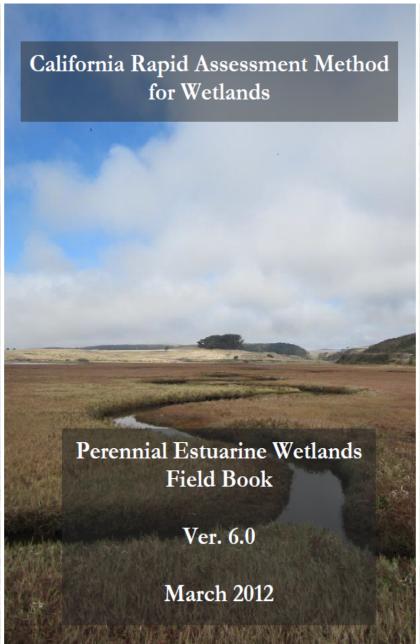
California Rapid Assessment Method for Wetlands and Riparian Areas

(CRAM)

Estuarine Training Module



Steps of CRAM Assessment

Step 1: Assemble background information
Step 2: Classify the wetland
Step 3: Verify the appropriate season
Step 4: Sketch the CRAM Assessment Area (AA)
Step 5: Conduct the office assessment of AA
Step 6: Conduct the field assessment of AA
Step 7: Complete CRAM QA/QC
Step 8: Submit assessment results using *e*CRAM

Assemble background information

- 1-3m pixel resolution digital geo-rectified site imagery with a scale (e.g. NAIP)
  - Google Earth, Bing Maps
- Preliminary map of assessment area (AA)
- Reports on hydrology, land use, water quality

Other considerations:

- Access permission (if needed)
- Map/directions to site

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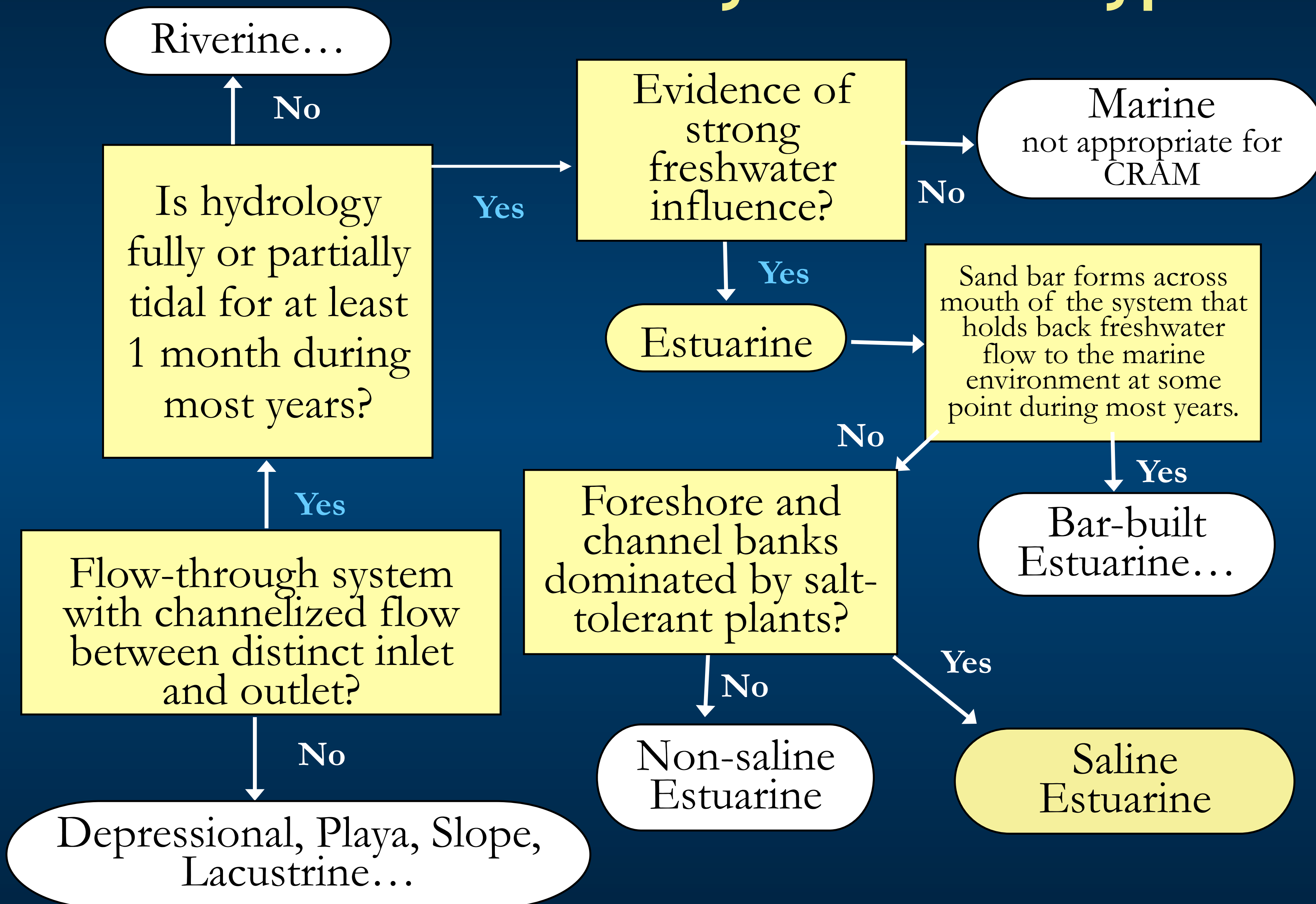
Identify Wetland Type



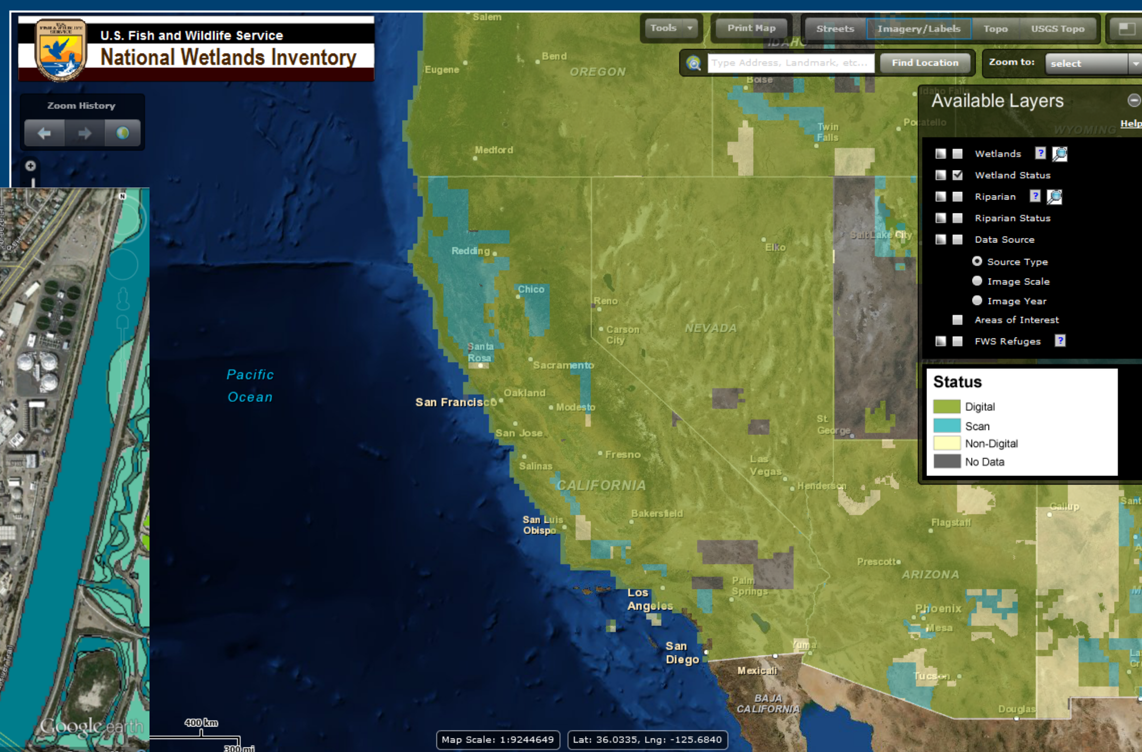
Estuarine Wetland sub-types

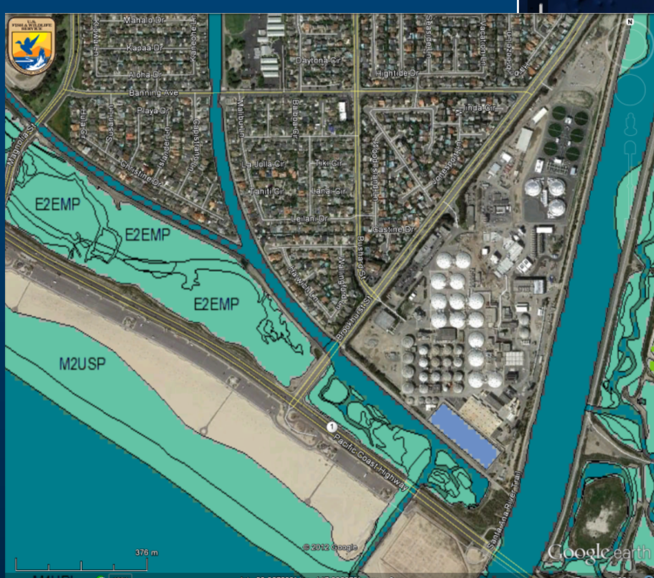
• Non-saline

• Saline

Sources of Wetland Maps

- Wetland Maps:
  - Jurisdictional delineation (JD)
  - NWI Wetlands Mapper (Google Earth kml)
  - So Cal Wetland Mapping Project (http://www.socalwetlands.com)





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CRAM Assessment Window

- Growing season of plants
  - New growth to senescence (~Mar-Sept)
  - Longer growing season for tidally influenced wetlands than others
- Estuarine during low tide
  - Most small intertidal channels are de-watered
  - Benthic indicators visible

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Considerations for delineating the AA

- Hydrogeomorphic Integrity
  - Minimize natural variability within a site
  - Maximize detection of management effects
  - Bound AA by physical features that control sources, volumes, rates, or general composition of sediment/ water supplies
- Size Limits for Estuarine AA
  - Recommended size is a 1 ha circle (radius of 55 m)
  - Can be non-circular to fit wetland
  - Minimum size is 0.1 ha
- Purpose of Assessment
  - Project (multiple AAs may be needed to cover site)
  - Ambient (AA located at probabilistic draw point)

Delineating the CRAM Assessment Area (AA)

- change in wetland type
- change in hydrology
- barriers to flow

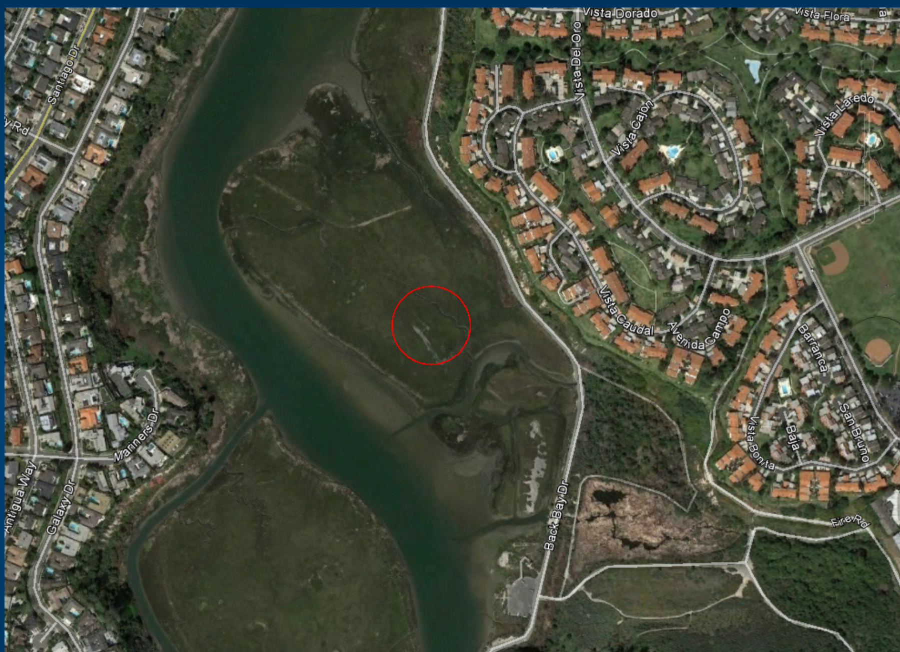
CRAM Assessment Areas (AAs)

a single estuary may have multiple AAs

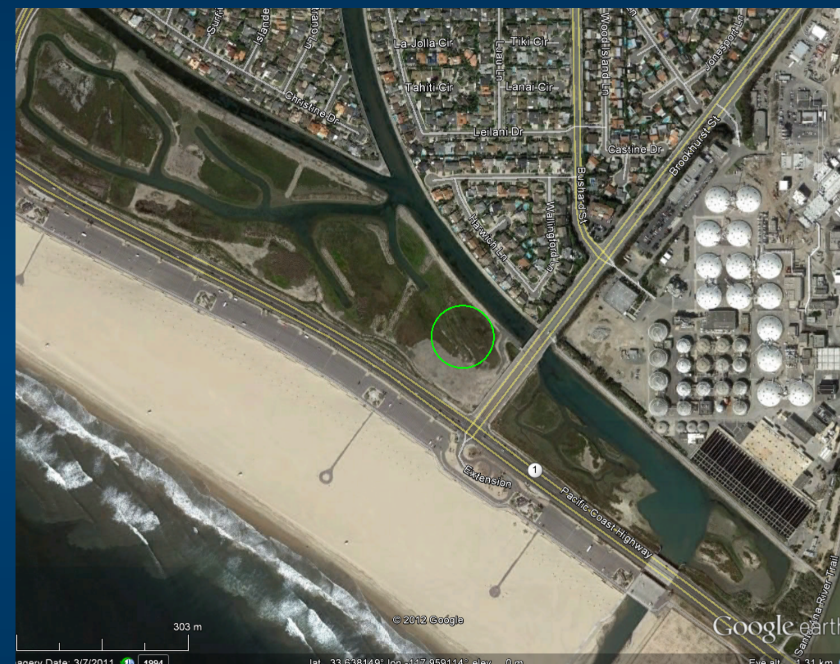
Sketch the AA subject to field verification

- Determine boundary of AA at low tide
- Not to extend above the backshore
  - Wrack lines
  - Transition from tidal to upland
- Not to extend across:
  - more than 10m of non-vegetated tidal flat
  - a tidal channel more than 30m wide

Delineating the CRAM Assessment Area (AA)



UNB Site 1 AA



Brookhurst AA

Features to delineate a wetland for CRAM

Delineating Feature	Description of Features
Backshore	The backshore of a wetland is the boundary between the wetland and the adjoining upland, where the upland is at least 5m wide. The high-water contour of the wetland is a good proxy for its backshore boundary.
Foreshore	The foreshore of a wetland is the boundary between the vegetated wetland and any adjoining semi-aquatic, non-wetland area, such as an intertidal flat or a non-vegetated riverine channel bar, or a fully aquatic area such as the open water area of a lake or estuary that is at least 30m wide.
Adjoining Wetland	Any wetland that is mostly less than 5m distant from the wetland being assessed is an adjoining wetland.

Delineating the Wetland for a CRAM AA

Upper Newport Bay AA 1

Brookhurst Marsh AA

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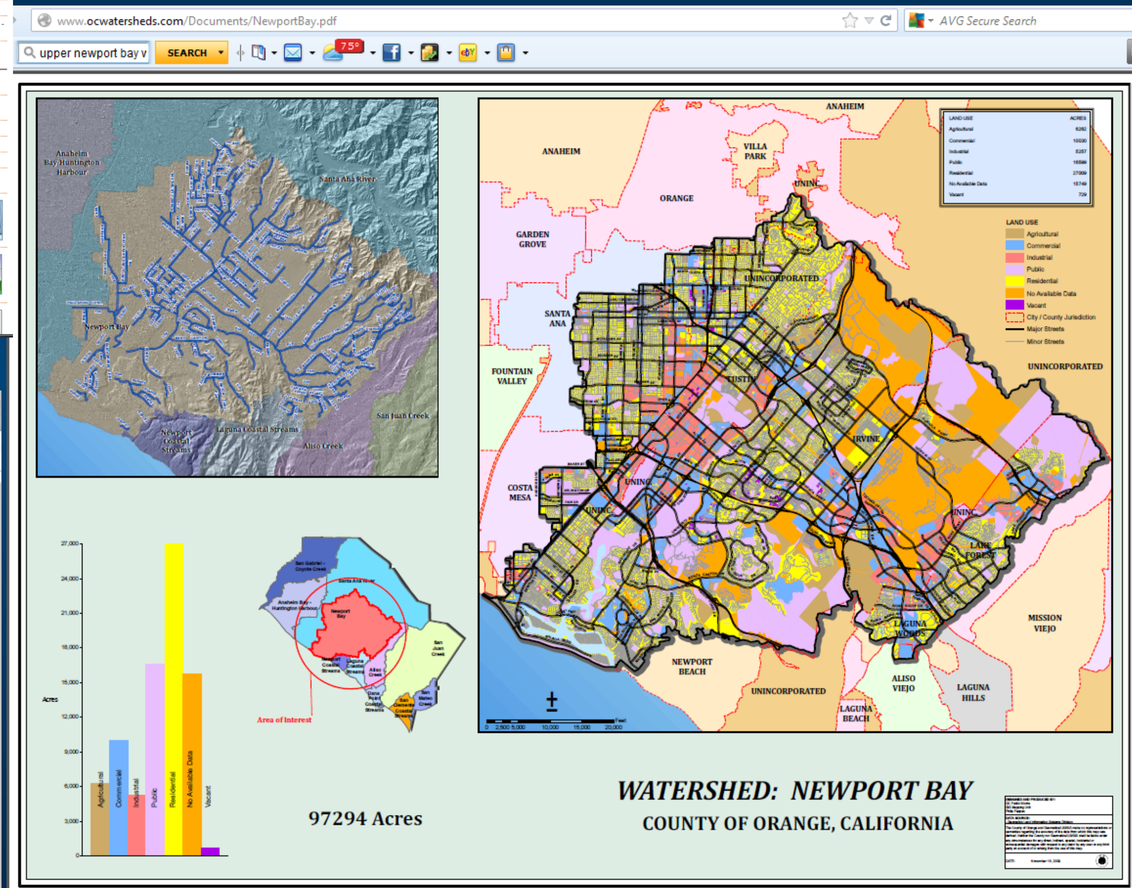
Information needed for Office Assessment

- Aerial imagery
- Preliminary map of assessment area (AA)
- Reports on hydrology, water quality, land use, etc.
- Site history

http://www.ocwatersheds.com

http://www.hbwetlands.org



Office Assessment

Some metrics that rely on background information and broad geographic overview are best assessed in the office, subject to field verification

- Buffer and Landscape Context Attribute
  - Aquatic Area Abundance (metric)
  - Percent of AA with Buffer (submetric)
  - Average Buffer Width (submetric)

- Hydrology Attribute
  - Water Source (metric)
  - Hydrologic Connectivity (metric)

- Stressor Checklist

Attribute 1: Buffer and Landscape Context (BLC)

- *Connectivity to other aquatic resources*
- *Extent and quality of buffer surrounding the assessment area*

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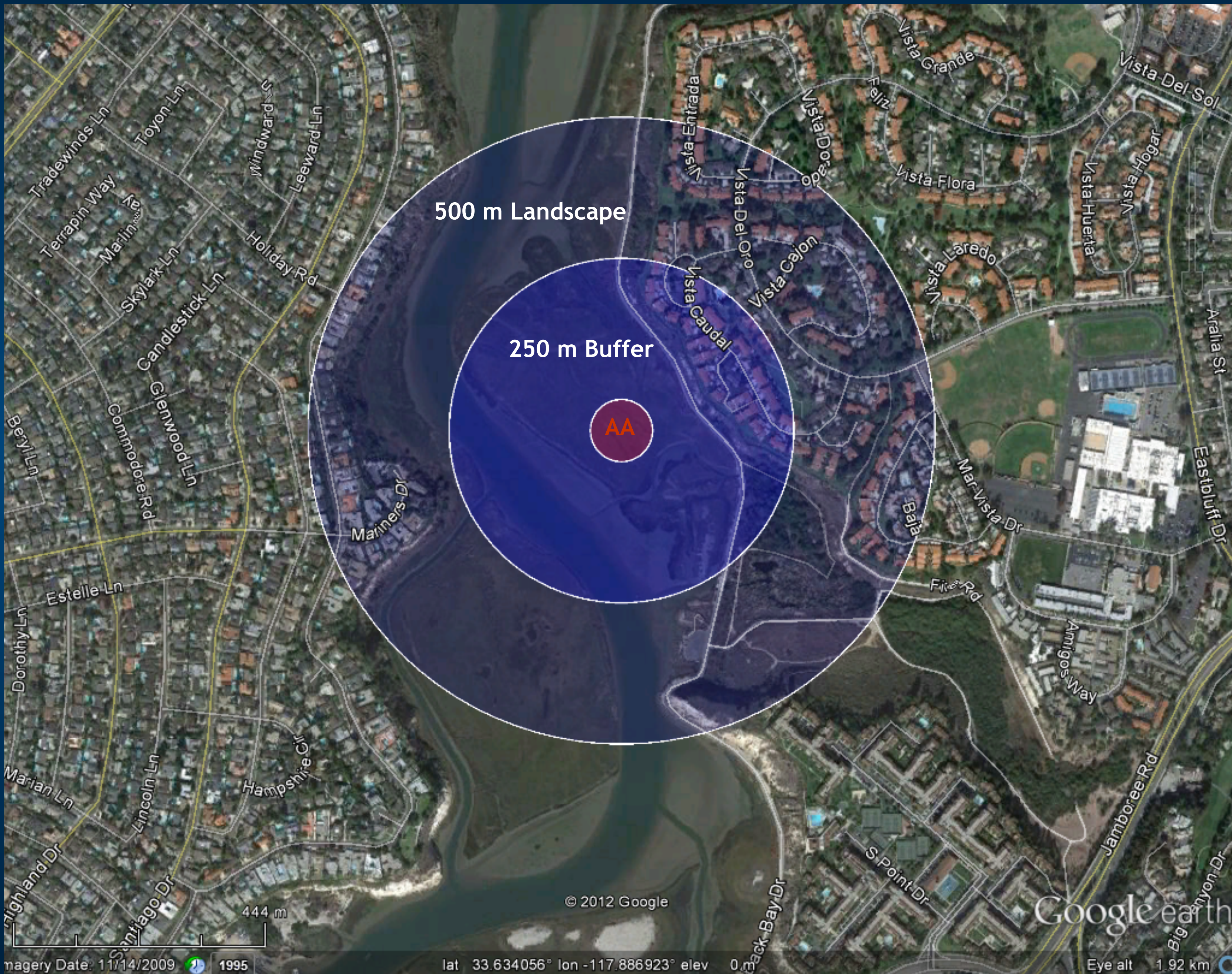
Assess Landscape Context and Buffer at Different Scales



Metric 1: Aquatic Area Abundance (BLC Attribute)

- Assess AA in terms of its spatial association with other "aquatic resources"
- Wetlands close to each other have greater potential to interact ecologically
- Include open water
- Draw four lines in cardinal compass directions 500m long on the aerial and determine average % made up of wetland habitat

Aquatic Area Abundance (BLC Attribute)

Upper Newport Bay AA 1

How abundant are wetlands near the AA?

Aquatic Area Abundance (BLC Attribute)

Rating	Alternative States
A	An average of 76-100% of the transects are wetland habitat of any kind
B	An average of 51-75% of the transects are wetland habitat of any kind
C	An average of 26-50% of the transects are wetland habitat of any kind
D	An average of 0-25% of the transects are wetland habitat of any kind

Average Percentage of Transect Length That Is Wetland

UNB AA1 = 71%
Brookhurst Marsh = 22%

Metric 2: Buffer

- The 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 forays into the AA by people and non-native predators, or otherwise protect the AA from stress and disturbance
- Three Submetrics comprise the Buffer Metric:
  - A: % AA with Buffer (presence)
  - B: Buffer Width (size)
  - C: Buffer Condition (quality)

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Submetric A: % of AA with Buffer (BLC Attribute)

Estimate percent of the AA perimeter adjoining buffer land cover that is at least 5m wide

- Open water over 30m adjoining the AA is neutral

- Three Reasons:
  - Inflates score
  - Req. lab analysis for quality
  - Can be direct or indirect source of stress, or benefit to wetland

Rating	Alternative States
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 < 25% of AA perimeter

Table 5: Guidelines for identifying wetland buffers and breaks in buffers

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, or trails (with light traffic) • horse trails • natural upland habitats • nature or wildland parks • range land and pastures • railroads (with infrequent use: 2 trains per 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) • intensive agriculture (row crops, orchards and vineyards) • golf courses • paved roads (two lanes or larger) • lawns • active railroads (more than 2 trains per day) • parking lots • horse paddocks, feedlots, turkey ranches, etc. • residential areas • sound walls • sports fields • urbanized parks with active recreation • pedestrian/bike trails (with heavy traffic)

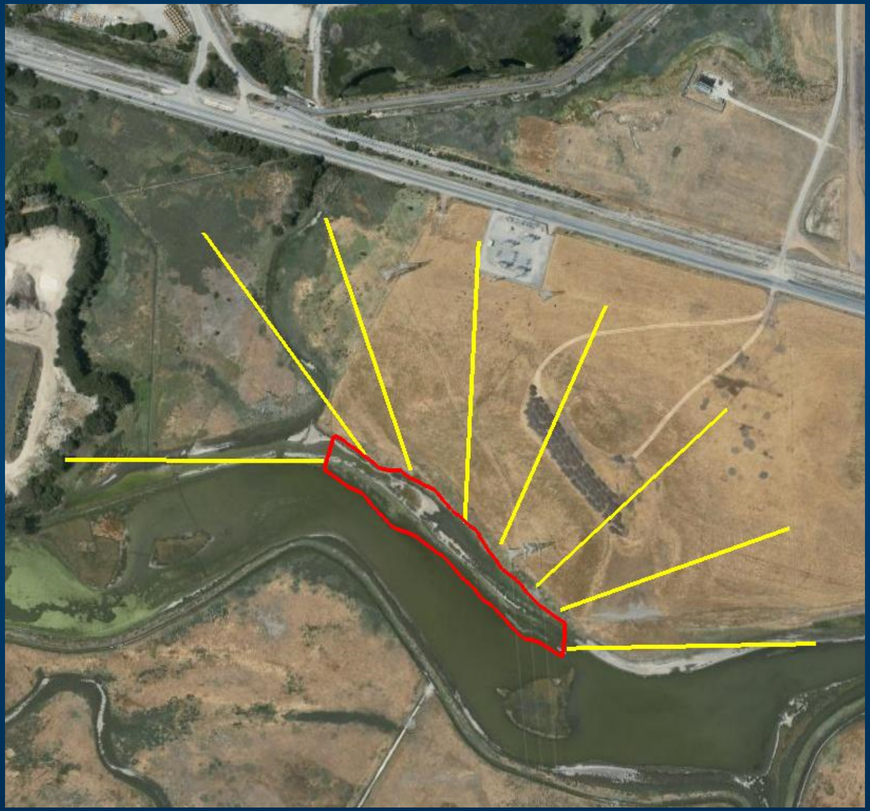
Submetric B: Average Buffer Width

(BLC Attribute)

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	250
C	250
D	250
E	250
F	250
G	250
H	250
Average Buffer Width	250

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.



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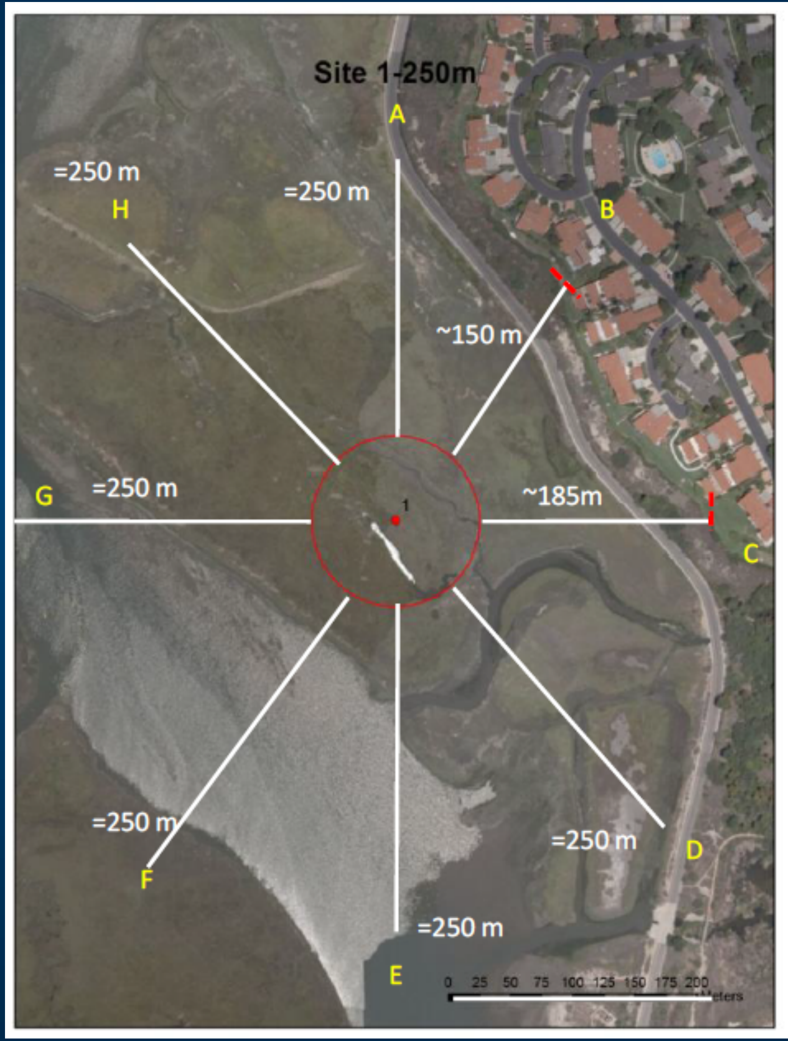
Average Buffer Width (BLC Attribute)

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	250
B	150
C	185
D	250
E	250
F	250
G	250
H	250
Average Buffer Width	= 1835/8 = 229

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 (BLC Attribute)

Buffer characteristics

- Native vegetation
- Intact soils
- Intensity of visitation

Aerial imagery can assist, but base final score on field indicators only

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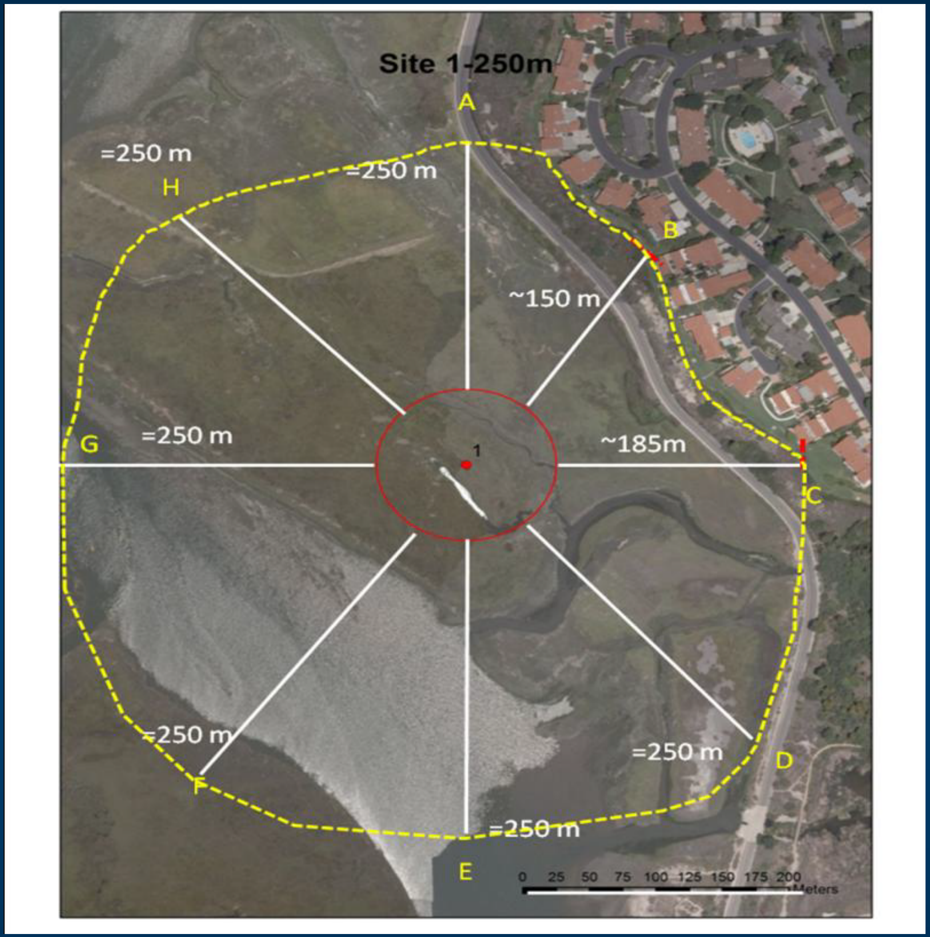
Buffer Condition (BLC Attribute)

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	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 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 amounts of non-native vegetation (>75%), AND there is at least a moderate degree of soil disturbance/compaction undisturbed soils, 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.

Buffer Condition (BLC Attribute)

Buffer Condition (BLC Attribute)



B = Buffer for AA is dominated by native vegetation, but shows some soil disturbance, and is apparently subject to little or low impact human visitation.

Attribute 2: Hydrology

- Sources, quantities, and movements of water to the AA

- Comprised of Three Metrics:
  - Water Source
  - Hydroperiod
  - Hydrologic Connectivity

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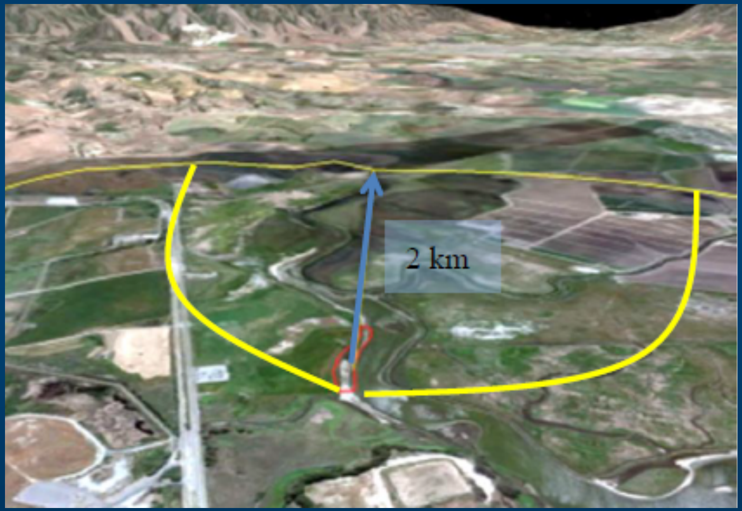
Metric 1: Water Source (Hydrology Attribute)

- Consider freshwater sources affecting dry season conditions of AA within 2 km
- Determine anthropogenic inputs
- Consider:
  - type and distribution of plant spp. (level of salt tolerance)
  - inputs of fresh water from tidal action



- Consult information sources
  - watershed reports
  - local experts
  - maps or imagery

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Table 10: 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, 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.

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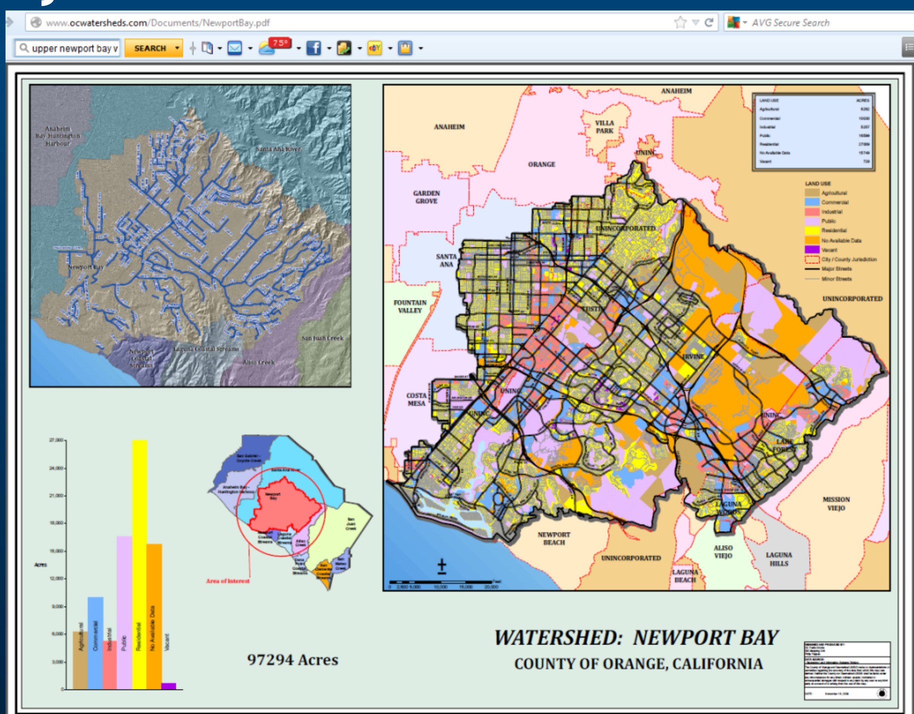
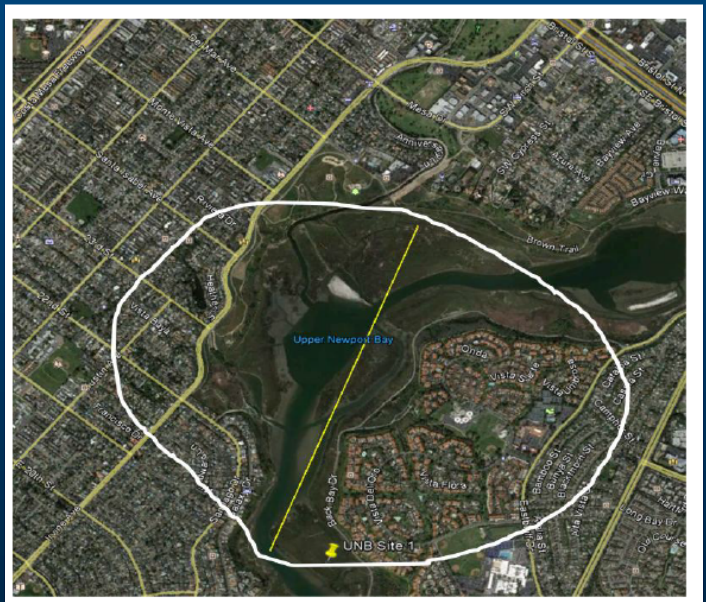
Rating Water Source

The fresh water that enters UNB comes from an area of approximately 154 square miles of land that drains to the Bay. About two-thirds of this area is covered with dense development. Fresh water enters the Upper Bay primarily via San Diego Creek in the north east corner of the Bay at Jamboree Blvd. and meets the tidal flow of the Pacific Ocean, entering from the Lower Bay at Pacific Coast Hwy. The remainder enters the Back Bay via the Santa Ana - Delhi Channel or from the surrounding bluffs.





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Field Assessment Procedure

1. Bring aerial with pre-drawn draft AA delineation
2. Modify AA based on field observation
3. Walk through entire A, make notes & record dominant plant species
4. Complete datasheets
5. Walk again to clarify uncertainties
6. Finalize field scores and datasheets

Basic Information Datasheet

Basic Information Sheet: Perennial Estuarine Wetlands

CRAM Site ID:

Project Site ID:

Assessment Area Name:

Project Name:	Date (m/d/y)			

Assessment Team Members for This AA

Center of AA:

Latitude: **Longitude:**

Wetland Sub-type:

□ Perennial Saline □ Perennial Non-saline

AA Category:

□ Restoration □ Mitigation □ Impacted □ Ambient □ Reference □ Training

□ Other:

What best describes the tidal stage over the course of the time spent in the field?
Note: It is recommended that the assessment be conducted during low tide.

□ high tide □ low tide

Photo Identification Numbers and Description:

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

1

Site Location Description:

Comments:

Field Book Pg.1

Metric 2: Hydroperiod (Hydrology Attribute)

- Frequency and duration of inundation and saturation during a typical year
- Naturally governed by tides in estuarine wetlands (tidal prism)

Table 11: Field Indicators of Altered Hydroperiod

Direct Engineering Evidence	Indirect Ecological Evidence
Reduced Extent and Duration of Inundation or Saturation	
• Upstream spring boxes • Impoundments • 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	
• Berms • Dikes • Pumps, diversions, ditching that move water ***into*** the wetland	• Late-season vitality of annual vegetation • Recently drowned riparian vegetation • Extensive fine-grain deposits

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Hydroperiod (Hydrology Attribute)

Rating	Alternative States
A	Full tidal prism, with two daily tidal minima and maxima.
B	Muted tidal prism, although two daily minima and maxima are observed.
C	Muted tidal prism, with tidal fluctuations evident only in relation to extreme daily highs or spring tides.
D	AA is subject to muted tidal prism, plus inadequate drainage, means that the marsh plain remains flooded during low tide.

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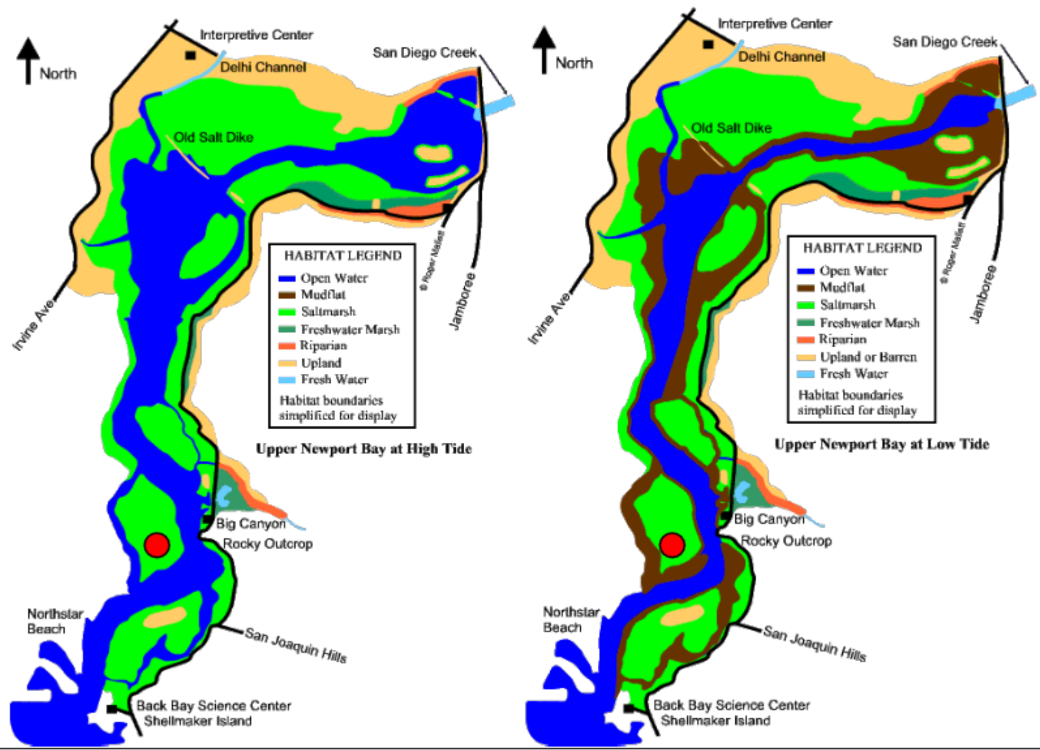
Metric 2: Hydroperiod (Hydrology Attribute)

At Upper Newport Bay there are two high tides and two low tides roughly every day. When there is a spring tide, there is about an 8 ft. difference between high and low water level. The approximate location of Training site 1 is indicated by the red circle.



Source: Newport Bay Naturalists and Friends http://www.newportbay.org

Figure 8. Upper Newport Bay at High (left) and Low Tide (right)

Metric 3: Hydrologic Connectivity (Hydrology Attribute)

- Ability of water to flow into or out of the <u>wetland</u> that contains the AA
- Ability to accommodate rising flood waters without large changes in water level
- Restrictions include:
  - Roads
  - Levees
  - Sea walls

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Hydrologic Connectivity (Hydrology Attribute)

Rating	Alternative States
A	Rising water has unrestricted access to adjacent uplands without obstructions to the lateral movement of flood flows.
B	Lateral excursion of rising waters is partially restricted by unnatural features but less than 50% of the wetland that contains the AA is restricted by barriers to drainage.
C	Lateral excursion of rising waters is restricted by unnatural features for 50 to 90% of the wetland that contains the AA .
D	Rising water is restricted by unnatural features for more than 90% of the wetland that contains the AA.

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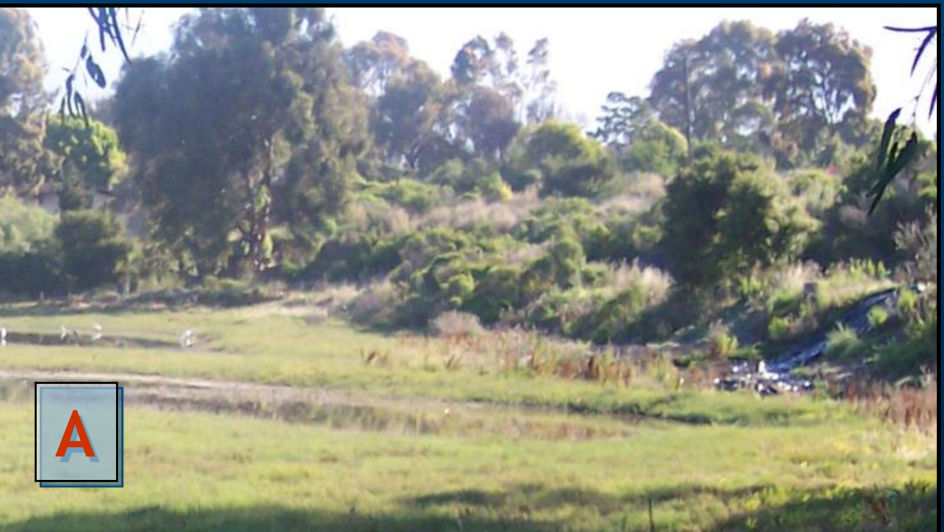

Hydrologic Connectivity (Hydrology Attribute)

Upper Newport Bay AA 1

Brookhurst Marsh AA

~ 41% (560 m) are restricted by an old levee along the north side and the Back Bay Dr. along the eastern edge = B

~ 55% are restricted by an old levee along the north side and the Back Bay Dr. along the eastern edge = C

Attribute 3: Physical Structure

- The spatial organization of living and non-living surfaces that provide habitat for biota

- Comprised by two Metrics:
  - Structural patch richness (# of different patch types)
  - Topographic complexity (variety of elevations; spatial arrangement and interspersion of patch types)

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Metric 2: Structural Patch Richness

STRUCTURAL PATCH TYPE (circle for presence)	Estuarine
Minimum Patch Size	3 m^2
Abundant wrackline or organic debris in channel, on floodplain, or across depressional wetland plain	1
Animal mounds and burrows	1
Bank slumps or undercut banks in channels or along shoreline	1
Debris jams	1
Filamentous macroalgae or algal mats	1
Non-vegetated flats or bare ground (sandflats, mudflats, gravel flats, etc.)	1
Pannes or pools on floodplain	1
Plant hummocks and/or sediment mounds	1
Point bars and in-channel bars	1
Pools or depressions in channels (wet or dry channels)	1
Secondary channels on floodplains or along shorelines	1
Shellfish beds (living)	1
Soil cracks	1
Standing snags (at least 3 m tall)	1
Submerged vegetation	1
Total Possible	**15**
No. Observed Patch Types (enter here and use in Table 14 below)	

- For estuarine wetlands, up to 15 different types of patch types can be expected.
- A structural patch type must have a minimum size of 3m^2. (area ~1.74 m x 1.74 m), NOT 3 meters squared (9m^2)
- Patch types do not have to occur as a singular 3m^2 area within the AA. If there are very small patches of a single type scattered over the entire AA that's approximates 3m^2, than it comprises a patch type

Structural Patch Richness (Physical attribute)

Rating	No. of Patch Types
A	≥ 9
B	6 – 8
C	3 – 5
D	≤ 2

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Bank Slumps

Shellfish beds

Abundant Wrack/Organic Debris

Wrack is an accumulation of natural or unnatural floating debris across the wetland plain, along the edges of channels or along the high water line of a wetland. Organic debris includes loose vegetation and twigs not yet deposited by hydrologic processes. This patch type does not include standing dead vegetation.

Bank slumps or undercut banks in channels or along shorelines

A bank slump is a portion of an estuarine 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. These areas can provide habitat for fishes and invertebrates

Debris Jams

A debris jam is an accumulation of drift wood and other flotage across a channel that partially or completely obstructs surface water flow.

Filamentous macroalgae and algal mats

Tijuana Slough, San Diego Co.

Macroalgae occurs on benthic sediments and on the water surface of all types of wetlands. 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

Non-vegetated flats (sandflats, mudflats, gravel flats, etc.)

A flat is a non-vegetated area of silt, clay, sand, shell hash, gravel, or cobble at least 10 m wide and at least 30 m long that adjoins the wetland foreshore and is a potential resting and feeding area for fishes, shorebirds, wading birds, and other waterbirds. Flats can be similar to large bars, except that they lack the convex profile of bars and their compositional material is not as obviously sorted by size or texture.

Pannes or pools on floodplain

A panne is a shallow topographic basin lacking vegetation but existing on a well-vegetated wetland plain. Pannes fill with water at least seasonally due to overland flow. They commonly serve as foraging sites for waterbirds and as breeding sites for amphibians.

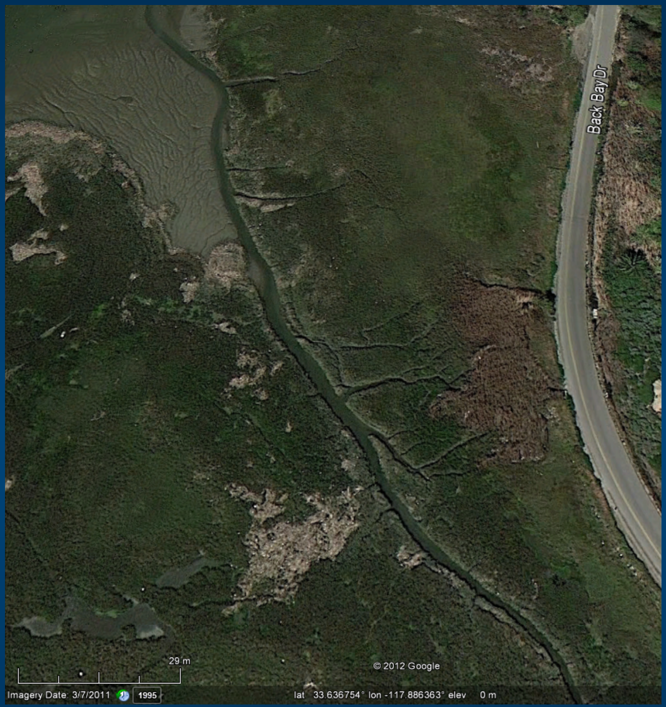
Plant hummocks or sediment mounds

Hummocks are mounds created by plants along the banks and floodplains of tidal 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.

Point bars and in-channel bars

Bars are sedimentary features within intertidal channels. They are patches of transient bedload sediment that form along the inside of meander bends or in the middle of straight channel reaches. They sometimes support vegetation. They are convex in profile and their surface material varies in size from small on top to larger along their lower margins. They can consist of any mixture of silt, sand, gravel, cobble, and boulders.

Secondary channels on floodplains or along shorelines



Channels confine estuarine flow. A channel consists of a bed and its opposing banks, plus its floodplain. Estuarine wetlands can have a primary channel, and one or more secondary channels of varying sizes that convey tidal flows.

Shellfish beds (living)

Oysters, cla t create beds on the banks and bottoms of wetland systems. Shellfish beds influence the condition of their environment by affecting flow velocities, providing substrates for plant and animal life, and playing particularly important roles in the uptake and cycling of nutrients and other water-borne materials.

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.

Other Patch Types

Snags: Tall, woody vegetation, such as trees and tall shrubs, can take many years to fall to the ground after dying. These standing “snags” provide habitat for many species of birds and small mammals. Any standing, dead woody vegetation within the AA that is at least 3 m (9 ft. 10 in) tall is considered a snag.

Animal burrows: Mounds or holes made by vertebrates and invertebrates due to their foraging, denning, predation, or other behaviors. 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.

Submerged vegetation: consists of aquatic macrophytes such as *Zostera marina* (eelgrass) 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.

Pools or depressions in channels: Areas along tidal channels that are much deeper than the average depths of their channels and that tend to retain water longer than other areas of the channel during periods of low or no surface flow

Metric 2: Topographic Complexity (Physical attribute)

Micro- and macro-topographic relief and variety of elevations within a wetland due to physical features and elevation gradients.

Table 15: Typical indicators of Macro- and Micro-Topographic Complexity for Estuarine Wetlands:

channels large and small, ditches, islands, bars, pannes, potholes, natural and unnatural levees or dikes, shellfish beds, hummocks, bank slumps, first-order tidal channels, soil cracks, partially buried debris, plant hummocks, burrows, animal tracks

Field Book Pg. 24

Topographic Complexity (Physical attribute)

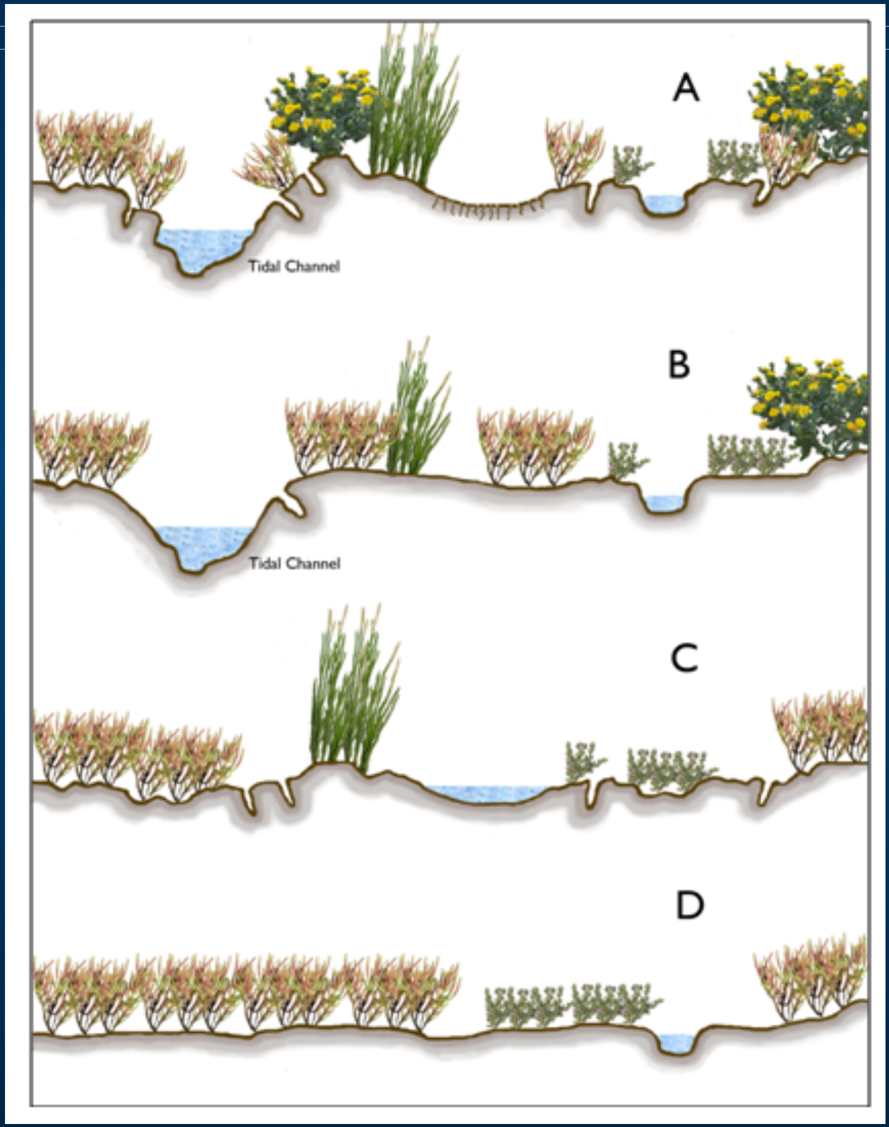
Sweetwater Marsh

Secondary Channels

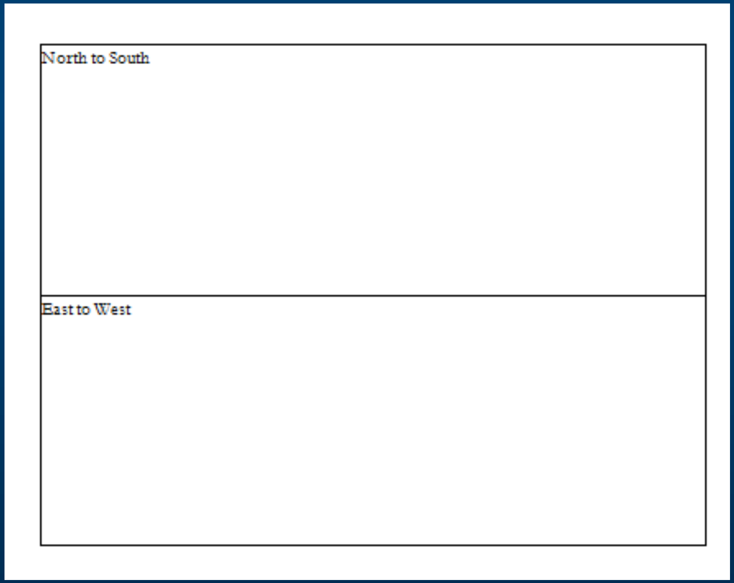
Sweetwater Marsh

Topographic Complexity (Physical attribute)

Figure 8: Scale-independent schematic profiles of Topographic Complexity



Worksheet for AA Topographic Complexity



Field Book Pg. 25-26

Topographic Complexity (Physical attribute)

Table 16: Rating of Topographic Complexity for Estuarine Wetlands

Rating	Alternative States (based on diagrams in Figure 8)
A	The vegetated plain of the AA in cross-section has well-formed tidal channels that are well-drained during ebb tide and a variety of micro-topographic features created by plants, animal tracks, cracks, partially buried debris, retrogressing channels (filling-in with sediment and plants), natural and unnatural levees along channels, potholes and pannes that together comprise a complex array of ups and downs resembling diagram A in Figure 8.
B	The vegetated plain of the AA has channels and a variety of micro-topographic features as described above for "A" but they are less abundant and/or they comprise less variability in elevation overall, as illustrated in diagram B of Figure 8.
C	The vegetated plain of the AA has a variety of micro-topographic features as described above for "A" but lacks well-formed tidal channels that are well-drained during ebb tide. If channels exist, they mostly do not drain well or are filling-in with sediment. The plain overall resembles diagram C of Figure 8.
D	The vegetated plain of the AA has little or no micro-topographic relief and few or no well-formed channels. The plain resembles diagram D of Figure 8.

Biotic Structure Attribute

Considers…

- Overall ecological complexity of plant community of the wetland
- Three metrics:
  - Plant Community
  - Horizontal interspersion
  - Vertical biotic structure

Field Book Pg. 28

Metric 1: Plant Community Metric (Biotic attribute)

Comprised of three Submetrics:

- Number of Plant Layers Present
- Number of Co-dominant Species Present
- Percent of Co-dominant Species that are Invasive

Field Book Pg. 28

Determining Plant Community Metrics

Step 1 : Determine number of plant layers

<5% absolute cover

Not counted as a layer

≥5% absolute cover

Counted as a layer

Step 2 : Determine co-dominant plant species/layer

<10% relative cover

Not counted as a dominant

≥ 10% relative cover

Counted as a dominant

Step 3 : Sum co-dominants and determine % that are invasive

Field Book Pg. 30

Table 17: Plant layer heights for Estuarine Wetlands

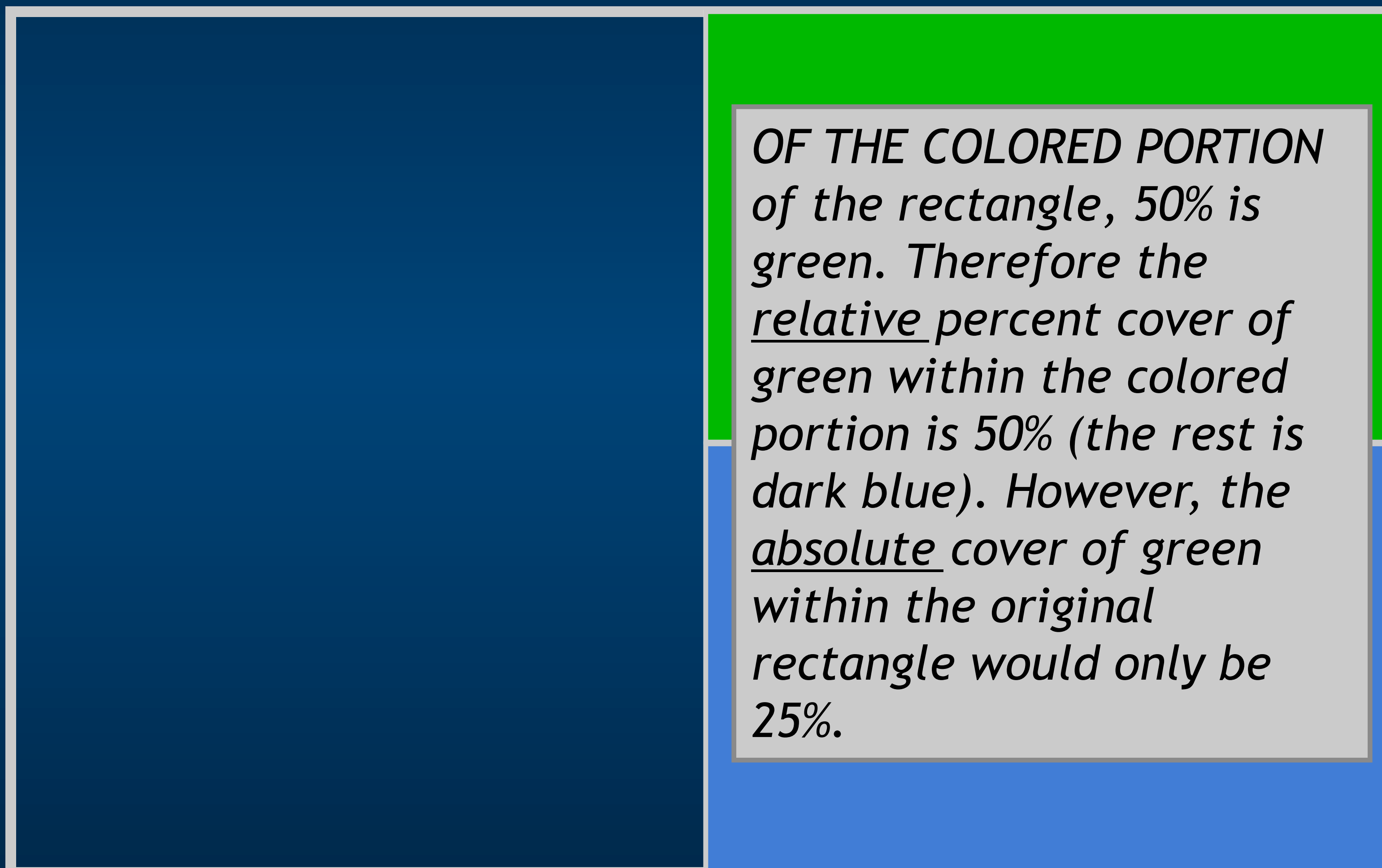
Plant Layers				
Aquatic	Semi-aquatic and Emergent			
Floating	Short	Medium	Tall	Very Tall
On Water Surface	<0.3 m	0.3 – 0.75 m	0.75 – 1.5 m	>1.5 m

Field Book Pg. 31

Absolute vs. Relative % Cover

50 % of the rectangle is colored. Therefore, the absolute percent cover of color in the rectangle is 50%.

Absolute vs. Relative % Cover



Number of Plant Layers

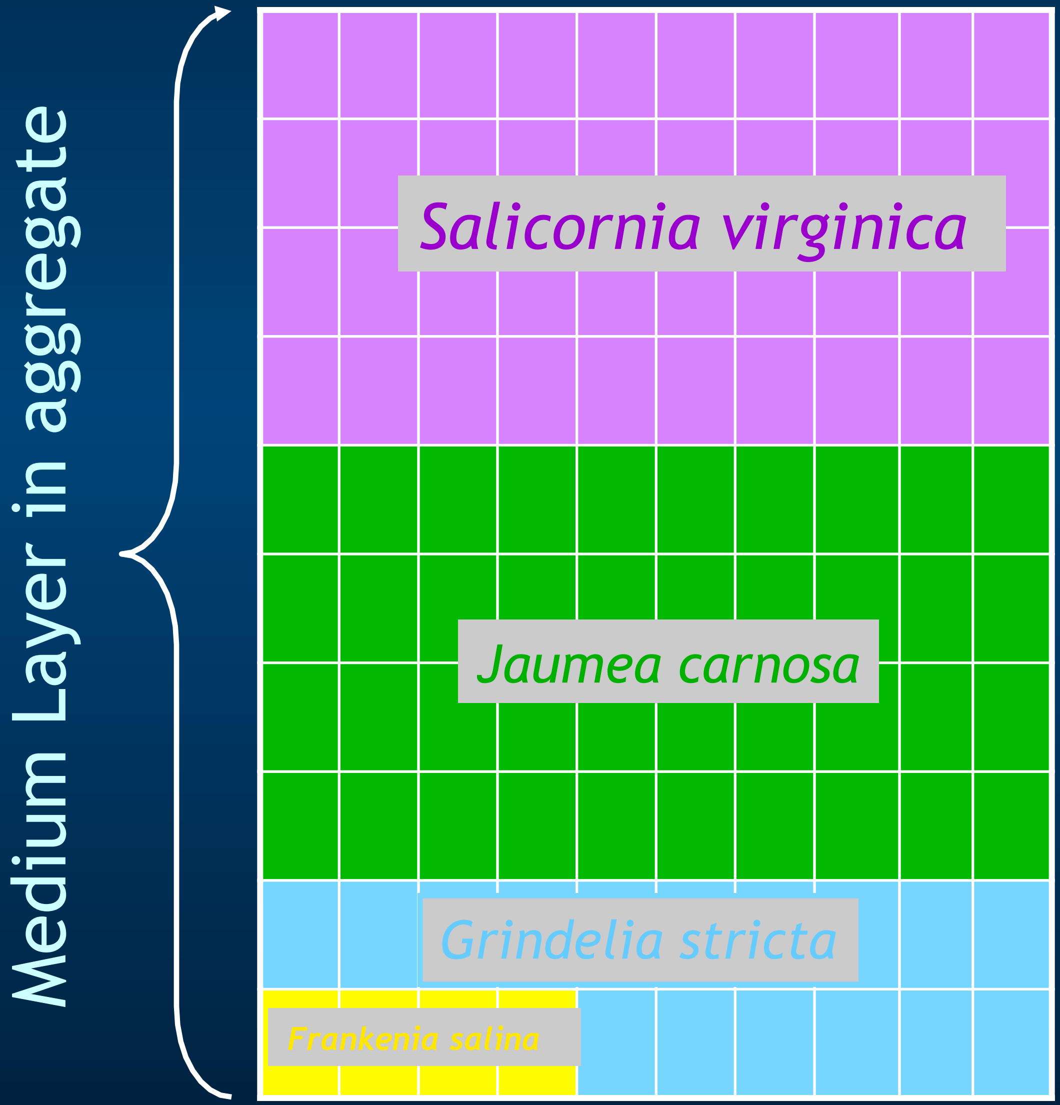
≥ 5% Absolute Cover, in aggregate, Within AA

One box = 5 % of Area, or 1/20

- Very Tall Layer (> 1.5m)
  - (20%)
- Tall Layer (75-1.5m)
  - (5%)
- Medium Layer (0.-75m)
  - (25%)
    - *next slide ->*
- Short (< 0.3m)
  - (5%)

Number of Co-Dominant Plant Species

≥ 10% Relative Cover, in aggregate, per Layer (Within AA)

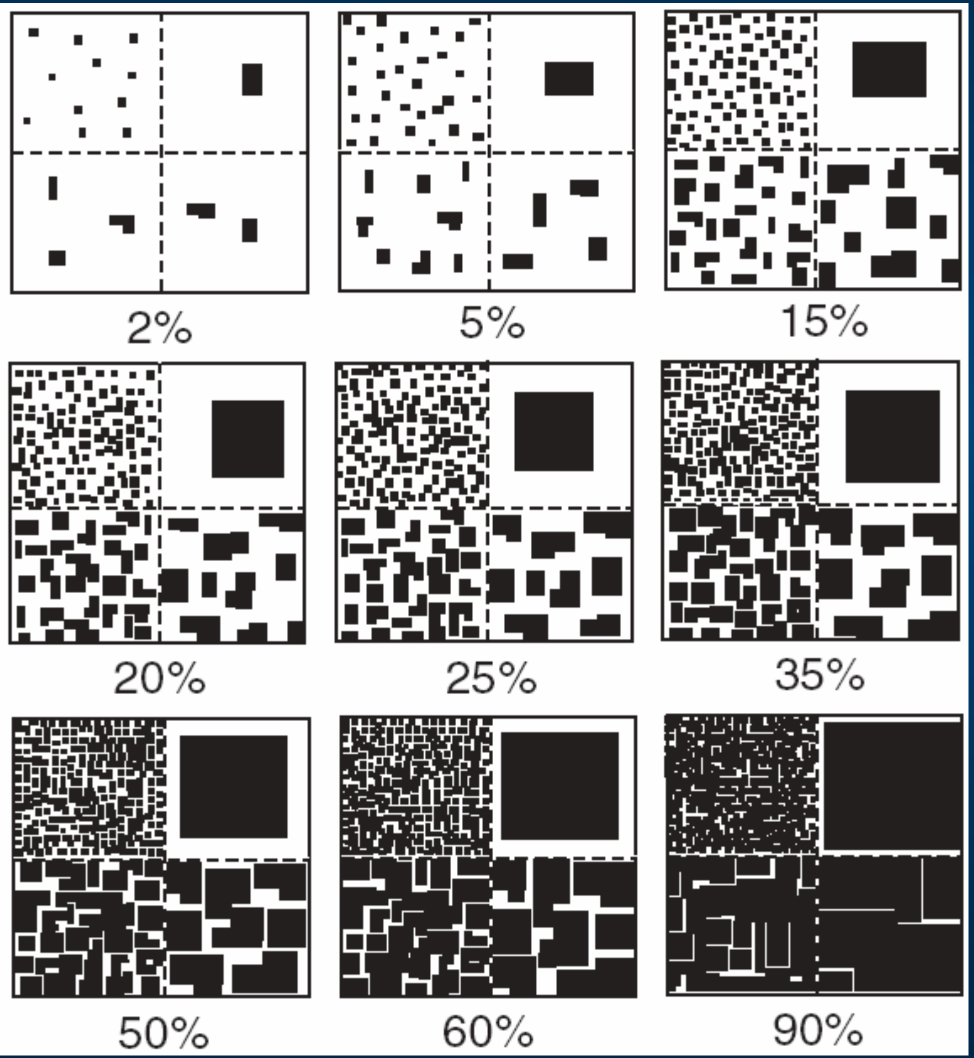


Relative Cover within layer ≥ 10%?

- *Salicornia virginica*
  40/100 = 40% Yes
- *Jaumea carnosa*
  40/100 = 40% Yes
- *Grindelia stricta*
  16/100 = 16% Yes
- *Frankenia salina*
  4/100 = 4% No

Estimating Percent Areal Cover

It's worthwhile to "calibrate your eyes" to different percent cover situations.



Example
Restoration Site AA

- Four Layers ≥ 5% Absolute Cover: Very Tall, Tall, Medium, Short

- Example:
  - 1 hectare = 10,000 sq. m
  - 500 sq. m = 5% of AA (~ 22.3 m x 22.3 m box)

Rules for Plant Community Metrics

- A given species can exist in >1 layer (but a given individual can exist only in one)
- Although it can be a co-dominant in multiple layers, a given plant species is counted only once when calculating total number of co-dominants in the AA and percent invasive spp.
- Dead vegetation contributes to the absolute cover requirement for a layer, but is not included in the dominant species count

Plant Community Metric Worksheet

Floating or Canopy-forming	Invasive?	Short (<0.3 m)	Invasive?
Medium (0.3 - 0.75 m)	**Invasive?**	**Tall (0.75 - 1.5 m)**	**Invasive?**
Very Tall (>1.5 m)	**Invasive?**		
		Total number of co-dominant species for all layers combined (enter here and use in Table 18)	
		Percent Invasion (enter here and use in Table 18)	

Field Book Pg. 32

Plant Community Sub-Metrics (Biotic attribute)

Co-dominant Species	Invasive?	
	Yes	No
Floating		
Short		
Medium		
Tall		
Very Tall		
# co-dominant species		
% invasive co-dominant		

Plant Community Sub-Metrics (Biotic attribute)

Co-dominant Species	Invasive?	
	Yes	No
~~Floating~~		
Short		
Medium		
Tall		
Very Tall		
# co-dominant species		
% invasive co-dominant		

Plant Community Sub-Metrics (Biotic attribute)

Co-dominant Species	Invasive?	
	Yes	No
~~Floating~~		
Short	0	3
Medium		
Tall		
Very Tall		
# co-dominant species		
% invasive co-dominant		

*Salicornia virginica**
Jaumea carnosa
Distichlis spicata

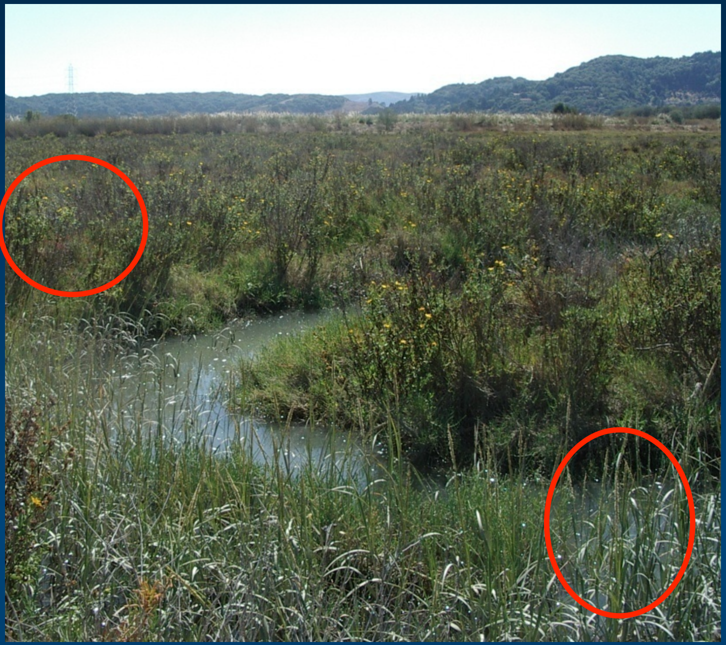
Plant Community Sub-Metrics (Biotic attribute)

Co-dominant Species	Invasive?	
	Yes	No
~~Floating~~		
Short	0	3
Medium	0	1
Tall		
Very Tall		
# co-dominant species		
% invasive co-dominant		

Grindelia stricta

Plant Community Sub-Metrics (Biotic attribute)

Co-dominant Species	Invasive?	
	Yes	No
~~Floating~~		
Short	0	3
Medium	0	1
Tall	0	1
Very Tall		
# co-dominant species		5
% invasive co-dominant		0



Spartina foliosa
Grindelia stricta

Table 18: Ratings for submetrics of Plant Community Metric

Rating	Number of Plant Layers Present	Number of Co-dominant Species	Percent Invasion
Perennial Saline Wetlands			
A	4 – 5	≥ 5	0 – 15%
B	2 – 3	4	16 – 30%
C	1	2 – 3	31 – 45%
D	0	0 – 1	46 – 100%
Perennial Non-Saline and Seasonal Estuarine Wetlands			
A	4 – 5	≥ 7	0 – 20%
B	3	5 – 6	21 – 35%
C	1 – 2	3 – 4	36 – 60%
D	0	0 – 2	61 – 100%

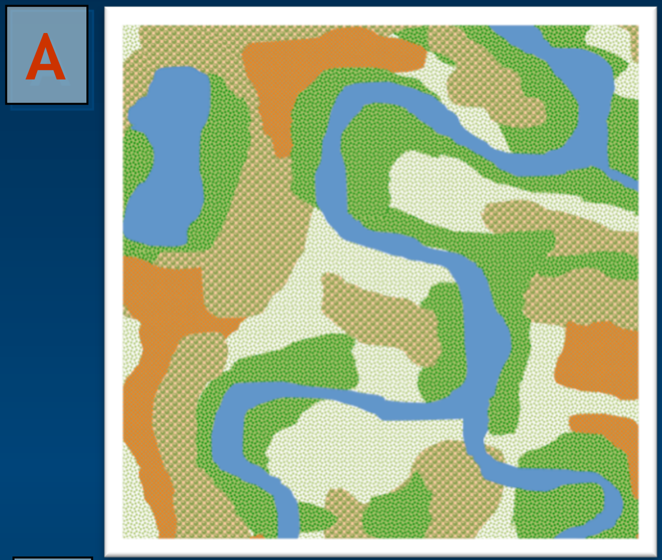
Metric 2: Horizontal Interspersion

(Biotic Structure attribute)

- Variety and interspersion of plant “zones”
- Monocultures or multi-species associations
- Gradients of elevation, moisture, etc.
- Helpful to assign species or zones to diagrams in field book

Field Book Pg. 33

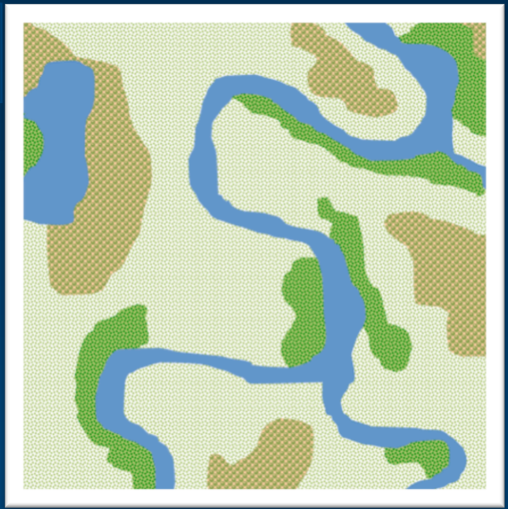
Horizontal Interspersion (Biotic Structure attribute)



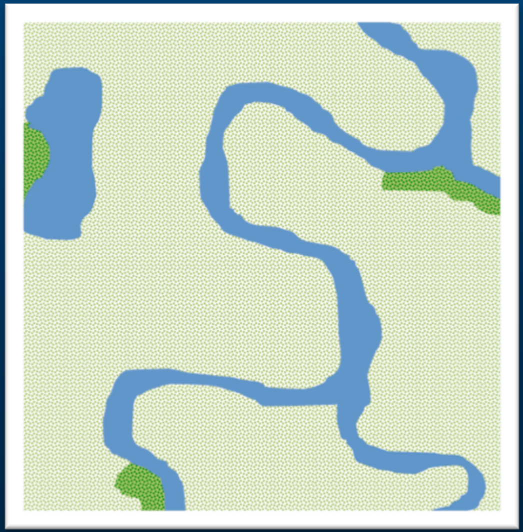
Field Book Pg. 35

Horizontal Interspersion (Biotic Structure attribute)

C



D



Field Book Pg. 35

Example of “A” interspersion

Example of “D” interspersion

Metric 3: Vertical Biotic Structure
(Biotic Structure attribute)

- For estuarine wetlands, assessed as presence and density of a canopy of entrained litter
- Height of litter above the ground at least 10-20 cm
- Provides habitat for faunal species

Field Book Pg. 36

Vertical Biotic Structure (Biotic structure attribute)

Entrained canopy forming a ceiling 10-20 cm above surface

Dense canopy with low ceiling <10-20 cm above surface

Lacking dense canopy

Vertical Biotic Structure (Biotic structure attribute)

Rating	Alternative States
A	**Most** of the vegetated plain of the AA **has** a dense canopy of vegetation, entrained litter or detritus forming a "ceiling" of cover 10-20 cm of above the wetland surface that shades the surface and can provide abundant cover for wildlife.
B	**Less than half** of the vegetated plain of the AA **has** a dense canopy of vegetation, entrained litter or detritus as described in "A" above; OR **More than half** of the vegetated plain **has** a dense canopy of living vegetation, entrained litter or detritus, but the ceiling it forms is **much less** than 10-20 cm above the ground surface.
C	**Less than half** of the vegetated plain of the AA **has** a dense canopy of living vegetation or entrained litter or detritus **AND** the ceiling it forms is **much less** than 10-20 cm above the ground surface.
D	**Most** of the AA **lacks** a dense canopy of living vegetation, entrained litter or detritus.

Field Book Pg. 37

Vertical Biotic Structure (Biotic structure attribute)

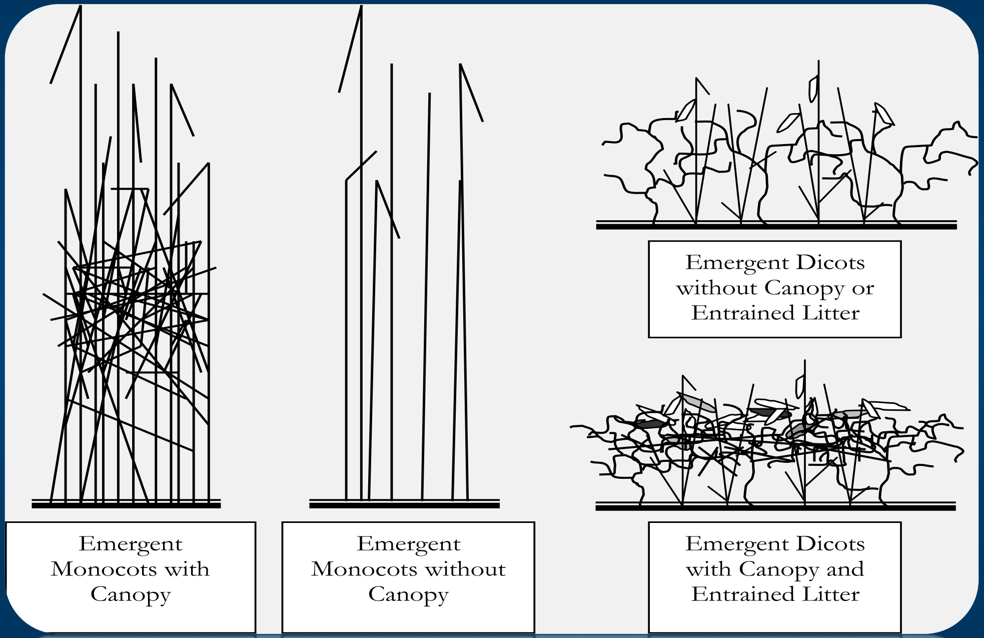


Figure 11: Schematic diagrams of plant canopies and entrained litter used to assess Vertical Biotic Structure in Estuarine wetlands

Tijuana Slough

Example of “D” vertical structure

Example of “A” vertical structure

San Elijo Lagoon

Steps of CRAM Assessment

Step 1: Assemble background information
Step 2: Classify the wetland
Step 3: Verify the appropriate season
Step 4: Sketch the CRAM Assessment Area (AA)
Step 5: Conduct the office assessment of AA
Step 6: Conduct the field assessment of AA
Step 7: Complete CRAM QA/QC
Step 8: Submit assessment results using *e*CRAM

CRAM Initial QA/QC

- Review map of AA
- Review CRAM results
  - Complete all CRAM data fields
- Add comments as needed
- Complete stressor checklist

Basic Information Sheet: Estuarine Wetlands

Basic Information Sheet: Perennial Estuarine Wetlands

CRAM Site ID:

Project Site ID:

Assessment Area Name:

Project Name: | Date (m/d/y)

Assessment Team Members for This AA

Center of AA:

Latitude: Longitude:

Wetland Sub-type:

□ Perennial Saline □ Perennial Non-saline

AA Category:

□ Restoration □ Mitigation □ Impacted □ Ambient □ Reference □ Training

□ Other:

What best describes the tidal stage over the course of the time spent in the field?
Note: It is recommended that the assessment be conducted during low tide.

□ high tide □ low tide

Photo Identification Numbers and Description:

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

1

Field Book Pg. 1

Scoring Sheet: Estuarine Wetlands

Attribute →
Metric →
Metric →
Sub-metric →
Sub-metric →
Sub-metric →
Attribute →
Metric →
Metric →
Metric →
Attribute →
Metric →
Metric →
Attribute →
Sub-metric →
Sub-metric →
Sub-metric →
Metric →
Metric →
Metric →
Overall Index Score →

AA Name:			(m/d/y)
Attribute 1: Buffer and Landscape Context			**Comments**
	Alpha	Numeric	
(D) Aquatic Area Connectivity Score			
Buffer (based on sub-metrics A-C)			
	Alpha	Numeric	
(A submetric) Score for Buffer: Percent of AA with Buffer			
(B submetric) Score for Buffer: Average Buffer Width			
(C submetric) Score for Buffer: Buffer Condition			
Raw Attribute Score = $D+[C \times (A \times B)^{½}]^{½}$ (use numerical value to nearest whole integer)			Final Attribute Score = (Raw Score/24) x 100
Attribute 2: Hydrology Attribute			
	Alpha	Numeric	
Water Source			
Hydroperiod			
Hydrologic Connectivity			
Raw Attribute Score = sum of numeric scores			Final Attribute Score = (Raw Score/36) x 100
Attribute 3: Physical Structure Attribute			
	Alpha	Numeric	
Structural Patch Richness			
Topographic Complexity			
Raw Attribute Score = sum of numeric scores			Final Attribute Score = (Raw Score/24) x 100
Attribute 4: Biotic Structure Attribute			
Plant Community Composition (based on sub-metrics A-C)			
	Alpha	Numeric	
Plant Community submetric A: Number of plant layers			
Plant Community submetric B: Number of Co-dominant species			
Plant Community submetric C: Percent Invasion			
Plant Community Composition (*average of submetrics A-C rounded to nearest whole integer*)			
Horizontal Interspersion			
Vertical Biotic Structure			
Raw Attribute Score = sum of numeric scores			Final Attribute Score = (Raw Score/36) x 100
Overall AA Score (average of four final Attribute Scores)			

Stressor Checklist

- Anthropogenic perturbation within the wetland or in the surrounding landscape with negative impact on condition and function
- Can be "present" or "significant"
- Four assumptions:
  - Stressor(s) can lead to deviation from best attainable condition
  - More stressors can cause a decline in condition
    - Linear, multiplicative, other non-linear model
  - Increase in intensity/proximity increases decline in condition
  - Continuous/chronic stress increases decline in condition

Field Book Pg. 34

Stressor Checklist

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		

Field Book Pg. 39

Steps of CRAM Assessment

Step 1: Assemble background information
Step 2: Classify the wetland
Step 3: Verify the appropriate season
Step 4: Sketch the CRAM Assessment Area (AA)
Step 5: Conduct the office assessment of AA
Step 6: Conduct the field assessment of AA
Step 7: Complete CRAM QA/QC
Step 8: Submit assessment results using *e*CRAM

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California Wetlands

The California Rapid Assessment Method (CRAM) is a standardized, cost-effective tool for assessing the health of wetlands and riparian habitats. CRAM software guides users through assessments that take less than one-half field day to complete. CRAM is applicable to all wetland types. It is designed for assessing ambient conditions within watersheds, regions, and throughout the State. It can also be used to assess the performance of compensatory mitigation projects and restoration projects.

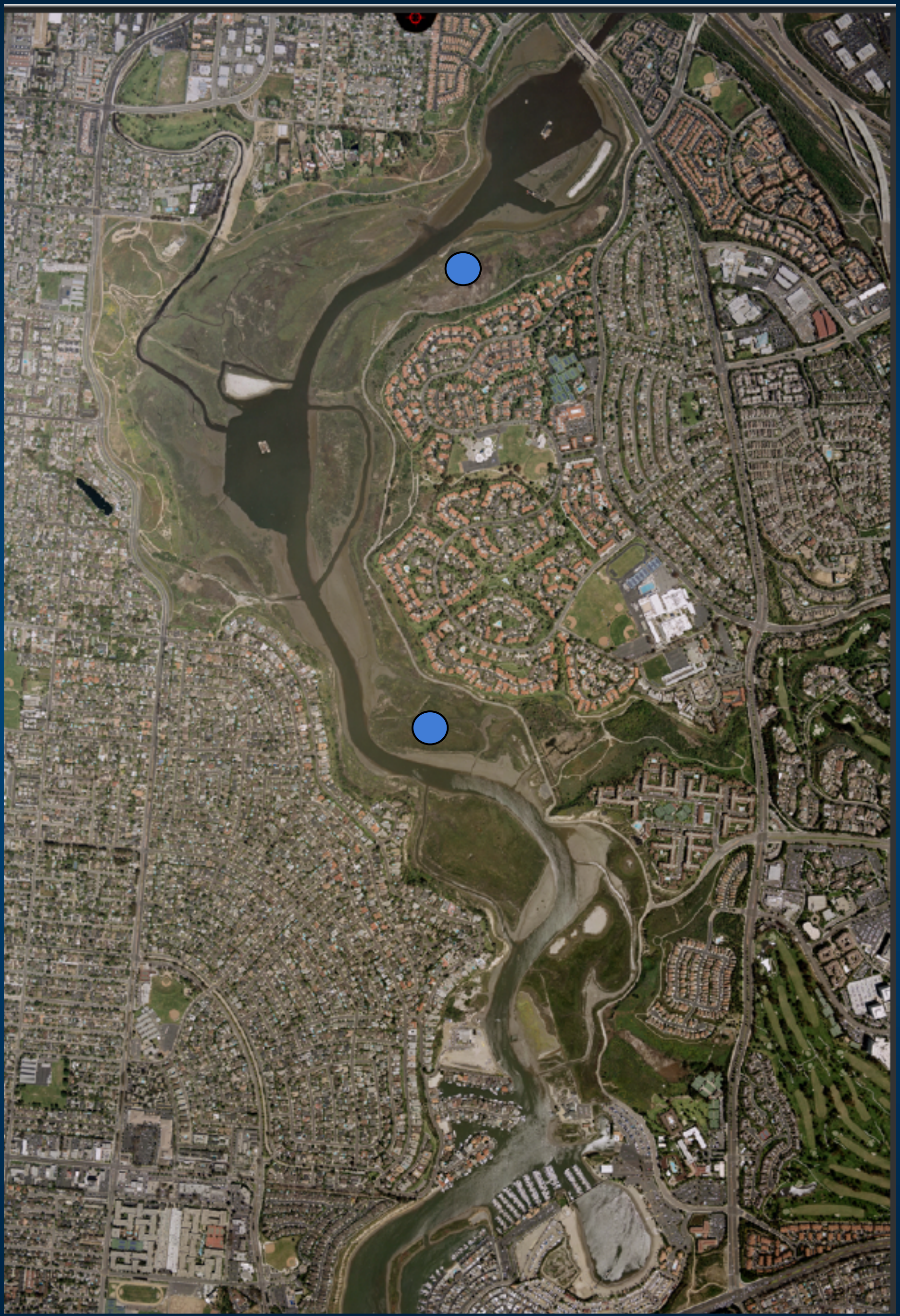
New & Featured

- Version 6.0 of the CRAM method has been released. See Documents
- Technical Bulletin: Using CRAM to Assess Wetland Projects as an Element of Regulatory and Mangement Programs
- Reports on wetlands mitigation available.
- Keep up with the latest CRAM developments. Join the CRAM News mailing list
- Information on **CRAM training**

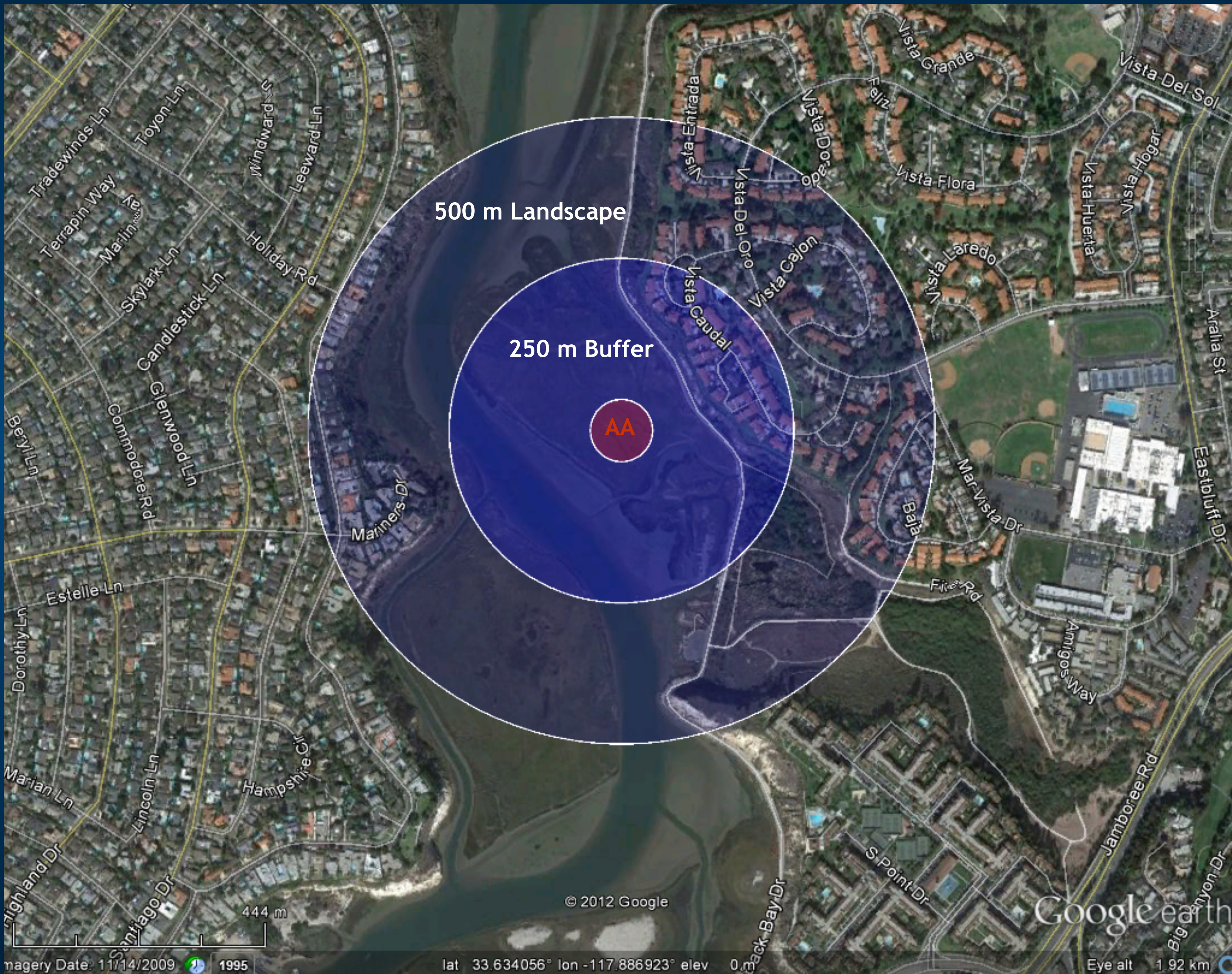
- Read more about CRAM
- Get started with CRAM
- Enter CRAM data on the web
- View CRAM results
- Browse CRAM documents

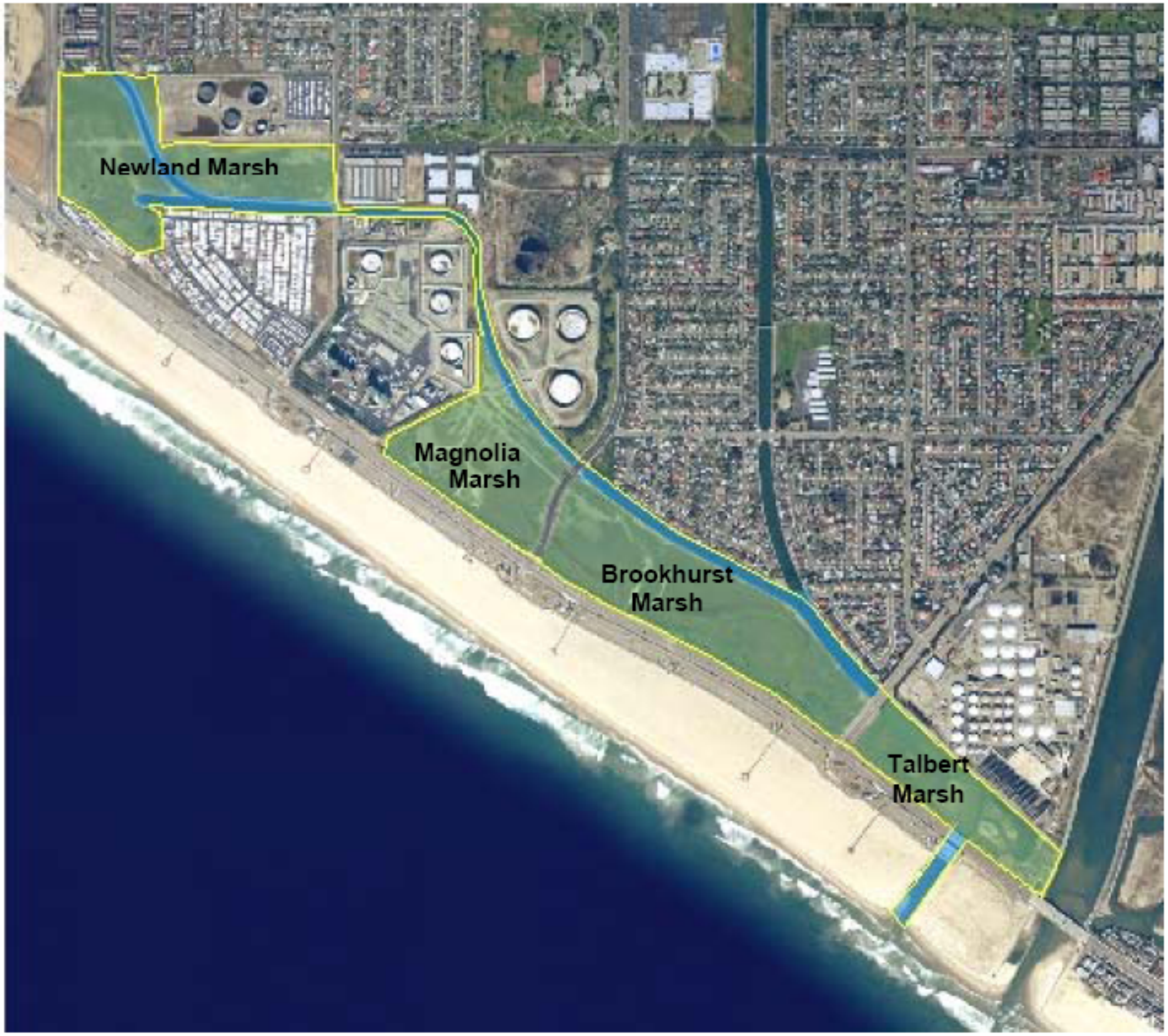
Register here

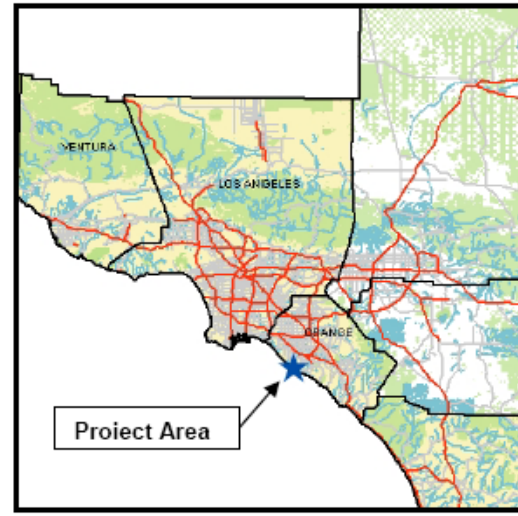
Upper Newport Bay, Newport Beach, CA



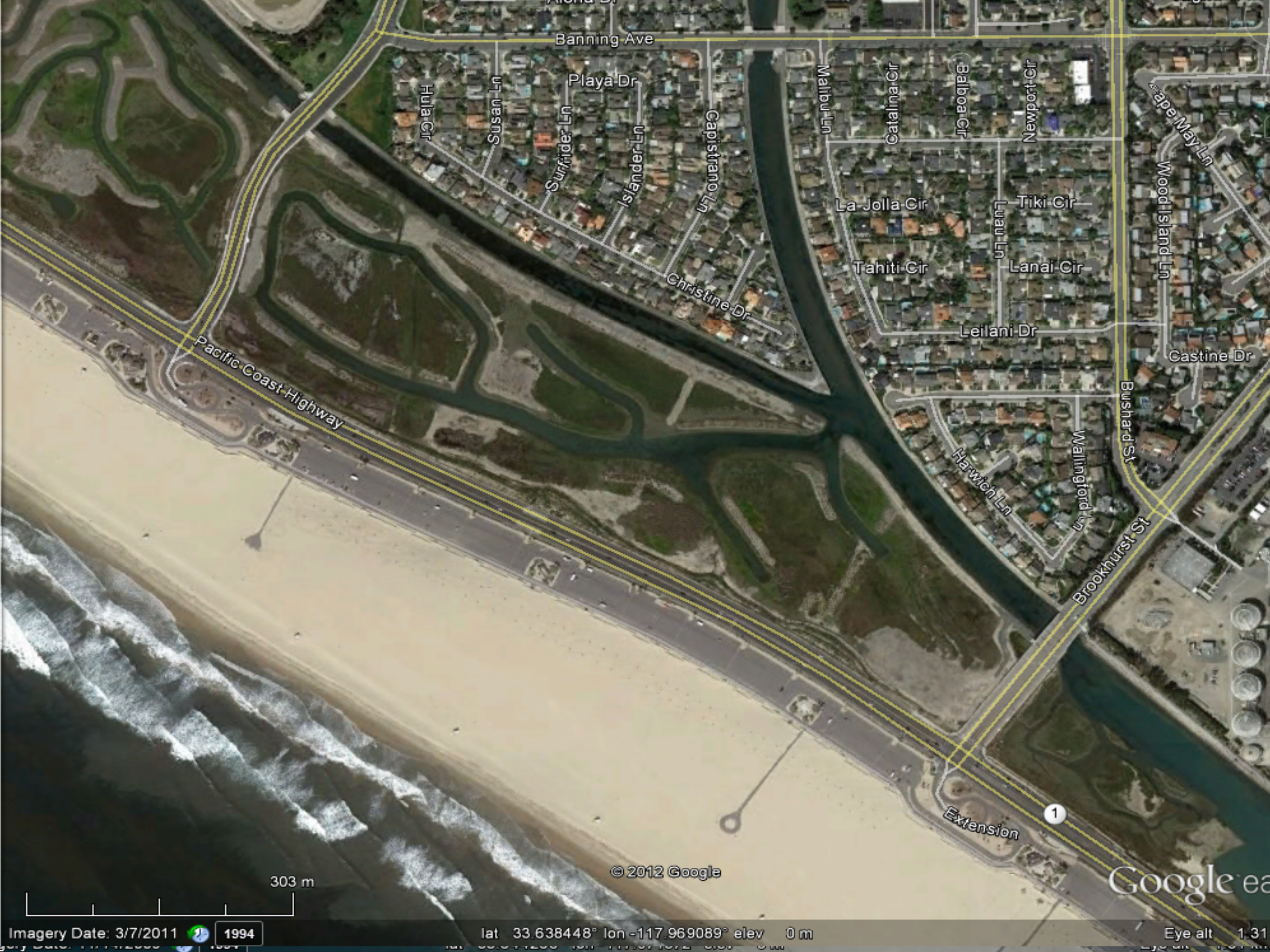
Assess Landscape Context and Buffer at Different Scales







Brookhurst Marsh restoration and channel dredging project completed in 2009


Banning Ave
Playa Dr
Hula Cir
Susan Ln
Surfside Ln
Islander Ln
Capistrano Ln
Malibu Ln
Catalina Cir
Balboa Cir
Newport Cir
Wood Island Ln
La Jolla Cir
Tiki Cir
Luau Ln
Tahiti Cir
Lanai Cir
Christine Dr
Leilani Dr
Castine Dr
Bushard St
Harwich Ln
Wallingford Ln
Brookhurst St
Pacific Coast Highway
Extension
1
© 2012 Google
303 m
Imagery Date: 3/7/2011
1994
lat 33.638448° lon -117.969089° elev 0 m
Eye alt

Aquatic Area Abundance (BLC Attribute)

Brookhurst AA

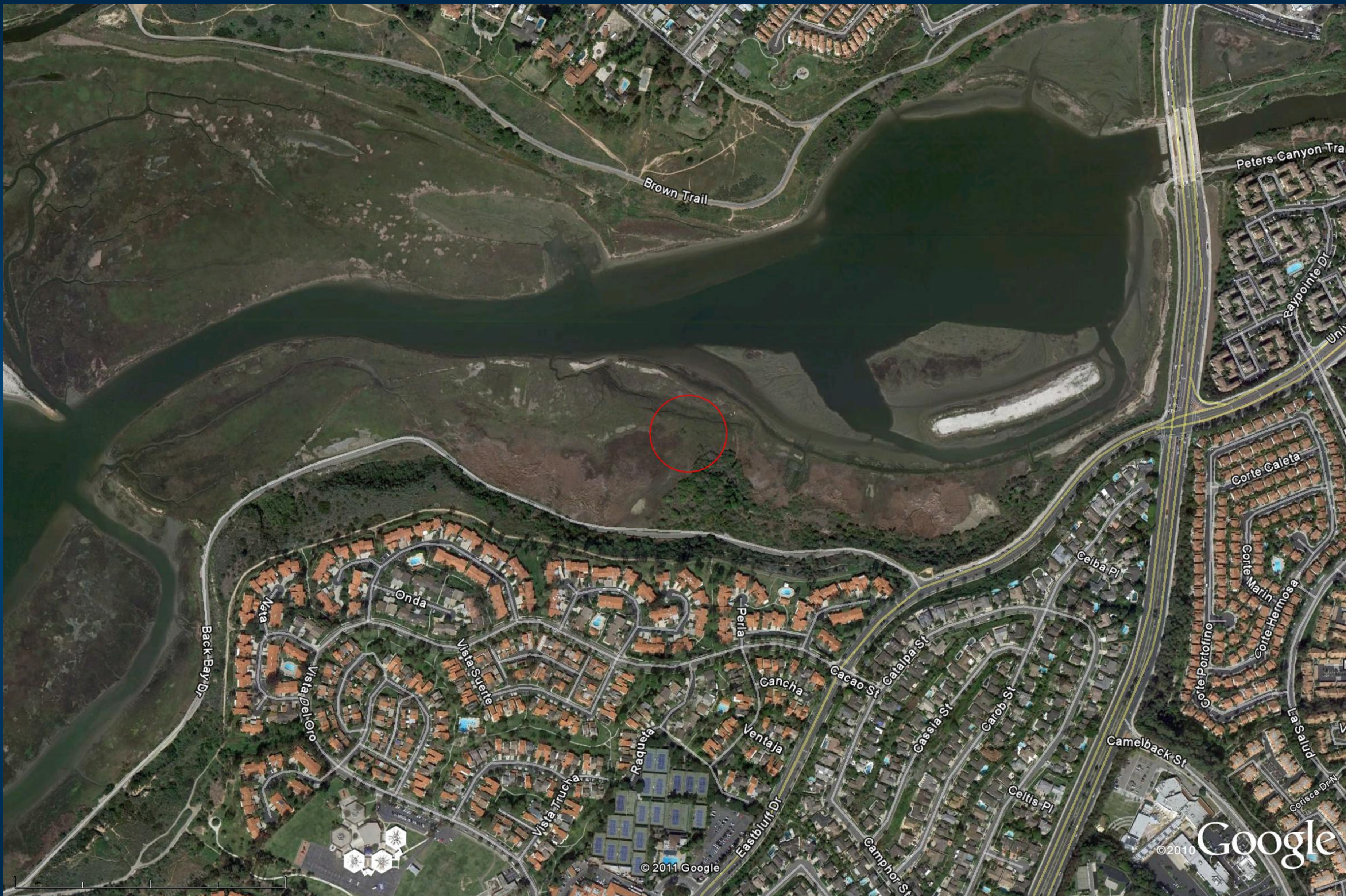
Rating	Alternative States
A	An average of 76-100% of the transects are wetland habitat of any kind
B	An average of 51-75% of the transects are wetland habitat of any kind
C	An average of 26-50% of the transects are wetland habitat of any kind
D	An average of 0-25% of the transects are wetland habitat of any kind

Average Buffer Width (BLC Attribute)

Worksheet for calculating average buffer width of AA

Line	Buffer Width (m)
A	120
B	70
C	80
D	45
E	90
F	70
G	180
H	250
Average Buffer Width	= 113 m

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.



Brown Trail
Peters Canyon Trail
Baypointe Dr
Corte Caleta
Ceiba Pl
Corte Marin
Corte Hermosa
Corte Portofino
Onda
Nata
Perla
Vista Suerte
Cacao St
Catalpa St
Cancha
Back Bay Dr
Vista Del Oro
Ventaja
Cassia St
Carob St
Raqueta
Vista Trucha
Eastbluff Dr
Camphor St
Celtis Pl
Camelback St
La Salud
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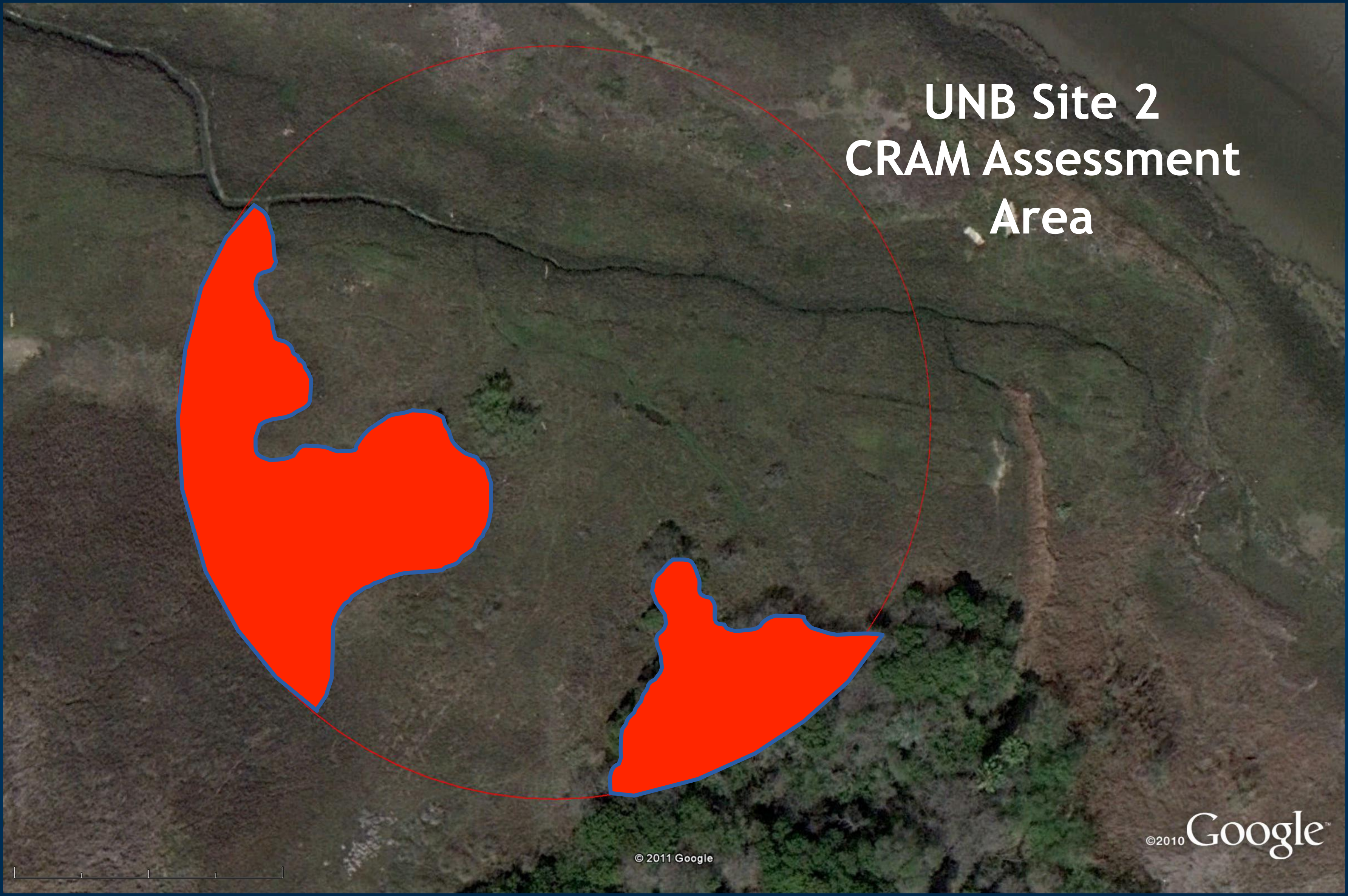
UNB Site 2
CRAM Assessment
Area
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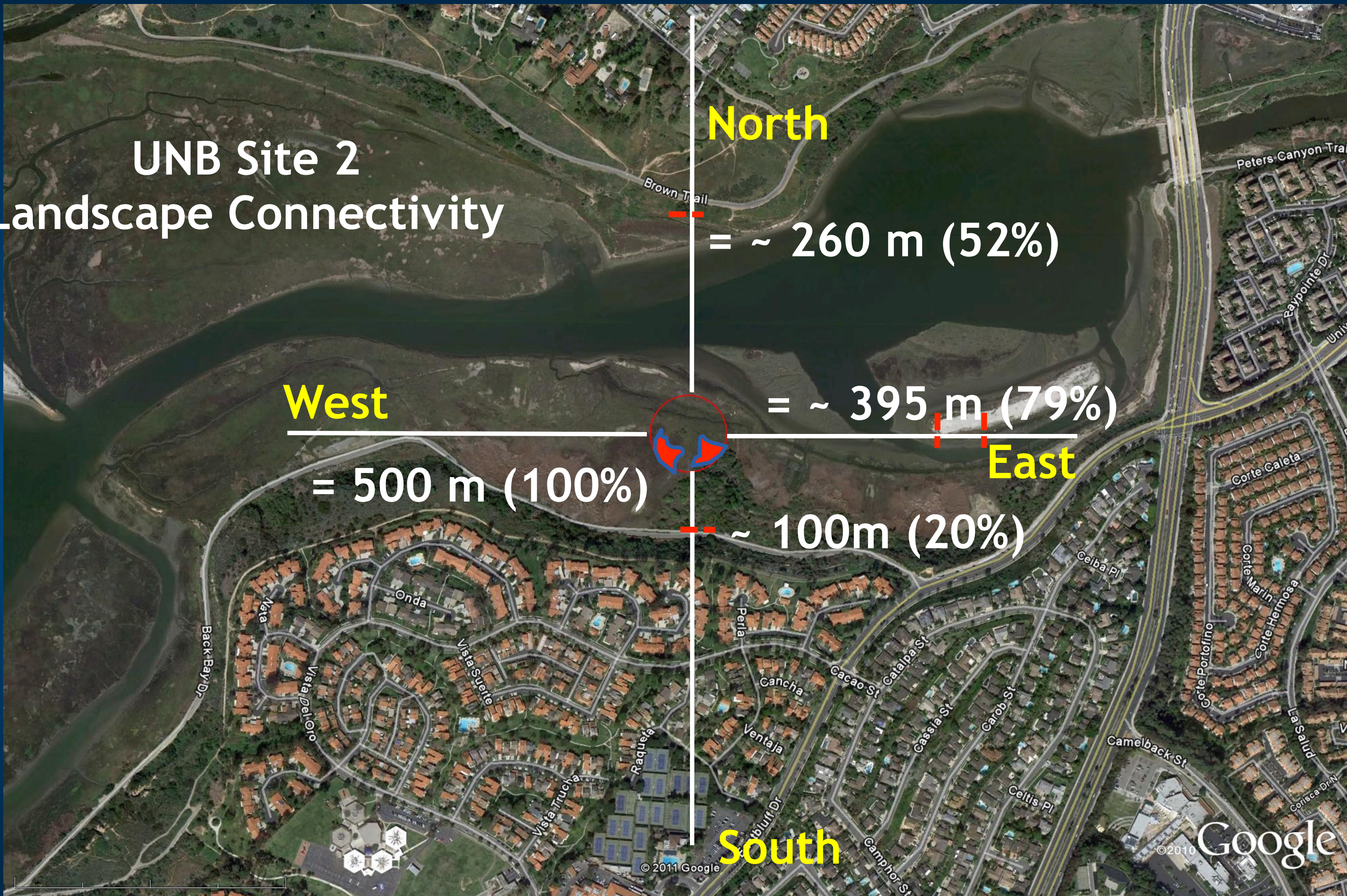
World • United States • CA • Orange Co. • Newport Beach
Old Berm
UNB Site 2 AA
center
Freshwater Drainage
Freshwat
er
Drainage
Freshwater Marsh
Riparian Woodland
© 2011 Microsoft Corporation Pictometry Bird's Eye © 2010 Pictometry International Corp

UNB Site 2 Landscape Connectivity




UNB Site 2
Buffer Width
A =250 m
B
=250 m
H
=250 m
G
=250 m
C
250 m
D
=250 m
E
~130m
F
~200 m
Back Bay Dr
Eastbluff Dr
Onda
Plata
Perla
Vista Quinta
Vista Del Oro
Catalpa St
© 2011 Google
©2010 Google

AA Name: Upper Newport Bay Training Site 2			(m/d/y)	10 / 11 / 2011
Attributes and Metrics		**Scores**		**Comments**
Buffer and Landscape Context Attribute				
Landscape Connectivity Metric (D)		B =9		
Buffer submetric A: Percent of AA with Buffer	A= 12			For the Buffer and Landscape Context Attribute, the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Landscape Connectivity metric using the formula to the left.
Buffer submetric B: Average Buffer Width	A = 12			
Buffer submetric C: Buffer Condition	B =9			
$D + [C \times (A \times B)^{½}]^{½}$ = Attribute Score		Raw: 19	Final: 81	Final Attribute Score = (Raw Score/24)100
Hydrology Attribute				
Water Source Metric		C= 6		Raw Attribute Score for the Hydrology Attribute is calculated as the sum of the numeric scores of the component Metrics
Hydroperiod Metric		A = 12		
Hydrologic Connectivity Metric		B= 9		
Attribute Score		Raw: 27	Final: 75	Final Attribute Score = (Raw Score/36)100
Physical Structure Attribute				
Structural Patch Richness Metric		C= 6		The Raw Attribute Score for the PS Attribute is the sum of the numeric scores of the component Metrics
Topographic Complexity Metric		B=9		
Attribute Score		Raw: 15	Final: 63	Final Attribute Score = (Raw Score/24)100
Biotic Structure Attribute				
Plant Community submetric A: Number of Plant Layers	B = 9			The Raw Attribute Score for the Biotic Structure Attribute is calculated as the sum of the numeric scores of the component Metrics
Plant Community submetric B: Number of Co-dominant species	A= 12			
Plant Community submetric C: Percent Invasion	A = 12			
Plant Community Metric (*average of submetrics A-C*)		11		Prior to calculating the Biotic Structure Raw Attribute Score, average the three Plant Community sub-metrics.
Horizontal Interspersion/Zonation Metric		B=9		
Vertical Biotic Structure Metric		B=9		
Attribute Score		Raw: 29	Final: 81	Final Attribute Score = (Raw Score/36)100
Overall AA Score		81+75+63+81= 300/4= 75		**Average of Final Attribute Scores***

AA Name: Upper Newport Bay Training Site 2		(m/d/y)	10	11	2011
Attributes and Metrics	**Scores**		**Comments**		
Buffer and Landscape Context Attribute					
Landscape Connectivity Metric (D)	B =9		For the Buffer and Landscape Context Attribute, the submetric scores relating to buffer are combined into an overall buffer score that is added to the score for the Landscape Connectivity metric using the formula to the left.		
Buffer submetric A: Percent of AA with Buffer	A= 12				
Buffer submetric B: Average Buffer Width	A = 12				
Buffer submetric C: Buffer Condition	B =9				
D + [C x (A x B)^{½}] ^{½} = **Attribute Score**	Raw: 19	Final: 81	Final Attribute Score = (Raw Score/24)100		
Hydrology Attribute					
Water Source Metric	C= 6		Raw Attribute Score for the Hydrology Attribute is calculated as the sum of the numeric scores of the component Metrics		
Hydroperiod Metric	A = 12				
Hydrologic Connectivity Metric	B= 9				
Attribute Score	Raw: 27	Final: 75	Final Attribute Score = (Raw Score/36)100		
Physical Structure Attribute					
Structural Patch Richness Metric	C= 6		The Raw Attribute Score for the PS Attribute is the sum of the numeric scores of the component Metrics		
Topographic Complexity Metric	B=9				
Attribute Score	Raw: 15	Final: 63	Final Attribute Score = (Raw Score/24)100		
Biotic Structure Attribute					
Plant Community submetric A: Number of Plant Layers	B = 9		The Raw Attribute Score for the Biotic Structure Attribute is calculated as the sum of the numeric scores of the component Metrics		
Plant Community submetric B: Number of Co-dominant species	A= 12				
Plant Community submetric C: Percent Invasion	A = 12				
Plant Community Metric *(average of submetrics A-C)*	11		Prior to calculating the Biotic Structure Raw Attribute Score, average the three Plant Community sub-metrics.		
Horizontal Interspersion/Zonation Metric	B=9				
Vertical Biotic Structure Metric	B=9				
Attribute Score	Raw: 29	Final: 81	Final Attribute Score = (Raw Score/36)100		
Overall AA Score	81+75+63+81= 300/4= 75		**Average of Final Attribute Scores***		