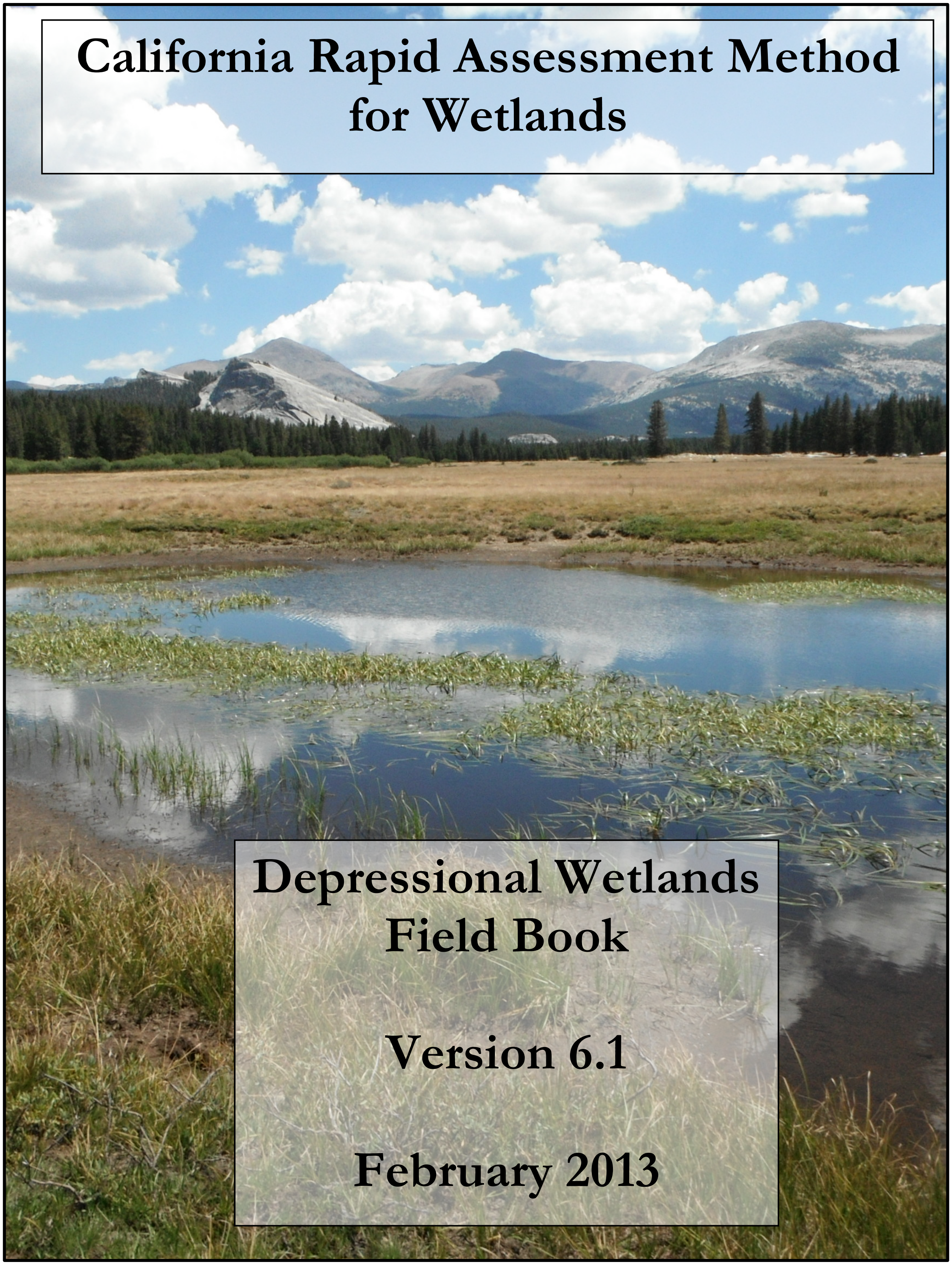


California Rapid Assessment Method for Wetlands

Depressional Wetlands Field Book

Version 6.1

February 2013

Basic Information Sheet: Depressional Wetlands

Assessment Area Name:	
Project Name:	
Assessment Area ID #:	
Project ID #:	**Date:**
Assessment Team Members for This AA	
AA Location: **Latitude:** **Longitude:** **Datum:**	

AA Category:

□ Pre-Restoration □ Post-Restoration □ Pre-Mitigation □ Post-Mitigation

□ Pre-Impact □ Post-Impact □ Training □ Ambient

□ Reference □ Other:

Origin of Wetland (if known):

□ Natural system □ Artificial system

Type of Management (if known):

□ waterfowl/birds □ amphibians □ general wildlife □ sediment □ water quality □ stormwater

□ water supply (agriculture) □ water supply (livestock) □ not managed □ other:

Which best describes the type of depressional wetland?

□ freshwater marsh □ alkaline marsh □ brackish marsh

□ other (specify):

AA Encompasses:

□ entire wetland □ portion of the wetland

Which best describes the hydrologic state of the wetland at the time of assessment?

□ ponded/inundated □ saturated soil, but no surface water □ dry

What is the apparent hydrologic regime of the wetland?

Perennially flooded systems contain surface water year-round, *seasonally flooded* depressional wetlands are defined as supporting surface water for 4-11 months of the year (in > 5 out of 10 years.) *Temporarily flooded* depressional wetlands possess surface water between 2 weeks and 4 months of the year.

□ perennially flooded □ seasonally flooded □ temporarily flooded

Does your wetland connect with the floodplain of a nearby stream? ☐ yes ☐ no

(system subject to overbank flow, a dammed stream does not count)

Does the wetland have a defined on undefined outlet? ☐ defined ☐ undefined

Does the wetland have a defined on undefined inlet? ☐ defined ☐ undefined

Are the inlet and outlet at the same location? ☐ yes ☐ no

Is the topographic basin of the wetland ☐ distinct **or** ☐ indistinct **?**

An *indistinct* topographic basin is one that lacks obvious boundaries between wetland and upland. Examples of such features are seasonal, depressional wetlands in very low-gradient landscapes.

Photo Identification Numbers and Description:

Photos should be taken from edge of AA looking toward the centroid of AA

	Photo ID No.	Description	Latitude	Longitude	Datum
1		(to) North			
2		(to) East			
3		(to) South			
4		(to) West			
5					
6					
7					
8					
9					
10					

Site Location Description and Land Use:

Comments:

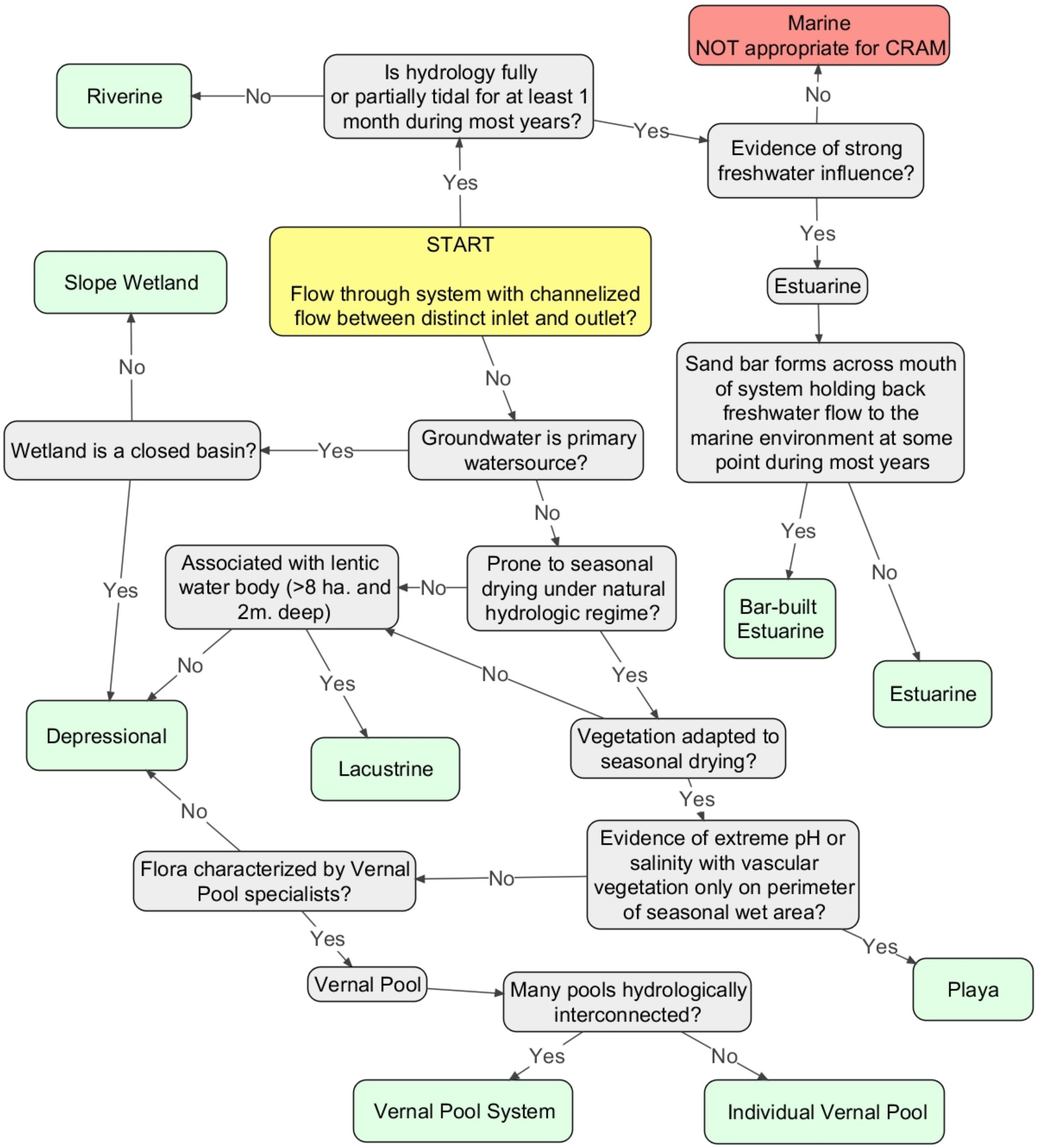
Scoring Sheet: Depressional Wetlands

AA Name:				**Date:**		

						Comments
Attribute 1: Buffer and Landscape Context (pp. 8-15)						**Comments**
Aquatic Area Abundance Score (D)			Alpha.	Numeric		
Buffer:						
Buffer submetric A: Percent of AA with Buffer	Alpha.	Numeric				
Buffer submetric B: Average Buffer Width						
Buffer submetric C: Buffer Condition						
Raw Attribute Score = D+[C x (A x B)$^{1/2}$]$^{1/2}$					**Final Attribute Score = (Raw Score/24) x 100**	
Attribute 2: Hydrology (pp. 16-21)						
Water Source			Alpha.	Numeric		
Hydroperiod						
Hydrologic Connectivity						
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/36) x 100**	
Attribute 3: Physical Structure (pp. 22-28)						
Structural Patch Richness			Alpha.	Numeric		
Topographic Complexity						
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/24) x 100**	
Attribute 4: Biotic Structure (pp. 29-39)						
Plant Community Composition (based on submetrics A-C)						
Plant Community submetric A: Number of plant layers	Alpha.	Numeric				
Plant Community submetric B: Number of Co-dominant species						
Plant Community submetric C: Percent Invasion						
Plant Community Composition Metric *(numeric average of submetrics A-C)*						
Horizontal Interspersion						
Vertical Biotic Structure						**Circle one:** Method 1 or Method 2
Raw Attribute Score = sum of numeric scores					**Final Attribute Score = (Raw Score/36) x 100**	
Overall AA Score (average of four final Attribute Scores)						

Identify Wetland Type

Figure 1: Flowchart to determine wetland type and sub-type.



Depressional Wetlands

Depressional wetlands occur in topographic lows (i.e., closed elevation contours) that allow the accumulation of surface water and, in some cases, groundwater. These systems can be natural or artificial in origin and can occur on the landscape as isolated basins with distinct boundaries, or as a complex of shallows and seasonally wet depressions created by the slight topographic relief with indistinct boundaries, or as a large complex of interconnected basins. The margins of distinct depressional wetlands are relatively easy to discern in aerial photos and in the field. Ponds on fault traces (e.g. sag ponds, snow melt ponds), valley bottoms (e.g. cutoff ox-bows on floodplains), landslide impoundments, and on broad saddles along ridges (e.g. kettle-holes in moraines) are examples of naturally occurring depressional wetlands. Stormwater treatment ponds, wildlife habitat enhancements (e.g., duck ponds), stock ponds, and water hazards on golf courses are examples of artificially constructed depressional wetlands.

Depressional wetlands often lack a direct hydrologic connection to surface waters, and their hydrologic regime may be determined by groundwater discharge, overland runoff, and precipitation. However, many depressional wetlands (e.g., stockponds, constructed wetlands, or oxbows) are directly connected to surface waters and. Depressional wetlands can be perennial (perennially/permanently flooded) or seasonal (seasonally or temporarily flooded), and may lack surface ponding or saturated conditions during dry years[1]. As defined by CRAM, perennially flooded depressional wetlands have some amount of surface ponding for at least 9 months during most years (i.e. in greater than 5 out of 10 years). Seasonally flooded depressional wetlands are defined as supporting surface ponding for between 4 and 9 months of the year, and temporarily flooded depressional wetlands possess surface water between 2 weeks and 4 months of the year.

CRAM recognizes that all wetlands have some amount of adjacent riparian area, as defined by the US National Research Council (see glossary). For the purposes of CRAM, the riparian areas adjacent to depressional wetlands are considered part of the wetland and are included in the Assessment Area.

Artificial Depressional Wetlands

A large variety of types and configurations exist for artificially constructed depressional wetlands. In the more urbanized areas of California, many depressional wetlands have been constructed and/or engineered primarily to treat urban runoff for water quality improvement or to store flood flows. In some areas of the state, such as the Central Valley, the majority of depressional wetlands are intensively managed and artificially flooded to promote a variety of benefits to many species of wildlife, especially waterfowl (vegetation for food and cover, adequate water quality, breeding and resting sites).

Special Note:

**Vernal Pools are a sub-type of Depressional Wetlands with an impervious substrate that controls a specialized hydrology and supports characteristic flora and fauna. They are assessed using the Individual Vernal Pool and Vernal Pool Systems sub-modules of CRAM.*

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[1] There may be a limit to the applicability of CRAM in extremely seasonal depressional wetlands (inundated less than 1-2 months/year) that tend not to support species-rich plant communities with complex horizontal and vertical structure. CRAM may be systematically biased against such naturally simple depressional systems. Therefore, while the current version of the CRAM depressional module can be used in these systems, the results are being tracked carefully.

Establish the Assessment Area (AA)
As a general rule, the AA should extend from the backshore, as indicated by high water marks or a transition from wetland to upland plants, to the foreshore, the boundary between the vegetated wetland and any adjoining semi-aquatic, non-wetland area, or a fully aquatic area such as open water. If open water is present, the AA should extend 10 meters beyond the foreshore into open water. The backshore (landward boundary) of the AA will include any adjacent riparian vegetation that directly overhangs the wetland, including the entire footprint of individual trees or plants that overhang the wetland. If riparian vegetation does not overhang the wetland, include an area 2 meters wide extending landward from the backshore as part of the AA.

Recommended maximum and minimum AA sizes for depressional wetlands are given in Table 3. The AA for a depressional wetland may include the entire wetland (for sites up to 2 ha in area; Figure 2a), or a portion of the wetland (for sites larger than 2 ha; Figure 2b and 2c). In wetlands with continuous emergent marsh habitat, the AA will be a randomly placed 1 hectare circle (Figure 2b). For depressional wetlands much greater than 2 ha and characterized by fringing marsh at the edges and an area of extensive open water in the center that is at least 30m wide, the AA cannot encompass the entire wetland. In these types of systems, AAs (approximating 1 hectare) should be established laterally along the fringing marsh (Figure 2c) and extend 10 meters out into the open water from the foreshore as described above. In wetlands that are smaller than 2 hectares, the AA will encompass the entire wetland.

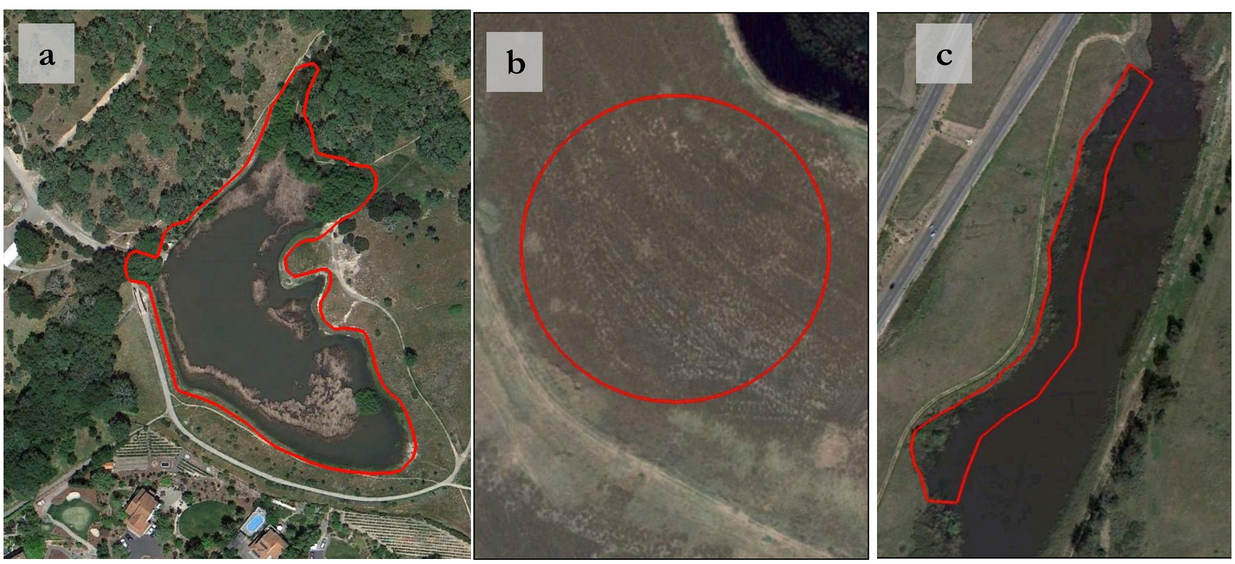

Figure 2. Example scenarios of characteristic depressional wetland Assessment Areas: a) a two hectare AA that encompasses the entire wetland, b) a one hectare circular AA on a large vegetated marsh plain, and c) a one hectare fringing marsh AA (note that scales are not equivalent).

Table 1: Examples of features that *should* be used to establish AA boundaries.

- above-grade roads and fills
- berms and levees
- major point sources or outflows of water
- open water areas more than 30 m wide on average or broader than the wetland
- foreshores, backshores and uplands at least 5 m wide
- weirs, culverts, dams, levees, and other flow control structures
- transitions between wetland types
- project boundaries if required by the purpose of the assessment

Table 2: Examples of features that should *not* be used to establish AA boundaries.

- at-grade, unpaved, single-lane, infrequently used roadways or crossings
- bike paths and jogging trails at grade
- bare ground within what would otherwise be the AA boundary
- equestrian trails
- fences (unless designed to obstruct the movement of wildlife)
- property boundaries (unless required by the purpose of the assessment)
- spatial changes in land cover or land use along the wetland border
- state and federal jurisdictional boundaries (unless required by the purpose of the assessment)

Table 3: Recommended maximum and minimum AA sizes for depressional wetlands.
Note: Wetlands smaller than the recommended AA sizes can be assessed in their entirety.

Wetland Type	Recommended AA Size
Depressional	Recommended size is 1.0 ha (a 56 m radius circle, or about 100m x 100m square, but shape can vary). Maximum size is 2.0 ha (an 80 m radius circle, or about 140m x 140m, but shape can vary); there is no minimum size.

Attribute 1: Buffer and Landscape Context

CRAM includes two metrics to assess the Buffer and Landscape Context attribute of wetlands: 1) the Aquatic Area Abundance metric and 2) the Buffer metric. The Buffer metric is composed of three submetrics: 1) percentage of the AA perimeter that has a buffer; 2) the average buffer width; and 3) the condition or quality of the buffer (see Metric 2).

Metric 1: Aquatic Area Abundance

Definition: Aquatic Area Abundance is a measure of an AA's spatial association with other areas of aquatic resources, such as other wetlands, lakes, streams, etc. Wetlands close to each other have greater potential to interact ecologically and hydrologically, and such interactions are often beneficial.

Procedure to Assess this Metric for Depressional Wetlands

This metric is assessed using aerial or digital imagery, and focuses on identifying aquatic areas in the landscape surrounding the depressional wetland AA. On digital or hardcopy site imagery, draw a straight line extending 500 m from the AA boundary in each of the four cardinal compass directions. Along each transect line, estimate the percentage of the segment that passes through wetland or aquatic habitat of any kind, including open water (see Figure 3 below). In scoring this metric, use the AA boundary definitions established in CRAM for each type of wetland to determine wetland extent along each transect. For example, if a depressional wetland AA is adjacent to a vernal pool landscape (see the Vernal Pool field books for a description of this), the entire vernal pool landscape is included as aquatic area for this metric. In general, a riverine system within 500 m of the AA would be considered aquatic habitat to the limits of the potential riverine AA. However, for riverine systems in broad valleys there may be a wide riparian area that would not be included in an AA but is still considered wetland for this metric. Use the worksheet below to record the estimates of percent aquatic area.

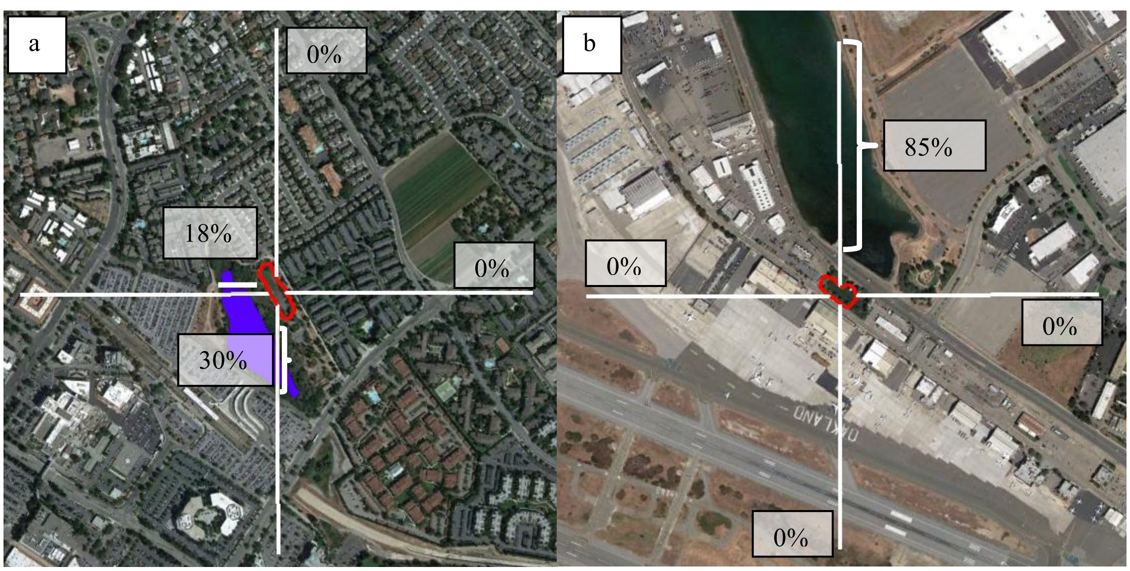

Figure 3. Method to assess Aquatic Area Abundance for depressional wetlands.

Worksheet for Aquatic Area Abundance Metric

Percentage of Transect Lines that Contains Aquatic Area of Any Kind	
Segment Direction	Percentage of Transect Length That is an Aquatic Feature
North	
South	
East	
West	
Average Percentage of Transect Length That Is an Aquatic Feature ***Round to the nearest whole number (integer)***	

Table 4: Rating for Aquatic Area Abundance

Rating	Alternative States
A	An average of 46 – 100 % of the transect passes through an aquatic feature of any kind.
B	An average of 31 – 45 % of the transect passes through an aquatic feature of any kind.
C	An average of 16 – 30 % of the transect passes through an aquatic feature of any kind.
D	An average of 0 – 15 % of the transect passes through an aquatic feature of any kind.

Metric 2: Buffer

Definition: The buffer is a zone of transition between the immediate margins of a wetland and its surrounding environment that is likely to help protect the wetland from anthropogenic stress and natural disturbance. For the purposes of CRAM, the buffer is an area adjoining the AA that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage visitation into the AA by people and non-native predators, or otherwise protect the AA from anthropogenic stress and natural disturbance.

The Buffer metric is composed of three submetrics: (1) percentage of the AA perimeter that has a buffer; (2) the average buffer width; and (3) the condition or quality of the buffer.

Special Notes:

**Any area of open water at least 30 m wide that is adjoining the AA, such as a lake, large river, or large slough, is not considered in the assessment of the buffer. Such open water is considered to be neutral, and is neither part of the wetland nor part of the buffer. There are three reasons for excluding large areas of open water (i.e., more than 30 m wide) from Assessment Areas and their buffers.*

1) Assessments of buffer extent and buffer width are inflated by including open water as a part of the buffer.

2) While there may be positive correlations between wetland stressors and the quality of open water, quantifying water quality generally requires laboratory analyses beyond the scope of rapid assessment.

3) Open water can be a direct source of stress (i.e., water pollution, waves, boat wakes) or an indirect source of stress (i.e., promotes human visitation, encourages intensive use by livestock looking for water, provides dispersal for non-native plant species), or it can be a source of benefits to a wetland (e.g., nutrients, propagules of native plant species, water that is essential to maintain wetland hydroperiod, etc.).

**However, any area of open water that is within 250 m of the AA but is not adjoining the AA is considered buffer.*

Submetric A: Percent of AA with Buffer

Definition: This submetric is based on the relationship between the extent of buffer and the functions buffers provide to wetlands. Areas with more buffer typically provide more habitat values, better water quality and other valuable functions.

Procedure to Assess this Metric for Depressional Wetlands

This metric is assessed by visually estimating the total percentage of the perimeter of the AA that adjoins land cover types that provide buffer functions (see Table 6). To be considered as buffer, a suitable land cover type must be at least 5 m wide starting at the edge of the AA extending perpendicular to the border of the AA and extend along the perimeter of the AA (measured parallel to the border of the AA) for at least 5 m. The assessment of this submetric should be conducted first in the office, using aerial imagery and land use maps, as available. The office work should then be verified in the field.

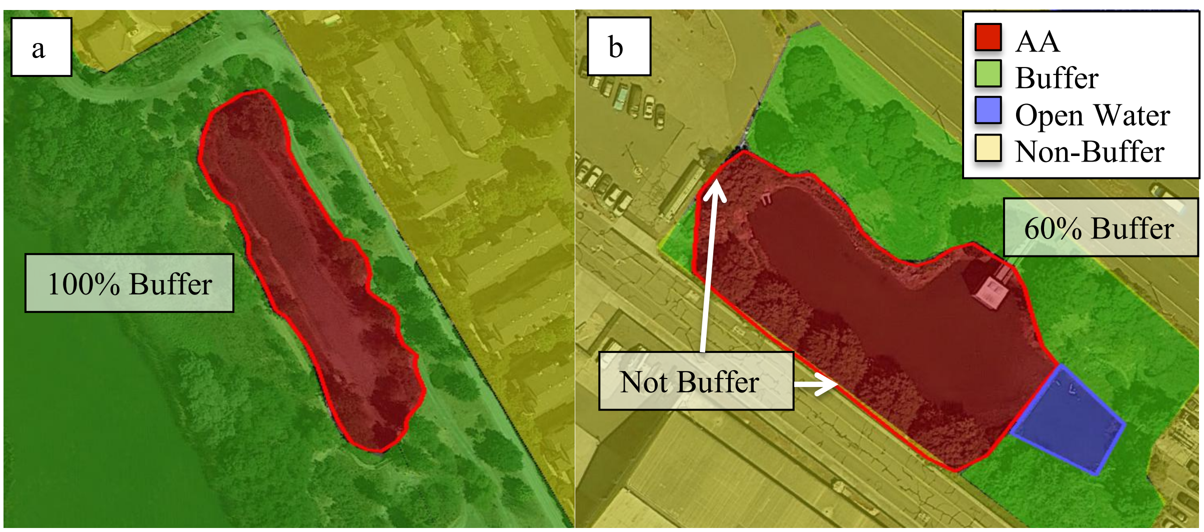

Figure 4: Diagram of two example AAs with buffer and non-buffer land cover types: a) 100% of the perimeter of the AA has buffer. b) The open water area adjoining the AA is neutral in the calculation of percent with buffer. About 60% of the remaining perimeter has buffer (the green area), and the other 40% of the perimeter is adjoining a road or parking lot (the yellow area).

Table 6: Guidelines for identifying wetland buffers and breaks in buffers.
**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following examples.*

Examples of Land Covers Included in Buffers	**Examples of Land Covers Excluded from Buffers** Notes: buffers do not cross these land covers; areas of open water adjacent to the AA are not included in the assessment of the AA or its buffer.
• at-grade bike and foot trails with light traffic • horse trails • natural upland habitats • nature or wildland parks • open range land • railroads (with infrequent use: one train a day or less) • roads not hazardous to wildlife, such as seldom used rural roads, forestry roads or private roads • swales and ditches • vegetated levees	• commercial developments • fences that interfere with the movements of wildlife (i.e. food safety fences that prevent the movement of deer, rabbits and frogs, or chain-link fences that are impenetrable) • intensive agriculture (row crops, orchards and vineyards) • golf courses • paved roads (two lanes or larger) • lawns • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls or other concrete walls • sports fields • urbanized parks with active recreation • pedestrian/bike trails (with heavy traffic)

Percent of AA with Buffer Worksheet.
In the space provided below make a sketch of the AA, or perform the assessment directly on the aerial imagery; indicate where buffer is present, estimate the percentage of the AA perimeter providing buffer functions, and record the estimate amount in the space provided.

Percent of AA with Buffer: ________ %

Table 7: Rating for Percent of AA with Buffer.

Rating	Alternative States (not including open-water areas)
A	Buffer is 75 - 100% of AA perimeter.
B	Buffer is 50 – 74% of AA perimeter.
C	Buffer is 25 – 49% of AA perimeter.
D	Buffer is 0 – 24% of AA perimeter.

Submetric B: Average Buffer Width

Definition: A wider buffer has a greater capacity to serve as habitat for wetland edge-dependent species, to reduce the inputs of non-point source contaminants, to control erosion, and to generally protect the wetland from human activities. The average width of the buffer adjoining the AA is estimated by averaging the lengths of eight straight lines drawn at regular intervals around the AA from its perimeter outward to the nearest non-buffer land cover or 250 m (the maximum length of a buffer), whichever is first encountered. It is assumed in CRAM that the functions of the buffer do not increase significantly beyond an average width of about 250 m. The maximum buffer width is therefore 250 m. At distances beyond 250 m from the AA, the buffer becomes part of the landscape context of the AA. The minimum buffer width is 5 m, and the minimum length of buffer along the perimeter of the AA is also 5 m. Any area that is less than 5 m wide and 5 m long is too small to be a buffer. See Table 6 above for more guidance regarding the identification of AA buffers.

Table 8: Steps to estimate Buffer Width

Step 1	Identify areas in which open water is directly adjacent to the AA, with no vegetated wetland or upland area in between. **These areas are excluded from buffer calculations.**
Step 2	For the area that has been identified as having buffer, draw 8 straight lines 250 m in length perpendicular to the AA (see Figure 5 below). These lines should be perpendicular to the trend of the edge of the AA, so if the AA is generally round the lines will radiate out in a starburst pattern. If the AA is long and narrow the lines extending from the edge of the AA should come out perpendicular to the long axis of the AA and the ends.
Step 3	Estimate the buffer width of each of the lines as they extend away from the AA. Record these lengths on the worksheet below.
Step 4	Calculate the average buffer width. Record this width on the worksheet below.

Figure 5. Example of the method used to estimate Buffer Width (scales not equivalent): a) buffer lines drawn at regular intervals around the AA. Note that the buffer lines go through open water in a nearby wetland that is not directly adjoining the AA; b) buffer lines drawn where buffer is present, excluding non-buffer areas and the open water area that directly adjoins the AA

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	
B	
C	
D	
E	
F	
G	
H	
Average Buffer Width ***Round to the nearest whole number (integer)***	

Table 9: Rating for average buffer width.

Rating	Alternative States
A	Average buffer width is 190 – 250 m.
B	Average buffer width 130 – 189 m.
C	Average buffer width is 65 – 129 m.
D	Average buffer width is 0 – 64 m.

Submetric C: Buffer Condition

Definition: The condition of a buffer is assessed according to the extent and quality of its vegetation cover, the overall condition of its substrate, and the amount of human visitation.

Procedure to Assess this Metric for Depressional Wetlands

Buffer conditions are assessed only for the portion of the wetland border that has *already been identified as buffer (*i.e., as in Figure 5). Thus, evidence of direct impacts (parking lots, buildings, etc.) by people are excluded from this metric, because these features are not included as buffer land covers; instead these impacts are included in the Stressor Checklist. If there is no buffer, assign a score of D.

Buffer condition must be assessed in the field. Prevalence of native vegetation, absence of exotic vegetation, absence of recent substrate disturbance, and absence of trash or debris are assumed to indicate good buffer conditions. Low impact human visitation includes activities like hiking, bird-watching, or other passive recreation. Moderate or intense human visitation could include activities such as off-road ATV use, 4WD parks, homeless encampments, construction of terrain parks for bikes, or other activities that disturb the soil or plant communities. For the purpose of assessing substrate condition in the buffer, evidence of problems more than 5 years old should not be considered. Narratives for Buffer Condition ratings are provided in Table 10.

Figure 6. Example of buffer areas to be considered for buffer condition metric (green shaded areas)

Table 10: Rating for Buffer Condition.

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following ratings.*

Rating	Alternative States
A	Buffer for AA is dominated by native vegetation, has undisturbed soils, and is apparently subject to little or no human visitation.
B	1) Buffer for AA is characterized by an intermediate mix of native and non-native vegetation (25-75%), but mostly undisturbed soils and is apparently subject to little or low impact human visitation.
	OR
	2) Buffer for AA is dominated by native vegetation, but shows some soil disturbance and is apparently subject to little or low impact human visitation.
C	Buffer for AA is characterized by substantial (>75%) amounts of non-native vegetation AND there is at least a moderate degree of soil disturbance/compaction, and/or there is evidence of at least moderate intensity of human visitation.
D	Buffer for AA is characterized by barren ground and/or highly compacted or otherwise disturbed soils, and/or there is evidence of very intense human visitation, or there is no buffer present.

Attribute 2: Hydrology

Metric 1: Water Source

Definition: Water Sources directly affect the extent, duration, and frequency of saturated or ponded conditions within an Assessment Area. Water Sources include direct inputs of water into the AA as well as any diversions of water from the AA. Diversions influence the water source because they affect the ability of the AA to function as a source of water for other habitats while also directly affecting the hydrology of the AA. Inputs of water affecting conditions during the dry season are especially important because they strongly influence the structure and composition of wetland plant and animal communities. The Water Source metric therefore focuses on conditions that affect dry season hydrology.

Natural sources of water for depressional wetlands include precipitation, snow melt, groundwater, and riverine flows. Examples of unnatural sources include stormdrains that empty into the AA or its drainage area, or irrigation runoff from agriculture. Indirect sources that should not be considered in this metric include large regional dams that have ubiquitous effects on broad geographic areas of which the AA is a small part. However, the effects of urbanization on hydrologic dynamics ("hydromodification") in the immediate watershed containing the AA are considered in this metric; because hydromodification both increases the volume and intensity of runoff during and immediately after rainy season storm events and reduces infiltration that supports base flow discharges during the drier seasons later in the year. Although flows that are influenced by hydromodification usually happen during the wet season, the change in hydrologic dynamics strongly affects conditions in the stream during the dry season.

Engineered hydrological controls such as weirs, flashboards, grade control structures, check dams, etc., can serve to demarcate the boundary of an AA but they don't affect the amount of water supplied to the AA, so they should not be considered in the assessment of this metric. These features may temporarily impound water, but they are not the source of the water. The water source metric looks beyond the scale of the AA to the upstream watershed within about 2 km.

Procedure to Assess this Metric for Depressional Wetlands

Evaluation of this metric should emphasize the identification of the unnatural sources or diversions that directly affect the dry season condition of the AA. It is initially assessed in the office using the site imagery, and may be revised based on the field visit. To score this metric initially, use site aerial imagery and any other information collected about the region or watershed surrounding the AA to assess the water source in the 2 km area that drains to the AA (Table 11). Topo maps or watershed maps can be used to determine the watershed area for a specific AA.

The office work should initially focus on the immediate margin of the AA and its wetland, and then expand to include the smallest watershed or storm drain system that directly contributes to the AA or its immediate environment, such as another part of the same wetland within about 2km of the AA. Natural sources of water for depressional wetlands are mainly direct rainfall, groundwater discharge, runoff, and riverine flows. Unnatural sources of water for depressional wetlands can include runoff from urban stormdrains that empty directly into the AA or into an immediately adjacent area, or pumped water from artificial sources. Landscape indicators of unnatural water sources include adjacent intensive development, irrigated agriculture, and wastewater treatment discharge. Although anthropogenic inputs may sustain wetland functions, they still constitute a deviation from natural hydrologic inputs and should be considered as such for this metric.

Table 11: 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 stormdrains 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 irrigation 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

Definition: Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. Depressional wetlands typically have daily variations in water height that are governed by diurnal increases in evapotranspiration and seasonal cycles that are governed by rainfall, runoff, and specialized management practices.

Procedure to Assess this Metric for Depressional Wetlands

This metric evaluates recent changes (within the last 5 years) in the hydroperiod, flow regime, or sediment regime of a wetland and the degree to which these changes affect the structure and composition of the wetland plant community. Common field indicators of an altered hydroperiod for depressional wetlands include pumps, spring boxes, ditches, hoses and pipes, and encroachment of terrestrial vegetation (Table 12).

For the purpose of this metric, berms and levees that are used to create a depressional wetland do not automatically lead to a decreased score. For example, the dam that is used to block a stream to create a stock pond does not automatically lead to a lower score because it increases the duration of inundation. Likewise, the spillway does not decrease the score because it artificially keeps the pond at a lower inundation level than if it were not present. These are passive feature that have theoretically been in place for a long period of time and the system has become naturalized. However, structures and features that actively alter the depth and duration of inundation (pumps that move water into or out of a wetland, actively controlled culverts, etc.) will have an effect on the scoring of this metric.

Special Considerations for Artificially Constructed Depressional Wetlands

Most of the managed depressional wetlands in the Central Valley of California are characterized by three main flooding regimes; seasonal, semi-permanent, and permanent (Smith *et al*. 1995). Without the application of water, most managed wetlands in the Central Valley would remain dry or experience only periodic flooding in the wettest of years. As a result, these wetlands have levees, water control structures, and other features that allow for relatively intensive management that notably affects the timing, depth, and duration of flooding. Whether the wetlands are perennial or seasonal, alterations in the hydrodynamics result in changes in either the high water or low water levels. Such changes can be assessed based on the patterns of plant growth along the wetland margins or across the bottom of the wetlands.

Table 12: Field Indicators of Altered Hydroperiod.

Direct Engineering Evidence	Indirect Ecological Evidence
Reduced Extent and Duration of Inundation or Saturation	
• Active water control structures at the outlet or inlet (culverts, flashboard dams, slide gates, etc.) • Upstream spring boxes • Upstream Impoundments and diversions • Pumps, diversions, ditching that move water ***out of*** the wetland	• Evidence of aquatic wildlife mortality • Encroachment of terrestrial vegetation • Stress or mortality of hydrophytes • Compressed or reduced plant zonation
Increased Extent and Duration of Inundation or Saturation	
• Active water control structures at the outlet or inlet (culverts, flashboard dams, slide gates, etc.) • Pumps, diversions, ditching that move water ***into*** the wetland	• Late-season vitality of annual vegetation • Recently drowned riparian vegetation • Extensive fine-grain deposits

Table 13: Rating of Hydroperiod for Depressional Wetlands.

Rating	Alternative States
A	Hydroperiod of the AA is characterized by mostly natural patterns of filling or inundation and drying or drawdown.
B	The filling or inundation patterns in the AA are of greater quantity or duration than would be expected under natural conditions, but thereafter, the AA is subject to natural drawdown or drying.
C	Hydroperiod of the AA is characterized by natural patterns of filling or inundation, but thereafter, is subject to more rapid or extreme drawdown or drying, as compared to more natural wetlands. OR The filling or inundation patterns in the AA are of substantially lower magnitude or duration than would be expected under natural conditions, but thereafter, the AA is subject to natural drawdown or drying.
D	Both the inundation and drawdown of the AA deviate from natural conditions (either increased or decreased in magnitude and/or duration).

Metric 3: Hydrologic Connectivity

Definition: Hydrologic Connectivity describes the ability of water to flow into or out of the wetland, to inundate its adjacent upland transition zones, allowing the system to accommodate rising flood waters without dramatic changes in water level, which can result in stress to wetland plants and animals. Additionally, the presence of this transition zone between the wetland and the upland provides varied saturation zones and their associated habitats and increases complexity.

Procedure to Assess this Metric for Depressional Wetlands

This metric is scored by assessing the degree to which the lateral movements of rising waters are restricted by features such as very steep banks, levees, concrete walls, rip-rap, or road grades in the AA, **its encompassing wetland** and the associated upland transition zone. In smaller depressional systems the entire wetland will be assessed, however, in larger systems this metric should be assessed only for the part of the wetland within about 500 meters of the AA.

For the purposes of this metric, the presence of a transition zone along the edge of the wetland should be the focus of the assessment. Higher condition scores result with gradual transitions that increase the complexity of the transition zone. For example, the presence of 5 meters of gradually sloped transition zone from a levee toe-of-slope out towards the wetland, rather than an abrupt transition from a steep levee slope to the wetland bottom, allows for waters to increase the size of the ponded system as they rise. Alternatively, if the toe of slope is not apparent, a 3-to-1 slope or greater on the levee to form a transition zone also increases the hydrologic connectivity of these depressional wetlands. CRAM assessments in artificially constructed depressional wetlands managed for habitat purposes should consider the nature and extent of the transition zones in scoring this metric.

Special Considerations for Artificially Constructed Depressional Wetlands

Many types of managed depressional wetlands have levees, water control structures, and other features that allows for habitat management practices to promote a variety of benefits to many species of wildlife, such as vegetation for food and cover, adequate water quality, breeding and resting sites . This infrastructure can influence the timing, depth, and duration of flooding in the wetland, however, the presence of a levee at the edge of a wetland does not automatically decrease its score.

Table 14: Rating of Hydrologic Connectivity for Depressional Wetlands

Rating	Alternative States
A	Rising water in the wetland that contains the AA has mostly unrestricted access to adjacent transition zones, without levees or other obstructions to the lateral movement of floodwaters. 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	There are features such as steep banks, levees or road grades that limit the amount of adjacent transition zone that accommodates the lateral movement of flood waters, but the limitations exist for less than 50% of the boundary of the wetland that contains the AA. Restrictions may be intermittent along margins of the wetland, or they may occur only along one bank or shore of the wetland.
C	The amount of adjacent transition zone that accommodates the lateral movement of flood waters is limited by unnatural features, such as levees or road grades, for 50-90% of the wetland that contains the AA. Flood flows may exceed the obstructions, but drainage back to the wetland can be obstructed by these features.
D	The amount of adjacent transition zone that accommodates the lateral movement of flood waters is limited by unnatural features, such as levees or road grades, for more than 90% of the wetland that contains the AA.

Attribute 3: Physical Structure

Metric 1: Structural Patch Richness

Definition: Patch richness is the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species. This metric is different from topographic complexity in that it addresses the number of different patch types, whereas topographic complexity evaluates the spatial arrangement and interspersion of the types.

Special Notes:

**Physical patches can be natural or unnatural.*

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following patch types.*

Patch Type Definitions:

Abundant wrack or organic debris in channel or on floodplain. Wrack is an accumulation of natural or unnatural floating debris along the high water line of a wetland. The organic debris must be free of its original growth position. Senesced plant material that is still attached to the parent plant does not count (for example, last year's cattail or bulrush growth)

Animal mounds and burrows. Many vertebrates make mounds or holes as a consequence of their foraging, denning, predation, or other behaviors. The resulting soil disturbance helps to redistributes soil nutrients and influences plant species composition and abundance. To be considered a patch type there should be evidence that a population of burrowing animals has occupied the Assessment Area. A single burrow or mound does not constitute a patch.

Bank slumps or undercut banks in channels or along shorelines. A bank slump is a portion of a depressional bank that has broken free from the rest of the bank but has not eroded away. Undercuts are areas along the bank or shoreline of a wetland that have been excavated by waves or flowing water.

Cobbles and boulders. Cobbles and boulders are rocks of different size categories. The middle axis of a cobble ranges from about 6 cm to about 25 cm. A boulder is any rock having a middle axis greater than 25 cm. Submerged cobbles and boulders provide abundant habitat for aquatic macroinvertebrates. Exposed cobbles and boulders provide roosting habitat for birds and shelter for amphibians. They contribute to patterns of shade and light and air movement near the ground surface that affect local soil moisture gradients, deposition of seeds and debris, and overall substrate complexity.

Concentric or parallel high water marks. Repeated variation in water level in a wetland can cause concentric zones in soil moisture, topographic slope, and chemistry that translate into visible zones of different vegetation types, greatly increasing overall ecological diversity. The variation in water level might be natural (e.g., seasonal) or anthropogenic.

Filamentous macroalgae and algal mats. Macroalgae occurs on benthic sediments and on the water surface. Macroalgae are important primary producers, representing the base of the food web in some wetlands. Algal mats can provide abundant habitat for macro-invertebrates, amphibians, and small fishes.

Islands (exposed at high-water stage). An island is an area of land above the usual high water level and, at least at times, surrounded by water. Islands differ from hummocks and other mounds by being large enough to support trees or large shrubs.

Large woody debris. Large woody debris (LWD) in ponds or on floodplain provides important services and is an indicator of dynamic hydrology and ecology. LWD is any woody fragment greater than 10 cm diameter and 1 meter long. It provides basking habitat for turtles, which use wood perches preferentially over rock substrates. LWD can be a source of food for invertebrates, and it increases overall topographic heterogeneity. It can provide structure to create scour pools or eddies with dynamic hydrology. It can be a refuge to hide from predators in a low-relief landscape.

Non-vegetated flats (sandflats, mudflats). A flat is a non-vegetated area of silt, clay, sand, or a mix of abiotic substrates (mud) that adjoins the wetland foreshore and is a potential resting and feeding area for fishes, shorebirds, wading birds, and other waterbirds.

Open water. Areas of deeper water depths within depressional wetlands that are more than 10 meters wide and do not support emergent vegetation. Open water habitat typically supports submerged macrophytes and provides important foraging habitat for waterfowl and other wildlife species.

Plant hummocks or sediment mounds. Hummocks are mounds created by plants along the banks and floodplains of wetland systems created by the collection of sediment and biotic material around wetland plants. Hummocks are typically less than 1m high. Sediment mounds are similar to hummocks but lack plant cover. They are depositional features formed from repeated flood flows depositing sediment on the floodplain.

Soil cracks. Repeated wetting and drying of fine grain soil that typifies some wetlands can cause the soil to crack and form deep fissures that increase the mobility of heavy metals, promote oxidation and subsidence, while also providing habitat for amphibians and macroinvertebrates. Cracks must be a minimum of 1 inch deep to qualify.

Standing snags. Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing "snags" they provide habitat for many species of birds and small mammals. Any standing, dead woody vegetation that is at least 3 m tall with at least a 10 cm diameter is considered a snag.

Submerged vegetation. Submerged vegetation consists of aquatic macrophytes such as *Elodea canadensis* (common elodea), that are rooted in the sub-aqueous substrate but do not usually grow high enough in the overlying water column to intercept the water surface. Submerged vegetation can strongly influence nutrient cycling while providing food and shelter for fish and other organisms.

Swales on floodplain or along shoreline. Swales are broad, elongated, vegetated, shallow depressions that can sometimes help to convey flood flows to and from vegetated marsh plains or floodplains. But, they lack obvious banks, regularly spaced deeps and shallows, or other characteristics of channels. Swales can entrap water after flood flows recede. They can act as localized recharge zones and they can sometimes receive emergent groundwater.

Variegated or crenulated foreshore. As viewed from above, the foreshore of a wetland can be mostly straight, broadly curving (i.e., arcuate), or variegated (e.g., meandering). In plan view, a variegated shoreline resembles a meandering pathway. Variegated shorelines provide greater contact between water and land.

Woody vegetation in water. Live trees or woody vegetation in water provide important foraging and bird nesting habitat, as well as allochthonous contributions of carbon to the wetland as the base of the food web. This does not include riparian woody vegetation at the edge of the wetland but rather trees or large shrubs that are within the wetland.

Structural Patch Type Worksheet for Depressional Wetlands

Check each type of patch that is observed in the AA and use the total number of observed patches in Table 15 below. Each patch should occupy in aggregate at least 3 m^2 of area in the AA.

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for photos of each of the following patch types.*

STRUCTURAL PATCH TYPE (circle for presence)	**Depressional**
Minimum Patch Size	**3 m^2**
Abundant wrack or organic debris in channel, on floodplain, or across depressional wetland plain	
Animal mounds and burrows	
Bank slumps or undercut banks in channels or along shoreline	
Cobbles and Boulders	
Concentric or parallel high water marks	
Filamentous macroalgae or algal mats	
Islands (mostly above high-water)	
Large woody debris	
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	
Open water	
Plant hummocks and/or sediment mounds	
Soil cracks	
Standing snag(s) (1 or more at least 3 m tall)	
Submerged vegetation	
Swales on floodplain or along shoreline	
Variegated, convoluted, or crenulated foreshore (instead of broadly arcuate or mostly straight)	
Woody vegetation in water	
Total Possible	**17**
No. Observed Patch Types (enter here and use in Table 15 below)	

Table 15: Rating of Structural Patch Richness.

Rating	Depressional
A	≥ 9
B	7 – 8
C	4 – 6
D	≤ 3

Metric 2: Topographic Complexity

Definition: Topographic complexity refers to the micro- and macro-topographic relief and variety of elevations within a wetland due to physical and abiotic features and elevation gradients that affect moisture gradients or that influence the path of flowing water. Table 16 indicates the range of topographic features that occur in depressional wetlands.

This metric is assessed by noting the overall variability in physical patches and topographic features (Table 16 and Figure 7). Care must be taken to distinguish indicators of topographic complexity or habitat features within a wetland. Topographic complexity can be evaluated by observing the number of elevational features that affect moisture gradients along a transect across the AA, and the amount of micro-topographic relief along the transect. Moisture gradients at various elevational features may be indicated by plant assemblages with different inundation/saturation tolerances.

Table 16: Typical indicators of Macro- and Micro-topographic Complexity for Non-Vernal Pool Depressional Wetlands

Type	Examples of Topographic Features
Depressional	pools, islands, cobbles, boulders, mounds or hummocks, variegated shorelines, soil cracks, partially buried debris, animal tracks

Worksheet for AA Topographic Complexity

At two locations in the AA, make a sketch of the profile from the AA boundary to AA boundary. Try to capture the major topographic features, slopes and intervening micro-topographic relief. Based on these sketches and the profiles in Figure 7, choose a description in Table 17 that best describes the overall topographic complexity of the AA.

North to South
East to West

Figure 7: Scale-independent schematic profiles of Topographic Complexity.
Each profile A-D represents a characteristic portion of a cross-section through an AA.

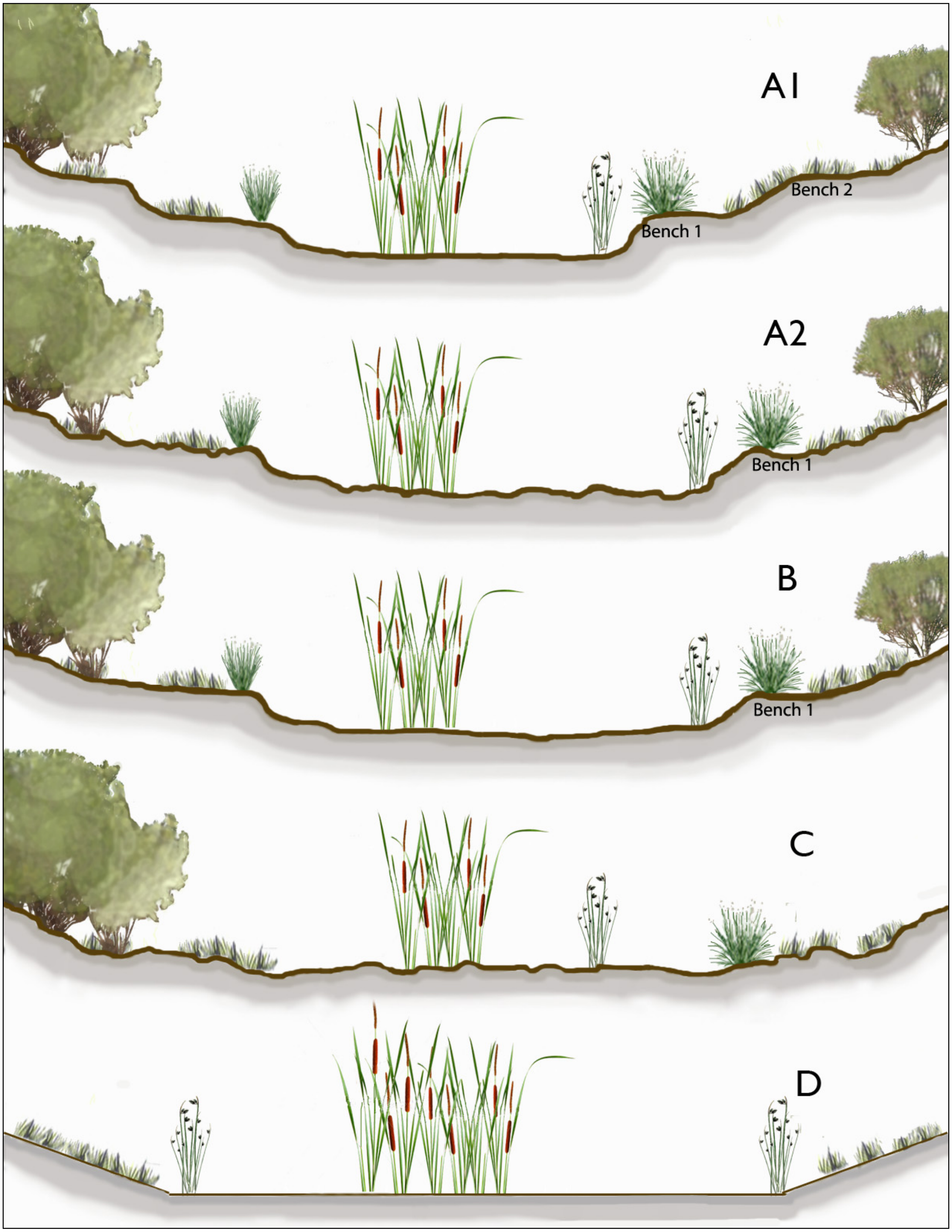

Table 17: Rating of Topographic Complexity for Depressional Wetlands

Rating	Alternative States
A	AA as viewed along a typical cross-section has **two or more** benches above the middle area or bottom zone of the AA, but these benches, and the slopes between them, **lack abundant** micro-topographic relief or variability as illustrated in profile A2 of Figure 6. **OR** AA as viewed along a typical cross-section has **one or more** benches above the middle area or bottom zone of the AA, and the bench(es), plus the slopes between them contain physical patch types or features that contribute to **abundant** micro-topographic relief or variability as illustrated in profile A1 of Figure 6.
B	AA has **one bench** above the middle area or bottom zone of the AA, but this bench **lacks abundant** micro-topographic relief. The AA resembles profile B of Figure 6.
C	AA **lacks any obvious bench**, and is best characterized by a single slope that has at least a **moderate** amount of micro-topographic complexity, as illustrated in profile C of Figure 6.
D	AA has a single, **uniform slope** with **little or no** micro-topographic complexity, as illustrated in profile D of Figure 6.

Attribute 4: Biotic Structure

Metric 1: Plant Community

Definition: The Plant Community Metric is composed of three submetrics: Number of Plant Layers, Number of Co-dominant Plant Species, and Percent Invasion. A thorough reconnaissance of an AA is required to assess the plant community. The assessment for each submetric is guided by a set of Plant Community Worksheets. The Plant Community metric is calculated based on these worksheets.

A "plant" is defined as an individual of any vascular macrophyte species of tree, shrub, herb/forb, or fern, whether submerged, floating, emergent, prostrate, decumbent, or erect, including non-native (exotic) plant species. Mosses and algae are not included among the species identified for the Plant Community Metric. For the purposes of CRAM, a plant "layer" is a stratum of vegetation indicated by a discrete canopy at a specified height that comprises at least 5% of the area of the AA *where the layer is expected.*

Non-native species owe their occurrence in California to the actions of people since the time of Euroamerican contact. Many non-native species are now *naturalized* in California, and may be widespread in occurrence. "Invasive" species are non-native species that "(1) are not native to, yet can spread into, wildland ecosystems, and that also (2) displace native species, hybridize with native species, alter biological communities, or alter ecosystem processes" (CalIPC 2012). CRAM uses the California Invasive Plant Council (CalIPC) list to determine the invasive status of plants, with augmentation by regional experts.

Submetric A: Number of Plant Layers Present

To be counted in CRAM, a layer must cover at least 5% of *the portion of the AA that is suitable for the layer*. This would be the littoral zone of depressional wetlands for the "floating" aquatic layer. The "short," "medium," and "tall" layers might be found throughout the periodically or permanently flooded areas of depressional wetlands, but might be absent in areas of exposed bedrock, mudflat, beaches, etc. The "very tall" layer is usually expected to occur along the backshore, but may occupy up to the entire AA in some depressional wetlands.

It is essential that the layers be identified by the actual plant heights (i.e., the approximate maximum heights) of plant species in the AA, regardless of the growth potential of the species. For example, a young *Juncus* sp. individual less than 0.3 m tall would belong to the "short" layer, even though in the future the same individual might belong to the "medium" or "tall" layer. Some species might belong to multiple plant layers. For example, areas of *Typha* of all different heights might collectively represent two layers in a depressional AA.

It should be noted that widespread species may occupy different layers in different parts of California, and the identification of dominant species must be based on an identification of the actual species present in the AA.

Layer definitions:

Floating Layer. This layer includes rooted aquatic macrophytes such as *Ruppia cirrhosa* (ditchgrass), *Ranunculus aquatilis* (water buttercup), and *Potamogeton foliosus* (leafy pondweed) that create floating or buoyant canopies at or near the water surface that shade the water column. This layer also includes non-rooted aquatic plants such as *Lemna* spp. (duckweed) and *Eichhornia crassipes* (water hyacinth) that form floating canopies.

Short Vegetation. This layer is never taller than 50 cm. It includes small emergent vegetation and plants. It can include young forms of species that grow taller. Vegetation that is naturally short in its mature stage includes *Rorippa nasturtium-aquaticum* (watercress), *Ranunculus flamula* (creeping buttercup), *Persicaria* spp. (smartweeds), and many grass species.

Medium Vegetation. This layer ranges from 50 cm to 1.5 m in height. It commonly includes emergent vegetation such as rushes (*Juncus* spp.), or forbs such as *Rumex crispus* (curly dock) and larger *Persicaria* spp. (smartweeds).

Tall Vegetation. This layer ranges from 1.5 m to 3.0 m in height. It usually includes the tallest emergent vegetation and the larger shrubs. Examples include *Typha latifolia* (broad-leaved cattail), *Schoenoplectus californicus* (bulrush), and *Baccharis piluaris* (coyote brush).

Very Tall Vegetation. This layer is reserved for emergent vegetation, shrubs, vines, and trees that are taller than 3.0 m. Examples include *Platanus racemosa* (western sycamore), *Populus fremontii* (Fremont cottonwood), very tall specimens of *Schoenoplectus californicus* (bulrush), and *Salix lasiolepis* (Arroyo willow)

Special Notes:

**Standing (upright) dead or senescent vegetation from the previous growing season can be used in addition to live vegetation to assess the number of plant layers present. However, the lengths of prostrate stems or shoots are disregarded. In other words, fallen vegetation should not be "held up" to determine the plant layer to which it belongs. The number of plant layers must be determined based on the way the vegetation presents itself in the field.*

**If the AA supports less that 5% plant cover and/or no plant layers are present (e.g. some concrete channels), automatically assign a score of "D" to the plant community metric*

Figure 8: Flow Chart to Determine Plant Dominance

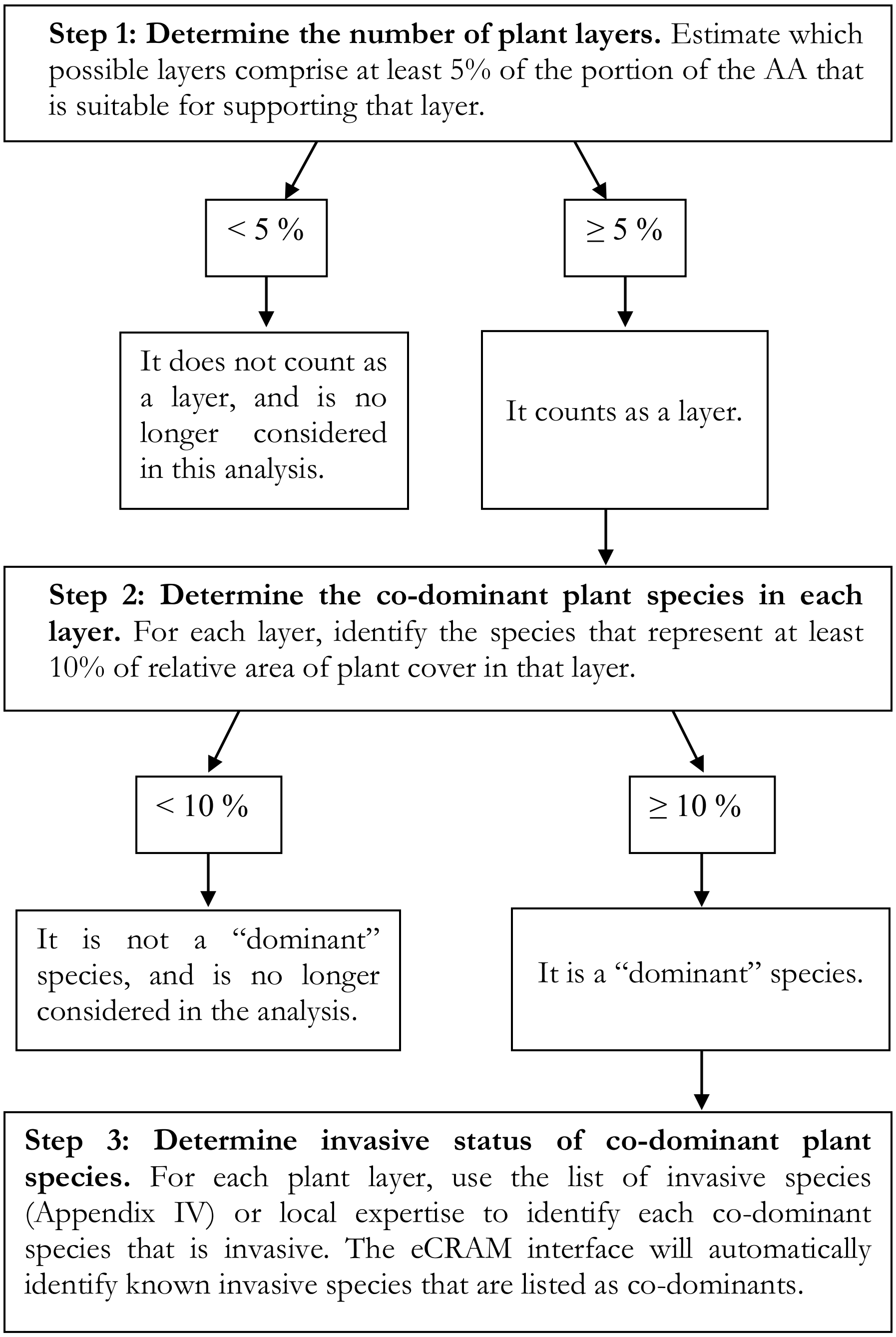

Table 18. Plant Layer Heights for Depressional Wetlands.

Wetland Type	Plant Layers				
	Aquatic	Semi-aquatic and Riparian			
	Floating	Short	Medium	Tall	Very Tall
Depressional	On Water Surface	<0.5 m	0.5 – 1.5 m	1.5 - 3.0 m	>3.0 m

Submetric B: Number of Co-dominant Species

For each plant layer in the AA, every species represented by living vegetation that comprises at least 10% relative cover within the layer is considered to be dominant in that layer, and should be recorded in the appropriate part of the Plant Community Metric Worksheet. Only living vegetation in growth position is considered in this metric. Dead or senescent vegetation is disregarded. When identifying the total number of dominant species in an AA, count each species only once; do not count a species multiple times if it is found in more than one layer.

Special Notes:

**If a plant species identified as codominant cannot be identified in the field, it is important to take a good quality photograph and a voucher specimen of the plant back to the office for subsequent identification, provided the appropriate permissions to collect samples have been have been acquired from the land manager).). Make sure to collect any flowers or fruit that are present to aid in the identification process.*

**Please refer to the CRAM Photo Dictionary at www.cramwetlands.org for a list of plant identification websites.*

Submetric C: Percent Invasion

The number of invasive co-dominant species for all plant layers combined is assessed as a percentage of the total number of co-dominants, based on the results of the Number of Co-dominant Species submetric. The invasive status for California wetland and riparian plant species is based on the Cal-IPC list. However, the best professional judgment of local experts may be used in addition to the Cal-IPC list to determine whether or not a co-dominant species is invasive in a localized context.

Plant Community Metric Worksheet: Co-dominant species richness
(A dominant species represents ≥10% *relative* cover)

** Combine the counts of co-dominant species from all layers to identify the total species count. Each plant species is only counted once when calculating the Number of Co-dominant Species and Percent Invasion submetric scores, regardless of the numbers of layers in which it occurs.*

Floating or Canopy-forming	Invasive?	Short (<0.5 m)	Invasive?
Medium (0.5 – 1.5 m)	**Invasive?**	**Tall (1.5 – 3.0 m)**	**Invasive?**
Very Tall (>3.0 m)	**Invasive?**		
		Total number of co-dominant species for all layers combined (enter here and use in Table 19)	
		Percent Invasion *Round to the nearest whole number (integer)* (enter here and use in Table 19)	

Table 19: Ratings for submetrics of Plant Community Metric for Depressional Wetlands

Rating	Number of Plant Layers Present	Number of Co-dominant Species	Percent Invasion
Depressional Wetlands			
A	4 – 5	≥ 9	0 – 10%
B	3	7 – 8	11 – 20%
C	2	5 – 6	21 – 30%
D	0-1	0 – 4	31 – 100%

Metric 2: Horizontal Interspersion

Definition: Horizontal interspersion refers to the variety and interspersion of plant "zones" arrayed along gradients of elevation, moisture, or other environmental factors that affect the plant community organization in a two-dimensional plan view. Plant zones often consist of more than one plant species, but some zones may be mono-specific. The zones may be discontinuous and they can vary in number within a wetland. Examples may include "riparian forest" composed of alders and cottonwoods; emergent marsh composed of cattails or bulrush above floating duckweed; a fringing zone of trees over an herbaceous understory; or a "grass zone" with a widely varying composition of numerous Eurasian grasses. In all cases, the plant "zones" are defined by a relatively unvarying combination of physiognomy and species composition. Interspersion is essentially a measure of the number of distinct zones and the amount of edge between them.

Procedure to Assess this Metric for Depressional Wetlands

It is important to base assessment of this metric on a combination of aerial image interpretation and field reconnaissance. For large wetlands, the prominent zonation is evident in aerial photographs of scale 1:24,000 or larger. For depressional wetlands that are essentially round in plan form, the plant zones might be more or less concentric. For small wetlands, the zonation is apparent only in the field.

Visualize each plant zone as extending from the top of the tallest trees down through all of the vegetation to ground level. An "A" condition means BOTH more zones AND a greater degree of interspersion, and the departure from the "A" condition is proportional to BOTH the reduction in the numbers of zones AND their interspersion. Although a zone may include groups of species of multiple heights, the Horizontal Interspersion metric is <u>not</u> based on the layers established in the Plant Community Submetric A.

Special Considerations for Depressional Wetlands:

The structure and composition of depressional wetland vegetation may indicate a particular system's hydroperiod. Perennially flooded depressional wetlands, with large areas that are continually inundated and water depths up to 2 meters (6.5 feet), tend to be characterized by a deeper central marsh zone dominated by cattails (*Typha* spp.) and bulrushes (*Schoenoplectus* spp.). Because depressions can vary in depth and duration of ponding, the hydrodynamics can have a strong effect on the arrangement and interspersion of plant species occurring on the site, which may be strongly influenced by periodic drought and wet periods. The wettest sites, where water stands through summer, can be characterized by bulrush (*Schoenoplectus* spp.), often occurring as a near monoculture, or with rush species (*Juncus* spp.) or common threesquare (*Schoenoplectus pungens)* along slightly drier margins. In permanently flooded sites, a floating layer of vegetation, including aquatic buttercups (*Ranunculus* spp.), aquatic smartweeds (*Persicaria* spp.), pondweeds (*Potamogeton* spp.) or duckweeds (*Lemna* spp.), may occur. The wetlands found adjacent to permanent areas of open water can occur as fringes of vegetation, such as around ponds or oxbows.

Many seasonal depressional wetlands are characterized by a central shallow marsh zone dominated by graminoids (grasses and sedges) surrounded by a mixed matrix of upland and riparian species. In these cases vegetation can occur in a concentric pattern from a wetter middle dominated by various species of spikerush (e.g. *Eleocharis* spp.) through a ring of annual grasses (e.g. *Hordeum jubatum*) and an outer margin of western wheatgrass (e.g. *Pascopyrum smithii*) or thickspike wheatgrass (e.g. *Elymus* *lanceolatus*). Seasonal depressional wetlands constructed for waterfowl habitat purposes are typically planted with grasses that provide waterfowl forage during winter, particularly watergrass (*Echinochloa crus-galli*) and sprangletop (*Leptochloa* spp.); these planted crops may occupy vast areas in constructed depressions.

Depressional wetlands may present a peripheral ring of woody "riparian" vegetation within the wetland, which is part of the AA; in some wetlands woody vegetation may occupy up to the entire wetland. Narrow-leaf willow (*Salix exigua*) and arroyo willow (*S. lasiolepis*) may provide a Tall layer, particularly around margins of depressions that dry seasonally. Red willow (*S. laevigata*), Pacific willow (*S. lucida* subsp. *lasiandra*), or (particularly in the Central Valley) Goodding willow (*S. gooddingii*) may occur with Fremont cottonwood (*Populus fremontii*) as a Very Tall layer around the outer margin of some depressions. Occasionally willow trees may be found growing inside a wetland, surrounded by herbaceous vegetation. Other woody species may occur in depressional wetland AAs, including red alder (*Alnus rubra*), western sycamore (*Platanus racemosa*), valley oak (*Quercus lobata*), various non-native broadleaved species, and even conifers.

Horizontal Interspersion Worksheet

Use the spaces below to make a sketch of the AA in plan view, outlining the major plant zones (this should take no longer than 10 minutes). Assign names to the zones and record them on the right. Based on the sketch, choose a single profile from Figure 8 that best represents the AA overall.

	Assigned zones: **1)** **2)** **3)** **4)** **5)** **6)**

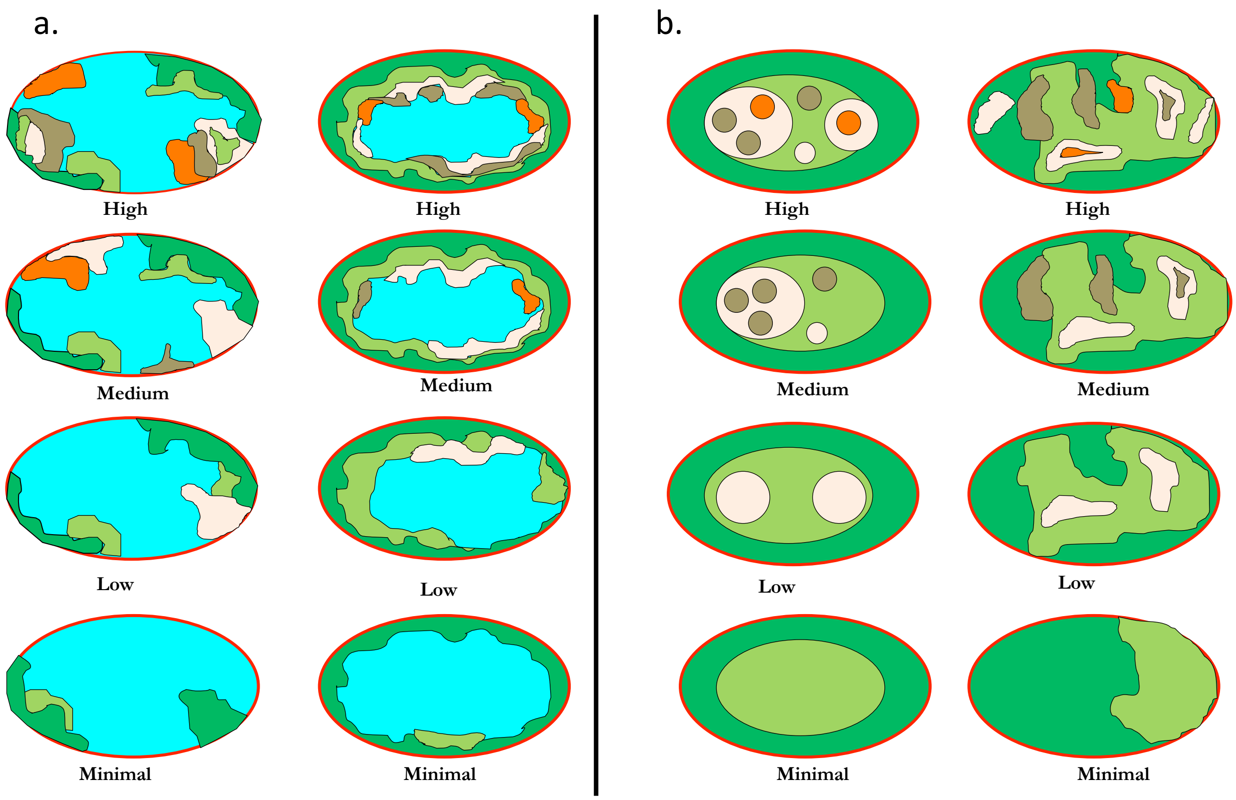

Figure 9: Schematic diagrams illustrating varying degrees of interspersion of plant zones, for a) depressional wetlands characterized by surface ponding, and b) depressional wetlands that lack surface ponding . The red line represents the boundary of an AA on both sets of diagrams, the blue represents open water, and the solid darker green (for the b type) represents the background "matrix" vegetation.

Table 20: Rating of Horizontal Interspersion of Plant Zones

Rating	Alternative States (based on Figure 9)
A	AA has a high degree of plan-view interspersion.
B	AA has a moderate degree of plan-view interspersion.
C	AA has a low degree of plan-view interspersion.
D	AA has minimal or no plan-view interspersion.

Special Note:

**When assessing this metric, it is helpful to assign names of plant species or associations of species, as well as open water and bare ground to the colored patches in Figure 8.*

Metric 3: Vertical Biotic Structure

Definition: The vertical structure component of the biotic structure attribute assesses the vertical complexity of the depressional wetland, commonly recognized as the overall number of plant layers, their spatial extent, and their vertical overlap relative to the expected conditions

Procedure to Assess this Metric for Depressional Wetlands

Vertical structure must be assessed in the field, using one of two methods based on the type of depressional wetland being assessed:

Method 1: For wetlands with large marsh plain areas dominated by emergent monocots, small or patchy zones of open water, and typically lacking substantial woody vegetation around the wetland perimeter, the entrainment method is used (Table 21). In many depressional wetlands, the detritus of above-ground growth of low and medium layers of herbaceous plants and emergent monocots tends to get entrained within the layers as an internal canopy below the maximum height of the upper plant layer. These "entrained canopies" serve as cover for many wildlife species. Over time, these entrained canopies can gain enough density and thickness to provide important shelter for many species of birds and small mammals. Birds that nest in depressional wetlands may choose to nest below an entrained canopy because it protects them from avian predators, including owls and harriers. Dense canopies can best provide these services. A sparse canopy still has some utility but the patchy cover may allow for predation.

Method 2: For wetlands with woody vegetation, the vertical overlap of plant layers is assessed (Table 22). These may be wetlands with central areas of open water surrounded by fringing vegetation, or they may have woody vegetation occupying large portions of the wetland. In these situations, the entrained canopy may be a less important structural element in the wetland than the structure of overlapping plant layers. The same plant layers used to assess the Plant Community Composition metrics are used to assess Vertical Biotic Structure. To be counted in CRAM, a layer must cover at least 5% of the portion of the AA that is suitable for the layer.

Special Note:

**If it is not clear which method to use on a particular Assessment Area, use both methodologies and choose the one with the higher score.*

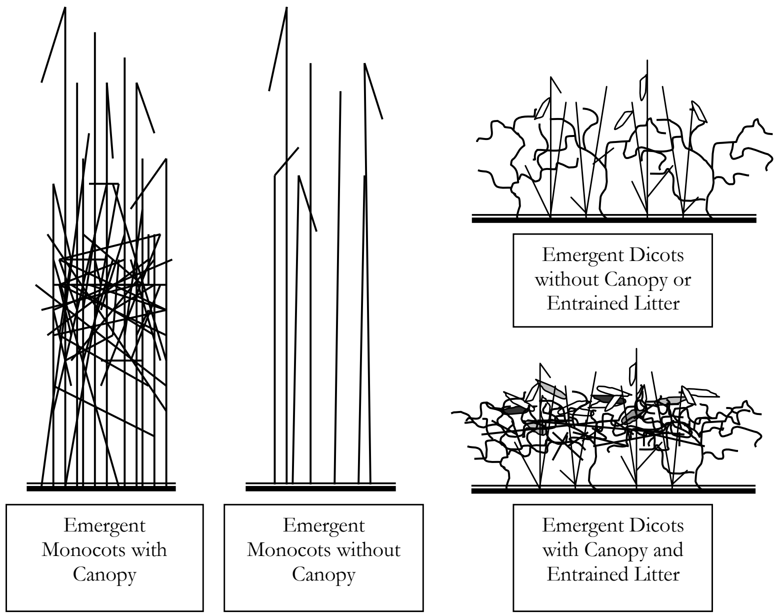

Figure 10: Schematic diagrams of plant canopies and entrained litter to assess Vertical Biotic Structure in Depressional wetlands using Method 1 (entrainment)

Table 21: Rating of Vertical Biotic Structure for Depressional wetlands using Method 1 (entrainment)

Rating	Alternative States
A	Most of the vegetated plain of the AA has a dense canopy of living vegetation or entrained litter or detritus forming a "ceiling" of cover above the wetland surface that shades the surface and can provide abundant cover for wildlife.
B	Less than half (25-50%) of the vegetated plain of the AA has a dense canopy of vegetation or entrained litter or detritus as described in "A" above; OR Most of the vegetated plain has a sparse canopy of vegetation or entrained litter or detritus.
C	25-50% of the vegetated plain of the AA has a sparse canopy of vegetation or entrained litter or detritus.
D	Most of the AA (>75%) lacks a canopy of living vegetation or entrained litter or detritus.

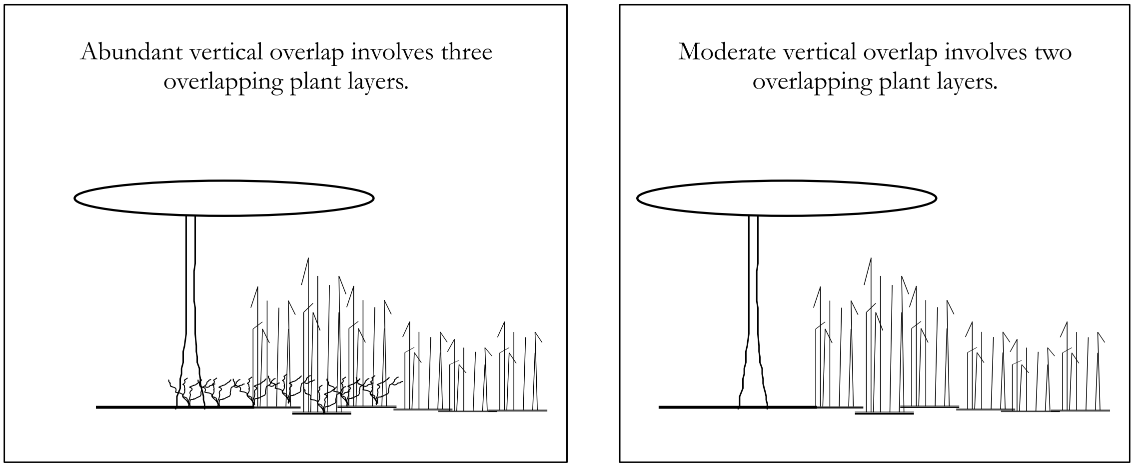

Figure 11: Schematic diagrams of plant canopies to assess Vertical Biotic Structure in Depressional wetlands using Method 2 (vertical overlap)

Table 22: Rating of Vertical Biotic Structure for Depressional wetlands using Method 2 (vertical overlap)

Rating	Alternative States
A	More than 50% of the vegetated area supports abundant overlap of plant layers
B	More than 50% of the vegetated area supports at least moderate overlap of plant layers
C	25–50% of the of the vegetated area supports at least moderate overlap of plant layers
D	Less than 25% of the vegetated area supports moderate overlap of plant layers, **or** the AA is sparsely vegetated overall.

Guidelines to Complete the Stressor Checklists

Definition: A stressor, as defined for the purposes of the CRAM, is an anthropogenic perturbation within a wetland or its environmental setting that is likely to negatively impact the condition and function of the CRAM Assessment Area (AA). A disturbance is a natural phenomenon that affects the AA.

There are four underlying assumptions of the Stressor Checklist: (1) deviation from the best achievable condition can be explained by a single stressor or multiple stressors acting on the wetland; (2) increasing the number of stressors acting on the wetland causes a decline in its condition (there is no assumption as to whether this decline is additive (linear), multiplicative, or is best represented by some other non-linear mode); (3) increasing either the intensity or the proximity of the stressor results in a greater decline in condition; and (4) continuous or chronic stress increases the decline in condition.

The process to identify stressors is the same for all wetland types. For each CRAM attribute, a variety of possible stressors are listed. Their presence and likelihood of significantly affecting the AA are recorded in the Stressor Checklist Worksheet. For the Hydrology, Physical Structure, and Biotic Structure attributes, the focus is on stressors operating within the AA or within 50 m of the AA. For the Buffer and Landscape Context attribute, the focus is on stressors operating within 500 m of the AA. More distant stressors that have obvious, direct, controlling influences on the AA can also be noted.

Table 23: Wetland disturbances and conversions.

Has a major disturbance occurred at this wetland?	Yes	No		
If yes, was it a flood, fire, landslide, or other?	flood	fire	landslide	other
If yes, then how severe is the disturbance?	likely to affect site next 5 or more years	likely to affect site next 3-5 years	likely to affect site next 1-2 years	
Has this wetland been converted from another type? If yes, then what was the previous type?	depressional	vernal pool	vernal pool system	
	non-confined riverine	confined riverine	bar-built estuarine	
	perennial saline estuarine	perennial non-saline estuarine	wet meadow	
	lacustrine	seep or spring	playa	

Stressor Checklist Worksheet

HYDROLOGY ATTRIBUTE (WITHIN 50 M OF AA)	**Present**	**Significant negative effect on AA**
Point Source (PS) discharges (POTW, other non-stormwater discharge)		
Non-point Source (Non-PS) discharges (urban runoff, farm drainage)		
Flow diversions or unnatural inflows		
Dams (reservoirs, detention basins, recharge basins)		
Flow obstructions (culverts, paved stream crossings)		
Weir/drop structure, tide gates		
Dredged inlet/channel		
Engineered channel (riprap, armored channel bank, bed)		
Dike/levees		
Groundwater extraction		
Ditches (borrow, agricultural drainage, mosquito control, etc.)		
Actively managed hydrology		
Comments		

PHYSICAL STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	**Present**	**Significant negative effect on AA**
Filling or dumping of sediment or soils **(N/A for restoration areas)**		
Grading/ compaction **(N/A for restoration areas)**		
Plowing/Discing **(N/A for restoration areas)**		
Resource extraction (sediment, gravel, oil and/or gas)		
Vegetation management		
Excessive sediment or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired (PS or Non-PS pollution)		
Heavy metal impaired (PS or Non-PS pollution)		
Pesticides or trace organics impaired (PS or Non-PS pollution)		
Bacteria and pathogens impaired (PS or Non-PS pollution)		
Trash or refuse		
Comments		

BIOTIC STRUCTURE ATTRIBUTE (WITHIN 50 M OF AA)	Present	Significant negative effect on AA
Mowing, grazing, excessive herbivory (within AA)		
Excessive human visitation		
Predation and habitat destruction by non-native vertebrates (e.g., *Virginia opossum* and domestic predators, such as feral pets)		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application or vector control		
Biological resource extraction or stocking (fisheries, aquaculture)		
Excessive organic debris in matrix (for vernal pools)		
Lack of vegetation management to conserve natural resources		
Lack of treatment of invasive plants adjacent to AA or buffer		
Comments		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (WITHIN 500 M OF AA)	Present	Significant negative effect on AA
Urban residential		
Industrial/commercial		
Military training/Air traffic		
Dams (or other major flow regulation or disruption)		
Dryland farming		
Intensive row-crop agriculture		
Orchards/nurseries		
Commercial feedlots		
Dairies		
Ranching (enclosed livestock grazing or horse paddock or feedlot)		
Transportation corridor		
Rangeland (livestock rangeland also managed for native vegetation)		
Sports fields and urban parklands (golf courses, soccer fields, etc.)		
Passive recreation (bird-watching, hiking, etc.)		
Active recreation (off-road vehicles, mountain biking, hunting, fishing)		
Physical resource extraction (rock, sediment, oil/gas)		
Biological resource extraction (aquaculture, commercial fisheries)		
Comments		

CRAM Score Guidelines

Table 24: Steps to calculate attribute scores and AA scores.

Step 1: Calculate Metric Score	For each Metric, convert the letter score into the corresponding numeric score: A=12, B=9, C=6 and D=3.
Step 2: Calculate raw Attribute Score	For each Attribute, calculate the Raw Attribute Score as the sum of the numeric scores of the component Metrics, except in the following cases: • For Attribute 1 (Buffer and Landscape Context), the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Aquatic Area Abundance metric, using the following formula: $\left(\text{Buffer Condition} \times \left(\text{\% AA with Buffer} \times \text{Average Buffer Width}\right)^{½}\right)^{½} + \text{Aquatic Area Abundance}$ • For Attribute 4 (Biotic Structure) Prior to calculating the Raw Attribute Score, average the three Plant Community submetrics. Then sum this result with the other two Biotic Structure metrics. • **Do not** round the Raw Attribute scores to the nearest integer.
Step 3: Calculate final Attribute Score	For each Attribute, divide its Raw Attribute Score by its maximum possible score, which is 24 for Buffer and Landscape Context, 36 for Hydrology, 24 for Physical Structure, and 36 for Biotic Structure. **Do not** round the final Attribute scores to the nearest integer before calculating the AA Index Score. You may round the final Attribute score to the nearest integer for reporting purposes.
Step 4: Calculate the AA Index Score	Calculate the AA Index score by averaging the Final Attribute Scores (with all significant figures: not rounded). Round this average to the nearest integer to get the AA Index Score (0.5 or greater rounds up, less than 0.5 rounds down).