Surface Water Management Report

for

Juno Ocean Walk RV Park
Juno Beach, Florida

Prepared for:

Juno Ocean Walk Condominium Association

Prepared by:

Civil Solutions, Inc.

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I. Introduction

In response to heavy rains and flooding conditions at Juno Ocean Walk RV Park during June of 2013, the Town of Juno Beach issued a Warning Letter to the Juno Ocean Walk Condominium Association requiring the following corrective actions:

- Devise and implement an emergency plan that will ensure compliance with the Property Maintenance Code as it relates to storm events (i.e., hurricanes, heavy rains, etc.).
- Maintain property in such a manner to prevent erosion of soil and accumulation of stagnant water.

In response to the Warning Letter from the Town of Juno Beach, Juno Ocean Walk Condo Association hired Civil Solutions, Inc. to prepare a Surface Water Management Action Plan for Juno Ocean Walk RV Park. The Surface Water Management Action Plan dated March 2014 provide an assessment of the existing surface water management system, identified areas most vulnerable to flooding, developed a surface water management action plan and identified mitigation strategies to reduce flooding and improve flood protection as required by the Town of Juno Beach.

The purpose of this report is to provide an update to The Surface Water Management Action Plan for Juno Ocean Walk RV Park dated March 2014. Our scope of services includes:

- Identify potential improvements (including onsite and offsite surface water management improvements) to reduce surface water flooding (and erosion caused by flooding) and increase flood protection).
- Preliminary engineering design and analysis of potential improvements.
- Prepare preliminary cost estimates of prospective improvements.
- Prepare a report containing findings and recommendations, preliminary cost estimates, and conceptual design criteria for potential/prospective improvements.
- Review potential/prospective improvements with Juno Ocean Walk Condo Association and prioritize prospective improvements for implementation.

II. Background

Juno Ocean Walk RV Park is located in Juno Beach, Florida. The surface water management system (consisting of two surface water management lakes) was designed, permitted and constructed in the late 1970s and early 1980s.

Juno Ocean Walk RV Park has had a long history of flooding. In response to extreme flooding conditions in October 1995, the Town of Juno Beach requested emergency authorization from South Florida Water Management District (SFWMD) to install and operate a portable pump to discharge surface water from the Juno Ocean Walk RV Park to a storm water drain located in the southwest corner of the Bluff's Shopping Center.

The extreme flooding conditions in October 1995 and long history of flooding are primarily due to: design flaws; substandard design; increased impervious area; elimination of perimeter swale; and offsite discharges from adjacent properties not considered in the original design and permitting.

The June 2013 flooding highlighted the need for property owners to work with the Town of Juno Beach, Palm Beach County, and SFWMD to improve their understanding and management of flood risk so they are better prepared for future events.

III. Surface Water Management System

A. Original Authorization

On April 22, 1981 Palm Beach County granted Drainage Approval D-033-481 for Yogi Bear Recreational Vehicle Park.

SFWMD General Permit No. 81-87 was issued on May 11, 1981 authorizing the construction of a surface water management system to serve the proposed 20 acre development known as Yogi Bear Recreational Vehicle Park.

Based on a review of the original surface water management plan and calculations approved by Palm Beach County and SFWMD, the approved surface water management system consisted of a perimeter swale and buffer, and two lakes to serve the proposed 20 acre recreational vehicle park. The proposed surface water management system was designed: to provide a 3 year 24 hour level of flood protection for roads; did not provide flood protection for buildings or concrete slabs; based on a total impervious area (including an administration building, roads and travel trailers) of 23%; and without consideration of historical offsite discharges.

B. Existing Conditions

Juno Ocean Walk RV Park (formerly known as Yogi Bear Recreational Vehicle Park) is a 20 acre manufactured home community located west of U.S. Highway One at the west end of Juno Ocean Walk. The existing surface water management system consists of two lakes separated by a natural ridge (at elevation 25-28 Ft. NGVD) toward the center of the site that divides the site into two 10 acre drainage basins: an eastern basin served by the east lake; and a western basin served by the west lake. According to SFWMD General Permit No. 81-87, the two lakes are not connected and there are no discharge facilities or stormwater outfall (i.e., the surface water management system was designed and permitted for total onsite retention).

Existing conditions not in compliance with SFWMD General Permit No. 81-87 include: impervious area significantly increased from original authorization; and portions of the original surface water management system have been eliminated. As a result, soil storage and surface storage are greatly reduced and contribute to flooding conditions. Also, the substandard design which may be acceptable for a recreational vehicle (which can easily be moved to higher ground) is unacceptable for the much less mobile manufactured/mobile home.

Flooding conditions are most problematic in the eastern basin (served by the east lake) due to:

- Flooding of the entrance road affects all residents and prompted emergency action by the Town of Juno Beach in October 1995.
- Offsite discharges from properties extending east of the east property line of Juno Ocean Walk RV Park to U.S. Highway One (not considered in the original design and authorization).
- Low-lying areas (as low as 4.0 Ft. NGVD) located immediately east, west and south of the east lake.
- The east lake and eastern basin were constructed over a wetland (that extended into the Juno Dunes Natural Area) and the predominant soil of the eastern basin (according to Palm Beach County Soil Survey) is Okeelanta muck, poorly drained soils prone to flooding.

IV. Surface Water Management Plan of Improvements

A. Aims and Objectives

The aims and objectives of this Surface Water Management Plan of Improvements are:

- develop a strategy for flood and erosion risk management and identify ways to implement it
- ensure that flood risks will be managed more effectively in the future by adopting a holistic, strategic, and integrated approach
- address the importance of property owner engagement in flood risk management approaches
- work with Town of Juno Beach, Palm Beach County, and SFWMD to improve understanding and the management of flood risk
- manage surface water flood risk by improving and optimizing coordination between property owners and local organizations
- develop a shared understanding of local flood risk, including setting out priorities for action and maintenance needs
- manage flood risk from all sources and reduce the consequence of flooding on human health, economic activity, and the environment
- provide understanding of the mechanisms of surface water flooding and propose mitigation measures
- provide a framework for the management of water quality (e.g., sustainable drainage systems and urban surface)
- implement solutions which have dual benefits, can address both flood and pollution risk, and can contribute to fulfilling improvements and compliance in ecology, water quality and habitats

B. Potential Improvements

The primary causes of surface water flooding are:

- design flaws including the original design neglected to provide for offsite discharges
- substandard design based on recreational vehicle park
- greatly increased impervious area
- elimination of perimeter swale and reduction of water management areas
- offsite discharges from developments to the east (including Ocean Key at Juno Beach which was designed and permitted for total onsite retention)

Following are potential improvements to reduce surface water flooding (and erosion caused by flooding) and increase flood protection:

1. Onsite Surface Water Managements Improvements

   Onsite surface water management improvements are proposed to mitigate surface water flooding resulting from design flaws, substandard design, greatly increased impervious area, and elimination of perimeter swale and reduction of water management areas.

   A. Create Dry Retention Areas

      In 2012, engineering plans were prepared to construct a dry retention area with exfiltration trench at the South Dog Park. The plans went out for bid during the last quarter of 2012 and the stormwater management improvements were constructed during the first quarter of 2013. The construction was found to be in substantial compliance with the approved plans and specifications and a certificate of completion was issued by the Town of Juno Beach on March 28, 2013. The 0.3 acre South Dog Park/Retention Area cost $50,000 to construct, provides 1.1 acre-feet of dry retention volume (3.67 acre-feet per acre of retention area), and reduces peak flood stages and duration of flooding in the eastern basin. Due to the success of the South Dog Park/Retention Area (additional surface storage and soil storage, reduce peak stages and provide dry pre-treatment (i.e., water quality treatment) of stormwater), other common areas are being considered for the creation of additional dry retention areas.

      Based on a review of other common areas (including the North Dog Park), the area with the greatest potential to provide additional surface storage and soil storage, and reduce peak stages is the large area south of the recreational building and pool deck. Although there is shuffleboard and playground that would need to be removed during construction, the area is ideal for a dry retention area and maximization of surface and soil storage due to: 1.) it is located on the natural ridge that separates the eastern basin from the western basin and fairly flat with elevations varying from 24 Ft. NGVD to 26 Ft. NGVD; 2.) it is located near the existing South Dog Park/Retention Area; and 3.) it would be more cost effective than the South Dog Park/Retention Area (i.e., the retention volume provided per acre of retention area will be greater).

   B. Stormwater Pumping Station

The South Dog Park/Retention Area relies on a stormwater pump to transfer stormwater from the east lake and surrounding low area to the dry retention area. At this time, a portable diesel pump is rented as necessary to alleviate flooding conditions. The disadvantages of renting a pump include: inability to pump ahead of storm; noisy; high cost of fuel; and pump and hose are above ground creating a liability and obstructions. A stormwater pump station would be underground, quiet, electrical with generator backup, and available for use in anticipation of and prior to any storm event. A stormwater pump station is a major investment but cost effective over the long term.

C. Increase Soil Storage

All representatives of the Juno Ocean Walk Condominium Association including board members and individual owners need to look for ways to increase soil storage in an effort to mitigate the reduction in soil storage that has occurred due to the increase in impervious surfaces from the original authorization by SFWMD in 1981 to the present. Following are effective alternatives to increase soil storage:

- exfiltration trenches
- reduce impervious areas
- increase pervious areas; use pervious materials for driveways, walkways, common areas, and recreational areas
- roof runoff controls; make use of rainwater by directing downspouts and gutters to drain into the lawn or plant beds

Implementation will require efforts by the Board to strengthen and enforce homeowner documents, and to educate and encourage individual members and owners to be part of the solution.

D. Erosion Control

Lake banks along the shorelines of lakes within the Juno Ocean Walk RV Park have experienced severe erosion since their construction over thirty years ago. The erosion has led to movement of the shoreline in a landward direction and creation of several feet of vertical scarp along the shoreline. Juno Ocean Walk Condominium Association has contracted with Anchor Marine Environmental Services for the installation of geo-filter tube erosion control along shoreline adjacent to: east, west and south sections of the east lake; and south and east sections of the west lake.

E. Stormwater Outfall

The ultimate and long-term objective to improve flood protection by lowering flood stages and decreasing the duration of flooding is to obtain a stormwater outfall. A potential stormwater outfall is a gravity connection (consisting of a pipe

and bubble up structure) from the Juno Ocean Walk RV Park to the Juno Dunes Natural Area. According to Palm Beach County Environmental Resources Management, direct drainage connections to environmentally sensitive lands are not allowed. However, if the Juno Ocean Walk RV Park increases surface and soil storage and reduces impervious areas (to comply with SFWMD General Permit No. 81-87), and it can be shown that the hydrology of the environmentally sensitive land would benefit from receiving treated discharge from the Juno Ocean Walk RV Park, there may be an opportunity to obtain an efficient and cost-effective stormwater outfall. A stormwater outfall would require modification of SFWMD General Permit No. 81-87 and approval/authorization from Palm Beach County Environmental Resources Management.

An alternative potential stormwater outfall is a gravity connection (consisting of approximately 3,300 linear feet of pipe) extending along the north side of the Juno Dunes Natural Area from the Juno Ocean Walk RV Park to the Intracoastal Waterway. This alternative potential stormwater outfall would also require modification of SFWMD General Permit No. 81-87 and approval/authorization (and an easement through the Juno Dunes Natural Area) from Palm Beach County Environmental Resource Management.

2. Offsite Surface Water Management Improvements

Stormwater discharge from developments east of Juno Ocean Walk RV Park to U.S. Highway One accumulates in the east lake and surrounding low areas of the Juno Ocean Walk RV Park. Offsite discharge from older developments (e.g., U.S. Highway One and Juno Beach Condo) is considered historical and should have been provided for in the design of the surface water management system; however, offsite discharge from newer developments is considered unauthorized and unpermitted (e.g., Ocean Key at Juno Beach). Coordination with the Town of Juno Beach, SFWMD, Palm Beach County, Florida Department of Transportation (FDOT) and representatives of these developments is essential to reduce offsite discharges and correct erosion.

A. U.S. Highway One

Stormwater discharge from U.S. Highway One to the Juno Ocean Walk RV Park is considered historical and should have been provided for in the design of the surface water management system. In August 1996, a letter was sent to the FDOT requesting corrective actions to mitigate adverse impacts of offsite discharges to the Juno Ocean Walk RV Park. A September 1996 letter from the FDOT indicated that upon completion of an evaluation by the Department a response would be provided. In 2002, the FDOT indicated that if it can be shown that U.S. Highway One is contributing to the flooding of the Juno Ocean Walk RV Park, they would be open to allowing exfiltration trench within the road right-of-way. In 2010, the FDOT designed and constructed resurfacing, restoration and rehabilitation improvements to State Road 5 (U.S. Highway One) from just north of Parker Bridge to south of Indiantown Road. The project included milling and

resurfacing the existing roadway pavement, improving design deficiencies, enhancing safety and traffic operations through the corridor and coordination of landscaping with the municipalities as required. In addition, new sidewalks were constructed along the east and west sides of the roadway, and minor drainage improvements (including shallow swales and exfiltration trench systems (in areas where swale storage is insufficient)) were constructed to compensate for the additional impervious area and reduce flooding of adjacent properties.

B. Juno Ocean Walk

The Town of Juno Beach 5-Year Capital Improvement Program includes the following: Juno Ocean Walk - Design and build exfiltration trench and french drains needed to capture and slow storm water drainage from the roadway to minimize localized flooding. According to Juno Beach Public Works, $35,000 has been budgeted for this project and the design phase is expected to begin in 2022. The design of drainage improvements for Juno Ocean Walk should include offsite discharges from U.S. Highway One.

C. Ocean Key at Juno Beach

SFWMD Standard General Permit No. 50-04655-P was issued on September 1, 2000 authorizing the construction of a surface water management system (consisting of 752 LF of exfiltration trench) to serve 2.6 acres of a residential development known as Ocean Key at Juno Beach. According to SFWMD Standard General Permit No. 50-04655-P: 1.) the system was designed for total onsite retention; a modification of the permit would be required for construction authorization of surface water management system to serve 0.7 acres of future commercial phase (office building); 2.) the permittee (Ocean Key at Juno Beach Condominium Association) shall be responsible for the correction of any erosion, shoaling or water quality problems that result from the construction or operation of the surface water management system; 3.) no later than 90 days after construction of the water management system and every 90 days thereafter, the permittee must prepare and keep onsite a quarterly monitoring report on the condition, operation and maintenance of the surface water management system, and said reports shall be made available to the District upon request; and 4.) this special condition shall be specifically added to the condominium association documents to notify all potential owners of the operation and maintenance responsibilities associated with the proposed surface water management system.

In response to numerous complaints from representatives of Juno Ocean Walk Condominium Association, a Notice of Violation dated November 21, 2013 was sent by SFWMD to Juno Ocean Key Condominiums, LLC for non-compliance with SFWMD Standard General Permit No. 50-04655-P including: the unauthorized offsite discharge of stormwater causing flooding conditions (and erosion) which negatively impacts adjoining property owners; and failure to prepare and maintain monitoring reports pertaining to the operation and

maintenance of the stormwater management system. As a result of this violation, SFWMD sought civil penalties, recovery of staff investigative costs and remediation of the non-compliance issues (including unauthorized offsite discharge of stormwater causing flooding of Juno Ocean Walk RV Park). In order to comply with SFWMD Standard General Permit No. 50-04655-P (remediation of non-compliance issues), Juno Ocean Key was required to design and build additional exfiltration trench, lower site grading, and raise curbs and install retaining walls along the north side of the parking lot as necessary to provide total onsite retention and prevent offsite discharges during a 100 year 3 day storm event.

D. Floridian Ocean Park

Stormwater discharge from Floridian Ocean Park to the Juno Ocean Walk RV Park is considered historical and should have been provided for in the design of the surface water management system. A sump pump that was discovered within an inlet at the west end of the Floridian Ocean Park has since been removed. Plans to redevelop the site include a surface water management system designed for total onsite retention.

E. Ocean Breeze

Ocean Breeze is the proposed 2.86 acres residential development to be located at the former Floridian Ocean Park site. A surface water management system (consisting of exfiltration trench) to serve the 2.86 acres residential development was designed to provide total onsite retention. The proposed surface water management system was designed by Southern Design Group with assistance from a geotechnical engineer (to ensure effectiveness of the proposed exfiltration trench) and a structural engineer (to ensure effectiveness of the proposed retaining wall) to avoid the failings of the Ocean Key at Juno Beach.

F. Juno Beach Condo

Stormwater discharge from Juno Beach Condo to the Juno Ocean Walk RV Park is considered historical and should have been provided for in the design of the surface water management system. On August 9, 2013 the Town of Juno Beach sent notification letters (regarding discharge of stormwater onto paved/impervious surfaces) to owners of the following Unit Numbers within the development: 1, 2, 4, 5, 6, 8, 10, 13, 14, 17, 18, 19, 20, 22, 23, 25, 26, 27, 29, 31, 32, 33, 34, 36, 39, 40, 41, 45, 47, 50, 53, 54, 60, 62, 63, 64, 65, 69, 71, 74; and the Clubhouse. In response to complaints from representatives of Juno Ocean Walk Condominium Association, an additional notification letter was sent to Unit No. 61 to correct erosion caused by roof runoff.

Based on a review of historical aerial photographs, soils maps, documents and drawings for Juno Beach Condo obtained from the Town of Juno Beach,

coordination with the Town of Juno Beach including Town Clerk and Planning & Zoning to review archived drawings for Juno Beach Condo, field reviews of Juno Beach Condo including drainage facilities, impervious areas, topography, and roof drains that may have increased offsite discharges to Juno Ocean Walk RV Park, and coordination with residents of Juno Beach Condo: 1.) drawings dated 1962 show a proposed Mobile Home Court with two entrances and loop road that extends west from U.S. Highway One to the western lots of the property; 2.) the property slopes from a high elevation of 20 to 22 Ft. NGVD at U.S. Highway One to 8 Ft. NGVD at the southwest corner of the property and 2 Ft. NGVD at the northwest corner of the property; 3.) stormwater runoff from the lots is to inverted crown roads that serve as flumes to convey the runoff from the high elevations at U.S. Highway One to the lower western end of the loop road; 4.) two 24" corrugated metal pipe outfalls extend from two catch basins (one located at the western end of the north road and one at the western end of the south road) to the west property line and historically low-lying undeveloped area (and wetland) to the west. In the late 1970s and early 1980s, this low-lying undeveloped area (and wetland) was developed and is now the eastern basin (and east lake) of Juno Ocean Walk RV Park.

V. Surface Water Management Calculations

A. SFWMD General Permit No. 81-87 (Original Permit Authorization: May 11, 1981)

project area = 20.0 acres

lake area = 1.0 acre + 1.0 acre = 2.0 acres

office and administration building = 0.1 acre (5000 sq. ft.)

roadways = 1.8 acres

lots = 16.1 acres

impervious area = 1.8 acres (roads) + 0.1 acre (building) + 2.7 acres (trailers) =
4.6 acres / 20.0 acres = 23%

pervious area = 20.0 acres - (4.6 acres + 2.0 acres) = 13.4 acres (67%)

control elevation = 2.0 Ft. NGVD (based on wet season water table elevation)

soil storage = 8.18 inches (coastal soils, compacted) x 1/12 x 13.4 acres =
9.13 acre-feet / 20 acres x 12 = 5.5 inches = S

surface storage: 2.0 acres of lakes store vertically from 2.0 Ft. NGVD

Stage (Ft. NGVD)	Lake Storage (AF)
2.0	0.0
3.0	2.0
4.0	4.0
5.0	6.0

Note: This project (formerly known as Yogi Bear Recreational Vehicle Park) was designed for total onsite retention (i.e., no stormwater outfall) with the minimum road elevation based on a 3 year 24 hour storm event. The minimum finished floor elevations for permanent buildings were to be determined by adding 18" to the adjoining road elevation. The minimum finished floor criteria did not apply to temporary structures such as recreational vehicles and the concrete slabs on which the recreational vehicles are parked.

allowable discharge = 0 cfs (total onsite retention)

flood protection (according to staff report):

local road criteria	3 year 24 hour storm event
3 year 24 hour rainfall	P = 6.7 inches
3 year 24 hour stage	4.4 Ft. NGVD
min. road crown elevation	4.4 Ft. NGVD

$$Q = \frac{(P - 0.2S))^2}{P + 0.8S} = \frac{(6.7 - 0.2(5.5))^2}{6.7 + 0.8(5.5)} = \frac{32.36}{11.10}$$

Q = 2.92" x 1/12 x 20 acres = 4.85 acre-feet (AF)

Stage = 4.4 Ft. NGVD = minimum road elevation

B. Evaluation of Existing Conditions

The existing surface water management system consists of two lakes separated by a natural ridge (at elevation 25-28 Ft. NGVD) toward the center of the site that divides the site into two 10 acres drainage basins: an eastern basin served by the east lake; and a western basin served by the west lake. Existing conditions not in compliance with SFWMD General Permit No. 81-87 include: impervious area significantly increased from original authorization; and portions of the original surface water management system (including perimeter swale) have been eliminated. Flooding conditions are most problematic in the eastern basin (served by the east lake) due to: offsite discharges from properties extending east of Juno Ocean Walk RV Park to U.S. Highway One (not considered in the original design and authorization); the east lake and eastern basin were constructed over a wetland; and the predominant soil of the eastern basin is Okeelanta muck, poorly drained soils prone to flooding.

Juno Ocean Walk RV Park (East Basin)

project area = 10.0 acres (eastern basin)

lake area = 1.0 acre (east lake)

dry retention area = 0.3 acre (south dog park/retention area)

impervious area = 75% = 7.5 acres

pervious area = 10.0 acres - (7.5 acres + 1.0 acre) = 1.5 acres (15%)

control elevation = 2.0 Ft. NGVD (from SFWMD General Permit No. 81-87)

soil storage = 8.18 inches (coastal, compacted) x 1/12 x 1.5 acres
= 1.02 acre-feet / 10 acres x 12 = 1.23 inches = S

surface storage: 1.0 acre of lake stores vertically from 2.0 Ft. NGVD
0.3 acre dry retention area with exfiltration trench

Stage (Ft. NGVD)	Lake Storage (AF)	Dry Retention (AF)	Total Storage (AF)
2.0	0.0	0.0	0.0
3.0	1.0	1.1	2.1
4.0	2.0	1.1	3.1
4.4	2.4	1.1	3.5

allowable discharge = 0 cfs (total onsite retention)

flood protection (according to staff report):

local road criteria	3 year 24 hour storm event
3 year 24 hour rainfall	P = 6.7 inches
3 year 24 hour stage	4.4 Ft. NGVD
min. road crown elevation	4.4 Ft. NGVD

$$Q = \frac{(P - 0.2S))^2}{P + 0.8S} = \frac{(6.7 - 0.2(1.23))^2}{6.7 + 0.8(1.23)} = \frac{41.66}{7.68}$$

Q = 5.42" x 1/12 x 10 acres = 4.5 acre-feet (AF)

Storage required at 4.4 Ft. NGVD (minimum road elevation) = 4.5 acre-feet (AF)

Storage provided at 4.4 Ft. NGVD (in existing lake/dry retention area) = 3.5 acre-feet (AF)

Additional storage required = 4.5 AF - 3.5 AF = 1.0 acre-feet (AF)

Juno Beach Condo (Offsite Area to Juno Ocean Walk RV Park)

offsite area = 6.5 acres (Juno Beach Condo)

impervious area = 6.5 acres x 95% = 6.2 acres

pervious area = 6.5 acres – 6.2 acres = 0.3 acre (5%)

control elevation = 2.0 Ft. NGVD (from SFWMD General Permit No. 81-87)

soil storage = 8.18 inches (coastal, compacted) x 1/12 x 0.3 acres
= 0.2 acre-feet / 6.5 acres x 12 = 0.4 inches = S

$$Q = \frac{(P - 0.2S))^2}{P + 0.8S} = \frac{(6.7 - 0.2(0.4))^2}{6.7 + 0.8(0.4)} = \frac{43.82}{7.02}$$

Q = 6.24" x 1/12 x 6.5 acres = 3.4 acre-feet (AF)

Storage required = 3.4 acre-feet (AF)

Storage provided = 0.0 acre-feet (AF)

Offsite discharge to Juno Ocean Walk RV Park from Juno Beach Condo
= 3.4 acre-feet - 0.0 acre-feet = 3.4 acre-feet (AF)

In order to provide a 3 year 24 hour level of protection for roads within the Juno Ocean Walk RV Park (minimum road elevation = 4.4 Ft. NGVD):

Total additional storage required at Juno Ocean Walk RV Park (at 4.4 Ft. NGVD) = 1.0 acre-feet + 3.4 acre-feet (offsite discharge from Juno Beach Condo) = 4.4 acre-feet (AF)

VI. Findings and Recommendations

Based on our review of data obtained from the Town of Juno Beach, South Florida Water Management District, and Palm Beach County (including drawings, topographic maps, soil surveys, and historical aerials), field reviews and evaluations of existing surface water management facilities (onsite and offsite), and surface water management calculations, our findings and recommendations are summarized below:

Juno Ocean Walk RV Park has had a long history of flooding. In June 1982, in response to numerous drainage and flooding complaints from Juno Ocean Walk RV Park (formerly known as Yogi Bear Travel Trailer Park) and Floridian Ocean Park, South Florida Water Management District conducted a field inspection to see what could be done to resolve the problem. They identified the reasons for the flooding to be: 1.) "no where for the water to go" (i.e., no outfall);

and 2.) substantial runoff from upstream sites. They found "no real solution for the problem" except to raise the four affected trailers and "a permanent solution cannot be obtained until such time as an outfall is available." In response to extreme flooding conditions in October 1995, the Town of Juno Beach requested an emergency authorization from South Florida Water Management to install and operate a portable pump to discharge surface water from the Juno Ocean Walk RV Park to a storm water drain located in the southwest corner of the Bluff's Shopping Center.

The long history of flooding and extreme flooding conditions in October 1995 are primarily due to: design flaws; substandard design based on recreational vehicle park; substantial increase in impervious area from the original authorization (23% to 75%); elimination of 25' wide perimeter swale and reduction of water management areas; and offsite discharges from developments to the east were not considered in the original design.

Juno Ocean Walk RV Park is a 20 acre manufactured home community. The existing surface water management system consists of two 1.0 acre lakes (and two drainage basins) separated by a natural ridge (at elevation 25-28 Ft. NGVD) that divides the site into two 10 acre drainage basins: an eastern basin served by the east lake; and a western basin served by the west lake. According to SFWMD General Permit No. 81-87, the two lakes are not connected and there are no discharge facilities or stormwater outfall (i.e., total onsite retention). Flooding conditions are most problematic in the eastern basin due to: flooding of the entrance road affects all residents and prompted emergency action by the Town of Juno Beach in October 1995; offsite discharges from developments to the east; low-lying areas within the eastern basin (as low as 4.0 Ft. NGVD) immediately east, west and south of the east lake; and the predominant soil of the eastern basin is Okeelanta muck, poorly drained soils prone to flooding.

Potential improvements to reduce surface water flooding and increase flood protection include the creation of dry retention areas with exfiltration trench, obtain approval for a stormwater outfall, and elimination of unauthorized offsite discharges and reduction of historical offsite discharges as follows:

- Due to the success of the South Dog Park/Retention Area which was constructed in 2013, other common areas were reviewed and the area with the greatest potential to provide additional surface and soil storage is the large area south of the recreational building and pool deck. This area is ideal for a dry retention area and maximization of surface storage and soil storage due to: 1.) it is located on the natural ridge that separates the east basin from the west basin and is fairly flat with elevations varying from 24 Ft. NGVD to 26 Ft. NGVD; 2.) it is located near the existing South Dog Park/Retention Area; and 3.) would be more cost effective than the South Dog Park/Retention Area (i.e., the retention volume provided per acre of retention area will be greater).
- The ultimate and long-term objective to improve flood protection by lowering flood stages and decreasing the duration of flooding is to obtain a stormwater outfall. Potential stormwater outfalls include: 1.) a gravity connection (consisting of a pipe and bubble up structure) from the Juno Ocean Walk RV Park to Juno Dunes Natural Area; and 2.) a gravity connection extending along the north side of the Juno Dunes Natural Area to the Intracoastal Waterway.

- Unauthorized and historical offsite discharges from developments to the east that have been eliminated or reduced include: 1.) Ocean Key at Juno Beach (in 2013, in response to numerous complaints from representatives of Juno Ocean Walk RV Park, SFWMD issued a Notice of Violation to Ocean Key for non-compliance with SFWMD Standard General Permit No. 50-04655-P including unauthorized offsite discharge of stormwater causing flooding conditions which negatively impacts of adjoining property owners; 2.) Floridian Ocean Park site has been redeveloped and a surface water management system to serve the new residential development (Ocean Breeze) was designed to provide total onsite retention; 3.) in 2010, the FDOT designed and constructed resurfacing, restoration and rehabilitation improvements to U.S. Highway One from north of Parker Bridge to south of Indiantown Road and minor drainage improvements (including shallow swales and exfiltration trench systems) were constructed to reduce flooding to adjacent properties; and 4.) the Town of Juno Beach 5-Year Capital Improvement Program includes $35,000 for the design and construction of exfiltration trench needed to capture stormwater runoff from Juno Ocean Walk to minimize local flooding.

Surface water management calculations prepared for Juno Ocean Walk RV Park include: 1.) SFWMD General Permit No. 81-87 issued on May 11, 1981 which were based on a single 20 acre drainage basin (i.e., did not consider natural ridge towards the center of site that divides the site into two 10 acre drainage basins), impervious area of 23% and no offsite discharges, and set the flood protection at a 3 year 24 hour storm event (6.7" of rainfall) and minimum road elevation at 4.4 Ft. NGVD; 2.) evaluation of existing conditions for the 10 acre eastern basin (and east lake), impervious area of 75% and offsite discharges from Juno Beach Condo. Results of the surface water management calculations indicate:

- During a 3 year 24 hour storm event, the volume of runoff from Juno Ocean Walk RV Park (East Basin) and the storage required in order to provide a 3 year 24 hour level of flood protection for roads (with a minimum road elevation of 4.4 Ft. NGVD) is 4.5 AF. The storage provided (in the existing lake and South Dog Park/Retention Area) at 4.4 Ft. NGVD (the minimum road elevation) is 3.5 acre-feet. Therefore, 1.0 acre-feet of additional storage is required at 4.4 Ft. NGVD (not including offsite discharges from Juno Beach Condo).
- During a 3 year 24 hour storm event, the volume of runoff from Juno Beach Condo (which is 95% impervious and discharges directly to Juno Ocean Walk RV Park via two 24" corrugated metal pipes) is 3.4 acre-feet. The storage provided by Juno Beach Condo is 0.0 acre-feet. Therefore, 3.4 acre-feet of additional storage is required at 4.4 Ft. NGVD.
- The total additional storage required at Juno Ocean Walk RV Park (including offsite discharges from Juno Beach Condo) to provide a 3 year 24 hour level of flood protection for the roads = 1.0 AF (Juno Ocean Walk RV Park) + 3.4 acre-feet (Juno Beach Condo) = 4.4 acre-feet at 4.4 Ft. NGVD (the minimum road elevation).
- Because all of the additional storage required is to provide the roads a 3 year 24 hour level of protection and the minimum road elevation is 4.4 Ft. NGVD (per SFWMD General Permit No. 81-87), the additional storage can best be mitigated by: 1.) creation of dry retention areas with exfiltration trench (the large area south of the recreational building and pool deck has the greatest potential as a dry retention area due to the location (near the existing South Dog Park/Retention Area) and fairly flat and high topography (24 Ft. NGVD to 26 Ft. NGVD); it is ideal for dry retention and exfiltration, and maximization of surface storage and soil storage, and would be more cost effective than the South Dog Park/Retention Area); and 2.) the ultimate and long-

term objective to improve flood protection by lowering flood stages and decreasing the duration of flooding is to obtain a stormwater outfall (potential stormwater outfalls include: 1.) a gravity connection (consisting of a pipe and bubble up structure) from the Juno Ocean Walk RV Park to Juno Dunes Natural Area; and 2.) a gravity connection extending along the north side of the Juno Dunes Natural Area to the Intracoastal Waterway).

Our recommendations are: 1.) move forward with the design and construction of a dry retention area located south of the recreational building and pool area in order to provide the greatest drainage improvements in the shortest amount of time (and provide relief for the existing South Dog Park Retention Area); 2.) maintenance/improvements are required at the existing South Dog Park Retention Area including repairs to the retaining wall in order for the existing dry retention area to continue to function as designed; 3.) due to the long history of flooding, total onsite retention, substantial runoff from offsite areas, low-lying areas (as low as 4.0 Ft. NGVD), and substandard design (based on 3 year 24 hour storm event), we need to pursue other mitigation strategies (i.e., obtaining a stormwater outfall) and available funding to mitigate recurring flooding issues within Juno Ocean Walk RV Park.