POND SITING REPORT

Florida Department of Transportation
District Five

S.R. 401 Bridge Replacement PD&E Study
Brevard County, Florida

Financial Project Identification (FPID) Number: 444787-1-22-01
ETDM Number: 14397

July 2022

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried out by FDOT pursuant to 23 U.S.C. & 327 and Memorandum of Understanding dated 12/14/2016 and executed by Federal Highway Administration and FDOT.

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EXECUTIVE SUMMARY

This Pond Siting Report is part of the Preliminary Engineering Report for the Project Development and Environmental (PD&E) Study for the SR 401 (Cape Road) Bridge Replacement from SR 528 (A1A) interchange to Port Canaveral in Brevard County, Florida. See ***Exhibit 1*** in ***Appendix A*** for a location map.

The three bascule bridges span the Barge Canal and connect Port Canaveral to SR 528. On the northbound bridge three 12-foot-wide lanes are provided with limited shoulders. The center southbound bridge provides two, 12-foot-wide lanes with limited shoulders. There is a second southbound bridge with a single 18-foot-wide lane along with a 8'-7" inside shoulder. The preferred alternative includes a high-level fixed bridge with three 12-foot-wide lanes and 10-foot-wide shoulders in each direction. Typical sections of the existing and proposed bridges are in ***Appendix B***.

Identified in this report are the existing drainage systems within the proposed project limits, available stormwater management facility options that comply with FDOT and environmental permitting criteria, and the pond site selected. Located in Brevard County, Florida, the environmental permitting agencies include the St. John's River Water Management District (SJRWMD) and United States Army Corps of Engineers (USACE).

For the north basin, linear dry detention or dry retention swales are recommended depending on the seasonal high-water elevations determined by ongoing Geotech analysis. For the south basin, infield wet detention ponds 12A and 12B are recommended to be modified after installation under the SR 528 project. The major receiving water bodies for these systems include the Barge Canal and the Banana Lagoon River (BLR) located south and north of S.R. 528.

TABLE 1

POND SITING MATRIX

Basin	North	North	North	South
Pond Alt.	1	2	3	1
Pond Site Area (ac)	Linear swales	Linear swales	3.34	2.42
Pond Type	Dry Detention or Retention	Dry Detention or Retention	Privately Owned Wet Detention Pond Modification	Wet Detention
Right-of-Way Needs	Uses existing roadway R/W	Uses existing roadway R/W	Requires easement from Port	Uses existing roadway R/W
Satisfies Hydraulic Requirements	Yes	Yes	Yes	Yes
Wetland Impacts	Low	Low	Low	Low
Airport Proximity	>5 miles	>5 miles	>5 miles	>5 miles
Species Impact	Low	Low	Low	N/A
Contamination Impact	Low	Low	Low	Low
Cultural Impact	Low	Low	Low	Low
Utility Impact	Low	Low	Low	Low
Proximity to Outfall	Excellent	Good	Excellent	Excellent
Ranking	1	2	3	1

1. INTRODUCTION

A Project Development and Environment (PD&E) study is being conducted in accordance with the Florida Department of Transportation requirements for the SR 401 bascule bridges at Port Canaveral, in Brevard County. The purpose of this report is to document the evaluation of pond site alternatives for the proposed improvements.

2. PROJECT DESCRIPTION

The Florida Department of Transportation (FDOT), District Five, is conducting a Project Development and Environment (PD&E) study to evaluate replacement alternatives for the three existing bascule bridges with either a new medium-level movable bridge or a new high-level fixed span bridge over the Canaveral Barge Canal, in Brevard County, Florida ***Exhibit* 1** in ***Appendix A*** shows the project location map.

The S.R. 401 bridges over the Canaveral Barge Canal provide a vital connection to Port Canaveral's operations including major cruise and cargo terminals. The bridges also serve as the primary access to Cape Canaveral Air Force Station, Naval Ordinance Test Unit, facilities for the U.S. Coast Guard, and access to Space Florida operations.

The existing 354-foot single-leaf bascule bridges consists of three separate structures accommodating southbound and northbound traffic with three travel lanes in each direction:

- Bridge No. 700030 (southbound), constructed in 1963
- Bridge No. 700031 (southbound), constructed in 1963
- Bridge No. 7000117 (northbound), constructed in 1972

Based on bridge inspections conducted in September 2019, the existing S.R. 401 bridges have been classified as functionally obsolete. Bridge improvements will provide additional capacity to address future traffic growth resulting from strategic expansion plans for Port Canaveral and military stakeholders in the immediate area. The PD&E study will assess navigational needs from the surrounding community to assist in determining the appropriate replacement structure for the bridge.

3. SITE INFORMATION

3.1 Topography

The existing ground is primarily level beyond the bridge approaches and sloping to a high point on the bridge.

3.2 Land Use Description

North of the bridges, the project area to the east is bordered by Port Canaveral facilities, Charles M. Rowland Drive and parking lots. To the west the project is bordered by the shoreline revetment, and an existing pond.

South of the bridges, the project area to the east is bordered by Mullet Road and marina facilities. To the west the project is bordered by Mullet Road and marsh land.

4. EXISTING DRAINAGE CHARACTERISTICS

4.1 Existing Drainage Basins

The bridges' midspans drain through grated decks directly into the Barge Canal. The southernmost two spans and approaches of bridges 700117 and 700030 drain to storm sewer inlets that discharge to the SR 528 ramp infield ponds. The southernmost two spans of Bridge 700031 drain down the slope pavement directly into the Barge Canal. The northernmost two spans of Bridge 700031 drain down the slope pavement directly into the Barge Canal.

The SR 401 roadways south of the bridges drain to the SR 528 ramp infield ponds. These infield ponds are connected to an existing mitigation pond in the loop ramp located in the southeast quadrant of the SR 528/SR 401 interchange. This pond connects to a smaller mitigation pond between the on-ramp and off-ramp which discharges to surface waters contiguous to the Banana River Lagoon (BRL). The mitigation areas provide no stormwater treatment but serve to reduce freshwater discharges to the BRL.

The SR 401 roadways north of the bridges drain in the following manner. A small portion of the southbound lanes drain directly down the side slope to the barge canal or to the Port Canaveral West Pond. Further north a shoulder gutter system collects runoff and delivers flow to the Port Canaveral interconnected pond system. This system consists of three ponds known as the West Pond, North Pond and South Pond. The West Pond is located west of SR 401 and the others are located east of SR 401. They share a common weir elevation of 7.0 feet and treat the first flush of runoff. The other bridges and approaches drain north to storm sewer systems which deliver flow to a roadside ditch on the eastside of SR 401 which drains southward to the Barge Canal. A minor amount of runoff from the SR 401 embankments sheet flows directly into the BRL.

4.2 Receiving Waterbody

The primary receiving water bodies are the Barge Canal, the BRL located south of S.R. 528 and the BRL located north of S.R. 528. The Barge Canal, which includes the Turning Basins, has a direct connection to the Atlantic Ocean. The BRL south of S.R. 528 is an Aquatic Preserve and an Outstanding Florida Water (OFW) and has waterbody identification number (WBID) 3057B. The BRL north of barge canal and S.R. 528 causeway has WBID 3057C. The BRL waters are impaired for nutrients (P and N) with seagrass as a parameter of concern. The BRL is a "negative estuary", characterized by low freshwater inflows and poor flushing resulting in long water residence time.

4.3 FEMA Floodplain

The Barge Canal has a 100-yr flood elevation of 7 to 9 feet. In the Banana River the 100-yr flood elevation of 3 feet. **See *Exhibit 4*** in ***Appendix A.***

4.4 Sea Level Rise

Anticipated storm management facilities are recommended to be designed for existing tailwater conditions. Although sea level rise in assessed to determine the vulnerability of flooding over the design life of a project, the stormwater management facilities are recommended to be designed according to current tailwater conditions to ensure proper functionality. However, stormwater management facilities are recommended to be modified in the future as needed to address evident sea level rise. This approach results in a better functioning system until sea level rise occurs.

4.5 Existing Permits

Existing permits will need to be modified in areas where improvements are proposed. The following is a list of existing FDEP permits in the project area:

- **Permit No. 88466-1 New Barge Canal Bridges Rehabilitation**

  This permit was issued in 2003 for the FDOT District 5 to make improvements to the existing bridges. Temporary pavement used to shift traffic during construction was left in place for future use to aid maintenance. Stormwater treatment of the new pavement is provided through infiltration in the basins of the infield areas located south of the bridges. This permit may require a modification for the preferred alternative.

- **Permit No. 186093-5 Canaveral Port Authority West Pond**

  A wet detention pond was permitted to allow modifications to the existing ponds. This system consists of three ponds known as the West Pond, North Pond and South Pond. The West Pond is located west of S.R. 401 and the others are located east of S.R. 401. They share a common weir elevation of 7.0 feet and treat the first flush of runoff. It is likely this pond could be modified to satisfy treatment requirements for the project if cooperation can be garnered from the Port.

- **Permit No. 23918-1 Canaveral Port Authority**

  Located on northeast side of project area at Charles M Rowland Dr. this permit was issued in 1992 and was to add a new 4-lane roadway alignment and removal of an existing 4-lane roadway. Permit is within the project area and may require a modification depending on proposed improvements.

- **Permit No. 23919-1 WTB Navigation Relief, Grouper Road Realignment**

  Located on the south side of the bridges including the interchange with S.R. 528. This permit was issued in 1992 and was to add a new 4-lane roadway alignment and removal of an existing 4-lane roadway. Stormwater treatment is provided by use of retention in roadway ditches utilizing ditch blocks. Permit is most likely outside the project area.

- **Permit No. 16070-4 West Turning Basin Improvement Modification**

  Located to east of bridges and S.R. 401 and most likely outside of project area.

- **Permit No. 16328-1 Port Canaveral Master Drainage Plan**

  A master drainage plan was issued in 1988 for development of drainage systems throughout the port area. Most of the system has been implemented or revised.

  Additionally, a US Army Corp of Engineers (USACE) permit will be required for dredge and fill activity in wetlands or surface waters. The BRL is retained by the USACE for permitting.

5. DRAINAGE DESIGN CRITERIA

The preliminary design of the proposed stormwater pond alternatives is provided with the intention of satisfying the project design criteria in accordance with the following documents:

- FDOT Drainage Manual (January 2022)
- FDOT Drainage Design Guide (January 2022)

5.1 FDOT Criteria

Pavement Hydraulics / Bridge Deck Drainage

- Keep 8 ft of the lane clear for design speed less than or equal to 55 MPH and greater than 45 MPH.
- Spread resulting from 10-year storm will not exceed one foot, three inches outside the gutter in the direction toward the front slope.
- Standard scuppers are 4 inches in diameter and spaced on 10-foot centers, unless spread calculations indicate closer spacing is required.

Stormwater Management

- Minimum 20 feet of horizontal clearance between top edge of the control elevation and the right-of-way line. Minimum 15 feet berm at a slope of 1:8 or flatter.
- At least one foot of freeboard between the maximum design stage of the pond and the inside top of berm. For linear treatment swales, the minimum freeboard is 0.5 foot.
- Half the retention volume must recover in 7 days, with the total volume available in 30 days.
- Treatment of existing untreated areas that discharge to the same receiving water body may be substituted in lieu of treating the project area where it cannot be feasibly achieved.
- Minimum permanent pool depth is six feet for wet detention ponds.

Stormwater Treatment

- Off-line retention of the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater.
- On-line retention of an additional one-half inch of runoff from the drainage area over that volume specified for off-line treatment.
- On-line retention that provides for percolation of the runoff from the three year, one-hour storm.
- System should be designed to provide for the drawdown of the appropriate treatment volume within 72 hours.
- The retention system must provide the capacity for the appropriate treatment volume of stormwater within 72 hours following a storm event.
- Off-line detention of the first one inch of runoff or 2.5 inches of runoff from the impervious area, whichever is greater. The outfall structure shall be designed to drawdown one-half the required treatment volume specified above between 24 and 30 hours following a storm event.

6. PROPOSED STORMWATER ALTERNATIVES

6.1 Stormwater Quantity

All roadway alternatives utilize the same stormwater quantity approach. For basins with discharge that is directly connected to the Atlantic Ocean, peak discharge requirements will not be required. Discharges to the BRL will be required to meet peak requirements for the mean annual storm to reduce freshwater flows. The 25-year storm will likely not be required to meet pre-post requirements because of the tidal conditions.

The existing pavement on the south basin is currently attenuated in the SR 528 ramp infield ponds. An FDOT SR 528 improvement project (FPID No. 407402-4) is under design and permitting that will modify the existing stormwater ponds at the SR 401 interchange. The proposed improvements include converting the infield dry ponds into wet detention ponds and utilizing the existing pipe connection under SR 528 to connect to the existing mitigation pond system in the southeast quadrant. The stormwater ponds could be modified as necessary to satisfy the preferred alternative.

For the north basin, additional attenuation is not needed for those areas that drain to the Barge Canal which is directly connected to the Atlantic Ocean.

6.2 Stormwater Quality

All roadway alternatives utilize the same stormwater quality approach and include additional impervious areas that will require nutrient removal and water quality treatment per SJRWMD criteria. See Appendix D for Stormwater Treatment Calculations and SJRWMD requirements.

Reconstructed pavement or new pavement area will require stormwater treatment although milled and resurfaced areas will not.

6.3 North Basin

6.3.1 Alternative 1:

Alternative 1 includes the use of roadside linear dry detention or dry retention swales. The advantage of this alternative is the swale system would be contained within the proposed project limits and existing right-of-way. Ditch blocks placed in the swale will provide the treatment volume. The swale system will maintain the existing outfall at the Barge Canal. There are no anticipated wetland or environmental impacts. This the preferred alternative.

6.3.2 Alternative 2:

Similarly, Alternative 2 consists of roadside linear dry detention or dry retention swales located uphill of the proposed work area. The linear treatment system starts near the outfall point near the barge canal on the east side of SR 401 and continues north along the project limits with the length dictated by the treatment needed as seen on the proposed Drainage Maps in ***Appendix C***. Treatment compensation of existing pavement would be utilized to satisfy requirements. The treatment system would be at the high end of the basin leading to better percolation. Geotechnical investigations will need to confirm the suitability of this approach. An advantage of positioning the treatment system at the high end of the basin is that flow accumulation is less for on-line systems leading to lower discharge rates over the ditch block weirs. A stormwater bypass system may be needed to carry upstream ditch flow around the linear treatment system. With this alternative, there are no anticipated wetland or environmental impacts.

6.3.3 Alternative 3:

Alternative 3 is to expand the existing pond known as West Pond. The pond is owned by the Port and appears to have additional treatment capacity. The existing weir is set at an elevation of 7 feet. The control structure has a 36” pipe that outfalls to the Barge Canal. Although the West Pond is owned by the Port and appears to have additional treatment capacity, it is not recommended to modify this pond as the Port may need it for future improvements. Coordination with the Port is necessary if this alternative is advanced.

6.4 South Basin

6.4.1 Alternative 1:

Alternative 1, is to modify the wet detention ponds to be install with the SR 528 project (FPID No. 407402-4). The proposed improvements in that project include converting the infield dry ponds at the SR 401 interchange into wet detention ponds. Existing pipe connection under SR 528 will connect the infield ponds to the existing mitigation pond system in the southeast quadrant. The stormwater pond control structure and pond side slopes would be modified as necessary to satisfy treatment and attenuation rules. In the case of needing to modify the

control structure, the weir would be raised to increase treatment volumes to compensate for the additional impervious added due to the project. No other alternatives are provided for this basin.

7. RECOMMENDATIONS

For the north basin, impervious areas from the southbound lanes are recommended to be treated in the West Pond at an equal amount to existing areas. For the impervious areas from the northbound lanes, a linear treatment system is recommended to satisfy treatment requirements.

For the south basin, suggested modifications to the infield wet detention ponds from the SR 528 project are recommended.

The proposed improvements require coordination and approval from several permitting agencies including the St. Johns River Water Management District, United States Coast Guard and U.S. Army Corps of Engineers. The recommendations and conclusions within this report may be updated pending the ongoing coordination and conditions of the permits obtained from these agencies.

Appendix A - Exhibits

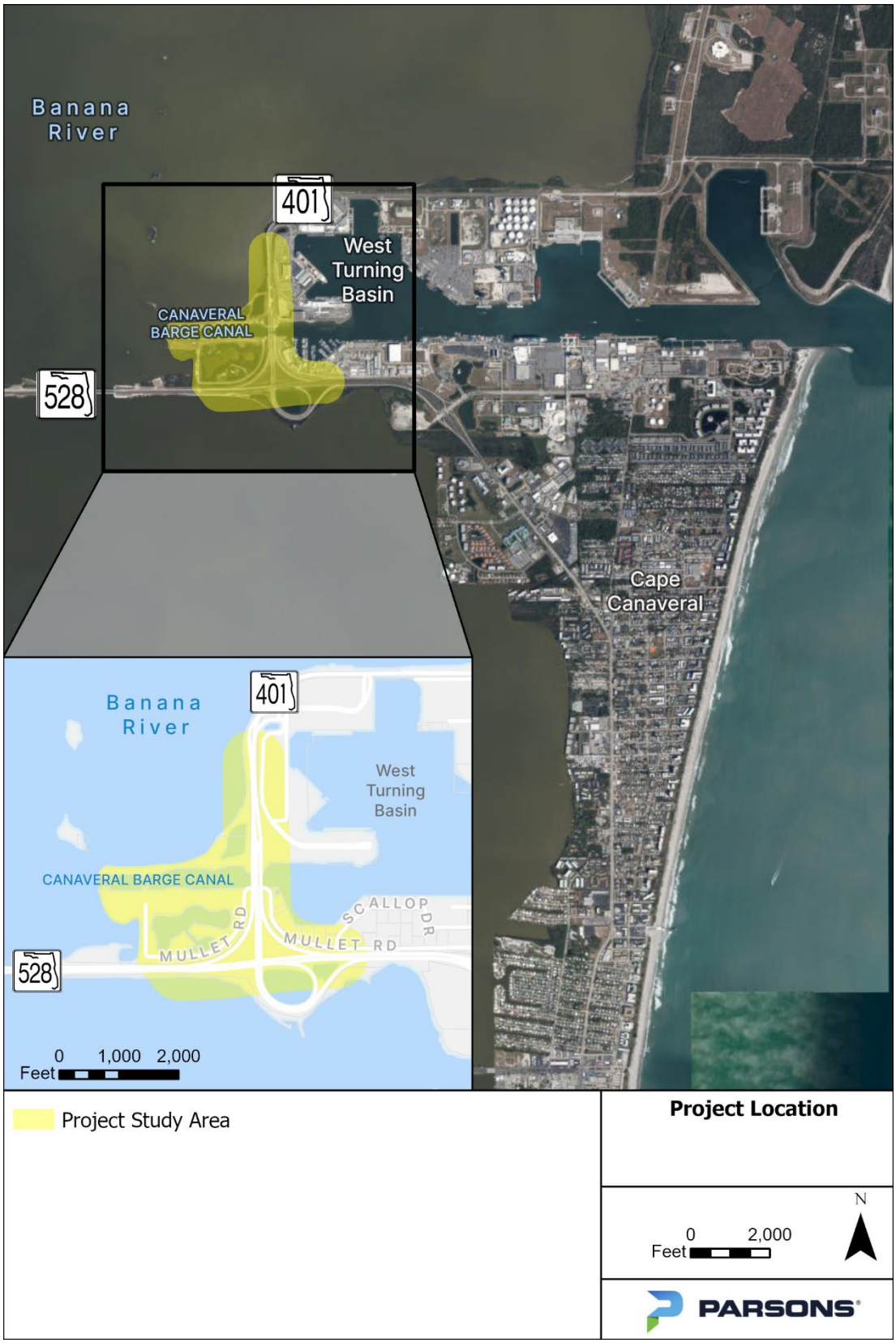


Exhibit 1 – Project Location

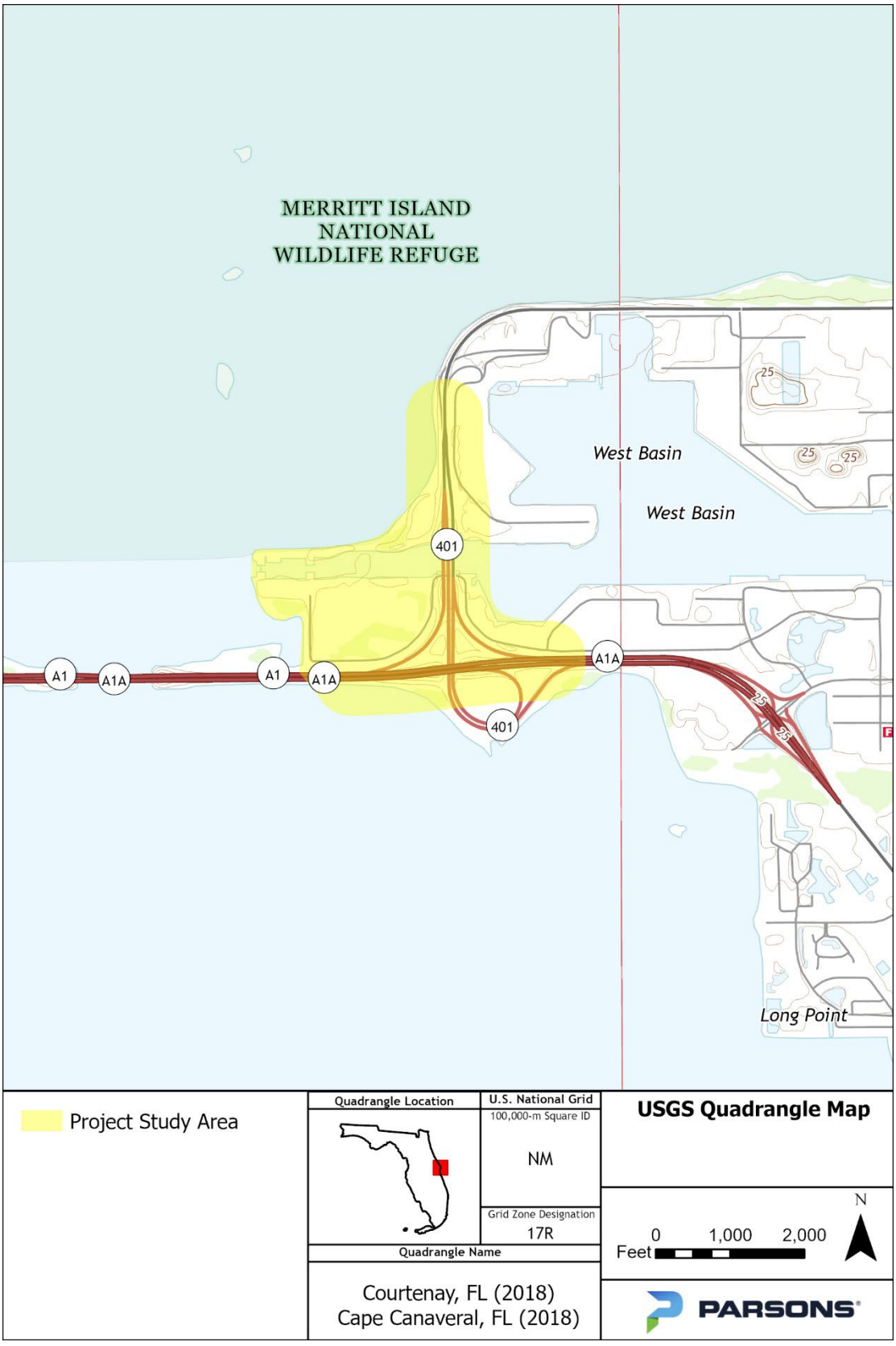


Exhibit 2 – USGS Quadrangle Map

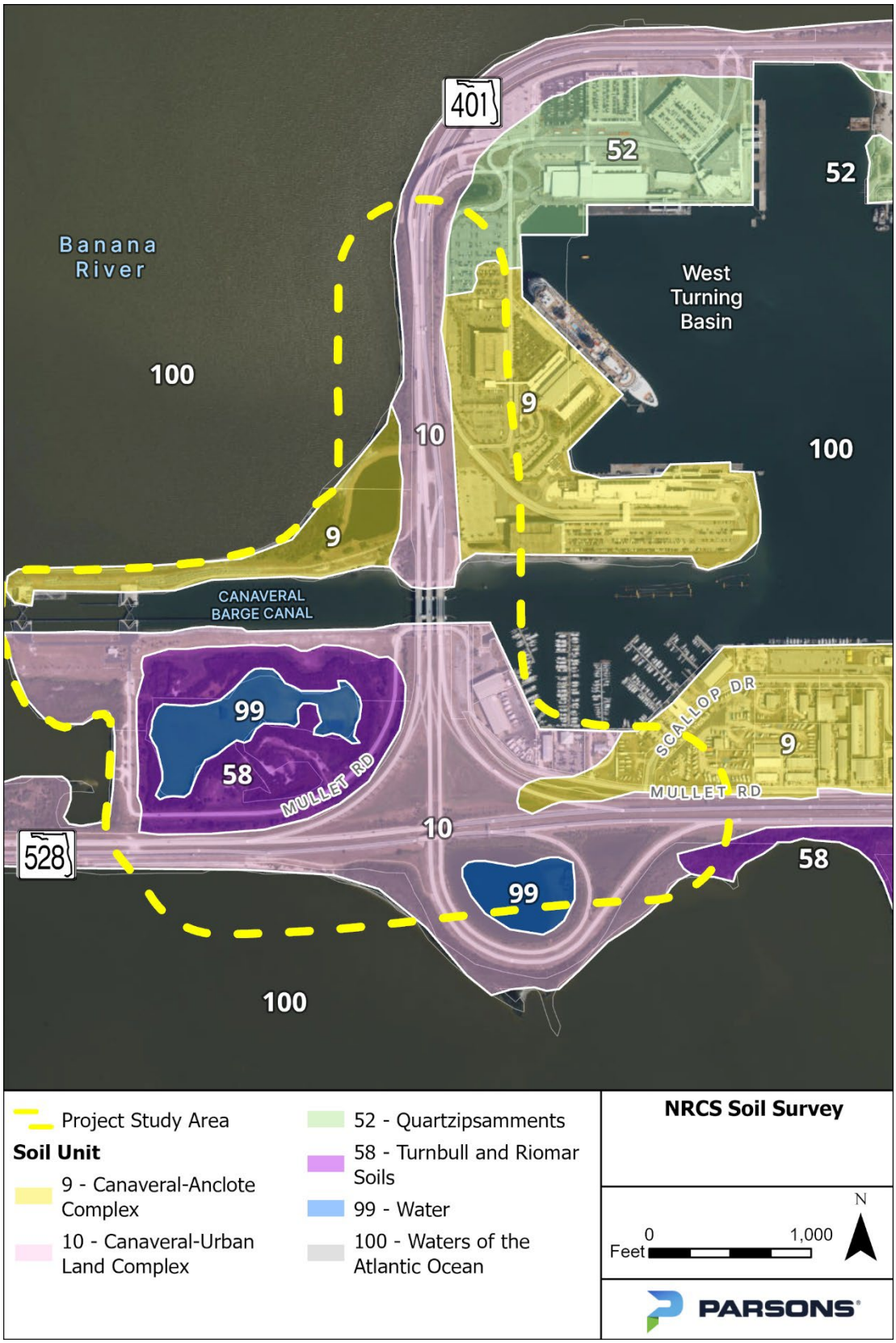


Exhibit 3 – NRCS Soil Survey

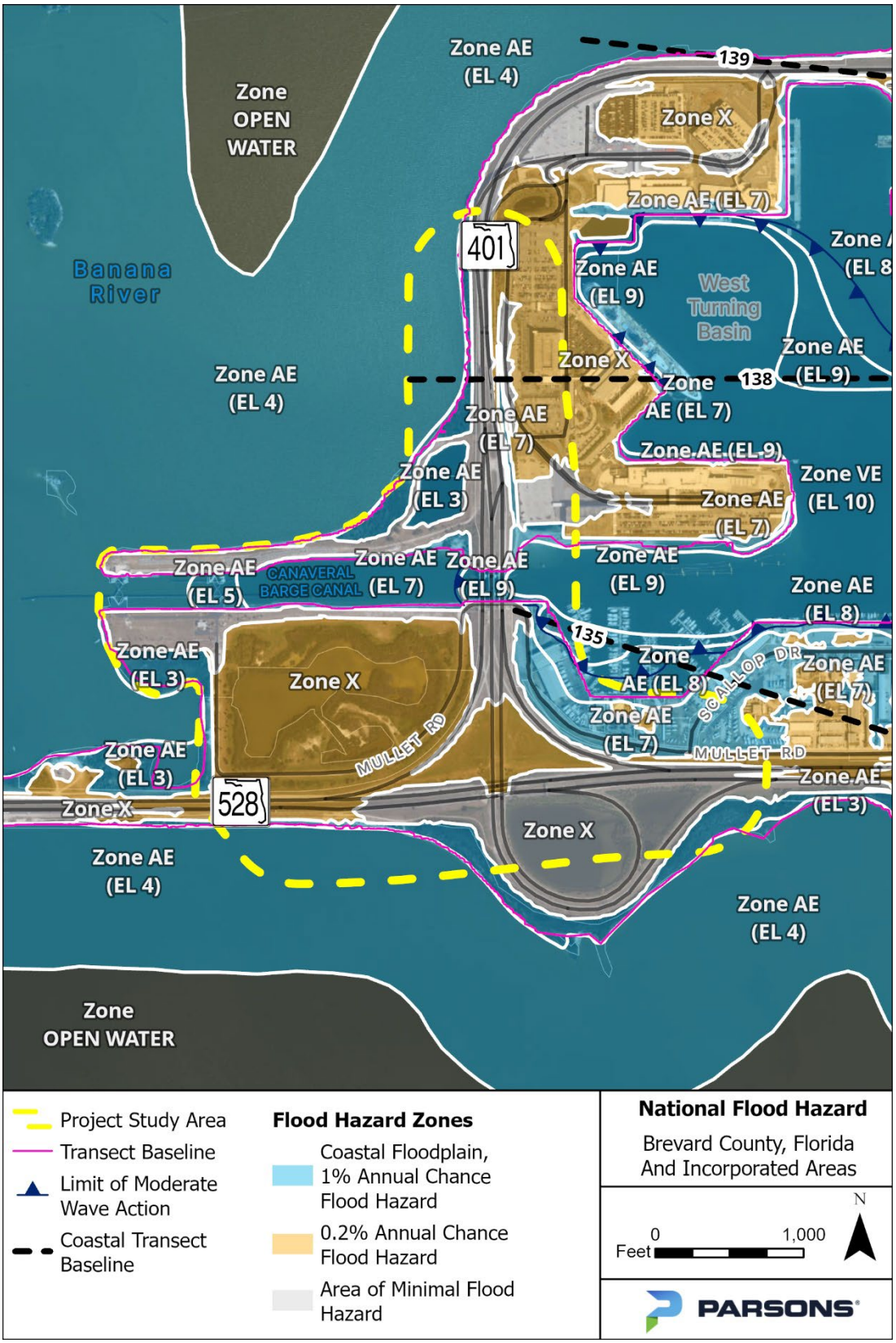


Exhibit 4 – Flood Hazard Map

Appendix B – Typical Sections

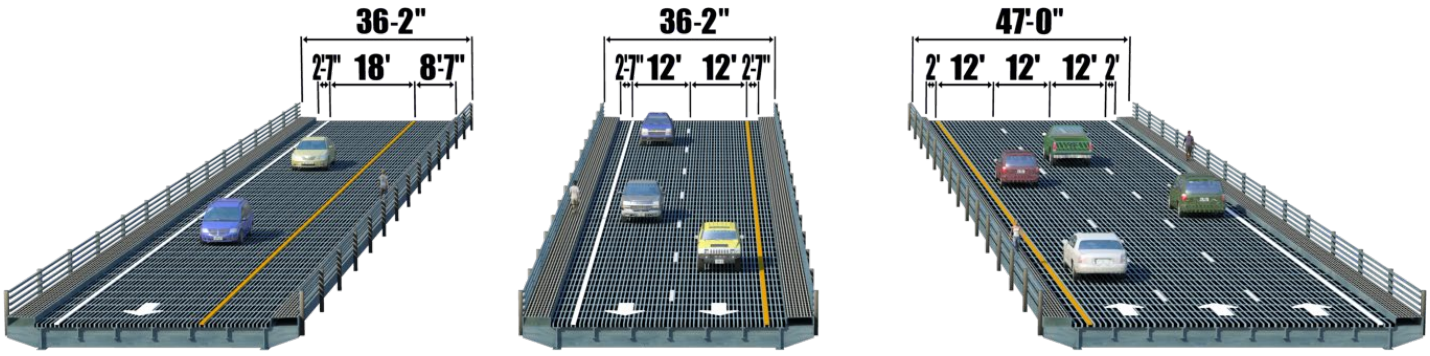
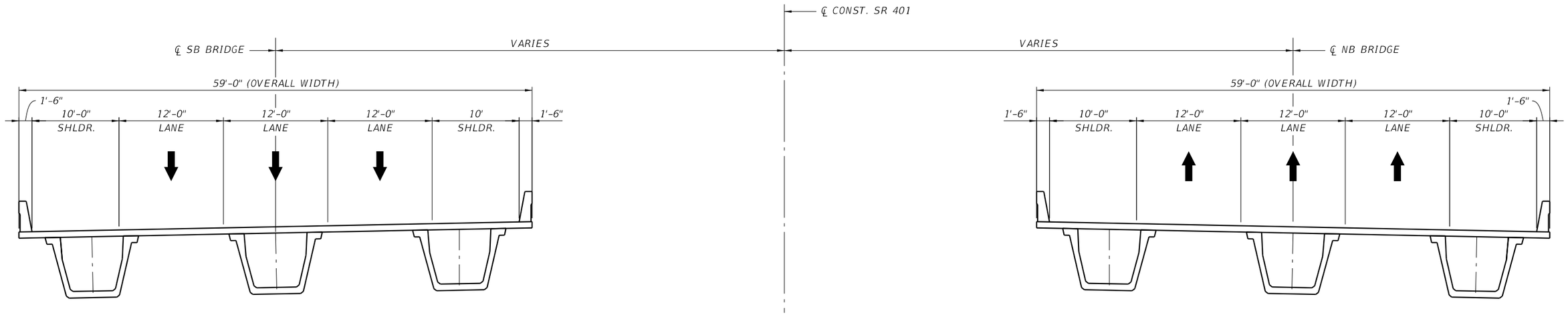


Exhibit 5
Existing Bridge Typical



BRIDGE TYPICAL SECTION

HIGH-LEVEL FIXED ALTERNATIVE

REVISIONS					
Date	By	Description	Date	By	Description

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 401	BREVARD	444787-1-22-01

SHEET TITLE: BRIDGE TYPICAL SECTION

REF. DWG. NO.

PROJECT NAME: SR 401 OVER CANAVERAL BARGE CANAL AND MULLET ROAD

SHEET NO.

Appendix C – Drainage Maps

BEGIN BRIDGE
STA. 19+61.08 ℄ CONST. SR 401

BEGIN PROJECT
STA. 10+00.00 ℄ CONST. SR 401

EXIST. GRADE ℄ SR 401

℄ MULLET RD.

BARGE CANAL

END BRIDGE
STA. 35+88.92 ℄ CONST. SR 401

EL. 6.38

EL. 5.85

EL. 43.33

EL. 10.56

MHW PLUS SEA LEVEL = 1.61'

MHW = 0.75'

Proposed SB bridge to drain to West Pond to simulate existing conditions.

SCALE: 1"=200' HORIZ.
1"=20' VERT.

60 40 20 0

10+00 15+00 20+00 25+00 30+00 35+00

NOTES:
1. DRAINAGE AREAS ARE SIMILAR FOR ALL ALTERNATIVES.
2. EXIST. POND 12A, POND 12B AND POND 12B CONTROL STRUCTURE TO BE MODIFIED FOR ALL ALTERNATIVES.
3. SR 528 PROJECT (FPID 407402-4-52-01) ASSUMED AS EXIST. CONDITION FOR ALL ALTERNATIVES AND ARE SHOWN SHADED BACK.

FLOODPLAIN ZONE AE

WEST POND

0 50 200
Feet

SR 528 (A1A)

770

℄ SURVEY SR 528

POND 12A

EXIST. LA R/W

℄ CONST. SR 401

10 15 20 25 30 35

SR 401 (CAPE RD.)

CONTROL STRUCTURE

POND 12B

BEGIN PROJECT
STA. 10+00.00 ℄ CONST. SR 401

675

MULLET RD.

FLOODPLAIN ZONE AE

EXIST. LA R/W

OUTFALL

SOUTH POND

PROPOSED LINEAR RETENTION OR DRY DETENTION

MATCHLINE STA. 37+00.00

Modify wet detention ponds 12A and 12B installed with SR 528 project.

Ditch blocks as needed. Expand retention/detention under bridge as needed. Type of system is dependent on seasonal high water elevation and infiltration rates.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 401	BREVARD	444787-1-22-01

DRAINAGE MAP

SHEET NO.

60
40
20
0

EL. 43.34

EXIST. GRADE ℄ SR 401

END PROJECT
STA. 45+97.10 ℄ CONST. SR 401

EL. 10.56
EL. 10.28
EL. 10.44

40+00
45+00

SCALE: 1"=200' HORIZ.
1"=20' VERT.

Estimated treatment requirements:
See stormwater treatment calculcations in Appendix D. Off-line dry retention recommended if supported by geotechnical data.

N

0 50 200
Feet

BANANA RIVER

FLOODPLAIN ZONE AE

EXIST. LA R/W

56 57 58 59 60 61 62 63 66 67

40

45

SR 401 (CAPE RD.)

PROPOSED LINEAR RETENTION OR DRY DETENTION

℄ CONST. SR 401

64

65

END PROJECT
STA. 45+97.10 ℄ CONST. SR 401

MATCHLINE STA. 37+00.00

EXIST. LA R/W

NORTH POND

If system does not work well in lower portion of basin due to SHW, consider treating existing pavement in this higher area. Use ditch blocks as needed. Not shown.

For simplicity on-line retention system shown.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 401	BREVARD	444787-1-22-01

DRAINAGE MAP

SHEET NO.

60
40
20
0

EXIST. GRADE ℄ SR 528

SR 401

EL. 6.29

EL. 12.24

SCALE: 1"=200' HORIZ.
1"=20' VERT.

EXIST. LA R/W

See first sheet for continuation

℄ SURVEY SR 528

℄ CONST. SR 401

POND 12A

POND 12B

SR 401 (CAPE RD.)

CONTROL STRUCTURE

MULLETT RD.

SR 528 (A1A)

EXIST. LA R/W

FLOODPLAIN ZONE AE

BEGIN PROJECT
STA. 10+00.00 ℄ CONST. SR 401

MITIGATION AREA

TO BANANA RIVER LAGOON

N

0 50 200
Feet

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

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SR 401	BREVARD	444787-1-22-01

DRAINAGE MAP

SHEET NO.

1. U ENDWALL
N-15" CMP Inv=3.76

2. GUTTER INLET
S-15" CMP Inv=13.84

3. U ENDWWALL
N-15" CMP Inv=2.57

4. GUTTER INLET
S-15" CMP Inv=19.12

5. GUTTER INLET
N-15" CMP Inv=18.92

6. U ENDWALL
S-15" CMP Inv=7.11

7. ENDWALL
N-30" RCP Inv=0.37

8. ENDWWALL
E-24" RCP Inv=2.02

9. DBI
W-24" RCP Inv=1.51
E-24" RCP Inv.=1.50

10. ENDWALL
W-24" RCP Inv=1.46

11. ENDWALL
N-30" RCP Inv=0.08

12. U ENDWALL
N-15" RCP Inv=4.47

13. GUTTER INLET
N-15" RCP Inv=13.95
S-15" RCP Inv=13.93

14. GUTTER INLET
S-15" RCP Inv=14.81

15. ENDWALL
S-30" RCP Inv=1.03

16. DBI
NE-24" HDPE Inv=3.27

17. MANHOLE
NW-36" HDPE Inv=3.35
E-36" HDPE Inv=4.20
SE-SIZE UNKNOWN Inv=3.34
SW-24" HDPE Inv=3.20

18. MANHOLE
N-36" HDPE Inv=3.02
S-36" HDPE Inv=3.31

19. DBI
N-15" RCP Inv=3.79

20. GUTTER INLET
NE-15" CMP Inv=7.40

21. MANHOLE
NE-15" RCP Inv=3.67
SE-15" RCP Inv=3.87
SW-15" CMP Inv=3.64

22. MANHOLE
N-15" RCP Inv=2.67
NW-15" RCP Inv=3.14
S-15" RCP Inv=3.28

23. MANHOLE
S-36" HDPE Inv.=2.70
W-18" RCP Inv.=1.81

24. GRATE INLET
E-18" RCP Inv=2.05
S-15" RCP Inv=2.17

25. GRATE INLET
N-18" RCP Inv=3.41
S-15" RCP Inv=3.40

26. MANHOLE

27. GRATE INLET
N-18" RCP Inv=3.72
S-18" RCP Inv=3.73

28. GRATE INLET
NE-18" RCP Inv=4.03
S-18" RCP Inv=3.91

29. GRATE INLET
SW-18" RCP Inv=4.44

30. U ENDWALL
E-18" RCP Inv=6.28

31. DBI
W-18" RCP Inv=7.44

32. U ENDWWALL
N-18" RCP Inv=6.52

33. MES
N-18" RCP Inv=6.52

34. MANHOLE
E-18" RCP Inv=6.84
S-18" RCP Inv=6.78

35. MANHOLE
E-18" RCP Inv=7.37
S-18" RCP Inv=7.35

36. GRATE INLET
N-18" RCP Inv=7.85
W-18" RCP Inv=7.89

37. GRATE INLET
N-18" RCP Inv=8.93

38. DBI
E-18" RCP Inv=8.31
S-18" RCP Inv=8.31

39. MANHOLE
N-18" RCP Inv=8.14
S-18" RCP Inv=8.13
W-18" RCP Inv=8.14

40. MANHOLE
E-18" RCP Inv=9.36
S-18" RCP Inv=9.33

41. DBI
S-18" RCP Inv=8.58

42. GRATE INLET
W-18" RCP Inv=9.74

43. OUTFALL
N-36" RCP Inv=4.02

44. CONTROL STRUCTURE
S-36" RCP Inv=4.19
N-8" PVC Inv=0.56
N-8" PVC Inv=0.53

45. DBI
N-12" CMP Inv=13.28

46. GUTTER INLET
E-15" CMP Inv=13.87

47. U ENDWALL
W-15" CMP Inv=2.96

48. MES
S-12" CMP Inv=11.19

49. GUTTER INLET
N-15" CMP Inv=8.32

50. MANHOLE
S-15" CMP Inv=7.52
N-15" CMP Inv=6.99

51. DBI
N-12" CMP Inv=13.28

52. MES
N-36" RCP Inv=6.13
N-36" RCP Inv=5.98

53. MES
S-36" RCP Inv=6.08
S-36" RCP Inv=6.09

54. ENDWALL
W-12" RCP Inv=2.79

55. GRATE INLET
SW-18" RCP Inv=4.44

56. GUTTER INLET
N-15" CMP Inv=6.40

57. GUTTER INLET
S-15" CMP Inv=5.66
N-15" CMP Inv=5.50

58. GUTTER INLET
S-15" CMP Inv=5.19
N-15" CMP Inv=5.11

59. GUTTER INLET
S-15" CMP Inv=4.51
N-15" CMP Inv=4.52

60. GUTTER INLET
S-15" CMP Inv=3.74
N-15" CMP Inv=3.70

61. GUTTER INLET
N-15" CMP Inv=2.94
S-15" CMP Inv=3.19

62. GUTTER INLET
E-24" CMP Inv=1.59
S-15" CMP Inv=2.09

63. MANHOLE
E-24" CMP Inv=1.47
N-15" RCP Inv=1.87
W-24" CMP Inv=1.57

64. MANHOLE
W-24" CMP Inv=0.89

65. MANHOLE
UNKNOWN

66. BARRIER WALL INLET
E-15" CMP Inv=3.32

67. GUTTER INLET
W-15" CMP Inv=3.22
S-15" CMP Inv=3.07

68. MANHOLE
E-36" HDPE Inv=3.60
W-36" HDPE Inv=3.77

69. DBI
N-18" RCP Inv=1.91

70. MES
S-24" HDPE Inv=2.60

71. MANHOLE
N-24" HDPE Inv=3.03
E-42" HDPE Inv=4.62
S-24" HDPE Inv=1.12
W-36" HDPE Inv=4.60

72. DBI
N-24" HDPE Inv=1.41
SE-15" RCP Inv=2.16
SW-18" RCP Inv=1.76

73. MANHOLE
E-42" HDPE Inv=4.15
W-42" HDPE Inv=4.05

74. MANHOLE
N-15" RCP Inv=3.39
S-15" RCP nv=3.32

75. CURB INLET
N-15" RCP Inv=6.12

76. DBI
N-15" RCP Inv=7.35
S-15" RCP Inv=7.36

77. GUTTER INLET
N-15" RCP Inv=8.02

78. DBI
E-18" RCP Inv=0.99

79. GUTTER INLET
S-15" RCP Inv=2.45

80. MES
N-15" RCP Inv=0.58

81. ENDWALL
E-30" RCP Inv=1.48

83. ENDWALL
W-30" RCP Inv=1.53

82. INLET
SE-36" RCP Inv=2.07

84. ENDWALL
S-30" RCP Inv=1.32

85. ENDWALL
N-30" RCP Inv=1.22

86. CURB INLET
SW-15" RCP Inv=1.79

87. DBI
NW-15" RCP Inv=0.72
S-18" RCP Inv=0.71

88. ENDWALL
N-18" RCP Inv=0.00

89. GUTTER INLET
N-15" RCP Inv=10.58

90. U ENDWALL
S-15" RCP Inv=4.61

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

ALEJANDRO A. BARRIOS, P.E.
P.E. LICENSE NO. 75972
PARSONS TRANSPORTATION GROUP, INC.
201 E. PINE STREET, SUITE 900
ORLANDO, FL 32801
PHONE: (407) 702-6800

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
SR 401	BREVARD	444787-1-22-01

DRAINAGE MAP

SHEET NO.

Appendix D – Stormwater Treatment Calculations

Basin 1 Stormwater Treatment Calculations

Basin 1 Recommendation:

No calculations are needed until SR 528 project design is completed. Modify the proposed SR 528 wet detention ponds located in the infield areas. Ponds have not been constructed. Side slopes will be modified based on SR 401 project design. Control elevations will remain as permitted under the SR 528 project. Adjust weir elevation as needed for SR 401 project.

Basin 2 Stormwater Treatment Calculations

Drainage Area Description	Acres	Comments
Existing West Pond drainage area from SB bridge high point to SB approach	2.33	Try to simulate in proposed condition.
Existing West Pond impervious area from SB bridge high point to SB approach	1.11	Try to simulate in proposed condition.
Proposed West Pond drainage area from SB bridge high point to SB approach	1.96	Existing total area not exceeded. OK
Proposed West Pond drainage area from SB bridge high point to SB approach	1.10	Existing pavement area not exceeded. OK
Remaining project drainage area from bridge highpoint to SR 401 basin highpoint near Charles M Rowland Dr	15.08	Large area influences TV approach. Bypass upstream area to reduce total drainage area.
Remaining project drainage area from bridge highpoint to Sta 48+50	8.05	Bypass upstream areas to reduce total area. Use for TV calc.
Remaining new impervious area from bridge highpoint to profile tie-down at Sta 45+00	4.66	Reconstructed proposed pavement. Use for TV calc.

Option 1: Dry Retention (off-line) - treat 0.5" of runoff over the drainage area or 1.25" x impervious

Treatment Volume Calculation	Comment
TV = 0.5"/12 x 15.08 ac = 0.63 ac-ft	To reduce treatment requirement don't use this area but instead bypass upstream flows to reduce total drainage area.
TV = 0.5"/12 x 8.05 ac = 0.34 ac-ft	
TV = 1.25"/12 x 4.66 ac = 0.49 ac-ft	This TV controls for off-line dry retention system.

Option 2: Dry Retention (on-line) - (treat 0.5" of runoff over the drainage area or 1.25" x impervious) + 0.5" of runoff from drainage area

Treatment Volume Calculation	Comment
TV = 0.5"/12 x 8.05 ac + 0.5"/12 x 8.05 ac = 0.67 ac-ft	
TV = 1.25"/12 x 4.66 ac + 0.5"/12 x 8.05 ac = 0.82 ac-ft	This controls for on-line dry retention system.

Option 3: Dry Detention (off-line) - treat 1.0" of runoff over the drainage area or 2.50" x impervious

Treatment Volume Calculation	Comment
TV = 1.0"/12 x 8.05 ac = 0.67 ac-ft	
TV = 2.50"/12 x 4.66 ac = 0.97 ac-ft	This controls for off-line dry detention system.

Basin 2 Recommendation:

Maximize discharge to West Pond to simulate existing conditions. Construct bypass system along NB lanes to allow smaller treatment basin. Utilize option 1. Use bypass system pipe for outfall from individual off-line dry retention cells. Size each cell just to meet drainage subbasin requirements. Confirm design approach based on geotechnical evaluation of seasonal high water and infiltration rates.

Excerpts from SJRWMD Permit Information Manual

PERMIT INFORMATION MANUAL

June 1, 2018

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
4049 Reid Street
Palatka, FL 32177-2529
(386) 329-4500

PART V – BEST MANAGEMENT PRACTICES

5.0 Retention System Design and Performance Criteria

Dry Retention Options for north basin. Off-line or on-line linear roadside systems are proposed.

5.1 Description *Revised 6/1/18*

Retention system is defined as a storage area designed to store a defined quantity of runoff, allowing it to percolate through permeable soils into the shallow ground water aquifer. Stormwater retention works best using a variety of retention systems throughout the project site. Examples of retention systems include:

- Man-made or natural depressional areas where the floor is graded as flat as possible and turf is established to promote infiltration and stabilize the basin slopes (see Figure 5-1)
- Shallow landscaped areas designed to store stormwater
- Vegetated swales with swale blocks or raised inlets
- Pervious concrete with continuous curb

Soil permeability and water table conditions must be such that the retention system can percolate the desired runoff volume within a specified time following a storm event. After drawdown has been completed, the basin does not hold any water, thus the system is normally "dry." Unlike detention basins, the treatment volume for retention systems is not discharged to surface waters.

Retention systems should not be located in close proximity to drinking water supply wells. Chapter 62-555, F.A.C., requires stormwater treatment facilities to be at least 100 feet from any public supply well. Chapter 62-532, F.A.C., identifies stormwater detention or retention basins as a “potentially moderate sanitary hazard” and includes additional setback requirements for certain wells from such basins. Chapter 40C-41, F.A.C., provides additional design features for systems constructed in Sensitive Karst Areas of the District where the drinking water aquifer is close to the land surface (see section 13.6).

Besides pollution control, retention systems can be utilized to promote the recharge of ground water to prevent saltwater intrusion in coastal areas or to maintain groundwater levels in aquifer recharge areas. Chapter 40C-41, F.A.C., contains recharge criteria for the Wekiva Recharge Protection Basin and the Tomoka River and Spruce Creek Hydrologic Basins (see sections 13.3.1 and 13.5.1).
Retention systems can also be used to meet the runoff volume criteria for projects which discharge to land-locked lakes (see section 3.2 of this Volume).

There are several design and performance criteria specific to retention systems which are described below.

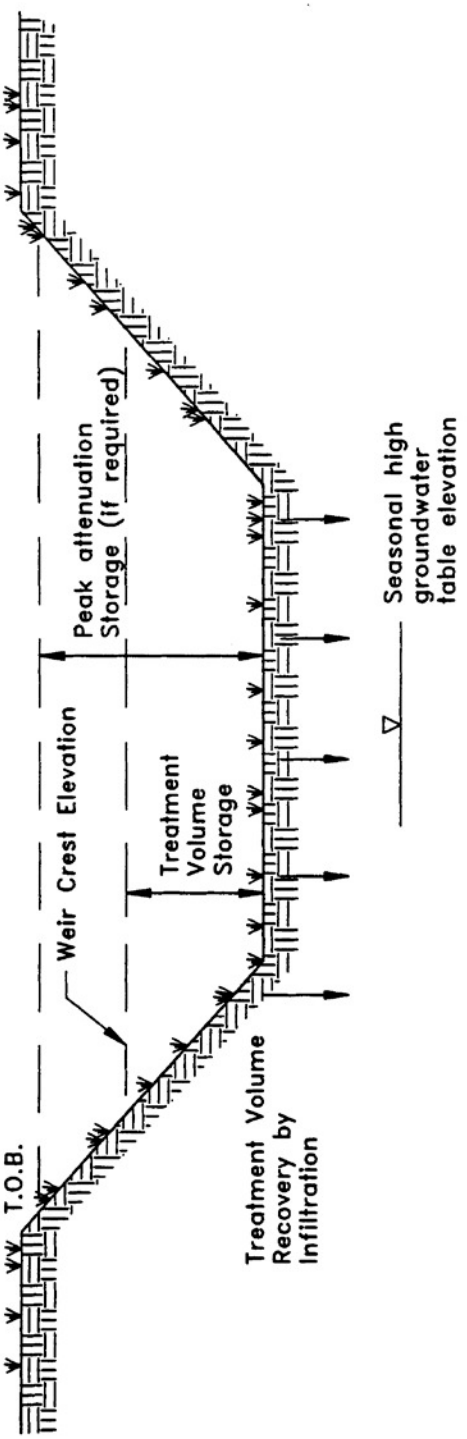

Figure 5-1. Retention (N.T.S.)

5.2 Treatment Volume

5.2.1

The first flush of runoff should be routed to the retention basin and percolated into the ground. Retention systems that discharge to Class III receiving water bodies shall provide for one of the following:

(a) *Off-line* retention of the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater.

(b) *On-line* retention of an additional one half inch of runoff from the drainage area over that volume specified for off-line treatment.

(c) *On-line* retention that provides for percolation of the runoff from the three year, one-hour storm.

(d) *On-line* retention of the runoff from one inch of rainfall or 1.25 inches of runoff from the impervious area, whichever is greater, for systems which serve an area with less than 40 percent impervious surface and that contain only U.S. Department of Agriculture Natural Resources Conservation Service (SCS) hydrologic group "A" soils.

5.2.2

For direct discharges to Class I, Class II, OFWs, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting the applicant shall provide retention for one of the following:

(a) At least an additional fifty percent of the applicable treatment volume specified for off-line retention in (a), above. *Off-line* retention must be provided for at least the first one-half inch of runoff or 1.25 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated.

(b) *On-line* retention of an additional fifty percent of the treatment volume specified in (b), above.

(c) *On-line* retention of the runoff from the three-year, one-hour storm.

(d) *On-line* retention that provides at least an additional 50 percent of the runoff volume specified in (d), above, for systems which serve an area with less that 40 percent impervious surface and that contain only U.S. Department of

Agriculture Natural Resources Conservation Service (SCS) hydrologic group "A" soils.

5.3 Recovery Time

The retention system must provide the capacity for the appropriate treatment volume of stormwater specified in section 5.2 within 72 hours following a storm event assuming average antecedent moisture conditions. In retention systems, the stormwater is drawn down by natural soil infiltration and dissipation into the ground water table, evaporation, or evapotranspiration, as opposed to underdrain systems which rely on artificial methods like drainage pipes.

Antecedent moisture condition (AMC) refers to the amount of moisture and storage in the soil profile prior to a storm event. Antecedent soil moisture is an indicator of wetness and availability of soil to infiltrate water. The AMC can vary from dry to saturated depending on the amount of rainfall received prior to a given point in time. Therefore, "average AMC" means the soil is neither dry or saturated, but at an average moisture condition at the beginning of a storm event when calculating recovery time for retention systems.

The antecedent condition has a significant effect on runoff rate, runoff volume, infiltration rate, and infiltration volume. The infiltration volume is also known as the upper soil zone storage. Both the infiltration rate and upper soil zone storage are used to calculate the recovery time of retention systems and should be estimated using any generally accepted and well documented method with appropriate parameters to reflect drainage practices, seasonal high water table elevation, the AMC, and any underlying soil characteristics which would limit or prevent percolation of storm water into the soil column.

5.4 Basin Stabilization

The retention basin should be stabilized with pervious material or permanent vegetative cover. To provide proper treatment of the runoff in very permeable soils, permanent vegetative cover must be utilized when U.S. Department of Agriculture Natural Resources Conservation Service (SCS) hydrologic group "A" soils underlie the retention basin, except for pervious pavement systems.

5.5 Retention Basin Construction

5.5.1 Overview

Retention basin construction procedures and the overall sequence of site construction are two key factors that can control the effectiveness of retention basins. Sub-standard construction methods or construction sequence can render the basin inoperable prior to completion of site development.

5.5.2 Construction Requirements

The following construction procedures are recommended to avoid degradation of retention basin infiltration capacity due to construction practices (Andreyev and Wiseman 1989):

(a) Initially construct the retention basin to rough grade by under-excavating the basin bottom and sides by approximately 12 inches.

(b) After the drainage area contributing to the basin has been fully stabilized, the interior side slopes and basin bottom should be excavated to final design specifications. The excess soil and undesirable material should be carefully excavated and removed from the pond so that all accumulated silts, clays, organics, and other fine sediment material has been removed from the pond area. The excavated material should be disposed of beyond the limits of the drainage area of the basin.

(c) Once the basin has been excavated to final grade, the entire basin bottom should be deep raked and loosened for optimal infiltration.

(d) Finally, the basin should be stabilized according to section 5.4, above.

5.6 References

Andreyev, N.E., and L.P. Wiseman. 1989. *Stormwater Retention Pond Infiltration Analysis in Unconfined Aquifers*. Prepared for Southwest Florida Water Management District, Brooksville, Florida.

Wet Detention Option for south basin.
Modify SR 528 project ponds.

8.0 Wet Detention Design and Performance Criteria

8.1 Description

These systems are permanently wet ponds which are designed to slowly release collected stormwater runoff through an outlet structure. A schematic of a typical wet detention system is shown in Figure 8-1.

There are several components in a wet detention system which must be properly designed to achieve the required level of stormwater treatment. A description of each design feature and its importance to the treatment process is presented below. The design and performance criteria for wet detention systems are discussed below.

8.2 Treatment Volume

For wet detention systems, the design treatment volume is the greater of the following:

(a) one inch of runoff over the drainage area

(b) 2.5 inches times the impervious area (excluding water bodies)

Additional treatment volume is required for systems which discharge directly to Class I, Class II, Outstanding Florida Waters, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting (see section 8.13 of this Volume).

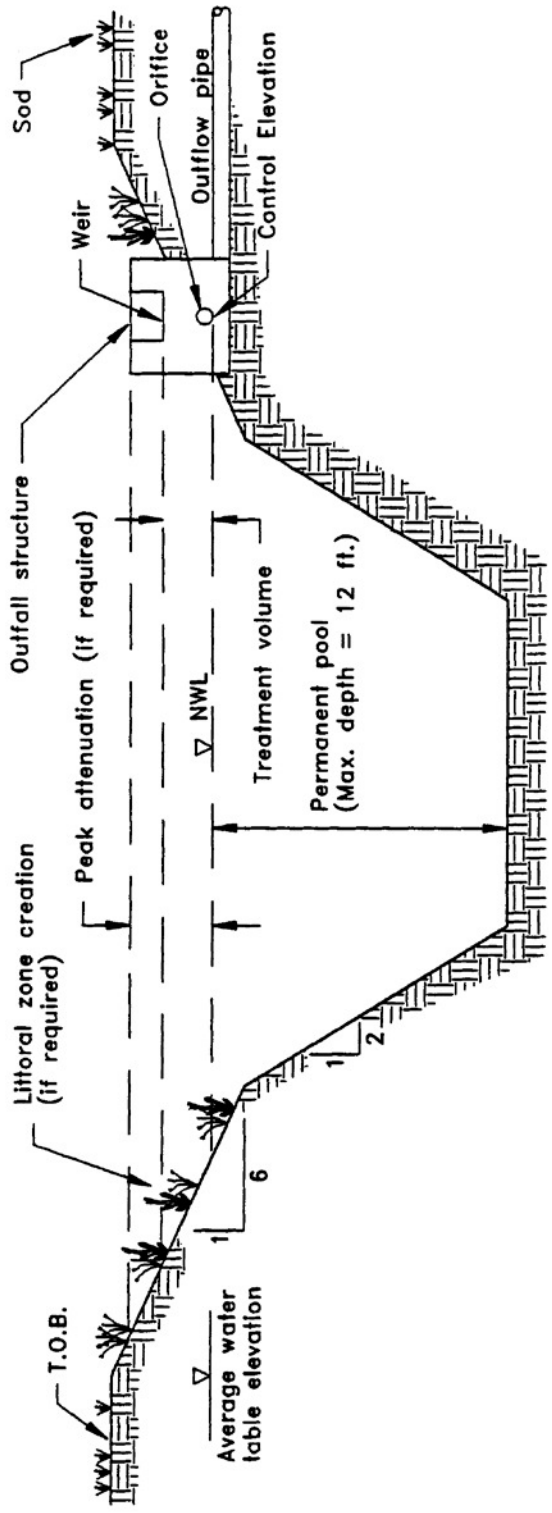

Figure 8-1. Wet detention (N.T.S.)

8.3 Recovery Time

The outfall structure shall be designed to drawdown one-half the required treatment volume within 24 and 30 hours following a storm event, but no more than one-half of this volume will be discharged within the first 24 hours.

8.4 Outlet Structure *Revised 6/1/18*

The outlet structure generally includes a drawdown device (such as an orifice, "V" or square notch weir) set to establish a normal water control elevation and slowly release the treatment volume (see Figures 8-2 and 8-3 for schematics). The design of the outfall structure must also accommodate the passage of ground water baseflows and flows from upstream stormwater management systems (see Figure 8-4).

The control elevation shall be set at or above the design tailwater elevation so the pond can effectively recover the treatment storage. Drawdown devices shall have a cross-sectional area of at least six (6) square inches and be at least two (2) inches wide. If the device is a “V” notch, the notch shall be at least twenty (20) degrees. Drawdown devices less than 6 inches wide or less than 45 degrees for "V" notches shall include a device to minimize clogging. Examples of such devices include baffles, grates, screens, and pipe elbows.

8.5 Permanent Pool

The permanent pool shall be sized to provide at least a 14-day average residence time during the wet season (June - October).

Additional permanent pool volume may be required for wet detention systems which directly discharge to Class I, Class II, or Outstanding Florida Waters (see section 8.13 of this Volume).

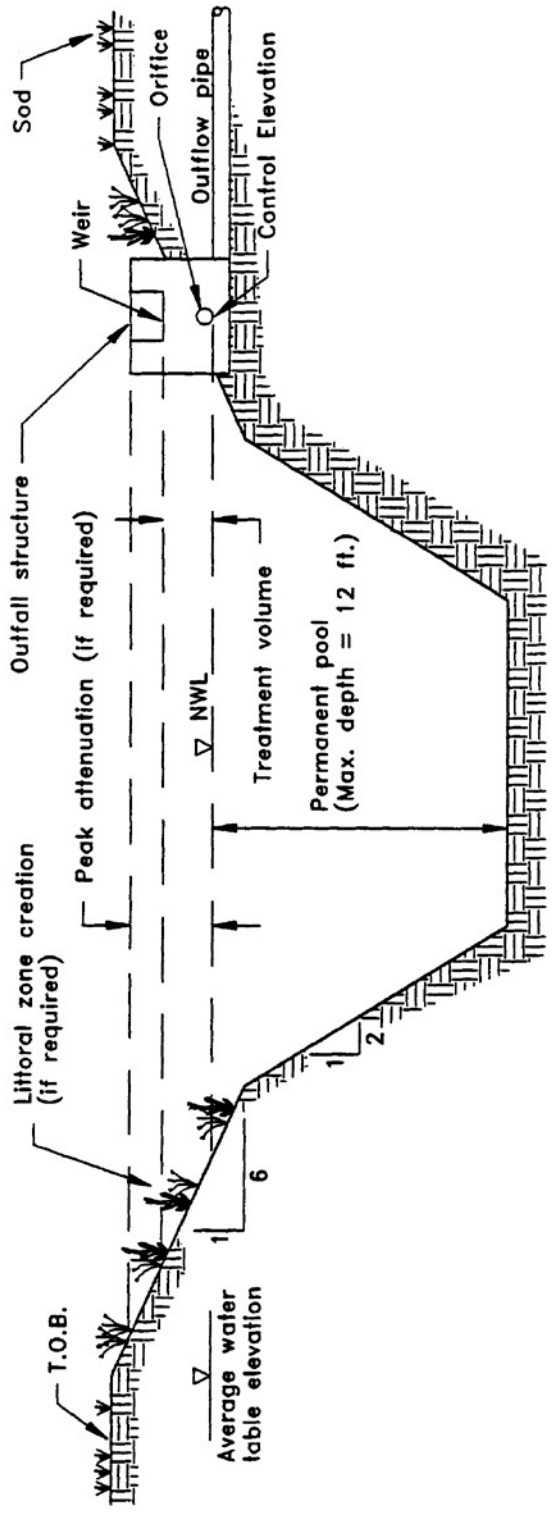

Figure 8-1. Wet detention (N.T.S.)

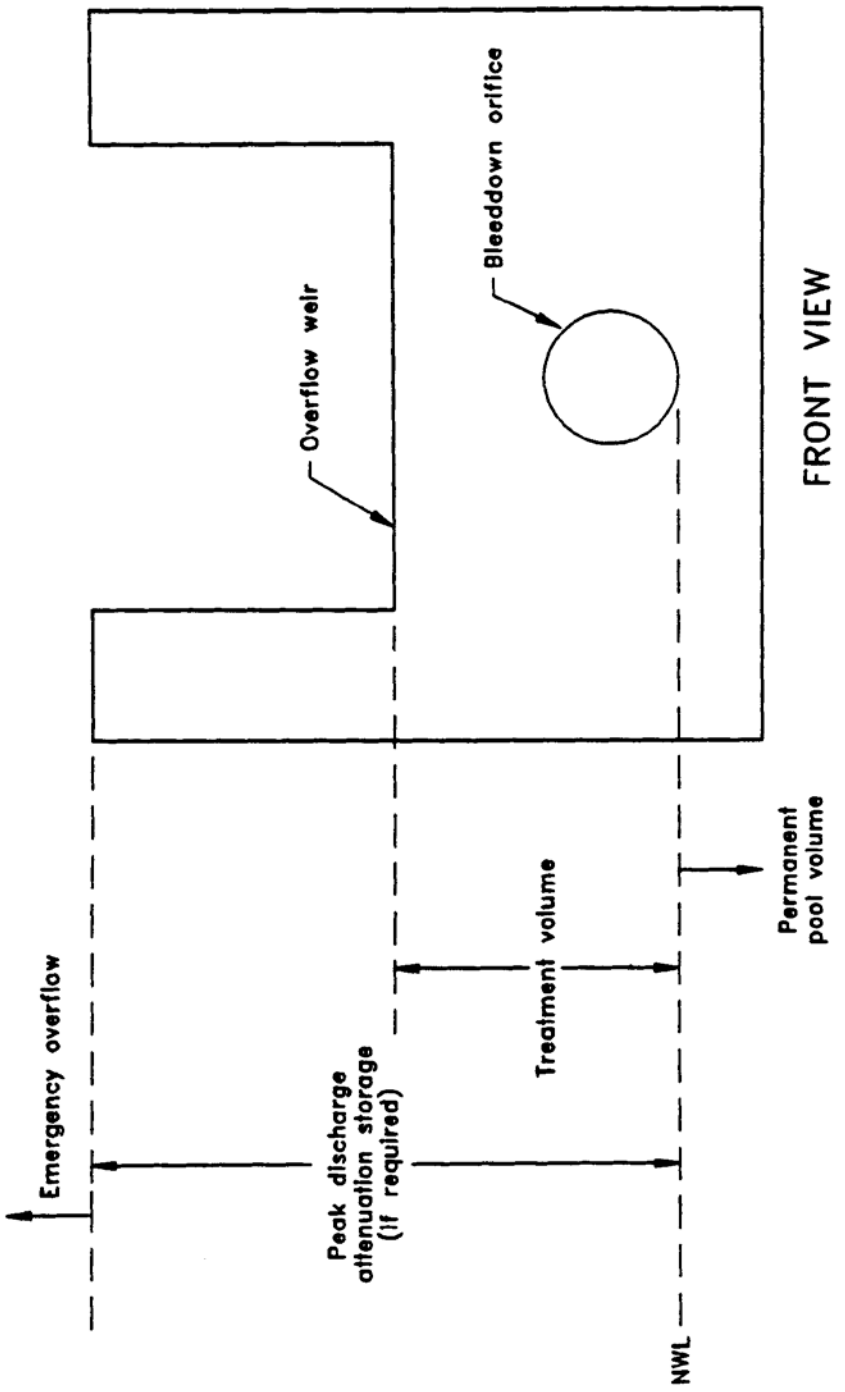

Figure 8-2. Typical wet detention outfall structure (N.T.S.)

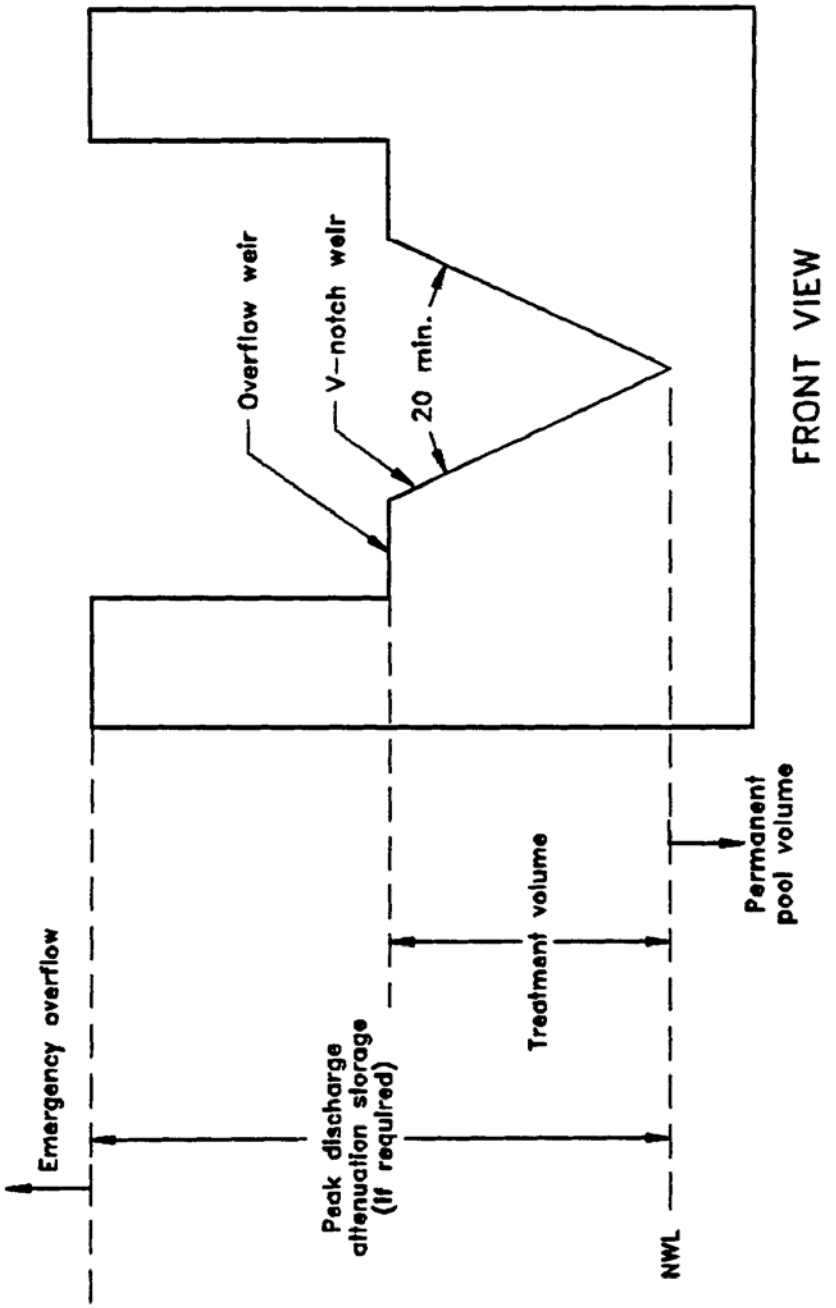

Figure 8-3. Typical wet detention outfall structure with "V"-notch weir (N.T.S.)

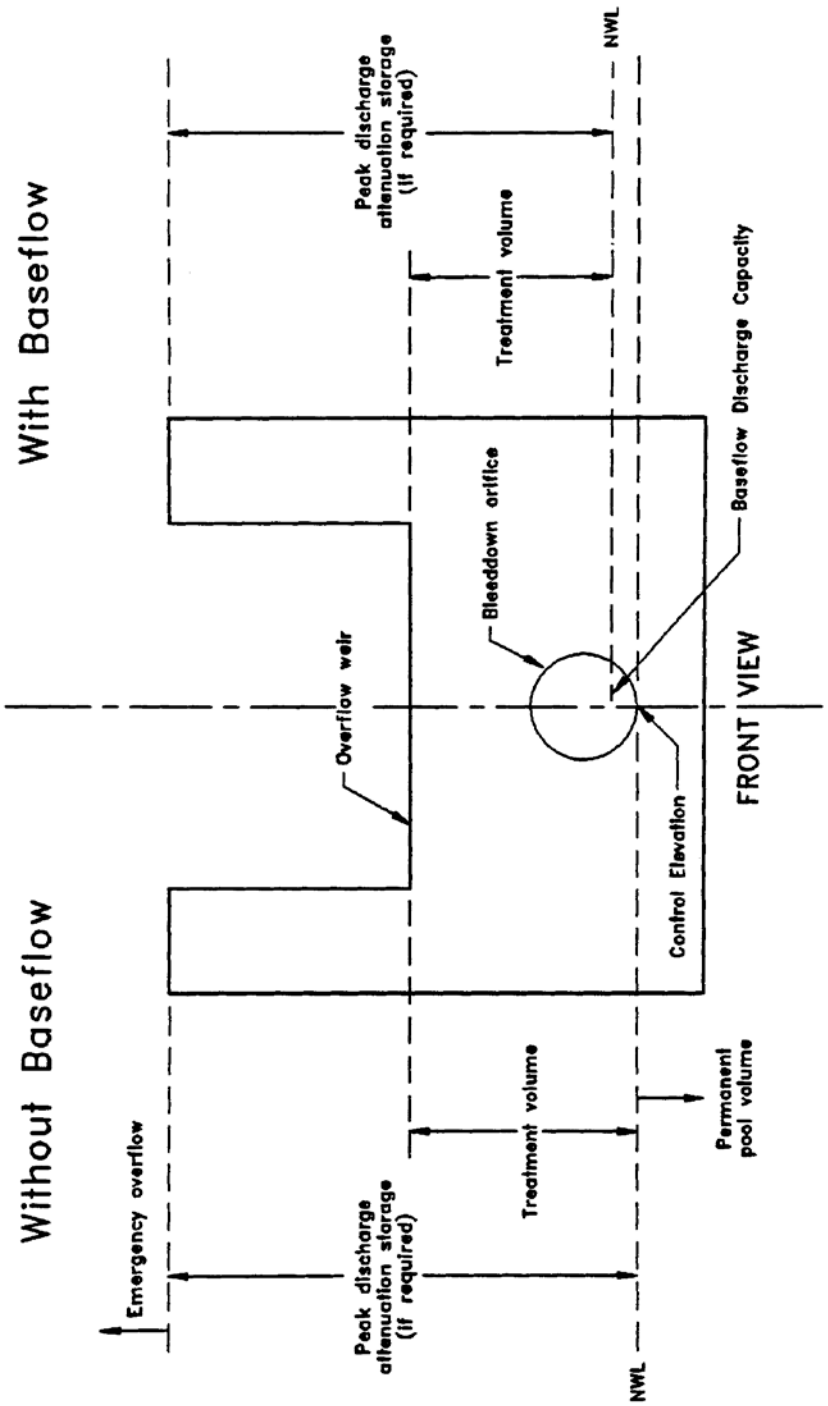

Figure 8-4. Typical wet detention outfall structure with and without baseflow conditions (N.T.S.)

8.6 Littoral Zone

The littoral zone is that portion of a wet detention pond which is designed to contain rooted aquatic plants. The littoral area is usually provided by extending and gently sloping the sides of the pond down to a depth of 2-3 feet below the normal water level or control elevation. Also, the littoral zone can be provided in other areas of the pond that have suitable depths (i.e., a shallow shelf in the middle of the lake).

The littoral zone is established with native aquatic plants by planting and/or the placement of wetland soils containing seeds of native aquatic plants. A specific vegetation establishment plan must be prepared for the littoral zone. The plan must consider the hydroperiod of the pond and the type of plants to be established. Livingston et al. (1988) has published a list of recommended native plant species suitable for littoral zone planting. In addition, a layer of muck can be incorporated into the littoral area to promote the establishment of the wetland vegetation. When placing muck, special precautions must be taken to prevent erosion and turbidity problems in the pond and at its discharge point while vegetation is becoming established in the littoral zone.

The following is a list of the design criteria for wet detention littoral zones:

(a) The littoral zone shall be gently sloped (6H:1V or flatter). At least 30 percent of the wet detention pond surface area shall consist of a littoral zone. The percentage of littoral zone is based on the ratio of vegetated littoral zone to surface area of the pond at the control elevation.

(b) The treatment volume should not cause the pond level to rise more than 18 inches above the control elevation unless the applicant affirmatively demonstrates that the littoral zone vegetation can survive at greater depths.

(c) Within 24 months of completion of the system or as specified by permit condition, 80 percent coverage of the littoral zone by suitable aquatic plants is required.

(d) Planting of the littoral zone is recommended to meet the 80% coverage requirement. As an alternative to planting, portions of the littoral zone may be established by placement of wetland top soils (at least a four inch depth) containing a seed source of desirable native plants. When utilizing this alternative, the littoral zone must be stabilized by mulching or other means and at least the portion of the littoral zone within 25 feet of the inlet and outlet structures must be planted.

8.7 Littoral Zone Alternatives

As an option to establishing and maintaining vegetative littoral zones as described in section 8.6, the applicant can provide either:

(a) An additional 50% of the appropriate permanent pool volume as required in section 8.5 or 8.13, or

(b) Pre-treatment of the stormwater prior to the stormwater entering the wet detention pond. The level of pre-treatment must be at least that required for retention, underdrain, exfiltration, or swale systems. See section 8.11 of this Volume for additional information on pre-treatment.

8.8 Pond Depth

Wet detention systems shall provide for a maximum pond depth of 12 feet and a mean depth (pond volume divided by the pond area at the control elevation) between 2 and 8 feet.

8.9 Pond Configuration

The average length to width ratio of the pond must be at least 2:1.

If short flow paths are unavoidable, the effective flow path can be increased by adding diversion barriers such as islands, peninsulas, or baffles to the pond. Inlet structures should be designed to dissipate the energy of water entering the pond. Examples of good and poor pond configurations are given in Figure 8-5.

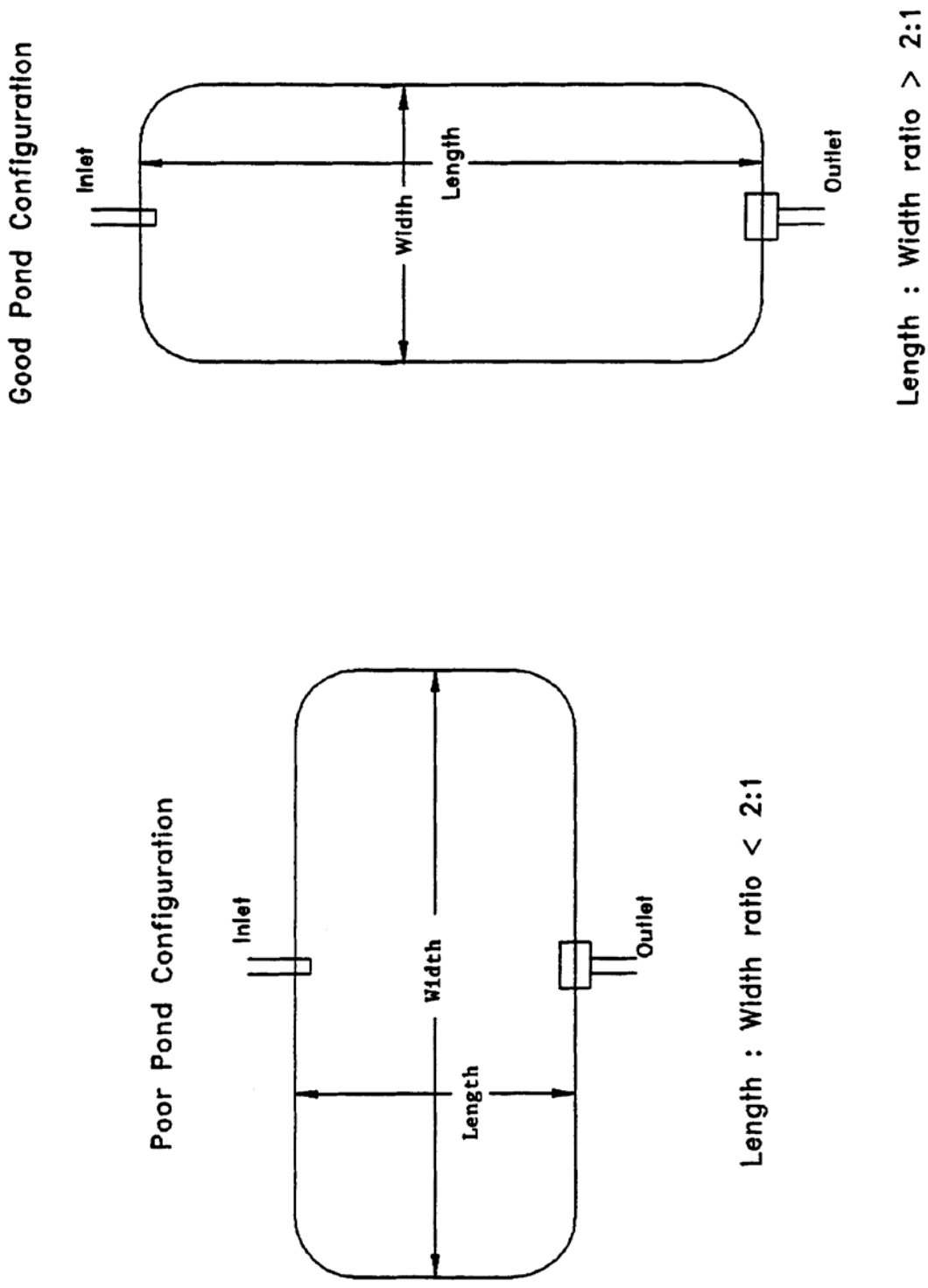

Figure 8-5. Examples of good and poor wet detention pond configurations (N.T.S.)

8.10 Ground Water Table

To minimize ground water contributions which may lower treatment efficiencies, the control elevation shall be set at or above the normal on-site ground water table elevation (Yousef et al. 1990). This elevation may be determined by calculating the average of the seasonal high and seasonal low ground water table elevations.

Ground water inflow (baseflow) must be considered when the control elevation is set below the normal ground water table elevation or the project utilizes underdrains (i.e., road underdrains) to control ground water conditions on-site. The design of the outfall structure must provide for the discharge of baseflow at the design normal water level in the pond. Baseflow rates must be included in the drawdown calculations for the outfall structure. Baseflow shall also be considered in the permanent pool residence time design. Establishment of the normal water level in the pond will also be influenced by baseflow conditions (see Figure 8-4).

8.11 Pre-treatment

"Pre-treatment" is defined as the treatment of a portion of the runoff prior to its entering the wet detention pond. Pre-treatment increases the pollutant removal efficiency of the overall stormwater system by reducing the pollutant loading to the wet detention pond. Pre-treatment may be used to enhance the appearance of the wet detention pond or meet the additional treatment criteria for discharges to receiving water which are classified as Class I, Class II, Outstanding Florida Waters (OFWs), or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting.

For developments where the appearance of the lake is important, pre-treatment can reduce the chances of algal blooms and slow the eutrophication process. Some types of pre-treatment practices include utilizing vegetative swales for conveyance instead of curb and gutter, perimeter swales or berms around the lake, oil and grease skimmers on inlet structures, retention storage in swales with raised inlets, or shallow landscaped retention areas (when soils and water table conditions will allow for adequate percolation).

For systems in which pre-treatment is utilized to meet the additional design criteria requirements for systems which directly discharge to Class I, Class II, OFWs, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting, pre-treatment practices must meet the appropriate design and performance criteria for that BMP. Acceptable types of pre-treatment include the following:

(a) Retention systems which meet the design and performance criteria in section 5,

(b) Underdrain systems which meet the design and performance criteria in section 6,

(c) Exfiltration trench section 7, or

(d) Swales systems which meet the design and performance criteria in section 9.

Alternative pre-treatment methods will be evaluated on a case-by-case basis by the District. Applicants or system designers are encouraged to meet with District staff in a pre-application conference if alternative methods are proposed.

8.12 Pond Side Slopes

The pond must be designed so that the average pond side slope measured between the control elevation and two feet below the control elevation is no steeper than 3:1 (horizontal:vertical).

8.13 Direct Discharges to Class I, Class II, OFWs, or Shellfishing Waters

Wet detention systems which discharge to Class I, Class II, OFWs, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting, must provide either:

(a) An additional fifty percent of both the required treatment and permanent pool volumes

(b) Pre-treatment of the stormwater prior to the stormwater entering the wet detention pond. The level of pre-treatment must be at least that required for retention, underdrain, exfiltration, or swale systems (see section 8.11 of this Volume).

8.14 References

Camp Dresser & McKee Inc (CDM). 1985. *An Assessment of Stormwater Management Programs.* Prepared for Florida Department of Environmental Regulation, Tallahassee, Florida.

Livingston, E.H., E. McCarron, J. Cox, P. Sanzone. 1988. *The Florida Land Development Manual: A Guide to Sound Land and Water Management*. Florida Department of Environmental Regulation, Nonpoint Source Management Section, Tallahassee, Florida.

Yousef, Y.A., M.P. Wanielista, L.Y. Lin, and M. Brabham. 1990. *Efficiency Optimization of Wet Detention Ponds for Urban Stormwater Management (Phase I and II).* University of Central Florida, Orlando, Florida

Dry Detention Option for north basin. Off-line linear roadside systems are required.

12.0 Dry Detention Design and Performance Criteria

12.1 Description *Revised 6/1/18*

Dry detention systems are normally dry storage areas which are designed to store a defined quantity of runoff and slowly release the collected runoff through an outlet structure to adjacent surface waters. After drawdown of the stored runoff is completed, the storage basin does not hold any water, thus the system is normally "dry." A schematic of a typical dry detention system is presented in Figure 12-1.

Dry detention basins are similar to retention systems in that the basins are normally dry. However, the main difference between the two systems is that retention systems are designed to percolate the stored runoff into the ground while dry detention systems are designed to discharge the runoff through an outlet structure to adjacent surface waters.

Sedimentation is the primary pollutant removal process which occurs in dry detention systems. Unfortunately, only pollutants which are primarily in particulate form are removed by sedimentation. Therefore, the pollutant removal efficiency of dry detention systems is not as great as systems such as retention and wet detention which remove both dissolved and particulate pollutants. Because of the limited pollutant removal efficiency of dry detention, this BMP must only be utilized where no other BMP is technically feasible. For example, use of dry detention must be restricted to the following situations:

(a) Where high ground water table or soil conditions limit the feasibility of other BMPs such as retention, and

(b) Small drainage basins (less than 5 acres). For larger projects (greater than 5 acres) other BMPs like wet detention shall be utilized instead of dry detention.

There are several design and performance criteria which must be met in order for a dry detention system to meet the District's requirements. A description of each design criterion is presented below.

12.2 Treatment Volume

For discharges to Class III receiving water bodies, the dry detention system shall provide *off-line* detention of the first one inch of runoff or 2.5 inches of runoff from the impervious area, whichever is greater.

For direct discharges to Class I, Class II, OFWs, or Class III waters which are approved, conditionally approved, restricted, or conditionally restricted for shellfish harvesting, the applicant shall provide dry detention for at least an additional fifty percent of the applicable treatment volume specified for off-line dry detention in (a),

above. Off-line detention must be provided for at least the first one inch of runoff or 2.5 inches of runoff from the impervious area, whichever is greater, of the total amount of runoff required to be treated.

Dry detention removes less pollutants on a per unit basis than other traditional best management practices. Therefore, dry detention systems must treat a greater volume of stormwater than the other treatment practices specified in this Volume to achieve an equivalent level of pollutant removal.

12.3 Recovery Time

The outfall structure shall be designed to drawdown one-half the required treatment volume specified above between 24 and 30 hours following a storm event.

12.4 Outlet Structure

The outlet structure shall include a drawdown device (such as an orifice, "V" or square notch weir) set to slowly release the treatment volume (see Figures 12-2 and 12-3 for conceptual schematics). In addition, the structure must include a device to prevent the discharge of accumulated sediment, minimize exit velocities, and prevent clogging. Examples of such devices include perforated risers enclosed in a gravel jacket and perforated pipes enclosed in sand or gravel (see Figure 12-5).

In addition, the control elevation shall be set at or above the design tailwater elevation so the basin can effectively recover the treatment storage.

12.5 Ground Water Table, Basin Floor, and Control Elevation

To minimize ground water contributions and ensure the basin floor is normally dry, the control elevation and basin floor shall be set at least one foot above the seasonal high ground water table elevation. Sumps may be placed up to one foot below the control elevation. The basin floor shall be level or uniformly sloped toward the control structure. The system may only contain standing water within 3 days of a storm event. Continuous standing water in the basin may also reduce the aesthetic value of the system and may promote mosquito production.

12.6 Basin Stabilization

The dry detention basin shall be stabilized with permanent vegetative cover.

12.7 Basin Configuration

The average length to width ratio of the dry detention basin must be at least 2:1. Under these design conditions, short circuiting is minimized and pollutant removal efficiency is maximized.

If short flow paths are unavoidable, the effective flow path can be increased by adding diversion barriers such as peninsulas or baffles to the basin. Examples of good and poor basin configurations are given in Figure 12-4.

12.8 Inlet Structures

Inlet structures shall be designed to dissipate the energy of water entering the basin.

12.9 Maintenance

Dry detention systems must include provisions for removal of sediment and debris from the basin and mowing and removal of grass clippings.

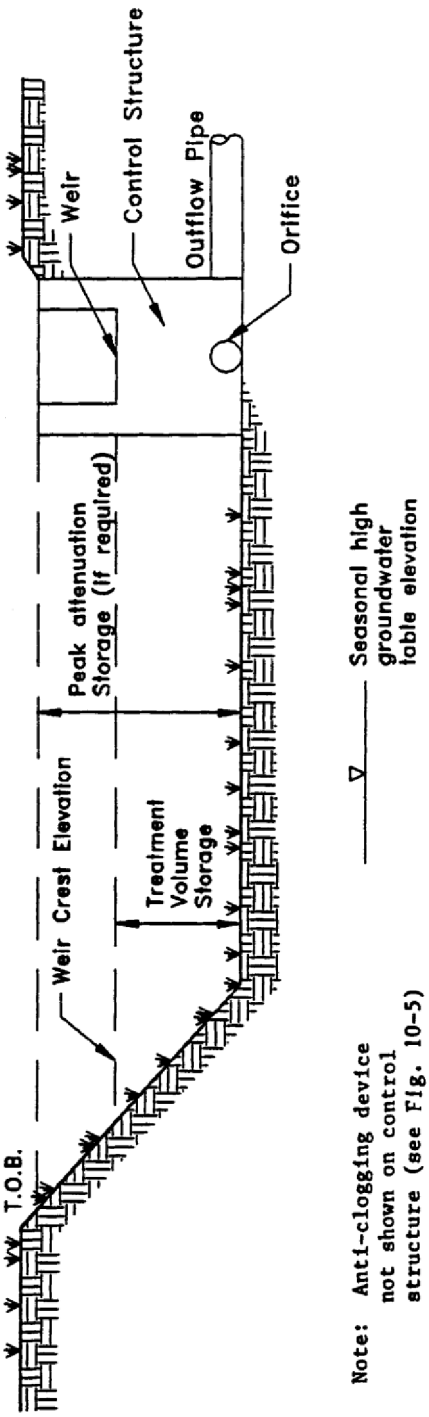

Figure 12-1 Dry detention (N.T.S.)

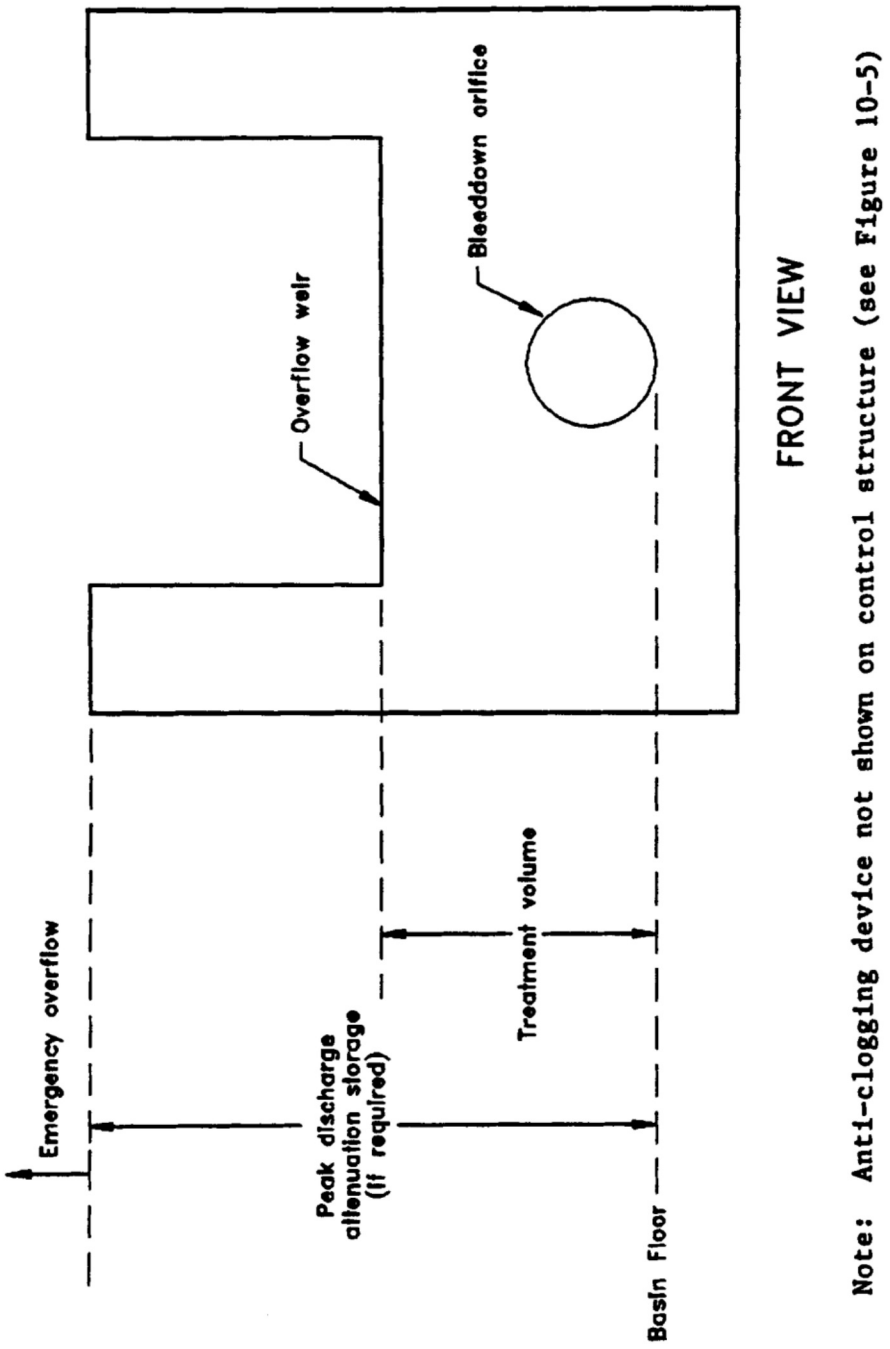

Figure 12-2. Typical dry detention outfall structure with orifice (N.T.S.)

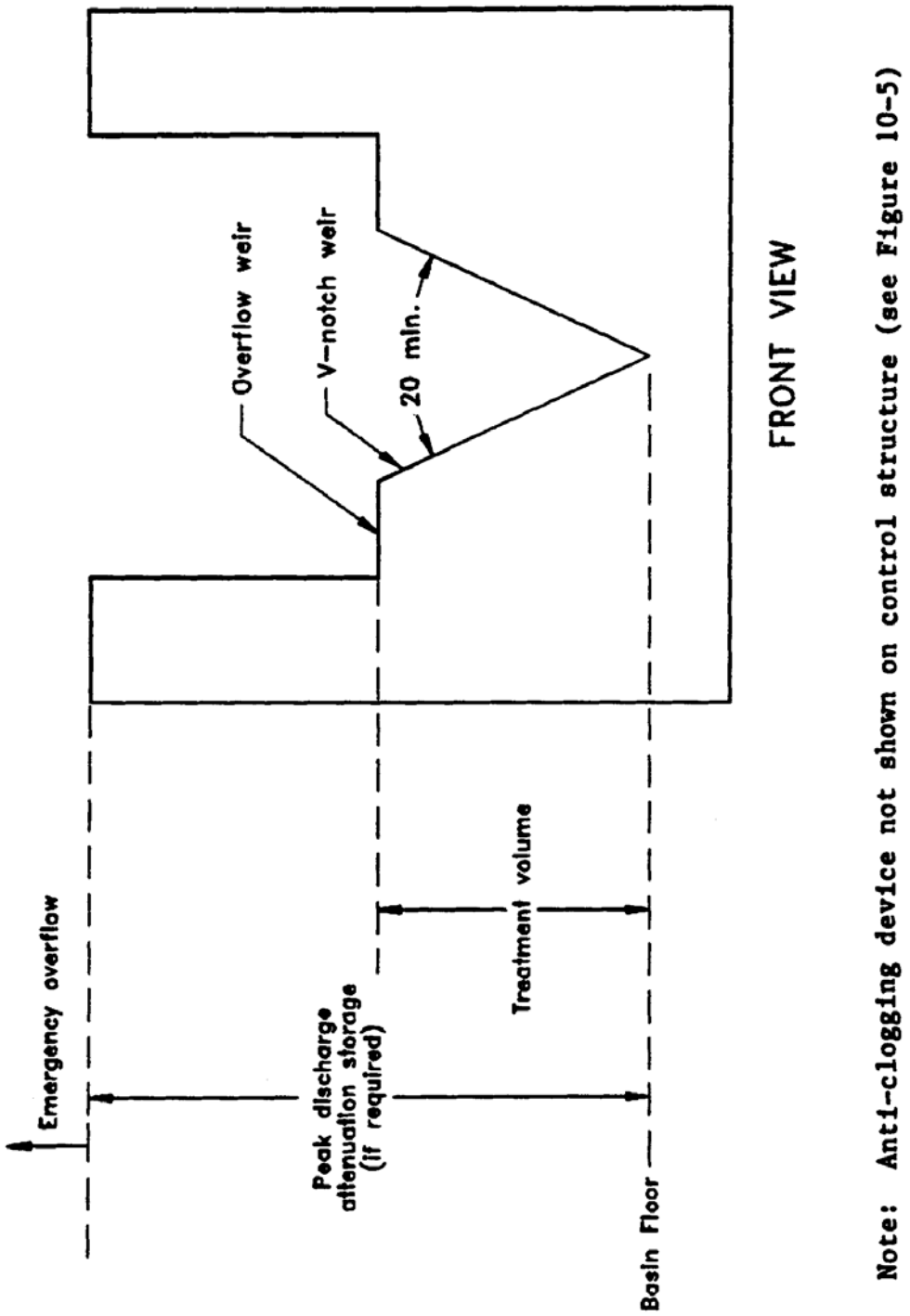

Figure 12-3. Typical dry detention outfall structure with “V”-notch weir (N.T.S.)

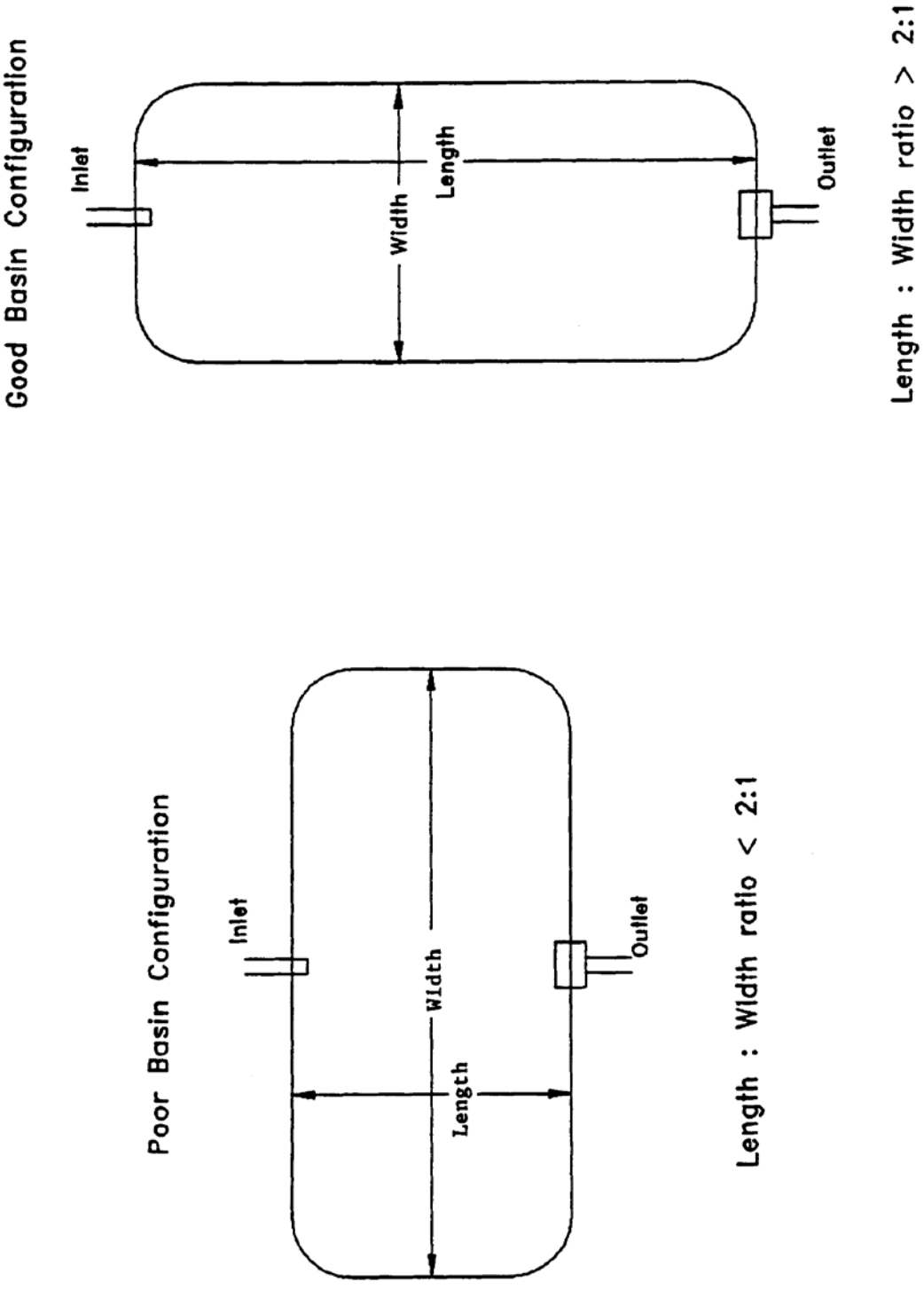

Figure 12-4. Examples of good and poor dry detention pond configurations (N.T.S.)

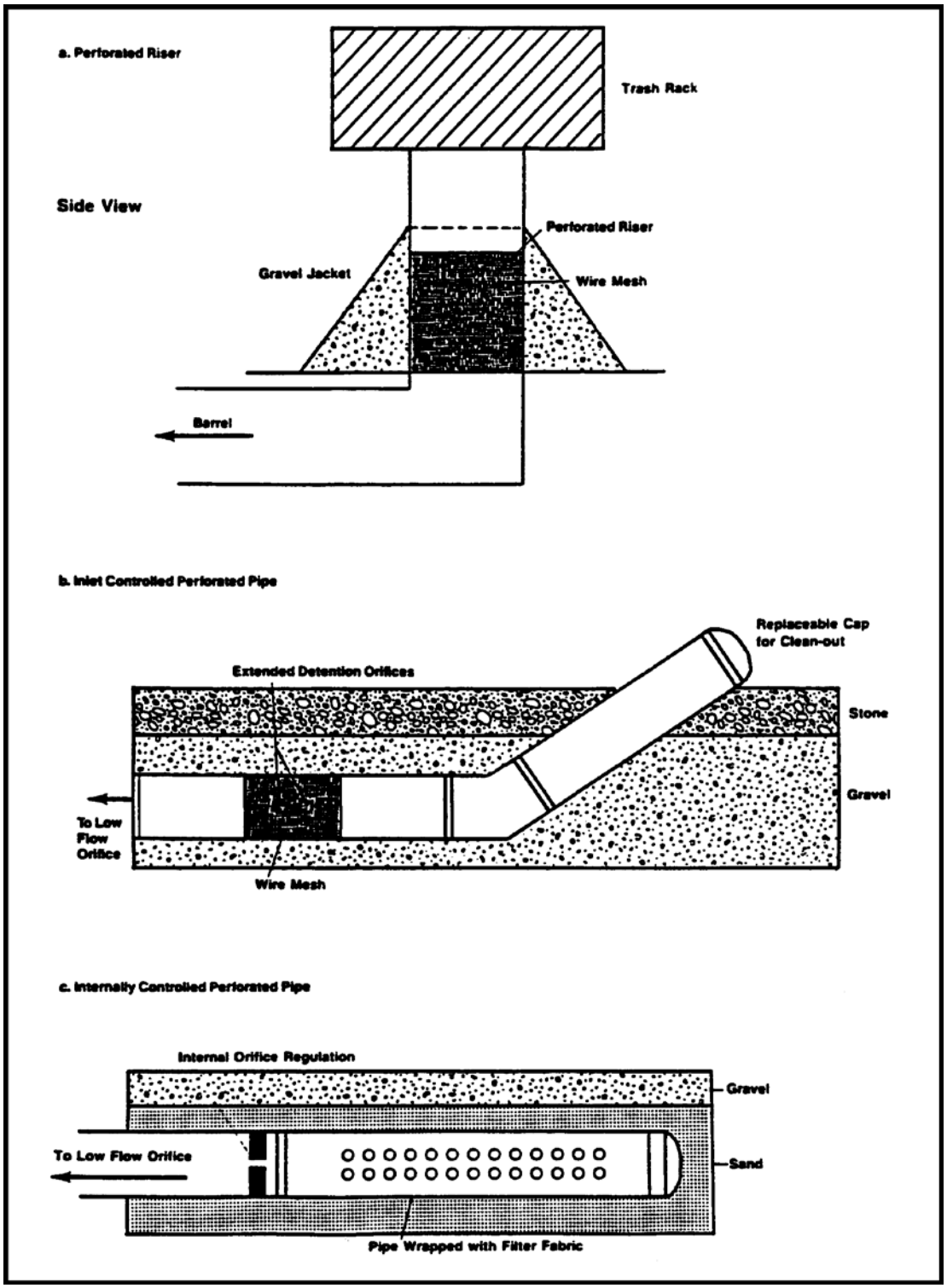

Figure 12-5. Devices to prevent clogging in dry detention control structures (Source: Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's. Metropolitan Washington Council of Governments, Washington, D.C.)