared as a component of the PD&E Study in accordance with the Florida Department of Transportation (FDOT) PD&E Manual (July 1, 2023).

The purpose of this Location Hydraulics Report is to:

- Provide preliminary analysis of floodplain impacts from the proposed improvements
- Evaluate alternatives for floodplain compensation (FPC) sites
- Identify right-of-way needs
- Recommend preferred FPC sites

The horizontal datum for the project is Florida State Plane (NAD 1983), East Zone. The vertical datum for the project is the North American Vertical Datum of 1988 (NAVD 88), and the elevation difference between NAVD 88 and NGVD 29 is -0.90 feet (i.e., the NAVD 88 elevation is 0.90 feet lower than the corresponding NGVD 29 elevation).

1.1 Project Description

FDOT D-5 is conducting a Project Development and Environment (PD&E) Study to evaluate the widening of SR 535 from four to six lanes from US 192 in Osceola County to just north of World Center Drive (SR 536) in Orange County, approximately 2.35 miles as shown in **Figure 1-1**. SR 535 is known as Vineland Road in Osceola County and Kissimmee-Vineland Road in Orange County.

Within the study limits, SR 535 is a four-lane divided minor arterial facility that runs generally in a north south direction with an existing posted speed that varies from 45 to 50 mph. Bicycle and pedestrian facilities are provided intermittently throughout the study area. There are three bridges over SR 535 within the study limits. Two of the existing bridges serve eastbound and westbound SR 417 and one of the existing bridges serves both eastbound and westbound Osceola Parkway. The existing drainage system collects roadway runoff in ditches and conveys the roadway runoff to treatment ponds via roadside ditches. The proposed improvements include widening SR 535 from four to six lanes, constructing signal improvements, providing drainage treatment and providing shared use paths along both sides of the roadway. The existing bridges will not be modified. The typical section for the preferred alternative is provided in **Figure 1-2**.

Figure 1-1: Project Location



1.2 Purpose & Need

The purpose of the project is to accommodate future projected traffic demand and improve safety.

1.2.1 Transportation Demand

In the existing condition, the section of SR 535 from US 192 to Kyngs Heath Road operates at a Level of Service (LOS) D with an Annual Average Daily Traffic (AADT) of 28,300; the section from Kyngs Heath Road to Poinciana Boulevard operates at LOS D with an AADT of 26,900; the section from Poinciana Boulevard to Polynesian Isle Boulevard operates at LOS D with an AADT of 46,800; the section from Polynesian Isle Boulevard to World Center Drive operates at LOS D with an AADT of 44,300.

Based on the approved Orange County and Osceola County Comprehensive Plan's future land-uses that are included in the Central Florida Regional Planning Model (CFRPM) version 7.0, in the future year (2045) No-Build condition, the section of SR 535 from US 192 and Kyngs Heath Road is projected to operate at LOS F with an AADT of 42,000; the section from Kyngs Heath Road to Poinciana Boulevard is projected to operate at LOS E with an AADT of 40,000; the section from Poinciana

Boulevard to Polynesian Isle Boulevard is projected to operate at LOS F with an AADT of 69,000; the section from Polynesian Isle Boulevard to World Center Drive is projected to operate at LOS F with an AADT of 66,000.

1.2.2 Safety

A total of 981 crashes were reported on SR 535 from US 192 to Lake Bryan Beach Boulevard in the five-year period from 2014 through 2018. Of those reported crashes, 463 (47%) resulted in injury and four (4) resulted in a fatality. The most frequent crash type was rear end with 605 (62%) total crashes, indicating congestion. Sideswipe crashes were the second highest with 106 (11%), followed by left-turn with 93 (9%) total crashes. Of the 981 crashes, 602 (61%) crashes occurred during daylight conditions. The crash rates along this segment of SR 535 exceed the FDOT statewide averages for similar facilities.

1.3 Project Status

The project is within the jurisdiction of MetroPlan Orlando. The MetroPlan Orlando 2045 Cost Feasible Plan (CFP) includes widening of SR 535 from US 192 in Osceola County to SR 536 in Orange County in years 2031 to 2035 (construction). The SR 535 improvements are funded for design in the Florida Department of Transportation (FDOT) 2024-2029 Five-Year Work Program and MetroPlan Orlando 2024-2029 Five-Year Work Program and MetroPlan Orlando 2023-2028 Transportation Improvement Program (TIP). This project was screened in the Efficient Transportation Decision Making (ETDM) system as ETDM #14325.

1.4 Commitments

FDOT has made a series of commitments and recommendations during this PD&E Study. The following sections summarize the commitments and recommendations that will be adhered to during the future transportation phases.

- The most recent version of the USFWS Standard Protection Measures for the Eastern Indigo Snake will be utilized during construction.
- FDOT will require contractors to remove garbage daily from the construction site or use bear proof containers for securing of food and other debris from the project work area to prevent these items from becoming an attractant for the Florida black bear (*Ursus americanus floridanus*). Any interaction with nuisance bears will be reported to the FWC Wildlife Alert hotline 888-404-FWCC (3922).

1.5 Alternatives Analysis Summary

The following alternatives were evaluated during the study:

- 'No-Build' Alternative
- Construction ('Build') Alternative

The build alternative consists of widening SR 535 from four to six lanes. The study evaluated a range of typical section and intersection alternatives including inside widening and outside widening of the existing roadway. The build alternative analysis included the evaluation of open and closed stormwater drainage conveyance systems together with the evaluation of pond site locations. The study also evaluated Transportation System Management and Operations (TSMO) and multimodal improvements.

1.6 Description of Preferred Alternative

The Preferred Alternative consists of inside widening from four to six lanes with a shared use path along both sides and intersection improvements. The preferred alternative is shown on **Figure 1-2**.

The Preferred Alternative has a design speed of 45-miles per hour (mph) and consists of full reconstruction with the additional lanes constructed towards the median. The typical section consists of three (3) 11-foot travel lanes in each direction separated by a 32-foot to 47-foot median with a 14-foot shared use path on the west side and a 12-foot shared use path on the east side of the roadway. The Preferred Alternative will be constructed within the existing right-of-way width of 200-feet to 224-feet. Swales with ditch bottom inlets in conjunction with flume inlets at the curb line will be provided for drainage conveyance. Stormwater attenuation and floodplain compensation will be provided.

Figure 1-2: Preferred Typical Section



SR 535 roadway improvements would not require extending or reconstructing the existing bridges over SR 535 (one (1) bridge carries Osceola Parkway traffic over SR 535 and two (2) bridges carry SR 417) as all improvements will fit under the existing structures (see **Figure 1-3** and **Figure 1-4**).

Figure 1-3: Osceola Parkway over SR 535

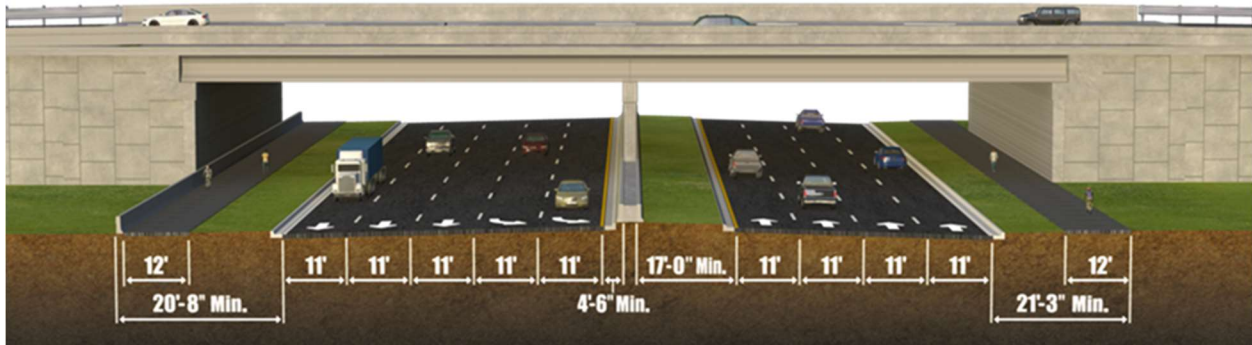
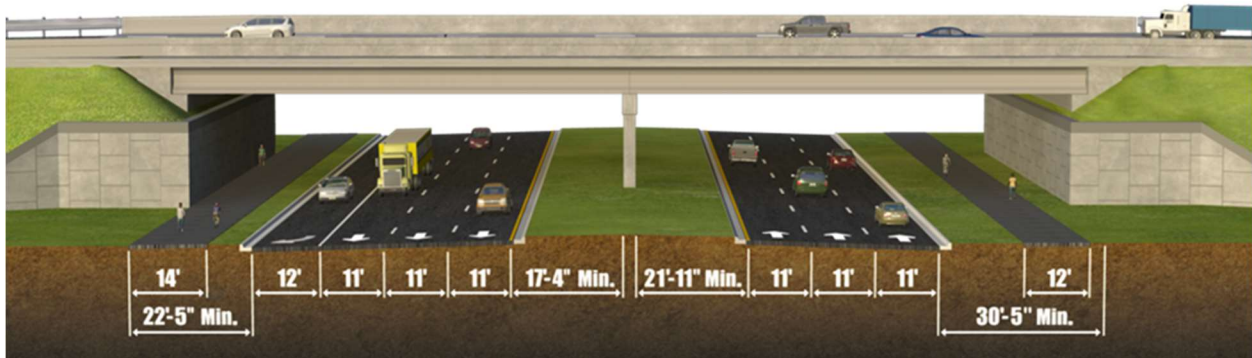


Figure 1-4: SR 417 over SR 535



1.6.1 Intersection Improvements

The Preferred Alternative will also implement intersection improvements including the following innovative intersection concepts.

- Polynesian Isle Boulevard Partial Median U-Turn (PMUT): Implementation of the PMUT involves the removal of northbound and southbound direct left turn movements from SR 535 to Polynesian Isle Boulevard and the addition of signalized U-turns at the existing median openings located just north and south of the intersection along SR 535 to accommodate vehicles wishing to travel east or west on Polynesian Isle Boulevard.
- International Drive Partial Displaced Left Turn (PDLT). Implementation of the PDLT involves the removal of direct eastbound and westbound left turns from International Drive at SR 535 with the displaced left turns installed on both legs International Drive. The northbound and southbound left turn movements for SR 535 continue to take place at the main intersection.
- SR 536 (World Center Drive) Partial Displaced Left Turn (PDLT). Implementation of the PDLT involves the removal and replacement of direct

northbound and southbound left turns from SR 535 at SR 536 with the displaced left turns installed on both legs of SR 535. The eastbound and westbound left turn movements for the SR 536/World Center Drive continue to take place at the main intersection.

1.6.2 Drainage

There are 4 basins in the existing and proposed condition, and all basins drain to permitted stormwater systems in the existing condition (see **Table 1-1**). Where feasible, stormwater management facilities have been recommended within existing FDOT or County right-of-way (R/W). Below is a summary of the preferred pond alternatives (see **Figure 1-5**).

- **Basin 1:** Alternative 1A is the Preferred Alternative for Basin 1. Alternative 1A consists of an existing wet detention pond (identified as Exist. Pond 1-1) within FDOT R/W to provide the required water quality treatment and attenuation volumes.
- **Basin 2:** Alternative 2A is the Preferred Alternative for Basin 2. Alternative 2A consists of 2 ponds, one existing wet detention pond within existing FDOT R/W (identified as Exist. Pond 2-1) interconnected with a second wet detention pond (identified as Pond 2-2) to provide the required water quality treatment and attenuation volumes. Since there is insufficient area within the existing FDOT R/W to provide a stormwater management alternative to meet water quality treatment and attenuation requirements, Pond Alternative 2A will require acquisition of R/W.
- **Basin 3:** Alternative 3A is the Preferred Alternative for Basin 3. Alternative 3A consists of 2 ponds, one existing wet detention pond within existing FDOT R/W (identified as Exist. Pond 3-1) interconnected with a second wet detention pond (identified as Pond 3-2) to provide the required water quality treatment and attenuation volumes. Since there is insufficient area within the existing FDOT R/W to provide a stormwater management alternative to meet water quality treatment and attenuation requirements, Pond Alternative 3A will require acquisition of R/W.
- **Basin 4:** Alternative 4A is the Preferred Alternative for Basin 4. Alternative 4A consists of an existing wet detention pond (identified as Exist. Pond 4-1) within existing R/W and easement to provide the required water quality treatment and attenuation volumes.

Table 1-1: Preferred Pond Alternatives

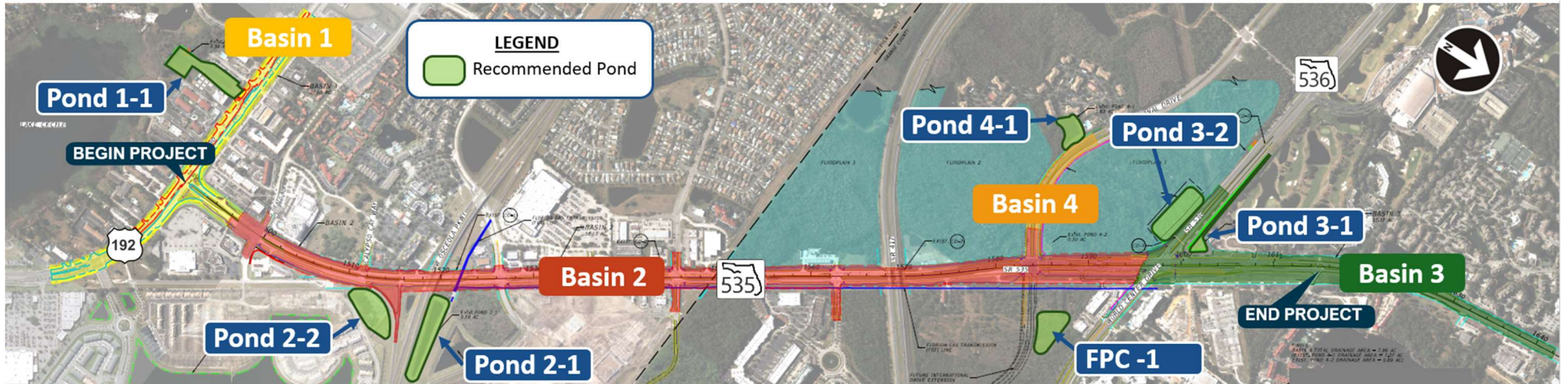
Basin	Preferred Alternative	Ponds	Type	R/W Req'd.	Remarks
1	1A	Exist. Pond 1-1	Wet	0.0	Exist. pond sufficient. Reduced drainage area (30.94 ac to 29.16 ac) from exist. to proposed conditions. Increased freeboard in exist. pond. Pond within exist. R/W
2	2A	Exist. Pond 2-1 and Pond 2-2	Wet	3.0	Interconnected ponds to provide required water quality treatment and attenuation. Utilize Exist. Pond 2-1 outfall to Shingle Creek. Exist. Pond 2-1 within exist. R/W. Estimated R/W needs for Pond 2-2 provided (excluding public R/W used for pond).
3	3A	Exist. Pond 3-1 and Pond 3-2	Wet	3.5	Interconnected ponds to provide required water quality treatment and attenuation. Utilize Exist. Pond 3-1 and Pond 3-2 outfalls to Shingle Creek. Exist. Pond 3-1 within exist. R/W. Estimated R/W needs for Pond 3-2 provided (excluding public R/W used for pond).
4	4A	Exist. Pond 4-1	Wet	0.0	Exist. pond sufficient. Reduced drainage area (8.70 ac to 7.63 ac) from exist. to proposed conditions. Increased freeboard in exist. pond. Pond within exist. R/W

An analysis of floodplain impacts and floodplain compensation (FPC) alternatives was performed. Project improvements will impact the 100-year floodplain as a result of longitudinal impacts and transverse impacts. The preferred FPC alternative and anticipated right of way needs associated with the preferred alternative are provided in Table 1-2.

Table 1-2: Preferred FPC Site

Name	Floodplain Impacts (ac-ft)	Floodplain compensation Volume Provided (ac-ft)	Estimated Pond R/W Req'd. (including access) (ac)
FPC-1	8.89	14.45	4.3

Figure 1-5: Preferred Alternative Ponds



1.6.3 Right of Way and Construction Cost

SR 535 has an existing right-of-way of 224 feet which is ample right-of-way to accommodate the Preferred Alternative. Some right-of-way impacts will be required to accommodate intersection improvements at the International Drive and World Center Drive (SR 536) intersections and for offsite ponds. Approximately 11.5 acres of right-of-way impacts (excluding public R/W required) are anticipated as a result of the preferred alternative. Approximately 0.7 acres are associated with improvements at the SR 535/International Drive and SR 535/World Center Drive (SR 536) intersections. Additionally, approximately 10.8 acres are associated with the required stormwater and floodplain compensation ponds (excluding public R/W required). A total of 8 parcels are anticipated to be impacted from the preferred alternative. See **Table 1-3** for cost estimate.

Table 1-3: Cost Estimate

	Cost
Construction	\$76.5M
R/W	\$38.1M
Utility Relocation	\$7.0M
Sub Total	\$121.6M
Design (15%)	\$11.5M
CEI (10%)	\$7.7M
Total Estimated Project Cost	\$140.8M

2.0 Data Collection

In order to locate the existing stormwater facilities, determine existing drainage patterns within the limits of the corridor, potential site availability, and design criteria and requirements, the following sources were used:

- FDOT Drainage Manual, 2024
- FDOT Drainage Design Guide, 2024
- SFWMD Environmental Resource Permit Applicant's Handbook, Volumes I (2020) and II (2016)
- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, Panel Nos. 12095C0605F, 12097C0055G, 12095C0585F
- Osceola and Orange County Property Appraiser Websites
- SFWMD Environmental Permit Research
- USDA Natural Resources Conservation Service (NRCS) Web Soil Survey
- NOAA LiDAR Data
- FDOT Aerial Maps
- USGS Topographic Map Quadrangles
- FDOT Straight Line Diagrams
- Geotechnical Investigations

3.0 Existing Conditions

3.1 Topography

SR 535 within the project limits is located within the Shingle Creek basin (WBID 3169A) and Lake Okeechobee Basin Management Action Plan (BMAP), and within the regulatory jurisdiction of the South Florida Water Management District (SFWMD). It should be noted that north of SR 417 SR 535 is located on the divide between WBID 3169A and WBID 3169B (Reedy Creek Basin), and the historical discharge from SR 535 is to WBID 3169A. The topography along the project corridor generally slopes from north to south, with elevations ranging from 101 feet NAVD at the SR 535/SR 536 intersection to 87 feet NAVD at the SR 535/SR 530 intersection). The existing project basin limits and existing permitted stormwater ponds are shown in **Table 3-1**.

Table 3-1: Summary of Existing Project Basins

Basin	Road	From	To	Outfall
1	SR 535	1490+00	1499+31	Exist. Pond 1-1
2	SR 535	1499+31	1595+75	Exist. Pond 2-1
3	SR 535	1595+75	1642+20	Exist. Pond 3-1 & Exist. Pond 3-2
4	International Dr	West of SR 535	End Construction	Exist. Pond 4-1 & Exist. Pond 4-2

3.2 Soils and Geotechnical Investigations

Based on the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey, soils in the area are predominantly fine sands with a groundwater depth of approximately 1 foot below the ground surface. The soils encountered along the project limits are mostly hydrologic soil group (HSG) A/D and B/D soils. For dual classification soils, the first letter represents the drained condition, and the second letter represents the undrained condition. A summary of the soil types found in the vicinity of the project is provided in **Appendix D**.

The hydrologic soil groups are defined as follows:

- Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Please see **Appendix D** for NRCS Soil Survey information as well as preliminary geotechnical investigation at potential floodplain compensation site locations.

3.3 Contamination Screening

A total of 19 sites of potential contamination risk were identified along the project corridor in the Draft Contamination Screening Evaluation (CSER) Report for this PD&E Study. The 19 sites included 2 high-risk sites, 8 medium-risk sites and 9 low-risk sites. No sites are located at potential floodplain compensation site alternatives identified in **Section 6.0** of this report. Please see exhibits of potential contamination sites from the CSER in **Appendix A**.

3.4 Environmental Characteristics

3.4.1 Land Use Data

The project corridor is a mixture of residential, commercial, upland and wetland forest and wetlands. In general, the SR 535 corridor is heavily developed within the Osceola County limits, while there are more undeveloped areas on both sides of SR 535 within the Orange County limits. The widening of SR 535 does not alter the existing or future land uses in the area. Please see the Land Use Maps in **Appendix A**.

3.4.2 Cultural Features

Cultural features preserve and enhance the cultural nature of a community and include parks, schools, churches and other religious institutions. Also included are historic sites, archaeologically significant sites and resources, and potential historic districts. Based on a review of the project corridor, there are no sites within the Area of Probable Effect (APE) eligible for the National Register of Historic Places (NRHP) and no archeological sites within the APE.

3.4.3 Natural and Biological Features

The proposed project has potential to involve several State and/or Federally listed protected wildlife species. The project corridor was evaluated for the presence of potentially occurring species. These species and their anticipated involvement are identified in the Natural Resources Evaluation Report (NRE). The preferred alternative has “no effect”, “no effect anticipated”, “not likely to affect”, or “no adverse effect anticipated” on listed or protected species.

The potential presence of wetlands and other surface waters (OSW) were identified on the west side of SR 535 in Orange County through a desktop review of the FDOT Environmental Screening Tool (EST). In addition, Orange County and SFWMD conservation easements have also been identified in this area. Please see Appendix A for an exhibit showing the location of wetlands and conservation easements in relation to the project limits.

3.5 Cross Drains

Five cross drains have been identified under SR 535 and SR 536 within the project limits. A summary of the cross drain locations is provided in **Table 3-2**.

Table 3-2: Cross Drain Summary

Cross Drain	Road	Station	Location (Milepost)	Basin	Cross Drain Size and Type
CD-1	SR 535	1521+30	0.600	2	2-30" RCP
CD-2	SR 535	1544+00	1.037	2	2-24" RCP
CD-3	SR 535	1570+00	0.382	2 (offsite)	1-24" RCP
CD-4	SR 536	1599+00 LT	1.694	3	1-3'x8' CBC
CD-5	SR 536	1609+50 LT	1.920	3	1-36" RCP

- Cross drain CD-1 conveys runoff from the west side of SR 535 in Basin 2 to Exist. Pond 2-1
- Cross drain CD-2 conveys runoff from the west side of SR 535 to the east side of SR 535 in Basin 2. Runoff is conveyed by roadside ditch to Exist. Pond 2-1.
- Cross drain CD-3 conveys offsite runoff from the west side of SR 535 (Floodplain 2) on the north side of SR 417 to an existing ditch which runs east to Shingle Creek.
- Cross drain CD-4 is an equalizer pipe under SR 536 that interconnects Exist. Pond 3-1 and Exist. Pond 3-2.
- Cross drain CD-5 conveys runoff from the north side of SR 536 to the south side of SR 536 west of SR 535 (Floodplain 1).

3.6 Floodplains and Floodways

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRMs) for the study area. The relevant FIRM panel numbers are 12095C0605F and 12095C0585F for Orange County, Florida dated September 25, 2009, and 12097C0055G for Osceola County, Florida dated June 18, 2013.

Based on the information contained within the FIRMs, there are no floodplains in the vicinity of the project within the Osceola County limits. There is a floodplain located on the west side of SR 535 between the Osceola/Orange County line and SR 536 within the Orange County limits, which is designated as Zone A (no base flood elevations determined).

The floodplain through this area is traversed by International Drive and SR 417, which creates 3 distinct sections (identified as Floodplain 1, 2 and 3), although the floodplain sections are hydraulically connected. There are no floodways located within the limits of the project. Please see **Appendix A** for exhibits showing the floodplain limits in the vicinity of the project, as well as the FEMA FIRMs.

In order to approximate a value for the BFEs to utilize in the floodplain impact calculations, the floodplain shapes were superimposed on contours generated from LiDAR data. The BFEs associated with each impact location have been identified in **Table 3-3**. This floodplain limit corresponds to approximately Sta. 1550+00 to 1597+00, Lt. along the SR 535 baseline.

There are no regulatory floodways within the project limits.

Table 3-3: Floodplain Limits and Approximate Base Flood Elevations

Floodplain ID	Location	SR 535 Station Range	Estimated Base Flood Elevation (ft)
1	Between International Drive and SR 536	1582+00 to 1597+00	95
2	Between SR 417 and International Drive	1569+00 to 1582+00	91
3	Between Osceola/Orange County line and SR 417	1550+00 to 1569+00	89.5

4.0 Proposed Conditions

The preferred typical section for SR 535 is a 6-lane divided urban roadway with shared use paths on both sides of the roadway. A combination of closed storm drain system and shallow roadside ditches located between the proposed curb and gutter and shared use paths are proposed on both sides of the roadway as shown in **Figure 1-2**. In general, basin limits and discharge points in the proposed condition will remain the same as the existing condition. The proposed project basin limits and outfalls are shown in **Table 4-1**.

Table 4-1: Summary of Proposed Project Basins

Basin	Road	From	To	Outfall (Preferred Pond Alternative)
1	SR 535	1490+00	1496+07	Exist. Pond 1-1
2	SR 535	1496+07	1595+75	Exist. Pond 2-1 & prop. pond
3	SR 535	1595+75	1642+20	Exist. Pond 3-1 & prop. pond
4	International Dr	West of SR 535	End Construction	Exist. Pond 4-1

4.1 Cross Drains

It is anticipated that cross drain improvements will consist of minor extensions or hydraulic replacements in kind to accommodate the proposed improvements. Several cross drains that convey runoff within on-site areas (e.g., CD-2 and CD-5) may be removed or plugged and filled if no longer needed for use in the proposed drainage system.

Modifications to cross drains will consist of minor extensions or replacement with hydraulically equivalent structures. Since the proposed structures will be hydraulically equivalent to or greater than the existing structures, backwater elevations are not expected to increase. As a result, the project will not adversely impact properties upstream of these cross drains.

4.2 Bridge Structures

There are no bridge structures over waterways within the project limits.

4.3 Floodplain Impacts and Mitigation

This project will impact the 100-year floodplain in 2 different ways:

- Longitudinal roadway impacts resulting from filling the floodplain areas. Project improvements will impact the 100-year floodplain as a result of longitudinal impacts as SR 535 does not bisect the floodplain but is instead on the upstream fringe of the mapped floodplain. Impacts to the floodplain were conservatively estimated based on the existing profile and the potential impacts of the road widening within the project limits. In addition to the impacts that result from the road widening, the Pond 3-2 maintenance berm will also encroach into the 100-year floodplain. Impacts from Pond 3-2 (part of the preferred Alternative 3A for Basin 3 in the Pond Siting Report) were conservatively estimated at the pond berm.
- Transverse impacts resulting from the extension or replacement of the existing cross drain culverts

The longitudinal impacts from the roadway improvements cannot be avoided as the project involves the widening of an existing roadway with site constraints (FGT line) to the east of SR 535. Minimization of impacts is accomplished by utilizing an urban typical section with widening to the inside as the preferred typical section. During the design phase, opportunities to minimize these impacts by optimizing the grading for ditches and proposed side slopes, or whether Pond 3-2 (which is an expansion of Exist. Pond 3-2) is able to provide any floodplain compensation, should be investigated. A summary of the estimated floodplain impacts is provided in **Table 4-2**, and calculations detailing the floodplain impacts within the project limits are provided in **Appendix B**.

Table 4-2: Base Flood Elevations and Floodplain Impacts

Floodplain ID	Station Range	Base Flood Elevation	Floodplain Impacts (ac-ft)
1	1582+00 to 1600+00	95	4.82*
2	1569+00 to 1582+00	91	1.78
3	1550+00 to 1569+00	89.5	2.29
Total			8.89

*the impacts for floodplain area 1 include the impacts associated with Pond 3-2

Since the three impact locations are hydraulically connected and within close proximity of each other, it was determined that the impacts from the three locations could be combined for developing compensation options. Five floodplain compensation (FPC) site alternatives have been developed and are included as part of this analysis. Equivalent

storage was checked to ensure impacts at the lower elevations could be accommodated at each floodplain compensation site. Pond liners have been assumed at FPC sites 1, 2, and 3 in order to provide compensation at equivalent elevations for those impacts at the lower end of the spectrum. Once more detailed information is obtained during the design phase it is anticipated that additional storage can be provided within the right of way at these lower elevations and the need for liners will either be reduced or eliminated. Since land adjacent to the floodplain in the vicinity of the project is limited due to the extent of floodplain and the conservation easements, four of the five FPC sites will be hydraulically connected to the floodplain utilizing storm drain piping. As discussed with SFWMD at the pre-application meeting, the average wet season water table was used to determine the vertical extents of the floodplain compensation available at each FPC site. The location of the five FPC sites are shown on the Pond Alternatives Drainage Map included in **Appendix A** and the compensation provided at each location is summarized in **Table 4-3** below. Detailed calculations for each floodplain compensation site are provided in **Appendix B**.

Table 4-3: Floodplain Compensation Site Alternatives

FPC Site	Station	Offset	Floodplain Compensation Provided (ac-ft)
1	1586+00	Rt	14.45
2	1581+00	Rt	19.74
3	1575+00	Rt	19.74
4	1572+00	Lt	10.08
5	1566+00	Rt	12.75

All FPC sites analyzed will provide the requisite storage to offset floodplain impacts. As part of this analysis a comparison matrix was developed to determine which location would be the preferred alternative. Based on this preliminary analysis, FPC Site 1 is the recommended alternative.

The evaluation matrix which outlines all of the variables included in the analysis has been provided in **Appendix C**.

4.4 Project Classification

The floodplain is located in a low density, urbanized area, and the encroachments are classified as "minimal". Minimal encroachments on a floodplain occur when there is a floodplain involvement but the impacts on human life, transportation facilities, and natural and beneficial floodplain values are not significant and can be resolved with minimal efforts. Normally, these minimal efforts to address the impacts will consist of applying the

Department's drainage design standards and following the Water Management District's procedures to achieve the results that will not increase or significantly change the flood elevations and/or limits.

4.5 Risk Evaluation

There is no change in flood "risk" associated with this project. The encroachments will not have a significant potential for interruption or termination of transportation facilities needed for emergency vehicles or used as an evacuation route. In addition, no significant adverse impacts on natural and beneficial floodplain values are anticipated and no significant impacts to highway users are expected.

4.6 Coordination with Local Agencies

Coordination with local agencies has occurred throughout the life of the study. The public involvement effort for this phase of the project included 4 Community Advisory Group (CAG) meetings as well as multiple meetings with representatives from Osceola and Orange Counties. All input received served as valuable information that was taken into consideration for the refinement of the alternatives and the development of the preferred alternative.

4.7 PD&E Manual Requirements for Projects with Minimal Encroachments

Part 2, Chapter 13 of the FDOT's PD&E Manual defines four categories of encroachments as they pertain to base floodplain involvement: no involvement, no encroachment, minimal encroachment and significant encroachment. The PD&E manual also lists the report criteria corresponding to these encroachment categories. The FDOT has different requirements based on the category of the encroachment. This SR 535 project is determined to have minimal encroachments, and as a result the requirements for this category are listed as follows:

1. Determination of whether the proposed action is within the base floodplain.
The proposed project is within the base floodplain.
2. The history of flooding of the existing facilities and/or measures to minimize any impacts due to the proposed project improvements.

According to FDOT District 5 Maintenance staff, there are no areas of flooding concern along SR 535 within the project limits. Compensating areas will be constructed to mitigate loss of storage in the floodplain due to the project improvements. The project will have no adverse impact on the existing condition.

3. Determination of whether the encroachment is longitudinal or transverse, and if it is a longitudinal encroachment an evaluation and discussion of practicable avoidance alternatives.

With the increase in the number of travel lanes and multimodal improvements proposed, there will be longitudinal and transverse impacts to the floodplain. There will also be isolated longitudinal impacts due to a stormwater pond berm. Longitudinal impacts will be minimized by widening the roadway towards the median and utilizing the maximum allowable roadway embankment slope. The transverse floodplain impacts from the project occur due to the minor extension or replacement of the existing cross drains. These impacts are not analyzed during this study and will need to be addressed during the design phase. The existing roadway is adjacent to the floodplain. Due to site constraints, there are no economically feasible avoidance alternatives.

4. The practicability of avoidance alternatives and/or measures to minimize impacts.

This project will make every effort to minimize the floodplain impacts resulting from the placement of fill. The maximum allowable roadway embankment slope will be used within the floodplain area to minimize the floodplain impacts, and floodplain compensation will be utilized in the stormwater ponds and roadside ditches.

5. Impact of the proposed improvements on emergency services and evacuation.

The cross drains will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase. Compensating areas will be constructed to mitigate loss of storage in the floodplain due to the project improvements. As a result, there will be no significant change in flood risk, and there will not be a significant change in the potential for interruption or termination of emergency service or in emergency evacuation routes.

6. Impacts of the proposed improvement on the base flood, likelihood of flood risk, overtopping, location of overtopping, backwater, etc.

The proposed cross drains will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase. Compensating areas will be constructed to mitigate loss of storage in the floodplain due to the project improvements. As a result, there will be no significant change in flood risk or overtopping.

7. Determination of the impact of the proposed improvements on regulatory floodways, if any, and documentation of coordination with FEMA and local agencies to determine the project's consistency with the regulatory floodway.

There is no involvement with regulatory floodways within the project limits.

8. The impacts on natural and beneficial floodplain values, and measures to restore and preserve these values (this information may also be addressed as part of the wetland impact evaluation and recommendations).

No impacts to natural and beneficial floodplain values are anticipated. Longitudinal floodplain impacts are limited to the upstream fringe of the mapped floodplain, and compensating areas will be constructed to mitigate loss of storage in the floodplain due to the project improvements. The proposed cross drains will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase.

9. Consistency of the proposed improvements with the local floodplain development plan or the land use elements in the Comprehensive Plan, and the potential impacts of encouraging development within the 100-year base floodplain.

The project will remain consistent with local floodplain development plans. The project will not support base floodplain development that is incompatible with existing floodplain management programs.

10. A map showing project, location and impacted floodplains. Provide copies of all applicable FIRM maps should be included within the final LHR report appendix.

See Appendix A for exhibits.

11. Results of any and all project risk assessments performed.

The proposed cross drains will perform hydraulically in a manner equal to or greater than the existing condition, and backwater surface elevations are not expected to increase. As a result, there will be no significant change in flood risk.

5.0 Conclusions

The modifications to drainage structures included in the project will result in an insignificant change in their capacity to carry stormwater. This change will cause minimal increases in flood heights and flood limits. Replacement drainage structures for this project are limited to hydraulically equivalent structures. The limitations to the hydraulic equivalency being proposed are basically due to restrictions imposed by the geometrics of design, existing development, cost feasibility, or practicability. An alternative encroachment location is not considered in this category since it defeats the project purpose or is economically unfeasible.

The proposed cross drains will be hydraulically equivalent to or greater than the existing condition, and backwater surface elevations are not expected to increase. Equivalent volumetric compensation will be provided for all locations where fill will be placed within the floodplain. As a result, the project will not affect existing flood heights or floodplain limits. This project will not result in any new or increased adverse environmental impacts. There will be no significant change in the potential for interruption or termination or emergency service or emergency evacuation routes. Therefore, it has been determined that this encroachment is not significant.