BENTHIC RESOURCE ASSESSMENT
T-PIER IMPROVEMENTS AT MALLORY SQUARE
CITY OF KEY WEST
MONROE COUNTY, FLORIDA

Prepared for:

City of Key West
Port & Marine Services
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The City of Key West is proposing improvements to the T-Pier located at Mallory Square, Key West, Monroe County. The Mallory T-Pier is critical infrastructure for the City of key West, supporting the mooring of cruise ships that are considered essential to the economic viability of the City. The proposed improvements include the replacement of several support pilings and the replacement and expansion of the pier surface. In addition, two 150-ton monopole dolphins will be added to the facility. Details of the proposed improvements are included in project plans for the project prepared by Jacobs Engineering (Attachment 1).

In order to evaluate the impacts of the proposed project to the marine environment, a current assessment of the biological resources that could potentially be impacted by the project is needed. The objective of this benthic resource assessment is to document living marine resources present on and within the proposed work area at the Mallory T-Pier. In addition, a specific-purpose survey for stony corals located on or within the proposed work area at the Mallory T-Pier is required to fulfill Florida Keys National Marine Sanctuary (FKNMS) regulatory requirements.

METHODS

A primary and secondary survey area was established using the project plans and a general understanding of where work barges will operate to complete the project. The survey areas included the following areas:

- The surfaces of all existing pilings proposed for demolition and replacement;
- The seafloor beneath the existing T-Pier proposed for demolition and replacement;
- The seafloor within the proposed expansion areas at either end of the T-Pier including a 30’ buffer zone;
- The seafloor in the work area located in the vicinity of the T-Pier;
- The seafloor at the location of the two 150-ton monopole dolphins including a 30’ buffer zone around the center point;
- Two large concrete structures approximately 14’ x 14’ x 12’ tall that are the site of a previous coral relocation project;

The locations of these survey areas are depicted in the Survey Area Plan (Attachment 2). The location of the two proposed 150-ton dolphins and the two existing coral relocation sites are identified by coordinates provided below.

ID	LAT	LON	Notes
New Dolphin South	24°33'33.43"N	81°48'29.23"W	Coordinates provided by Jacobs.
New Dolphin North	24°33'38.85"N	81°48'27.44"W	Coordinates provided by Jacobs.
Coral Relo South	24°33'34.98"N	81°48'28.93"W	Coordinates taken from hand-held GPS, location approximate.
Coral Relo North	24°33'36.83"N	81°48'28.21"W	Coordinates taken from hand-held GPS, location approximate.

An in-water assessment of all survey areas was conducted on April 8, April 11 and May 4, 2020. Water clarity was typically good during incoming tides, averaging 10-20 feet, and surface water temperatures were variable around 80 degrees. Surveys consisted of a complete accounting of all benthic habitats in the benthic survey areas as well as a complete accounting of all corals attached to pilings that support the T-pier structure and located on debris throughout the survey areas. In addition, corals were assessed on two coral relocation sites adjacent to the T-Pier that were created from a prior coral rescue and relocation effort.

Benthic habitat characterization within survey areas consisted of performing an assessment of habitat types throughout survey areas following 10’ transect spacing using keson measuring tapes placed in a grid on the seafloor. Indexing off the existing pier made location of the proposed pier expansion area a simple task. Observed benthic resources were categorized into generalized habitat classifications adapted for nearshore conditions typically encountered on similar nearby bridge repair projects. Habitats present were assessed using general descriptors, and described qualitatively based on the following criteria:

Habitat Type	**Cover Description**	**Cover Class**
Seagrass	Sparse	5-25%
Seagrass	Moderate	25-75%
Seagrass	Dense	75-100%

Habitat Type	Cover Description	Cover Class
Hardbottom	Sparse	5-25%
Hardbottom	Moderate	25-75%
Hardbottom	Dense	75-100%
Sand and Rubble, Scour	NA	NA
Mud and organics	NA	NA

Reference photographs representing dominant benthic species, examples of seagrass and macro-algal communities encountered, and other applicable reference photographs were also taken (Attachment 3).

Each stony coral encountered was identified to species, measured for size along three axes (length, width, height), and their approximate vertical location on the piling recorded (Attachment 4 - Excel database provided on request). Following the guidelines established in the "Protocol for Benthic Surveys of Coral Resources in FKNMS", coral surface area for colonies <10cm was determined simply as length x width. However, surface area calculations for corals ≥10 cm diameter take into account a third dimension (e.g. height). Because the surface area of a dome (or ½ of the surface area of an oblate, prolate, or scalene ellipsoid) cannot be easily expressed by a simple elementary function, the following approximate formula for an ellipsoid (Knud Thomsen, 2004) was utilized, and divided in half for a dome:

$$S \approx 4\pi \left(\frac{a^p b^p + a^p c^p + b^p c^p}{3} \right)^{1/p}$$, where p=1.6075 (relative error of at most 1.178%).

RESULTS

BENTHIC HABITATS

The benthic habitats identified in the Mallory Pier survey areas including the areas below the T-Pier, the expansion area, and the work area was uniformly a disturbed Sand and Rubble, Scour habitat as a result of large ships mooring alongside the T-Pier plus strong currents along Mallory Pier and throughout Key West Harbor. No seagrass or hardbottom habitat was observed in the benthic survey areas. The seafloor was loose sand and scattered rubble and debris lacking a defined benthic community (e.g. seagrass, macroalgae). Scattered debris including concrete slabs, metal pipes bricks and other hard materials were present mainly between the T-Pier and Mallory Square.

The debris within this survey area includes two coral relocation sites from a previous project at this location are present between the T-Pier and Mallory Pier, and consist of large concrete monoliths with substantial corals cemented to their upper surface. These two structures measure approximately 14’ x 14’ x 12’ tall, extending well above the seafloor.

The seafloor at both the New Dolphin South and New Dolphin North survey areas consisted of barren seafloor with sand and loose rubble. No seagrass or hardbottom habitat was observed in the benthic survey areas. The seafloor was loose sand and scattered rubble and debris lacking a defined benthic community (e.g. seagrass, macroalgae).

CORAL RESOURCES

The submerged portions of the concrete T-Pier pilings are heavily encrusted with living marine organisms including a diversity sponges, hydroids, telestaceans, tunicates, and algae. Coral resources consisted of stony corals attached to the pilings supporting the T-Pier as well as attached to various debris on the seafloor within the survey areas. Also included in the assessment were those corals attached to the coral relocation sites, although those corals were not identified as directly impacted.

Soft corals, octocorals, were uncommon, consisting of three sea fingers (*Briareum asbestinium*) and one sea whip (*Pseudopterogorgia americana*) attached to the upper sections of select pilings. The Common Sea Fan (*Gorgonia ventalina*) was not observed on the project site.

A total of 823 corals totaling 202,492 cm2 were identified within the survey area (Table 1 & 2) including two Federally-listed Threatened species; *Orbicella annularis* and *Orbicella faveolata*. Corals included a diversity of species consisting of the following:

Coral Species	Coral Code	Status
Cladocora arbuscula	Carb	
Colpophyllia natans	Cnat	
Diploria labyrinthiformis	Dlab	
Dichocoenia stokesii	Dsto	
Favia fragum	Ffra	
Manicina areolata	Mare	
Montastrea cavernosa	Mcav	
Orbicella annularis	Oann	Federally-listed
Orbicella faveolata	Ofav	Federally-listed
Oculina diffusa	Odif	
Porites astreoides	Past	
Pseudodiploria clivosa	Pcli	
Porites porites	Ppor	
Pseudodiploria strigosa	Pstr	
Porites porites	Ppor	
Solenastrea bournoni	Sbou	
Stephanocoenia intercepta	Sint	
Siderastrea radians	Srad	
Siderastrea siderea	Ssid	

Based on their location within the project, it can be determined that approximately **205 coral colonies totaling approximately 54,775 cm^2** will be directly impacted by the proposed project, including Federally-listed corals on the South Dolphin pilings. These include corals that are located in the area of proposed repairs, either attached to a piling proposed for demolition or attached to a piling on the South Dolphin that will be shaded by the proposed T-Pier expansion decking and likely suffer as a result (Tables 1 & 2). Corals in the remaining areas (seafloor debris, north and south relocation sites, and North Dolphin Existing) will need to be carefully avoided during construction to avoid secondary impacts resulting from construction.

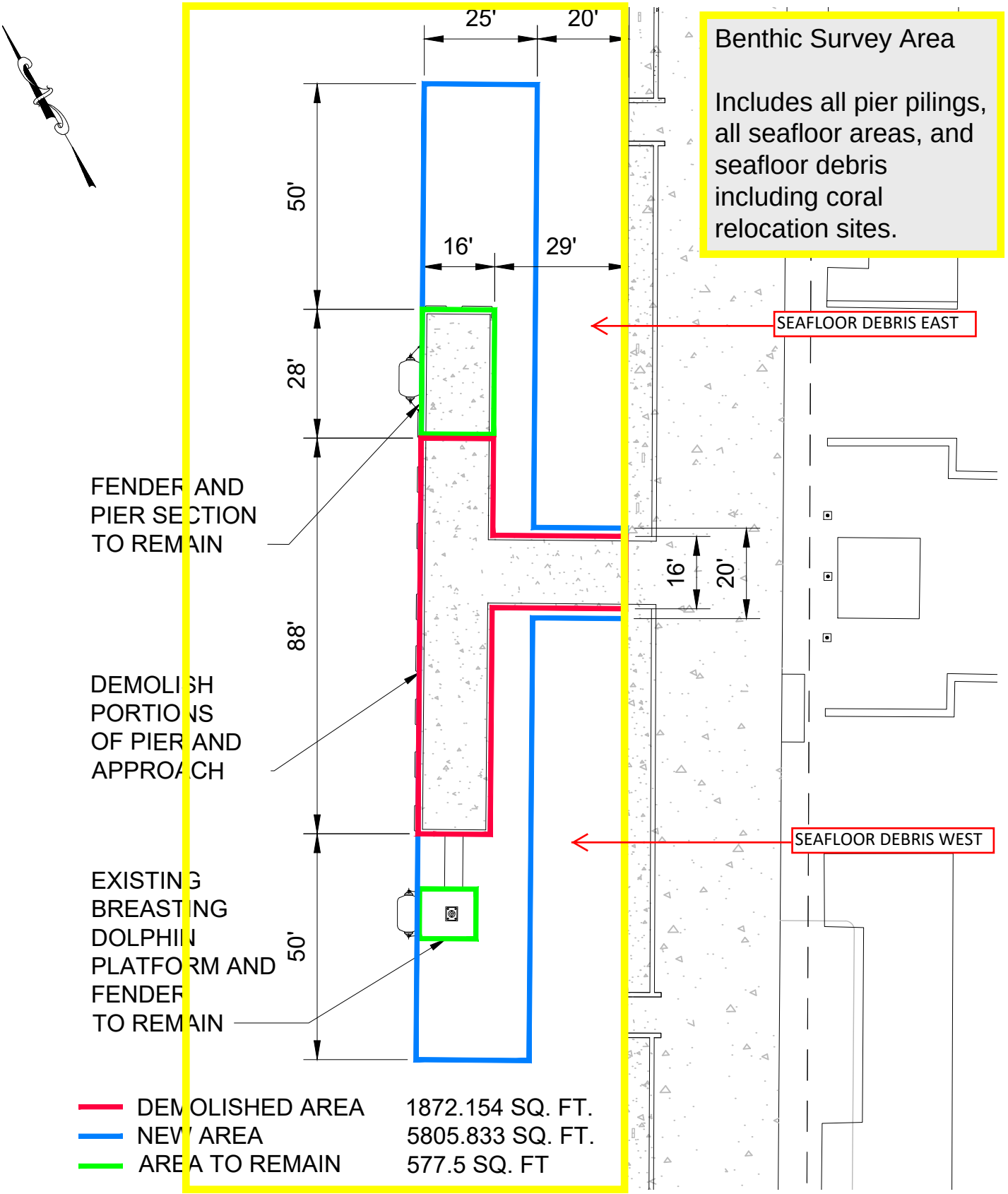
In order to proceed with permitting of this project, it is recommended that coordination with the Florida Keys National Marine Sanctuary be initiated to better understand potential project impacts, avoidance and mitigation strategies, construction operations, and the regulatory process required to proceed with the project.

Table 1. Summary of corals impacted or within the vicinity of the T-Pier project. Columns shaded in red are corals that will be impacted directly by the project.												
Location	**1**	**2**	**3**	**4**	**2016 Pier Piles**	**Coral Relo North**	**Coral Relo South**	**Dolphin North**	**Dolphin South**	**Seafloor North**	**Seafloor South**	**Grand Total**
Carb							2	1			3	6
Cnat					1		1		4			6
Dlab			1				1		5			7
Dsto						1	4	1				6
Dstr							2					2
Ffra					38		1	18	15	1		73
Mare					1							1
Mcav						6	15	1	5			27
Oann						2						2
Odif		1	1		2	3		4	9	1	4	25
Ofav					1	3	9		4			17
Past	3			12	12	5	4	50	44			130
Pcli			1			1			1			3
Ppor				5					1			6
Pstr	1		1		1				2			5
Sbou						7			1	2	1	11
Sint						14	27	2	6	1	11	61
Srad						49	19	3	13	21	82	187
Ssid				2		83	44	40	67	6	6	248
Total Corals	**4**	**1**	**4**	**19**	**56**	**174**	**129**	**120**	**177**	**32**	**107**	**823**
Impacts Total	**4**	**1**	**4**	**19**					**177**			**205**

Table 1. Summary of area of coral impacted or within the vicinity of the T-Pier project. Columns shaded in red are corals that will be impacted directly by the project.												
Location	**1**	**2**	**3**	**4**	**2016 Pier Piles**	**Coral Relo North**	**Coral Relo South**	**Dolphin North**	**Dolphin South**	**Seafloor North**	**Seafloor South**	**Grand Total**
Carb							50	36			49	135
Cnat					16		2107		367			2490
Dlab			2898				1573		4687			9158
Dsto						977	1760	351				3088
Dstr							3226					3226
Ffra					932		9	360	164	6		1471
Mare					36							36
Mcav						7110	21001	87	1545			29743
Oann						3241						3241
Odif		223	562		84	148		465	936	9	67	2494
Ofav					87	2721	16349		5654			24811
Past	706			4253	539	2197	610	15862	10941			35108
Pcli			3648			1229			954			5831
Ppor				409					268			678
Pstr	625		759		25				1053			2461
Sbou						8413			1539	271	36	10259
Sint						5228	4559	386	907	64	235	11379
Srad						2858	1058	271	923	353	1761	7223
Ssid				211		10732	16653	10767	10541	500	255	49660
Coral Area	**1331**	**223**	**7867**	**4873**	**1719**	**44854**	**68956**	**28585**	**40481**	**1203**	**2403**	**202,492**
	1331	**223**	**7867**	**4873**	**0**	**0**	**0**	**0**	**40,481**	**0**	**0**	**54,775**

ATTACHMENT 2. BENTHIC SURVEY AREA PLAN


Mallory Pier Repairs
Survey Area Plan
Existing and Proposed Structures
Dolphin South
Dolphin North
Coral Relo South
Coral Relo North
New Dolphin North
New Dolphin South
Mallory T Pier



A 2-2 EXHIBIT A

1" = 30'

0 30 60 FT.

1"=30'

Filename: C:\Users\pruittjm\JEFFS STUFF\PROJECTS\MALLORY SQUARE WHARF\PERMIT SET\EXHIBIT A.dwg Plot Time: Wednesday, April 08, 2020

JACOBS
245 RIVERSIDE AVE. SUITE 300
JACKSONVILLE, FL 32202
EB0000072 AAC001992

PIER REPLACEMENT AND IMPROVEMENTS
AT MALLORY SQUARE
FOR
CITY OF KEY WEST, FLORIDA

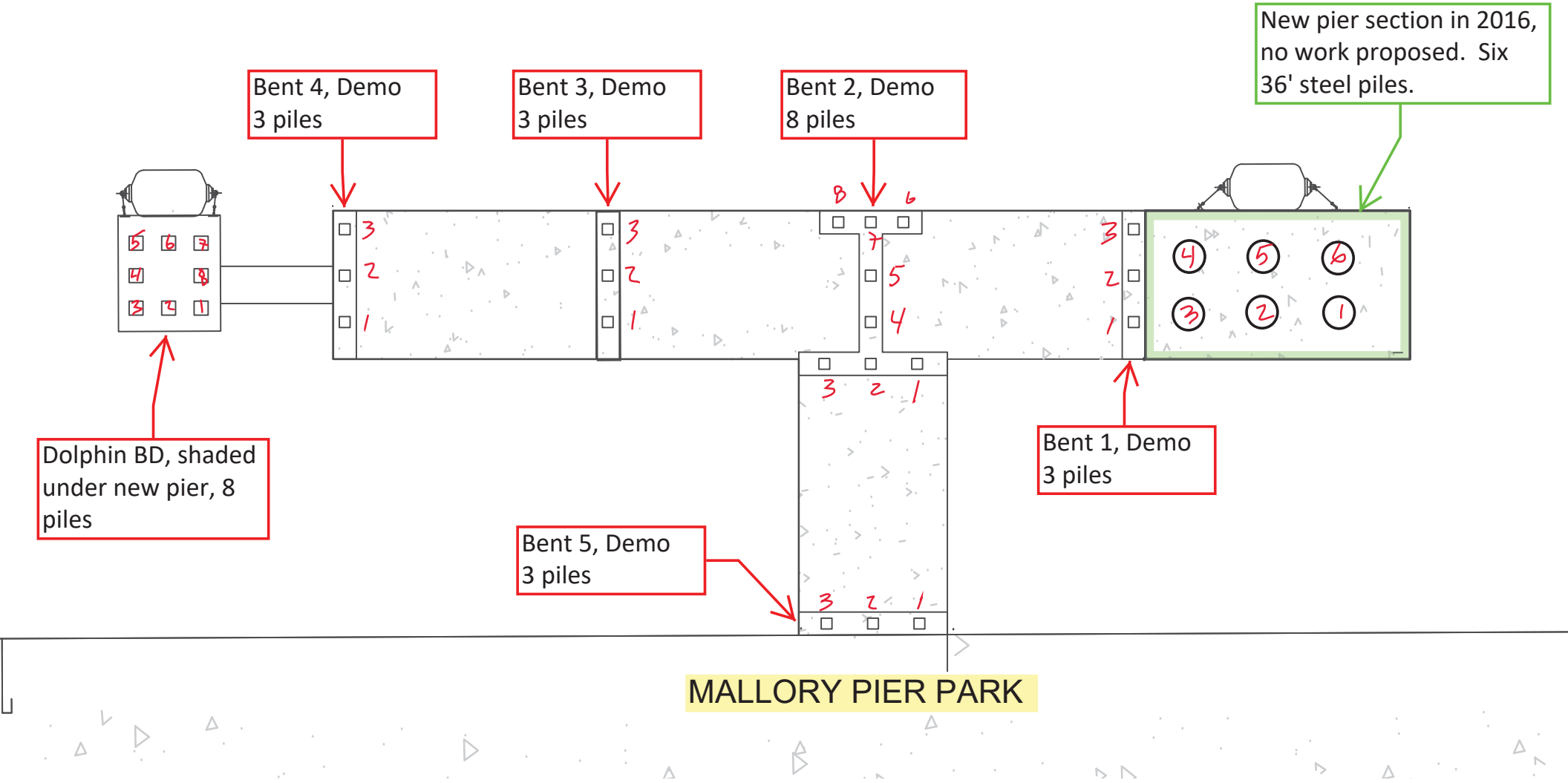
STRUCTURAL
PIER
EXHIBIT A
PLAN

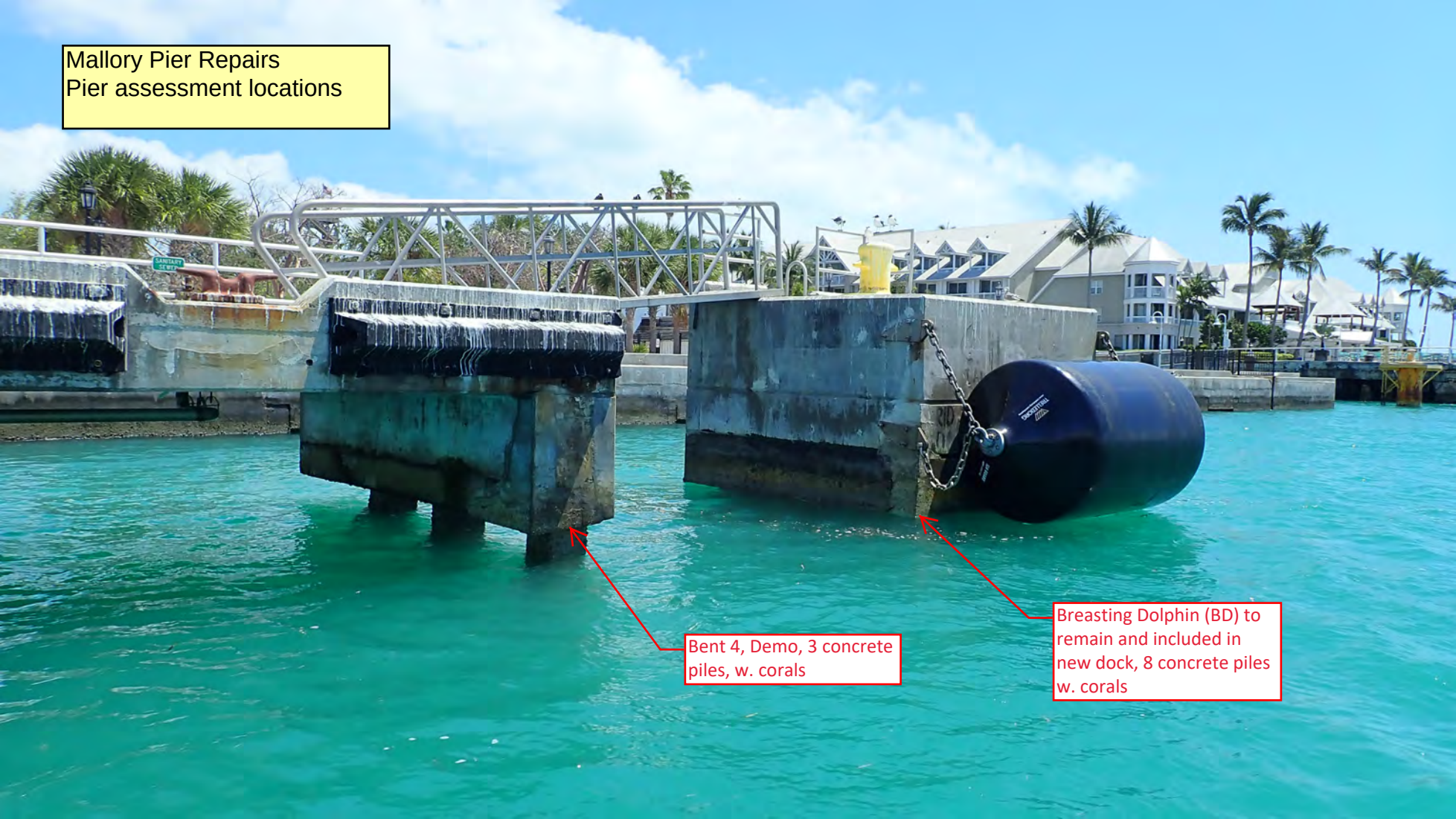
NO.	DATE	REVISION	BY	APV

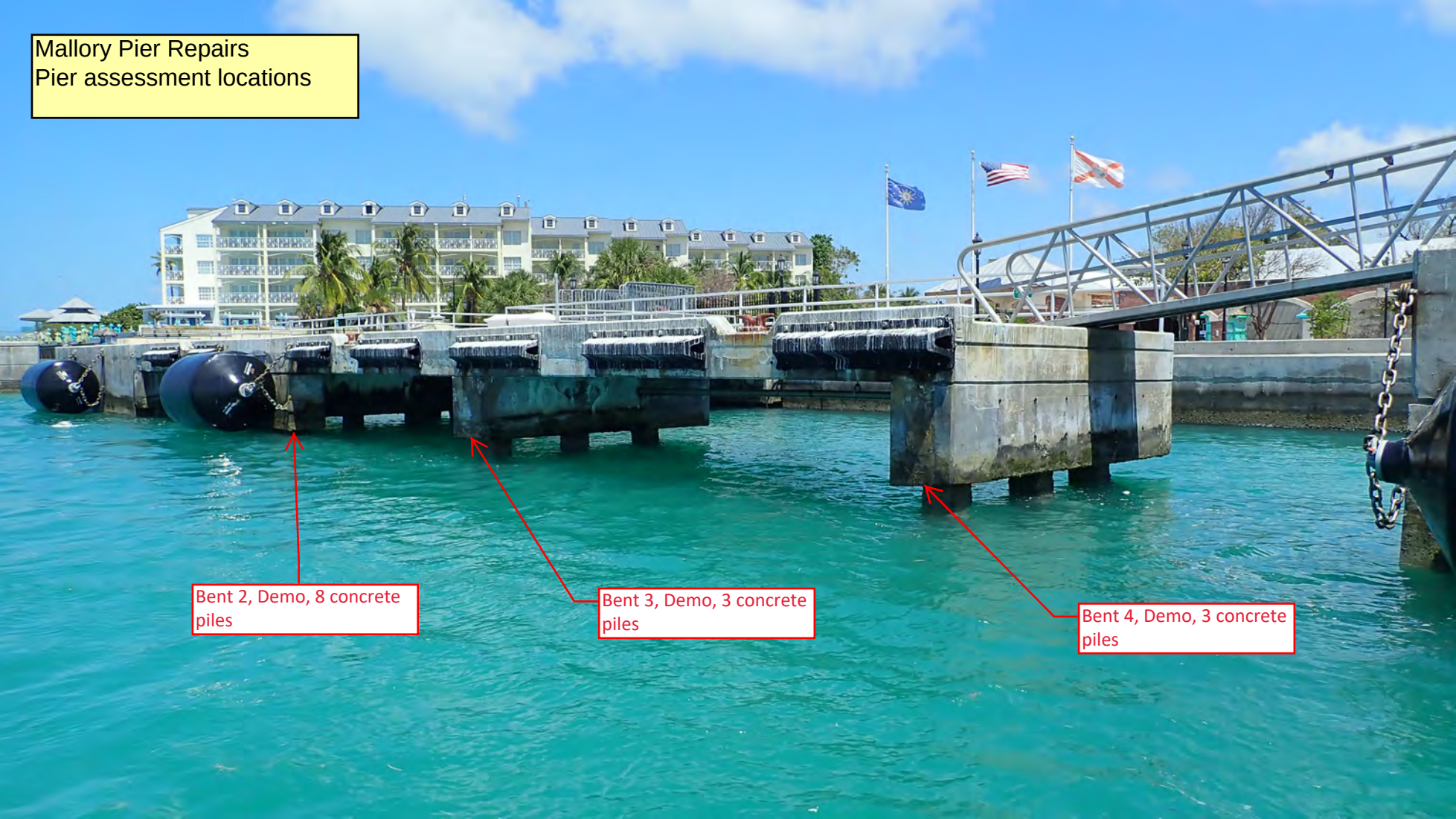
DSGN DR CHK APVD

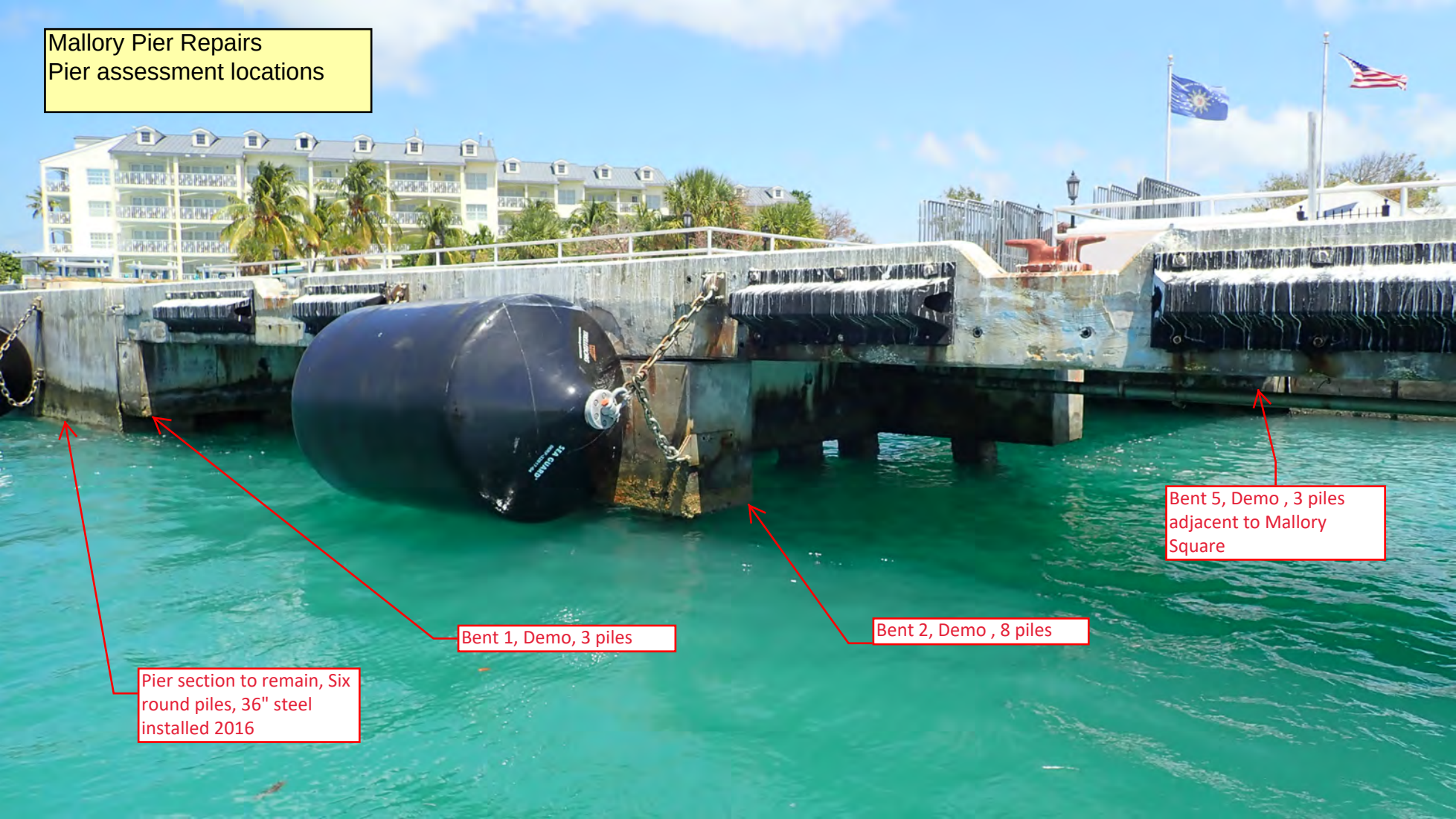
SCALE: SHOWN
PROJ #: D3334102
FIG. A
SHEET: OF
DWG

Mallory Pier Repairs
Piling Assessment Plan
Bent / Pile ID corresponds
to coral assessment summary




Mallory Pier Repairs
Pier assessment locations
Bent 4, Demo, 3 concrete piles, w. corals
Breasting Dolphin (BD) to remain and included in new dock, 8 concrete piles w. corals


Mallory Pier Repairs
Pier assessment locations
Bent 2, Demo, 8 concrete piles
Bent 3, Demo, 3 concrete piles
Bent 4, Demo, 3 concrete piles


Mallory Pier Repairs
Pier assessment locations
Bent 5, Demo , 3 piles adjacent to Mallory Square
Bent 1, Demo, 3 piles
Bent 2, Demo , 8 piles
Pier section to remain, Six round piles, 36" steel installed 2016


Mallory Pier Repairs
Pier assessment locations
Dolphin South, Demo, 8 piles
Bent 2, Demo, 8 piles
Bent 1, Demo, 3 piles
Pier section to remain, Six round piles, 36" steel installed 2016

ATTACHMENT 3. SITE PHOTOS

Photo 1. Typical piling at Mallory Pier with dense cover of sponges and invertebrates.

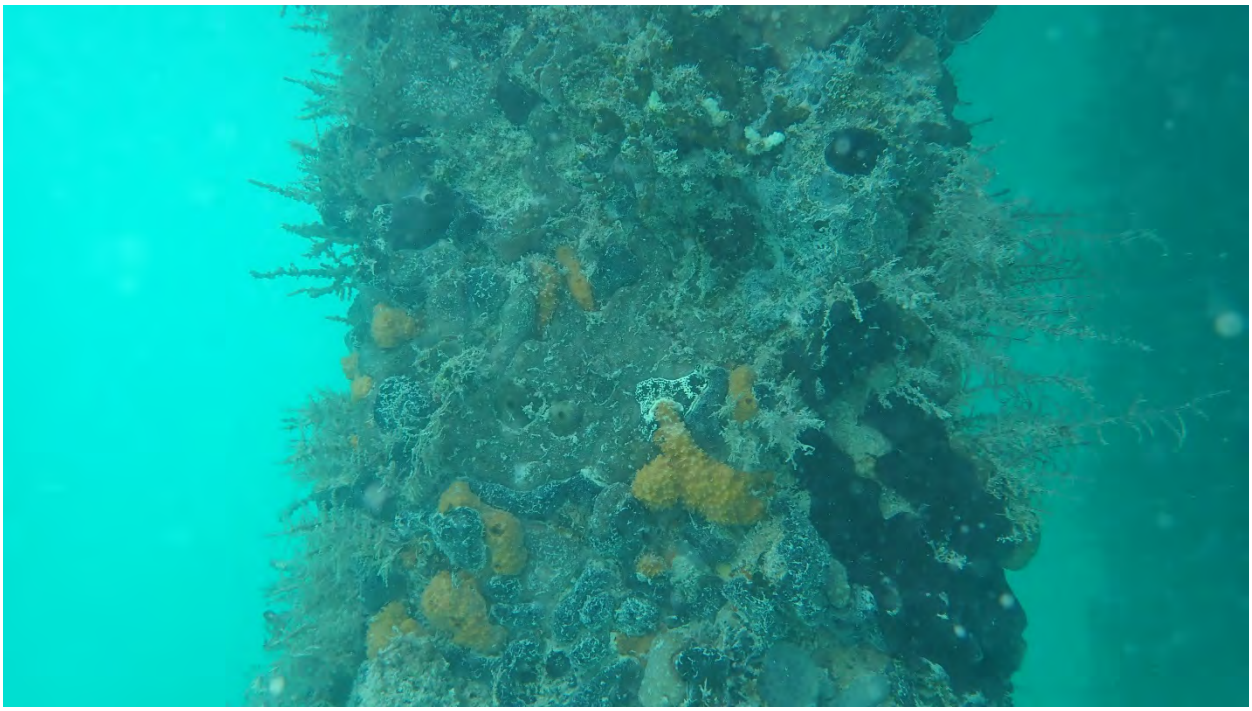


Photo 2. Typical piling at Mallory Pier with dense cover of sponges and invertebrates.

Photo 3. Typical seafloor conditions over the majority of the seafloor survey area. The seafloor consists of sand and rubble as a result of high scour and currents.

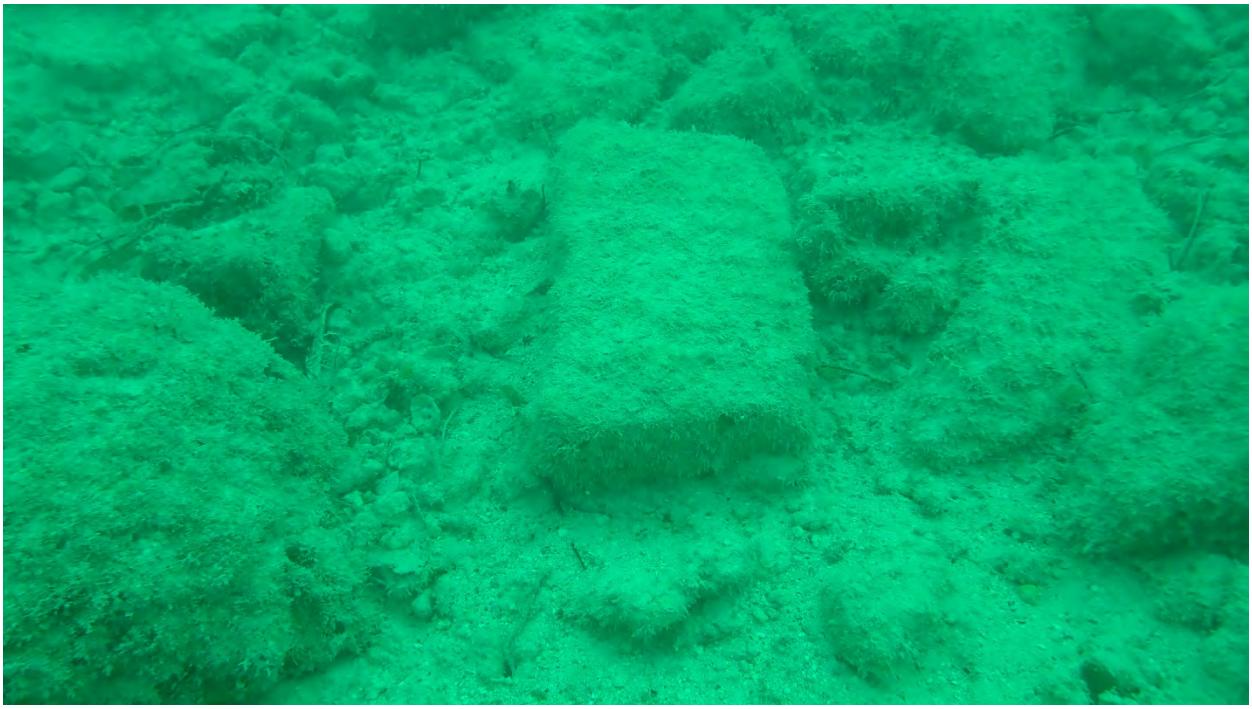


Photo 4. Typical seafloor conditions over the majority of the seafloor survey area. The seafloor consists of sand and rubble as a result of high scour and currents.

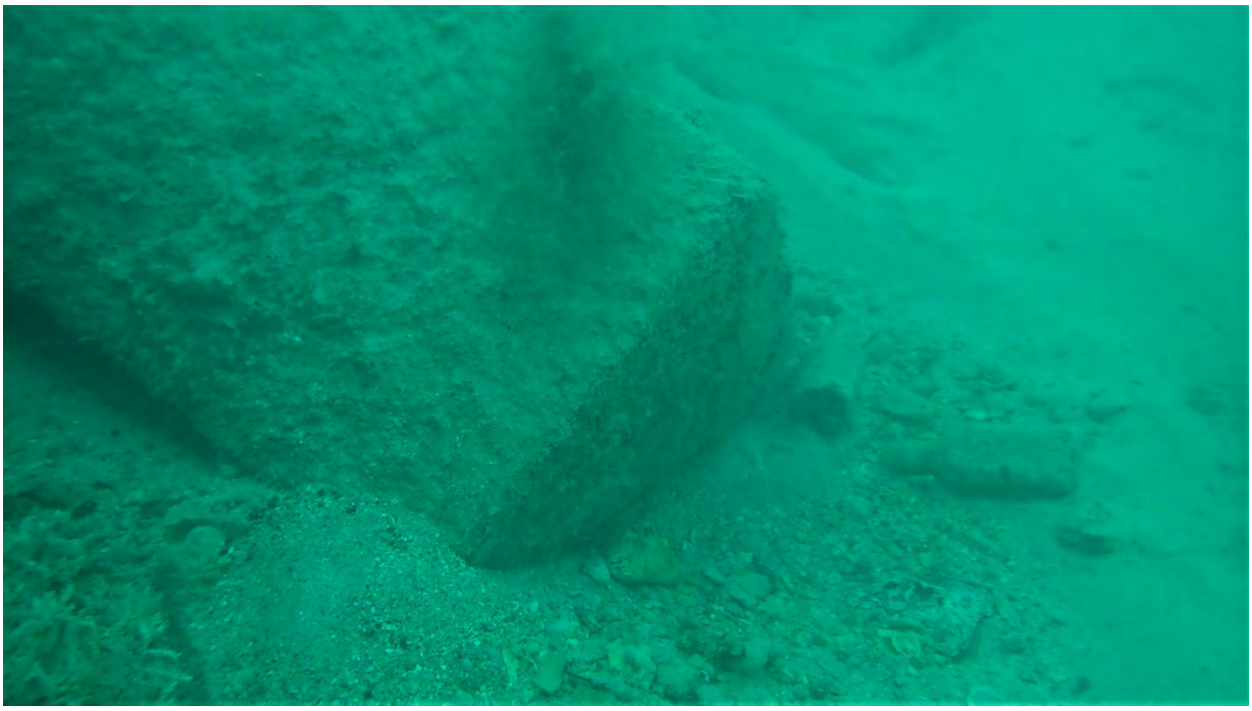


Photo 5. Typical seafloor conditions within the survey area adjacent to the existing pier including misc. concrete debris, pipes and items tossed from the pier including bicycles.

Photo 6. Typical seafloor conditions within the survey area adjacent to the existing pier. This is one of two large concrete blocks appx. 14' x 14' x 12" tall and supports a previous coral relocation project.

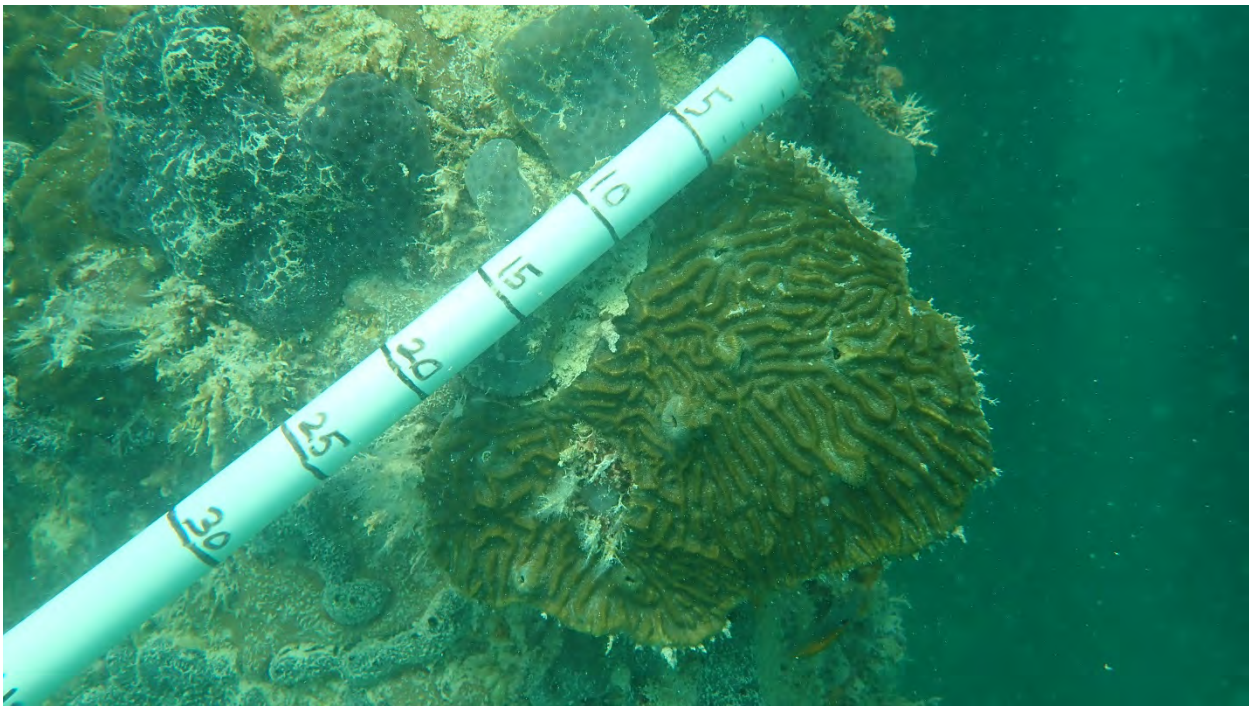


Photo 7. Typical coral attached to piling proposed for impact, Pseudodiploria clivosa.

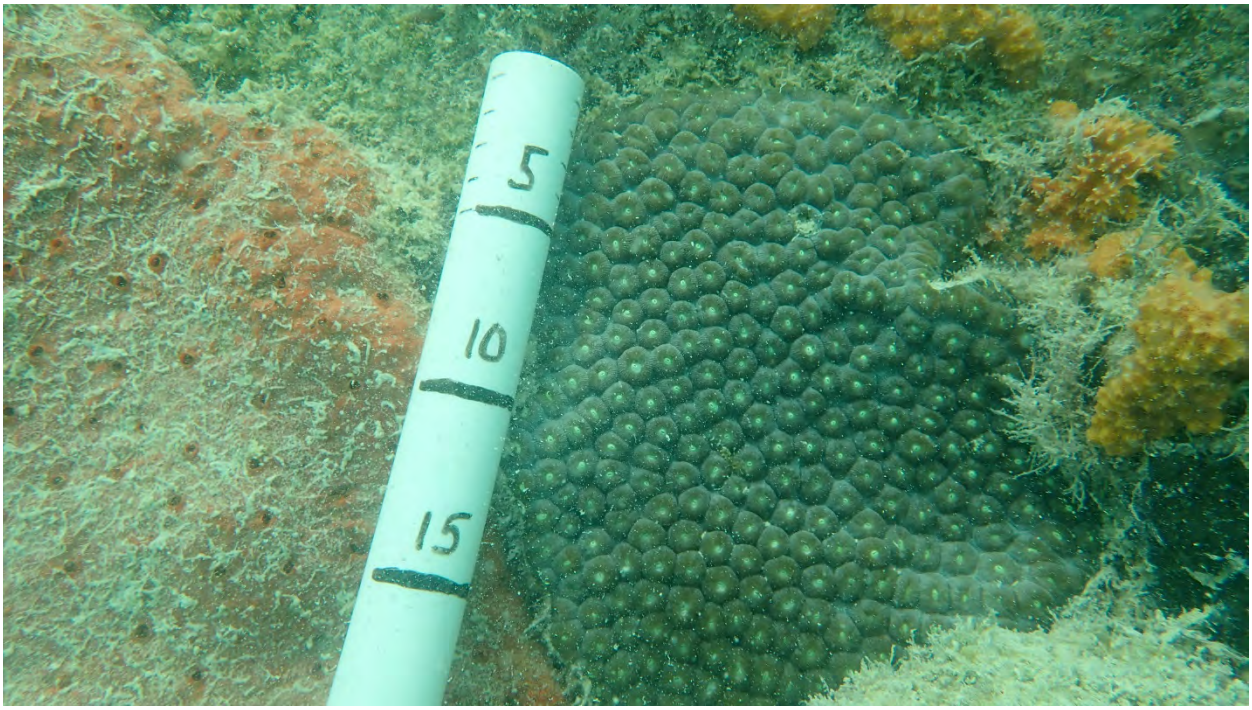


Photo 8. Typical coral attached to piling proposed for impact, Montastrea cavernosa.

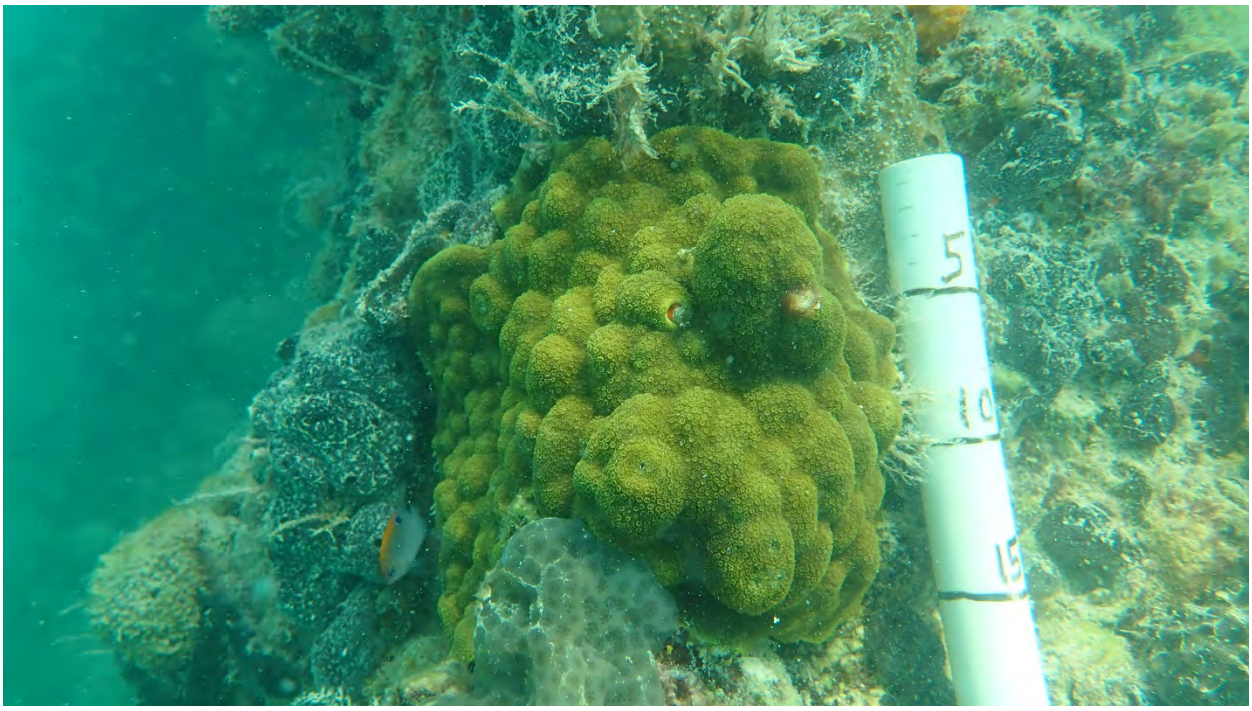


Photo 9. Typical coral attached to piling proposed for impact, Porites astreoides.

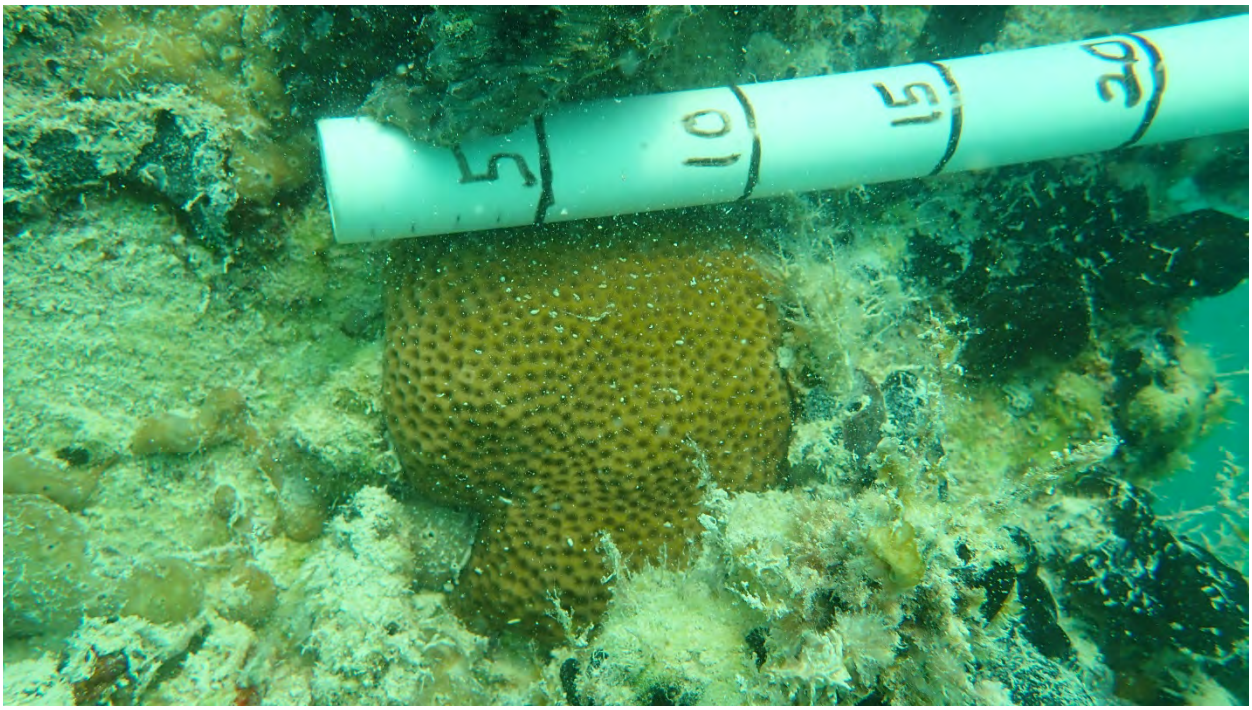


Photo 10. Typical coral attached to piling proposed for impact, Siderastrea siderae.

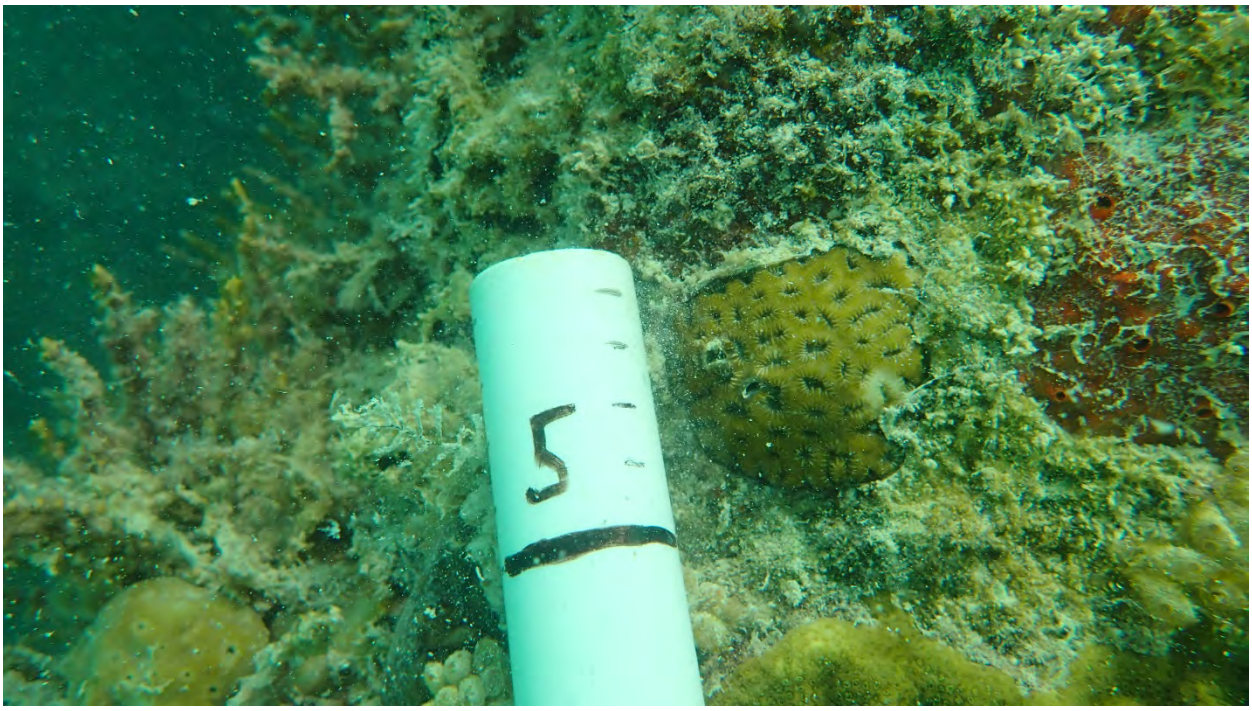


Photo 11. Typical coral attached to piling proposed for impact, Favia fragum.

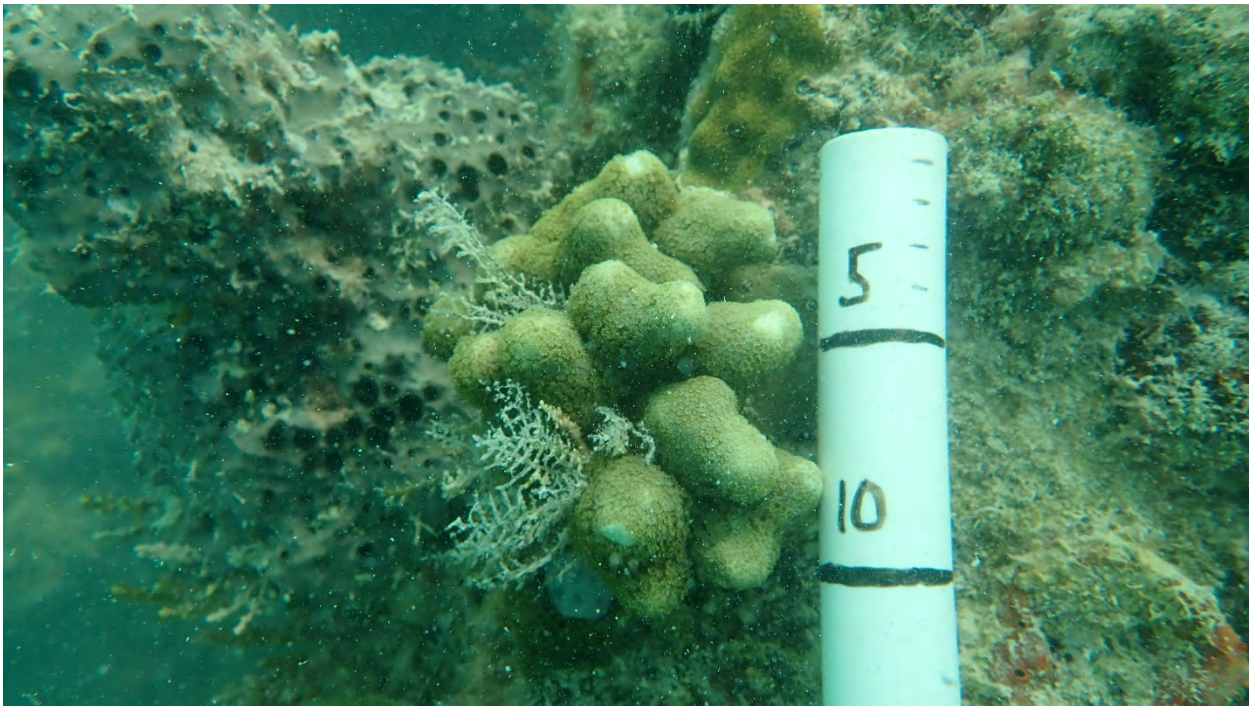


Photo 12. Typical coral attached to piling proposed for impact, Porites porites.

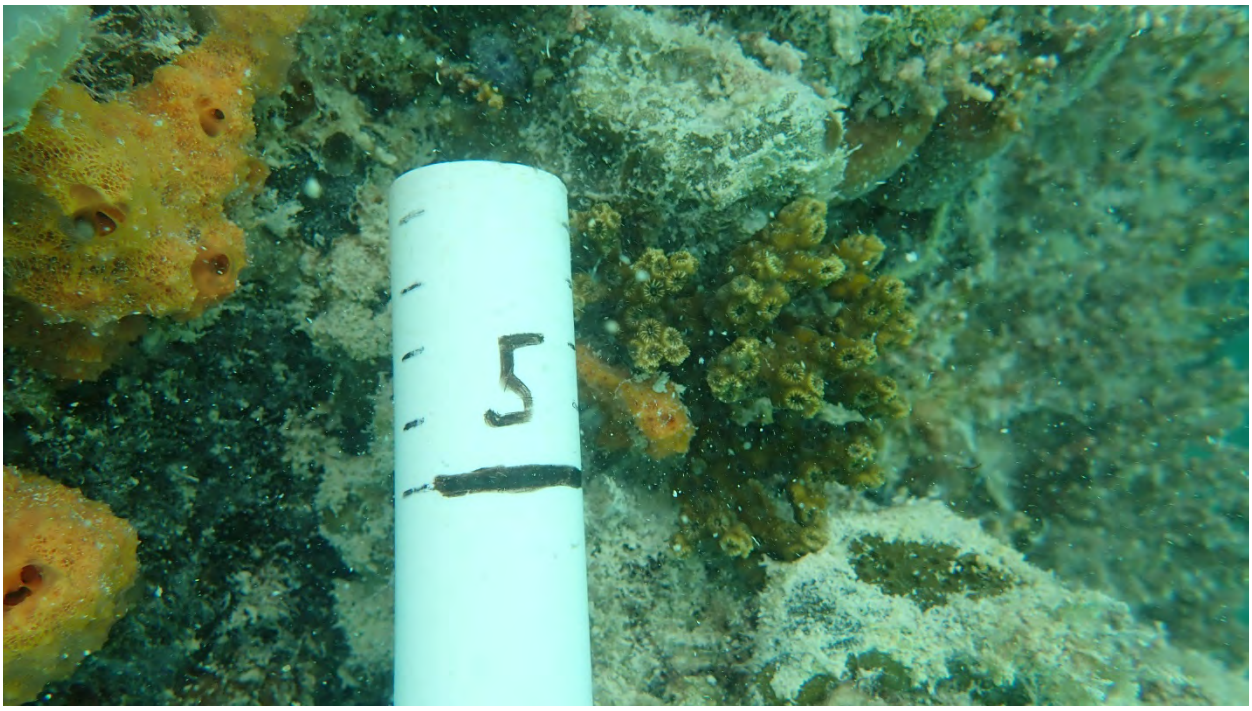


Photo 13. Typical coral attached to piling proposed for impact, Cladocora arbuscula.

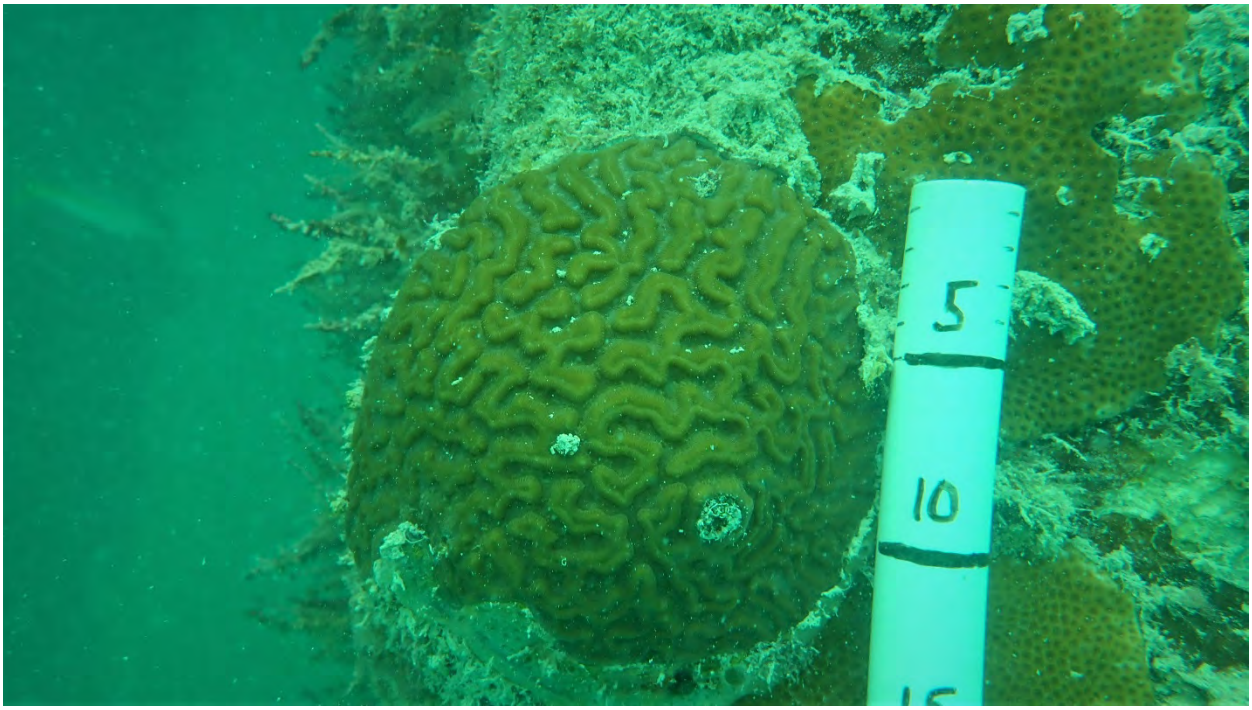


Photo 14. Typical coral attached to piling proposed for impact, Colpophyllia natans.

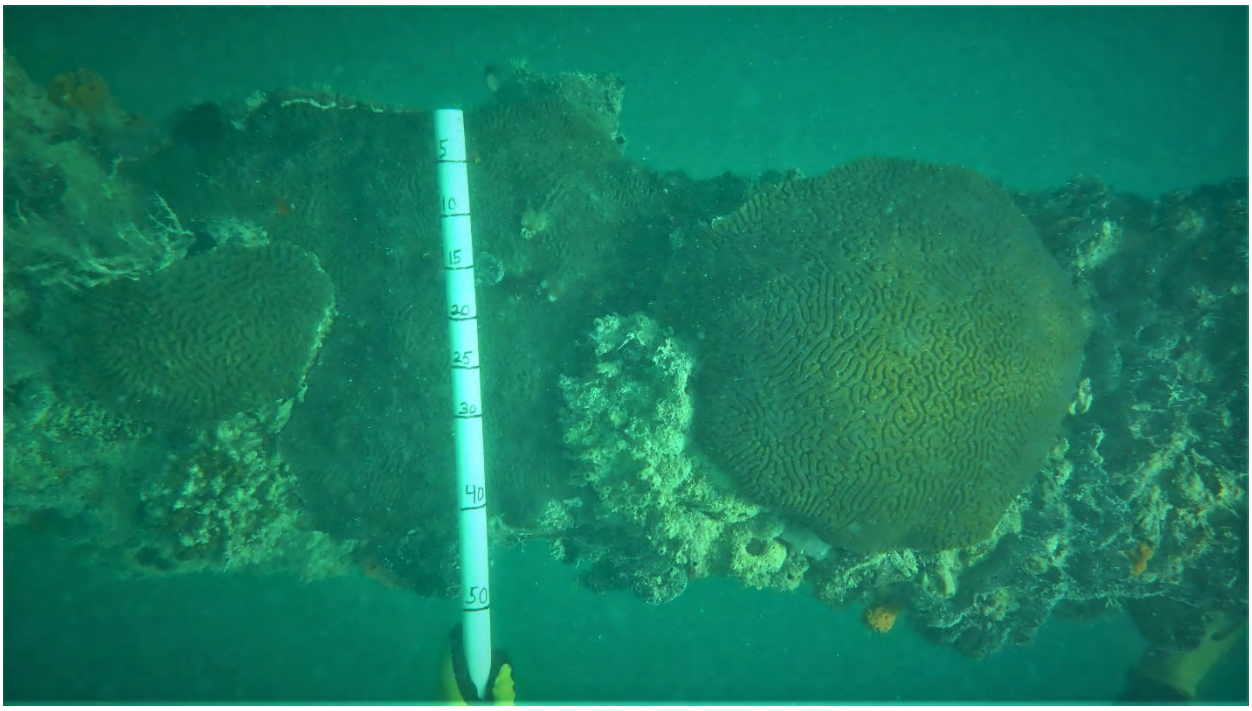


Photo 15. A cluster of large corals on Bent 3, pile 1 including Dlab, Pstr and Pcli. Photo turned sideways for presentation.

Photo 16. Federally-listed Orbicella faveolata attached to the South Dolphin, pile 2, which will be impacted by the proposed project.

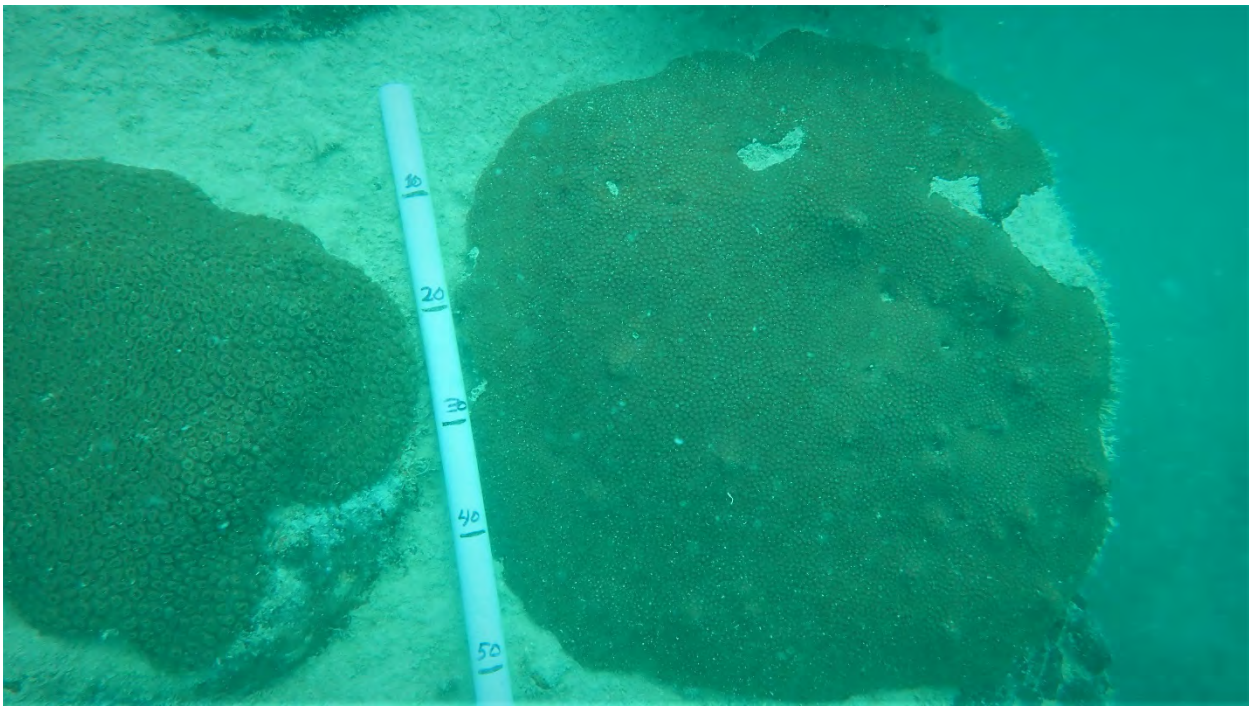


Photo 17. Two large corals, Mcav and Ofav at the Coral Relocation South site. Note most of these large corals are attached to the concrete block with cement.

Photo 18. Large corals including Mcav and Ssid at the Coral Relocation South site. Note most of these large corals are attached to the concrete block with cement. .