Standard Operating Procedures (3.2): Vegetation Cover Surveys

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Prepared for the United States Environmental Protection Agency

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Standard Operating Procedures:
Vegetation Cover Surveys

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Protocol Suitability Evaluation

A habitat suitability table containing appropriate estuarine wetland habitat types (of those evaluated) to implement vegetation cover protocols is displayed in Table 1. For subtidal or heavily intertidal habitats, use Submerged Aquatic Vegetation cover protocol (SOP 3.1). A comparative assessment of cost, effort, and data quality are shown in Table 2. A matrix of additional detailed categorical evaluations of implement vegetation cover protocols can be found in Appendix 3.2A.

Table 1. Appropriate habitat types by vegetation cover survey protocol.

	Habitat Types					
Survey Protocol	**Tidal Channel**	**Mud/sand flat**	**Emergent salt marsh**	**Non-tidal salt marsh**	**Salt pan**	**'Degraded' / fill**
Point-contact		X	X	X	X	X
Line-intercept		X	X	X	X	X
Cover Class		X	X	X	X	X
Laser Quadrat		X	X		X	

Table 2. Categorical assessment of cost/effort and data quality by vegetation cover survey protocol.

	Evaluation Metric	Point-contact	Line-intercept	Cover Class	Laser Quadrat	Notes
Time / Effort	Office Preparation Time	10-30 minutes	10-30 minutes	10-30 minutes	10-30 minutes	----
	Equipment Construction Time (one time)	10-30 minutes	10-30 minutes	10-30 minutes	> 60 minutes	----
	Field Time (per transect)	10-30 minutes	10-30 minutes	10-30 minutes	30-60 minutes	----
	Laboratory Time	0 minutes	0 minutes	0 minutes	0 minutes	----
	Post-Survey Processing / QAQC Time	10-30 minutes	10-30 minutes	10-30 minutes	10-30 minutes	Post QAQC for species identification may occur
	Minimum Repetition (site-dependent)	Many Repetitions	Many Repetitions	Many Repetitions	Many Repetitions	Fewer repetitions may be conducted in salt pan or lower diversity habitat areas
	Relative Cost (equipment and supplies)	< $15	< $15	< $15	$15 – 50	Laser quadrat is a specialized tool requiring construction
Survey / Data Quality	Accuracy (at a survey area level)	Low	Medium	Medium	High	----
	Precision (at a survey area level)	Low	Medium	Medium	High	May be decreased by wind, especially for laser
	Qualitative-Quantitative Score	Quantitative	Quantitative	Quantitative	Quantitative	----
	Subjectivity-Objectivity Score	Objective	Objective	Subjective	Objective	Subjectivity of cover class may be reduced by calibrations and trainings

Resulting Data Types

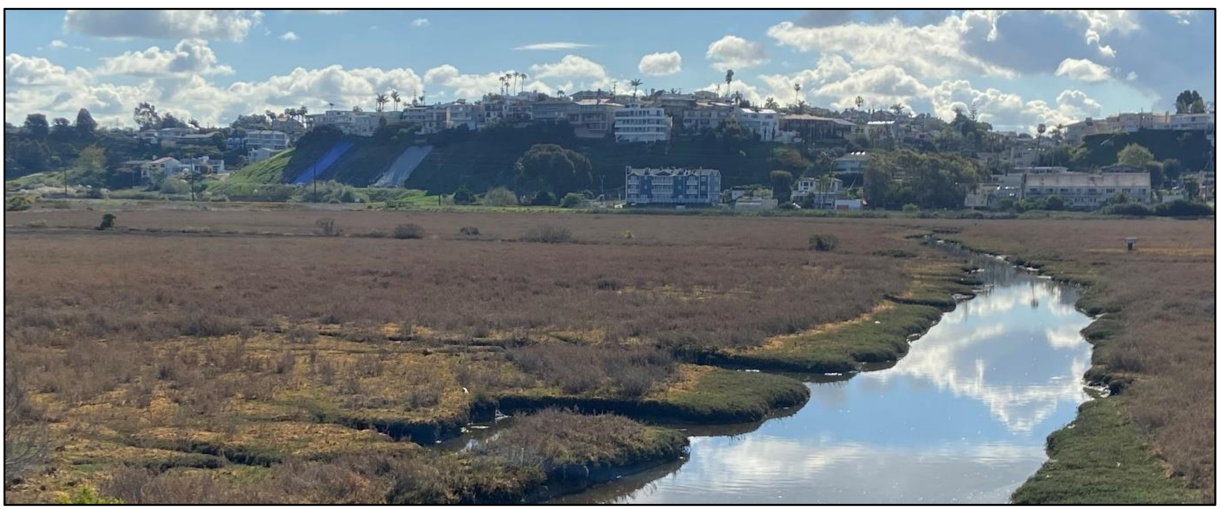
Each of the four cover protocols provide variable quantitative vegetation cover estimates at the quadrat- or transect-level that can be extrapolated up to a habitat- or site-level. Data can be presented by species or grouped for nativity or other considerations/needs. Data can be supplemented by biomass or other biological or physical parameters to evaluate a higher level of habitat function.

Objective

Long-term monitoring of vegetation is one of the most common methods of evaluating the health and functioning of a wetland system (Zedler 2001). Change in the relative presences of native and non-native plant species may affect the distributions of associated wildlife species. Many different approaches have been used to estimate plant species cover, especially for terrestrial vegetation (see review in Murray et al. 2006).

This Standard Operating Procedure (SOP) focuses on four types of cover surveys: point-contact transect, line-intercept transect, cover class quadrat, and laser quadrat. While all methods are based on transects allocated within habitats, they each provide a different degree of accuracy, difficulty, observer bias, and time commitment. All methods can be species-specific (or taxa-specific), and they all collect information on plant cover, live/dead/bare ground cover, plant canopy height, and general site conditions.

Cover surveys can be used to provide a wide range of information and data, including summarizing the prevalence of native and non-native plant cover in each habitat, determining species cover, relative species richness and diversity, and assessing canopy height.



Equipment

Equipment and supplies needed for these surveys varies depending on the specific type of vegetation survey to be conducted. Four types are discussed, including laser quadrat, cover class quadrat, line-intercept transect, and point-contact transect.

Several pieces of equipment are used in all vegetation cover surveys, including:

- 30m-transect tape (*Helpful hint: purchase the ones with both sides in metric units*)
- Meter stick or measuring tape (for vegetation canopy heights)
- Datasheets (Appendices 3.2B – E)
- Vegetation identification field guides (optional) or an electronic guide (e.g., phone app for plant identification)

- GPS equipped with compass (with additional power source if needed)
- GPS-enabled digital camera (preferred) or digital camera or smart phone camera application
- Two, 1m PVC pipes to permanently mark the beginning and ends of each transect (optional)

For the point-contact and line-intercept surveys, the above equipment is all that is needed. Individual surveys use some specialized equipment.

The cover class quadrat survey also requires:

- 1-meter square quadrat divided into 16 smaller squares using string, PVC pipes, and elbow joints (Figure 1)
  Note: quadrat size can be adjusted based on the monitoring program objectives with somewhat comparable results, but it may affect species richness.
- Percent cover calibration guides (Appendix 3.2F)

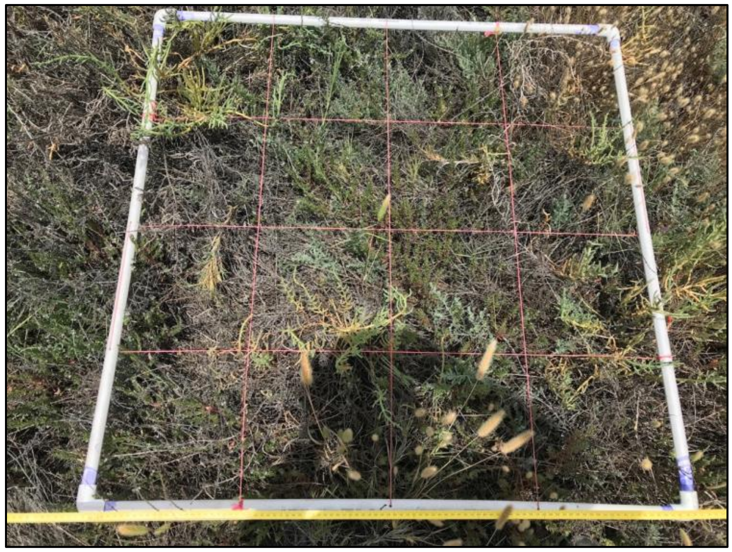


Figure 1. Cover class 1 m^2 quadrat with 16 sub-quadrants for increased accuracy.

The laser quadrat cover survey also requires:

- Laser quadrat (0.5 x 0.5 m square clear plexiglass board with 49 evenly spaced holes drilled through the board; Figure 2)
- Laser pointer; *Helpful hint*: *a weak laser will be very difficult to see on a sunny day; blocking the sun with the observer's body often increases the visibility of the laser in the field*.

Figure 2. Laser quadrat (0.5m x 0.5m) and laser pen with taped holes for increased accuracy.

Field Preparation

Equipment described above should be collected prior to the field shift. Batteries for all electronic devices should be checked and replaced as needed, and relevant data sheets should be printed and attached to the clipboards. Plant surveys should occur annually during the peak biomass season for each habitat type (e.g., estuarine wetland in late summer; Zedler 2001), or more frequently to capture seasonal variability.

The general sampling design consists of identifying distinct marsh zones or habitat types (e.g., low marsh, mid-marsh, upper marsh, etc.) within the site and randomly assigning transects within each zone using Geographic Information System (GIS) software and a stratified sampling design based on area of each habitat. The criteria for creating potential transects are as follows: Transects should be 25 m in length and spaced a minimum of 10 m apart; they should not be placed within 5 m of a zone (habitat) boundary or tidal creek (Ambrose and Diaz 2008) and should not cross the boundary. A random number generator may then be used to select a suggested minimum of three to five transects per habitat. More transects may be allocated to habitats that cover a larger area or that contain a diverse vegetation community to reduce precision error.

The beginning and end points of each transect should be mapped using a GPS (high resolution is recommended), and then permanently identified using thin, UV-resistant PVC piping and a waterproof tag (Figure 3; optional) to easily return to the same sampling location on subsequent trips.

Field Methods

Field methods were based on protocols used in the Ballona Wetlands Baseline Monitoring Program (Johnston et al. 2011, 2012, 2015). Laser quadrat protocols were developed by Dr. Sean Anderson at California State University, Channel Islands. Laser quadrat transects are not recommended in vegetation with an average height greater than approximately 1 meter.

Figure 3. UV-resistant PVC pipe marking the beginning of a vegetation transect.

For all transects, additional vegetation species occurring within 10 m of the transect should be noted on the back of the data sheet (presence, not quantified cover; see Appendices 3.2B – E). A minimum of three points for canopy height and the tallest vegetation height should also be recorded for each transect (see individual transect protocols below). Several additional places for site notes are also included in Appendices 3.2B - E.

For all transects, if the contact or quadrat cover is not plant tissue, the ground type should be recorded as bare ground, trash, wrack, or wood (as appropriate). Trash is defined as man-made debris, and wrack is defined as dead organic material. Algae on top of plants should be noted as present for each location, removed to reveal the plant tissue below, and not included in percent cover estimates (Ambrose and Diaz 2008); *Cuscuta salina* (salt marsh dodder) should be recorded similarly.

All transects begin by deploying the 25 m-transect tape between the permanent PVC pipes or GPS locations.

Point-contact Transects

Point-contact transects document every species observed below the transect tape at a set distance between points (e.g., every 20 cm). A minimum of 100 points per transect is recommended. The minimum length can be increased (i.e., fewer points) to reduce time commitment per transect, but this will also reduce the accuracy and precision of the average vegetation cover. Diverse plant habitats (e.g., transition zones) should record more points to increase accuracy.

The transect tape should be straightened between transect beginning and end points. If vegetation occurs below the top of the transect tape (i.e., if the tape is stretched taught and the vegetation is several inches below), then the first species (or ground type if no vegetation is present) that comes in contact with a hypothetical vertical line straight down from that point on the transect should be recorded (Ambrose and Diaz 2008). Canopy heights should also be recorded for plants every few meters. A minimum of four or five measurements are recommended per transect, as well as a maximum canopy height and species identification for each transect. A point-contact transect datasheet for transect with 20 cm point distances is shown in Appendix 3.2B.

Line-intercept Transects

Line-intercept transects are similar to point-contact. The transects document every species observed directly below the transect tape where the vegetation crosses a minimum of 0.01 m in length (the minimum length can be increased to reduce time commitment per transect, but this will also reduce precision). The start and end points are recorded on the datasheet (e.g., 1.05 – 1.22 m) as well as the species identification and whether the species is living or dead.

The transect tape should be straightened between transect beginning and end points. If vegetation occurs below the top of the transect tape (i.e., if the tape is stretched taught and the vegetation is several inches below), then the first species (or ground type if no vegetation is present) that comes in contact with a hypothetical vertical line straight down from that point on the transect should be recorded (Ambrose and Diaz 2008). Canopy heights should also be recorded for plants every few meters. A minimum of four or five measurements are recommended per transect, as well as a maximum canopy height and species identification for each measurement. A line-intercept transect datasheet is shown in Appendix 3.2C.

Cover Class Transects

The cover-class quadrat allows for surveys of taller vegetation and a more rapid assessment of the plant community in a given area. This survey method is based on the Daubenmire (1959) cover-class system using a 7-point scale (Table 3; Appendix 3.2F). Five to ten quadrats can be completed along each transect, depending on the degree of variability of the vegetation along the transect (higher variability = more quadrats). If quadrats are randomly assigned, they should be allocated by a random number generator (Excel is one option) prior to field deployment. If the quadrats are 'fixed', then the same meter marking can be used on every transect.

Surveys should be conducted using 1 m^2 PVC quadrats (Figure 1) subdivided into 16 sub-quadrats to increase the accuracy of cover estimates (Daubenmire 1959). Because canopies of different strata (e.g., grasses, shrubs) may overlap and the cover is broken down into classes, these cover estimates may total more than 100% (Ambrose and Diaz 2008), unlike the laser-based quadrat cover estimates. Each species (and whether it is alive or dead) should be recorded as one cover class. A cover class transect datasheet for a transect with seven quadrats is shown in Appendix 3.2D.

Table 3. Cover categories and associated cover class identification numbers used in the BAP surveys (modified from Daubenmire 1959).

Estimated cover category	Cover class
> 0 - 1 %	1
> 1 - 5 %	2
> 5 - 25 %	3
> 25 - 50 %	4
> 50 - 75 %	5
> 75 - 95 %	6
> 95 - 100 %	7

Three intersections of the sub-quadrats should be randomly chosen, and the plant species identity and height recorded as a measure of canopy for that quadrat. The overall tallest plant species and height should also be recorded for each quadrat to characterize maximum canopy height. Observers tend to generally think about cover estimates in terms of rounded numbers to the nearest 5 or 10 (K. Johnston, personal observation). Thus, it is very important to have the discussion in the field about whether the actual cover is more or less than the cover class boundary value (e.g., “5” or “25”). If agreed that the cover is less, then it should stay in that category, if it is higher than the boundary number, then it should be bumped up to the next higher cover class.

Alternate Cover Estimate Methods

In addition to the method described above for the cover-class quadrat (“Canopy Cover Method”), there is another method identified here. The Canopy Cover Method recommends a total cover estimate for each species regardless of whether it is in the top canopy layer or not. In some cases, one vegetation species will overlap another, and the above method will capture total cover for both species (Figure 4). As an alternate, some monitoring programs assess overall aerial cover (“Aerial Cover Method”), which does not account for canopy overlap (Figure 4). The results produced are not transferrable between methods, except for total cover / bare ground. The Canopy Cover Method produces more accurate total estimates of cover by species, but the Aerial Cover Method can be quality control checked from visuals such as aerial or on-site photographs. Both produce similar types of data outputs.

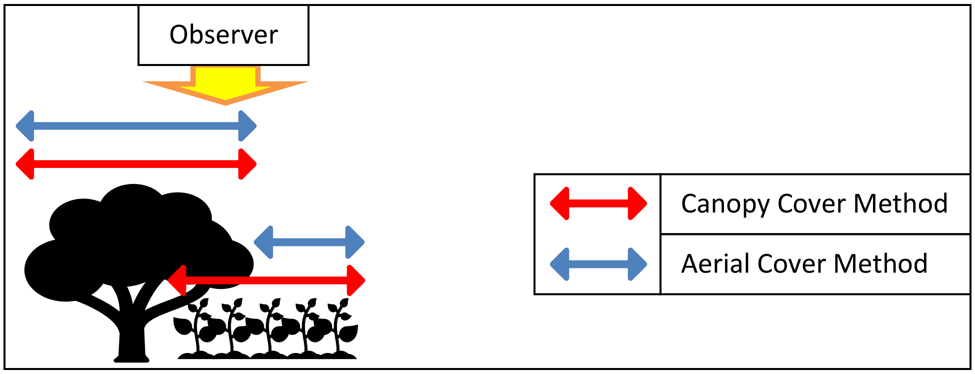


Figure 4. Graphic showing two methods of cover estimation for vegetation.

Additionally, as an alternate to the cover-class method, some programs like to make exact cover estimates in the field of each species. For example, if a plant species had an estimated 17% cover within a quadrat, instead of the 5-25% category being recorded on the data sheet, it would be the exact value (i.e., 17%). These data, while more precise, are often less accurate. They also often require specialized trainings or field calibration days with full teams doing "blind" calibration estimates (independent from one another), and then comparing to make sure all individual estimates are within a comfortable error margin of each other. However, the benefit of this exact cover estimate method is that exact percentages can be analyzed in the data and are then comparable to the cover-class estimates once transformed (which can be done as a post-processing data transformation into the categories). With large data sets, either method can be performed with similar grand mean averages for the analyses, but usually larger error bars for the cover-class estimates.

Laser Quadrat Transects

For all salt marsh habitats, where the average vegetation height is less than 1 m, the laser quadrat method can be utilized to demarcate exact points (Figure 5). The laser quadrat reduces observer bias and can be used to determine average percent cover. Five to ten quadrats can be completed along each transect, depending on the degree of variability of the vegetation along the transect (higher variability = more quadrats). If quadrats are randomly assigned, they should be allocated by a random number generator (Excel is one option) prior to field deployment. If the quadrats are 'fixed', then the same meter marking can be used on each transect. A laser quadrat transect datasheet for a transect with seven quadrats is shown in Appendix 3.2E.

Figure 5. Photo of an example laser quadrat transect.

A portable 0.5 x 0.5 m (0.25 m^2) Plexiglas™ board (Figure 2), supported by three independently adjustable legs, is positioned parallel to the substrate and leveled at each quadrat starting meter point along the transect (the left corner of the Plexiglas™ board should be placed on the transect starting meter point, to maintain consistency throughout the survey) (Shuman and Ambrose 2003, Ambrose et al. 2006, S. Anderson, pers. comm.). The board design is a modified pin-drop cover board with a downward shining laser pointer taking the place of the rod or pin that would make contact and define a single contact point. A laser pointer should be inserted successively into each of the 49 evenly distributed points in a 7 x 7 grid so that the laser beam points in a direction perpendicular to the substratum. This method is much faster than traditional pin-drop methods, does not disturb the architecture of the canopy (particularly important to surveying vegetation with vertical gramminoid-morphology or with interwoven stems and leaves), and is observer-independent. Species should be further delineated as either living or dead. *Note: If the laser beam happens to shine on two independent pieces of vegetation, then the top illuminated species is the only one recorded*.

Within each quadrat, three of the 49 points should be randomly sampled for canopy height (these should be marked in advance with tape to avoid observer bias). At each of the three points, the plant height and species identity are recorded. Additionally, the plant height and species identity should be recorded for the tallest plant within the 0.5 x 0.5 m quadrat area (to nearest cm) as a measure of maximum canopy height.

Laboratory Methods

Not applicable. Vouchers from the field should be pressed for later identification.

Data Entry and QAQC Procedures

Data should be entered in the field using the appropriate data sheet (Appendices 3.2B – E). All required fields should be completed in full, and the data recorder should assign their name at the top of the document(s). Data should be transferred to the appropriate electronic database within three days, and the hard copies filed in labeled binders. Electronic copies of all data should be housed on an in-house dedicated server and backed up to a cloud-based or off-site server nightly. Hard copies should be saved for five years. Electronic copies should be saved indefinitely.

Quality Assurance and Quality Control (QAQC) procedures should be conducted on all data. QAQC procedures should be conducted by the QA Officer and include a thorough review of all entries, double checking of all formulas or macros, and a confirmation that all data sheets, Chain-of-Custody forms, and field notes are filed appropriately with electronic back-up copies available. QAQC should verify that the entered data match the hard copies of the field data sheets. Any discrepancies should be corrected, and the initial data entry technician notified.

Data Analyses

After data have been entered, corrections made, and QAQC procedure completed, data can be used in multiple analyses. Examples include bar graphs with native and non-native cover comparisons, spatial analyses based on maps of averages across each transect or habitat, species lists or richness, and many more. Individual analyses for each transect type should be completed as follows:

Point-contact and Line-intercept Transects

Point-contact data should be summed as the number of points for each species per transect and then divided by the total number of points per transect to determine percent cover by transect (per species). Line-intercept data should be summed by species and divided by the total length of the transect to determine percent cover for each transect and habitat.

Cover Class Transects

Species data should be analyzed using the median of each Daubenmire cover category and averaged to determine percent cover within each transect and/or habitat. Variability should be represented as standard deviation or error. If using the exact cover estimate method for your analyses, no data transformation is needed (i.e., median of the cover class). However, to compare data using both methods, the exact cover estimate method must then be binned into the cover class categories and the median used similar to above. Data can not be transformed the other way (i.e., turning binned data into exact percentages). With large data sets, either method can be performed with similar grand mean averages for the analyses, but usually larger error bars for the cover-class estimates (K. Johnston and C. Whitcraft, unpublished data).

Laser Quadrat Transects

Percent cover is analyzed as the proportion of points (out of a total of 49) hitting a particular plant species. Plant cover can be averaged by transect and then again by habitat type. Variability should be represented as standard deviation or error.

Health and Safety Precautions

Not applicable.

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Contact Information

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APPENDIX 3.2A

	Evaluation Metric	Point-contact	Line-intercept	Cover Class	Laser Quadrat	Notes
	Correlation to L2 CRAM	Attribute 4	Attribute 4	Attribute 4	Attribute 4	----
Personnel Requirements	Specialty Equipment or Clothing Required	No Specialty Items	No Specialty Items	No Specialty Items	Few Specialty Items	Laser quadrat
	Ease of Transport (amount or weight of supplies)	Few Items / Easy	Few Items / Easy	Few Items / Easy	Some Items / Moderate	----
	Ease of Implementation	Moderate	Moderate	Moderate	Moderate	Easy implementation within salt pan habitats
	Expertise / Skill Level	Some Technical Knowledge	Some Technical Knowledge	Some Technical Knowledge	Some Technical Knowledge	Familiarity with species identifications is required
	Number of Personnel	2	2	2	2	----
	Training Requirements	None	None	None	None	Calibration between team members may be necessary for subjective surveys
	Seasonality of Survey Time	Late summer	Late summer	Late summer	Late summer	Seasonality of 'Degraded' / fill habitat areas is site dependent
	Suggested Frequency	Annual	Annual	Annual	Annual	Annual or herbaceous habitats may require more
Survey / Data Quality	Type of Output	Numerical	Numerical	Numerical	Numerical	----
	Active or Passive Monitoring Style	Passive	Passive	Passive	Passive	----
	Specialty Computer Software Required	No	No	No	No	----
	Availability of Online / External Resources	Many	Many	Many	Few	Many online and print media are also available to assist with species identifications
Potential Limitations	Wetland Type Applicability	All	All	All	All	Dependent on vegetation height
	Images or Multi-Media Required	Images Required	Images Required	Images Required	Images Required	----
	Degree of Impact / Disturbance	Low Disturbance	Low Disturbance	Low Disturbance	Low Disturbance	----
	Vegetation Height Limitation	Overhead (~2m)	Overhead (~2m)	Overhead (~2m)	Low Vegetation Only (< 1 m)	----
	Appropriate for Tidal / Wet Habitats	Yes	Yes	Yes	Yes	See category below
	Tide Height	Low Tide Only	Low Tide Only	Low Tide Only	Low Tide Only	Submersion of low-lying vegetation will skew numbers and not allow for accurate estimates
	Regional or Broad Implementation *	Frequently Used	Frequently Used	Almost Always Used	Infrequently Used	** based on monitoring literature review*
	Potential for Hazards / Risk	Low to No Risk	Low to No Risk	Low to No Risk	Low to No Risk	----
	Restrictions	Special status species	Special status species	Special status species	Special status species	----

APPENDIX 3.2B

VEGETATION SAMPLING DATA SHEET – POINT CONTACT

Sampling Program Information		**NOTES:**
DATE:	HABITAT:	
TIME (start): (end):	FID #: _________	**SITE:**
STAFF:	PAGE: _____ of _____	**WEATHER:**

METER	SPECIES	D/L	METER	SPECIES	D/L	METER	SPECIES	D/L
0.20			8.00			15.80		
0.40			8.20			16.00		
0.60			8.40			16.20		
0.80			8.60			16.40		
1.00			8.80			16.60		
1.20			9.00			16.80		
1.40			9.20			17.00		
1.60			9.40			17.20		
1.80			9.60			17.40		
2.00			9.80			17.60		
2.20			10.00			17.80		
2.40			10.20			18.00		
2.60			10.40			18.20		
2.80			10.60			18.40		
3.00			10.80			18.60		
3.20			11.00			18.80		
3.40			11.20			19.00		
3.60			11.40			19.20		
3.80			11.60			19.40		
4.00			11.80			19.60		
4.20			12.00			19.80		
4.40			12.20			20.00		
4.60			12.40			20.20		
4.80			12.60			20.40		
5.00			12.80			20.60		
5.20			13.00			20.80		
5.40			13.20			21.00		
5.60			13.40			21.20		
5.80			13.60			21.40		
6.00			13.80			21.60		
6.20			14.00			21.80		
6.40			14.20			22.00		
6.60			14.40			22.20		
6.80			14.60			22.40		
7.00			14.80			22.60		
7.20			15.00			22.80		
7.40			15.20			23.00		
7.60			15.40			23.20		
7.80			15.60			23.40		

APPENDIX 3.2B

METER	SPECIES	D/L	METER	SPECIES	D/L
23.60			24.40		
23.80			24.60		
24.00			24.80		
24.20			25.00		

Height at 5m:
SPS:

Height at 10m:
SPS:

Height at 15m:
SPS:

Height at 20m:
SPS:

MAX HEIGHT:
SPS:

NOTES:

SOIL COND'N:	
SOIL TYPE:	

ADDT'L SPECIES:

TARGET SPECIES:

CROSS:
WATER? Y / N **ROAD?** Y / N

CHAIN OF CUSTODY			
NAME	**DATE**	**TIME**	**ACTION**
			Recorded
			Data Folder
			Entered
			QAQC

APPENDIX 3.2C

VEGETATION SAMPLING DATA SHEET - LINE INTERCEPT

Sampling Program Information		**NOTES:**
DATE:	HABITAT:	
STAFF:	FID #: ______	**SITE:**
TIME (start): (end):	PAGE: _____ of _____	**WEATHER:**

	Start	End	SPECIES	D/L		Start	End	SPECIES	D/L
1					40				
2					41				
3					42				
4					43				
5					44				
6					45				
7					46				
8					47				
9					48				
10					49				
11					50				
12					51				
13					52				
14					53				
15					54				
16					55				
17					56				
18					57				
19					58				
20					59				
21					60				
22					61				
23					62				
24					63				
25					64				
26					65				
27					66				
28					67				
29					68				
30					69				
31					70				
32					71				
33					72				
34					73				
35					74				
36					75				
37					76				
38					77				
39					78				

APPENDIX 3.2C

	Start	End	SPECIES	D/L
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				
101				
102				
103				
104				
105				
106				
107				
108				
109				
110				
111				
112				
113				
114				
115				
116				
117				
118				
119				
120				

SOIL COND'N:	
SOIL TYPE:	

ADDT'L SPECIES (10m):

TARGET SPECIES:

CROSS: Y / N **ROAD?** Y / N

Height at 5m:
SPS:

Height at 10m:
SPS:

Height at 15m:
SPS:

Height at 20m:
SPS:

MAX HEIGHT:
SPS:

NOTES:

CHAIN OF CUSTODY			
NAME	DATE	TIME	ACTION
			Recorded
			Data Folder
			Entered
			QAQC

APPENDIX 3.2D

VEGETATION SAMPLING DATA SHEET - 25m *% COVER* TRANSECT				**NOTES:**
DATE:	PHOTO: Y / N	HABITAT:		
TIME (start):	(end):	FID #: ________		**SITE:**
FIELD LEAD:		PAGE: _____ of _____		**WEATHER:**
DATA RECORDER:	ADDITIONAL STAFF:			
*****Quadrats on the Right*****		*Cover Classes A:[0-1] B:[1-5] C:[5-25] D:[25-50] E:[50-75] F:[75-95] G:[95-99]*		

QUADRAT: 1 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 2 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 3 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 4 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 5 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 6 METER: PHOTO: Y / N

SPECIES	**DEAD %**		**LIVE %**	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

APPENDIX 3.2D

QUADRAT: 7 METER: PHOTO: Y / N

SPECIES	DEAD %		LIVE %	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

Dominance within 20m:		
Cover:	Native (>50%) ☐	Non-Native (<50%) ☐

Soil Condition/ Texture:

SPECIES W/IN 10m:

______ ______ ______ ______

______ ______ ______ ______

______ ______ ______ ______

______ ______ ______ ______

______ ______ ______ ______

______ ______ ______ ______

TARGET SPECIES:

CROSS CHANNEL?	Y / N	ROAD?	Y / N

SITE DESCRIPTION:

CHAIN OF CUSTODY			
NAME	DATE	TIME	ACTION
			Recorded
			Data Folder
			Entered
			QAQC

ADDT'L NOTES:

APPENDIX 3.2E

VEGETATION SAMPLING DATA SHEET -LASER QUADRAT TRANSECT				NOTES:
DATE:	PHOTO	HABITAT:		
TIME (start):	(end):	FID #: ________		SITE:
FIELD LEAD:		PAGE: _____ of _____		WEATHER:
RECORDER:	ADDITIONAL STAFF:			
***Quadrats on the Right**				

QUADRAT: 1 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 2 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 3 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 4 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 5 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

QUADRAT: 6 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

APPENDIX 3.2E

QUADRAT: 7 METER: PHOTO: Y / N

SPECIES	LIVE	DEAD	TOTALS	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
			/	
BARE GROUND				
HEIGHTS	1st	2nd	3rd	Max
HT Species	1st	2nd	3rd	Max
Dead/Live	D / L	D / L	D / L	D / L

Dominance within 20m:		
Cover:	Native (>50%) ☐	Non-Native (<50%) ☐

Soil Condition:

SPECIES W/IN 10m:

TARGET SPECIES:

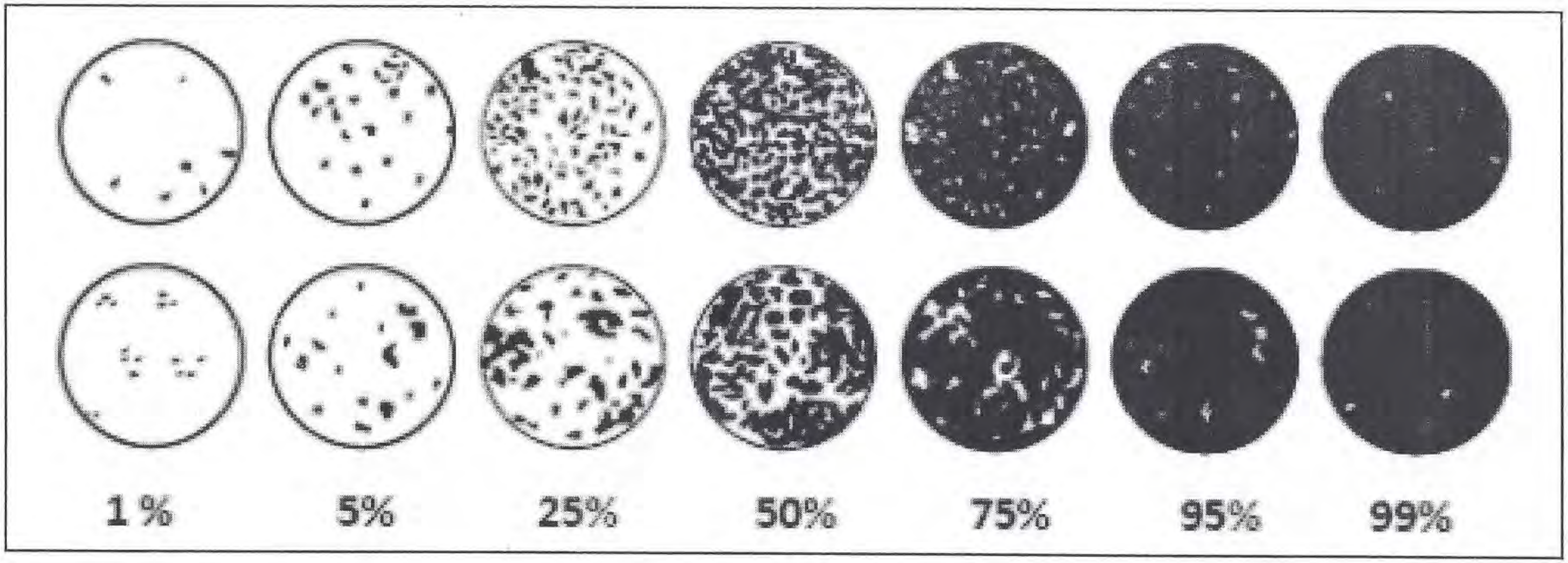
CROSS CHANNEL? Y / N	ROAD? Y / N

SITE DESCRIPTION:

CHAIN OF CUSTODY			
NAME	DATE	TIME	ACTION
			Recorded
			Data Folder
			Entered
			QAQC

ADDT'L NOTES:

APPENDIX 3.2F



Excerpted from Daubenmire 1959.