WATER QUALITY MONITORING PROJECT FOR DEMONSTRATION OF CANAL REMEDIATION METHODS FLORIDA KEYS

Preliminary Report #3: Assessment of Canal Remediation Methods Canal using Water Quality Data Before and After Remediation

May 6, 2016

Presented to:
Water Quality Program Canal Restoration Advisory Committee

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Objective
• To provide data needed to make unbiased, statistically rigorous statements about the status and temporal trends of water quality parameters in the remediated canals

Conceptual model
The execution of the project includes two phases:
1) Before remediation
2) After remediation
Water quality testing parameters

• Vertical profiles

• Continuous 24-hour recording (Diels) of physical-chemical data:

%DO (Dissolved Oxygen) sat exceedances calculations: % readings below 42% saturation in a full day of diel data

• Water sampling for total nutrients analysis
Demonstration canals included in this report

- Canal #29 in Key Largo. Backfilled to reduce canal depth

- Canal #137 in Plantation Key. A weed barrier was installed to prevent input of wrack

- Canal #472 in Geiger Key. A culvert was installed to enhance circulation
Water quality criteria

- 62-302.533 DO (Dissolved Oxygen) criteria for Class III Waters
- 62-302.532 Estuary-Specific Criterion for Total Phosphorus (TP) and Total Nitrogen (TN), by biogeochemical subdivisions of South Florida coastal and estuarine waters (Briceno et al, 2013)

Canal #29  Manatee Bay-Barnes Sound segment of Biscayne Bay
Canal #137  Middle Keys
Canal #472  Lower Keys
Canal #29. Remediation technology: Backfilling. Completed Jul-15

### Surface waters in compliance during the whole monitoring period

### Post-remediation surveys showed %DO saturation in compliance in shallower new bottom waters

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>SHORT TERM</th>
<th>LONG TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth</td>
<td>31-Mar-14</td>
</tr>
<tr>
<td>No more than 10% of the daily measured values should fall below 42 %DO saturation</td>
<td>S 0% 0% ▲</td>
<td>0% ▲ 0% ▲</td>
</tr>
<tr>
<td></td>
<td>B 43% 100% ▲</td>
<td>0% ▼ 0% ▲</td>
</tr>
</tbody>
</table>

**LEGEND**
- Stable within favorable range
- Declining within favorable range
- Improving within favorable range
- Stable within negative range
- Declining within negative range
- Increasing within negative range

- S: Surface water Measurements ~ 2 ft below water surface
- B: Bottom water Measurements ~ 1 ft above canal bottom

† A full day of diel data consist of 24 hours of measurements collected every 10 min
Canal #29. Remediation technology: Backfilling. Completed Jul-15

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>PRE-REMEDIATION</th>
<th>POST-REMEDIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>31-Mar-14</td>
<td>16-Oct-14</td>
</tr>
<tr>
<td>TP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 0.007 ppm†</td>
<td>S 0.021</td>
<td>0.004 ▼</td>
</tr>
<tr>
<td></td>
<td>B 0.030</td>
<td>0.003 ▼</td>
</tr>
<tr>
<td>TN</td>
<td>less than 0.58 ppm†</td>
<td>S 0.28</td>
</tr>
<tr>
<td></td>
<td>B 0.39</td>
<td>0.59 ▲</td>
</tr>
</tbody>
</table>

- Stable within favorable range
- Declining within favorable range
- Improving within favorable range
- Stable within negative range
- Declining within negative range
- Increasing within negative range

†Manatee Bay-Barnes Sound segment of Biscayne Bay

- First post-remediation survey rendered TP concentrations out of compliance
- Surface and Bottom TN concentrations in compliance after remediation
Canal #137. Remediation technology: Weed gate installation. Completed Nov-14

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Depth</th>
<th>1-Apr-14</th>
<th>14-Sep-14</th>
<th>30-Jun-15</th>
<th>7-Feb-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>No more than 10% of the daily measured</td>
<td>S</td>
<td>83%</td>
<td>0%</td>
<td>29%</td>
<td>0%</td>
</tr>
<tr>
<td>values should fall below 42 %DO saturation†</td>
<td>B</td>
<td>100%</td>
<td>5%</td>
<td>74%</td>
<td>0%</td>
</tr>
</tbody>
</table>

LEGEND

- **Stable within favorable range**
- **Declining within favorable range**
- **Improving within favorable range**
- **Stable within negative range**
- **Declining within negative range**
- **Increasing within negative range**

Second post-remediation survey showed both surface and bottom waters %DO saturation in compliance.
Canal #137. Remediation technology: Weed gate installation. Completed Nov-14

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Depth</th>
<th>1-Apr-14</th>
<th>14-Sep-14</th>
<th>30-Jun-15</th>
<th>7-Feb-16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 0.007 ppm</td>
<td>S</td>
<td>0.028</td>
<td>0.010 ▼</td>
<td>0.019 ▲</td>
<td>0.020 ▲</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>0.027</td>
<td>0.010 ▼</td>
<td>0.018 ▲</td>
<td>0.019 ▲</td>
</tr>
<tr>
<td><strong>TN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 0.22 ppm</td>
<td>S</td>
<td>0.12</td>
<td>0.35 ▲</td>
<td>0.20 ▼</td>
<td>0.37 ▲</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>0.12</td>
<td>0.34 ▲</td>
<td>0.19 ▼</td>
<td>0.28 ▲</td>
</tr>
</tbody>
</table>

**LEGEND**

- ▲ Stable within favorable range
- ▼ Declining within favorable range
- ▲ Stable within negative range
- ▼ Declining within negative range
- ▲ Improving within favorable range
- ▼ Increasing within negative range

- Post-remediation surveys rendered TP concentrations out of compliance
- Surface and Bottom TN concentrations returned to out of compliance in Feb-16
Canal #472. Remediation technology: Culvert installation. Completed May-15 and was closed shortly after

Post-remediation surveys showed %DO saturation in compliance and a return to values out of compliance in bottom waters after the culvert was closed
**Canal #472. Remediation technology: Culvert installation. Completed May-15 and was closed shortly after**

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>Depth</th>
<th>22-May-14</th>
<th>25-Sep-14</th>
<th>4-May-15</th>
<th>7-May-15</th>
<th>21-Jul-15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Culvert open</td>
<td>Culvert closed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP</td>
<td>less than 0.008 ppm</td>
<td>S 0.019</td>
<td>0.004 ▼</td>
<td>0.014 ▲</td>
<td>0.015 ▲</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B 0.020</td>
<td>0.004 ▼</td>
<td>0.012 ▲</td>
<td>0.013 ▲</td>
<td></td>
</tr>
<tr>
<td>TN</td>
<td>less than 0.21 ppm</td>
<td>S 0.20</td>
<td>0.25 ▲</td>
<td>0.36 ▲</td>
<td>0.21 ▼</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B 0.19</td>
<td>0.24 ▲</td>
<td>0.28 ▲</td>
<td>0.24 ▼</td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND**

- ▲ Stable within favorable range
- ▼ Declining within favorable range
- ▲ Stable within negative range
- ▼ Declining within negative range
- △ Increasing within negative range

- Post-remediation surveys rendered TP concentrations out of compliance
- TN concentrations in bottom water have bounced in and out of compliance
Score cards by canal

http://serc.fiu.edu/wqmnetwork/Canals/index.htm

Canal #29

Canal #137

Canal #472