Ecological Integrity Assessments of Sites Sampled for EPA's National Wetland Condition Assessment

Results Summary in Support of EPA Award No. I-01J83801

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1.0 Introduction

The National Wetland Condition Assessment (NWCA) is an ongoing project of the US Environmental Protection Agency (EPA) that tracks the status and trends of wetlands across the United States. Washington Department of Ecology (DOE) staff collaborated with Washington Natural Heritage Program to sample 32 wetlands as part of the 2021 round of NWCA data collection. NWCA is considered a level 3 monitoring method in EPA's three-tiered framework (https://www.epa.gov/wetlands/wetlands-monitoring-and-assessment). In addition to the NWCA protocols, field staff applied a pair of level 2 rapid assessments of wetland function and condition. Function was assessed via the Washington Wetland Rating System (Hruby, 2014a, 2014b), while condition was estimated using Ecological Integrity Assessment methodology (Rocchio et al., 2020a). Level 2 assessments are designed for rapid application and employ relatively qualitative metrics compared to a level 3 protocol. The benefit of the three-tiered framework, however, is that level 3 results may be used to validate and calibrate level 2 protocols. By applying each of these protocols at the wetlands targeted in the 2021 NWCA sampling, this project will improve our understanding of the resolution and calibration of these commonly used level 2 methods.

While DOE staff were responsible for applying the Wetland Rating System at each site, WNHP ecologists conducted EIA sampling. The EIA method (Faber-Langendoen et al., 2016a, 2016b, 2016c, 2016d, 2019; Rocchio et al., 2020b, 2020c) aims to measure the ecological integrity of a site through a standardized and repeatable assessment of current ecological conditions. Condition is assessed relative to expectations for an ecosystem occurrence operating within the bounds of natural variation. The EIA enables a user to rapidly assess and communicate the composition, structure, and function of an ecosystem occurrence through an index of ecological integrity, which in turn aids in identifying conservation value, management effects, restoration success, and more. The EIA standardizes expert opinion and existing data up front, enabling the user to apply the EIA in a rapid manner to estimate a site's ecological integrity. The EIA improves our understanding of current ecological conditions, leading to more effective and efficient use of available resources for ecosystem protection, management, and restoration efforts.

This report represents a summary of EIA data collected at NWCA sample sites during the 2021 field season. Supplementary Floristic Quality Assessment (FQA) data are also provided (Rocchio & Crawford, 2013) along with a summary of new and revised element occurrences (EOs) (NatureServe, 2002) documented by WNHP staff in the course of NWCA sampling.

1.1 Project Scope

Study sites (n = 32) were selected by EPA using a Generalized Random Tesselation Stratified design (GRTS; Stevens Jr & Olsen, 2003), along with an oversample list. NWCA is a nationwide assessment with samples stratified across various wetland types. This approach selects a disproportionate number of estuarine sample sites in WA and other coastal states, in order to reach nationwide sample size targets in each of those categories. Sites were distributed across 6 of the 9 ecoregions in Washington, with no sampling occurring in the Blue Mountains, East Cascades, or West Cascades (Figure 1).

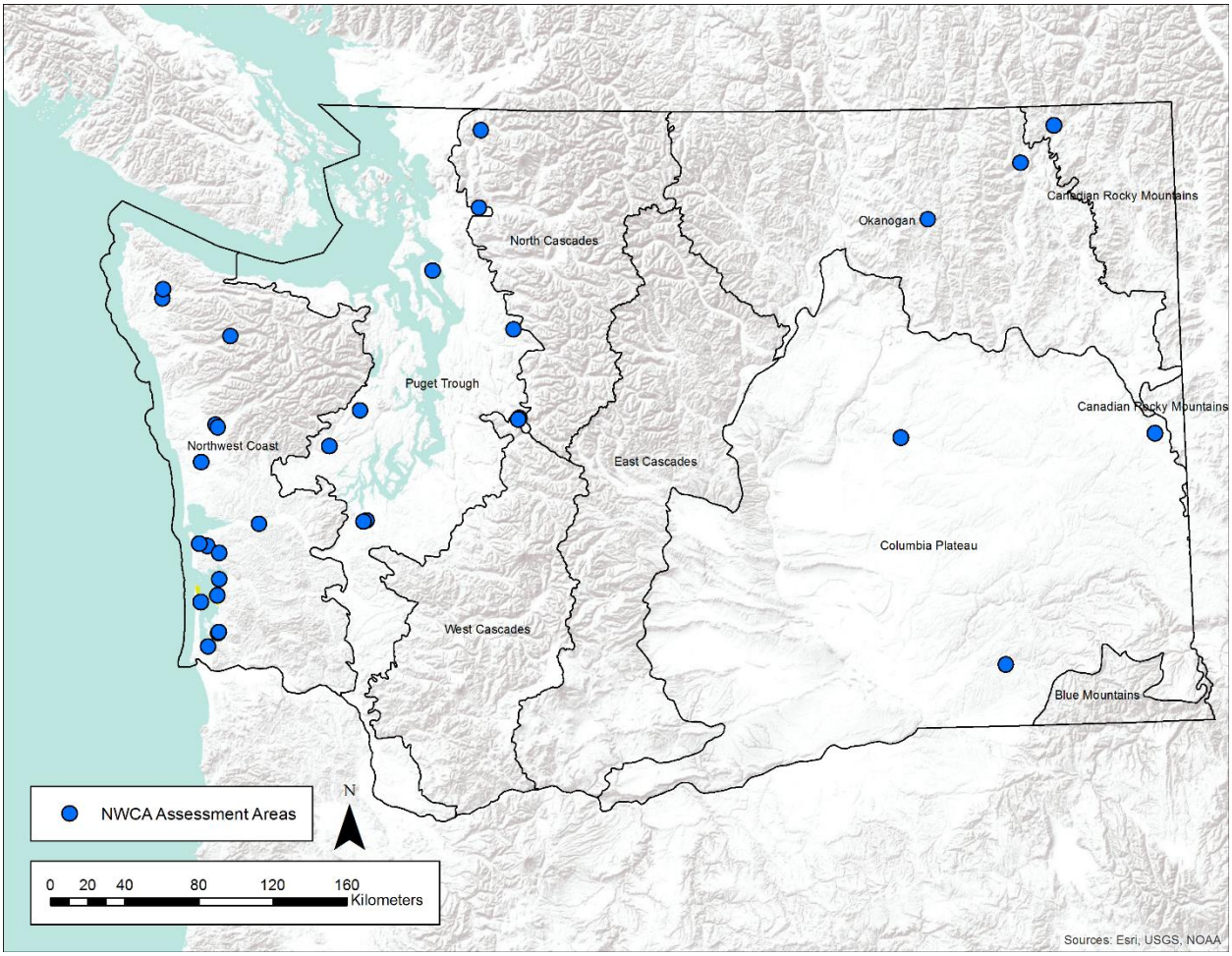

Figure 1. Project Scope. EIAs were conducted within all 32 NWCA assessment areas.

2.0 Methods

2.1 EIA Overview

Ecological integrity may be defined as "an assessment of the structure, composition, function, and connectivity of an ecosystem as compared to reference ecosystems operating within the bounds of natural or historical disturbance regimes" (Parrish et al., 2003; Faber-Langendoen et al., 2016c, 2016d). Ecological Integrity Assessments (EIA) summarize the ecological integrity of individual occurrences of ecosystems through consideration of composition, structure, and ecological processes (Faber-Langendoen et al., 2019; Rocchio & Ramm-Granberg, 2019). The method can be applied to occurrences as small as 0.05 ha and as large as thousands of hectares. EIAs can be conducted at three different sampling intensities: Level 1 (entirely GIS-based), Level 2 (rapid, mostly qualitative, field-based), and Level 3 (intensive, quantitative, field-based). We used level 2 methods in this project.

The EIA is intended to measure current ecological condition as compared to a reference standard via a multi-metric index of biotic and abiotic measures of condition, size, and landscape context. Each metric is rated by comparing measured values with expected values under relatively unimpaired conditions (i.e. the reference standard), and the ratings are aggregated into a total score. Unimpaired is defined as the lack of deviation from the natural range of variability due to human-induced stressors. The EIA uses a scorecard matrix to communicate individual metric ratings, as well as an overall index of ecological integrity. All together, the EIA framework provides a standardized language for assessing and communicating ecosystem integrity across all terrestrial ecosystem types—upland and wetland ecosystems.

Classification is critical to both the development and application of an EIA. By constraining natural variability, classification helps to clarify whether differences in ecological condition are natural or anthropogenic. Developing ecological integrity indicators requires an understanding of the characteristic structure, composition, and processes of a wide variety of ecosystem types. By classifying ecosystem types, ecologists can account for the natural variability *within types* and thereby make the differences *between occurrences* of a given type more recognizable. In other words, classification helps differentiate between signal (indicators of degradation) and noise (natural variability). Classifications are important for establishing "ecological equivalency"—particularly important for setting restoration targets and benchmarks. EIA methods can be adapted to any number of classification schemes and ecoregional frameworks. The EIA used in this project is primarily based on wetland subgroups, a modification of the U.S. National Vegetation Classification (USNVC) created by WNHP (Rocchio & Ramm-Granberg, In Progress).

The metrics used in the wetland/riparian EIA (Table 1) are presented below. Detailed information on the metrics and the methodology used to score them may be found in Rocchio et al. (2020a). Each metric is scored with a letter rating between A and D, with an "A" indicating no deviation from the reference standard for that metric and a "D" indicating severe deviation from the standard. Once scored, metrics may be rolled up into major ecological factor scores/ranks (e.g., landscape, buffer/edge, vegetation, hydrology, soils, and size). These major ecological factor scores are in turn rolled up into three primary rank factors: landscape context, condition, and size. Lastly, these three factors may then be integrated to calculate an overall EIA Rank (landscape context +

condition) and EO Rank (EIA score + size). These different roll-up procedures are optional and dependent on the project objective.

The EIA Rank summarizes the overall current ecological integrity of the stand (useful for prioritizing restoration or management actions). Similar to the metric ratings, an "A" EIA Rank indicates a wetland operating well within the natural range of variability, while a "D" ranked wetland is well outside that natural range due to anthropogenic stressors. The integration of size into the EO Rank is useful for prioritizing sites for conservation, since larger stands are generally considered more important and more likely to retain their integrity than smaller occurrences. For more targeted insight into management needs, goals, and measures of success, land managers may have more interest in specific metric scores. In the middle ground, primary and/or major ecological factor scores/ranks can be helpful for understanding the current status of primary ecological drivers. For example, a site may score very poorly in vegetation metrics, but have intact hydrology, indicating potential for restoration.

Table 1. Wetland and Riparian EIA Metrics

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
LANDSCAPE CONTEXT	LANDSCAPE	**LAN1 Contiguous Natural Cover** (0-500 m)	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		LAN2 Land Use Index (0-500 m)	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
	BUFFER	**BUF1 Perimeter with Natural Buffer**	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		BUF2 Width of Natural Buffer Width	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
		BUF3 Condition of Natural Buffer	Office then field check	All Types (not for use with sub-AAs or most point-based AAs)
CONDITION	VEGETATION	**VEG1 Native Plant Species Cover**	Field	All Types (not for use with sub-AAs or most point-based AAs)
		<u>*Submetrics*</u>*:* *VEG1a. Tree Stratum*		Flooded & Swamp Forest Formation
		VEG1b. Shrub/Herb Stratum		All Types
		VEG2 Invasive Nonnative Plant Species Cover	Field	All Types
		VEG3 Native Plant Species Composition	Field	All Types
		<u>*Submetrics*</u>*:* *VEG3a. Native Diagnostic/Functional Species*		See USNNVC Subgroup descriptions for guidance
		VEG3b. Native Species Diversity		See USNNVC Subgroup descriptions for guidance
		VEG3c. Native Increasers		See USNNVC Subgroup descriptions for guidance
		VEG3d. Native Decreasers		See USNNVC Subgroup descriptions for guidance
		VEG4 Vegetation Structure	Field	All Types (variant differs by USNVC Formation)
		VEG4, variant 1		Flooded & Swamp Forest Formation
		<u>*Submetrics*</u>*:* *VEG4 var1a. Canopy/Subcanopy Age Class diversity*		
		VEG4 var1b. Old/Large Live Trees		

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
		VEG4, variant 3		Freshwater Marsh, Wet Meadow and Shrubland Formation
		VEG4, variant 4		Salt Marsh Formation
		VEG4, variant 5		Bog and Fen Formation
		Submetrics: *VEG4 var5a. Tree Structure*		
		VEG4 var5b. Shrub/Herb Structure		
		VEG4 var5c. Bryophyte Structure		
		VEG4, variant 6		Aquatic Vegetation Formation
		VEG5. Woody Regeneration	Field	Flooded & Swamp Forest Formation
		VEG6 Coarse Woody Debris	Field	Flooded & Swamp Forest Formation and optional for shrub-dominated types
		VEG6, variant 1		Forested Wetlands
		Submetrics: *VEG6 var.1a. CWD Size Diversity*		
		VEG6 var.1b. CWD Decay Class Diversity		
		VEG6 var.1c. Snag Size Diversity		
		VEG6 var.1d. Snag Decay Class Diversity		
		VEG6, variant 2		Non-forested Wetlands
		Submetrics: *VEG6 var2a. Litter Source*		
		VEG6 var2b. Litter Accumulation		
	HYDROLOGY	**HYD1 Water Source**	Field & Office	All Types (varies by HGM Class)
		HYD1, variant 1		Riverine (non-tidal)
		HYD1, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD1, variant 3		Depression, Lacustrine, Slope
		HYD1, variant 4		Estuarine Fringe (tidal)
		HYD2 Hydroperiod	Field	All Types (varies by HGM)
		HYD2, variant 1		Riverine (non-tidal)
		HYD2, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD2, variant 3		Depression, Lacustrine, Slope
		HYD2, variant 4		Estuarine Fringe (tidal)
		HYD3 Hydrologic Connectivity	Field	All Types (varies by HGM)
		HYD3, variant 1		Riverine (non-tidal)

Primary Rank Factor	Major Ecological Factor	Metric/Variant NAME	Where Measured	Apply to:
		HYD3, variant 2		Organic Soil Flats, Mineral Soil Flats
		HYD3, variant 3		Depression, Lacustrine, Slope
		HYD3, variant 4		Estuarine Fringe (tidal)
	SOIL	**SOI1 Soil Condition**	Field	All Types (variant differs by USNVC Formation)
		SOI1, variant 1		Flooded and Swamp Forest, Freshwater Marsh, Wet Meadow and Shrubland (nontidal), Bog and Fen, and Aquatic Vegetation formations.
		SOI1, variant 2		Salt Marsh Formation and Freshwater Marsh, Wet Meadow, and Shrubland (tidal) Formation
SIZE	SIZE	**SIZ1 Comparative Size (Patch Type)**	Office then field check	All Types (ratings vary by patch type); not for use with sub-AAs or points
		SIZ2 Change in Size (optional)	Office then field check	All Types (not for use with sub-AAs or points)

2.2 EIA Field Work

2.2.1 Assessment Areas

The Assessment Area (AA) is the spatial area in which the assessment is applied. Default NWCA assessment areas were 0.5 ha circular plots. Wetland-boundary or non-standard AAs were established whenever the site did not meet NWCA 2021 site evaluation guidelines for circular plots (US Environmental Protection Agency, 2021).

For EIAs, the AA is "the entire area, subarea, or point of an occurrence" of an ecosystem type "with a relatively homogeneous ecology and condition" (Faber-Langendoen et al., 2016a,b,c). In Washington, EIAs are most frequently applied to polygon-based assessment areas. With polygon-based AAs, the entirety of a wetland ecosystem occurrence is usually evaluated, so long as it does not span multiple USNVC formations or HGM classes (Brinson, 1993). This method is most useful for evaluating individual wetlands. In this project, point-based EIA assessment areas were used in order to align with NWCA methodology. Point-based AAs are used for assessing the ecological condition of populations of wetlands (as NWCA does).

It was frequently necessary to subdivide NWCA AAs into smaller EIA AAs that did not span multiple USNVC formations (e.g. shrubland AND forest) or HGM classes (e.g. slope AND depressional wetland). In such cases, each EIA AA within the larger NWCA AA was assessed separately. EIA AAs still had to meet minimum assessment area sizes as outlined in Rocchio et al. (2020a). At sites where potential EOs were identified, an additional, separate AA was established in order to evaluate the full extent of the occurrence, extending beyond the NWCA AA (see Section 2.2.3). These data have been kept separate and will not be used for any statistical analyses.

2.2.2 Data Collection

Within each EIA assessment area, WNHP staff traversed the area to ensure that the full extent of ecological variation was observed. EIA metrics were then scored based on protocols and rating criteria in the EIA manual (Rocchio et al., 2020a). Species lists and ocular cover estimates were collected using a site walkthrough approach covering the full extent of the AA (not the smaller, more intensive relevés used by the NWCA crew). Depending on access restrictions, the area outside of the AA was also observed to assist with buffer metrics. Landscape context and size metrics were finalized via GIS assessments in the office.

2.2.3 Sites Meeting 'Element Occurrence' Criteria

WNHP documented several new element occurrences (EOs) in the course of NWCA sampling and many existing EOs were also revisited. EOs are specific sites or stands of a given ecosystem type that have significant conservation value (NatureServe, 2002). In the context of the Wetland Rating System, EOs are known as "Wetlands of High Conservation Value" (WHCV).

Occurrences are prioritized for inclusion in WNHP's database based on a combination of two ranks: the conservation status rank (CSR) and the element occurrence rank (EO Rank) (https://www.dnr.wa.gov/NHPmethods). The CSR establishes how rare and threatened that *ecosystem* is across its global and subnational (i.e. state) range. The EO Rank integrates the EIA rank and Size score for a specific *occurrence* of the ecosystem (Rocchio et al., 2020a). The EIA and EO Ranks range from "A" (excellent ecological integrity) to "D" (poor ecological integrity). A decision matrix (Table 2) is then used to determine whether the occurrence meets the criteria for an EO. Essentially, most occurrences of rare ecosystem types, regardless of their condition, are

considered EOs, while more common ecosystem types must be in good to excellent condition to receive that designation.

Table 2. Decision matrix for identifying WNHP element occurrences (EOs).

<table>
<tr><th rowspan="2">EORANK</th><th>Global Rank</th><td rowspan="2">G1S1, G2S1, GNRS1, GUS1</td><td rowspan="2">G2S2, GNRS2, G3S1, G3S2, GUS2</td><td rowspan="2">GUS3, GNRS3, G3S3, G4S1, G4S2, G5S1, G5S2, any SNR</td><td rowspan="2">G4S3, G4S4, G5S3, G5S4, G5S5, GNRS4, GNRS5, GUS4, GUS5</td></tr>
<tr><th>State Rank</th></tr>
<tr><td colspan="2">A+ (3.8 to 4.0)</td><td>EO</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">A- (3.5 to 3.79)</td><td>EO</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">B+ (3.0 to 3.49)</td><td>EO</td><td>EO</td><td>EO</td><td rowspan="4">Not an Element Occurrence</td></tr>
<tr><td colspan="2">B- (2.5 to 2.99)</td><td>EO</td><td>EO</td><td>EO</td></tr>
<tr><td colspan="2">C+ (2.0 to 2.49)</td><td>EO</td><td>EO</td><td rowspan="2">Not an Element Occurrence</td></tr>
<tr><td colspan="2">C- (1.5 to 1.99)</td><td>EO</td><td rowspan="2">Not an Element Occurrence</td></tr>
<tr><td colspan="2">D (1.0 to 1.49)</td><td>EO</td></tr>
</table>

2.3 Data Analysis and Storage

WNHP uses an automated Microsoft Excel EIA workbook to calculate rolled-up major ecological factors, primary rank factors, and overall EIA scores. Metric ranks, comments, and calculations (buffer widths, etc.) are entered into this workbook. Raw metric scores, calculated scores, and associated comments are stored in individual worksheets within the workbook. Field forms will be scanned and stored on DNR servers. EIA AA and EO shapes/locations are stored in a file geodatabase (Table 3). EO information is also stored in WNHP's Biotics database. A selection of that information is publically available via WNHP's Wetlands of High Conservation Value Map Viewer (https://www.dnr.wa.gov/NHPwetlandviewer).

Table 3. WNHP attribute fields used in EIA feature classes

Feature Class	Field	Definition
AA_EIA	AA_ID	The unique identifier of the EIA assessment area
	NWCA_siteID	The ID code for the NWCA site in which the EIA assessment area was located
NWCA_EOs	PA	Abbreviation for the USNVC plant association represented by the element occurrence
	ELCode	USNVC (http://www.usnvc.org) code associated with the association entered in "PA"
	AA	The unique identifier of the EIA assessment area used for this EO. This is usually the same as "AA_ID" in the AA_EIA feature class, so long as all of the scores and comments recorded for the point-based EIA AA also pertained to the full EO polygon. In one location, scores varied between the point-based AA and the larger polygon-based AA used for EOs. In that case, I created a record ("10281-EO") separate from the point-based EIA AA ("10281-AA"). New EOs found nearby—but not overlapping with NWCA AAs—are also included in this feature class. One pre-existing EO overlaps with multiple NWCA AAs.
	New_Existing	New = Previously undocumented EO Existing = Documented EO. No change to boundary or substantial change to EO Rank Expanded Existing EO = Expanded the boundary of a documented EO EO-Quality, but data sensitive = Ecosystem occurrence meets the requirements for inclusion as an EO, but has been excluded from our public database for data sensitivity reasons
	EO ID	Unique EO identifier in WNHP's Biotics database

2.4 FQA Analysis

Floristic Quality Assessment (FQA) is an approach based on the concept of plant conservatism in which vegetation composition is used to assess ecological condition (Rocchio & Crawford, 2013). Plant species with high "c-values" are "restricted to intact ecosystems where ecological processes functions, composition, and structure have not been…degraded/modified by human stressors" (Rocchio & Crawford, 2013). Species with low c-values tolerate or even benefit from anthropogenic disturbance. Some FQA indices are somewhat sensitive to variation in sample area (Francis et al., 2000; Matthews, 2003; Matthews et al., 2005), but the consistent point-based assessment areas used in this project largely negated that consideration. As a supplement to the EIA data, we calculated FQA indices for the species lists collected in each assessment area (Table 4).

Table 4. Definitions of FQA indices and other plant composition summaries

Metric	Notation	Definition
Mean C (native species)	$\bar{C}n$	$\sum Ci \div N$
Mean C (all species)	$\bar{C}all$	$\sum Cj \div S$
Mean C (native trees)	$\bar{C}ntrees$	Same as $\bar{C}n$ except limited to native tree species
Mean C (native shrubs)	$\bar{C}nshrubs$	Same as $\bar{C}n$ except limited to native shrub species
Mean C (native herbaceous)	$\bar{C}nherbs$	Same as $\bar{C}n$ except limited to native herbaceous species
FQAI (native species)	FQI*n*	$\bar{C}n * \sqrt{N}$
FQAI (all species	FQI*all*	$\bar{C}all * \sqrt{S}$
Adjusted FQAI*	AFQI	$\left\{\frac{\bar{C}n}{10} * \frac{\sqrt{N}}{\sqrt{S}}\right\} * 100$
% intolerant (C value ≥ 7)	$\bar{C}n \geq 7$	Same as $\bar{C}n$ except limited to species with C values ≥ 7
% tolerant (C value ≤ 3)	$\bar{C}n \leq 3$	Same as $\bar{C}n$ except limited to species with C values $n \leq 3$
Species richness (all species)	S	Total number of all (native + nonnative) vascular plant species
Species richness (native species)	N	Total number of native vascular plant species
% nonnative		Percentage of nonnative species relative to S
Wet Indicator (all species)	$\overline{WI}all$	$\sum WIj \div S$
Wet Indicator (native species)	$\overline{WI}n$	$\sum WIi \div N$
% hydrophytes		% of species with wetland indicator status of OBL or FACW relative to S
% native perennial		% of native perennial species relative to S
% native annual		% of native annual species relative to S
% annual		% of annual species relative to S
% perennial		% of perennial species relative to S
% native forbs		% of native forb species relative to S
% native graminoids		% of native graminoid species relative to S

Notation: i = individual native species; j = individual species (native or nonnative); N = native species richness; S = total species richness (native and nonnative); WI = numeric wetland indicator status as follows: OBL/OBL*(-5), FACW+(-4), FACW*(-3), FACW(-3), FACW-(-2), FAC+(-1), FAC*(0), FAC(0), FAC-1(+1), FACU+(+2), FACU*(+3), FACU(+3), FACU-(-4), UPL (5)

3.0 Results

3.1 EIA

The 32 NWCA AAs were subdivided into a total of 42 EIA assessment areas, distributed across 19 USNVC subgroups (Table 5). Table 5 summarizes the distribution of ratings (i.e. A/A-, B, C/C, D) across the full suite of EIA metrics.

Table 5. EIA Assessment Areas, Classification, and EIA Results.

NWCA AA	EIA AA	Site Name	HGM Class	Cowardin System/ Subsystem + Class/ Subclass	USNVC Subgroup	Landscape Context MEF Rank	Condition MEF Rank	Overall EIA Rank
NWC21-WA-10003	10003-F	Quinault	Depressional	PFO4	North Pacific Conifer Basin Swamp	B	B	B+
NWC21-WA-10003	10003-S	Quinault	Depressional	PSS1	Vancouverian Shrub Basin Swamp	B	A	A-
NWC21-WA-10004	10004	Ellsworth	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B-
NWC21-WA-10007	10007-Low	Bruceport	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific Low Salt Marsh	B	A	A-
NWC21-WA-10007	10007-High	Bruceport	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B+
NWC21-WA-10013	10013-Low	Sopun Inlet	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific Low Salt Marsh	A	A	A+
NWC21-WA-10013	10013-High	Sopun Inlet	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	A	A	A+
NWC21-WA-10015	10015	Naselle	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B-
NWC21-WA-10016	10016	Bay Center	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B+
NWC21-WA-10017	10017	Hobbit Trail	Slope + Depressional (historically estuarine fringe)	PFO1	Temperate Pacific High Brackish Marsh	C	D	D
NWC21-WA-10026	10026-A	Snohomish	Depressional	PEM1	North Pacific Freshwater Aquatic Vegetation	B	B	B+
NWC21-WA-10026	10026-F	Snohomish	Slope	PFO4	North Pacific Conifer Seepage Swamp	B	A	A-
NWC21-WA-10026	10026-S	Snohomish	Depressional	PSS1	Vancouverian Lagg Shrub Swamp	B	B	B+
NWC21-WA-10027	10027-XER	Sanpoil	Slope	PFO4	Central Rocky Mountain Grand Fir – Douglas-fir Xeroriparian Forest	B	B	B+

NWCA AA	EIA AA	Site Name	HGM Class	Cowardin System/ Subsystem + Class/ Subclass	USNVC Subgroup	Landscape Context MEF Rank	Condition MEF Rank	Overall EIA Rank
NWC21-WA-10027	10027-RIP	Sanpoil	Riverine	PSS1	Rocky Mountain Perennial Riparian Shrubland	B	B	B+
NWC21-WA-10028	10028	Rayonier	Slope	PFO4	North Pacific Conifer Seepage Swamp	B	B	B-
NWC21-WA-10030	10030	Pope	Depressional	PSS1	Vancouverian Shrub Basin Swamp	B	A	A-
NWC21-WA-10033	10033	Thurston	Depressional (historically a slope wetland)	PEM1	North Pacific Conifer Seepage Swamp	B	D	D
NWC21-WA-10037	10037	Chehalis	Estuarine Fringe (Tidal)	PFO1	North Pacific Freshwater Tidal Forested Swamp	B	B	B+
NWC21-WA-10038	10038	Tollgate	Slope	PSS1	Vancouverian Shrub Basin Swamp	B	B	B+
NWC21-WA-10039	10039	Beaver	Slope	PFO1	North Pacific Conifer Seepage Swamp	C	B	B-
NWC21-WA-10045	10045	Johns River	Slope	PEM1	Vancouverian Lowland Basin Marsh	B	A	A-
NWC21-WA-10046	10046-F	North Bend	Slope (historically riverine)	PFO1	North Pacific Lowland Floodplain Forest	C	C	C-
NWC21-WA-10046	10046-S	North Bend	Depressional	PSS1	Vancouverian Shrub Basin Swamp	C	B	C+
NWC21-WA-10047	10047	Wilson Creek	Slope + Riverine	PEM1	Columbia Plateau Streamside Marsh	C	C	C-
NWC21-WA-10090	10090	Willapa	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	A	A	A-
NWC21-WA-10092	10092	Skokomish	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific Low Salt Marsh	C	C	C+
NWC21-WA-10094	10094	Elk River	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B+
NWC21-WA-10095	10095-L	Oysterville	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific Low Salt Marsh	B	A	A+
NWC21-WA-10095	10095-H	Oysterville	Estuarine Fringe (Tidal)	EI EM1	Temperate Pacific High Brackish Marsh	B	B	B+
NWC21-WA-10252	10252	Touchet	Riverine	PEM1	Western North American Ruderal Herbaceous Wetland	C	C	C+

NWCA AA	EIA AA	Site Name	HGM Class	Cowardin System/ Subsystem + Class/ Subclass	USNVC Subgroup	Landscape Context MEF Rank	Condition MEF Rank	Overall EIA Rank
NWC21-WA-10260	10260	Pepoon Lake	Slope	PFO4	Central Rocky Mountain Inland Western Red-cedar – Western Hemlock Xeroriparian Forest	B	A	A-
NWC21-WA-10261	10261	Deschutes	Riverine	PSS1	Vancouverian Perennial Riparian Shrubland	C	B	B-
NWC21-WA-10268	10268-H	Hangman Creek	Riverine	PEM1	Western North American Ruderal Herbaceous Wetland	C	C	C+
NWC21-WA-10268	10268-S	Hangman Creek	Riverine	PSS1	Columbia Plateau Intermittent Riparian Shrubland	C	C	C+
NWC21-WA-10275	10275	Minkler Lake	Riverine	PFO1	North Pacific Lowland Floodplain Forest	C	C	C+
NWC21-WA-10277	10277	Quinault River	Riverine	PSS1	Vancouverian Perennial Riparian Shrubland	B	B	B+
NWC21-WA-10281	10281-AA	Humptulips	Slope	PSS1	North Pacific Coastal Bog Woodland	B	A	A-
NWC21-WA-10283	10283	Nooksack	Riverine	PFO4	North Pacific Lowland Floodplain Forest	B	A	A-
NWC21-WA-10288	10288	Kettle River	Slope	PFO4	Rocky Mountain Headwater Riparian Forest	B	A	A-
NWC21-WA-10289	10289-H	Hoh	Riverine	PEM2	Vancouverian Lowland Basin Marsh	A	A	A+
NWC21-WA-10289	10289-F	Hoh	Riverine	PFO1	North Pacific Lowland Floodplain Forest	A	B	B+

Figure 2 shows the breakdown of EIA Ranks by total number of AAs, while Figure 3 and Figure 4 are subdivided by HGM and Cowardin classifications, respectively. 32 of the 42 EIA assessment areas (76%) were considered "within the natural range of variability" (A- or B-ranked = NRV). HGM classes ranged from 50% within NRV (Riverine) to 92% (Estuarine). Cowardin categories ranged from 43% within NRV (Palustrine Emergent) to 92% (Estuarine-Intertidal Emergent).

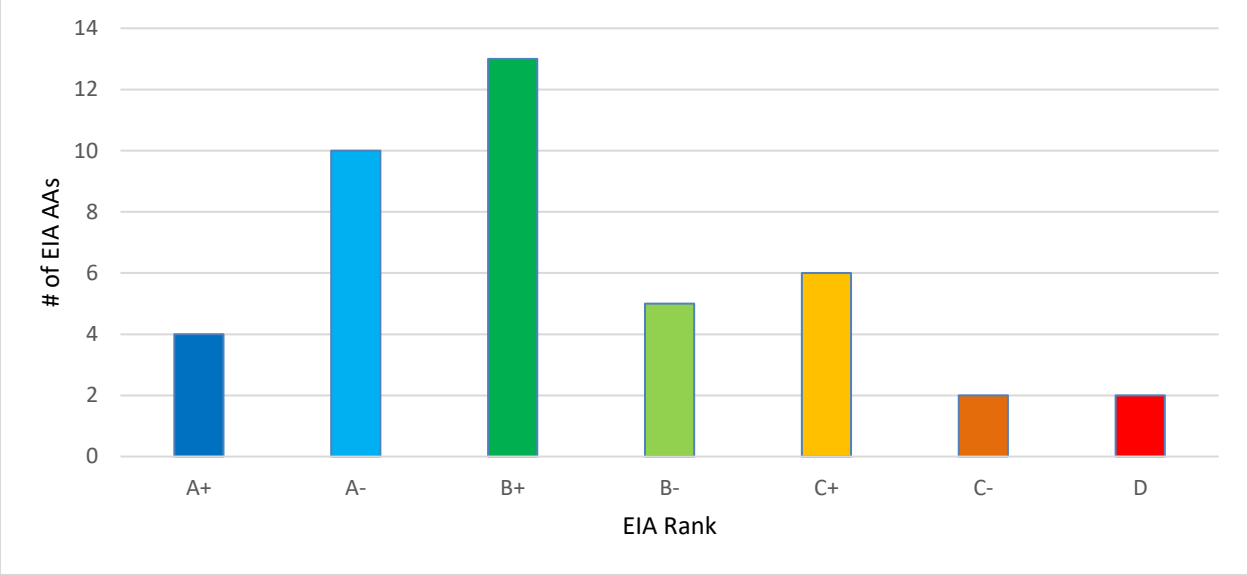

Figure 2. EIA Ranks by number of assessment areas.

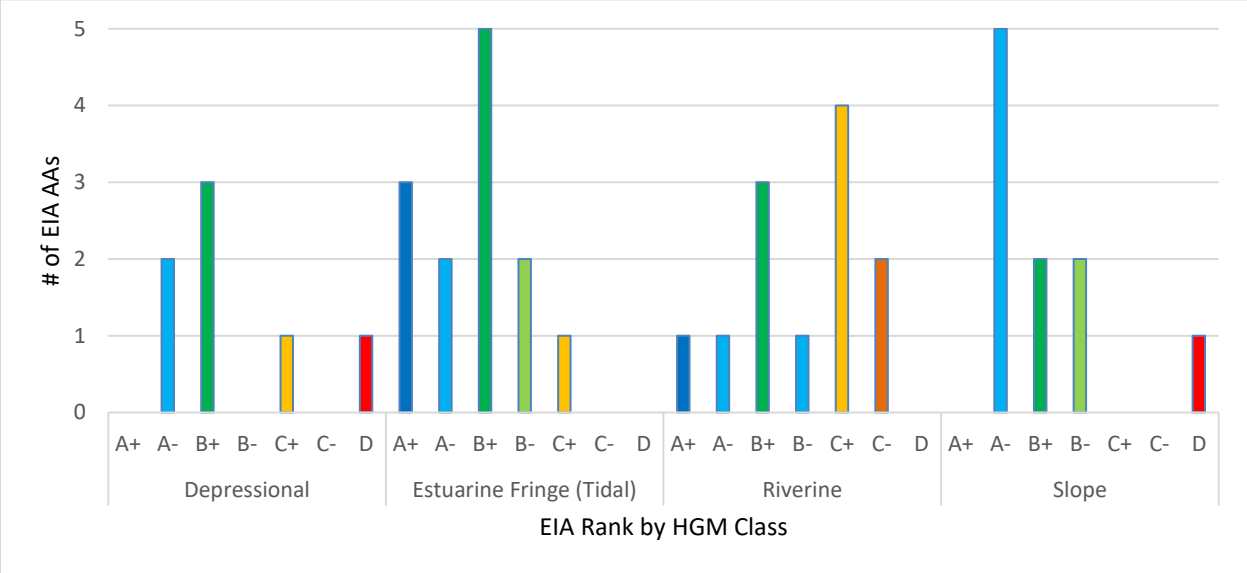

Figure 3. EIA Ranks by number of assessment areas, grouped by HGM class.

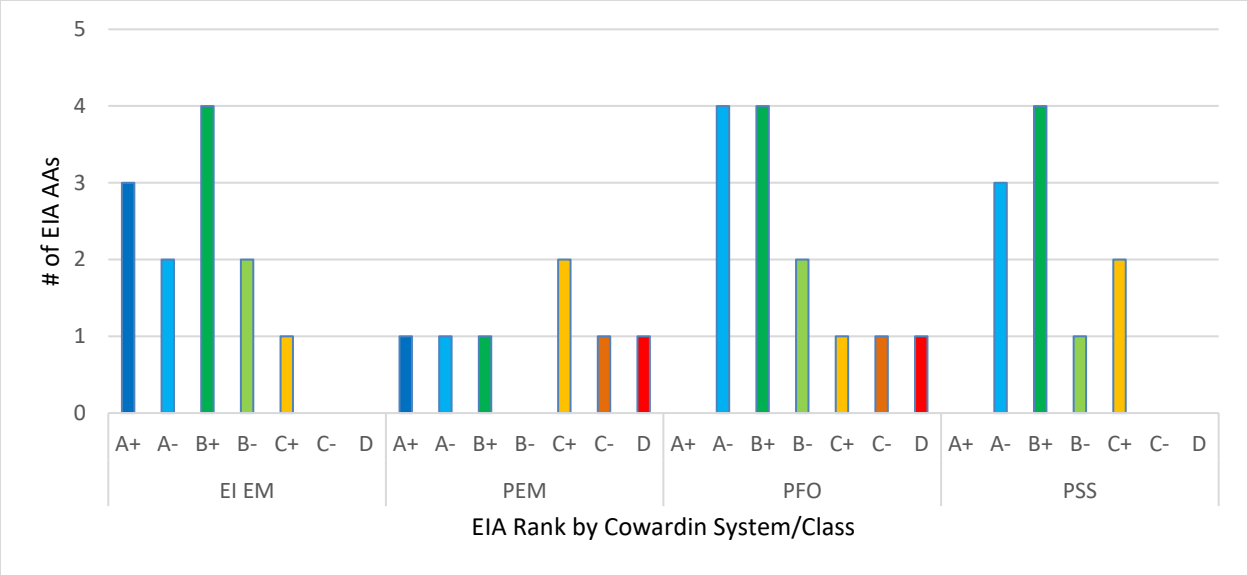

Figure 4. EIA Ranks by number of assessment areas, grouped by Cowardin system/class.

Individual EIA ranks may be slightly inflated by the application of EIA buffer metrics to point-based AAs, but note that point-based AAs are being employed to assess the integrity of a *population* of wetlands, as opposed to saying anything definitive about specific wetland occurrences. Regardless, when we focus just on Condition Rank (excluding landscape/buffer metrics) we still find that 79% of EIA AAs were within NRV (Figure 5), compared to 76% of overall EIA Ranks. There are no appreciable differences when Condition Rank is broken down by HGM or Cowardin classification, either (Figure 6, Figure 7). While the assessment area impacts the overall EIA Rank in some individual cases, there appears to be minimal impact at a population scale.

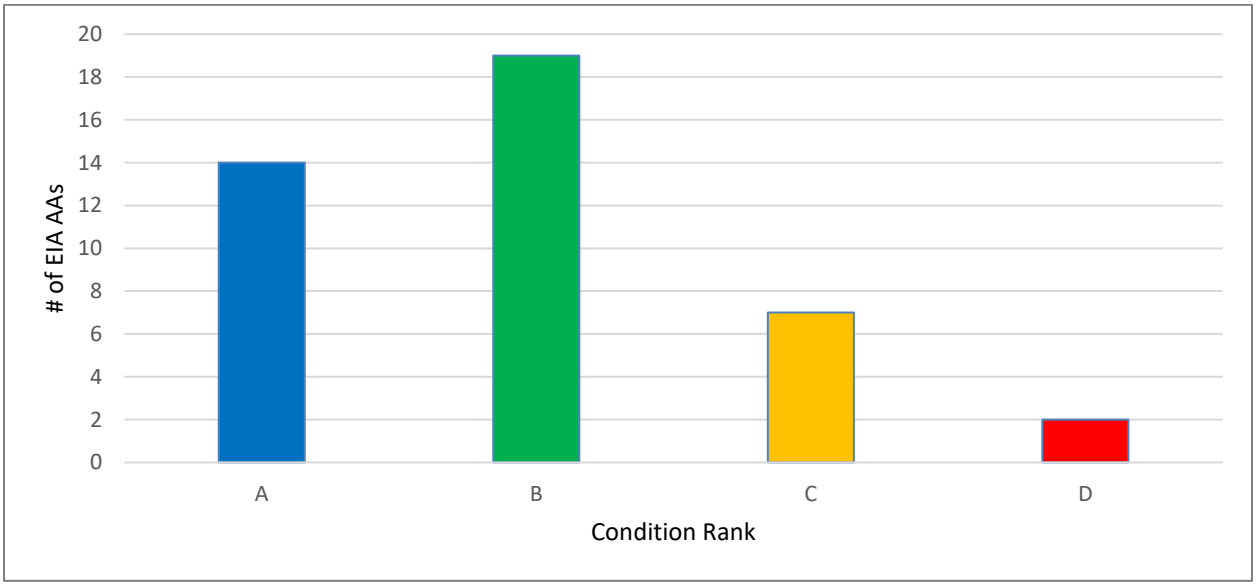

Figure 5. Condition Ranks by number of assessment areas.

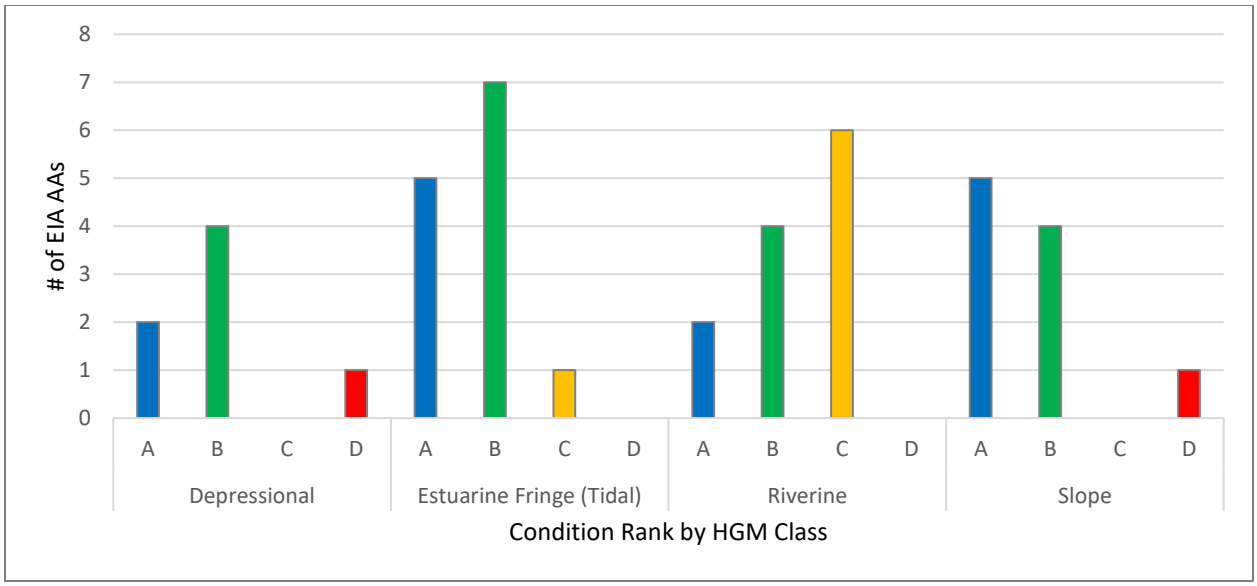

Figure 6. Condition Ranks by number of assessment areas, grouped by HGM class.

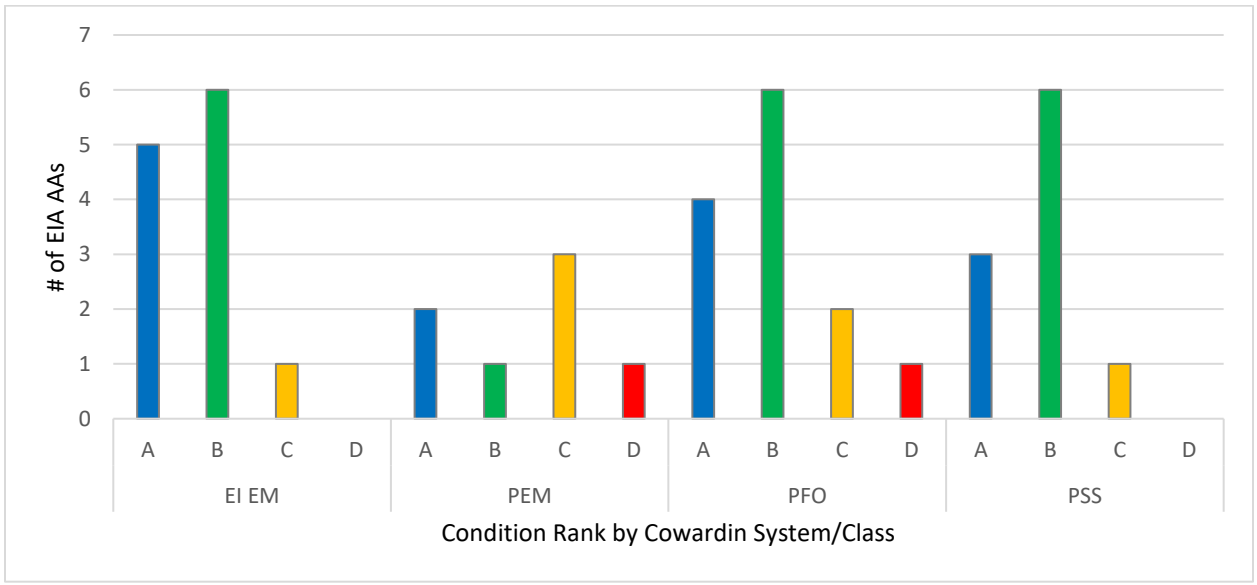

Figure 7. Condition Ranks by number of assessment areas, grouped by Cowardin system/class.

Table 6 and Figure 8 through Figure 22 show the distribution of ratings for each of the EIA metrics.

Table 6. Summary of EIA metric ratings by number of assessment areas. The most frequent rating for each metric is highlighted with a dark color and the second most frequent is highlighted with a faint color.

	Metric Rating			
Metric	**A/A-**	**B**	**C**	**C-/D**
LAN1	11	**18**	12	1
LAN2	5	10	**25**	2
BUF1	**38**	4	0	0
BUF2	**19**	18	5	0
BUF3	4	**24**	12	2
VEG1	14	5	**16**	7
VEG2	13	1	10	**18**
VEG3	**17**	10	11	4
VEG4	**26**	8	4	4
VEG5	**7**	5	1	2
VEG6	**6**	3	4	2
HYD1	**29**	5	4	4
HYD2	**25**	12	1	4
HYD3	**30**	5	4	3
SOI1	**27**	12	1	2

Contiguous Natural Land Cover (LAN1, Figure 8) measures the broader connectivity of natural land cover to the AA (within 500m). This was most frequently marked down due to networks of paved or gravel roads. Also within 500m, Land Use Index (LAN2, Figure 9) estimates the intensity of human impacts on the landscape. Each land use receives a coefficient ranging from 0 (paved roads, parking lots, buildings, quarries, etc.) to 10 (land managed for natural vegetation). The percentage of each land use within the inner (0-100m) and outer landscape (100-500m) is estimated and multiplied by its coefficient. These numbers are then summed to arrive at the overall Land Use Index (with inner landscape scores receiving a higher weight). Only five AAs received excellent (A-rank) marks in LAN2. Each of those was either in a seldom-visited portion of Olympic National Park or in the middle of an extensive, high-integrity salt marsh far away from any upland areas.

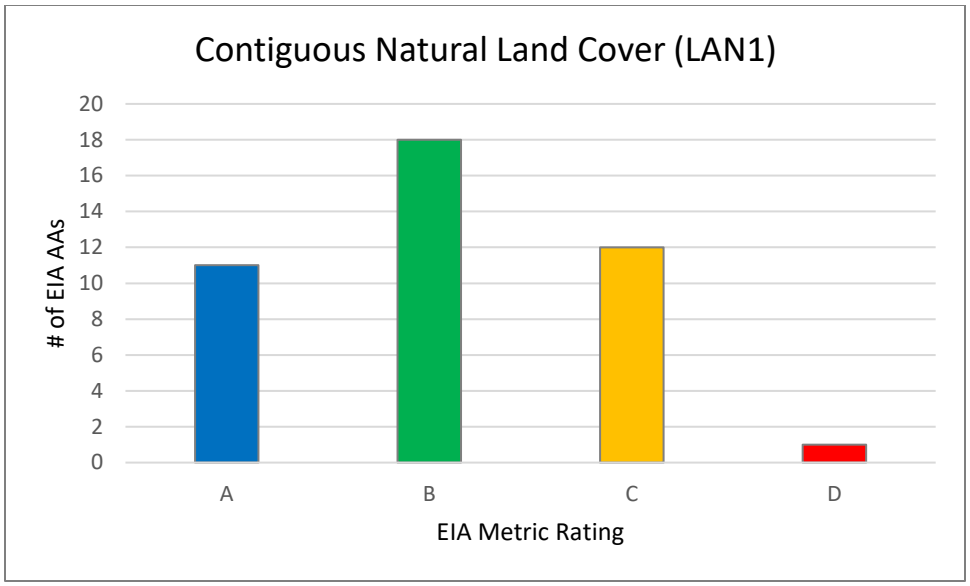

Figure 8. Contiguous Natural Land Cover (LAN1) metric ratings, by number of assessment areas.

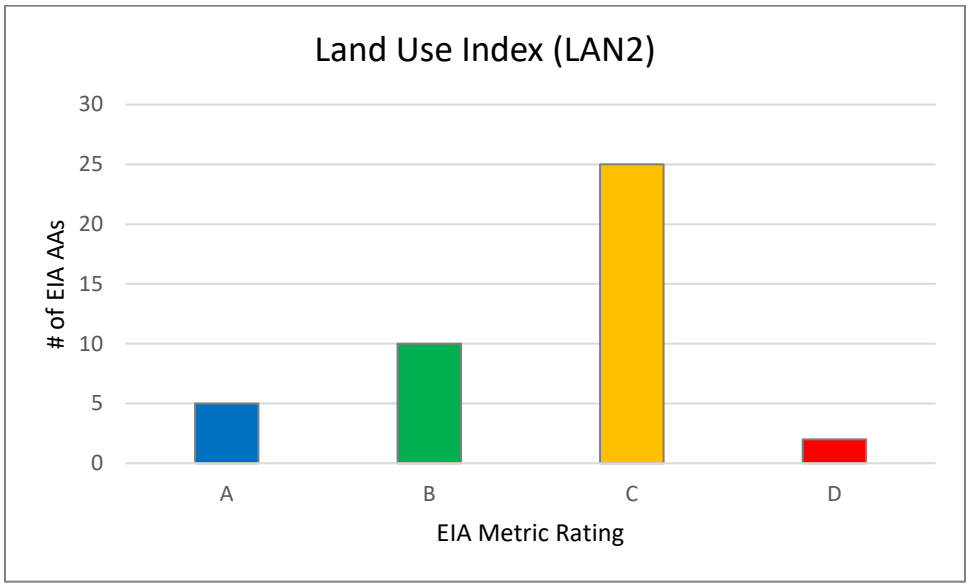

Figure 9. Land Use Index (LAN2) metric ratings, by number of assessment areas.

The large majority of AAs scored well in Perimeter with Natural Buffer (BUF1, Figure 10), with only 4 AAs adjoining unnatural land cover for >1% of their total perimeter. However, note that any 40m-radius circular plot is very unlikely to both a) meet the criteria necessary for a NWCA AA and b) adjoin unnatural land cover for more than a meter or two.

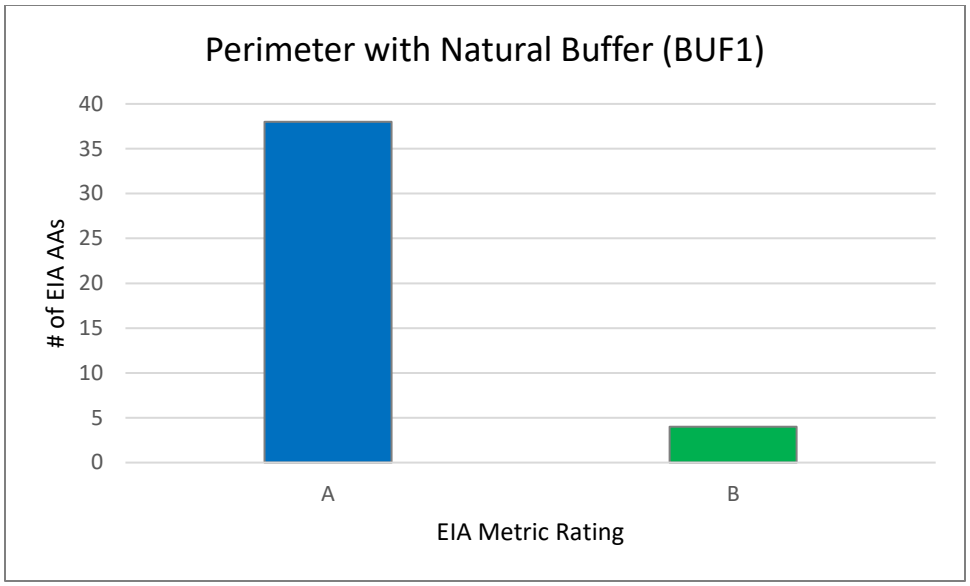

Figure 10. Perimeter with Natural Buffer (BUF1) metric ratings, by number of assessment areas.

Similarly, Width of Natural Buffer (BUF2) rarely received lower marks than a "B" rating (Figure 11). A few C-ranked AAs were positioned within close proximity to dikes, roads, or subdevelopments.

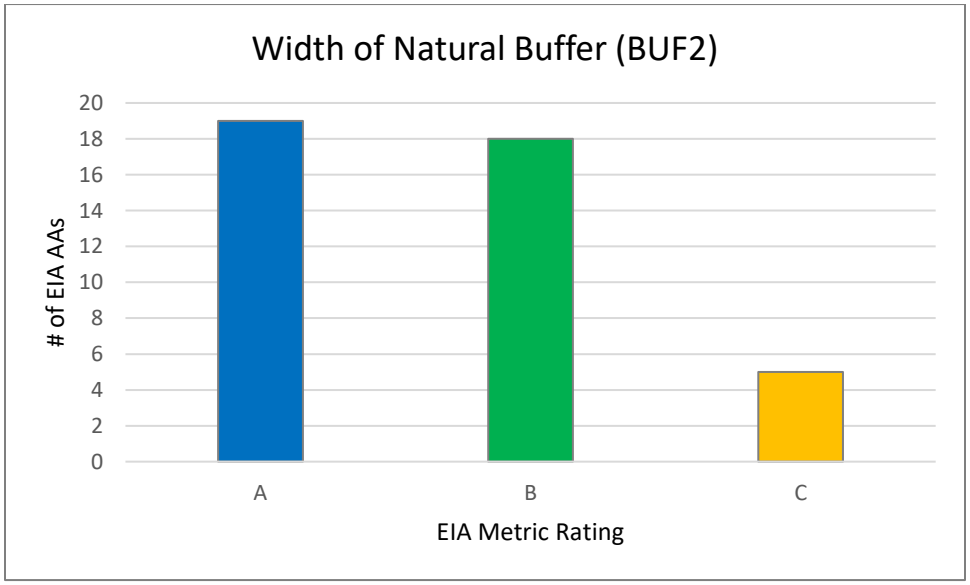

Figure 11. Width of Natural Buffer (BUF2) metric ratings, by number of assessment areas.

An AA can theoretically have a 100% natural perimeter (BUF1) and a large natural buffer (BUF2), but that natural buffer may be in very poor condition. Condition of Natural Buffer (BUF3) assess the biotic and abiotic condition within the portions of the buffer that are considered natural land cover. BUF3 was marked down at least slightly for nearly all AAs, usually because relative cover of native vegetation was <95%. Other buffers had extremely impacted hydrology due to levees and other topographic alterations.

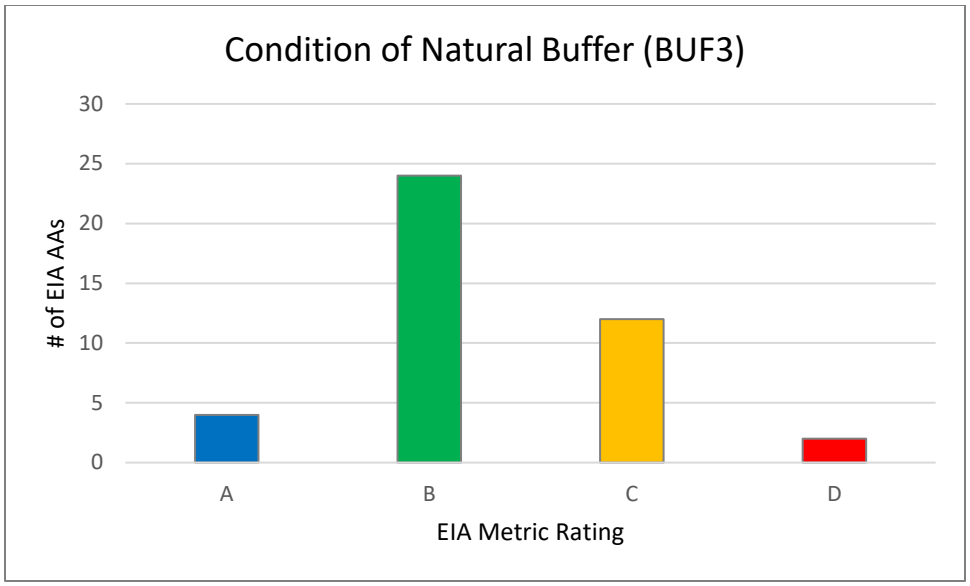

Figure 12. Condition of Natural Buffer (BUF3) metric ratings, by number of assessment areas.

Roughly 55% of assessment areas had relative native plant cover (VEG1) lower than 85% (C or D) (Figure 13). Ratings of the absolute cover of invasive plants (VEG2) were similar, but with a larger proportion of D-ranks (Figure 14). Taken together, these are by far the metrics in which NWCA sites were rated most poorly. *Phalaris arundinacea* was found in 20 of 42 AAs and was the most frequently encountered species overall. The lowest ratings in VEG1 and VEG2 were generally found in herbaceous wetlands and/or on frequently flooded riparian gravel bars.

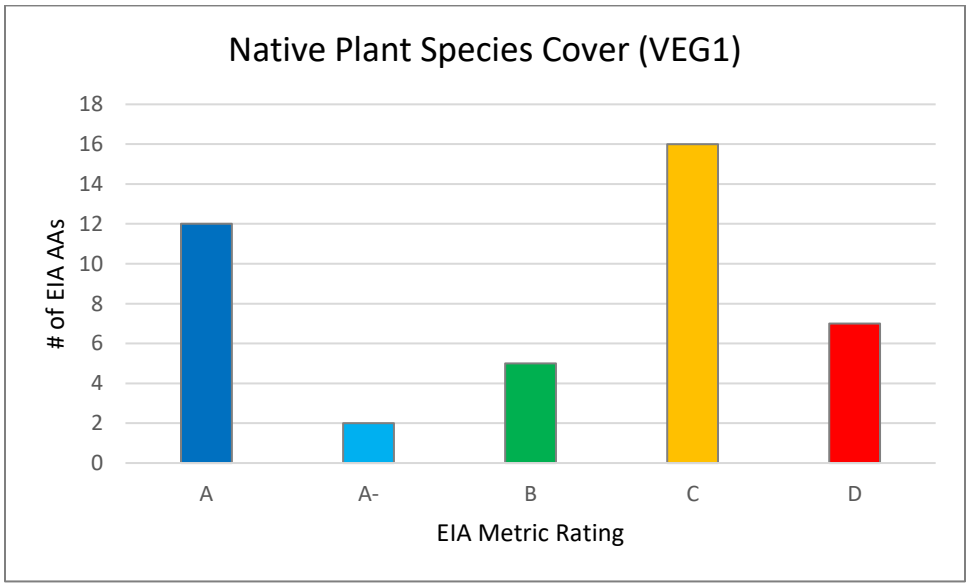

Figure 13. Native Plant Species Cover (VEG1) metric ratings, by number of assessment areas.

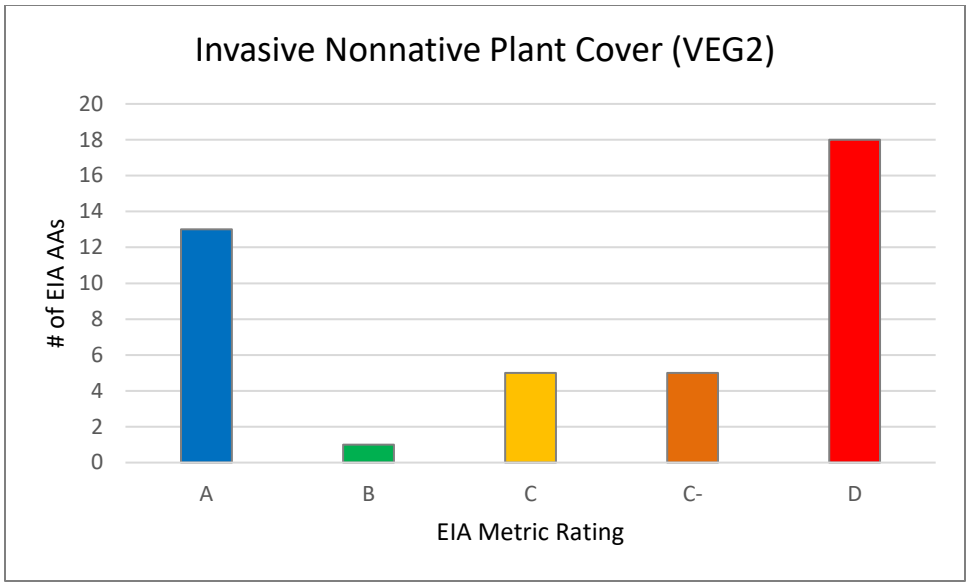

Figure 14. Invasive Nonnative Plant Species Cover (VEG2) metric ratings, by number of assessment areas.

Native Plant Species Composition (VEG3) assesses the overall composition of the native plants on site, with submetrics split out for diagnostic species, native diversity, native "increasers", and native "decreasers" (Figure 15). Native increasers are also known as "native invasives", successful competitors, or aggressive natives (e.g. *Juncus effusus*, *Spiraea douglasii*, and *Typha latifolia*). Meanwhile, native decreasers are the opposite--those species most likely to decline rapidly due to anthropogenic stressors. Each submetric is scored relative to the natural range of variability of the plant community being assessed. For example, completely undisturbed salt marshes are *naturally* species-poor communities dominated by successful competitors such as *Potentilla anserina* ssp. *pacifica*, so AAs in those locales would *not* be marked down in the diversity or native increaser submetrics. AAs receiving "C" or "D" ratings in VEG3 typically had reduced cover of diagnostic species and reduced native diversity due to high cover of invasives, or because of past logging or farming. *Spiraea douglasii* and *Typha latifolia* were the two taxa most frequently found to be acting as native increasers due to anthropogenic disturbance. With that said, the plurality of AAs had excellent ("A") native plant species composition.

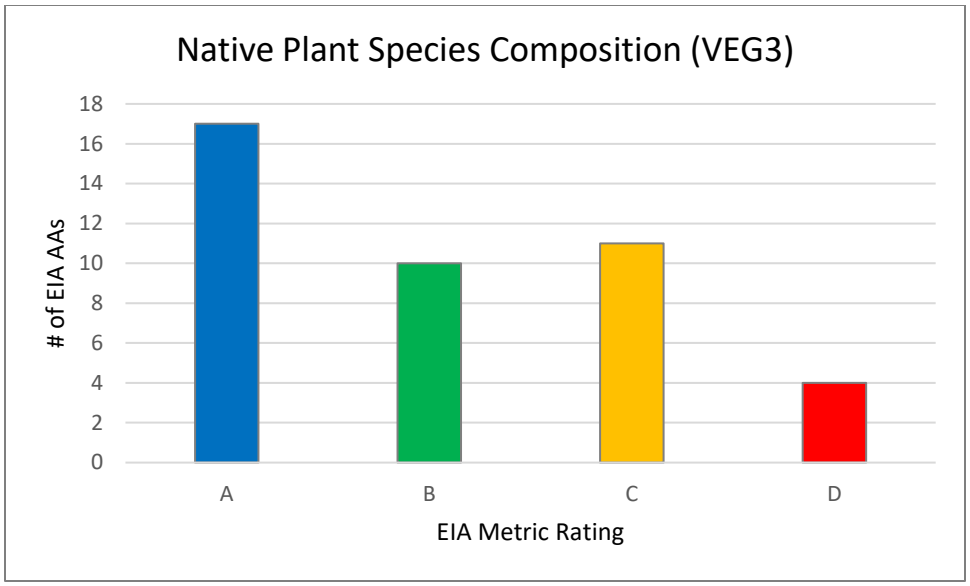

Figure 15. Native Plant Species Composition (VEG3) metric ratings, by number of assessment areas.

Vegetation structure (VEG4) was excellent ("A") in 62% of AAs and within NRV ("B" or greater) in 81% (Figure 16). AAs that were outside the natural range of variability were usually those with extensive logging histories, or ones that had been converted to different wetland types due to hydrologic alterations (e.g. a diked salt marsh apparently converted to a forested wetland).

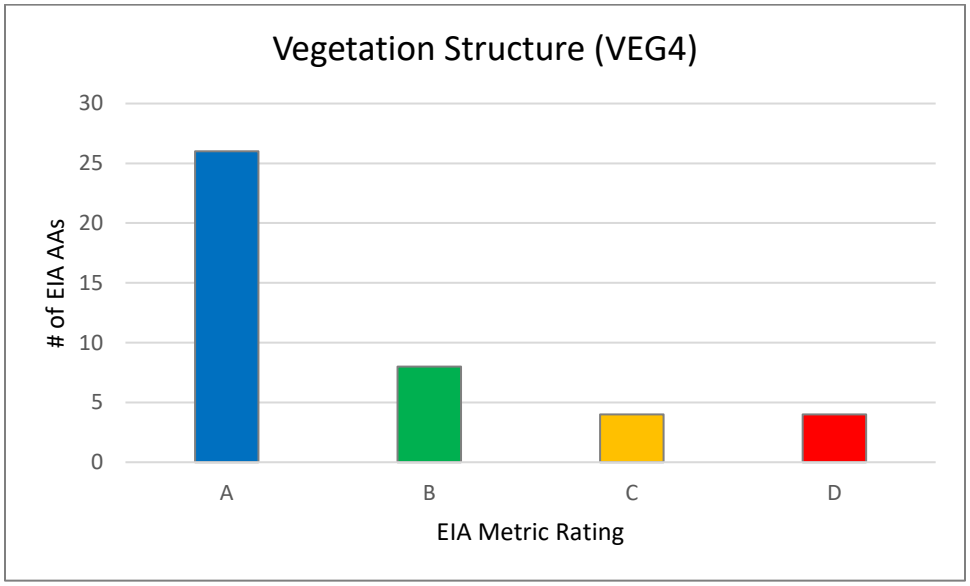

Figure 16. Vegetation Structure (VEG4) metric ratings, by number of assessment areas.

Woody regeneration (VEG5, Figure 17) and Coarse Woody Debris (VEG6, Figure 18) were not scored in every AA. These metrics are required only for forested wetlands and are optionally applied in shrublands. Across the AAs, native tree saplings/seedlings and shrubs common to each

ecosystem were generally present in expected amounts and diversity and were clearly regenerating. In some forested stands, species that require woody debris on which to germinate were sometimes reduced due to past logging. In one AA, timber species appeared to have been planted. Planted stands typically have reduced species diversity. Planting is often done in conjunction with herbicide treatments in order to bypass the shrubland seral stage, with implications for nitrogen fixation and wildlife habitat. Coarse Woody Debris was more frequently outside of NRV due to logging practices.

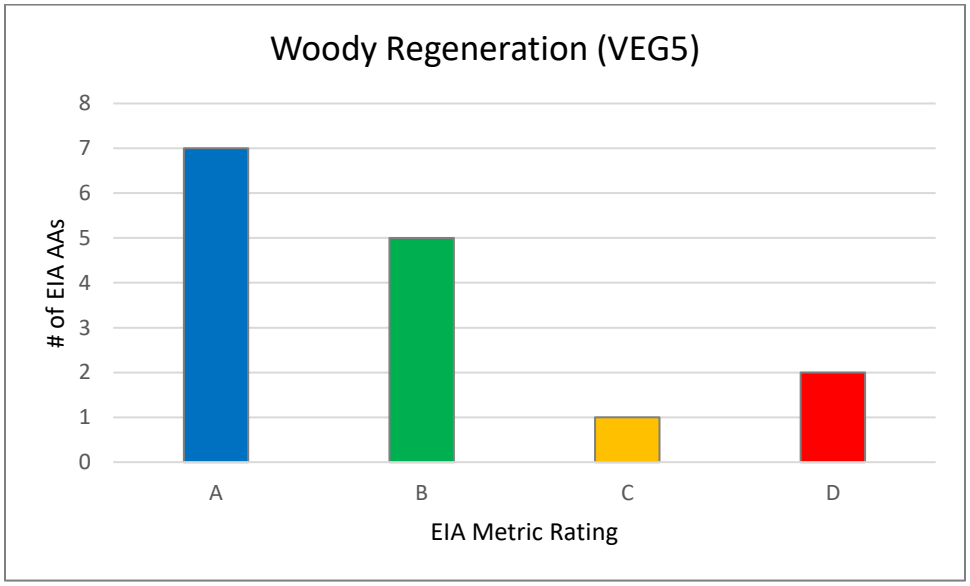

Figure 17. Woody Regeneration (VEG5) metric ratings, by number of assessment areas. This metric is optional for most wetland types and was only scored in 15 of 42 assessment areas.

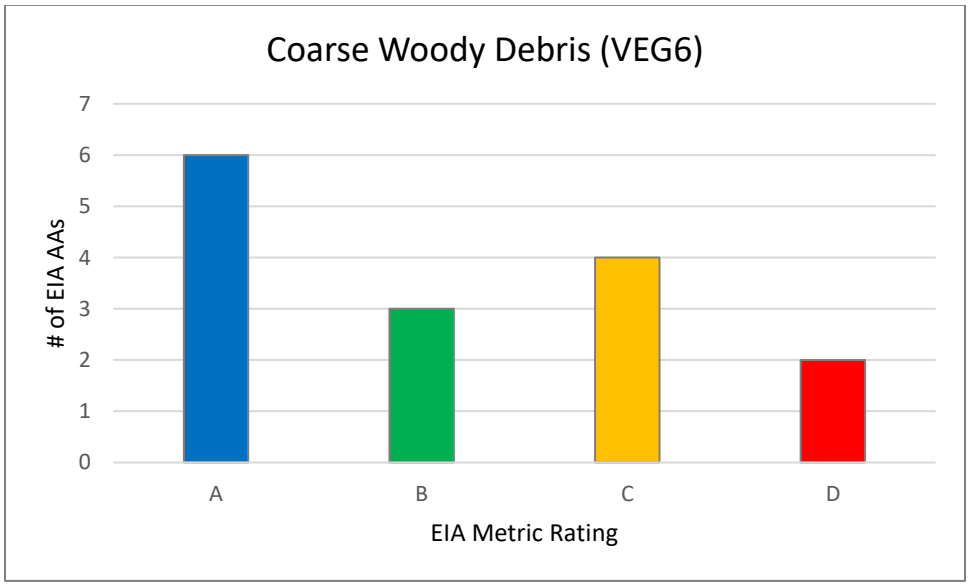

Figure 18. Coarse Woody Debris (VEG6) metric ratings, by number of assessment areas. This metric is optional for most wetland types and was only scored in 15 of 42 assessment areas.

Most AAs had excellent hydrologic integrity, based on our rapid assessment. Level 2 EIA hydrology metrics—Water Source (HYD1), Hydroperiod (HYD2), and Hydrologic Connectivity (HYD3)—are "snapshots" that are largely dependent on context clues such as visible stressors. Most of the wetlands we assessed had entirely natural water sources (Figure 19), though approximately 30% had considerable non-natural land cover (with presumed runoff) in the surrounding drainage basin and received lower marks in this metric. 88% of AAs were also within the natural range of variability for hydroperiod (Figure 20). AAs receiving the lowest hydroperiod ratings had artificial water management (dikes, managed ag-related flooding, etc.) or had clearly been converted from one wetland type to another presumably due to an altered hydroperiod. When hydroperiod was impacted, hydrologic connectivity was usually outside the natural range of variability as well (Figure 21). Nearby roads were the most frequent obstructions to the exchange of water between the wetland AA and surrounding systems.

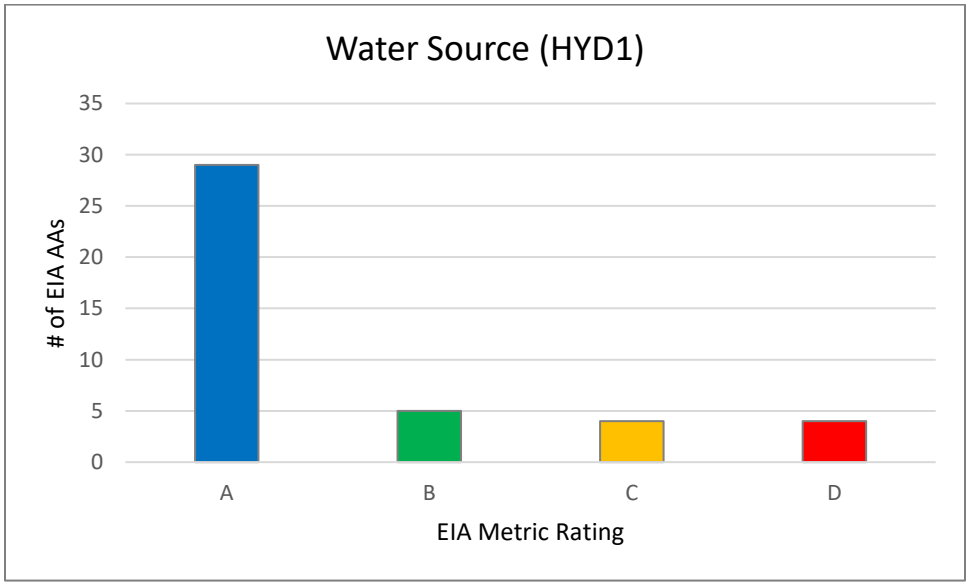

Figure 19. Water Source (HYD1) metric ratings, by number of assessment areas.

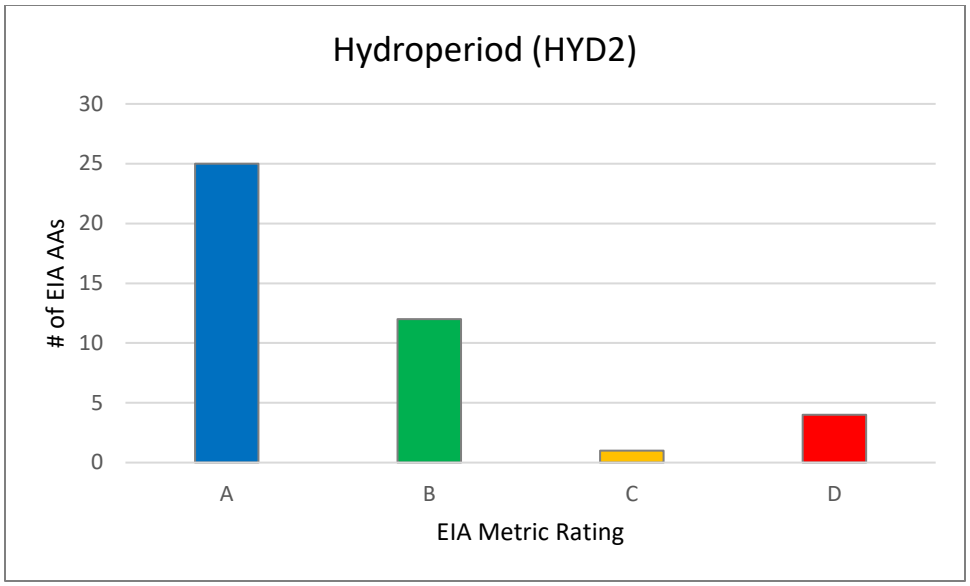

Figure 20. Hydroperiod (HYD2) metric ratings, by number of assessment areas.

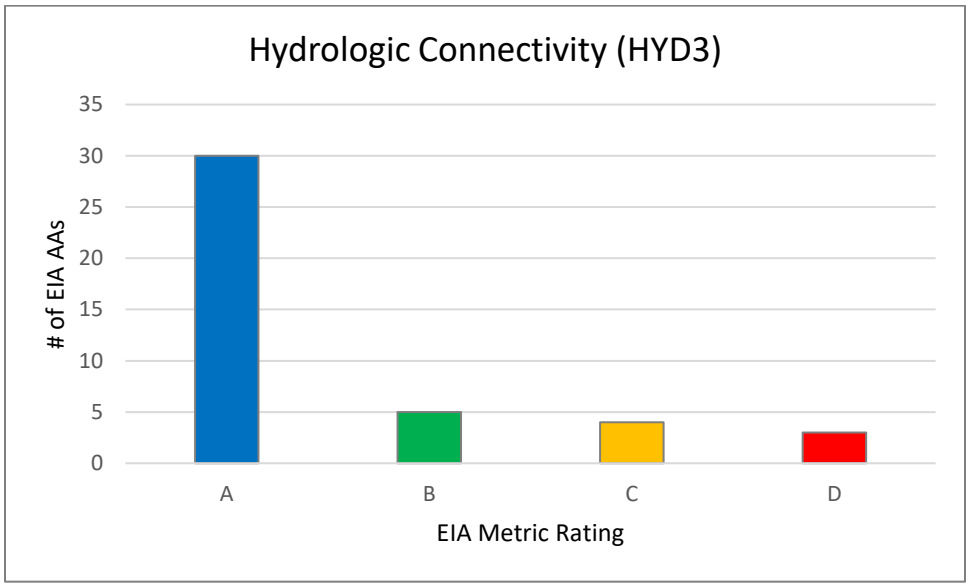

Figure 21. Hydrologic Connectivity (HYD3) metric ratings, by number of assessment areas.

Within a level 2 EIA, the Soil Condition metric (SOI1) is a very rapid assessment of soil condition that is primarily dependent on visible, surficial disturbance. This metric was only marked down beyond NRV in three AAs: two had been plowed and the third had extensive trampling and pugging from grazing cattle (Figure 22).

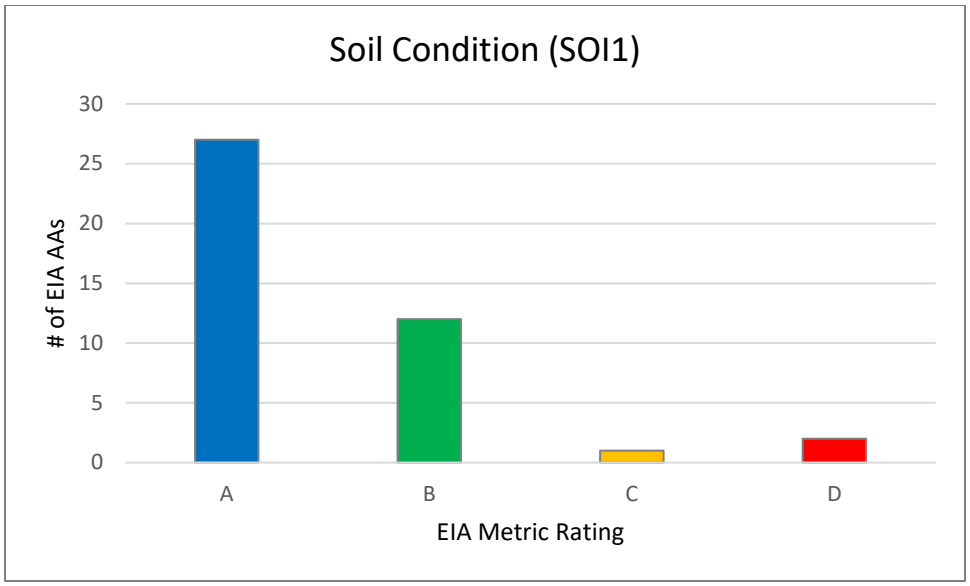

Figure 22. Soil Condition (SOI1) metric ratings, by number of assessment areas.

For AA-specific scores, including comments and rating rationale, please see the accompanying Excel workbook.

3.2 FQA

As a supplement to the EIA data, we calculated FQA indices and assorted summary statistics for the species lists collected in each assessment area (Table 7, Table 8). Note that these species lists are somewhat different from the intensive fixed relevé sampling performed by the NWCA botany team. Species lists compiled during the EIA sampling followed a "site walkthrough" approach in which all species encountered in the full AA were recorded, but intensive effort was not always applied to identifying taxa present in only trace amounts, or to differentiate between closely related taxa if both species were native (or exotic). On the other hand, while NWCA botanists identified everything possible within their relevés (10% of the full AA), any species found only outside of those relevés were ignored. Full FQA results (including c-values of individual species) are included in an accompanying Excel workbook.

Table 7. FQA results for EIA assessment areas. Note that EIA assessment areas sometimes represented subdivisions of the full NWCA AA. If the EIA AA was the same as the NWCA AA, the FQA results are identical.

EIA AA	Mean C (native species)	Mean C (all species)	Mean C (native trees)	Mean C (native shrubs)	Mean C (native herbaceous)	FQAI (native species)	FQAI (all species)	Adjusted FQAI	% intolerant (C value >= 7)	% tolerant (C value =< 3)
10004	4.38	3.29	4.00	4.00	4.42	20.08	17.39	37.94	4%	43%
10015	4.91	4.15	n/a	n/a	4.91	16.28	14.98	45.16	8%	31%
10016	4.80	4.24	n/a	n/a	4.80	18.59	17.46	45.09	6%	24%
10017	2.87	2.00	2.50	3.50	2.75	15.70	13.11	23.94	0%	81%
10028	4.21	4.21	3.67	4.40	4.33	15.77	15.77	42.14	7%	29%
10030	3.14	2.76	2.40	3.50	3.31	15.04	14.07	29.50	4%	69%
10033	3.33	2.30	2.70	3.50	3.49	23.29	19.34	27.64	0%	69%
10037	3.17	2.88	3.00	3.33	3.20	17.34	16.54	30.19	3%	70%
10038	3.70	3.29	3.00	4.63	3.68	23.40	22.06	34.88	4%	49%
10039	3.61	3.05	3.00	4.29	3.52	20.72	19.06	33.17	3%	59%
10045	3.37	3.14	3.00	4.33	3.32	17.51	16.90	32.52	0%	59%
10047	3.33	1.20	n/a	4.00	3.50	10.00	6.00	20.00	0%	88%
10090	3.69	3.20	n/a	4.00	3.67	13.31	12.39	34.37	0%	53%
10092	3.78	2.37	3.00	3.33	3.95	19.63	15.55	29.94	0%	65%
10094	3.33	2.70	3.33	3.60	3.27	18.26	16.44	30.02	0%	68%
10252	2.90	0.67	n/a	3.00	3.17	10.05	4.52	14.98	4%	93%
10260	4.70	3.88	3.75	4.08	5.15	32.24	29.27	42.70	14%	35%
10261	3.03	1.43	3.00	3.00	3.05	17.66	12.14	20.82	0%	88%
10275	3.34	2.77	2.83	3.43	3.56	22.16	20.19	30.44	0%	64%
10277	2.55	1.12	2.00	3.00	2.63	11.94	7.92	16.88	0%	94%
10283	3.53	3.06	2.91	3.90	3.67	23.70	22.05	32.87	0%	58%
10288	4.29	3.95	4.00	3.85	4.76	25.35	24.33	41.13	8%	39%
10268-S/H	Species data collected at NWCA AA scale (were not subdivided by EIA AA at this site). See accompanying Excel spreadsheet									
10003-F/S	Species data collected at NWCA AA scale (were not subdivided by EIA AA at this site). See accompanying Excel spreadsheet									
10007-High	4.89	3.67	n/a	n/a	4.89	14.67	12.70	42.34	8%	42%

EIA AA	Mean C (native species)	Mean C (all species)	Mean C (native trees)	Mean C (native shrubs)	Mean C (native herbaceous)	FQAI (native species)	FQAI (all species)	Adjusted FQAI	% intolerant (C value >= 7)	% tolerant (C value =< 3)
10007-Low	5.25	4.67	n/a	n/a	5.25	21.65	20.34	49.66	11%	16%
10013-L/H	Species data collected at NWCA AA scale (were not subdivided by EIA AA at this site). See accompanying Excel spreadsheet									
10026-A	4.14	3.78	n/a	n/a	4.14	18.98	18.14	39.59	4%	39%
10026-F	3.38	3.09	2.75	4.17	3.43	15.49	14.80	32.31	0%	57%
10026-S	3.73	3.29	3.33	3.33	4.00	14.46	13.58	35.07	0%	47%
10027-RIP	3.52	2.50	3.25	3.45	3.58	25.86	21.79	29.66	1%	66%
10027-XER	3.26	2.07	3.00	3.67	3.10	14.22	11.32	25.97	0%	80%
10046-F	2.95	2.32	2.70	3.33	3.00	13.86	12.28	26.19	0%	82%
10046-S	3.31	2.67	3.17	3.80	3.22	17.83	16.00	29.71	0%	72%
10095-H/L	Species data collected at NWCA AA scale (were not subdivided by EIA AA at this site). See accompanying Excel spreadsheet									
10281-AA	5.26	5.26	3.25	6.25	5.53	26.30	26.30	52.61	28%	24%
10289-F/H	Species data collected at NWCA AA scale (were not subdivided by EIA AA at this site). See accompanying Excel spreadsheet									

Table 8. FQA results for NWCA assessment areas. These represent statistics for all species found within the full NWCA AA, regardless of EIA AA.

NWCA AA	Mean C (native species)	Mean C (all species)	Mean C (native trees)	Mean C (native shrubs)	Mean C (native herbaceous)	FQAI (native species)	FQAI (all species)	Adjusted FQAI	% intolerant (C value >= 7)	% tolerant (C value =< 3)
NWC21-WA-10026	3.80	3.48	2.75	4.00	4.04	25.18	24.10	36.34	2%	46%
NWC21-WA-10003	3.39	3.30	3.00	4.11	3.20	20.33	20.06	33.43	3%	54%
NWC21-WA-10004	4.38	3.29	4.00	4.00	4.42	20.08	17.39	37.94	4%	43%
NWC21-WA-10007	5.12	4.14	n/a	n/a	5.12	21.71	19.43	46.29	9%	27%
NWC21-WA-10013	4.71	4.71	n/a	n/a	4.71	17.64	17.64	47.14	14%	21%
NWC21-WA-10015	4.91	4.15	n/a	n/a	4.91	16.28	14.98	45.16	8%	31%
NWC21-WA-10016	4.80	4.24	n/a	n/a	4.80	18.59	17.46	45.09	6%	24%
NWC21-WA-10017	2.87	2.00	2.50	3.50	2.75	15.70	13.11	23.94	0%	81%
NWC21-WA-10026	3.80	3.48	2.75	4.00	4.04	25.18	24.10	36.34	2%	46%
NWC21-WA-10027	3.62	2.65	3.25	3.60	3.68	28.01	23.96	30.94	1%	63%

NWCA AA	Mean C (native species)	Mean C (all species)	Mean C (native trees)	Mean C (native shrubs)	Mean C (native herbaceous)	FQAI (native species)	FQAI (all species)	Adjusted FQAI	% intolerant (C value >= 7)	% tolerant (C value =< 3)
NWC21-WA-10028	4.21	4.21	3.67	4.40	4.33	15.77	15.77	42.14	7%	29%
NWC21-WA-10030	3.14	2.76	2.40	3.50	3.31	15.04	14.07	29.50	4%	69%
NWC21-WA-10033	3.33	2.30	2.70	3.50	3.49	23.29	19.34	27.64	0%	69%
NWC21-WA-10037	3.17	2.88	3.00	3.33	3.20	17.34	16.54	30.19	3%	70%
NWC21-WA-10038	3.70	3.29	3.00	4.63	3.68	23.40	22.06	34.88	4%	49%
NWC21-WA-10039	3.61	3.05	3.00	4.29	3.52	20.72	19.06	33.17	3%	59%
NWC21-WA-10045	3.37	3.14	3.00	4.33	3.32	17.51	16.90	32.52	0%	59%
NWC21-WA-10046	3.09	2.42	2.75	3.50	3.13	20.28	17.93	27.35	0%	78%
NWC21-WA-10047	3.33	1.20	n/a	4.00	3.50	10.00	6.00	20.00	0%	88%
NWC21-WA-10090	3.69	3.20	n/a	4.00	3.67	13.31	12.39	34.37	0%	53%
NWC21-WA-10092	3.78	2.37	3.00	3.33	3.95	19.63	15.55	29.94	0%	65%
NWC21-WA-10094	3.33	2.70	3.33	3.60	3.27	18.26	16.44	30.02	0%	68%
NWC21-WA-10095	5.11	3.83	n/a	n/a	5.11	21.68	18.78	44.26	17%	29%
NWC21-WA-10252	2.90	0.67	n/a	3.00	3.17	10.05	4.52	14.98	4%	93%
NWC21-WA-10260	4.70	3.88	3.75	4.08	5.15	32.24	29.27	42.70	14%	35%
NWC21-WA-10261	3.03	1.43	3.00	3.00	3.05	17.66	12.14	20.82	0%	88%
NWC21-WA-10275	3.34	2.77	2.83	3.43	3.56	22.16	20.19	30.44	0%	64%
NWC21-WA-10277	2.55	1.12	2.00	3.00	2.63	11.94	7.92	16.88	0%	94%
NWC21-WA-10281	5.26	5.26	3.25	6.25	5.53	26.30	26.30	52.61	28%	24%
NWC21-WA-10283	3.53	3.06	2.91	3.90	3.67	23.70	22.05	32.87	0%	58%
NWC21-WA-10288	4.29	3.95	4.00	3.85	4.76	25.35	24.33	41.13	8%	39%
NWC21-WA-10289	3.70	3.26	2.75	3.83	3.81	22.52	21.14	34.75	2%	55%

Biodiverse ecosystems are often assumed to be in good condition. Across our full sample, however, we found a flat to slightly negative relationship between native species richness and the mean C-values of native species (Figure 23). The trend is more negative when all species, including exotic species, are included in the analysis (Figure 24). Many intact native ecosystems in the Pacific Northwest are naturally species-poor in terms of vascular plants (e.g. salt marshes, bogs). The most diverse sites encountered in this project were often naturally or anthropogenically disturbed and frequently had high numbers of exotic species.

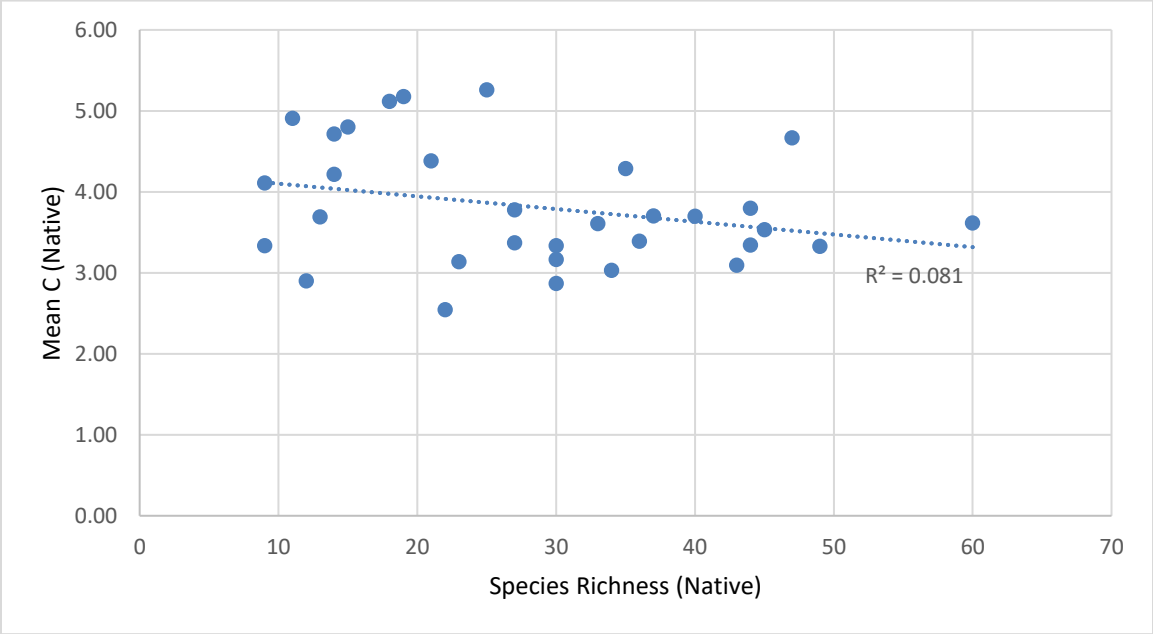

Figure 23. Mean C (native species) as a function of Native Species Richness of NWCA AA

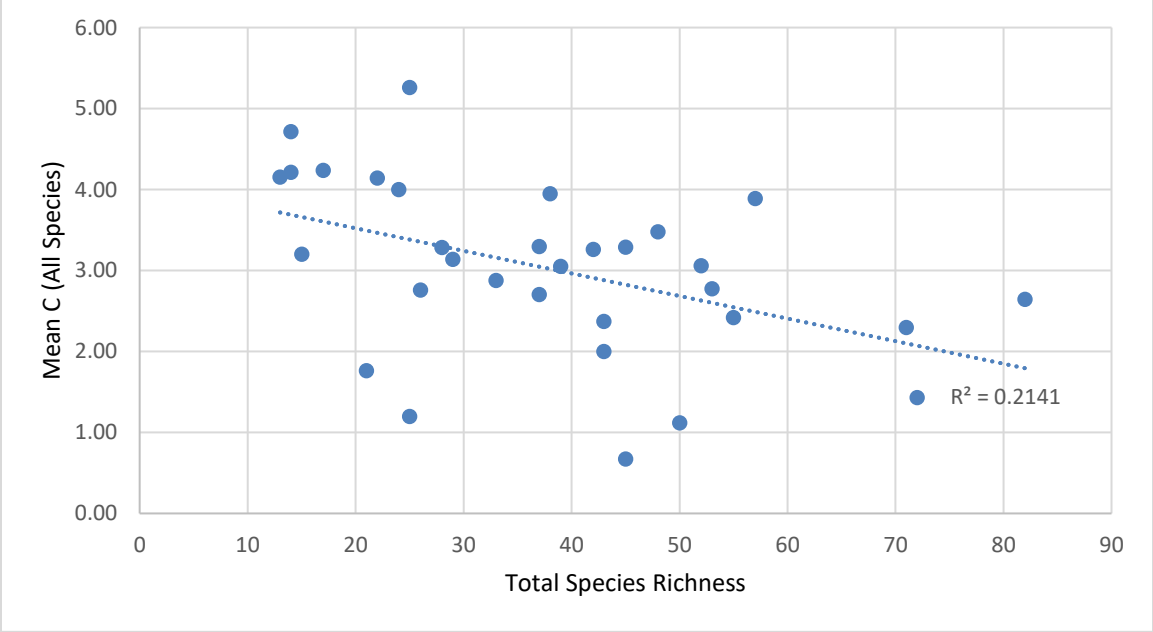

Figure 24. Mean C (all species) as a function of Total Species Richness of NWCA AA

When comparing EIA and FQA results, we see a lot of overlap between A- and B-ranked assessment areas, as well as C- and D-ranked AAs (Figure 25, Figure 26). More promisingly, we do see separation between those AAs considered to be within the natural range of variability (A and B) and those considered to be outside of NRV (C and D). This distinction is less apparent when zooming in on just the native plant species composition metric, however, although there is still a Mean C gradient from A to D (Figure 27).

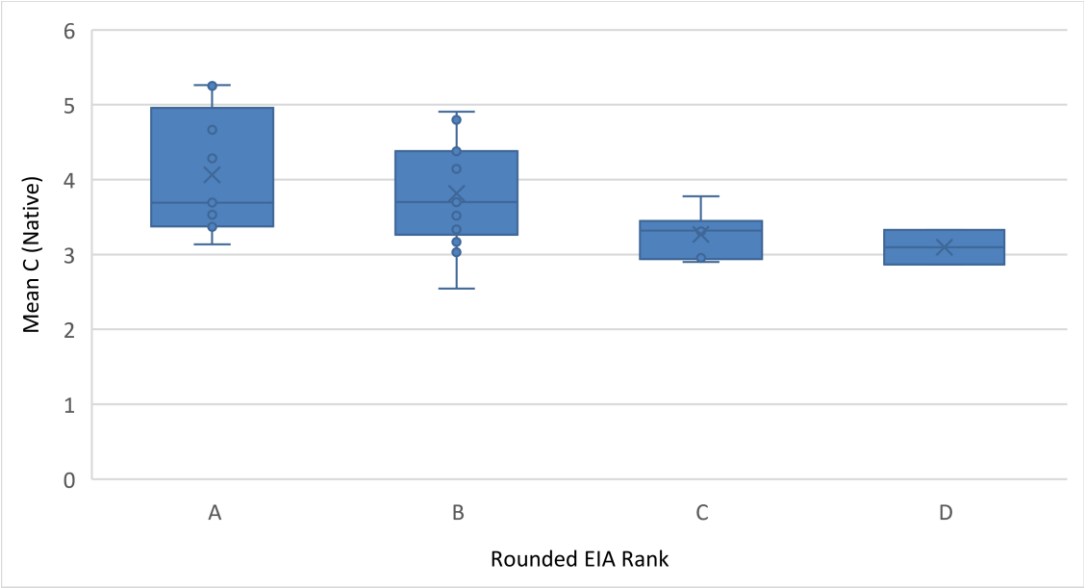

Figure 25. Mean C (native species) by Rounded EIA Rank (A+/A- = A, etc.).

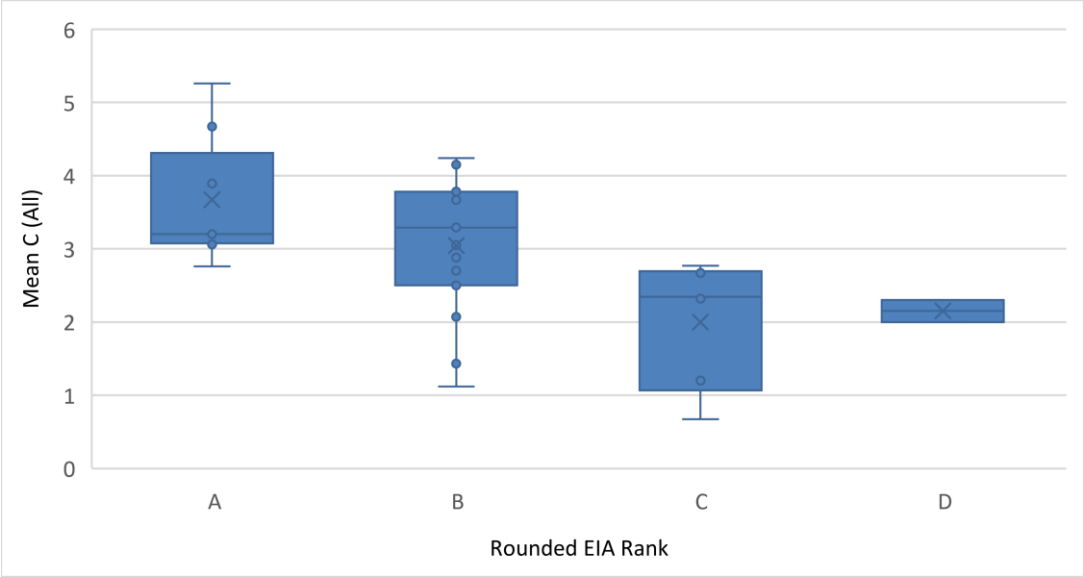

Figure 26. Mean C (all species) by Rounded EIA Rank (A+/A- = A, etc.).

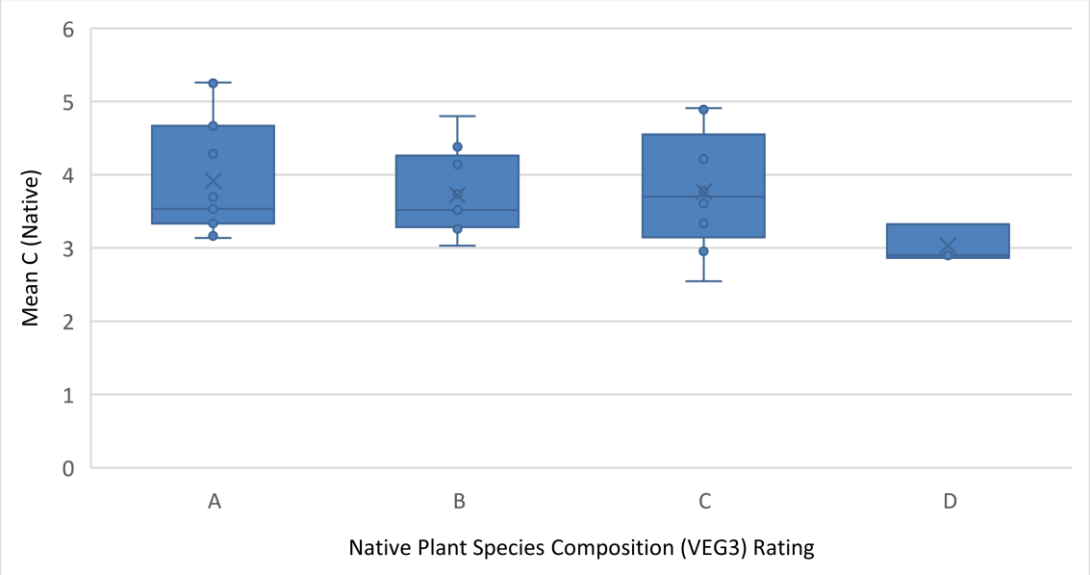

Figure 27. Mean C (native species) by Native Plant Species Composition (VEG3) Rating.

Within this project, we do not have sufficient sample sizes to limit our analyses to similar ecological types (e.g., comparing swamp forests only to other swamp forests). Such a step is often helpful for reducing the noise that is introduced by variation in the ecological complexity of different systems (Rocchio & Crawford, 2013). Along those lines, WNHP is beginning an EPA-funded project (Wetland Program Development Grant CD-01J68901) in which we will collect data across a human stressor gradient for two wetland types in order to test the efficacy of FQA-based indices for tracking change across that gradient.

3.3 Element Occurrences

Thirteen element occurrences were visited over the course of NWCA sampling (Table 9). Five entirely new EOs were documented, of which three overlapped with NWCA AAs (the other two were sampled opportunistically). Three existing EOs were expanded and five additional EOs were simply revisited. Two additional occurrences were of sufficient integrity to qualify as EOs, but were excluded from our database for data sensitivity reasons. For additional information, see the accompanying Excel workbook and/or the WNHP Wetlands of High Conservation Value Map Viewer (https://www.dnr.wa.gov/NHPwetlandviewer).

Table 9. Summary of element occurrences encountered during NWCA sampling. For additional information, see the accompanying Excel workbook.

EO ID	EIA AA	NWCA AA	EL Code	NVC Plant Association	Conservation Status Rank	EO Rank	New/ Existing
3231	10013-Low	NWC21-WA-10013	CEGL003366	Salicornia virginica - Distichlis spicata - Triglochin maritima - (Jaumea carnosa) Salt Marsh	G3/S2	A+	Existing

EO ID	EIA AA	NWCA AA	EL Code	NVC Plant Association	Conservation Status Rank	EO Rank	New/ Existing
3972	10090	NWC21-WA-10090	CEGL003382	Deschampsia caespitosa - Argentina egedii Salt Marsh	G3G4/S2	A+	Existing
4155	10013-High	NWC21-WA-10013	CEGL003357	Deschampsia caespitosa - (Carex lyngbyei, Distichlis spicata) Salt Marsh	G3G4/S2	A+	Existing
4405	10095-L	NWC21-WA-10095	CEGL003366	Salicornia virginica - Distichlis spicata - Triglochin maritima - (Jaumea carnosa) Salt Marsh	G3/S2	A+	Expanded
5116	10094	NWC21-WA-10094	CEGL003421	Calamagrostis nutkaensis - Argentina egedii - Juncus balticus Salt Marsh	G1/S1	A+	Expanded
5625	10016	NWC21-WA-10016	CEGL003382	Argentina egedii - Juncus balticus Salt Marsh	G3G4/S2	A-	Expanded
6121	10004, 10015	NWC21-WA-10004	CEGL003382	Argentina egedii - Juncus balticus Salt Marsh	G3G4/S2	B-	Existing
8755	10283	NWC21-WA-10283	CEGL003407	Populus balsamifera ssp. trichocarpa - Alnus rubra / Rubus spectabilis Riparian Forest	G2G3/S2?	B	Existing
9930	SCHAMEPUN	--	CEGL003367	Schoenoplectus (americanus, pungens) Tidal Salt Marsh	G3/S2	AC	New
9980	Goin-Rogue	--	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	B+	New
9984	10045	NWC21-WA-10045	CEGL003313	Carex obnupta Wet Meadow	G4/S4	A-	New
9985	10281-EO	NWC21-WA-10281	CEGL001691	Pinus contorta var. contorta - Thuja plicata / Myrica gale / Sphagnum spp. Treed Fen	G3G4/S1	A+	New
9986	10288	NWC21-WA-10288	CWWA000174	Betula papyrifera / Alnus incana Swamp Forest	G2?/S1	A-	New
	10003-F	NWC21-WA-10003	CEGL000400	Picea sitchensis / Rubus spectabilis / Carex obnupta - Lysichiton americanus Swamp Forest	G2G3/S2	B+	EO-quality
	10003-S	NWC21-WA-10003	CEGL003432	Salix hookeriana - (Malus fusca) / Carex obnupta - Lysichiton americanus Wet Shrubland	G3/S2	B+	EO-quality

4.0 Summary

This document summarizes EIA and FQA data collected at NWCA sample sites during the 2021 field season. Site-level data are available in the accompanying Excel workbook. Because of the sampling methodology, however, these data are most useful for making population-level estimates of ecological integrity.

The EIA is a metric-based approach and the data from this project can be used in a wide assortment of applications. If land managers are interested in a particular ecological facet of a specific sample point, the metric ratings estimate the degree of deviation from the natural range of variability (Table 1). If a slightly coarser approximation of ecological integrity is needed, those metrics can be rolled up into six "major ecological factors": Landscape, Buffer/Edge, Vegetation, Hydrology, Soil, and Size. In turn, the major ecological factors are aggregated into three primary rank factors: Landscape Context, Condition, and Size. Landscape Context and Condition are integrated to reach the EIA rank. For EO assessment areas that extended beyond the NWCA plots, Size was brought in at the end to calculate the overall EO Rank, which approximates the conservation significance of the site.

To summarize, if you want to know the onsite ecological condition of a particular assessment area, look at the condition score. If you want to know the overall ecological integrity, look at the EIA Rank. If you want to know the statewide/global conservation significance of the full extent of the occurrence, look at the EO Rank (and consult the conservation status rank for that ecosystem). Users of the EIA data are encouraged to read the comments associated with each metric rating, to get a full understanding of the stressors and ecological processes considered by the surveyor.

When processed NWCA plot data are available, we should be able to delve into a number of questions related to our EIA and FQA data:

- How well do the level 2 EIA hydrology metrics (HYD1, HYD2, HYD3) approximate water quality on site when compared with lab-measured water chemistry results?

- How many species are typically missed when using the "site walkthrough" approach—employed for most level 2 EIAs—when compared to intensive fixed-plot relevés, or vice versa? Do those missed species typically impact EIA or FQA results? How do cover estimates diverge?

- How well does the level 2 Soil Condition (SOI) metric capture impacts recorded in the NWCA soil pits?

- How do results compare between primarily GIS-based EIA landscape context metrics and on-the-ground NWCA buffer plots?

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