DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, JACKSONVILLE DISTRICT
9900 SW 107TH AVENUE, SUITE 203
MIAMI, FLORIDA 33176

May 15, 2020

Regulatory Division
South Branch
Miami Permits Section

PUBLIC NOTICE

Permit Application No. SAJ-2020-01257 (SP-MIB)

TO WHOM IT MAY CONCERN: The Jacksonville District of the U.S. Army Corps of Engineers (Corps) has received an application for a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403) as described below:

APPLICANT: Village of Islamorada
C/o Seth Lawless
86800 Overseas Highway
Islamorada, Florida 33036

WATERWAY AND LOCATION: The project would affect waters of the United States associated with the Atlantic Ocean. The project site is located at 205 Harbor Drive; legally described as Pt Lots 6 & 7 PB1-101 in Section 18, Township 63 south, Range 38 east; Plantation Key, Monroe County, Florida (RE#00093420-005500).

Directions to the site are as follows: Take U.S. 1 South to U.S. 1; Continue on U.S. 1 South to MM87; Turn left onto South Drive; Turn left onto Harbor Drive; Project is located at 205 Harbor Drive.

APPROXIMATE CENTRAL COORDINATES: Latitude 24.959022°
Longitude -80.568387°

PROJECT PURPOSE:

Basic: To restore water quality.

Overall: To restore water quality in Plantation Key, Monroe County, Florida.

EXISTING CONDITIONS: The project is located within a developed residential subdivision of Plantation Key adjacent to a canal basin referenced as Canal 132 that flows directly into the Atlantic Ocean. According to the agent, the sites were accessed by foot on March 29, 2019 and August 2, 2019. A submersible camera was used to take video recordings under water within the vicinity of the concrete seawall to note the presence sensitive aquatic resources (i.e. seagrasses, stony corals, hydrocorals, black corals, sea fans, and sponges. Due to the water clarity of the canal, visibility was low, and recordings were unable to capture any images.

PROPOSED WORK: The applicant seeks authorization to install a gravity injection well within the upland area with a connection to the surrounding canal water through a culvert, a check valve and a wedge wire intake screen will be installed at the mouth the intake culvert, and to install temporary floating turbidity barriers around all work areas that are in/over U.S. navigable waters. The maximum daily injection rate will be approximately 4.1 MGD to improve water quality by promoting circulation and reducing the presence of organic sediments.

COMPENSATORY MITIGATION – The applicant has offered the following compensatory mitigation plan to offset unavoidable functional loss to the aquatic environment: If it is determined that the issuance of a DA permit is appropriate, mitigation will be required. The applicant has indicated that the mitigation proposal will be based on the Keys Restoration Fund (KRF). Time lag and risk will be a required component of any mitigation requirement.

CULTURAL RESOURCES:

The Corps is not aware of any known historic properties within the permit area. By copy of this public notice, the Corps is providing information for review. Our final determination relative to historic resource impacts is subject to review by and coordination with the State Historic Preservation Officer and those federally recognized tribes with concerns in Florida and the Permit Area.

ENDANGERED SPECIES:

The U.S. Army Corps of Engineers (Corps) has determined the project *may affect, but is not likely to adversely affect* ("MANLAA") the West Indian manatee (*Trichechus manatus*) or its designated critical habitat. Since the proposal by the applicant is for in-water construction, potential impacts to the endangered manatee were evaluated using The Corps of Engineers, Jacksonville District, and the State of Florida Effect Determination Key for the Manatee in Florida (Manatee Key), dated April 2013. Use of the Manatee Key resulted in the following sequential determination: A > B > C > G > N > O > P5 "*may affect, but is not likely to adversely affect*." This determination partially was based on the implementation of the *Standard Manatee Conditions for In-Water Work*. The Corps will request concurrence with the U.S. Fish and Wildlife Service.

The project is located within American crocodile (*Crocodylus acutus*) the designated critical habitat area. According to the 28 October 2014 American Crocodile Key, the property does not support suitable nesting habitat for the crocodile as the shoreline is hardened. Use of the Key resulted in the sequence #2 *may affect, not likely to adversely affect*. Therefore, the Corps has reached a "may affect not likely to adversely affect" determination on the American crocodile and its suitable nesting habitat.

The Corps has determined the proposed project may affect, but is not likely to adversely affect ("MANLAA") the swimming green sea turtles (Chelonia mydas), loggerhead sea turtles (Caretta caretta), hawksbill sea turtles (Eretmochelys imbricata), Kemp's ridley sea turtles (Lepidochelys kempii), leatherback sea turtles (Dermochelys coriacea), the smalltooth sawfish (Pristis pectinata), and Nassau grouper (Epinephelus striatus) species. A no effect determination was reached on Acorpora sp. and its designated critical habitat and corals species; (Dendrogyra cylindrus, Orbicella annularis, Orbicella faveolata, Orbicella franksi, and Mycetophyllia ferox). The Corps will request National Marine Fisheries Service concurrence with this determination pursuant to Section 7 of the Endangered Species Act.

ESSENTIAL FISH HABITAT (EFH): This notice initiates consultation with the National Marine Fisheries Service on EFH as required by the Magnuson-Stevens Fishery Conservation and Management Act 1996. The proposal would impact submerged bottom utilized by various life stages of marina species. Our initial determination is that the proposed action would not have a substantial adverse impact on EFH or Federally managed fisheries in the Florida Keys. Our final determination relative to project impacts and the need for mitigation measures is subject to review by and coordination with the National Marine Fisheries Service.

NOTE: This public notice is being issued based on information furnished by the applicant. This information has not been verified or evaluated to ensure compliance with laws and regulation governing the regulatory program. The jurisdictional line has not been verified by Corps personnel.

AUTHORIZATION FROM OTHER AGENCIES: Water Quality Certification may be required from the Florida Department of Environmental Protection and/or one of the state Water Management Districts.

COMMENTS regarding the potential authorization of the work proposed should be submitted in writing to the attention of the District Engineer through the Miami Permits Section, 9900 Southwest 107th Avenue, Suite 203, Miami, Florida 33176 within 21 days from the date of this notice.

The decision whether to issue or deny this permit application will be based on the information received from this public notice and the evaluation of the probable impact to the associated wetlands. This is based on an analysis of the applicant's avoidance and minimization efforts for the project, as well as the compensatory mitigation proposed.

QUESTIONS concerning this application should be directed to the project manager, Maria Bezanilla, in writing at the Miami Permits Section, 9900 Southwest 107th Avenue, Suite 203, Miami, Florida 33176; by electronic mail at Maria.I.Bezanilla@usace.army.mil or by telephone at (305) 779-6057.

IMPACT ON NATURAL RESOURCES: Coordination with U.S. Fish and Wildlife Service, Environmental Protection Agency (EPA), the National Marine Fisheries Services, and other Federal, State, and local agencies, environmental groups, and concerned citizens generally yields pertinent environmental information that is instrumental in determining the impact the proposed action will have on the natural resources of the area.

EVALUATION: The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits, which reasonably may be expected to accrue from the proposal, must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including cumulative impacts thereof; among these are conservation, economics, esthetics, general environmental concerns, wetlands, historical properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food, and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people. Evaluation of the impact of the activity on the public interest will also include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act or the criteria established under authority of Section 102(a) of the Marine Protection Research and Sanctuaries Act of 1972. A permit will be granted unless its issuance is found to be contrary to the public interest.

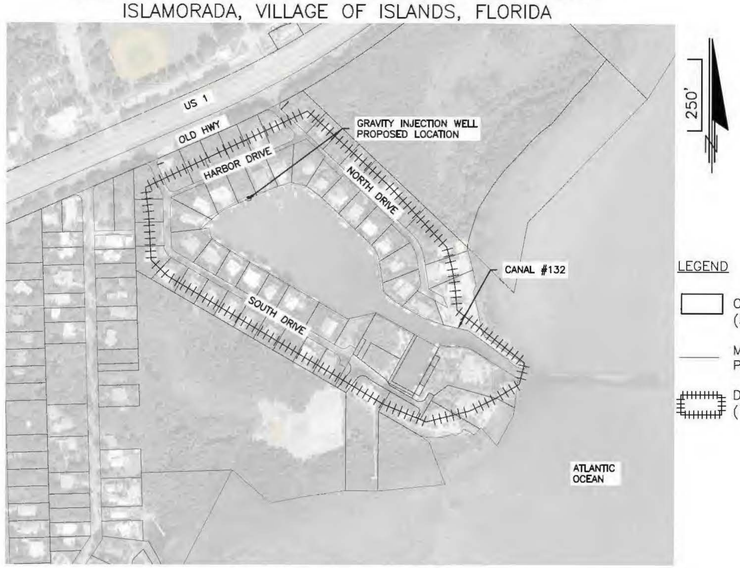
The US Army Corps of Engineers (Corps) is soliciting comments from the public; Federal, State, and local agencies and officials; Indian Tribes; and other Interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps to determine whether to issue, modify, condition, or deny a permit for this proposal. To make this determination, comments are used to assess impacts to endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

COASTAL ZONE MANAGEMENT CONSISTENCY: In Florida, the State approval constitutes compliance with the approved Coastal Zone Management Plan. In Puerto Rico, a Coastal Zone Management Consistency Concurrence is required from the Puerto Rico Planning Board. In the Virgin Islands, the Department of Planning and Natural Resources permit constitutes compliance with the Coastal Zone Management Plan.

REQUEST FOR PUBLIC HEARING: Any person may request a public hearing. The request must be submitted in writing to the District Engineer within the designated comment period of the notice and must state the specific reasons for requesting the public hearing.

FINAL DESIGN AND PERMITTING
FOR CANAL #132 GRAVITY INJECTION WELL
ISLAMORADA, VILLAGE OF ISLANDS, PLANTATION KEY, FLORIDA

LOCATED IN
SECTION 18, TOWNSHIP 63 SOUTH, RANGE 38 EAST
ISLAMORADA, VILLAGE OF ISLANDS, FLORIDA



LEGEND

- CANAL 132 FOOTPRINT (5.3 ACRES)
- MONROE COUNTY PARCEL BOUNDARIES
- DRAINAGE AREA (17.4 ACRES)

VICINITY MAP

SHEET INDEX

ATTENTION IS DIRECTED TO THE FACT THAT THESE PLANS MAY HAVE BEEN CHANGED IN SIZE BY REPRODUCTION. THIS MUST BE CONSIDERED WHEN OBTAINING SCALED DATA.

GOVERNING SPECIFICATIONS:
THE PROJECT DEVELOPMENT CODE;
CODE OF ORDINANCES ISLAMORADA VILLAGE OF ISLANDS DATED JANUARY 2016;
FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) DESIGN STANDARDS 2010;
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP);
SOUTH FLORIDA WATER MANAGEMENT DISTRICT (SFWMD);
UNITED STATES ARMY CORPS OF ENGINEERS (USACE);
IN THE EVENT OF A CONFLICT, THE MOST RESTRICTIVE APPLIES.

PLANS PREPARED BY:

wood.

WOOD ENVIRONMENT & INFRASTRUCTURE SOLUTIONS,INC
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL:(305) 826-5588 FAX (305) 826-1799
WEBSITE: www.woodplc.com

DEVELOPER

VILLAGE OF ISLAMORADA

wood.
ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL: (305) 826-5588

ENGINEER OF RECORD
STEPHEN HANKS
FL PE #72253

PROJECT:

CANAL #132 PLANTATION KEY GRAVITY INJECTION WELL FINAL DESIGN

APPLICANT:

AMEC PROJECT No:
6783-19-3137

REVISIONS

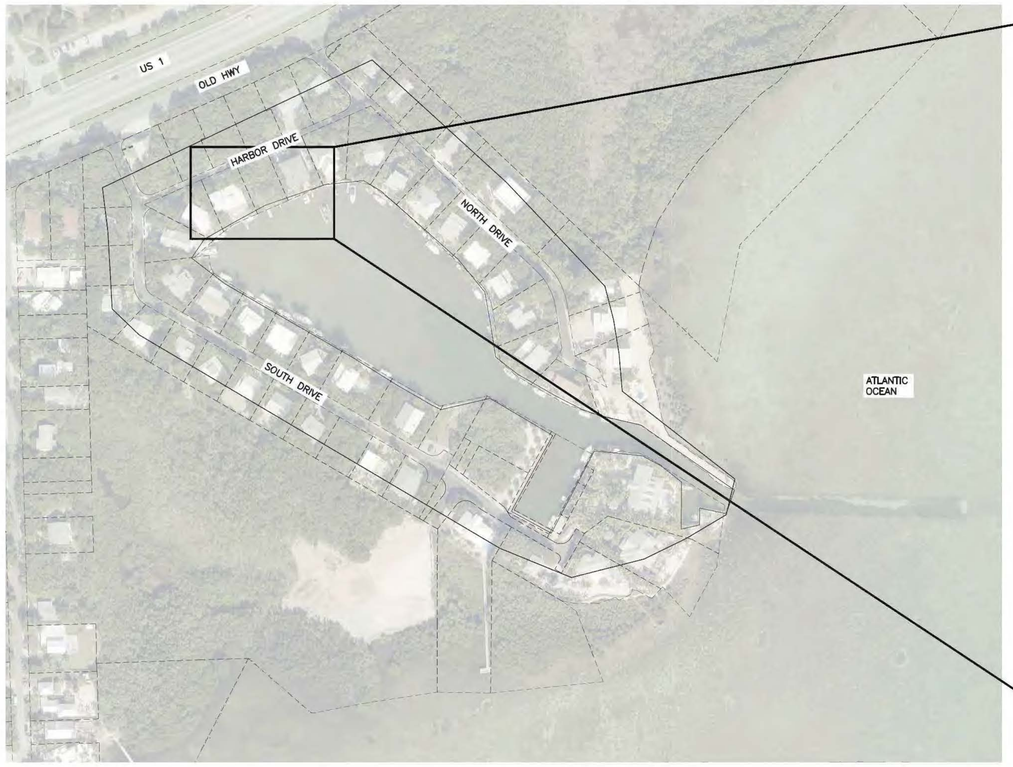
NO.	DATE	BY	APPROVED

DESIGNED BY:	SJH/GWC
DRAWN BY:	GWC
CHECKED BY:	SJH
APPROVED BY:	JK
DATE:	03/28/2019

SHEET TITLE:

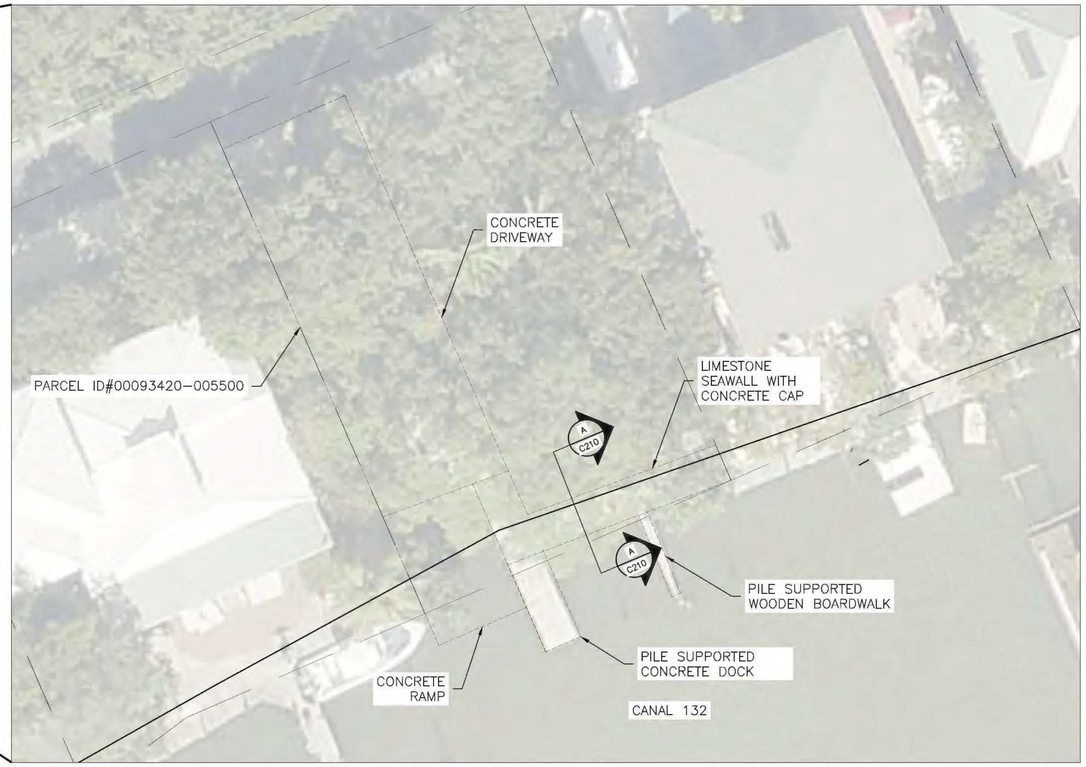
COVER SHEET

SHEET NUMBER:	REV. #
C100	
SHEET 1 OF 5 SHEETS	



OVERALL SITE LAYOUT

0 150' 300'



EXISTING SITE LAYOUT

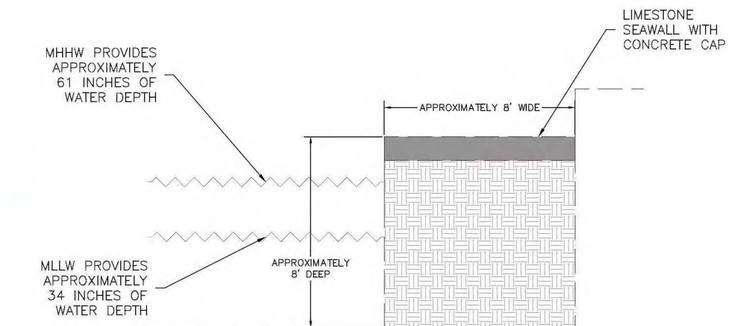
0 15' 30'

LEGEND

MONROE COUNTY PARCELS, 2010

CONCRETE DRIVEWAY, BOAT RAMP AND ELEVATED DOCK

LIMESTONE SEAWALL WITH CONCRETE CAP AND ELEVATED WOODEN DOCK



DETAIL A-A

0 3' 6'

NOTES:

1) THE MEASUREMENTS ARE BASED ON LIMITED FIELD DATA OBTAINED ON MARCH 28, 2019.

2) THE TIDE LEVELS ARE BASED ON NOAA STATION ID 8723851 IN LOWER MATECUMBE KEY, FLORIDA.

wood.

ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL: (305) 826-5588

ENGINEER OF RECORD
STEPHEN HANKS
FL PE #72253

PROJECT:

CANAL #132 PLANTATION KEY GRAVITY INJECTION WELL FINAL DESIGN

APPLICANT:

AMEC PROJECT No:
6783-19-3137

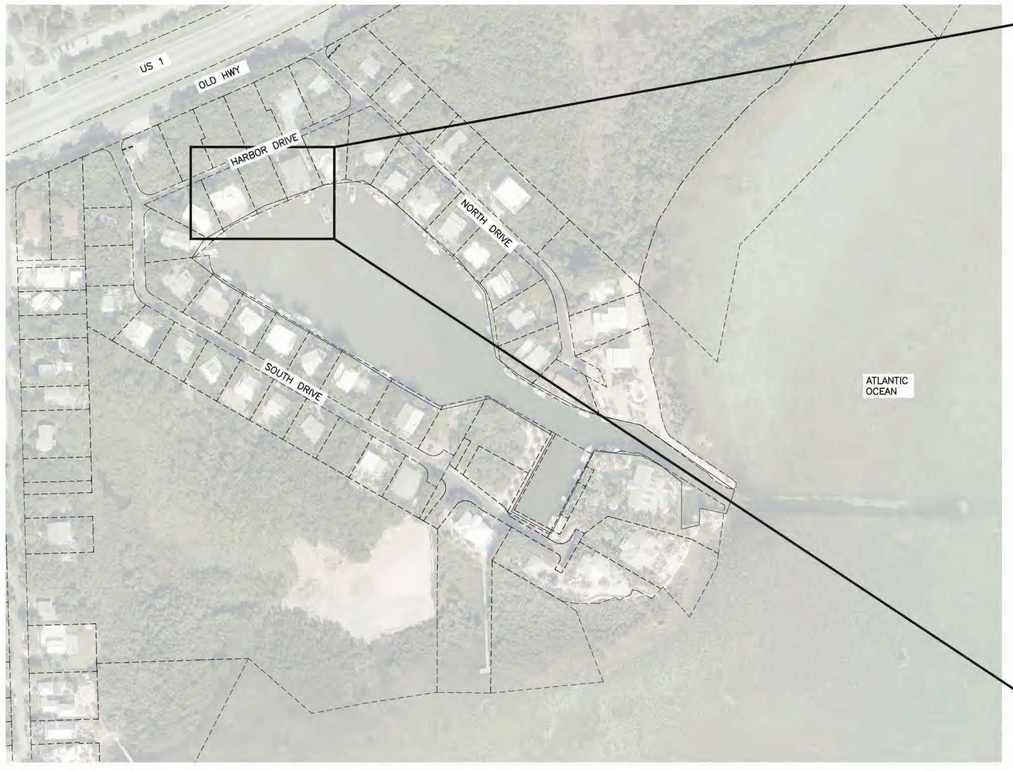
REVISIONS			
NO.	DATE	BY	APPROVED

DESIGNED BY:	SJH/GWC
DRAWN BY:	GWC
CHECKED BY:	SJH
APPROVED BY:	JK
DATE:	03/28/2019

SHEET TITLE:

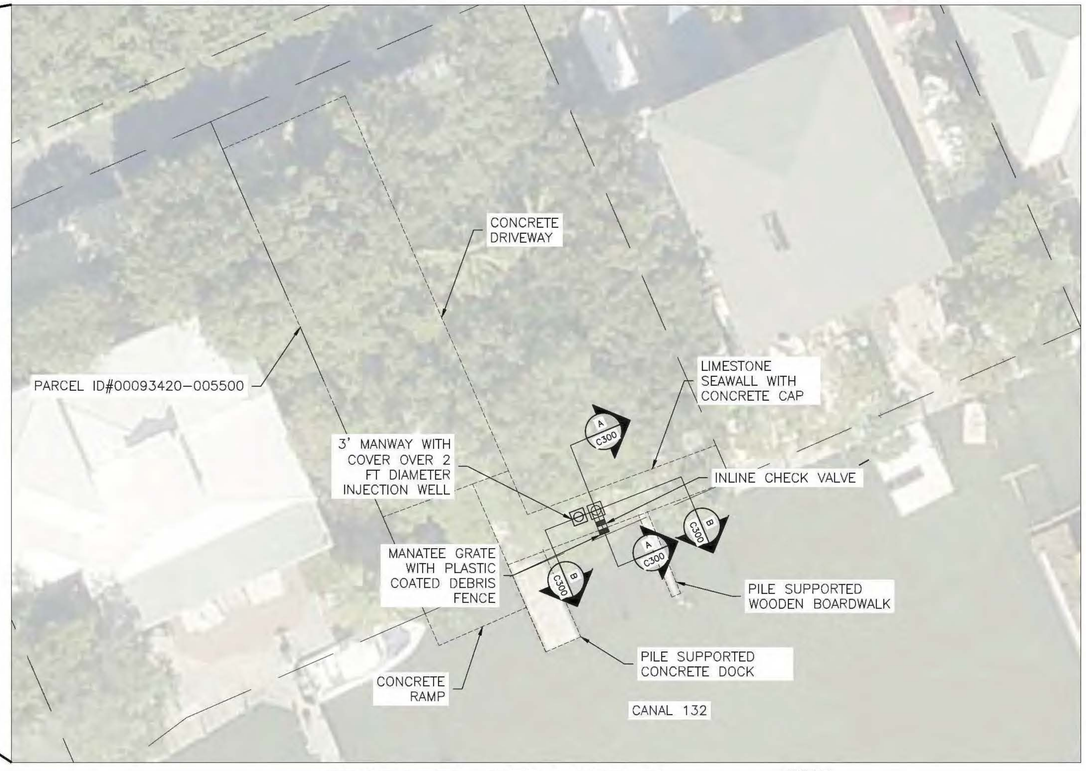
EXISTING SITE PLAN

SHEET NUMBER:	REV. #
C210	
SHEET 2 OF 5 SHEETS	



OVERALL SITE LAYOUT

0 150' 300'

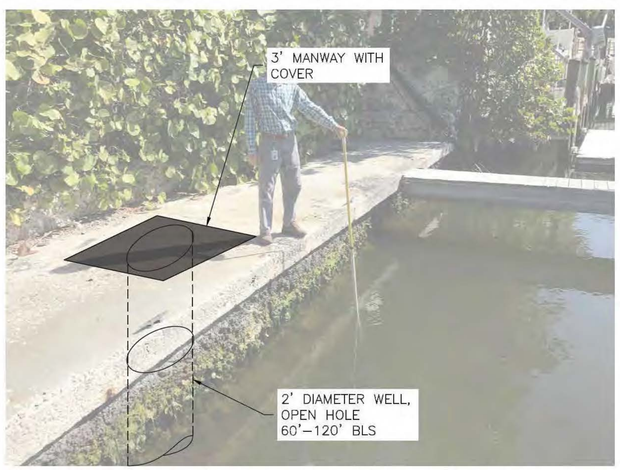


PROPOSED SITE LAYOUT

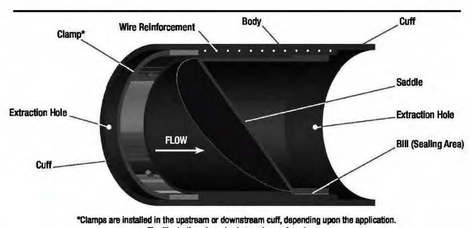
0 15' 30'

LEGEND

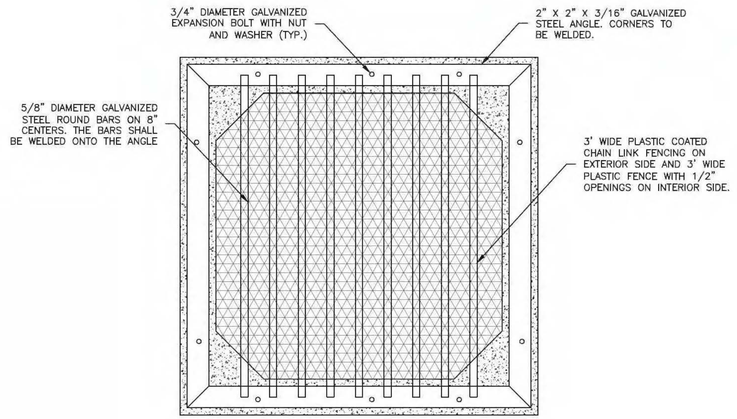
MONROE COUNTY PARCELS, 2010



PROPOSED LOCATION OF WELL ALONG SEAWALL



INLINE CHECK VALVE



MANATEE GRATE INTAKE STRUCTURE DETAIL

wood.
ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL: (305) 826-5588

ENGINEER OF RECORD
STEPHEN HANKS
FL PE #72253

PROJECT:

CANAL #132 PLANTATION KEY GRAVITY INJECTION WELL FINAL DESIGN

APPLICANT:

AMEC PROJECT No:
6783-19-3137

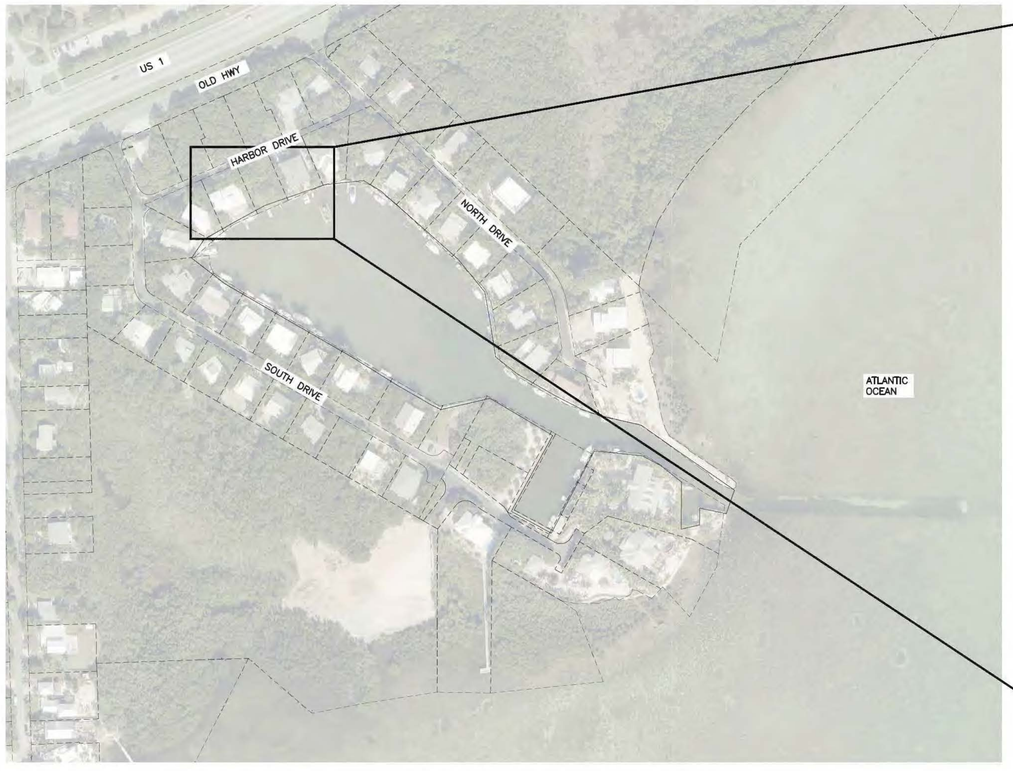
REVISIONS			
NO.	DATE	BY	APPROVED

DESIGNED BY:	SJH/GWC
DRAWN BY:	GWC
CHECKED BY:	SJH
APPROVED BY:	JK
DATE:	03/28/2019

SHEET TITLE:

PROPOSED SITE PLAN

SHEET NUMBER:	REV. #
C220	
SHEET 3 OF 5 SHEETS	



OVERALL SITE LAYOUT

0 150' 300'

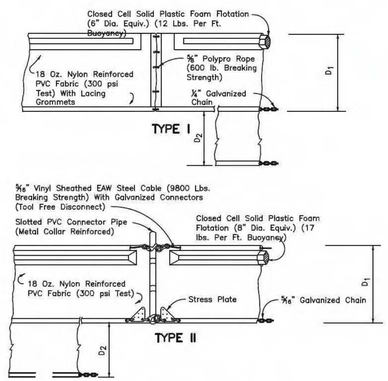
PROPOSED EROSION AND CONTROL SITE LAYOUT

0 15' 30'

LEGEND

MONROE COUNTY PARCELS, 2010

FLOATING TURBIDITY BARRIER



D1=5' Std. (Single Panel For Depths 5' or Less).
D2=5' Std. (Additional Panel For Depths > 5'). Curtain To Reach Bottom Up To Depths Of 10 Feet. Two (2) Panels To Be Used For Depths Greater Than 10 Feet Unless Special Depth Curtains Specifically Called For In The Plans Or As Determined By The Engineer.

NOTICE: COMPONENTS OF TYPES I AND II MAY BE SIMILAR OR IDENTICAL TO PROPRIETARY DESIGNS. ANY INFRINGEMENT ON THE PROPRIETARY RIGHTS OF THE DESIGNER SHALL BE THE SOLE RESPONSIBILITY OF THE USER. SUBSTITUTIONS FOR TYPES I AND II SHALL BE AS APPROVED BY THE ENGINEER.

FLOATING TURBIDITY BARRIERS

wood.

ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL: (305) 826-5588

ENGINEER OF RECORD
STEPHEN HANKS
FL PE #72253

PROJECT:

CANAL #132 PLANTATION KEY GRAVITY INJECTION WELL FINAL DESIGN

APPLICANT:

ISLAMORADA, VILLAGE OF ISLANDS

AMEC PROJECT No:
6783-19-3137

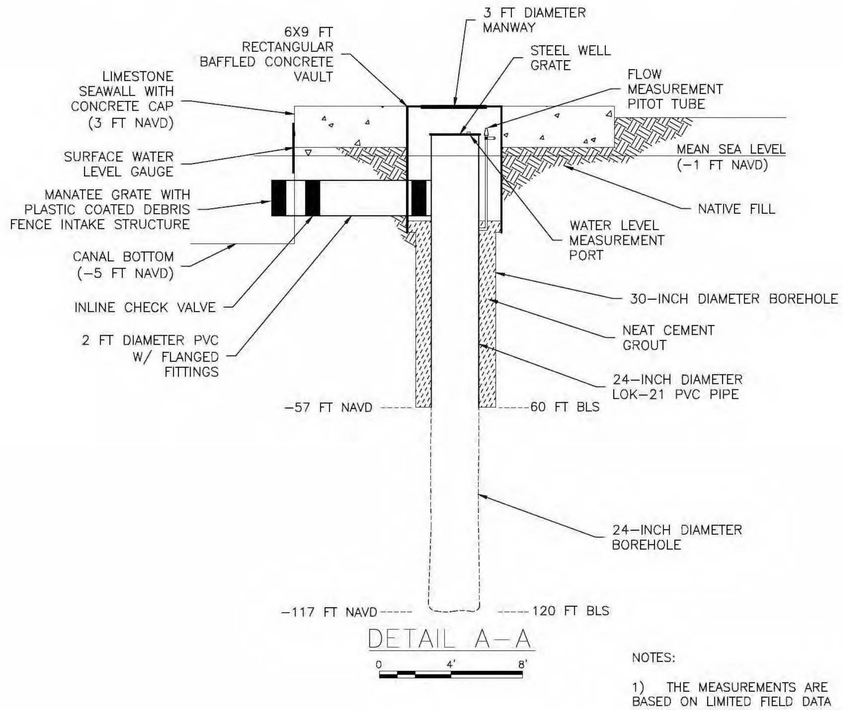
REVISIONS			
NO.	DATE	BY	APPROVED

DESIGNED BY:	SJH/GWC
DRAWN BY:	GWC
CHECKED BY:	SJH
APPROVED BY:	JK
DATE:	03/28/2019

SHEET TITLE:

PROPOSED EROSION AND SEDIMENT CONTROL PLAN

SHEET NUMBER:	REV. #
C230	
SHEET 4 OF 5 SHEETS	

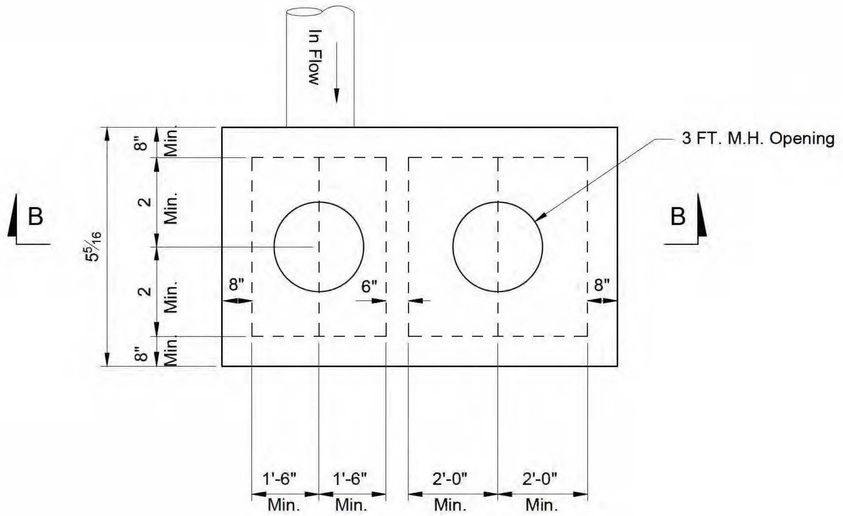


DETAIL A-A

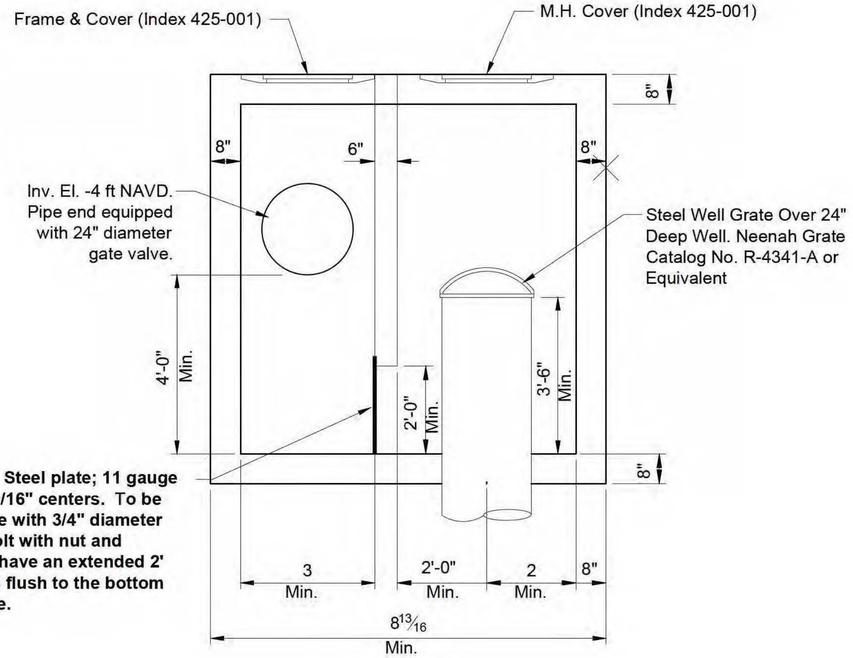
NOTES:

1) THE MEASUREMENTS ARE BASED ON LIMITED FIELD DATA OBTAINED ON MARCH 28, 2019.

2) THE TIDE LEVELS ARE BASED ON NOAA STATION ID 8723851 IN LOWER MATECUMBE KEY, FLORIDA.



TOP SLAB PLAN



Perforated 304 Stainless Steel plate; 11 gauge with with 3/8" holes on 9/16" centers. To be connected to lower baffle with 3/4" diameter galvanized expansion bolt with nut and washer. The plate shall have an extended 2' inch angle bend that sits flush to the bottom and sides of the manhole.

SECTION B-B

wood.

ENVIRONMENT & INFRASTRUCTURE SOLUTIONS, INC.
5845 NW 158TH STREET
MIAMI LAKES, FL 33014
TEL: (305) 826-5588

ENGINEER OF RECORD
STEPHEN HANKS
FL PE #72253

PROJECT:

CANAL #132 PLANTATION KEY GRAVITY INJECTION WELL FINAL DESIGN

APPLICANT:

AMEC PROJECT No:
6783-19-3137

REVISIONS			
NO.	DATE	BY	APPROVED

DESIGNED BY:	SJH/GWC
DRAWN BY:	GWC
CHECKED BY:	SJH
APPROVED BY:	JK
DATE:	03/28/2019

SHEET TITLE:

PROPOSED DETAILS

SHEET NUMBER:	REV. #
C300	
SHEET 5 OF 5 SHEETS	

TECHNICAL MEMORANDUM

Prepared For: Mr. Peter Frezza, Village of Islamorada

Prepared By: Wood Environment & Infrastructure Solutions, Inc.

Subject: Canal 132 – Injection Well Conceptual Design

The gravity flow injection well system will be comprised of an intake structure, a check valve, a gate valve, and a two foot diameter injection well. The injection well will be constructed of a two foot diameter LOK 21 PVC casing advanced to 60 feet bls, with an open hole interval from 60 feet to 120 feet bls. The equipment specifications for the LOK 21 PVC casing are provided in Attachment D. The annulus of the PVC casing will be sealed with neat cement grout from 60 feet bls to the base of the access structure. The well cover will be equipped with an access port to allow for water level gauging. The well will be equipped with a Dwyer DS-400 pitot tube to facilitate flow measurement. Additionally, the headwall near the intake structure will be equipped with a surface water gauge to facilitate the measurement of surface water elevation.

The intake structure will prevent entrapment and impingement of marine life, and the check valve will prevent backflow during low tide conditions. The gate valve will allow for flow control, and to provide off-line status for maintenance activities.

The injection rate estimate is provided in Attachment G. Due to the potential variability in flow capacity of the aquifer at the site, two injection rate scenarios were evaluated. The first, the conservative scenario, estimated the potential daily injection volume using the hydraulic conductivity for the Key Largo Limestone formation observed in Big Pine Key of 1,400 m/d (Halley 1997), and the average hydraulic conductivity of the Tamiami Formation (as an estimate for the Long Pine Key formation) of 170 m/d (Fish 1991) to estimate an average hydraulic conductivity at the site of 1,300 m/d. Based on the findings of the dye tracer study for Cudjoe Key (Briceno 2014), it was assumed that the average piezometric elevation in the well would be equal to mean sea level.

Based on the information provided in “Tidal and Meteorological Influences on Shallow Marine Groundwater Flow in the Upper Florida Keys” (Reich 2013), it is anticipated that inflow to the well will only occur during the incoming tide at a head differential of approximately 70-percent of the water surface elevation differential above mean sea level. Injection rates were estimated using both the transmissivity of the aquifer and flow through an orifice. It was determined that the transmissivity of the aquifer was the determining factor for the injection rate.

Based on the characteristic tides for tide station 8723769 – Plantation Key, it is estimated that a maximum injection rate of approximately 910 gallons per minute (gpm) will be observed for the conservative scenario, resulting in a daily injection volume of 0.37 Million Gallons per Day (MGD). Based on the geometry of Canal 132, it is estimated that this volume represents a 3.2% increase in water body turnover.

For the second scenario, the upper range scenario, the potential daily injection volume was estimated using the average hydraulic conductivity for the Key Largo Limestone formation observed in Dade County of 5,600 m/d (Fish 1991), and the average hydraulic conductivity of the Tamiami Formation of 170 m/d (Fish 1991) to estimate an average hydraulic conductivity at the site of 5,200 m/d. Additionally, it was assumed that the mean piezometric level in the injection well would be 0.81 feet below mean sea level based on the vertical hydraulic gradient

well would be 0.81 feet below mean sea level based on the vertical hydraulic gradient observations at Turkey Point (FPL 2016). Therefore, it was assumed for the upper range scenario that inflow to the well will only occur during the incoming tide at a head differential of approximately 70-percent of the water surface elevation differential above 0.81 feet below mean sea level. As with the conservative scenario, the transmissivity of the aquifer was the determining factor for the injection rate, rather than the orifice flow injection rate.

It is estimated for the upper range scenario that a maximum injection rate of approximately 6,700 gpm will be observed, resulting in a daily injection volume of 4.1 MGD. Based on the geometry of Canal 132, it is estimated that this volume represents a 35% increase in water body turnover.

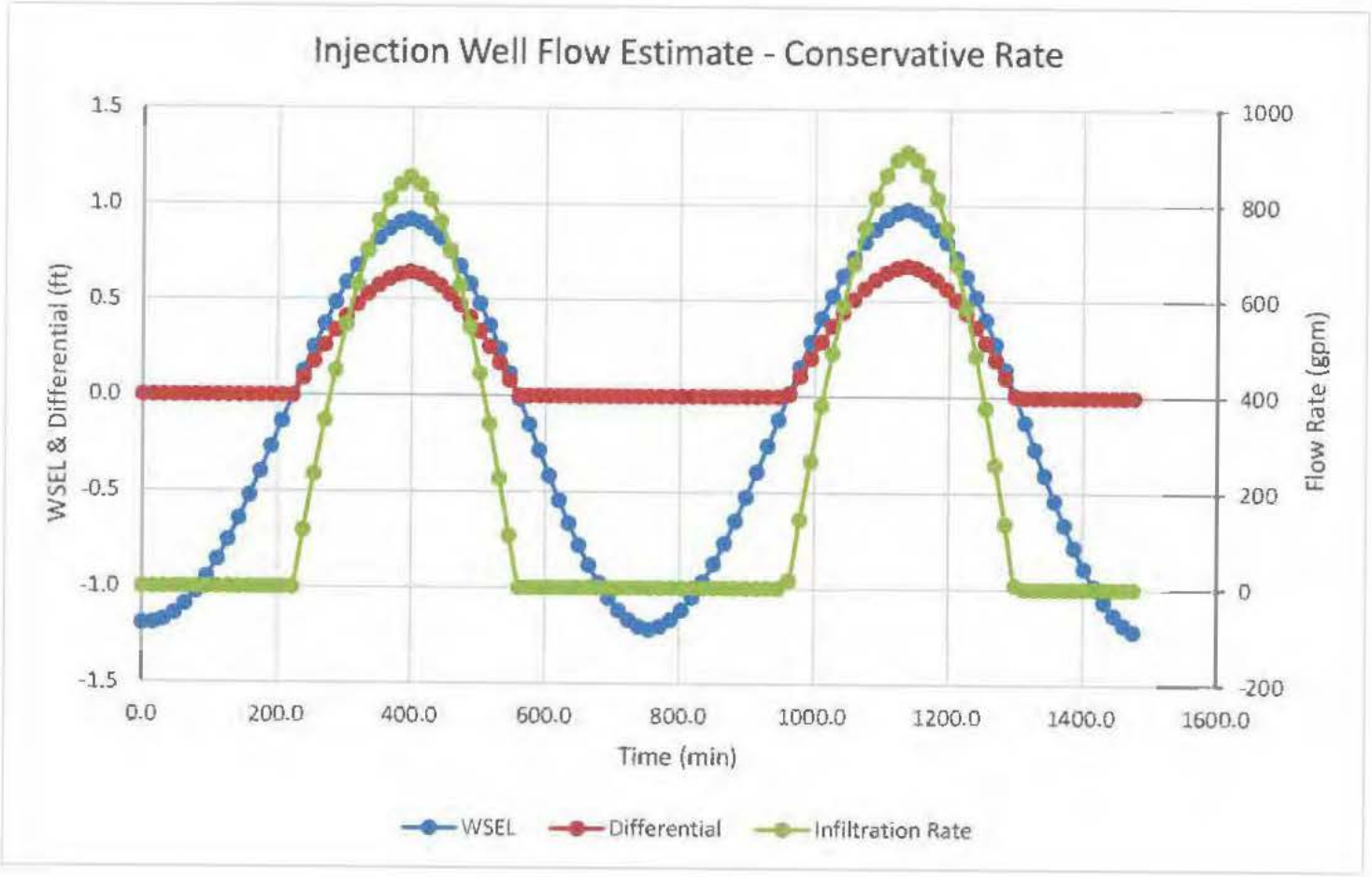
Simulation Time (Hours)	Simulation Time (Minutes)	Water Surface Elevation (WSEL)[1] (ft NAVD)	WSEL (ft above MSL)	Maximum Potential Orifice Differential (feet)	Conservative Head Differential (feet above MSL)	Upper Range Head Differential (feet above MSL)	Conservative Orifice Incremental Flow Rate (gpm)	Upper Range Orifice Incremental Flow Rate (gpm)	Conservative Transmissivity Based Incremental Flow Rate (gpm)	Upper Range Transmissivity Based Incremental Flow Rate (gpm)	Conservative Infiltration Volume (gallons)	Upper Range Infiltration Volume (gallons)
0.0	0	-2.08	-1.19	1.81	0.00	0.00	0	0	0	0	0	0
0.3	16	-2.08	-1.19	1.81	0.00	0.00	0	0	0	0	0	0
0.5	32	-2.06	-1.17	1.83	0.00	0.00	0	0	0	0	0	0
0.8	48	-2.03	-1.14	1.86	0.00	0.00	0	0	0	0	0	0
1.1	64	-1.98	-1.09	1.91	0.00	0.00	0	0	0	0	0	0
1.3	80	-1.92	-1.03	1.97	0.00	0.00	0	0	0	0	0	0
1.6	96	-1.84	-0.95	2.05	0.00	0.00	0	0	0	0	0	0
1.9	111	-1.75	-0.86	2.14	0.00	0.00	0	0	0	0	0	0
2.1	127	-1.65	-0.76	2.24	0.00	0.04	0	1.741	0	197	0	3.136
2.4	143	-1.53	-0.64	2.36	0.00	0.12	0	3.074	0	614	0	9.770
2.7	159	-1.41	-0.52	2.48	0.00	0.20	0	4.040	0	1.061	0	16.880
2.9	175	-1.29	-0.40	2.60	0.00	0.29	0	4.852	0	1.530	0	24.352
3.2	191	-1.16	-0.27	2.73	0.00	0.38	0	5.568	0	2.015	0	32.070
3.4	207	-1.03	-0.14	2.87	0.00	0.47	0	6.212	0	2.508	0	39.912
3.7	223	-0.89	0.00	3.00	0.00	0.56	0	6.795	0	3.000	0	47.754
4.0	239	-0.76	0.13	3.13	0.09	0.65	2.702	7.324	119	3.485	1.888	55.472
4.2	255	-0.64	0.25	3.25	0.18	0.74	3.812	7.801	236	3.955	3.757	62.944
4.5	271	-0.52	0.37	3.37	0.26	0.83	4.626	8.230	348	4.401	5.534	70.053
4.8	287	-0.40	0.49	3.49	0.34	0.91	5.274	8.611	452	4.818	7.192	76.687
5.0	302	-0.30	0.59	3.59	0.41	0.98	5.803	8.944	547	5.198	8.706	82.742
5.3	318	-0.21	0.68	3.68	0.47	1.04	6.235	9.230	631	5.536	10.051	88.120
5.6	334	-0.13	0.76	3.76	0.53	1.09	6.583	9.469	704	5.826	11.205	92.738
5.8	350	-0.07	0.82	3.82	0.57	1.14	6.855	9.661	763	6.064	12.151	96.524
6.1	366	-0.02	0.87	3.87	0.61	1.17	7.056	9.804	809	6.246	12.874	99.416
6.4	382	0.01	0.90	3.90	0.63	1.20	7.189	9.900	840	6.369	13.363	101.370
6.6	397	0.03	0.92	3.92	0.64	1.21	7.255	9.948	855	6.431	12.718	95.655
6.9	412	0.01	0.90	3.90	0.63	1.20	7.188	9.899	839	6.368	12.485	94.721
7.1	427	-0.02	0.87	3.87	0.61	1.17	7.053	9.802	808	6.243	12.022	92.869
7.4	442	-0.07	0.82	3.82	0.57	1.14	6.849	9.656	762	6.059	11.336	90.127
7.6	456	-0.14	0.75	3.75	0.53	1.09	6.573	9.462	702	5.818	10.439	86.540
7.9	471	-0.22	0.67	3.67	0.47	1.04	6.219	9.220	628	5.524	9.345	82.162
8.1	486	-0.31	0.58	3.58	0.41	0.97	5.779	8.929	543	5.181	8.071	77.064
8.4	501	-0.41	0.48	3.48	0.34	0.90	5.240	8.590	446	4.795	6.636	71.326
8.6	516	-0.52	0.37	3.37	0.26	0.82	4.578	8.203	340	4.372	5.064	65.038
8.8	531	-0.65	0.24	3.24	0.17	0.74	3.740	7.766	227	3.919	3.379	58.299
9.1	546	-0.77	0.12	3.12	0.08	0.65	2.580	7.279	108	3.443	1.609	51.217
9.3	561	-0.91	-0.02	2.98	0.00	0.55	0	6.739	0	2.951	0	43.901
9.6	575	-1.04	-0.15	2.85	0.00	0.46	0	6.142	0	2.452	0	36.469
9.8	590	-1.17	-0.28	2.72	0.00	0.37	0	5.481	0	1.952	0	29.036
10.1	605	-1.31	-0.42	2.58	0.00	0.27	0	4.740	0	1.460	0	21.721
10.3	620	-1.43	-0.54	2.46	0.00	0.18	0	3.892	0	984	0	14.638
10.6	635	-1.56	-0.67	2.33	0.00	0.10	0	2.859	0	531	0	7.899
10.8	650	-1.67	-0.78	2.22	0.00	0.02	0	1.291	0	108	0	1.611
11.1	665	-1.77	-0.88	2.12	0.00	0.00	0	0	0	0	0	0
11.3	680	-1.86	-0.97	2.03	0.00	0.00	0	0	0	0	0	0
11.6	694	-1.94	-1.05	1.95	0.00	0.00	0	0	0	0	0	0
11.8	709	-2.01	-1.12	1.88	0.00	0.00	0	0	0	0	0	0
12.1	724	-2.06	-1.17	1.83	0.00	0.00	0	0	0	0	0	0
12.3	739	-2.09	-1.20	1.80	0.00	0.00	0	0	0	0	0	0
12.6	755	-2.11	-1.22	1.78	0.00	0.00	0	0	0	0	0	0
12.8	771	-2.09	-1.20	1.80	0.00	0.00	0	0	0	0	0	0
13.1	787	-2.06	-1.17	1.83	0.00	0.00	0	0	0	0	0	0
13.4	803	-2.01	-1.12	1.88	0.00	0.00	0	0	0	0	0	0
13.6	819	-1.94	-1.05	1.95	0.00	0.00	0	0	0	0	0	0
13.9	835	-1.86	-0.97	2.03	0.00	0.00	0	0	0	0	0	0
14.2	851	-1.76	-0.87	2.13	0.00	0.00	0	0	0	0	0	0
14.4	867	-1.66	-0.77	2.23	0.00	0.03	0	1.541	0	154	0	2.464
14.7	883	-1.54	-0.65	2.35	0.00	0.11	0	3.011	0	589	0	9.399
15.0	899	-1.41	-0.52	2.48	0.00	0.20	0	4.029	0	1.055	0	16.831
15.2	915	-1.28	-0.39	2.61	0.00	0.29	0	4.875	0	1.544	0	24.643
15.5	931	-1.15	-0.26	2.74	0.00	0.39	0	5.616	0	2.050	0	32.711
15.8	946	-1.01	-0.12	2.88	0.00	0.48	0	6.281	0	2.563	0	40.908
16.0	962	-0.87	0.02	3.02	0.01	0.58	1.012	6.882	17	3.077	266	49.106
16.3	978	-0.74	0.15	3.15	0.11	0.67	2.967	7.425	143	3.583	2.283	57.174
16.6	994	-0.61	0.28	3.28	0.20	0.77	4.042	7.916	265	4.072	4.236	64.986
16.8	1010	-0.48	0.41	3.41	0.29	0.85	4.848	8.357	382	4.538	6.094	72.418

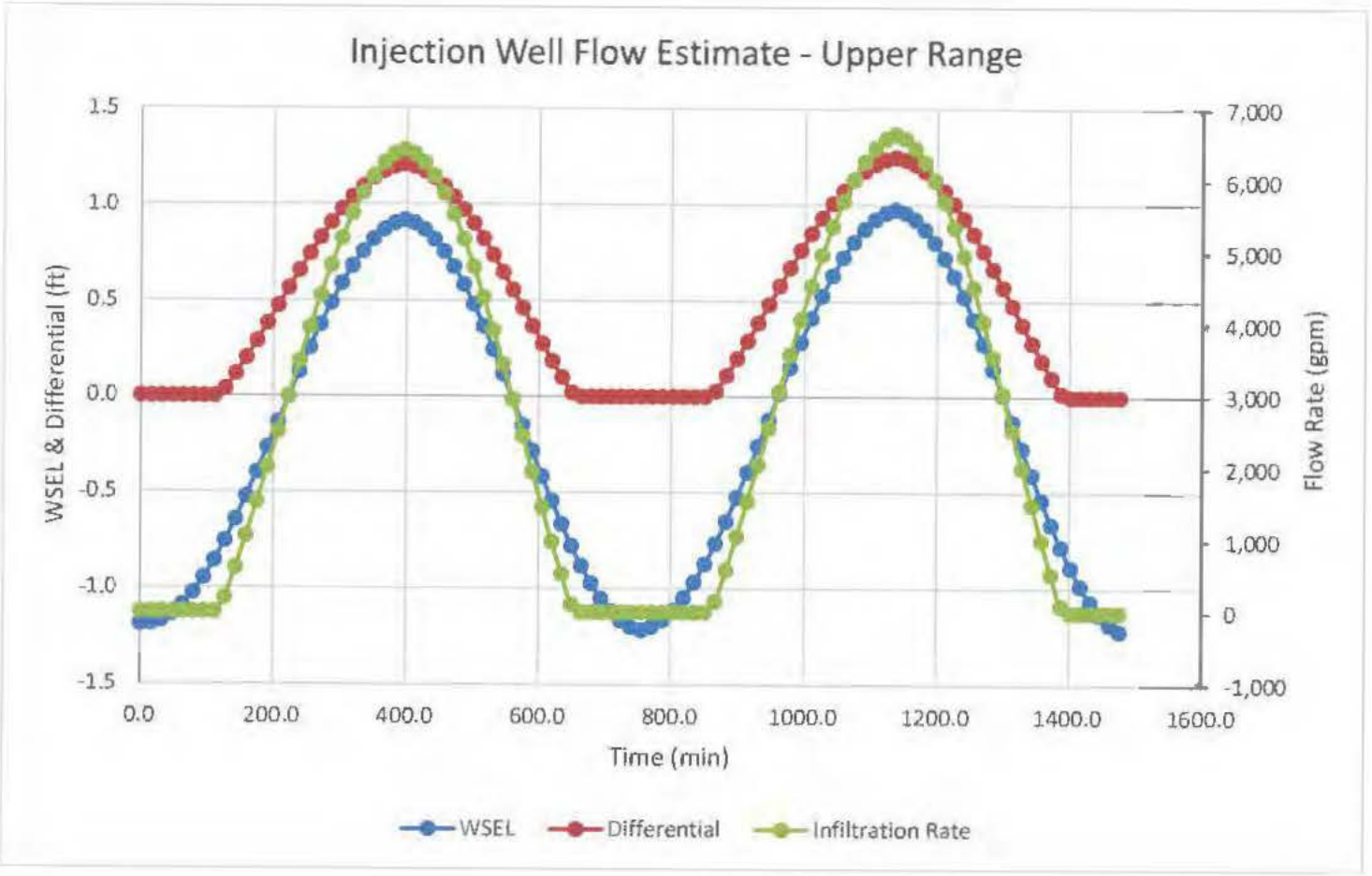
Simulation Time (Hours)	Simulation Time (Minutes)	Water Surface Elevation (WSEL)[1] (ft NAVD)	WSEL (ft above MSL)	Maximum Potential Orifice Differential (feet)	Conservative Head Differential (feet above MSL)	Upper Range Head Differential (feet above MSL)	Conservative Orifice Incremental Flow Rate (gpm)	Upper Range Orifice Incremental Flow Rate (gpm)	Conservative Transmissivity Based Incremental Flow Rate (gpm)	Upper Range Transmissivity Based Incremental Flow Rate (gpm)	Conservative Infiltration Volume (gallons)	Upper Range Infiltration Volume (gallons)
17.1	1026	-0.36	0.53	3.53	0.37	0.93	5,495	8,748	490	4,973	7,827	79,353
17.4	1042	-0.26	0.63	3.63	0.44	1.01	6,025	9,090	590	5,369	9,410	85,682
17.6	1058	-0.16	0.73	3.73	0.51	1.07	6,459	9,383	678	5,721	10,815	91,304
17.9	1074	-0.08	0.81	3.81	0.57	1.13	6,810	9,628	753	6,024	12,022	96,132
18.2	1090	-0.01	0.88	3.88	0.61	1.18	7,085	9,825	815	6,272	13,011	100,089
18.4	1106	0.04	0.93	3.93	0.65	1.21	7,287	9,972	863	6,461	13,767	103,113
18.7	1122	0.07	0.96	3.96	0.67	1.24	7,421	10,070	895	6,589	14,278	105,156
18.9	1137	0.09	0.98	3.98	0.68	1.25	7,488	10,119	911	6,654	13,435	98,144
19.2	1152	0.07	0.96	3.96	0.67	1.24	7,421	10,070	895	6,589	13,194	97,184
19.4	1166	0.04	0.93	3.93	0.65	1.21	7,285	9,970	862	6,460	12,718	95,278
19.7	1181	-0.02	0.87	3.87	0.61	1.18	7,081	9,822	814	6,268	12,013	92,458
19.9	1196	-0.08	0.81	3.81	0.57	1.13	6,803	9,624	752	6,018	11,090	88,768
20.2	1211	-0.16	0.73	3.73	0.51	1.07	6,449	9,376	676	5,713	9,965	84,265
20.4	1225	-0.26	0.63	3.63	0.44	1.01	6,010	9,080	587	5,357	8,654	79,021
20.7	1240	-0.37	0.52	3.52	0.37	0.93	5,473	8,734	487	4,957	7,178	73,118
20.9	1255	-0.49	0.40	3.40	0.28	0.85	4,817	8,339	377	4,519	5,561	66,650
21.2	1270	-0.61	0.28	3.28	0.20	0.76	3,997	7,893	260	4,049	3,828	59,718
21.4	1284	-0.74	0.15	3.15	0.10	0.67	2,894	7,396	136	3,555	2,007	52,432
21.7	1299	-0.88	0.01	3.01	0.01	0.57	723	6,845	8	3,045	125	44,907
21.9	1314	-1.02	-0.13	2.87	0.00	0.47	0	6,235	0	2,526	0	37,261
22.1	1329	-1.16	-0.27	2.73	0.00	0.38	0	5,559	0	2,008	0	29,616
22.4	1343	-1.30	-0.41	2.59	0.00	0.28	0	4,801	0	1,498	0	22,090
22.6	1358	-1.43	-0.54	2.46	0.00	0.19	0	3,930	0	1,004	0	14,805
22.9	1373	-1.55	-0.66	2.34	0.00	0.10	0	2,866	0	534	0	7,873
23.1	1388	-1.67	-0.78	2.22	0.00	0.02	0	1,211	0	95	0	1,405
23.4	1402	-1.78	-0.89	2.11	0.00	0.00	0	0	0	0	0	0
23.6	1417	-1.88	-0.99	2.01	0.00	0.00	0	0	0	0	0	0
23.9	1432	-1.96	-1.07	1.93	0.00	0.00	0	0	0	0	0	0
24.1	1447	-2.02	-1.13	1.87	0.00	0.00	0	0	0	0	0	0
24.4	1461	-2.08	-1.19	1.81	0.00	0.00	0	0	0	0	0	0
24.6	1476	-2.11	-1.22	1.78	0.00	0.00	0	0	0	0	0	0

Notes:
Calculations detailed on subsequent page.
(1) - Synthetic tide developed using the tidal datums for NOAA station 8723769 - Plantation Key and the sine wave function.

	Conservative Scenario	Upper Range Scenario
Maximum Flow Rate (gpm)	911	6,654
Infiltration Volume (gpd)	373,602	4,096,692
% WB Volume	3.2%	34.9%

ID	Parameter:	Units	Summary of Calculation
Z1	Maximum Potential Orifice Differential	Feet	Equal to the estimated Water Surface Elevation (WSEL) above the intake structure invert of -3 ft MSL. [WSEL-(-3)]
Z2	Conservative Head Differential	Feet	70 percent of the WSEL above MSL. [0.7*(WSEL-(0)], with negative values returned as 0
Z3	Upper Range Piezometric Elevation in Well	Feet MSL	Equal to the vertical gradient (-0.0094) times the depth of the center of the injection interval (86 ft). [-0.0094*86] = -0.808 ft MSL
Z4	Upper Range Head Differential	Feet	70 percent of the WSEL above -0.808 ft MSL. [0.7*(WSEL-(-0.808)], with negative values returned as 0
Z5	Conservative Orifice Incremental Flow Rate	gpm	Orifice coefficient * Cross Sectional Area * (2*gravitational constant*head differential/conversion factor)$^{0.5}$*conversion factor =0.8*(1/4*π*(2 ft/3.28 ft/m)^2)*(2*9.81*Z3/3.28 ft/m)$^{0.5}$*15850.37 gpm/cms
Z6	Upper Range Orifice Incremental Flow Rate	gpm	Orifice coefficient * Cross Sectional Area * (2*gravitational constant*head differential/conversion factor)$^{0.5}$*conversion factor =0.8*(1/4*π*(2 ft/3.28 ft/m)^2)*(2*9.81*Z4/3.28 ft/m)$^{0.5}$*15850.37 gpm/cms
Z7	Conservative Hydraulic Conductivity	m/d	Interval weighted conductivity = Key Largo Limestone conductivity (Big Pine) *Key Largo Limestone interval depth/open hole interval depth + Long Pine Key conductivity*Long Pine Key interval depth/open hole interval depth – 1400*56/60+170*4/60 = 1318 – 1300
Z8	Upper Range Hydraulic Conductivity	m/d	Interval weighted conductivity = Key Largo Limestone conductivity (Miami Dade Average) *Key Largo Limestone interval depth/open hole interval depth + Long Pine Key conductivity*Long Pine Key interval depth/open hole interval depth – 5600*56/60+170*4/60 = 5238 = 5200
Z9	Conservative Transmissivity Based Incremental Flow Rate	gpm	Hydraulic conductivity (Z7) * conversion factor * open hole interval * head differential (Z2)* conversion factor =1100*3.28 ft/m*60 ft*Z2*0.0052 gpm/cfd
Z10	Upper Range Transmissivity Based Incremental Flow Rate	gpm	Hydraulic conductivity (Z8) * conversion factor * open hole interval * head differential (Z4)* conversion factor =4300*3.28 ft/m*60 ft*Z4*0.0052 gpm/cfd
Z11	Conservative Infiltration Volume	gallons	Incremental Flow Rate$_i$ (Z9)* (simulation time$_i$ -simulation time$_{(i-1)}$)
Z12	Upper Range Infiltration Volume	gallons	Incremental Flow Rate$_i$ (Z10)* (simulation time$_i$ -simulation time$_{(i-1)}$)
Z13	Infiltration Volume	gallons	Summation of Z11 or Z12
Z14	Waterbody Volume	gallons	Area *conversion factor * average depth (MSL-average bottom elevation) * conversion factor =5.26*43560 ft2/ac*(7.74-0.89)*7.48 gal/ft3 = 11,739,937 = 12E6


Injection Well Flow Estimate - Conservative Rate
WSEL & Differential (ft)
Flow Rate (gpm)
Time (min)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1000
800
600
400
200
0
-200
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
1600.0
WSEL
Differential
Infiltration Rate


Injection Well Flow Estimate - Upper Range
WSEL & Differential (ft)
Flow Rate (gpm)
Time (min)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
0.0
200.0
400.0
600.0
800.0
1000.0
1200.0
1400.0
1600.0
WSEL
Differential
Infiltration Rate

Background

Construction of residential canals in the Keys was initiated in the mid-20th century, before resource managers fully understood their impacts on local water quality and the broader coastal ecosystems. Depending upon how much fill material was required at the time of development; contractors routinely dredged the canals to a depth in excess of 20 feet below the water's surface. Most canals were designed as long, multisegmented, dead-end canal networks, which maximize waterfront property, but resulted in little or no tidal flushing. From their onset, the canals have accumulated oxygen consuming sediments, nutrients, and organic matter due to inadequate tidal flushing.

From 1950 to 1970, studies of residential canals that focused on water quality were conducted throughout Florida. These studies determined that canal construction created significant water quality and biological degradation within both the canals and the coastal halo. In addition to the findings published in the studies, residents of the Keys have witnessed a steady deterioration of the water quality within their canals. Water quality degradation not only presents aesthetic and ecological problems, but a public health threat as well. Previous studies concluded that degraded canal water quality results in the deterioration of the environmental quality of receiving waters as well as impacts the adjacent benthic communities including seagrass beds and coral reefs.

Need

The site is in the Village of Islamorada near mile marker 87 at 205 Harbor Drive in Plantation Key, Florida. The site is comprised of residential parcels surrounding a canal basin system referred to as Canal 132 in the Monroe County Canal Management Master Plan (CMMP). Canal 132 was selected for pumping based on criteria gathered from the CMMP database.

In 2017, the CMMP technology for pumping was evaluated due the excessive operation and maintenance issues with the system. The technology evaluation ranked gravity injection wells as the most economical and efficient technology at improving water quality within the long dead-end canal systems.

The gravity injection well system for Canal 132 will be comprised of a manatee intake structure, a check valve, a gate valve, and a two-foot diameter injection well. The injection well will be constructed of a two-foot diameter LOK 21 PVC casing advanced to 60 feet bls, with an open hole interval from 60 feet to 120 feet bls.

Ecological Assessment

The sites were accessed by foot on March 29, 2019 and August 2, 2019. A submersible camera was used to take video recordings under water within the vicinity of the concrete seawall to note the presence sensitive aquatic resources (i.e. seagrasses, stony corals, hydrocorals, black corals, sea fans, and sponges. Due to the water clarity of the canal, visibility was low, and recordings were unable to capture any images. The benthic survey followed the protocols detailed in each of the following National Oceanic and Atmospheric Association (NOAA) guidance documents for benthic surveys: Protocol for sampling Halophilia johnsonii (2011) and Protocol for Benthic Surveys of Coral Resources in FKNMS (2011).

Below are the photographs taken during the site visit:

Photo 1: Existing concrete boat ramp with limestone and concrete seawalls

Photo 2: Existing concrete seawall with barnacle and algae growth. Seagrape bushes along the upland side of the concrete seawall.

Photo 3: Existing concrete seawall with wooden bumpers

Photo 4: Gumbo limbo tree, seagrape bushes, and ornamental rocks within upland property along boat ramp