

**CORE SAMPLING  
BENTHIC ASSESSMENT OF CANALS 5 and 7  
IN KING'S BAY**

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*Final Report Prepared for:*

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## SCOPE OF WORK

This Report includes the results of pre-restoration (baseline) and post-restoration benthic core sampling from five locations in Canal 5 and Canal 7 to document conditions before and after the de-mucking and the planting *Vallisneria americana* planting. The objectives were: Document the effectiveness of flocculent organic removal and; Determine the suitability of sediments for growth and survival of *Vallisneria americana* post-restoration. The methodology is detailed in the following section

## METHODS

In order to verify that the *Lyngbya* sp. and flocculent organic substrate has been sufficiently removed to support *Vallisneria americana* restoration, colonization and survival we collected pre-restoration core samples on August 13, 2018 and post-restoration core samples on December 6, 2018. Johnson Engineering Senior Aquatic Ecologist, assisted by an Environmental Specialist collected core samples in a stratified pattern at along the length of each canal shown in Figure 1 with a total of five (5) samples collected and analyzed from each canal.

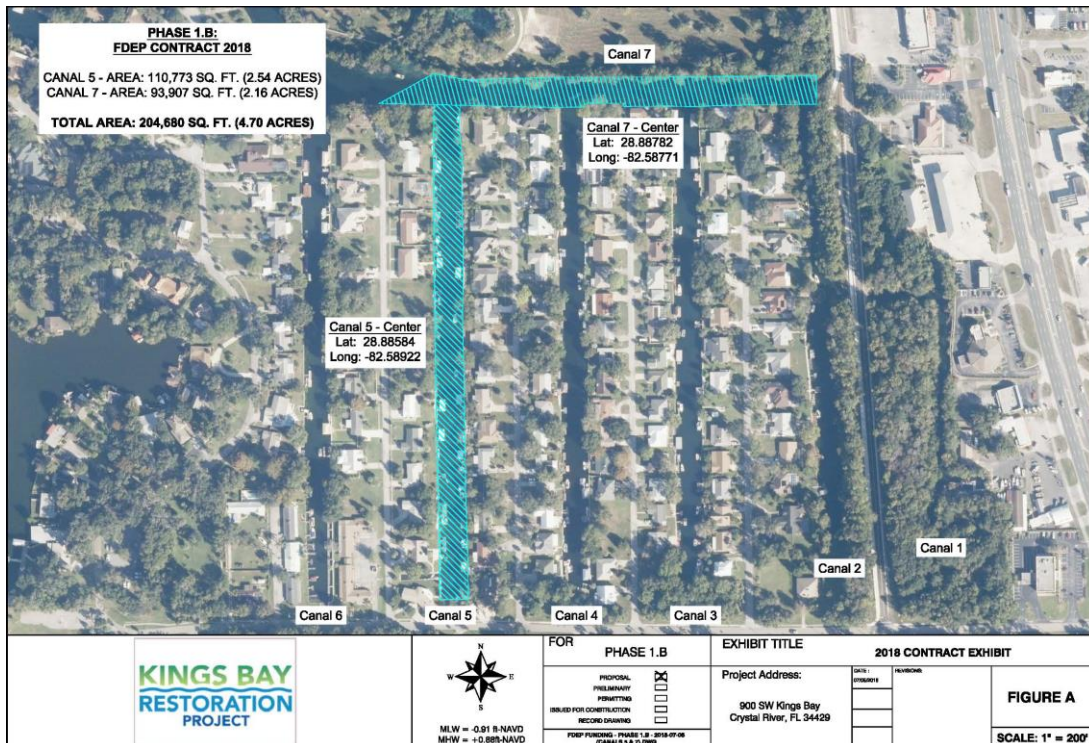


Figure 1. Canals of Phase 1B where core sampling will be conducted (Canals 5 and 7).

Core samples from the benthos were collected using a customized vacuum core sampler developed by Florida Gulf Coast University for limnological studies and characterizing sediment types. The core sampler consists of a 3.1 meter-long section of 3.8 cm diameter schedule 40 PVC pipe, with a one-way ball valve, rubber coupler, and 7.6 diameter x 0.75 meter clear Plexiglas™ cylinder at the base for collecting and viewing benthic samples (Figure 2).



Figure 2. Core sampling device ready to be deployed in Canal 7 on December 6, 2018.

Sediment cores were removed from the PVC extension and photographed against a white board with location and date for archival and later comparison with post-restoration sediment profiles. Flocculent (floc) unconsolidated organic materials were measured on the surface of sediments. Consolidated sediments were also measured in depth and categorized as floc (including live and

dead *Lyngbya*) mud/muck, sand, shell, and clay. The focus is on the upper layer of flocculent material along with *Lyngbya* and unconsolidated organics which is unsuitable habitat for survival and growth of *Vallisneria americana*. Substrate samples were GPS located during the baseline assessment and we returned the same locations in December for post-restoration sampling.

## **RESULTS**

The following are the results of the pre-restoration (baseline) core samples collected in August 2018. Canal 5 sampling was initiated at the southern end and continued north to the confluence with Canal 7 (Figure 1). Water depths were relatively consistent, ranging from 1.6 to 2.0 meters with an average of 1.7 to 1.8 meters for baseline and post-restoration respectively (Table 1). The area is tidally influenced so water depths vary depending tide cycles. Most important are sediment core composition and depth of the flocculent organic layer. Floc depths ranged from 2.0 to 10.0 cm deep with an average of 4.9 cm during the baseline. At all the sampling sites in Canal 5, there were deep deposits of soft muck/mud ranging from approximately 10 to 21.5 cm in depth over another layer of sand/clay. Core sample depths ranged from 32.0 to 38.0 cm with an average depth of 35.2 cm. At three locations (C5-3, C5-4 and C5-5) during the baseline sampling, the lower sections of the core samples contained pockets of peat. Peat forms when plant material does not fully decay because of acidic or anaerobic conditions like in a bog or swamp. These peat deposits may be remnants of historic habitat conditions prior to human development and excavation of canals. The post-restoration core samples contained an average floc layer depth of 4.3 cm, representing a reduction of only 12.3 % overall. The sediment cores depth average decreased from the baseline of 35.2cm to 25.3 cm post-restoration (Table 1). Johnson Engineering was informed that Canal 5 restoration was incomplete when November 2018 manatee season halted de-mucking operations. This explains why floc layers were only slightly reduced in Canal 5. Photographs of post-restoration core samples from Canal 5 are included in the Appendix.

| Table 1. Canal 5: Baseline Results of Core Samples collected on August 13 and December 6, 2018 |          |           |   |           |          |           |      |              |
|--|----------|-----------|---|-----------|----------|-----------|------|--------------|
| King's Bay Core Sample Locations   |          |           | Pre-restoration Sediment Profile (cm)     |           |          |           |      |              |
| Site   | Latitude | Longitude | Water Depth (m)                           | Floc (cm) | Muck/Mud | Sand/Clay | Peat | Overall (cm) |
| C5-1   | 28.53043 | -82.35352 | 1.6                                       | 2.0       | 21.5     | 12.5      | 0.0  | 36.0         |
| C5-2   | 28.53103 | -82.35350 | 1.7                                       | 10.0      | 12.0     | 10.0      | 0.0  | 32.0         |
| C5-3   | 28.53156 | -82.35358 | 1.7                                       | 5.0       | 10.0     | 10.0      | 13.0 | 38.0         |
| C5-4   | 28.53209 | -82.35351 | 1.7                                       | 5.0       | 20.0     | 5.0       | 6.0  | 36.0         |
| C5-5   | 28.53251 | -82.35353 | 1.9                                       | 2.5       | 20.0     | 8.0       | 3.5  | 34.0         |
|  |          | Mean =    | 1.7                                       | 4.9       |          |           |      | 35.2         |
|  |          |           |   |           |          |           |      |              |
|  |          |           | Post-restoration Sediment Profile         |           |          |           |      |              |
| Site   |          |           | Water Depth (m)                           | Floc (cm) | Muck/Mud | Sand/Clay | Peat | Overall (cm) |
| C5-1   |          |           | 1.7                                       | 2.0       | 21.6     | 2.5       | 0.0  | 26.1         |
| C5-2   |          |           | 1.8                                       | 2.5       | 10.5     | 10.0      | 5.0  | 28.0         |
| C5-3   |          |           | 1.8                                       | 8.9       | 12.7     | 0.0       | 6.4  | 28.0         |
| C5-4   |          |           | 1.8                                       | 4.5       | 7.0      | 8.0       | 7.0  | 26.5         |
| C5-5   |          |           | 2.0                                       | 3.8       | 11.4     | 2.5       | 0.0  | 17.7         |
|  |          | Mean =    | 1.8                                       | 4.3       |          |           |      | 25.3         |
|  |          |           | <b>Mean Floc Removal Efficiency 12.3%</b> |           |          |           |      |              |

Samples from Canal 7 were collected from east to west (C1-C5) at the same locations and in the same order as the baseline sampling. Canal 7 had water depths ranging from 1.2 to 2.0 meters (average of 1.5 m) during the baseline and from 1.2 to 1.9 meters (average of 1.4 m) during post restoration sampling. Flocculent material ranged in depth from a low of 0.5 cm near Three Sisters Spring up to 6.5 cm in the middle and 6.0 along the eastern half of Canal 7. Average floc depths were 4.0 cm but it was unevenly distributed due to the influence of the springs, adjacent canals, boat traffic and uneven water depths. Core samples ranged from 16.5 to 32.0 cm deep during the baseline sampling in August 2018, with an average of 23.6 cm. The post-restoration floc layer depths ranged from 0.3 to 5.0 cm with an average depth of 1.8 cm, representing a floc removal efficiency of 55%. Sediment core depths decreased approximately 3.9 cm on average. However the category of muck/mud appeared to increase at some locations based on the five core samples taken in December 2018. It is possible that some of the material from Canal 5 was displaced during de-mucking operations and settled out in Canal 7. The sediment conditions in Canal 7 are variable due to Three Sisters Springs, exposed limestone, and the confluence with Canals 2,3,4, and 5. Overall the sediment conditions are suitable for growth and spread of *Vallisneria* and other species of SAV. At least two enclosure cages were flipped upside down and another was dented, possibly as the result of tour boat anchors and boat traffic in Canal 7.

| <b>Table 2. Canal 7: Results of Core Samples collected on August 13 and December 6, 2018</b> |                 |                  |  |                  |                 |                   |                     |  |
|--|-----------------|------------------|--|------------------|-----------------|-------------------|---------------------|--|
| <b>King's Bay Core Sample Locations</b>  |                 |                  | <b>Pre-restoration Sediment Profile (cm)</b> |                  |                 |                   |                     |  |
| <b>Site</b>  | <b>Latitude</b> | <b>Longitude</b> | <b>Water Depth (m)</b>                       | <b>Floc (cm)</b> | <b>Muck/Mud</b> | <b>Sand/Shell</b> | <b>Overall (cm)</b> |  |
| C7-1   | 28.53266        | -82.35240        | 1.5  | 6.0              | 5.0             | 14.0              | 25.0                |  |
| C7-2   | 28.53269        | -82.35269        | 2.0  | 6.0              | 5.0             | 21.0              | 32.0                |  |
| C7-3   | 28.53091        | -82.35228        | 1.3  | 6.5              | 2.0             | 16.5              | 25.0                |  |
| C7-4   | 28.53273        | -82.35350        | 1.3  | 1.0              | 3.0             | 15.5              | 19.5                |  |
| C7-5   | 28.53266        | -82.35374        | 1.2  | 0.5              | 4.0             | 12.0              | 16.5                |  |
|  |                 | Mean =           | 1.5  | 4.0              |                 |                   | 23.6                |  |
| <b>Post-restoration Sediment Profile (cm)</b>  |                 |                  |  |                  |                 |                   |                     |  |
| <b>Site</b>  |                 |                  | <b>Water Depth (m)</b>                       | <b>Floc (cm)</b> | <b>Muck/Mud</b> | <b>Sand/Shell</b> | <b>Overall (cm)</b> |  |
| C7-1   |                 |                  | 1.4  | 1.0              | 7.5             | 8.0               | 16.5                |  |
| C7-2   |                 |                  | 1.9  | 0.3              | 5.0             | 21.0              | 26.3                |  |
| C7-3   |                 |                  | 1.2  | 5.0              | 13.0            | 1.0               | 19.0                |  |
| C7-4   |                 |                  | 1.2  | 1.9              | 16.5            | 2.5               | 20.9                |  |
| C7-5   |                 |                  | 1.2  | 0.7              | 5.0             | 10.2              | 15.9                |  |
|  |                 | Mean =           | 1.4  | 1.8              |                 |                   | 19.7                |  |
| <b>Mean Floc Removal Efficiency 55%</b>  |                 |                  |  |                  |                 |                   |                     |  |

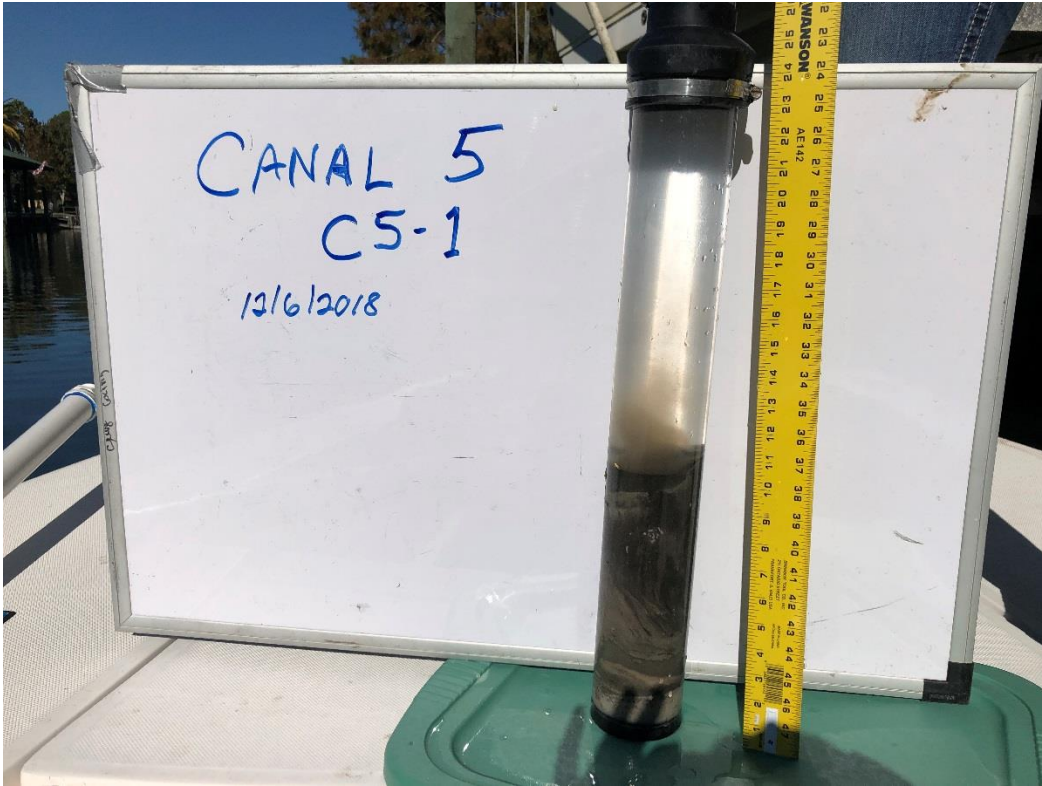
## CONCLUSIONS

Canal 5 was relatively consistent in water depths and sediment composition with deeper deposits of flocculent material and deep mud, sand/clay, and peat in some areas. Apparently the de-mucking operation was not completed by November 2018 manatee season and prior to the core sampling conducted on December 6, 2018. The suitability of Canal 5 for *Vallisneria americana* establishment will depend on the completion of de-mucking to restore suitable sediment conditions.

Canal 7 had variable sediment conditions with the influence of Three Sisters Spring on water clarity and substrate conditions. Post-restoration core samples indicated that 55% floc and *Lyngbya* were successfully removed from Canal 7. Overall, sediments in Canal 7 appear suitable for establishment and spread of *Vallisneria* and other species of SAV. Disturbance to planting enclosures was documented in Canal 7 and reported to Sea and Shoreline for corrective action and replanting if necessary. Boat traffic and boat anchoring during the December sampling event appeared to be the cause of disturbances to planting enclosures.

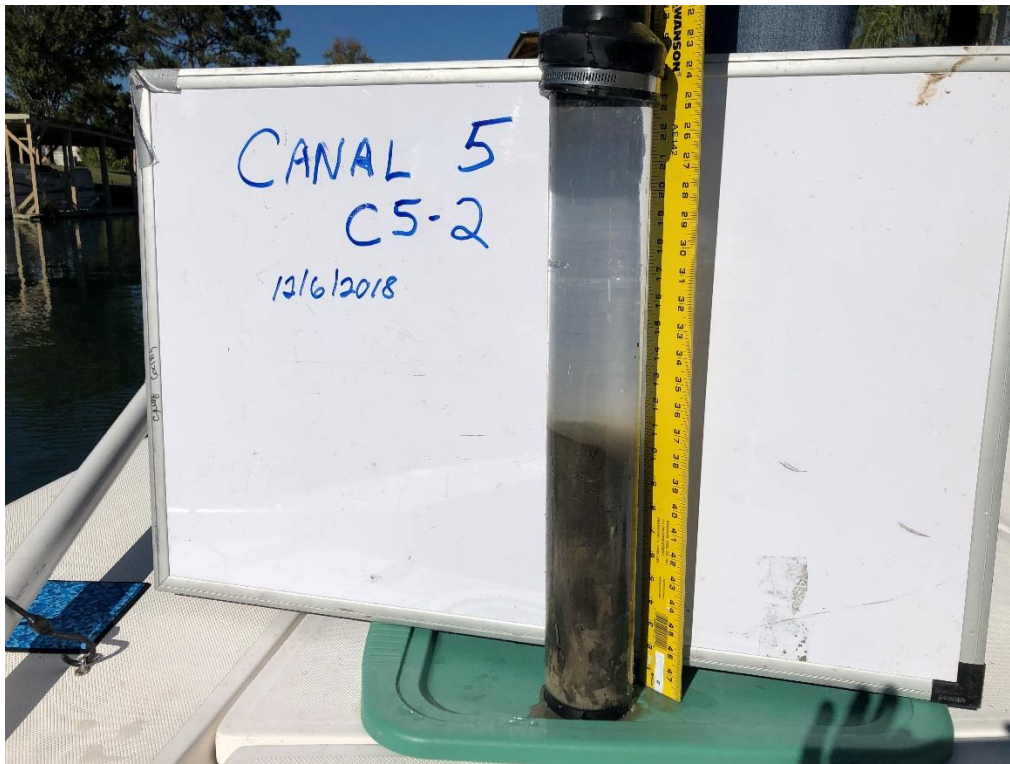
Photographs of core samples from both canals are included in Appendix A.

**APPENDIX A**  
**Photographs of Core Samples from Canals 5 and 7**  
**Collected December 6, 2018**



Canal 5: Core sample 1 with 2.0 cm of floc over 2mud/clay and sand layers.

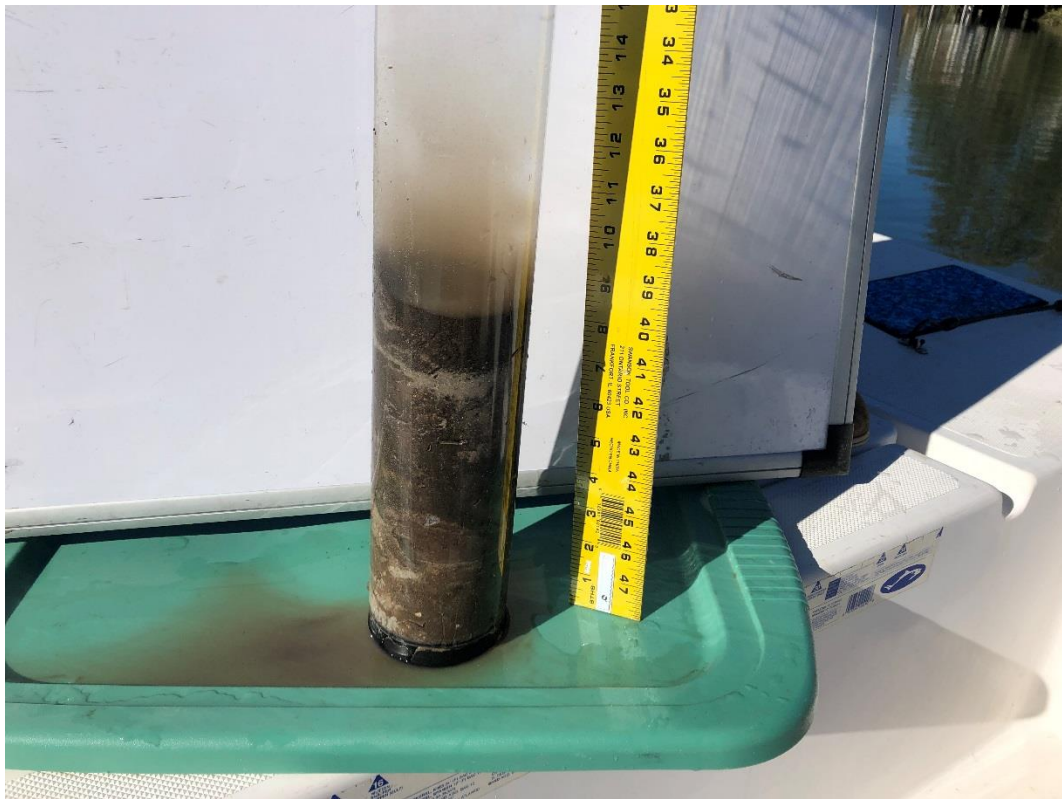




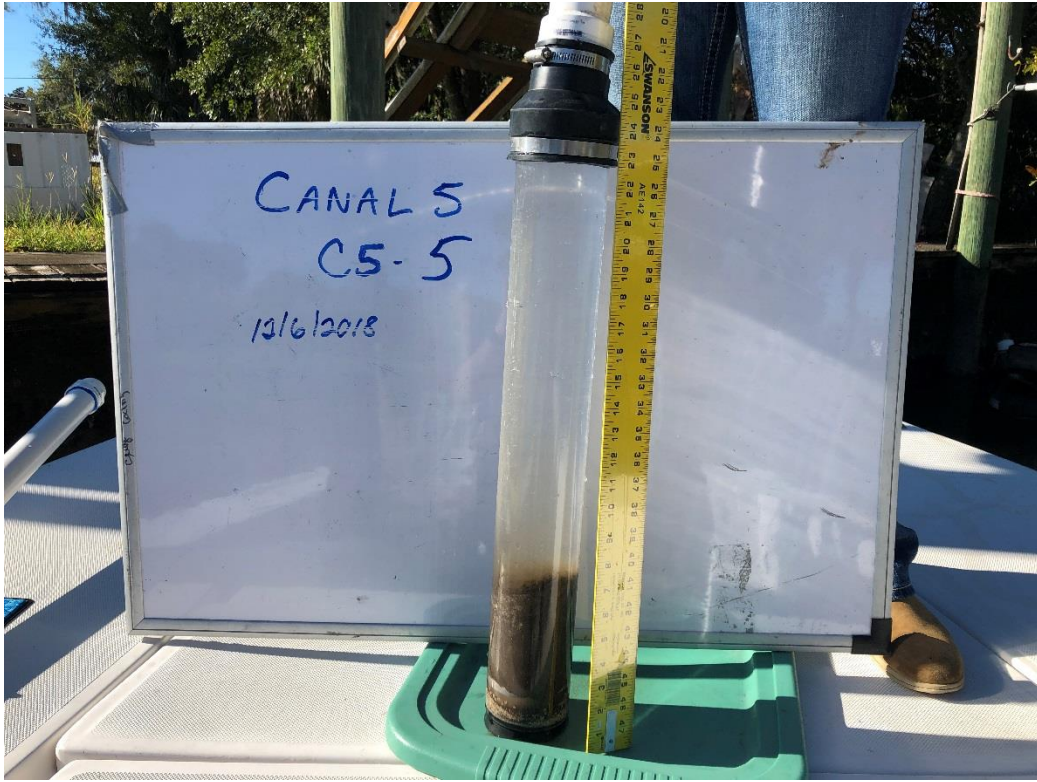
Canal 5: Core Sample 2 with 2.5 cm of floc over 25.5 cm of mud/clay/sand and peat.



Canal 5: Core sample 3 with 8.9 cm of floc over 19.1 cm of mud/muck and peat.



Canal 5: Core Sample 4 with 4.5 cm of floc over 22.0 cm of mud/sand/clay and peat layers.



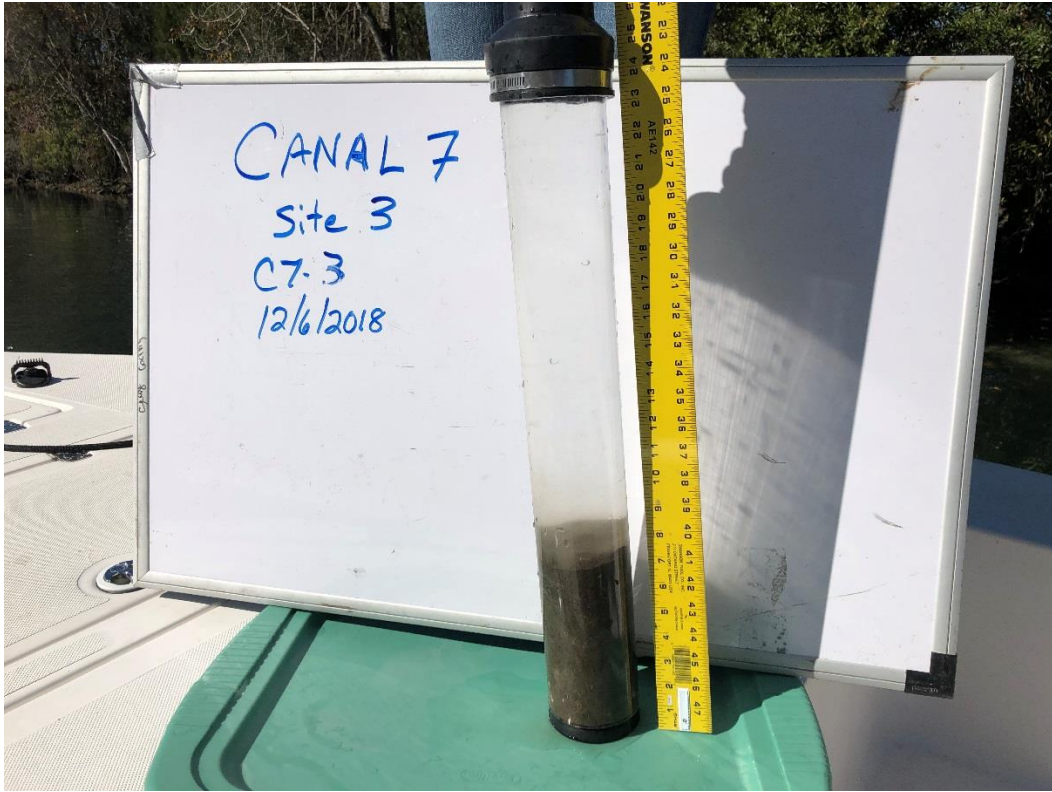
Canal 5: Core sample 5 with 3.8 cm of floc over 13.9 cm of mud/clay and sand layers.



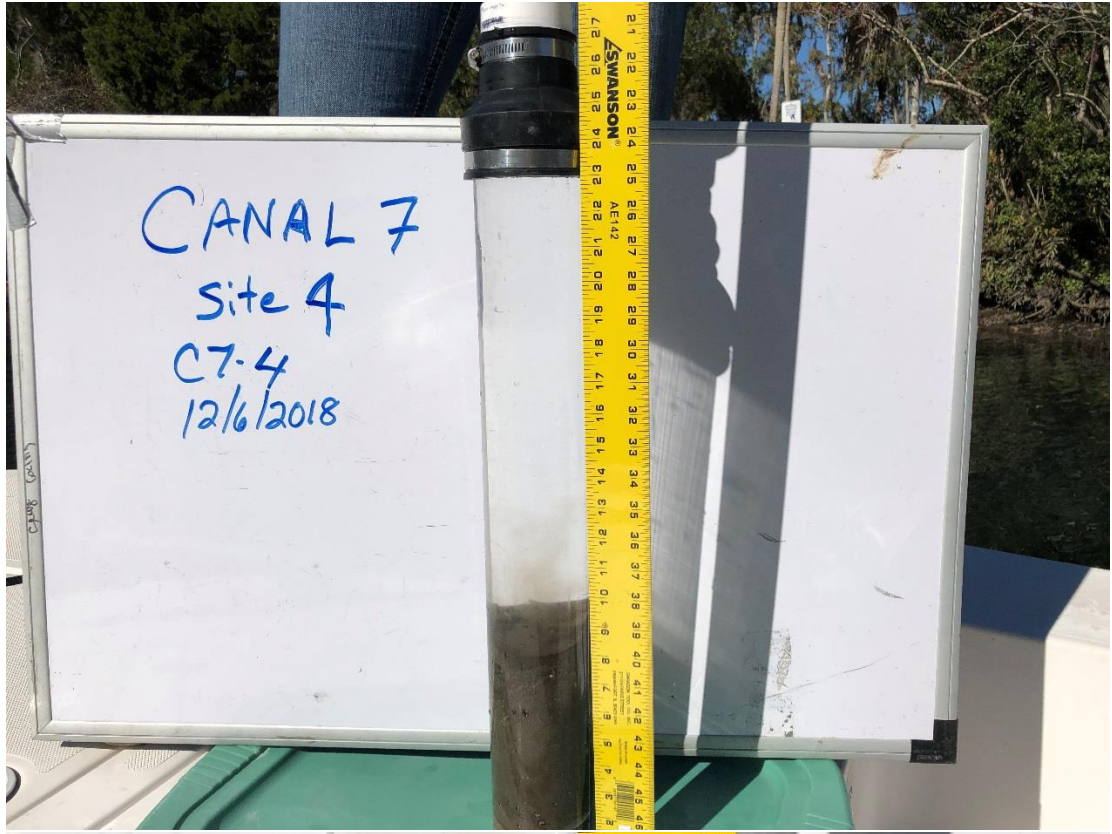
Canal 7: Post-restoration core sample with 1.0 cm floc over 15.5 cm of mud/sand



Canal 7: Core sample 2 with 0.3 cm of floc over 26 cm of mud/sand and shell layers.

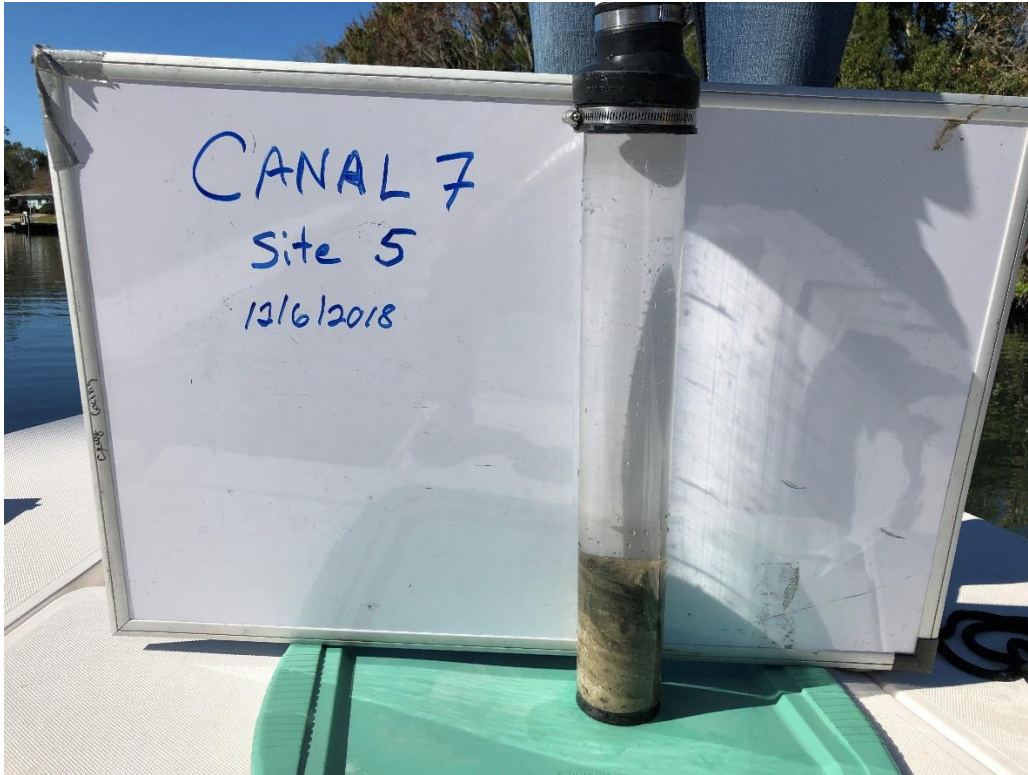


Canal 7: Core Sample 3 with 5.0 cm of floc over 14.0 cm of mostly muck/mud and some sand.



Canal 7: Core sample 4 with 1.9 cm of floc over 19.0 cm of mosly muckl/mud and some sand.





Canal 7: Core sample 5 with 0.7 cm of floc over mud (5.0 cm) and sand/shell (10.2 cm).