

Water Quality Protection Program – Canal Demonstration Projects

Presented to:

Florida Keys National Marine Sanctuary Advisory Council

Presented by:

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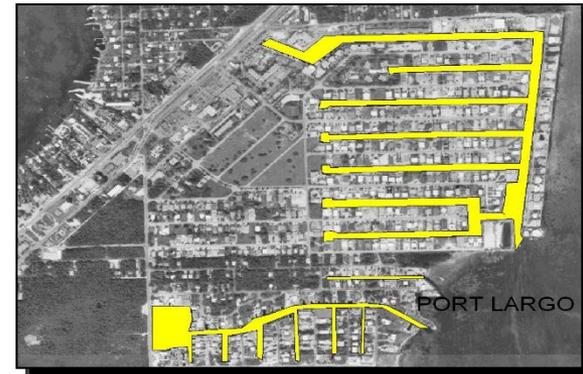
Canal Construction in the Florida Keys

- Dredge and fill activities created 170 miles of canals, with 312 miles of waterfront property to accommodate the increasing population
- Many canals dug 10 - 20 feet to maximize fill material
- Most canals are long dead-end networks with little or no tidal flushing
- Canal development initiated before ecologists and resource managers were aware of the implications



Impacts of Canal Development

- Increased population growth in a sensitive area without storm water and waste water systems
- Added excessive nutrients, turbidity and sediment to canal waters causing long-term water quality degradation
- Destroyed shoreline habitat especially mangroves
- The canals discharge directly to nearshore [Outstanding Florida Waters](#) in the FKNMS which may not receive direct or indirect discharges that would significantly degrade these waters



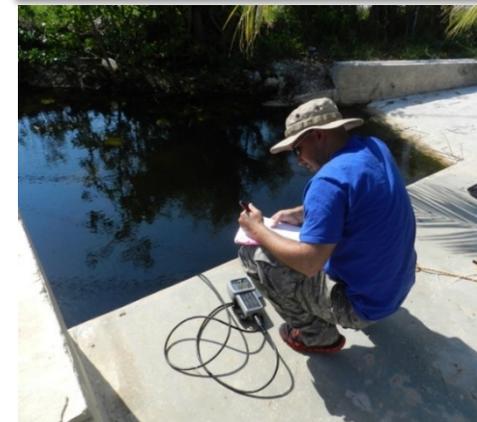
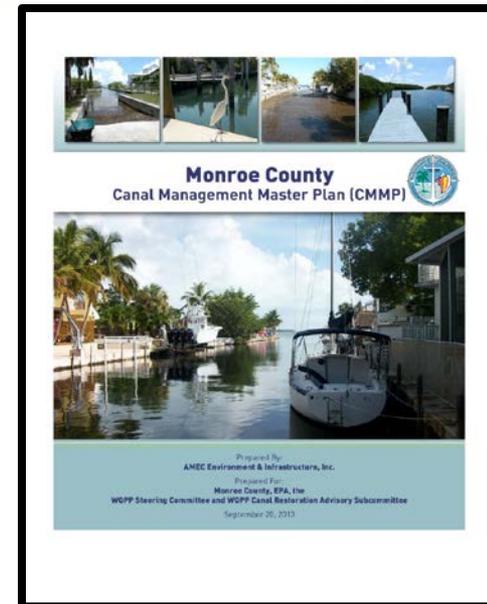
Water Quality Protection Program (WQPP) Canal Restoration Advisory Subcommittee

- Canal Restoration Advisory Subcommittee created to specifically address canal water quality restoration
- Canal Restoration Advisory Subcommittee Members
 - Federal: EPA, NOAA
 - State: DEP, FWC
 - County: George Neugent
 - Cities: All 5 represented
 - Other: Florida Keys Environmental Fund
 - Advisory: Rhonda Haag - County
 - Advisory: Wendy Blondin - Amec Foster Wheeler
- First recommendation of Subcommittee was to prepare a Canal Management Master Plan



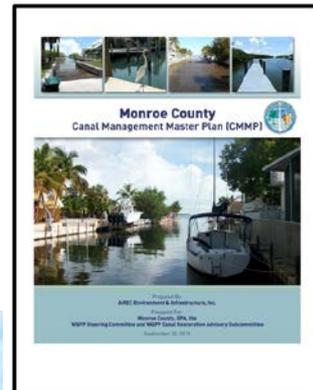
Monroe County Canal Management Master Plan for Residential Canals(CMMP)

- Defined **goals** for canal water quality improvement agreed upon by all stakeholders
- Developed a basic conceptual **framework** for canal **restoration and management**
- Completed a comprehensive County-wide **mapping** of residential canals
- Completed a County-wide **field study of water quality** in the canals
- Developed a **ranking system** for categorizing canals based on observed characteristics
- **Prioritized** canals based on need for water quality improvement
- Proposed potential **corrective actions** and management practices to improve water quality in residential canals



Canal Management Master Plan (CMMP)

- Phase 1 was funded \$100,000 by DEP in March 2012
 - Created the framework of the plan: goals, objectives, ranking process
- Phase II was funded \$100,000 by EPA in October 2012
 - Completed September 2013 - assessed 502 residential canals; completed the ranking and prioritization; recommended technologies for each canal focused at remediating canal depth, seaweed loading, and flushing
- 311 canal systems throughout the County identified as needing some form of water quality improvement



Why is Canal Restoration Needed?



Key Colony Beach

Only 1/3
of the
canals
have
“Good”
Water
Quality



Duck Key



Key Haven



Conch Key



Sugar Loaf

This is Why Restoration is Needed



Upper Keys – accumulated seaweed

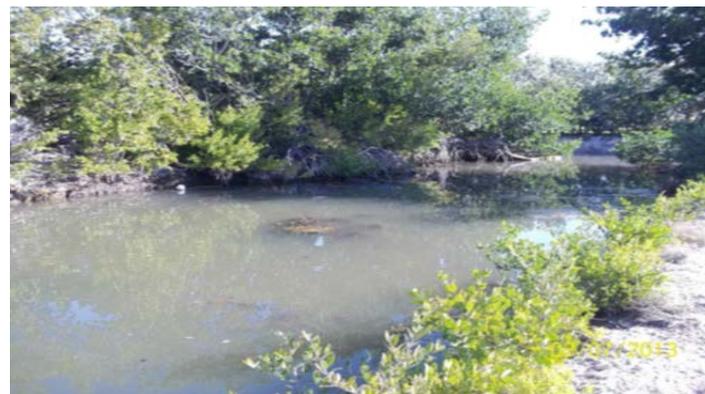


Middle Keys – trapped seaweed



Summerland – trapped seaweed

2/3 of the canals have either “Poor” or “Fair” Water Quality



Lack of flushing

CMMP Recommended Restoration Technologies

- CMMP restoration techniques focused on improving the canal water quality conditions related to **reduced dissolved oxygen** and associated lack of flushing



Examples of Technologies

- **Removal of accumulated organics** from within canals
- **Weed gates, air curtains or other physical barriers** to minimize additional organic accumulation in the canals
- **Culvert connections** to facilitate flushing
- **Backfilling** to prevent occurrence of deep stagnant zones
- **Pumping systems** to facilitate flushing

Canal Restoration Demonstration Program

- The Canal Restoration Advisory Subcommittee recommended that the first step to implement the CMMP was a **Canal Restoration Demonstration Program**
- Purpose of the Demonstration Projects:
 - Implement CMMP technologies (backfilling, organic removal, weed barriers, culverts, and pumping)
 - Evaluate the effectiveness of the technologies (EPA grant)
 - Obtain realistic permitting, scheduling, and cost information
- Monroe County initially funded **\$5 Million and recently added \$2 Million** for demonstration projects in Unincorporated Monroe County
- The Village of Islamorada funded \$100,000 to join in the demonstration program



Monroe County Demonstration Projects

Weed Barriers	Organic Removal	Culvert Installation	Backfilling	Pumping
<p>#266 Big Pine Doctor's Arm between Witters & Bailey Lanes</p> <p><i>Same Canal – 2 categories</i></p> <p>#1</p>		<p>#459 Geiger Key Boca Chica Ocean Shores between Boca Chica Rd & Jay Lane</p> <p>#2</p>	<p>#29 Key Largo Sexton Cove between Bunting & Pigeon Drives</p> <p>#3</p>	<p>#278 Big Pine Eden Pines Colony Pine Ave</p> <p>Not Included in current permitting scope – access issue caused delay, evaluating redesigns</p> <p>#7</p>
<p>#287 Big Pine Atlantic Estates between Hollerich and Atlantis Drs</p> <p>#4</p>	<p>#290 Big Pine between Ave I and J</p> <p>Canal already has an existing effective weed gate</p> <p>#5</p>	<p>#277 Big Pine Tropical Bay between Watson Blvd and Sunrise Drive</p> <p>#6</p>		
		<p>#Geiger Key #472 Geiger Mobile Homes</p> <p>DEP Grant Project</p>		

Update on Canal #29 Backfilling Demonstration Project Sexton Cove, Key Largo between Pigeon and Bunting Drives

Cause of Impairment: Extremely deep (>20 feet deep) stagnant pockets with low dissolved oxygen and high hydrogen sulfide which can flush into nearshore waters during storm events

1. Restoration consisted of placing 900 Truckloads of clean fill (26,000 cubic yards) to raise canal bottom elevation from -35 feet Mean Low Water (MLW) to -7.7 feet MLW to eliminate deep stagnant pockets and assist in flushing

2. Construction Process

- a) Adventure Environmental selected Contractor at \$1.36 Million
- b) 10-20 truckloads of clean fill transported from Florida City
- c) Excavator loaded fill onto a conveyor belt placed over the mangrove fringe along canal shoreline
- d) Fill moved onto a 60' x 24' barge for uniform emplacement throughout the canal



Update on Canal #29 Backfilling Demonstration Project Sexton Cove, Key Largo (continued)

3. Project Events

- a) On-going maintenance of turbidity curtains
- b) Crocodiles and manatees visited the site – able to maintain 50 foot radius and continue work
- c) Homeowners said construction much less disruptive than they had anticipated

4. Project Schedule

- a) Construction started March 4, 2015
- b) Sand fill emplacement, minimum of 1 foot, May 12 - 26
- c) Survey documented completion all except in one small area
- d) Project completed July 3, 2015**
- e) Staging area restoration
- f) 90 day post backfill survey verified no settling/compaction
- g) Project closeout in process**



Update on Canal #29 Backfilling Demonstration Project Sexton Cove, Key Largo (continued)

5. Benefits

- a) Dissolved oxygen impairment corrected
- b) Return of sea life
- c) Return of sea grasses



Homeowner Quotes:

- a. *"The canal is coming alive! We've been seeing mullet, snapper, jacks, barracuda, manatees over the past month. Today another milestone; I heard a commotion in the canal and looked out to see a school of snapper chasing a shrimp. The shrimp was jumping for all it's worth trying to get away. After four jumps a snapper finally ate it. Then a few minutes later I saw two more shrimp jumping out of the water trying to avoid the snapper. All this happened in broad daylight about noon."*
- b. *"Today I snorkeled in the canal, and am happy to report that I could see the bottom, all over!! AND – fish. All sizes of snapper. Schools of finger mullet. Barracuda."*
- c. *"We have noticed lots of fish, big and small in our canal. The Manatees seem to like the more shallow water, 6 of them show up just about every day:"*

Update on Organic Removal Project Canal #266 Drs. Arm, Big Pine Key

Cause of Impairment: Buildup of decomposing seaweed on canal bottom depleting the dissolved oxygen and adding nutrients

1. Restoration consists of removal of 5 feet of decayed seaweed and muck from the canal bottom from -3.4 feet MLW to -8.4 feet MLW (estimated muck volume 8,300 cy)

2. Construction Process

- a) JND Thomas, Company selected Contractor at \$1.2 Million
- b) Barge operated **hydraulic vacuum dredge** removes muck
- c) Dredge spoils piped to land side staging areas
- d) **Spoils dewatered mechanically** using belt presses
- e) Water discharged back into canal
- f) Polymers added to assist in dewatering
- g) **Reuse of dredge spoils at a local facility**



Update on Organic Removal Project Canal #266 Drs. Arm, Big Pine Key (continued)

3. Project Events

- a) Good coordination with sewer installation work
- b) No manatees or key deer within project footprint – no incidents
- c) Resolution of muck removal within a 5 foot buffer along seawalls/structures



4. Project Schedule

- a) Mobilization May 18, 2015
- b) Dredging completed October 19, 2015
- c) Survey documented sediment removal to < 3 inches
- d) Placement of 6 inches of sand to be completed in Dec
- e) Demobilization/site restoration – completed by end of Dec
- f) Reinstallation of air curtain after organic removal completion



Site Tour of Canal #266

Doctors Arm Big Pine Key, Organic Removal Project

1. EPA Public Outreach Grant for Canal Restoration Education funded a site tour of the organic removal project at Canal #266

2. Site tour conducted August 5, 2015

- a) Three tour sessions conducted
- b) Over 50 people attended
- c) Topics included:
 - Background of the CMMP and Canal Restoration Demonstration Program
 - Overview of the Canal #266 project
 - Site tour of dewatering equipment and operation
 - Site tour of dredging operation
 - Question and answers



3. Great feedback received

Update on 2nd Organic Removal Project Canal #290 between Ave I and J, Big Pine Key

1. Removal of 5 feet of decayed seaweed and muck from the canal bottom from -3.9 feet MLW to -8.9 feet MLW (estimated muck volume 4,700 cy).



2. Construction Process

- a) Same contractor as Canal #266, JND Thomas, at a cost of \$800,000. **Saved over \$200,000 combining the two projects.**
- b) **Same equipment as Canal #266**
- c) Canal #290 spoils disposed at a permitted landfill due to slightly elevated arsenic and copper levels

3. Project Schedule

- a) Mobilization in process - dredging to start in December
- b) **Project Completion estimated late February 2016**
- c) Weed barrier/air curtain to be upgraded by homeowners



Update on Air Curtains Canal #266 Drs. Arm and Canal #287 Atlantic Estates, Big Pine Key

Cause of Impairment: Continual influx of seaweed into dead end canals where it sinks and decomposes depleting the dissolved oxygen and adding nutrients



1. Three demonstration projects for air curtains – Effectiveness monitoring will compare results

- a) Air Curtain Alone – Canal #287 Atlantic Estates
- b) Air Curtain Combined with Organic Removal – Canal #266 Doctors Arm
- c) Air Curtain Combined with Aerators - #137 Treasure Harbor, Plantation Key, Islamorada



2. Canals #287 and #266 in Big Pine

- a) Proposals due December 15, 2015
- b) Construction start date estimated for February 2016

3. Canal #137 Treasure Harbor – system installed Nov 2014



Update on Culvert Installations

Cause of Impairment: Lack of tidal flushing due to dead end canal construction which produces stagnant water depleted of dissolved oxygen

1. Canal #459 Boca Chica Ocean Shores Geiger Key

- a) Navy access approval slowing down design

2. Canal #277 Tropical Bay Estates Big Pine Key

- a) DEP will fund \$50,000 of the construction costs
- b) 60" circular reinforced concert pipe connect two segments of canal
- c) DEP will fund \$50,000 of the construction costs
- d) Permit applications submitted October/November
- e) Advertise for Proposals Nov 6 with the Opening on Dec 29
- f) Construction start date estimated for March 2016

3. Canal #472 Geiger Key

- a) First to be installed – details follow



Update on Geiger Key #470 / #472 Culvert Project – Combined funding by DEP and Monroe County

1. Design Basis

- a) Increase natural tidal flushing and add dissolved oxygen
- b) Submerged to prevent seaweed from Canal #472 impacting Canal #470 - Not designed to reduce seaweed entry into Canal #472

2. Culvert Construction

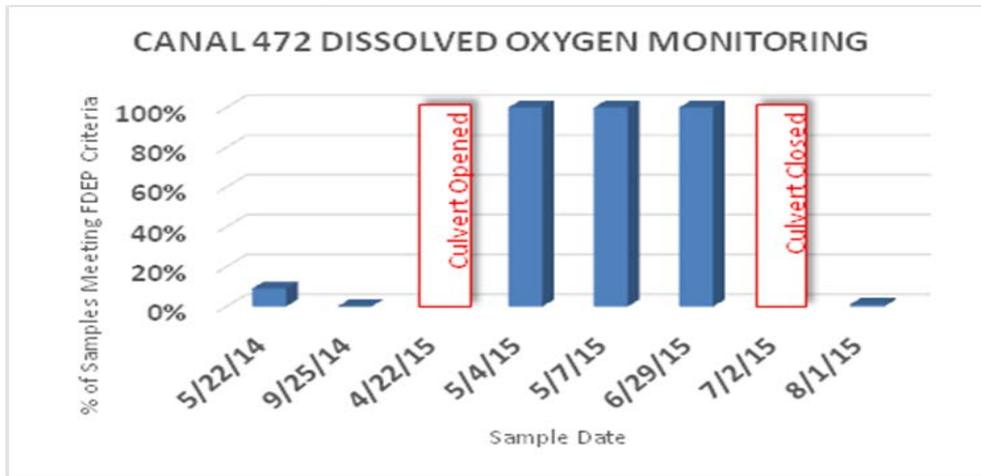
- a) Concrete reinforced pipe 112 foot 24-inch by 38-inch
- b) Installed in March/April 2015 by Charley Toppino & Sons, Inc.
- c) Previously **unknown subsurface obstructions** on the Canal #472 side (private property seawall supports and a concrete junction box) led to a field decision to angle the culvert
- d) **Erosion prevention added** (metal deflector plate and concrete barricade to direct flow away from seawall)
- e) Some homeowner concerns about the culvert affect on seaweed migration temporarily caused culvert to be closed while situation is evaluated



Update on Geiger Key #470 / #472 Culvert Project (continued)

3. Water Quality Improvements

- a) Upon opening of the culvert the natural tidal flow immediately improved water clarity and increased fish populations in both canals
- b) FIU dissolved oxygen data at depth show the culvert improved the water quality to meet State Standards even with heavy seaweed loading as observed in June 2015



4. Evaluating opening of the culvert to allow monitoring



Update on Geiger Key #470 / #472 Culvert Project (continued)



Update on Canal #278 Pumping Demonstration Project - Eden Pines, Big Pine Key

1. Proposed restoration consists of using pumps to pump clean bay water to the farthest ends of the canal system to increase natural tidal flushing



2. Complex project

- a) **High operation and maintenance costs that will need to be paid by homeowners after 2 years**
 - **Need mechanism for ensuring funding of operation and maintenance**
- b) **Need approvals of over 450 property owners**
- c) **USFWS coordination for access for intake pipe**



Restoration Effectiveness Monitoring by Florida International University

- **Water Quality and Benthic Resource Monitoring**
- **Pre-restoration and post-restoration monitoring**
- **Water Quality Monitoring Toolkit**
 - **Profile measurements** (YSI and Seabird)
 - Temperature, DO, Depth, Conductivity, Salinity, pH, Turbidity, Photosynthetically Active Radiation, Colored Dissolved Organic Matter
 - **Diel cycles** (24 hr monitoring @ 10 min sampling rate)
 - DO, Turbidity, Conductivity, Salinity, Temperature, pH
 - **Water Quality analysis**
 - Nutrients - Total Nitrogen, Total Phosphorous, Dissolved Inorganic Nitrogen
 - **Bacteria analysis** (Enterococci/Enterolert)
- **Benthic Monitoring**
 - Seagrass, algae, fish and marine life, organisms on seawalls, sediment characteristics



2016 EPA Grant for Water Quality Improvements in Residential Canal

A. Bench Scale Testing to Assist with **Beneficial Re-Use of Organics** Removed from Canal Bottoms

- 1) Soil flushing laboratory testing to remove salts



B. Alternative Technologies Evaluation to Address **Accumulated Muck** in Canal Bottoms

- 1) Research alternative technologies to dredging, documented history of effectiveness evaluated



C. Alternative Technology Evaluation for **Water Quality Improvements** in Canals

- 1) Identify technologies not currently included in the CMMP
- 2) Identify passive & less energy intensive techniques



D. Development of a **Business Plan** for Canal Management

- 1) Identify reliable and equitable funding mechanism

Future of the Canal Restoration Program in MONROE COUNTY



1. BOCC Requested a Workshop to discuss Programmatic Plan for future Canal Restorations

- a) **Restoration needed in 229 canals** in Unincorporated Monroe County
- b) Discussion of **Regulatory Requirements** for Canal Restorations
 - Clarification of EPA and DEP mandates and expectations
- c) Need to identify a **funding mechanism** for future restorations
- d) **March 2016** date anticipated





DEP and EPA Grants Funds for Canals

- 03/21/12: Approval and authorization of a **\$100,000 Grant from FDEP to fund Phase 1 of the Canal Management Master Plan** and also authorized execution of a task order with AMEC under the on-call professional engineering services contract to develop Phase 1.
- 09/19/12: Approval of a **\$100,000 EPA grant that funded Phase 2** of the Canal Master Plan.
- 03/20/13: Approval of **\$5 million** for the canal restoration demonstration projects.
- 02/20/13: Approval of **FDEP Grant providing \$100,000 to perform bathymetric surveys**
- 11/20/13: Approval of a **\$100,000 Grant Agreement from the FDEP to provide culvert design and permitting of the third ranked culvert of Canal #472 Geiger Key** in the demonstration project list and **sediment characterization** testing
- 09/17/14: Approval of a **\$100,000 Grant Agreement FDEP** for funding of construction support services and the **installation of a culvert on Canal #472 Geiger Key**, the 3rd ranked canal demonstration project in the Canal Management Master Plan
- 10/17/14: Approval to enter into a Grant Agreement for a **\$234,190.00 grant awarded by EPA in support of two environmental education programs for canals**, of which \$100,000 of canal restoration funds were offered as a cash match, \$59,190 was offered as in-kind services from the IFAS Extension Service, and of which **\$75,000 is awarded in cash to the County**.
- 10/21/15: Approval to enter into Grant Agreement for a **\$73,909.66 grant awarded by the EPA** for the South Florida Geographic Initiative Grant **Improving Water Quality in Residential Canals**.
- TBD: Approval to enter into a **Grant Agreement with DEP for \$50,000** for a portion of the construction installation costs for the **culvert at Canal #277** in Big Pine Key.

QUESTIONS?

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