ASWM Energy Project
Cumulative Adverse Effects

Wing Goodale: July 24, 2018
Webinar Overview

- Project objectives
- Overview: Cumulative adverse effects (CAE)
- Assessment: A process for assessing cumulative adverse effects of pipelines on wetlands
- Questions/feedback
Project Objective

- Provide a literature review on framing, assessing, and managing cumulative adverse effects of natural gas transmission pipelines on wetlands

- Provide an approach to consider cumulative adverse effects under NEPA when conditioning pipeline permits

- Provide an actionable guidance document to support management decisions
Project Process

- Association of State Wetland Managers developed “Cumulative Effects” sub-workgroup
  - Comprised of state, federal, and tribal representatives
- Members responded to a survey focused on defining adverse effects, hazards, and vulnerable wetlands
- Several working calls discussing aspects of framing
- Presentation to the group of the basic process
- Development of a white paper
- Overall results presented in the webinar
Cumulative Adverse Effects (CAE)

Background and Overview
Why do we care?

- **Legal**: Legal requirement to include cumulative effects in environmental assessments in the U.S., Canada, U.K., E.U.
- **Ecological**: Ecologically it is the accumulation of all anthropogenic actions over time and space
- **Pipelines and wetlands**: While the effects of one project maybe insignificant, those cumulatively from multiple projects will lead to significant loss or conversion of wetlands
What are Adverse Effects?

- **Hazards**: physical changes to the environment from pipelines
- **Vulnerability**: documented wetland sensitivity to hazards
- **Exposure**: present of wetland in a development area
- **Wetland adverse effects**:
  - Direct: Loss of wetland function and conversion
  - Indirect: Degraded water quality and modified hydrology

Crichton 1999
What is cumulative adverse effects?

- NEPA Definition: “Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (40 CFR §1508.7)

- Cumulative adverse effects (CAE) is a process through which adverse effects accumulate

- CAE assessments are inconsistent partly because of a lack of clear framing
What Type of Risk is CAE

- **Risk type**
  - **NOT Simple:** Basic cause and effect
  - **IS Systemic**
    - **Complex:** Cause and effects relationships multifaceted
    - **Uncertain:** Limits and absence of scientific knowledge
    - **Ambiguous:** Different perspectives

Renn et al. 2011
How and why do we assess cumulative adverse effects?

- **Why assess CAE?**
  - Support conservation measures to avoid, minimize, and compensate for adverse effects
    - *Cumulative adverse effects are reduced by minimizing adverse effects of each project*

- **How to assess?**
  - Must narrow the scope to have a meaningful assessment

- **Risk governance process**
  - **Framing** the risk in order to assess
  - **Assess** the risk in order to evaluate
  - **Evaluate** the risk in order to manage
  - **Manage** the risk
Governing Cumulative Adverse Effects

- **Select** Take conservation measures to avoid, minimize and compensate for adverse effects

- **Identify** direct and indirect effects
  - **Identify** hazards
  - **Identify** vulnerable receptors

- **Evaluate** the significance of the cumulative adverse effects based upon the severity of the hazard, exposure, and vulnerability

- **Determine** Hazard Severity
  - **Determine** Exposure Severity
  - **Determine** Vulnerability Severity

- **Manage** (How are effects reduced?)

- **Frame** (What are the types of effects from pipelines?)

- **Assess** (What wetlands are affected?)

- **Evaluate** (How significant are the effects?)
Homotypic Stressors of Pipeline Development

Heterotypic

Other anthropogenic stressors
- Other construction
- Roadways
- Agriculture

ID Vulnerable Wetlands

ID Hazard

ID Adverse Effects Pathways

Assess Exposure

Direct
- Wetland Function Loss & Conversion

Indirect
- Degraded Water Quality
- Modified Hydrology

Temporal

Spatial

Determine Cumulative Effects Pathways

Additive (CAE = a + b)
Synergistic (CAE > a + b)
Countervailing (CAE < a + b)

Evaluate Cumulative Adverse Effects
Assessing the CAE of Pipeline Development on Wetlands
Framing (scoping)

- Hazard Scope: Homotypic, i.e., pipelines only
- Receptor Scope: Freshwater wetlands as defined by NWI
- Primary Adverse Effects: Direct and indirect will be project specific

Spatial boundaries
- Political boundaries: Individual states
- Watershed boundaries: HUC 6 & 8 watersheds
- Pipeline buffer: 300 feet on either side of the central line of the pipeline

Temporal boundaries
- Past: Number of pipelines operating within the HUC watershed defined in the spatial scope
- Present: Number of pipelines currently being permitted within the watershed
- Future: Number of pipelines planned within the watershed
Qualitatively Assess CAE

- **Determine hazard severity:** How extensive is the project?
  - Identify adverse effects: What are the anticipated direct and indirect effects

- **Determine spatial exposure severity:** How many wetland are exposed and will be converted and/or will lose functionality?

- **Determine temporal exposure severity:** How does the proposed pipeline incrementally contribute to adverse effects from past, present, and anticipated development?

- **Determine vulnerability severity:** How significant (i.e., high quality) are the wetlands that are to be exposed?

- **Evaluate Cumulative Adverse Effects:**
  - What is the significance
Assessment Output

- Development of a simple risk index

<table>
<thead>
<tr>
<th>Project #</th>
<th>Hazard</th>
<th>Spatial Exposure</th>
<th>Temporal Exposure</th>
<th>Vulnerable Wetlands</th>
<th>CAE Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 - 5</td>
<td>0 - 5</td>
<td>0 - 5</td>
<td>0 - 5</td>
<td>0 - 1</td>
</tr>
</tbody>
</table>

- Index can then be mapped to categories

<table>
<thead>
<tr>
<th>CAE Risk Level</th>
<th>CAE Index Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>0 – 0.2</td>
</tr>
<tr>
<td>Minor</td>
<td>0.2 – 0.4</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.4 – 0.6</td>
</tr>
<tr>
<td>Major</td>
<td>0.6 – 1.0</td>
</tr>
</tbody>
</table>
Determine Hazard Severity

- **How extensive is the project?**
  - How many miles is the planned pipeline?
  - How many support structures are planned?

- **What are the anticipated adverse effects?**
  - Direct
    - Is wetland loss and conversion expected?
  - Indirect
    - Are hydrological changes expected?
    - Is water quality degraded?

Make qualitative hazard severity determination: Scale 0 (negligible) - 5 (high) = 2

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Number</th>
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<tbody>
<tr>
<td>Pipeline</td>
<td>10 km</td>
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<tr>
<td>Auxiliary structure A</td>
<td>1 structure</td>
</tr>
<tr>
<td>Auxiliary structure B</td>
<td>1 structure</td>
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</table>
## Assessment Matrix

<table>
<thead>
<tr>
<th>Project</th>
<th>Hazard</th>
<th>Spatial Exposure</th>
<th>Temporal Exposure</th>
<th>Vulnerable Wetlands</th>
<th>CAE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

* CAE = Cumulative Adverse Effects
Determine Spatial Exposure Severity

- **How many wetlands are being exposed?**
  - How many NWI wetlands within the study area (300 feet of the central line of the pipeline)?

- **How many wetlands within the watershed are exposed?**
  - How many HUC 8 watersheds will the pipeline pass through?
  - How many NWI wetlands are in each HUC 8 watershed?

- **Make qualitative spatial exposure determination:**
  - Scale 0 (negligible) - 5 (high) = 4

<table>
<thead>
<tr>
<th>Wetlands</th>
<th>Number</th>
<th>Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within project area</td>
<td>17</td>
<td>1.2</td>
</tr>
<tr>
<td>HUC 8</td>
<td>77</td>
<td>8,563</td>
</tr>
<tr>
<td>Percent of wetlands within watershed exposed</td>
<td>22%</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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</table>
Determine Temporal Exposure Severity

- **How does the proposed pipeline incrementally contribute to adverse effects from past, present, and anticipated development?**
  - Past: How many pipelines currently are operational within the watershed?
  - Present: How many pipelines are currently being permitted within the watershed?
  - Future: How many pipelines are planned within the watershed?

- **Make qualitative temporal exposure determination:**
  - Scale 0 (negligible) - 5 (high) = 1
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<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
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</table>
Determine Vulnerability Severity

- **How significant are the wetlands being exposed?**
  - What are the wetland types exposed to the project?
  - What is the conservation status of each wetland type?
  - What is the status of the wetlands within the HUC 8 watershed?

- Make qualitative vulnerability determination: Scale 1 (low) - 5 (high) = 5

<table>
<thead>
<tr>
<th>NWI Type</th>
<th>Cons Status</th>
<th># Project</th>
<th>Area Project (km²)</th>
<th># HUC</th>
<th>Area HUC (km²)</th>
<th>% Exposed</th>
<th>% Area Exposed</th>
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</thead>
<tbody>
<tr>
<td>Emergent</td>
<td>Low</td>
<td>2</td>
<td>0.1</td>
<td>45</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrub-shrub</td>
<td>Moderate</td>
<td>5</td>
<td>0.4</td>
<td>1,289</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forests</td>
<td>High</td>
<td>1</td>
<td>0.2</td>
<td>234</td>
<td>34</td>
<td></td>
<td></td>
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</table>
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<td>2</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
Assessment Matrix & Index

- **Simple sum**: Hazard + S. Exposure + T. Exposure + Vul. = 12/20 = 0.6 CAE index

- **Weighted**: Hazard + S. Exposure + T. Exposure + (Vul. x 5) = 32/40 = 0.8 CAE index

**Scale:**
- Negligible = 0-0.2; Low = 0.2-0.4; Medium =0.4-0.6; High =0.6 <

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<td>2</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>0.6-0.8</td>
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</table>
## Maine State Assessment Matrix

<table>
<thead>
<tr>
<th>Project</th>
<th>Km of Pipeline</th>
<th>Cumulative Sum of Development</th>
<th>CAE Index</th>
<th>Cumulative Sum of Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.5</td>
<td>7.50</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>23</td>
<td>30.50</td>
<td>0.35</td>
<td>0.95</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>36.50</td>
<td>0.35</td>
<td>1.3</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>81.50</td>
<td>0.7</td>
<td>2</td>
</tr>
</tbody>
</table>
Cumulative Adverse Effects of Pipelines on Wetlands in Maine

\[ y = 0.019x + 0.47 \]
\[ R^2 = 0.97 \]
Evaluate and Manage

- **Evaluate**
  - Based upon the assessment how significant are the cumulative adverse effects

- **Manage**
  - What conservation measures or management actions should be taken to reduce cumulative adverse effects
  - Inform selection of BMPs based upon CAE assessment
Thank you!

Questions, Comments?