California Rapid Assessment Method for Wetlands (CRAM)  
Physical Structure Attribute

- Considers complexity of form and structure affecting biodiversity and other wetland functions
- Spatial organization of living and non-living surfaces that provide habitat
  (Maddock 1999, Frissell et al. 1986)
- Physical conditions indicate capacity of a wetland to support flora and fauna

Physical Structure Attribute

Richness of structural surfaces and features reflects the diversity of physical processes including:
- Energy dissipation
- Water storage
- Groundwater exchange
- Flood attenuation
- Filtering of pollutants
Physical complexity promotes ecological complexity and increases:
• Ecological functions
• Beneficial uses
• Overall condition

Physical Structure Attribute

Composed of two metrics:
• **Structural patch richness**
  - Number of patch types within AA
• **Topographic complexity**
  - Variety of elevations and extent of microtopography within AA

Structural Patch Richness

For each wetland type:
• Visible patches of physical structure
• May occur along hydrologic/moisture gradients
• Not all patches are expected to occur in all wetlands
• Minimum patch size for many (3 m² for most)
• May be artificial
Structural Patch Richness

- Large woody debris
- Boulder in channel
- In-channel bar
- Pool in channel
- Rifflle

**Abundant Wrackline**

- Provides organic material for detritivores
- Source of genetic material (seed dispersal)
- Foraging habitat
- Structure for nesting/burrowing
- Soil nutrients cycling

- Variegated Shore
- Debris Jam
- Undercut bank
- Hummocks
Animal Burrows

Bank Slumps or Undercut Banks
- Shading (temperature)
- Fish habitat
- Invertebrate habitat
Note: Slump must still be present

Cobbles and Boulders
Note: Large broken cement pieces (i.e. unnatural) may still count toward the patch type
Concentric or Parallel High Water Marks

Structural Patch Richness
- Soil Cracks
- Debris Jam
- Beaver Dam

Structural Patch Richness
- Bare Ground
  - Foraging habitat
  - Biogeochemical cycling
  - Invertebrate habitat
Structural Patch Richness
Submerged vegetation

Structural Patch Richness
Filamentous macroalgaes or algal mats

Note: Channel does not have to be wet to score patch type

Structural Patch Richness
Plant Hummocks
• Each module has a unique set of expected patch types
• Some patch type definitions vary as well
Structural Patch Richness
- Transient in nature, appropriate timing of observations are critical
- Expected patch types vary between modules
- Read the definitions
- Photo dictionary (http://www.cranwetlands.org/documents)

Topographic Complexity
- Physical, abiotic features and elevation gradients
- Micro- and macro-topographic relief
- Reference standard varies among wetland types

Topographic Complexity
- Promotes variable hydroperiods and moisture gradients
- Promotes ecological complexity
- Increases spatial and temporal variability in:
  - Energy dissipation
  - Surface water storage
  - Groundwater recharge
  - Particulate matter detention
  - Cycling of elements and compounds
  - Habitat dynamics
Indicators of Topographic Complexity by Module

<table>
<thead>
<tr>
<th>Type</th>
<th>Examples of Topographic Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressional</td>
<td>pools, sloughs, hummocks, variegated shorelines, soil mounds, partially buried debris, plant/soil mounds, leaves, roots</td>
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<tr>
<td>Emergent</td>
<td>benches, low to small islands, lakes, ponds, variegated shorelines, soil mounds, partially buried debris, plants/soil mounds</td>
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<tr>
<td>Leptocline</td>
<td>islands, bars, barrens, dikes, levees, variegated shorelines, cobbles, boulders, partially buried debris, plants/soil mounds</td>
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<tr>
<td>Reservoir</td>
<td>pools, mires, fish, ponds, hummocks, bars, dikelets, cobbles, boulders, levees, small creeks, small rivers, plant/soil mounds</td>
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<tr>
<td>Slope Wetlands</td>
<td>pools, mires, plant/soil mounds, cobbles, plant/soil mounds, small rivers, partially buried debris, small creeks, small rivers</td>
</tr>
<tr>
<td>Variegated Shoreline</td>
<td>pools, mires, plant/soil mounds, cobbles, plant/soil mounds, small rivers, partially buried debris, small creeks, small rivers</td>
</tr>
<tr>
<td>Pools</td>
<td>pools, mires, plant/soil mounds, cobbles, plant/soil mounds, small rivers, partially buried debris, small creeks, small rivers</td>
</tr>
<tr>
<td>Islands</td>
<td>pools, mires, plant/soil mounds, cobbles, plant/soil mounds, small rivers, partially buried debris, small creeks, small rivers</td>
</tr>
<tr>
<td>Partially Buried Debris</td>
<td>pools, mires, plant/soil mounds, cobbles, plant/soil mounds, small rivers, partially buried debris, small creeks, small rivers</td>
</tr>
</tbody>
</table>

Examples of Topographic Features

Scale of Topographic Features Varies with Complexity

- Benches may be centimeters up to meters in scale
- May vary by module (i.e. depressional often smaller scale than riverine)
- May vary within module (i.e. small creek versus large river)
Topographic Complexity

Riverine Topographic Complexity

Macro-topographic Indicators

Presence and number of benches
Micro-topographic Indicators

- Pools, pits, bars, debris jams
- Cobble, bank slumps, tree fall holes

Topographic Complexity

- Map showing various topographic features
- Diagram illustrating complexity with labeled areas (A, B, C, D, etc.)
Thank You