California Rapid Assessment Method for Wetlands

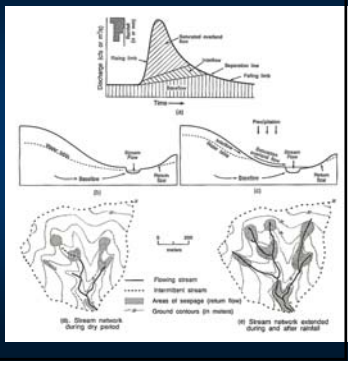
Hydrology Attribute

Hydrology

- Determines existence of wetlands, drives primary physical and ecological processes:
  - Establishment of reducing conditions
  - Nutrient transport and budget
  - Sediment transport and budget
  - Biological productivity
  - Biological dynamics in the substrate and the water column
- Most important determinant of wetland function (Mitsch & Gosselink 2007)

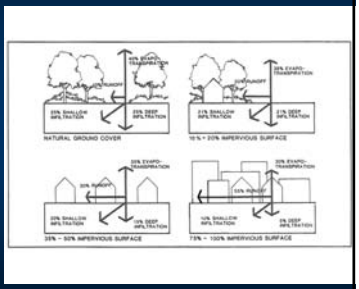
Precipitation Increases the Extent of Wetlands

- All wetlands are influenced by both surface water and groundwater.
- Precipitation increases surface flow.
- Precipitation raises groundwater table, increasing groundwater discharge to the surface.
- As volume of water (surface water + groundwater) increases, extent and length of surface wetlands and streams increases.

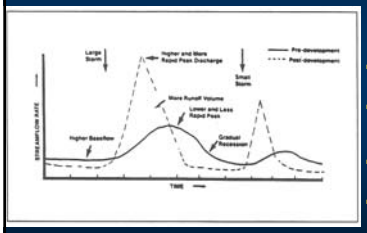


Effects of Impervious Surfaces

- Under natural conditions precipitation infiltrates, evaporates, is transpired by plants, or runs off.
- Impervious surfaces (pavement, houses, etc.) prevent infiltration and increase runoff, reducing evapotranspiration.
- Irreversible changes can occur at 10% or more impervious cover.



Effects of Hydromodification on Stream Basin Hydrology



- Increased impervious cover speeds runoff to channels, resulting in earlier flow peaks
- Increased runoff increases peak discharge
- Disrupted hydrologic regime causes streambed alteration
- More rapid decrease in stream discharge
- Reduced infiltration results in less groundwater and lower baseflow discharge during dry part of year

Imported Water Affects Native Biological Diversity

- Change in seasonal runoff patterns toward increased summertime flow
  - In urban areas, increased dry-season flows ("urban drool") can perennialize formerly episodic or intermittent streams.
  - In agricultural areas, irrigation return flows can extend streamflows into the dry season.
- The altered hydrology strongly favors exotic plant and fish species, which can impact native species and communities

Hydrology Attribute

- The Hydrology attribute measures the extent of departure of observed conditions from the "least-disturbed" state (i.e. reference condition)
- CRAM scores this primary wetland attribute in three metrics:
  - Water Source
  - Hydroperiod (Channel Stability for Riverine wetlands)
  - Hydrologic Connectivity

Metric 1: Water Source

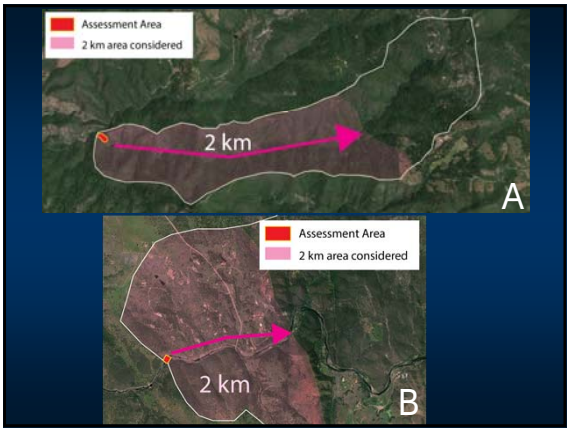
- California has a Mediterranean climate, with nearly all precipitation in winter (except summer monsoonal rains in SE California)
- CRAM assesses sources and diversions of freshwater that **affect** the dry season condition of the AA
- Alterations to flow inputs can occur at any time of the year, but the affect on the dry season is emphasized because that is when wetland biota are most stressed
- Scoring is similar for all modules, although assessments must address local conditions

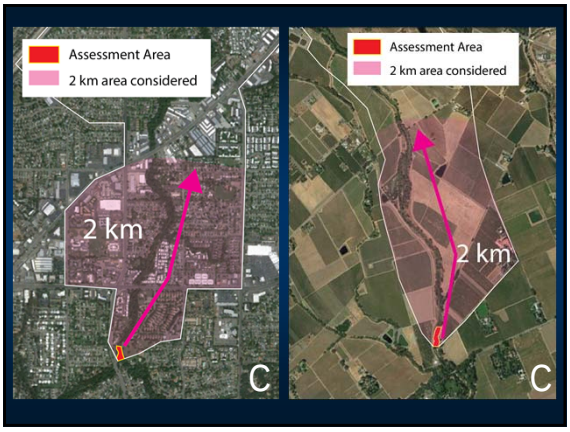
Water Source Metric Scoring

- Limit area of consideration to local watershed within 2 km of the AA
  - Distances beyond 2 km are considered to be part of the "setting".
  - Some wetlands (e.g., vernal pools) have small basins and water source scoring is restricted to the actual source watershed.
  - Large, distant dams are not considered.
- Diversions affect water availability for wetland processes, and are considered alterations to the water source for this metric

Rating for Water Source

Rating	Alternative States
A	Freshwater sources that affect the dry season condition of the AA, such as its flow characteristics, hydroperiod, or salinity regime, are precipitation, groundwater, and/or natural runoff, or natural flow from an adjacent freshwater body, or the AA naturally lacks water in the dry season. There is no indication that dry season conditions are substantially controlled by artificial water sources.
B	Freshwater sources that affect the dry season condition of the AA are mostly natural, but also obviously include occasional or small effects of modified hydrology. Indications of such anthropogenic inputs include developed land or irrigated agricultural land that comprises less than 20% of the immediate drainage basin within about 2 km upstream of the AA, or that is characterized by the presence of a few small steamboats or scattered homes with septic systems. No large point sources or dams control the overall hydrology of the AA.
C	Freshwater sources that affect the dry season conditions of the AA are primarily urban runoff, direct ingestion or flooding, pumped water, artificially impounded water, water remaining after diversions, regulated releases of water through a dam, or other artificial hydrology. Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises more than 20% of the immediate drainage basin within about 2 km upstream of the AA, or the presence of major point source discharges that obviously control the hydrology of the AA. OR Freshwater sources that affect the dry season conditions of the AA are substantially controlled by known diversions of water or other withdrawals directly from the AA, its encompassing wetland, or from its drainage basin.
D	Natural, freshwater sources that affect the dry season conditions of the AA have been eliminated based on the following indicators: impoundment of all possible wet season inflows, diversion of all dry-season inflow, predominance of xeric vegetation, etc.



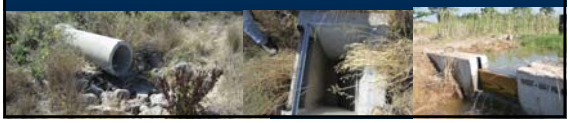


Metric 2: Hydroperiod / Channel Stability

- "Hydroperiod" is the duration and frequency of saturation for a wetland. Scoring is based on departure from "natural" hydroperiod.
  - Tidal for estuarine wetlands.
  - Seasonal and daily fluctuations for depressions, lakes, meadows, etc.
  - May not fluctuate for some groundwater-driven wetlands.
- For Riverine wetlands, this metric is scored as "Channel Stability."

Hydroperiod Metric Scoring

- Recent changes in the hydroperiod, flow regime, or sediment regime of a wetland
- Effects on the structure and composition of the plant community
- Riverine wetlands: how severely these changes affect the stability of the riverine channel
  - Equilibrium, aggradation, or degradation



Rating of Hydroperiod for Depressional Wetlands

	Alternative States
A	Hydroperiod in AA is characterized by mostly **natural patterns of inundation and drawdown.**
B	**Inundation patterns of the AA are of greater quantity** or duration than natural but the **drawdown is natural**.
C	**Inundation patterns of the AA are natural** but the **drawdown pattern is more rapid or extreme than natural.** **OR** **Inundation patterns of the AA are of substantially lower magnitude** or duration than natural but the **drawdown is a natural pattern**.
D	Both **inundation and drawdown patterns of the AA deviate from natural patterns.**

Rating of Channel Stability for Riverine Wetlands

	Alternative States
A	**Most** of the channel through the AA is characterized by **equilibrium conditions**, with **little evidence** of aggradation or degradation.
B	Most of the channel through the AA is characterized by **some aggradation or degradation**, none of which is **severe**, and the channel seems to be approaching an equilibrium form.
C	There is evidence of **severe aggradation or degradation** of **most of the channel** through the AA or the channel bed is artificially hardened through less than half of the AA.
D	The channel bed is **concrete** or otherwise **artificially hardened** through **most of the AA**.

Metric 3: Hydrologic Connectivity

- Water flow into or out of the wetland
- Ability to accommodate flood waters
- Abrupt changes in water level can result in stress to wetland plants and animals
- Hydrologic connection to the adjacent aquatic environment
- Enhances ability of the wetland to exchange colonists, seeds, nutrients, etc., with other wetlands

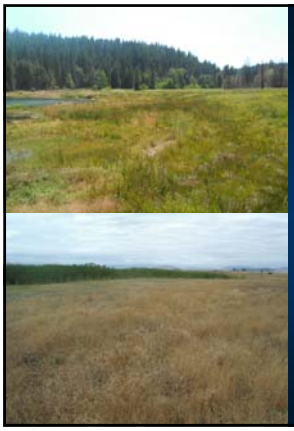
Hydrologic Connectivity Connects Wetlands to Their Surroundings

- For wetlands except riverine:
  - Assess the degree to which the lateral movement of rising tides or flood waters is restricted
  - Restrictions by unnatural features such as levees, dikes, sea walls, or road grades (steeper than 3 to 1 slope)
  - Restrictions by natural features such as steep banks, bedrock outcrops, or cliffs
  - Measure connectivity in the AA and its encompassing wetland
  - Look for the associated upland transition zone

Rating for Hydrologic Connectivity for Depressional and Estuarine Wetlands

	Alternative States
A	Rising water in the **wetland that contains the AA** has mostly unrestricted access to adjacent areas, without levees or other obstructions to the lateral movement of flood waters. Obstructions such as steep banks, culverts or small road grades that affect **less than about 10%** of the perimeter of the wetland are permissible.
B	Unnatural features such as levees or road grades limit lateral movement of water along **less than 50%** of the boundary of the wetland that contains the AA.
C	Unnatural features such as levees or road grades limit lateral movement of water along **50-90%** of the boundary of the wetland that contains the AA.
D	Unnatural features such as levees or road grades limit lateral movement of water along **more than 90%** of the boundary of the wetland that contains the AA.

- Steep levee
- No "transition zone"
- Abrupt change from wetland to upland
- Rising water increases depth with little increase in wetted area



- Gradually sloped bank
- Presence of "transition zone"
- Moisture gradient provides habitat niches
- Rising water increases wetted area with small increases in depth

Hydrologic Connectivity Connects Wetlands to Their Surroundings

- For riverine wetlands:
  - Hydrologic Connectivity is assessed based on the degree of channel entrenchment
  - Entrenchment measurement shows the ability of rising floodwater to gain access to the river's floodplain
  - Entrenchment is the ratio of flood prone width to bankfull width

Channel Entrenchment Calculation for Riverine Wetlands

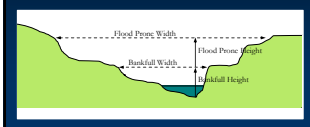


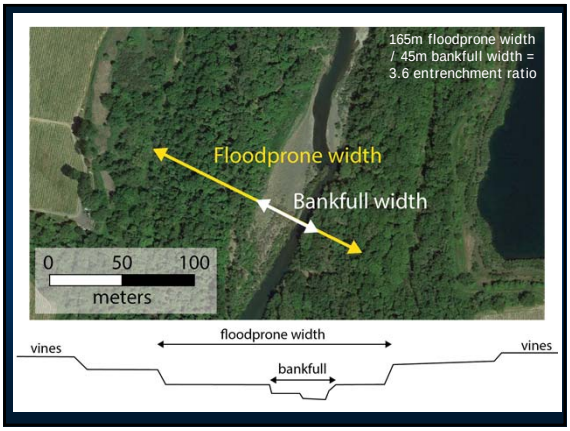
Figure 9: Diagram of channel entrenchment elements. Flood-prone depth is twice maximum bankfull depth. Entrenchment is measured as flood prone width divided by bankfull width.

- Identify the bankfull width and the corresponding bankfull depth
- Double the bankfull depth to identify the flood prone depth
- Measure the associated flood prone width
- Calculate the entrenchment ratio, which is the basis for scoring this metric for Riverine wetlands.

Stadia rod is placed at the bankfull elevation

Bankfull indicators should be at the same elevation


Sometimes bankfull elevation is subtle, and requires looking carefully, looking up and downstream from the cross section, and on both banks for matching elevation indicators. Also consider the size of watershed draining to that location.



Rating for Hydrologic Connectivity for Non-confined Riverine Wetlands

	Alternative States
A	Entrenchment ratio is > 2.2
B	Entrenchment ratio is 1.9 to 2.2
C	Entrenchment ratio is 1.5 to 1.8
D	Entrenchment ratio is <1.5