Replacement

Meeting Date
December 5, 2017

AGENDA	
Section	New Business
Item No.	VI.A.1.

AGENDA REPORT

BREVARD COUNTY BOARD OF COUNTY COMMISSIONERS

SUBJECT:	Presentation by Utility Services Department, Re: Hurricane Mitigation Efforts
DEPT/OFFICE:	Utility Services Department

Requested Action:

It is requested that the Board discuss the attached PowerPoint Presentation and provide direction to staff. It is also requested that the Board authorize staff to move forward with funding for the replacement of a 3.4 mile section of the county's South Riverside Drive force main utilizing the State Revolving Fund (SRF). If SRF funds are not available, it is requested that the Board approve the County Manager and staff working with the County's Finance Advisor and Clerk of Courts to determine and utilize the best available financing option for replacement of the sewer force main and approve any necessary budgetary actions to implement Board direction.

Summary Explanation & Background:

During severe weather (rainfall) associated with and after Hurricane Irma, the south beaches sanitary sewer collection and transmission system experienced sanitary sewer discharges of approximately 20 million gallons of diluted sewage. The circumstances and data associated with this discharge are contained in the attached PowerPoint presentation "Hurricane Impacts on Sanitary Sewer Systems." A similar presentation was provided to the Citizen's Oversight Committee for the "Save Our Indian River Lagoon" (SOIRL) project on October 20, 2017. One of the specific actions suggested by the Utilities Department presentation to alleviate sewage discharges to the lagoon is to accelerate the replacement of a beachside force main.

The attached PowerPoint presentation outlines other actions underway as well as alternate potential options available to reduce sanitary sewer discharges into the Indian River Lagoon (IRL). In summary the actions are:

1. Accelerate utility-owned gravity main lining efforts for the south beaches area as well as other sensitive locations
2. Accelerate frequently failing force main replacement (as described below)
3. Perform smoke testing operations to identify defective, illegal and improper connections to the sanitary sewer system
4. Develop partnerships, where feasible, with impacted cities to explore and implement efforts to encourage private property owners to make needed corrections.
5. Develop partnerships, where feasible, with impacted cities to explore and implement more and improved severe weather responses with the goal of reducing sanitary sewer discharges into the IRL.
6. Consider, as appropriate and as directed by the BOCC, development of alternative mechanisms to reduce discharges such as considering a new Wastewater Treatment Plant, and programs to incentivize private property owners to correct defective sewer connections.
7. Other direction from the Board of County Commissioners.

The County's main sanitary sewer transmission line (force main) in the South Beaches runs approximately 13.1 miles from Sea Park on South Patrick Drive to the South Beaches Regional Wastewater Treatment Plant in Melbourne Beach. A frequently breaking 1.1 mile section of this force main from Banana River Drive to Desoto is undergoing replacement at this time and is near completion. In addition, over the past 18 months the county has experienced intermittent failures in a 3.4 mile section of the South Riverside Drive portion of the force main from Eau Gallie Boulevard to Oakland Avenue in Indialantic. The breaks of this force main have resulted in 4 discharges of sewage into the Indian River Lagoon in the last five years.

The 3.4 mile section of pipe now requires replacement to alleviate the costs of repairs and the discharges to the lagoon. The estimated construction cost of this project is approximately $10 million. The project will be designed by HDR Engineering, one of the department's continuing engineering consulting firms (see Agenda item II.C.1. of this BOCC meeting). The project will take approximately one year to design. Construction is to begin in early 2019 and will take more than a year to complete.

The County plans to use SRF for funding this project. HDR Engineering's task order includes the completion of the SRF application process. If for any reason SRF funds are unavailable, the County Manager and department staff will work with the County's Finance Advisor and the Clerk of Court's staff to explore other financing opportunities.

Contact: Jim Helmer, Utility Services Director, 321-633-2091, Jim.Helmer@brevardfl.gov

Clerk to the Board Instructions:

Exhibits Attached: Utility Services' PowerPoint presentation "Hurricane Impacts on Sanitary Sewer Systems."

Contract /Agreement (If attached): Reviewed by County Attorney	**Yes** ☐	**No** ☐	PR ☐

County Manager Frank Abbate	Assistant County Manager John Denninghoff	Department Director / Extension
	Interim Assistant County Manager Jim Liesenfelt	Jim Helmer, Utility Services Director / x52091

BREVARD County
BOARD OF COUNTY COMMISSIONERS

FLORIDA'S SPACE COAST

Tammy Rowe, Clerk to the Board, 400 South Street • P.O. Box 999, Titusville, Florida 32781-0999

Telephone: (321) 637-2001
Fax: (321) 264-6972
Tammy.Rowe@brevardclerk.us

December 6, 2017

M E M O R A N D U M

TO: Jim Helmer, Utility Services Director

RE: Item VI.A.1., Presentation by Utility Services Department Regarding Hurricane Mitigation Efforts

The Board of County Commissioners, in regular session on December 5, 2017, acknowledged and discussed PowerPoint Presentation regarding Hurricane Mitigation Efforts; and authorized staff to move forward with funding for the replacement of a 3.4 mile section of the County's South Riverside Drive force main utilizing the State Revolving Fund (SRF).

Your continued cooperation is always appreciated.

Sincerely,

BOARD OF COUNTY COMMISSIONERS
SCOTT ELLIS, CLERK

Tammy Rowe

Tammy Rowe, Deputy Clerk

cc: Assistant County Manager Denninghoff
Finance
Budget

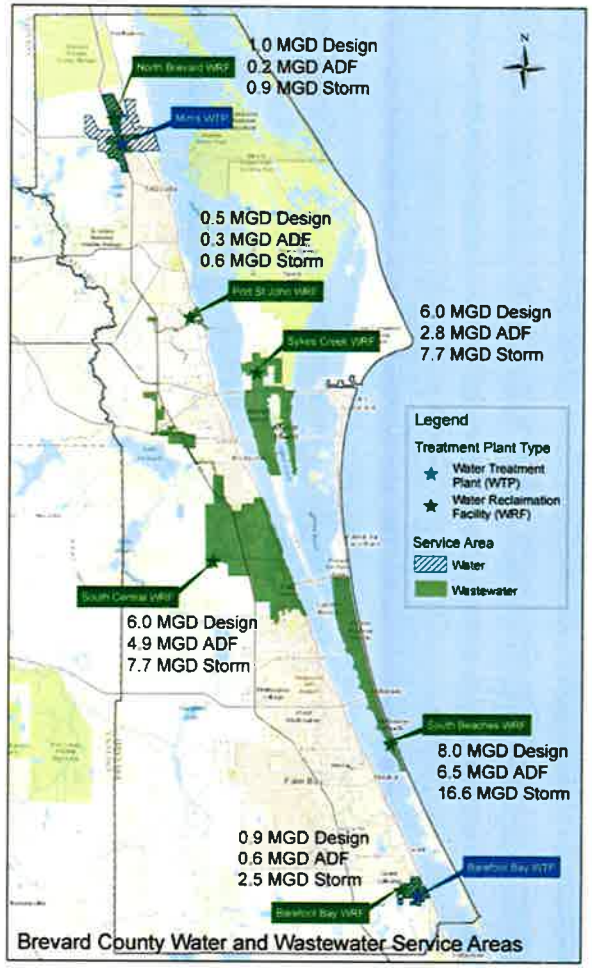
Hurricane Impacts on Sanitary Sewer Systems

Brevard County

Brevard County Utility Services Department

December 5, 2017

Brevard County Utility Services Service Locations



PEAK DAILY FLOWS DURING STORM PERIOD
September - October 2017

- Other Water and Sewer Utility Providers in Brevard County
  - Cape Canaveral
  - Cocoa
  - Cocoa Beach
  - Melbourne
  - Palm Bay
  - Rockledge
  - Titusville
  - West Melbourne
  - Private utilities

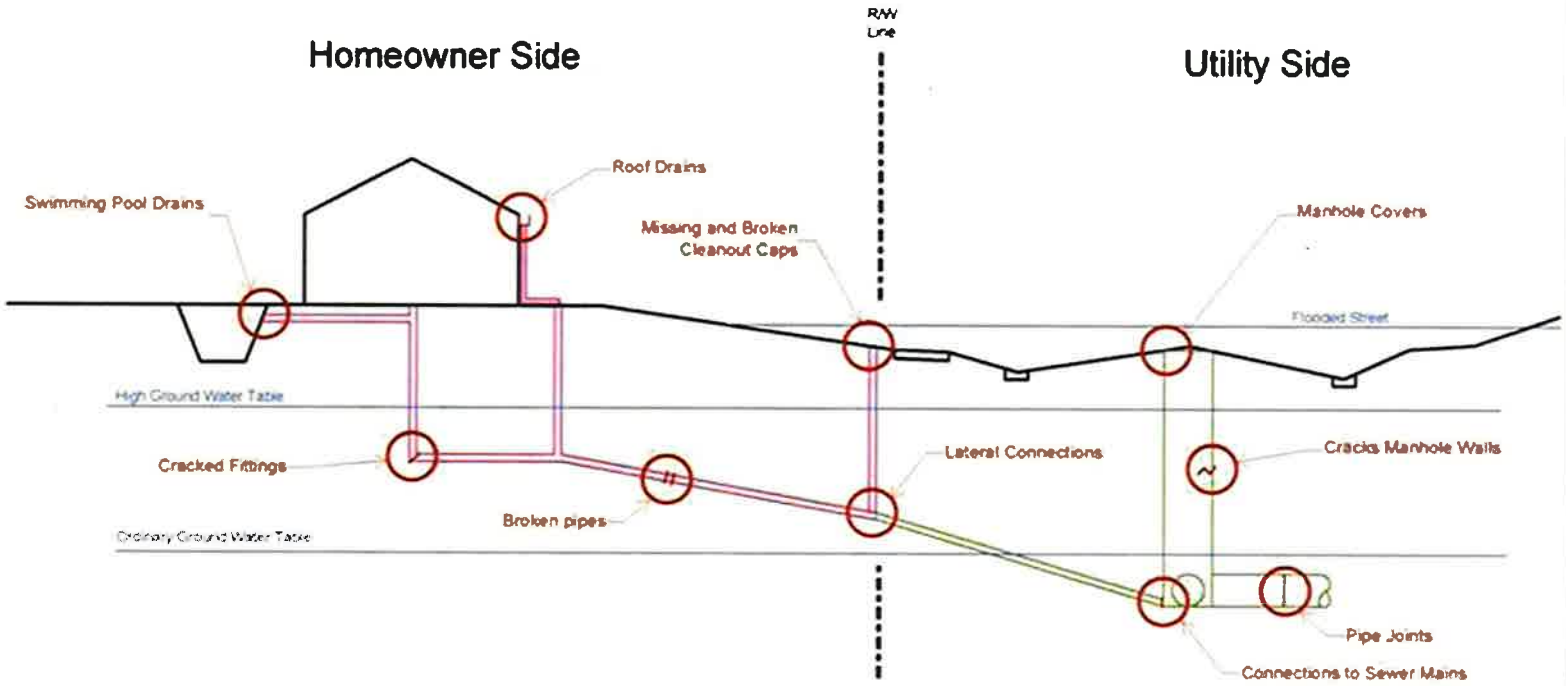
Questions

- Why has sewage been discharged into the Indian River Lagoon?
- Why wasn't it stopped sooner?
- What are we doing to prevent it in the future?
- How long will adjustments take?
- What is it going to cost?
- Who is going to pay for it?

Why has sewage been discharged into the Indian River Lagoon?

- Wastewater is discharged into the lagoon when the inflow to the sanitary sewer exceeds the capacity of the collection system
  - Designed for 8 million gallons per day
  - Hurricane Irma's 10-inches of rain dropped 2,350,000,000 gallons of water on service area
  - Sewer becomes flooded if 0.3% gets in
  - Overflows may have to be discharged in lieu of customers homes, schools and businesses
- Inflow and infiltration

Inflow and Infiltration



Typical Sources of Inflow and Infiltration (I & I)
Into the Sanitary Sewer System

Inflow and Infiltration

Observations

Distance	Length	Code	Reversed	Clock Pos.	Severity	Comment
200.3	5.5	Infiltration	No	12 / 12	Water	

How often does the sewer get flooded?

- Sewers have been flooded deep enough to cause discharge to the IRL seven times in the last 13 years
  - 2004 Hurricanes Francis (7") and Jeanne (6")
  - 2005 Hurricane Wilma (13")
  - 2008 Tropical Storm Fay (20")
  - 2014 Rained 7 days in a row September (8")
  - 2017 Hurricane Irma (10") & Oct 1st (5")
    - Actual total rainfall reported by National Weather Service in Melbourne during Sept-Oct period was 33.6"

What was recently discharged into the lagoon?

- Uncomfortable part of the discussion
- 20 million gallons of a combination of sewage and storm water were discharged to the lagoon (Sept 10 - Oct 10)
- Chart shows influence of storm water

mg/L (ppm)	Raw Sewage	WWTP Permit	Discharge to Canal	Storm Water
BOD	200	20	43	10
Nitrogen	30	12	11	2
Phosphorus	10	4	2	0.3

- 1835 pounds of nitrogen

Nitrogen Calculation

$$\frac{11\ mg}{1\ liter} \times \frac{1\ gram}{1000\ mg} \times \frac{1\ liter}{1000\ gram} \times$$

$$\frac{8.34\ lbs}{gal} \times 20{,}000{,}000\ gal = 1835\ lbs$$

(discharge volume)

(mg/L x 8.34 x number of million gal = lbs)

11 x 8.34 x 20 = 1835

Note: mg/L = ppm

Discharge Management

- Difficult decisions
  - School or retention pond
  - Houses or canal
- Discharge Priority
  - Tankers
  - On-site isolated retention pond
  - Storm water retention pond
  - Canal
- Discharged to the IRL 6 times in last 5 years for B-19 force main breaks
- Largest force main break overflow 1.4 million gallons

What about other overflows?

- Power failures
  - Adding fixed generators to more lift stations
  - Using on-site engine driven pumps
  - Partnering with Satellite Beach for support for storage of portable generators, refueling, routine maintenance, etc.
- Low lying areas along lagoon
  - As the sewer system floods, overtops manholes into streets at low elevations
  - Isolate low elevation gravity sewers from overall system and pump to higher level
  - Customer installation of high head grinder pumps at individual houses in low areas

Ongoing Improvements

- Infrastructure Asset Evaluation (2013)
- Resulted in Board approved program of $134 million of projects over 10 years
- Currently in Year 4 of 10
- March 2017 update handout
- Utility projects and operations are funded by ratepayers - not taxes
- Utility will construct four IRL (SOIRL) funded/authorized septic to sewer projects

How is this going to get fixed?

- The key is to keep storm water out of the sanitary sewer system
- Utility Services has spent $7.4 million in the last 3 years lining sewer pipes throughout system ($4.2 million in South Beaches)
- Have budgeted $1.9 million for FY-18

Reprioritization of Project Funds

- **The reprioritization accelerates implementation of improvements intended to reduce discharges while maintaining previously scheduled and badly needed infrastructure repairs**

PROJECT	LOCATION	PREVIOUS PLAN	REVISED PLAN
FORCE MAIN REPLACEMENT (B-19)	1.1 MILES-DESOTO PKWY TO BANANA RIVER DR	NOT PLANNED	$3M NEAR COMPLETION*
FORCE MAIN REPLACEMENT (B-19)	3.4 MILES-N. RIVERSIDE DR	NOT PLANNED	$10M DESIGN PLANNED**
GRAVITY MAIN RELINING	B20 BASIN - SOUTH BEACHES	$.5M IN SB, AN ADDITIONAL $1.4M PRIMARILY ON MAINLAND	$1.1M SB THIS FY*
GRAVITY MAIN RELINING	B19 BASIN - SOUTH BEACHES	NOT PLANNED	$0.8M SB THIS FY*
GRAVITY MAIN RELINING	B1 BASIN - SOUTH BEACHES	NOT PLANNED	NONE

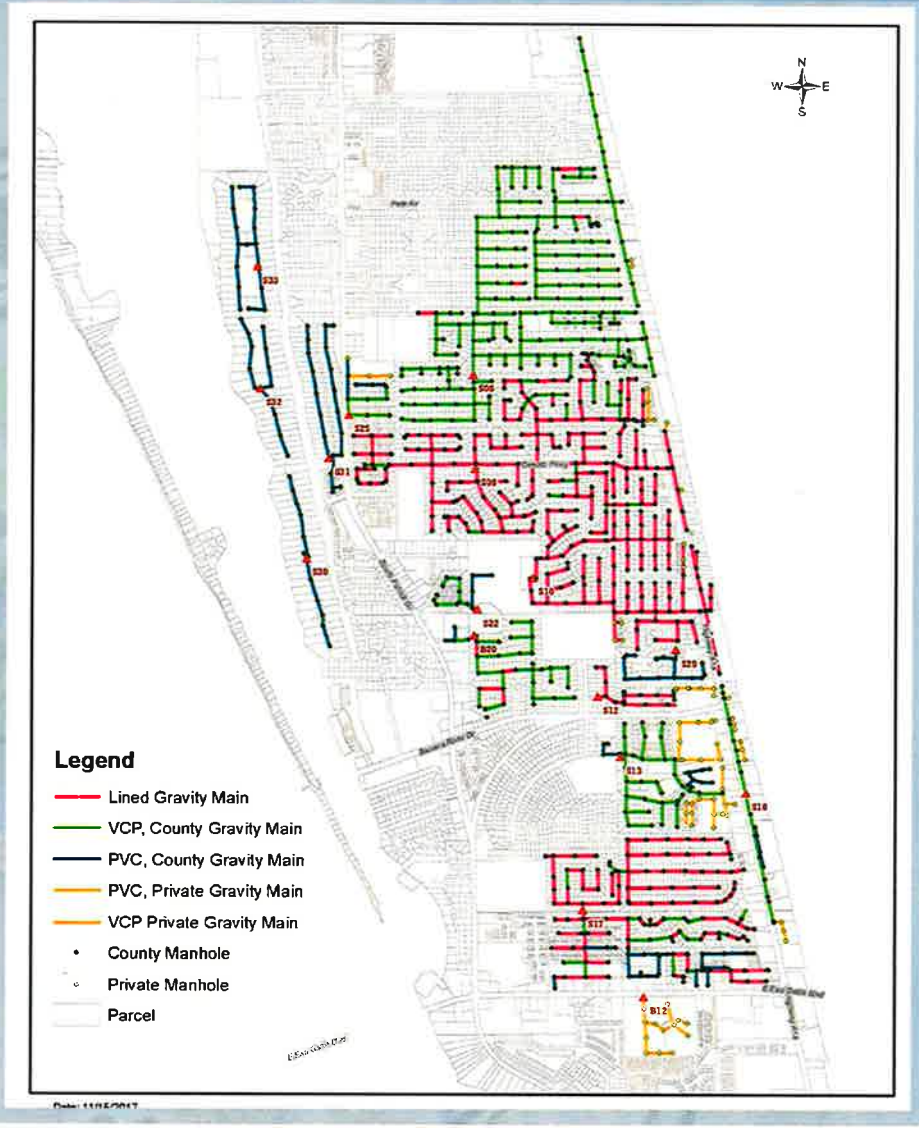
NOTE: THESE PROJECTS WILL BE FUNDED WITH EXISTING REVENUE (NO RATE INCREASE PROPOSED)

** Funds Available ** Financing Required - SRF*

South Beaches
Ongoing Sewer Lining

- Pink = already lined
- Blue = does not need to be lined
- Green = not yet lined
- Cost to line remainder = $14 million (Utility costs)
- Cost to repair laterals = unknown (Homeowner costs)

B-20 Lift Station Basin



- **100% of the clay pipes in the B-20 basin will be lined by the end of FY-18**

What can we expect from the pipe lining and repair program?

- EPA studied I&I programs that it had funded and found that up to 30% reduction could be achieved
- Does not appear to be a complete solution on that basis
- Might be enough if we can reduce 15%

How is this going to get fixed?

- Utility can repair only what is in R/W
- Need cooperation of the homeowners
- Have formed partnership with the City of Satellite Beach for a pilot test of an incentive program for inspection and repair of homeowner plumbing also in discussion with Indian Harbour Beach

Smoke Test Inspection

What other alternatives are available?

- Do nothing
  - Accept that overflows occur 0.3% of the time
  - Lowest dollar cost
  - Highest health risk and is unacceptable
- Increase capacity of sewer system
  - Oversized facilities have significant drawbacks
    - Pipes not flushed the other 99.7% of the time
    - Unreasonably high cost ($100's millions)

Alternatives

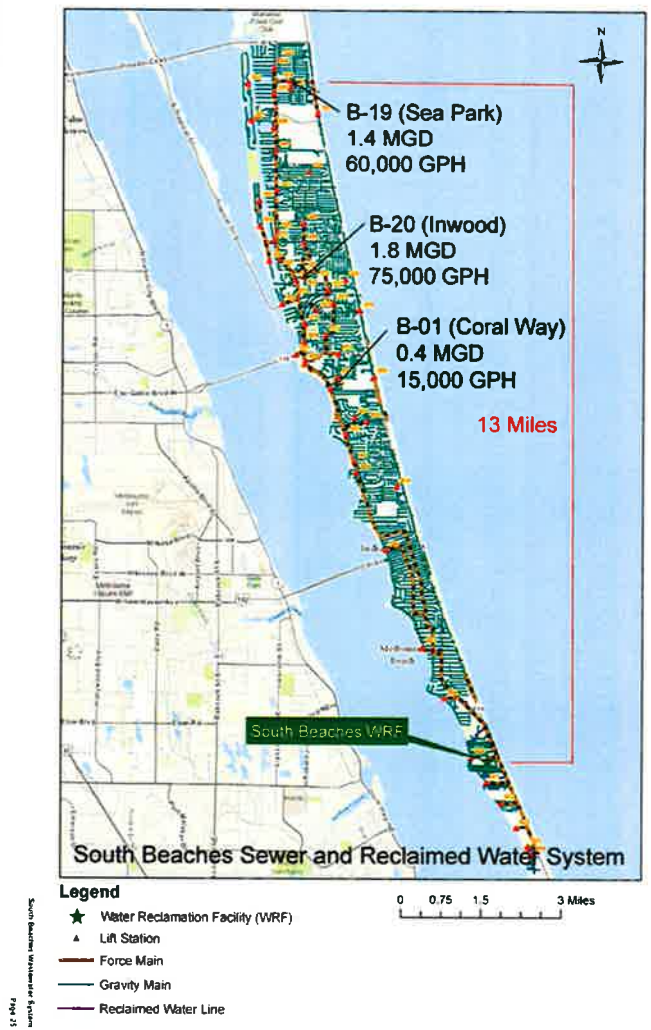
- **Store overflow** (20 million gallons)
  - Retention basins
    - Expand what we have now to avoid canal discharge
    - Land intensive - 12 acres for 20 million gallons
    - Unpopular with local residents
    - $25 million
  - Storage tanks
    - Storage tanks on soccer fields in IHB
    - 20 tanks, 75' dia., 40' high
    - Six acres
    - $30 million

Alternatives

- **Further reduce inflow and infiltration**
  - Create incentives for homeowners to repair - unfunded (cost unknown)
  - Smoke testing needs to be an ongoing effort to maintain - funded (pilot program Satellite Beach $185,000)
- **Construct WWTP in Indian Harbour Beach**
  - Taking B-20 in IHB off line and discharging to the IRL allows the remainder of the system to work
  - Construct 6.0 MGD treatment plant in IHB
  - Unfunded - Approximately $50 million
    - Would require acquisition of property
    - Would require rate increases
    - Would take 4 to 5 years to build

What about discharges from force main breaks?

- Primary sewer main from PAFB to Melbourne Beach
- B-19 force main
- Three major lift stations
- Shut off lift stations to make FM repair
- For a break south of B-01, one tanker every two minutes
- Tankers can't keep up



What are we doing to stop force main breaks?

- Replace PVC pipe with ductile iron pipe
- The sewer force main running from Desoto to Banana River Drive is in the second and final stage of replacement. The Board approved the design and construction of this 1.1 mile section of pipe on an emergency basis.
- The North Riverside force main has experienced several breaks, including two recently. An engineering task order with HDR Engineering is in process of Board approval. This three mile section of the force main will be replaced at a cost of approximately $10 million. We will apply for funds from the Florida State Revolving Fund to finance this replacement.

Pro-Active Measures

- Continuing inflow and infiltration reduction program
  - Identify priority areas for lining public sewers
  - Create partnerships with municipalities
  - Smoke test sewers and work with homeowners
  - Explore funding for incentives to homeowners for repairs
- Exploring opportunities for overflow storage and treatment
- Accelerating PVC force main replacement
- Continuing capital improvement plan

Closing

- Implementation of the improvements discussed in the presentation should reduce the magnitude and duration of future storm event impacts on the wastewater collection system

Glossary

ADF = Average daily flow
Board = Brevard County Board of County Commissioners
BOD = Biological Oxygen Demand - amount of dissolved oxygen required to break down organic material
EPA = United States Environmental Protection Agency
FM = Force main (pressurized sewer main)
FY = Fiscal year (October 1 to September 30)
Force main = Pressurized pipe that conveys pumped sewage from a lift station to a treatment plant or gravity sewer closer to the plant
GPH = Gallons per hour
Gravity sewer = A non-pressurized pipe that conveys sewage to a lift station by gravity flow
I & I = Inflow and Infiltration - water other than sanitary sewage that enters the sewer system
IHB = Indian Harbour Beach
IRL = Indian River Lagoon
Lift station = A pumping station that conveys pumped sewage to a treatment plant or gravity sewer closer to the plant
MGD = Million gallons per day
PAFB = Patrick Air Force Base
PPM = Parts per million (milligrams per liter)
PVC = Polyvinyl Chloride (plastic pipe)
Ratepayer = Customer of the Utility that pays a monthly bill for services
R/W = Right of way for a public road
WTP = Drinking water treatment plant
WWTP or WWRF = Wastewater treatment plant

VI.A.1.

City of
INDIAN HARBOUR BEACH
Florida

2055 South Patrick Drive
Indian Harbour Beach, FL 32937
Phone 321-773-3181
Fax 321-773-5080
www.indianharbourbeach.org

December 5, 2017

Commissioner Rita Pritchett, District 1
Chairperson, Brevard County Board of Commissioners
2000 South Washington Avenue
Titusville, Fl. 32780

Dear Chairperson Pritchett:

Happy Holidays!

On Tuesday, December 5, 2017, you and the entire membership of the Brevard County Board of County Commissioners will hear a presentation by Brevard County Utilities concerning the state of the County Sanitary Sewer System, the impact of more than 30 inches of rainfall before, during, and after Hurricane Irma had on the system, the discharge of approximately 20 million gallons of sewage to the Indian River Lagoon, and potential alternatives to prevent re-occurrences of these discharges.

On October 20, 2017 I attended the Save Our Indian River Lagoon ½ Cent Sales Tax Citizens' Oversight Committee Meeting to hear the presentation by Brevard County Utilities on this issue. I commend Mr. Helmer and the team at Brevard County Utilities for an excellent presentation.

While it is unclear at the writing of this letter what the December 5th presentation to you, the Board of County Commissioners, will consist of, I believe the Utilities Department will present similar alternatives that were presented on October 20th to the Citizens' Oversight Committee.

Therefore, I am submitting the following information and comments.

Indian Harbour Beach was Ground Zero for the discharge of nearly 20 million gallons of sewage to the canals and retention ponds behind homes and businesses here in our community. The residents and businesses had the unfortunate experience of seeing and smelling the impact of sewage, including solids in these water bodies, adjoining their properties. It impacted their lives. Citizens couldn't utilize their yards, the discharge was less than 300 feet from a day care facility, and one business owner informed me he had to send his employees home due to the odors and health concerns.

Before the hurricane the City of Indian Harbour Beach engaged a consultant to perform water quality testing in our community in order to create baselines for nutrient removal for various water quality projects the city may submit for funding through the ½ Cent Sales Tax.

We want to not only install these improvements to protect and improve the water quality of the lagoon, but we want to provide a scientific basis that these investments are working after the installation.

Attached you will find a copy of the preliminary analysis of samples taken on September 18, 2017 and October 19, 2017. As pointed out by Brevard County Utilities, the discharges to the lagoon following the hurricane and rainfall event were diluted. The attached water sample analysis provides information concerning samples in the area of the discharge with amounts as high as: Ammonia 7.0 mg/L, TKN 10.5 mg/L, Total Nitrogen 10.55 mg/L, and Phosphorus 1.20 mg/L.

Each of these samples far exceed the samples of other areas in the community.

Following the second sampling in October I directed the consultant to test the water near sites 7 & 8, the sites adjoining the discharge, for fecal matter. The November 27, 2017 test results for fecal reflect 206 CFU/100ml at Site 7 and 92 CFU/100ml at Site 8. It is noted that additional testing for fecal matter may be needed.

While it is unclear what alternatives are being presented, utilizing the alternatives presented to the Citizens' Oversight Committee, these alternatives need to be carefully examined and vetted with the community. One alternative presented in October is to construct a 6.0 MGD Wastewater Treatment Plant, at a cost of $50 million to the north of existing homes on Bella Coola Drive,/Wimico Drive, east of Anchor Drive, west of the Satellite Beach Library, and south of Jamaica Blvd./Trinidad Drive. A second alternative presented in October is to construct 20 above ground storage tanks, 75 feet in diameter and 40 feet tall at a cost of $30 million.

Typically, governments will hear from residents who purchased property adjoining an existing objectionable facility, such as a sewage treatment plant. The local government will be sympathetic with the complaints, but will typically point to the fact the objectionable facility pre-existed the purchase of the property. With this proposal the placement of wastewater treatment facility would occur after the property owner acquired the property. It is unclear what the placement of these facilities will have economically on these properties. That is certainly a question for a real estate appraiser or broker. However, the underlying concern on the property owners is the impact on the quality of life at their homes as they realize that the proposed facility behind their homes does not manufacture Chanel No. 5. They are deeply concerned about their property values and their re-sale values and what steps will be taken to protect their properties.

The above alternatives do not address the root cause of the discharges: inflow and infiltration. The hundreds of miles of old clay pipes used for mains and laterals will continue to leak. This must be addressed not only to prevent ground water from infiltrating into the sewer system and having to be treated, but to prevent any seepage out of the leaking pipes into the ground water and the Indian River Lagoon.

Lastly, the City of Indian Harbour Beach has embarked on a Muck Removal Assessment to dredge the canals in our community. The preliminary assessment revealed hundreds of

thousands of yards of muck to be removed. Now, being ground zero for this discharge, who knows how much additional "Stuff" must be removed as a result of this discharge. Our preliminary assessment is the muck removal in Indian Harbour Beach will cost $8 million. Will there be additional consideration in the funding ratios as a result of being Ground Zero for this discharge?

Again, I urge you to engage the community on this important issue.

Thank you.

Sincerely,

Mark K. Ryan
City Manager

enclosure

Cc: Brevard County Commissioners
Brevard County Manager, Frank Abbate
Brevard County Utilities, Jim Helmer
Brevard County Natural Resources Director, Virginia Barker

INDIAN HARBOUR BEACH
Florida

INDIAN HARBOUR BEACH WATER QUALITY SAMPLING: DRAFT DATA

December 5, 2017

Applied Ecology Inc.

WATER QUALITY SAMPLING PLAN

- Goal: Use site-specific nutrient data to prioritize basins for BMP implementation
- City initiative and funding
- Based on grab sampling to allow 11 sites to be monitored
- Initiated September 2018 - Feb 2018 (6 monthly events)
- Initial Parameters:

EPA 351.2 - Total Kjeldahl Nitrogen (TKN)
EPA 350.1 - Ammonia
EPA 353.2 - Nitrate/nitrite
EPA 365.3 - Total phosphorous
EPA 365.1 - Ortho-phosphate
SM2540D - Total suspended solids

SAMPLE EVENT 1 (SEPTEMBER 18, 2017)

Table 1: Sample Event #1 Lab Parameters

Site	TSS (mg/L)	Ammonia (mg/L)	TKN (mg/L)	NOx (mg/L)	TN (mg/L)	Orthophosphate (mg/L)	Total Phosphorus (mg/L)
Site 1	9.0	0.020	1.30	0.025	1.325	0.100	0.13
Site 2	11.5	0.020	1.50	0.039	1.539	0.100	0.16
Site 3	16.5	0.230	0.85	0.140	0.990	0.120	0.12
Site 4	5.0	0.280	0.77	0.250	1.020	0.160	0.15
Site 5	5.0	0.100	0.63	0.380	1.010	0.170	0.15
Site 6	5.0	0.160	0.62	0.320	1.940	0.100	0.12
Site 7	15.5	1.400	2.50	0.025	2.525	0.360	0.30
Site 8	42.5	7.000	10.5	0.050	10.550	1.100	1.20
Site 9	11.0	0.110	0.89	0.130	1.020	0.099	0.10
Site 10	8.5	0.079	0.96	0.130	1.090	0.092	0.10
Site 11	5.0	0.260	0.73	0.110	0.840	0.092	0.11

SAMPLE EVENT 2 (OCTOBER 19, 2017)

Table 2: Sample Event #2 Lab Parameters

Site	TSS (mg/L)	Ammonia (mg/L)	TKN (mg/L)	NOx (mg/L)	TN (mg/L)	Orthophosphate (mg/L)	Total Phosphorus (mg/L)
Site 1	7.5	0.230	0.88	0.110	0.087	0.087	0.15
Site 2	11.5	0.082	1.10	0.037	0.076	0.076	0.13
Site 3	7.0	0.300	0.69	0.340	0.120	0.120	0.16
Site 4	5.0	0.300	0.63	0.410	0.120	0.120	0.17
Site 5	5.0	0.140	0.46	0.630	0.150	0.150	0.17
Site 6	5.0	0.560	0.81	0.630	0.110	0.110	0.13
Site 7	8.0	4.000	4.50	0.056	0.550	0.550	0.62
Site 8	5.0	0.590	0.96	0.080	0.180	0.180	0.19
Site 9	13.5	0.450	1.10	0.110	0.085	0.085	0.11
Site 10	11.0	0.350	0.96	0.150	0.089	0.089	0.12
Site 11	5.0	0.310	0.56	0.086	0.073	0.073	0.12

PRELIMINARY SAMPLING EVENT #3 DATA (NOVEMBER 27, 2017)

- Added Fecal Coliform to Sites 7 & 8
- Site 7: 206 CFU/100ml
- Site 8: 92 CFU/100ml
- Chapter 62-302: Surface Water Quality Standards (EPA, 2015)

Target	EPA Rule
1	Median ≤ 14 (MPN/100mL or CFU/100mL)
2	≤ 10% exceedances (over 43 MPN/100mL or 31 CFU/100mL)
3	< 800 (MPN/100mL or CFU/100mL)

AVERAGE OF SAMPLE EVENTS 1 AND 2

Table 3. Average values for TSS, Ammonia, TKN, NOx, TN, Orthophosphate, and Total Phosphorous per site for the first two sampling events (September 18th, 2017 and October 19th, 2017).

Site ID	TSS (mg/L)	Ammonia (mg/L)	TKN (mg/L)	NOx (mg/L)	TN (mg/L)	Orthophosphate (mg/L)	Total Phosphorus (mg/L)
Site 1	8.25	0.125	1.09	0.068	1.158	0.094	0.14
Site 2	11.50	0.051	1.30	0.038	**1.338**	0.088	0.15
Site 3	11.75	0.265	0.77	0.240	1.010	0.120	0.14
Site 4	5.00	0.290	0.70	0.330	1.030	0.140	0.16
Site 5	5.00	0.120	0.55	0.505	1.050	0.160	0.16
Site 6	5.00	0.360	0.72	0.475	1.190	0.105	0.13
Site 7	11.75	**2.700**	**3.50**	0.041	**3.541**	**0.455**	**0.46**
Site 8	23.75	**3.795**	**5.73**	0.065	**5.795**	**0.640**	**0.70**
Site 9	12.25	0.280	1.00	0.120	1.115	0.092	0.11
Site 10	9.75	0.215	0.96	0.140	1.100	0.091	0.11
Site							

AMMONIA (MG/L)


10
9
11
7
8
6
3
4
5
2
1
Legend
Average Ammonia
0.05 - 0.13
0.14 - 0.22
0.23 - 0.29
0.30 - 0.36
0.37 - 3.79
IHE City Limits
0 310 620 1,240 Feet
N

TN (MG/L)

BRL Site-specific criteria for TN*:

- ❖ Annual median ≤ 1.32 mg/L
- ❖ Wet season median ≤ 1.7 mg/L

* Based on: Using multiple lines of evidence for developing numeric nutrient criteria for Indian River and Banana River lagoons, Florida (Steward, Lasi, and Phips, 2010)

TOTAL PHOSPHORU (MG/L)

BRL Site-specific criteria for TP*:

- ❖ Annual median ≤ 0.029 mg/L
- ❖ Wet season median ≤ 0.055 mg/L

* Based on: Using multiple lines of evidence for developing numeric nutrient criteria for Indian River and Banana River lagoons, Florida (Steward, Lasi, and Phips, 2010)