Use of Indicator of Reduction in Soils (IRIS) tubes as a Performance Measure in Wetland Restoration

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IRIS Tubes

• Indicator of Reduction In Soils
  • Used to evaluate the presence of reducing soil conditions
  • Ferrihydrite coating on Polyvinyl Chloride (PVC) pipe
  • Developed by B.J. Jenkinson, Purdue University and M. Rabenhorst, University of Maryland
  • Available commercially
IRIS Tubes

- **Indicator of Reduction In Soils**
  - Approved by NTCHS (2007) as an alternative way to document reducing soil conditions
  - 3 of 5 tubes having at least 30% removal over 15 cm of tube; top of removal zone considered is within 15 cm of surface
IRIS Tubes

- Indicator of Reduction In Soils
  - Installation recommendations provided by US Army Corps of Engineers Research and Development Center, Wetland Regulatory Assistance Program (ERDC TN-WRAP-09-1)
  - Typically 5 tubes in multiple nests along upland-wetland gradient depending upon purpose of study
  - Remain in place 2 to 4 weeks, or site specific monitoring strategy
IRIS Tubes

- **Indicator of Reduction In Soils**

- Tubes can be used for evaluation outside of NTCHS criteria

- For regulatory purposes follow NTCHS criteria
Evaluation of IRIS tube use on Wetland Restoration Projects

Project Example 1

- Bottomland hardwood restoration in northeast Louisiana
- USACE recommended use of IRIS tubes
- 13 Sampling plots
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- One 12 inch IRIS tube installed at center of sample plots
- IRIS tubes were allowed to remain in place for one year
- Documented percent removal after one year
- Compared removal with other vegetative monitoring data
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- IRIS Tube Removal

<table>
<thead>
<tr>
<th>Plot</th>
<th>IRIS Tube Loss</th>
<th>Plot</th>
<th>IRIS Tube Loss</th>
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<tbody>
<tr>
<td>1</td>
<td>80%</td>
<td>7</td>
<td>50%</td>
</tr>
<tr>
<td>2</td>
<td>40%</td>
<td>8</td>
<td>25%</td>
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<tr>
<td>3</td>
<td>40%</td>
<td>9</td>
<td>5%</td>
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<td>4</td>
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<td>10</td>
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<tr>
<td>5</td>
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<td>11</td>
<td>40%</td>
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<td>6</td>
<td>50%</td>
<td>12</td>
<td>30%</td>
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<tr>
<td></td>
<td></td>
<td>13</td>
<td>15%</td>
</tr>
</tbody>
</table>
% of Observed Redox Features

IRIS Tube Removal
% Survival of Tree Species

IRIS Tube Removal

$R^2 = 0.21$
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Lessons Learned

• Follow ERDC and NTCHS guidance

• Develop monitoring strategy that fits need

• NTCHS criteria vs. regulatory requirements in wetland jurisdictional determinations (e.g. hydrologic data)
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Project Example 2

• Wetland restoration and Stormwater Treatment Area in Central FL

• Compare IRIS tube response to Eh measurements in a constructed system
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- Pre and Post Construction
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- Construction involved significant soil disturbance
- Soils mapped as Basinger Series
- Mixing of organic matter into surface of exposed argillic horizon
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- Measurements observed across upland-wetland gradient over 5m x 5m area
- Installed nine IRIS tubes in groups of 3 perpendicular to slope
- Tubes remained in place over 14 days
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- Eh and pH measurements were recorded parallel to IRIS tubes and at 15 and 30 cm depths at each location.

- Eh was measured using platinum electrodes and Ag/AgCl reference electrode with commercial grade digital multimeter.

- Water level measurements also recorded along gradient.
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IRIS Tube Evaluation

- Tubes scanned on each 90° axis
- Scans stitched using Adobe Photoshop
- Percent removal analyzed using ImageJ Software (Wayne Rasband, NIH)
- Converted to binary images to isolate areas of removal
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IRIS Tube Evaluation
Evaluation of IRIS tube use on Wetland Restoration Projects

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IRIS Tube Evaluation
Evaluation of IRIS tube use on Wetland Restoration Projects

![Graph showing % Removal (0 to 15 cm) vs. Eh (mV). The graph includes a line of best fit with the equation R^2 = 0.93 and P < 0.05.]
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\[
R^2 = 0.95 \\
P < 0.05
\]
Evaluation of IRIS tube use on Wetland Restoration Projects

![Graph showing the relationship between % Removal (0 to 30 cm) and Eh (mV). The regression line is shown with a correlation coefficient (R²) of 0.65 and a p-value (P) of < 0.05.](image)
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\[ R^2 = 0.63 \]
\[ P < 0.05 \]
Evaluation of IRIS tube use on Wetland Restoration Projects

IRIS Tube Evaluation
Evaluation of IRIS tube use on Wetland Restoration Projects

Lessons Learned

• Evaluate IRIS tubes in segments that correspond to soil profile; consistent with NTCHS criteria

• Understand soil morphology effect on IRIS tube response

• Understand effect of application of soil amendments on ability to demonstrate development of hydric soils
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Questions?

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