# VALIDATION OF A RAPID WETLAND ASSESSMENT PROTOCOL FOR UTAH: TESTING INTER-OBSERVER AND INTRA-SEASON VARIABILITY

*by Diane Menuz and Miles McCoy-Sulentic*

**REPORT OF INVESTIGATION 278**
**UTAH GEOLOGICAL SURVEY**
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*Cover photo: Pond near the shore of Great Salt Lake on land owned by The Nature Conservancy where training was conducted for the large group testing.*

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# VALIDATION OF A RAPID WETLAND ASSESSMENT PROTOCOL FOR UTAH: TESTING INTER-OBSERVER AND INTRA-SEASON VARIABILITY

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## ABSTRACT

Wetland rapid assessment protocols have been developed by many states to assess the function and condition of wetland resources. Rapid assessment methods allow information to be gathered at a large number of sites for a relatively small investment of time and money. In 2017, the Utah Geological Survey (UGS) undertook a major effort to assess the repeatability and reproducibility of the Utah Rapid Assessment Procedure (URAP), a rapid assessment method developed and used by the UGS in Utah. Repeatability is particularly important because the UGS is considering using surveyors outside of the agency, including scientists from other agencies and citizen scientists, to help collect URAP data. The goals of the project were to 1) assess the repeatability of the protocol within and across teams of UGS employees and external stakeholders, 2) evaluate the consistency of results at different times of the year, and 3) identify individual metrics that need refinement. Four URAP components were evaluated for the study, including wetland condition metrics, sensitive amphibian habitat metrics, and checklists for water quality improvement and wildlife habitat.

We tested inter-observer variability within and between two UGS teams at 11 sites ("UGS testing") and among four to six UGS and external teams at six sites ("large group testing"), and we tested within-season variability at six sites visited three times each by one team ("repeat testing"). For the within-team UGS testing, two individuals assessed each site separately and then compared answers with one another and came up with a consensus rating. The consensus rating was then used to compare results across the two UGS teams. Only consensus results were used for the large group and repeat testing. We used Krippendorff's alpha (α) to evaluate agreement among observers, teams, and visits; a Krippendorff's α value of 1 indicates perfect agreement and a value of 0 indicates agreement no better than chance.

Metric agreement was generally high within UGS teams, low across UGS teams, and lowest in the large group testing; 28% and 44% of metrics across all URAP components had slight to poor agreement ($\alpha < 0.40$) in the across-UGS teams and large group testing, respectively. Despite this disagreement, overall condition and amphibian habitat scores, calculated from individual metrics, were almost always substantial or near-perfect ($\alpha > 0.60$). We also found that survey results were similar regardless of the time of year of the survey; in the repeat testing, 77% of all metrics had moderate or higher ($\alpha > 0.40$) agreement and the overall condition and amphibian habitat aggregated scores all had substantial or higher agreement.

Several steps could be made to improve metric rating consistency, including making sure surveyors walk an adequate portion of the site and buffer before evaluating metrics, providing more training, providing additional reference material with photo guidance, and rewording some of the inconsistently rated metrics. Furthermore, because it appears that observers become calibrated to one another over time due to the higher within-team agreement compared to across teams, it is important that, when multiple teams are using URAP, they periodically survey a site together to stay calibrated with one another. If individuals outside UGS want to collect the

URAP data, they should participate in more intensive initial training and periodic refresher training to ensure continued correct and consistent use of the protocol. Though limited by the relatively small sample size, this study provides clear recommendations of which metrics are working well and which need improvement and instills confidence that overall condition and amphibian habitat scores are robust across surveyors and times of the year.

## INTRODUCTION

Wetland rapid assessment protocols have been developed by many state wetland programs as a method to assess and monitor the function and condition of wetland resources. Rapid assessment methods, when appropriately calibrated with more intensive monitoring data, allow information to be gathered at a large number of sites for a relatively small investment of time and money. However, rapid assessment protocols typically rely on qualitative metrics for evaluation and are specific to regions and programs, thus metric validation is important for each program to determine the reliability and repeatability of their assessment protocol. Validation of rapid assessment metrics in other protocols has been shown to be valuable not only to demonstrate the utility of rapid assessment metrics, but also to highlight those metrics which may need refinement (Fennessy and others, 2007; Lemly and Rocchio, 2009; Stein and others, 2009; Bourdaghs, 2012). While the Utah Rapid Assessment Procedure (URAP), a wetland rapid assessment method, has been calibrated against other measures of wetland condition (Menuz and others, 2016), an exploration of inter-observer and temporal variability is needed to provide data to refine methods and metrics to ensure repeatability.

The Utah Geological Survey (UGS) began developing URAP in 2014 as a tool to rapidly assess the condition of Utah's wetland resources. The initial protocol was largely based on one used by the Colorado Natural Heritage Program (Lemly and Gilligan, 2013) based on the Ecological Integrity Assessment developed by NatureServe (Faber-Langendoen and others, 2008). Wetland condition data are collected using a series of qualitative or semi-quantitative metrics. Each metric is composed of a series of potential states, ranked from A through D, to denote a range of condition from pristine unaltered wetlands to severely altered wetlands that may have little conservation value and be extremely difficult to restore. Metrics are divided into five categories: landscape context, hydrologic condition, physical structure, vegetation structure, and plant species composition. The UGS added metrics to assess habitat for sensitive amphibian species to the protocol in 2015 and 2016 (Menuz and Sempler, 2018) and developed draft methods for wildlife habitat and water quality improvement functionality in 2017 (Menuz, 2017). The latter two components were developed as simple checklists of indicators rather than more complex multivalued metrics due to feedback from a working group meeting; stakeholders thought more complex approaches would be too difficult to validate and simple approaches would be more repeatable across observers (Menuz, 2017). Repeatability is particularly important because the UGS is considering using surveyors outside of the agency, including scientists from other agencies and citizen scientists, to help collect URAP data. The latest version of the URAP User's Manual is found in appendix B of Menuz and Sempler (2018).

The UGS undertook a major effort to assess URAP in 2017 to evaluate the repeatability and reproducibility of the protocol. The goals of the project were to 1) assess the repeatability of the URAP protocol within and across teams of UGS employees and external stakeholders, 2) evaluate the consistency of results at different times of the year, and 3) identify individual metrics that need refinement. Four URAP components were evaluated for the study, including wetland condition metrics, sensitive amphibian habitat metrics, and checklists for water quality improvement and wildlife habitat functions. We also conducted a small study comparing the use of a water quality checklist versus a metric-based assessment.

## METHODS

### Survey Sites

We tested inter-observer variability within and between two UGS teams at 11 sites ("UGS testing") and among four to six UGS and external teams at six sites ("large group testing") (figure 1). The 11 sites tested only by UGS teams were previously surveyed by the UGS in 2015 or 2016 and were subjectively selected to span a range of conditions and wetland types while being practical and efficient to access. To select these sites, previously surveyed sites were categorized into low, moderate, and high score categories for four wetland condition categories—landscape, hydrologic, soil, and vegetation structure—based on previously collected data. We selected at least one site in each combination of score and condition category while simultaneously eliminating sites that would be logistically challenging to access, except that we did not have a low scoring site in the Vegetation Structure category due to lack of available sites. The selected sites were within 75 linear miles of the UGS office in Salt Lake City and all but one were within about 300 m of the nearest mapped road.

The six sites used for the large group testing were primarily selected for logistical reasons to make access easy for non-UGS volunteers who conducted some of the work, while also representing a range of wetland types. We selected pairs of wetland sites located very close to one another to enable teams of volunteers to survey two sites in one day. Large group testing sites included two new sites at Farmington Bay Waterfowl Management Area, two new sites on the Uinta-Wasatch-Cache National Forest in Big Cottonwood Canyon, and two previously surveyed sites at the Swaner Preserve.

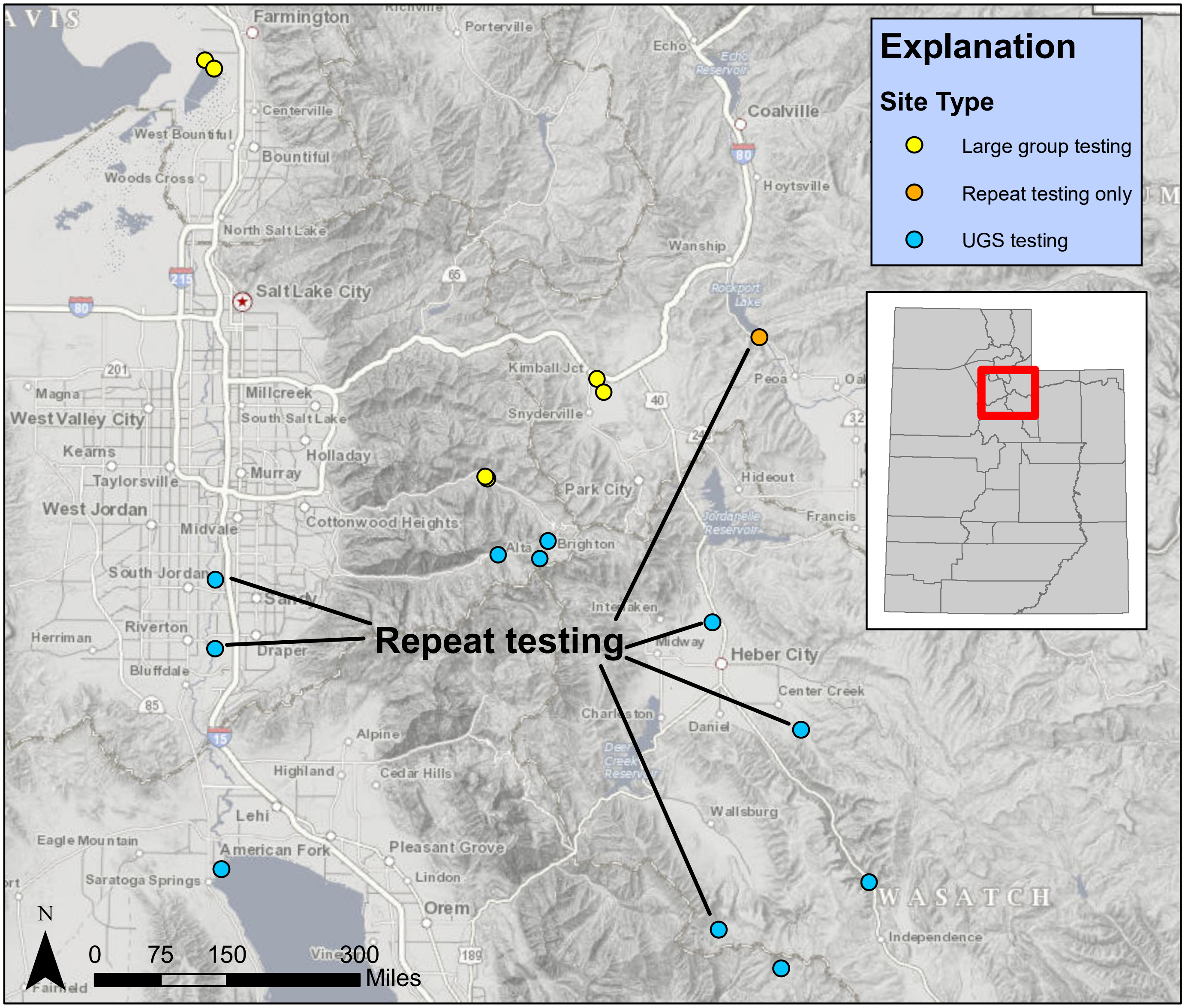


***Figure 1.*** *Sites surveyed for the wetland assessment protocol test, color-coded by the observer groups used for testing. The red box on the inset map indicates the location depicted on the main map.*

Six sites were surveyed three times in 2017 to compare within-season URAP scores ("repeat testing"): two wet meadows, two shrublands, one alkaline depression, and one emergent marsh. The repeat testing sites were a subset of 19 sites surveyed as part of an assessment of methods for collecting wetland vegetation data (McCoy-Sulentic and Menuz, 2019). The 19 sites were selected using similar logistical considerations as those discussed above and stratified by wetland type (wet meadow, shrubland, alkaline depression, and marsh), and had to meet the following requirements: 1) have a minimum of five species, 2) are not dominated by a single species, 3) represent low, medium, and high diversity for the wetland type, and 4) be at least 0.3 ha in area. The subset used for repeat testing (of both URAP and vegetation data) included two sites of each of the more diverse wetland types and one site each of the less diverse types and were logistically some of the easiest to revisit. Each site was surveyed once in June or July, once in August, and once in September; surveys of the same site were always at least 25 days apart. At two sites, amphibian habitat and wildlife indicator checklist data were only collected during the second and third visit.

## Field Methods

Two teams of two UGS employees each conducted the within- and between-UGS team testing. The "experienced team" received multiple days of field and office training on the protocol and used the protocol at least 16 times in the field before testing commenced. The "novice team" received one day of training on soils with a Natural Resources Conservation Service soil scientist, several hours of training on URAP in the office, and one full day of training on URAP in the field, all of which was also attended by the experienced team. Three teams of UGS employees, including the experienced and novice UGS teams and a third team composed of one very experienced and one novice employee, surveyed all six of the large group testing sites. Seven other teams composed of volunteer natural resource professionals from a variety of entities ("external teams") each surveyed one or two of the large group testing sites. All members of the external teams participated in a half-day training before conducting assessments. Five of the seven teams had at least one team member who rated themselves as experts in their knowledge and experience with wetlands as well as at least one person who rated themselves as experts or near-experts with noxious weeds and other plant species.

Sites were set up as one of three plot types: 40-meter circular, rectangular, and freeform. Circular plots were established by flagging the plot boundaries 40 meters in each of the cardinal directions from the plot center point, and rectangular plots were established by flagging the corners and midpoints of the sides. Freeform plots were established by using spatial data from a tablet personal computer to determine and flag site boundaries from previous survey boundaries. For the inter-observer variability testing, sites were flagged by the first survey team and removed by the last survey team so that teams were evaluating the same plots. The same site was surveyed by all teams within two days of one another for the internal UGS testing and within about one week for the large group testing to maintain consistent conditions. For the sites surveyed for the repeat testing, flagging was removed between survey visits.

Survey teams were provided with identical site packets having descriptive background information along with maps of the site, buffer, and larger landscape, and were instructed to use those data in combination with field observations to fill out URAP forms (appendices A and B). Surveyors collected data on descriptive site information, water quality and wildlife indicators, condition metrics, amphibian habitat metrics, and dominant and noxious plant species. At the UGS testing sites, each surveyor conducted their assessment independently and then consulted with the other surveyor to record a consensus result; at the large group testing sites, teams only recorded consensus results. We used detailed vegetation data collected by the experienced team and described in McCoy-Sulentic and Menuz (2019) to rate the two vegetation composition metrics in the repeat testing; these two metrics were not rated in the UGS testing. Descriptive information was only collected by the team, not individuals, and included 1) classification of sites by Ecological System and hydrogeomorphic class, 2) wetland origin (four classes ranging from natural to completely artificial), 3) grazing status (four classes ranging from never grazed to grazed during current year), and 4) estimates of actual and potential water cover by water depth. Surveyors at the UGS testing sites also obtained soil electroconductivity measurements by mixing one part soil with five parts distilled water, allowing the soil to settle, and then taking a measurement with a multiparameter probe. We requested feedback on the protocol from the external team members at the conclusion of the study.

## Data Analysis

Variability of metric responses was assessed using Krippendorff's alpha (α), a reliability coefficient used to measure agreement among observers. A Krippendorff's α value of 1 indicates perfect agreement and a value of 0 indicates agreement no better than chance (Krippendorff, 2011). Krippendorff's α works with two or more raters and with nominal, ordinal, and interval data and can handle incomplete datasets. We calculated an overall buffer score from the four buffer subcomponent metrics (buffer soil, buffer vegetation, buffer width, and percent buffer) and converted buffer scores to ranks using the formulas described in Menuz and Sempler (2018). Ranks for all metrics were transformed to numerical values as follows: A & AB = 5, A- = 4.5, B = 4, C = 3, C- = 2, D = 1. Ratings of "not applicable" were treated as missing data. Checklist metrics, recorded as present or absent, were transformed to 1 and 0, respectively. Krippendorff's α was calculated using the "irr" package (Gamer and others, 2012) in the statistical software R (R Core Development Team, 2016) using data type "ordinal" for metrics having more than two options and data type "nominal" for checklist indicators. Five Krippendorff's α values were calculated for each metric and checklist item, one for each of the UGS teams to compare within-team agreement, one for across-UGS-team agreement, one for the large group testing agreement, and one for the repeat testing agreement.

We also calculated Krippendorff's α values for aggregated wetland condition and amphibian habitat. We calculated categorical condition scores in the landscape, hydrologic, vegetation structure, and vegetation composition condition categories by taking the mean value of all metrics rated within a particular category, following the methods described in Menuz and Sempler (2018) and using the mean value of the buffer vegetation condition metric from the second and third visit to estimate this metric at the first visit at two sites due to missing data. We only calculated the vegetation composition score for the large group testing and repeat visits since one of the two metrics in this category was not evaluated in other tests. We then calculated the overall condition score as the mean of the soil disturbance metric and the four categorical scores (using just the noxious weed metric when the vegetation composition score was missing). We calculated Krippendorff's α for the categorical and overall scores using the data type "interval." We also converted the numeric overall score to rank scores by rounding scores to the nearest whole number, except that scores <2.5 were given a value of 1 instead of 2, and calculated Krippendorff's α using data type "ordinal" on the rank scores.

For the amphibian metrics, we converted the slope/water depth, north shore, and Columbia spotted frog waterbody vegetation metrics to values of 1 if the waterbody type for the associated species was rated as 1 and then took the mean values across the relevant metrics for each species. Values were then converted to 1 if they were equal to or greater than thresholds of habitat suitability determined from previous work for each species (Menuz and Sempler, 2018) using thresholds of 3.5 for Columbia spotted frog and 3.8 for boreal toad.

We classified Krippendorff's α scores as indicating poor, slight, moderate, substantial, and near perfect agreement based on thresholds modified from those used by the Colorado Natural Heritage Program in a similar validation exercise (table 1; Lemly and Rocchio, 2009). We also examined the degree of variability in metric rating because Krippendorff's α penalizes datasets where coders do not vary much in their responses (Krippendorff, 2004). For example, if one team rated a metric as A at 11 sites and a second team rated the same metric as A at all but one site, that metric would get a Krippendorff's α of 0, regardless of whether the rating at the last site was B or F. Conversely, a metric would get a value of 1 if both observers always rated a metric as B, even though that metric may not be working well. Low variability in responses may indicate either that testing sites did not represent a broad enough range of conditions for the specific metric, that narratives need improvement to facilitate better distinction for the user, or that the raters themselves were unreliable and not varying in their responses. In general, the effect of lack of variability on Krippendorff's α scores is less pronounced for comparisons involving three or more "observers" (e.g., large group testing and repeat visits).

***Table 1.*** *Thresholds used to interpret Krippendorff's α values for observer agreement.*

| Krippendorff's α | Agreement Level |
|---|---|
| >0.80–1 | Near-perfect |
| >0.60–0.80 | Substantial |
| >0.40–0.60 | Moderate |
| >0.20–0.40 | Slight |
| ≤0.20 | Poor |

# RESULTS

## Site Descriptive Information

Agreement in responses to site descriptive information varied. Classification by Ecological System was only tested between the two UGS teams, which agreed at six of 11 sites. Hydrogeomorphic classification agreed between UGS teams at all 11 sites, but only had perfect agreement among teams at two of the six large group testing sites. Responses varied greatly at the other sites with no more than two teams selecting the same response for any given site. Wetland origin showed perfect agreement at 64% of UGS testing sites and 50% of large group testing sites, and only one site, a large group testing site, had responses that differed by more than one rank. Grazing status showed perfect agreement at 73% of UGS testing sites but none of the large group testing sites, though only one UGS site and one large group site had responses that differed by more than one rank. Never grazed and historically/rarely grazed were frequently used on the same site and all four potential responses were used at one site. Soil electroconductivity measurements were collected at 10 UGS testing sites and ranged from 31 to 3970 uS. Measurements between teams were strongly correlated (r = 0.92) and differed by <160 uS at six sites, but by over 320 uS at the remaining sites.

Teams varied considerably in their estimates of both actual and potential water at survey sites. At UGS testing sites, teams disagreed on estimates of actual shallow (<20 cm) water cover by a mean of 17.2% and on actual deep water cover by a mean of 2.2%, though only four sites were recorded as having any deep water. In the large group testing, the difference between the maximum and minimum water cover estimates across groups was 15.7% for shallow water and 1.8% for deep water; all teams agreed that three sites had no surface water present. However, estimates of shallow water were 0%, 40%, and 75% at one site (not all teams provided estimates). Potential cover estimates showed even more variability, especially for the large group testing. At UGS testing and large group testing sites, respectively, estimates differed by a mean of 28.3% and 72.8% cover for potential shallow water and 5.6% and 22.5% cover for potential deep water. Estimates at large group testing sites were considerably better if the most anomalous estimate was dropped from each site, resulting in mean differences of 22.0% for potential shallow and 3.0% for potential deep water cover.

## Condition Metrics

For the individual condition metrics, Krippendorff's α agreement was highest for the experienced UGS team, which had substantial or better agreement on 70% of metrics, and lowest in the large group testing (table 2). Half or more of the metrics had slight or worse agreement across UGS teams and in the large group testing. Agreement was moderate or higher for all four observer comparisons for five metrics: dry algae, buffer width, hydroperiod, timing of inundation, and soil disturbance, but slight or worse for three of four comparisons for three metrics: buffer soil condition, wetland connectivity, and turbidity (appendix C, table C1). Agreement in overall condition scores calculated from the metrics was substantial or higher for all comparisons for the raw scores and somewhat lower for the rank scores (table 3). Agreement in categorical scores was more variable, with poor agreement on landscape and vegetation structure categories for the large group testing and vegetation structure category for the UGS team testing, moderate agreement for three category-testing combinations, and substantial or higher agreement elsewhere.

***Table 2.*** *Percent of metrics in each Krippendorff's α category for different components of the URAP wetland assessment protocol across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Cells are shaded gray if ≥50% of the metrics were rated as substantial or higher or ≥25% of the metrics were rated slight or worse to highlight high and low performing components. Total number of metrics indicated for each protocol component.*

| Krippendorff's α | Experienced Team (%) | Novice Team (%) | UGS Teams (%) | Large Group (%) | Repeat (%) |
|---|---|---|---|---|---|
| Condition (n=20, n=21 for large group and repeat testing) | | | | | |
| >0.80–1 | 45 | 30 | 15 | 5 | 29 |
| >0.60–0.80 | 25 | 20 | 25 | 19 | 38 |
| >0.40–0.60 | 20 | 35 | 10 | 14 | 19 |
| >0.20–0.40 | 0 | 10 | 25 | 29 | 5 |
| ≤0.20 | 10 | 5 | 25 | 33 | 10 |
| Amphibian Habitat (n=12) | | | | | |
| >0.80–1 | 42 | 50 | 17 | 17 | 67 |
| >0.60–0.80 | 33 | 17 | 33 | 25 | 17 |
| >0.40–0.60 | 8 | 25 | 25 | 17 | 0 |
| >0.20–0.40 | 8 | 0 | 17 | 8 | 8 |
| ≤0.20 | 8 | 8 | 8 | 33 | 8 |
| Wildlife Checklist (n=63) | | | | | |
| >0.80–1 | 51 | 67 | 41 | 11 | 25 |
| >0.60–0.80 | 11 | 16 | 13 | 10 | 22 |
| >0.40–0.60 | 5 | 10 | 11 | 22 | 10 |
| >0.20–0.40 | *6* | 2 | 6 | 16 | 11 |
| ≤0.20 | 27 | 6 | 29 | 41 | 32 |
| Water Quality Checklist (n=23) | | | | | |
| >0.80–1 | 57 | 39 | 43 | 0 | 30 |
| >0.60–0.80 | 13 | 52 | 0 | 9 | 26 |
| >0.40–0.60 | 0 | 0 | 22 | 26 | 26 |
| >0.20–0.40 | 4 | 0 | 4 | 30 | 9 |
| ≤0.20 | 26 | 9 | 30 | 35 | 9 |

***Table 3.*** *Krippendorff's α values for agreement in presence of amphibian habitat and overall wetland condition and categorical scores across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Agreement in amphibian habitat suitability was evaluated as the presence or absence of suitable habitat based on threshold mean habitat metric values. Wetland condition score agreement was evaluated for both the rank and raw score for overall condition and for the raw score for the categorical components.*

| Protocol Component | Experienced Team | Novice Team | UGS Teams | Large Group | Repeat |
|---|---|---|---|---|---|
| *Wetland condition score and categorical components* | | | | | |
| Overall condition score (rank) | 0.84 | 0.69 | 0.38 | 0.62 | 0.54 |
| Overall condition score (raw) | 0.90 | 0.77 | 0.71 | 0.62 | 0.91 |
| Landscape score | 0.84 | 0.54 | 0.80 | 0.15 | 0.82 |
| Hydrologic score | 0.94 | 0.77 | 0.46 | 0.66 | 0.77 |
| Vegetation structure score | 0.65 | 0.68 | 0.16 | 0.15 | 0.70 |
| Vegetation composition score | | | | 0.46 | 0.84 |
| *Amphibian habitat suitability* | | | | | |
| Columbia spotted frog habitat | 1 | 0.82 | 0.79 | 0.27 | 1 |
| Boreal toad habitat | 0.73 | 1 | 0.71 | 0.44 | 1 |

Fourteen of twenty-one condition metrics had substantial to near-perfect agreement in the repeat testing (table 2) and agreement was near-perfect for the overall condition, landscape, and vegetation composition scores and substantial for the remaining categorical scores (table 3). Turbidity and woody regeneration had poor agreement, dry algae had slight agreement, and wet algae, buffer soil, overall buffer, and timing of inundation had moderate agreement (appendix C, table C1). Some low Krippendorff's α values reflect actual temporal changes in some metrics. For example, ratings on the dry algae metric improved at one reservoir lake fringe site where large algal mats had been deposited as water receded in the spring. During subsequent visits, the algal mats were increasingly decomposed and obscured by vegetation growth.

## Amphibian Metrics

For the amphibian habitat metrics, Krippendorff's α agreement was highest for the experienced UGS team, which had substantial or higher agreement on three-quarters of metrics, and lowest in the large group testing, though the novice UGS team had the lowest percent of metrics having slight or worse agreement (table 2). Agreement was moderate or higher for all four comparisons for five metrics—livestock, toad waterbody type, toad hibernation features, toad forb cover, and toad shrub cover—and slight or worse for at least three comparisons for waterbody substrate and waterbody slope and depth. Agreement on the presence of amphibian habitat was substantial to near-perfect or perfect for all testing combinations except the large group, which had slight agreement for Columbia spotted frog habitat and moderate agreement for boreal toad habitat (table 3). Columbia spotted frog and boreal toad habitat agreement could not be evaluated at two and five of the UGS testing sites, respectively, due to missing data.

Eight amphibian habitat metrics had near-perfect or perfect agreement in the repeat visit survey, two had moderate agreement, and two, waterbody vegetation and waterbody slope and depth, had slight or worse agreement (appendix C, table C2). Agreement on the presence of amphibian habitat was perfect for both the Columbia spotted frog and boreal toad, though boreal toad habitat was only rated at two of the six sites (table 3).

## Wildlife Indicator Checklist

Agreement on wildlife indicator checklist items was highest for the novice team, which had substantial or greater agreement on 83% of indicators, and lowest for the large group testing (table 2). At least one of the two UGS teams had no variation in their responses to almost half of the wildlife indicators in the across-UGS-team comparison, including about two-thirds of all indicators that had poor agreement (appendix C, table C3). Agreement was moderate or higher for all four comparisons for 17 of the indicators, including for three metrics that frequently had little variation in scoring, and agreement was slight or worse for at least three of the four comparisons for 11 metrics. Five of the ten poorest scoring checklist items, based on the average value across the four observer comparisons, related to whether particular habitat types important for different taxonomic groups were present within 1 km of sites. Other poorly performing items included statements related to the presence of shallow emergent water, upland habitat, gradual shorelines, and animal burrows. The best performing checklist items included (1) items regarding whether year-round water was available at depths appropriate for specific wildlife species, (2) observations of beaver, wading birds, and secretive marsh birds, (3) grazing disturbance, and (4) presence of mudflat and shrubs.

Forty-three percent of the checklist items had slight to poor agreement in the repeat testing. Twenty metrics were rated as poor, including 13 that had very low variability in responses. Five of the six worst performing items were those related to habitat within 1 km of sites. Other poorly performing indicators included indicators related to problematic plant species, submerged aquatic vegetation, shallow open water, barriers to aquatic connectivity, structural complexity in dry parts of the assessment area, hydrologic manipulations, and species observations for six taxonomic groups. There were no obvious relationships between time of visit and metric scores; e.g., cover of submerged aquatic vegetation did not increase or decrease across site visits across all sites.

## Water Quality Function Indicator Metrics

Agreement on the water quality indicator checklist was very high for each of the UGS teams—≥70% or more of the items had substantial or higher agreement—but relatively poor across UGS teams and very poor in the large group testing (table 2). Eight of the 24 checklist items had no variability for at least one of the four observer comparisons. The three poorest performing metrics were related to short herbaceous vegetation cover, whether site receives water from impaired waterbody, and whether site receives other sources of pollutants (appendix C, table C4). Five metrics had moderate or higher agreement for all four observer comparisons.

Substantial or better agreement was found in 56% of items in the repeat testing and 18% of the items had slight to poor agreement. Three of the four worst performing metrics in the repeat testing had moderate or better agreement across observers, including top 5 cm of soil true clay or true organic, surface depressions trapping sediment, and shallow slope, while one item, other sources of pollutants entering wetland, performed poorly in all comparisons. Conversely, the short herbaceous vegetation cover metric, which potentially could be dynamic across a field season, performed well in the repeat testing, but poorly across observer groups (appendix C, table C4).

### Feedback from the External Team

We received feedback about the URAP protocol from five members of external teams. Respondents reported that they had received an adequate amount of training and felt at least moderately confident in their ability to rate each component; the highest levels of reported confidence were for the wildlife and water quality checklists and slightly lower confidence for the condition and amphibian metrics. Respondents also expressed some confusion in the format of the wildlife indicator checklist and had feedback on individual components and the organization of the forms.

## DISCUSSION

This study provides important information on the validity of the URAP assessment method. While some of the individual condition and amphibian habitat metrics showed substantial variability across observers and site visits, agreement in overall condition scores and estimates of potential habitat suitability were always substantial or higher (except for amphibian habitat for the large group testing). These results are similar to results from a test of a wetland rapid assessment protocol in Colorado, where agreement in the overall condition score was 0.62 although 42% of individual metrics had Krippendorff's $\alpha$ values $\leq 0.40$ (Lemly and Rocchio, 2009). There is no current method for summarizing the wildlife or water quality indicator checklists, so we were not able to perform a similar analysis with those components. We also found that survey results were similar regardless of the time of year of the survey; 82% or more of all metrics for all but the wildlife checklist component had moderate or higher agreement and the overall, categorical, and amphibian habitat aggregated scores all showed substantial or near-perfect agreement. Most, though not all, of the assessed components did not appear to vary across the study season, which ranged from June 19 through September 19.

Several general recommendations for changes in metrics and training arose from this study. First, surveyors need more information on when metrics should be rated versus marked "not applicable" for metrics such as woody species regeneration, algae cover, and amphibian habitat (which is dependent on whether the site is within the expected range of the focal species). Second, many of the landscape condition metrics could be improved by ensuring that surveyors walk an adequate portion of the buffer and clarifying which land cover classes count as buffer land cover, particularly for dirt roads, hay fields, and other lower intensity cover classes. Third, surveyors would likely benefit from having more photo guidance in the field for metrics such as turbidity, slope and water depth, and algae cover. Surveyors at UGS watch a presentation as part of their training that includes photographs with examples of many metrics, but they may benefit from being able to access the images more easily in the field. The UGS is moving towards collecting data on tablet forms and may be able to directly integrate more photos into the forms. Fourth, surveyors likely need more training on how to use and interpret the office evaluation data provided to them. Water quality metrics related to whether a wetland is in a basin with known water quality issues (e.g., on 303d list) or whether there is critical habitat for sensitive species should come directly from the office evaluation data and yet there was disagreement across observers on these metrics. It would be beneficial to develop a more robust user's guide for URAP that includes all the newer components; the current user's manual mainly focuses on the condition metrics. Fifth, some metrics should be reworded for greater clarity or even potentially removed. See appendix C for specific recommendations for individual metrics.

In addition to changes in metrics and training, we have several recommendations for other changes in the URAP process. The presence of two observers at a site could have increased agreement across teams by having two people to notice wetland features or remember details of the protocol. Instead, we found that agreement of observers within teams was considerably higher than agreement across teams. This result suggests that observers may become calibrated to one another over time since observers talked about their responses at the end of each site visit. If multiple teams are conducting wetland assessments for the UGS within a field season, we recommend that teams periodically meet up to survey a site together to test calibration and that team members potentially be moved between teams. If individuals outside of the UGS want to collect URAP data, they should participate in more intensive training and they should periodically participate in refresher training to ensure continued correct and consistent use of the protocol. We also recommend substantially revising the wildlife indicator checklist and to consider using a metric-based approach for evaluating function rather than checklists (appendix D). We found no evidence that the checklist approach performed better than metrics. The two checklists had the highest percent of components rated as poor in the UGS team and large group testing and the wildlife indicator checklist also had the most disagreement in the repeat visit data.

Several limitations should be acknowledged with this study. First, the study had small sample sizes, with typically only two observers or teams involved in most comparisons and only six sites used for the large group and repeat visit testing. Sample size was decreased even further for metrics that were scored as not applicable. Small sample size limited our ability to test metrics that lacked variability in ratings. Second, all UGS employees testing the protocol, except for one of the employees involved in the large group testing, were new to working with wetlands in Utah. The test was therefore a good test of the protocol's performance with new employees that had an aquatic resources background rather than performance with more experienced employees. Third, the tested protocol was a simplified version of the full field assessment that UGS employees usually conduct that focused on testing the different metrics in each component of the survey. The full field protocol involves one surveyor collecting soil profile and water quality data while a second surveyor spends an hour or more collecting intensive vegetation and ground cover data. One of the surveyors also typically walks four 100-m transects in each of the cardinal directions through the buffer. The more intensive data collection may facilitate better understanding of wetland sites and thus better agreement across observers, but that is untested by this study. Despite these limitations, this study provides clear recommendations of which metrics are working well and which need improvement and validation that overall condition and amphibian habitat scores are robust across surveyors and times of the year.

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# APPENDICES

# Appendix A
# Field Forms and Reference Cards Provided to Large Group Testing Participants

## Brief Description

The following forms were used to collect URAP data by the large group testing participants. Two modifications have been made to the original URAP forms. First, unique metric identifiers have been added to the wildlife and water quality checklists to match the results shown in appendix C. Second, for the wildlife checklist identifiers, a dash in a box indicates that the box should have been scored with the same value as the first box in the row and thus does not have its own unique identifier.

| UTAH RAPID ASSESSMENT PROCEDURE | |
|---|---|
| **Site ID:** | **Site Name:** |
| **Survey Date:** | **Surveyors:** |
| NAD83 Zone: | UTME: __ __ __ __ __ __ UTMN: __ __ __ __ __ __ __ |
| Ecological System: | HGM Class: |
| Classification comments: | |
| Is site whole-wetland? Yes No | Site area: ha |
| AA dimensions (circle one): 40-m radius circle Rectangle, width___, length___ Freeform (collect GPS track of edge) | |
| Photos: Collect photos and GPS coordinates at four locations on the edge of AA looking into site. | |
| Briefly describe rationale for site boundary if not whole wetland: | |
| **Composition of AA (should add to 100%)**<br>_____ % AA with target wetland<br>_____ % AA with non-wetland riparian area<br>_____ % AA with >1 m standing water<br>_____ % AA with upland inclusions | **Wetland origin (select one)**<br>___ Natural feature with minimal disturbance<br>___ Natural feature, but altered or augmented<br>___ Non-natural feature created by passive or active management<br>___ Origin unknown |
| **Livestock grazing (evaluate based on freshness of dung and tracks, presence of livestock and fencing, etc.)**<br>__ AA grazed in current year prior to survey<br>__ AA historically or rarely grazed | __AA likely routinely grazed but not yet grazed in current year<br>__ No physical evidence suggests that AA has ever been regularly grazed |

**Soil and Water Chemistry**

| | |
|---|---|
| **Soil profile data collected?** Yes No | |
| **Soil Salinity Measurement:** Collect soil sample from top 15 cm of soil near soil pit. Remove rocks and roots and homogenize. Add 50 ml distilled water to 50 ml soil sample (soil:water ratio of 1:1). Stir for one minute and allow to settle for 30 minutes. | |
| **EC after settling**:<br>_______ uS or mS | **Notes on reading:** |

**Site Hydrology**

| | |
|---|---|
| Actual cover of shallow water <20 cm: % | **Potential** cover of shallow water <20 cm at ordinary high water: % |
| Actual cover of deep water ≥20 cm: % | **Potential** cover of deep water ≥20 cm at ordinary high water: % |

SURFACE WATER TYPES PRESENT (circle all that apply)

| | | | |
|---|---|---|---|
| 1. permanent lake/pond | 2. temporary pool/pond | 3. active beaver pond | 4. inactive beaver pond |
| 5. springhead pool | 6. springhead channel | 7. stream/river | 8. ditch |
| 9. wet meadow with standing water | 10. depressional impoundment | 11. impoundment release (no channel) | 12. impoundment fringe |
| 13. other (describe): | | | |

MAX WATER DEPTH: NA <1 m 1 -2 m >2 m | PRIMARY SUBSTRATE: NA Silt/mud Sand/gravel Cobble Boulder/Bedrock

| *Water Type (#)* | *Stand. or Flow.* | *Depth of water (cm)* | *Lab Sample* | *pH* | *EC (uS)* | *Temp (°C)* | *Color[1]* | *Turbidity Tube (at water ≥20 cm deep)* | *Size of wetted area[2]* | *Avg. channel width (cm)* | *Notes/ Photo #s* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | S F | | Y N | | | | Cl Br Gr Re Bl Or | > *or* = (circle one): _____ cm | | | |
| | S F | | Y N | | | | Cl Br Gr Re Bl Or | > *or* = (circle one): _____ cm | | | |
| | S F | | Y N | | | | Cl Br Gr Re Bl Or | > *or* = (circle one): _____ cm | | | |
| | S F | | Y N | | | | Cl Br Gr Re Bl Or | > *or* = (circle one): _____ cm | | | |

[1]Colors include Cl (clear), Br (brownish), Gr (greenish), Re (reddish), Bl (blue), or Or (orange);
[2]Sizes of wetted area include 1. <10m$^2$ 2. 10-<100m$^2$ 3. 100-<1000m$^2$ 4. 1000-5000m$^2$ 5. >5000m$^2$

## SITE MAP

# WILDLIFE HABITAT CHECKLIST

Circle any observations made during surveys (including footprints, dens, etc.)

Aquatic: crayfish bullfrog salamander predacious fish (trout, bass, etc.) carp other

Terrestrial: snake feral cats raccoon/skunk fox coyote other

Other wildlife observations:

**Key to species:** 1 Wildlife in general; 2 Piscivorous birds (e.g., gull, tern, grebe, cormorant, pelican); 3 Diving ducks (e.g., redhead, goldeneye, ruddy duck); 4 Dabbling ducks (e.g., mallard, pintail, cinnamon teal); 5 Wading birds (e.g., egret, heron, ibis); 6 Secretive marsh birds (e.g., moorhen, coot, sora, rail, bittern); 7 Shorebirds (plover, sandpiper, stilt, avocet, curlew); 8 Amphibians; 9 Aquatic mollusks

**Fill in boxes with 1 if statement is true for site and 0 if false. Greyed boxes should be left blank. Consider within wetland site only unless stated otherwise. Asterisk indicates indicators that may vary by taxonomic group.**

| Indicator | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| **SPECIES OBSERVATIONS AT SITE** | | | | | | | | | |
| *Species in taxonomic group observed during site survey (list above, ducks grouped together) | | SO1 | SO2 | SO3 | SO4 | SO5 | SO6 | SO7 | SO8 |
| Dragonflies or damselflies observed at site. | SO9 | | | | | | | | |
| Beaver activity evident at site (dams, gnawed logs). | SO10 | - | - | - | - | | | - | |
| **SOCIETAL VALUE OF SITE (See office evaluation form)** | | | | | | | | | |
| *Site has potential to provide habitat for federal threatened or endangered or Utah sensitive species in group (based on range and wetland type). Enter 2 for T&E (including plants) and 1 for other state sensitive species. See https://dwrcdc.nr.utah.gov/ucdc/Links/maps.htm | SV1 | SV2 | | | SV5 | SV6 | SV7 | SV8 | SV9 |
| *Site has critical habitat mapped for a federal T&E species. | SV10 | | | | | | | | |
| **LANDSCAPE CONTEXT** | | | | | | | | | |
| Site gets water directly from stream and there are no major dams evident within 5 km upstream controlling water to site. Mark with a dash if not along stream (See office eval form) | LC1 | | | | | | | - | - |
| Barriers (such as above-grade culverts, levees) impeding aquatic connectivity are nonexistent or easily passed by most organisms. | LC2 | | | | | | | - | - |
| 30-m buffer of relatively intact vegetation and soils extends along at least 90% of the site perimeter (no roads [except very low use, vegetated], minimal unnatural bare soil, etc.) | LC3 | - | - | - | - | - | - | - | - |
| Site is surrounded by undisturbed or minimally disturbed land cover for approximately 300 m in all directions. Lightly grazed rangeland or pasture, low use tracks and unmaintained dirt roads, and low-use recreational areas can all be considered minimal disturbances | LC4 | - | - | - | - | - | - | - | - |
| At least 2/3rds of area within 1 km of site is *directly connected* to site and does not have high intensity development (e.g., urban/industrial areas, high-intensity agriculture (excluding haying/pasture), or high-intensity recreation (e.g., golf courses, ball fields). | LC5 | - | - | - | - | - | - | - | - |
| **SITE DISTURBANCE** | | | | | | | | | |
| Site not grazed or only lightly grazed by livestock or wild horses OR livestock known to be kept off site during key development periods for wildlife. | SD1 | - | - | - | - | - | - | - | - |
| Site does not appear routinely disturbed by activities such as mowing, mechanical plant removal, vehicle travel, dredging, excavation, filling of sediment, etc. | SD2 | - | - | - | - | - | - | - | - |
| Site not used or only lightly used for recreation (based on trash, trails, ATV tracks, etc.). | SD3 | - | - | - | - | - | - | - | - |
| **WATER QUALITY AND HYDROLOGY** | | | | | | | | | |
| Site doesn't have any noticeable water quality issues. No excessive (>20% cover in open water) filamentous algae and no evidence of turbidity, unnatural oil sheens, or other pollutants. Enter dash if water >10 cm depth not present at site. | WQ1 | - | - | - | - | - | - | - | - |
| There are no apparent hydrologic manipulations at site that are likely to artificially reduce water levels (local diversions, drainage, spring boxes, etc.) or severely alter water timing. | WQ2 | | | | | | | - | - |
| Site has perennial stream or canal within boundary or directly touching site edge. | WQ3 | - | - | - | - | | | - | - |
| Wetland includes springs that flow most of the year. | WQ4 | | | | | | | - | - |
| Shores of seasonally or permanently inundated waterbodies (streams, pools, ponds, lakes) are predominantly gradual creating a lot of area with shallow water (<10 cm) and a diversity of water depths when site is inundated. | WQ5 | | | - | - | - | - | - | |
| Site has areas of open water with structural features above the high water mark such as tufted litter, logs, or rocks that could provide shelter and habitat for wildlife. | WQ6 | - | - | - | - | | - | - | - |
| Submerged aquatic vegetation is found at site. | WQ7 | | - | - | - | | - | - | - |

**Key to species:** 1 Wildlife in general; 2 Piscivorous birds (e.g., gull, tern, grebe, cormorant, pelican); 3 Diving ducks (e.g., redhead, goldeneye, ruddy duck); 4 Dabbling ducks (e.g., mallard, pintail, cinnamon teal); 5 Wading birds (e.g., egret, heron, ibis); 6 Secretive marsh birds (e.g., moorhen, coot, sora, rail, bittern); 7 Shorebirds (plover, sandpiper, stilt, avocet); 8 Amphibians; 9 Aquatic mollusks

| **Indicator** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| **HABITAT TYPES PRESENT (OR ADJACENT/WITHIN 1 KM IF SPECIFIED BY INDICATOR)** | | | | | | | | | |
| **Habitat type must be present in spring (April, May, June) or Fall (July, August, September), or both. Water must be within indicated depth range for most of season. See office evaluation form for more information on site hydrology.** | | | | | | | | | |
| **Deep open water** (depth typically >35 to 100 cm). Can have submergents or floating species, but no emergents. If emergent water (as defined below) also present, open water must be clearly distinct from emergent water, not interspersed with it. | H21 | - | - | | | | | - | - |
| **Shallow open water** with submergent vegetation but no emergents (depth typically >10 to 35 cm). If emergent water (as defined below) also present, open water must be clearly distinct from emergent water, not interspersed with it. | HT2 | - | - | - | - | | - | - | - |
| **Deep emergent water** (depth typically >25 to 60 cm); approximately 20 to 50% emergent cover of cattails and bulrushes with the remaining open water or submergent vegetation. | HT3 | | - | - | | | | - | - |
| **Shallow emergent water** (depth typically 5 to 25 cm); approximately 20 to 50% emergent cover of alkali bulrush or other emergent species with the remaining area open water or submergent vegetation. | HT4 | | - | - | - | | - | - | |
| **Dense emergent water**; at least 70% cover of emergent species that are mostly 0.75-2 m tall; water predominantly 5 to 30 cm deep; if emergent also present, dense emergent must be clearly distinct from emergent water, not interspersed with it. | HT5 | | | | | - | | | |
| **Partially vegetated mudflat** (e.g., area with saltgrass, pickleweed, seepweed that is seasonally flooded and exposed). Water depth typically 0 to 5 cm and usually brackish. | HT6 | | | - | - | | - | | |
| **Wet meadow** (saline or alkaline, saturated or with surface flooding). Score two points if adjacent to one of the above open water or emergent wetland types. Typical meadow species include sedges, rushes, and saltgrass, as well as a mixture of grass species. | HT7 | | - | - | - | | - | - | |
| **Natural upland** within 100 m of and connected without disturbance to site. | HT8 | | - | - | | | - | | |
| *At least three of the above habitats are present within 1 km of site (including within site). Open water habitat only counts as one habitat, regardless of depth, and emergent water only counts as one habitat, regardless of depth. Only count habitats relevant to focal taxon. | HT10 | | HT12 | HT13 | HT14 | | HT16 | | |
| *Site typically has **open water** or **emergent water *year-round*** at one or more of the depth and vegetation combinations ideal for species (see list of above). | HT19 | | HT21 | HT22 | HT23 | HT24 | | HT26 | HT27 |
| **STRUCTURAL FEATURES** | | | | | | | | | |
| Undercut banks are present at site along intermittent or perennial watercourses (streams, ponds, lakes). | SF1 | | | | | | | - | - |
| Roosting structures are available at site, such as trees, shrubs, and standing snags. | SF2 | - | | | - | | | | |
| Animal burrows are readily apparent at site. | SF3 | | | | | | | - | |
| Features such as logs, tufted litter, and rocks that provide structural complexity at site are present in drier areas of wetland (providing cover and potential food sources). Enter dash if site all typically inundated. | SF4 | | | | | | | - | |
| **VEGETATION** | | | | | | | | | |
| Site has a diversity of plant species. Site not a near "mono"culture of only one or two predominant herbaceous or graminoid species with other species rare. Put a dash instead of 0 or 1 if site is unvegetated. | VE1 | - | - | - | - | - | - | - | |
| Problematic plant species, such as noxious weeds, are uncommon or absent (only one or a few individuals). LIST: | VE2 | - | - | - | - | - | - | - | |
| Site includes bulrush species such as *Schoenoplectus acutus*, *S. americanus*, or *S. maritimus*. | VE3 | | - | - | | - | | | |
| Trees are found growing in or along edge of wetland (woody species with DBH >7.5 cm). | VE4 | | | | | | | | |
| Wetland shrubs are growing within site (woody species with DBH<7.5 cm). | VE5 | | | | | | | - | |
| Woody vegetation recruitment healthy. Mixture of age classes (i.e., seedling, sapling, adult) present. Vegetation not limited to decadent/dying individuals. Examples of decadent vegetation include mushroom-shaped shrubs and very short woody plants with thick bases (from repeatedly being grazed or mowed down). Enter dash if site has no woody species. | VE6 | | | | | | | - | |

Site ID: Observers:

## WATER QUALITY FUNCTIONAL CHECKLIST

**Site HGM Class:**

**Check all indicators present at site (indicators in italics should be evaluated with office data).**

**Capacity to improve water quality**

☐ 1. The top 5 cm of soil is true clay (forming strong ribbon ≥5 cm before breaking) or true organic.

☐ 2. At least 1/2 of AA is covered by **persistent** (meaning dead stalks will be standing in winter) **herbaceous vegetation ≥13 cm tall** (~height of clipboard) and dense enough to obscure ground; estimate vegetation height based on likely flood season conditions. Ignore areas with water >1 m deep for percent estimates.

☐ 3. At least 1/3 of AA is covered by **persistent herbaceous vegetation ≥1 m tall** and dense enough to obscure ground (see definitions from above). Ignore areas with water >1 m deep for percent estimates.

☐ 4. At least 1/3 of AA has over-story cover from **tree or shrubs at least 1 m tall** (ignore stream channels).

☐ 5. At least 1/4 of AA is seasonally ponded (surface water ≥2 consecutive months, but drying annually).

☐ 6. Wetland is **lacustrine fringe**, **depressional impoundment fringe**, **depressional impoundment**, or **depressional** and waterbody either has no surface water outlet or an intermittently flowing outlet.

☐ 7. Wetland is **riverine** and at least 1/5 of wetland has surface depressions that can trap sediments during flooding events.

☐ 8. Wetland is **lacustrine fringe** or **depressional impoundment fringe** and the average width of vegetation (including aquatic bed) extending into the lake or impoundment is at least 5 m.

☐ 9. Wetland is **slope** or **impoundment release** and average surface slope is 1% or less (1.75°)

**Landscape potential**

☐ *10. There are homes within 75 m of wetland that are likely to be on septic system (outside special service district and municipal boundaries).*

☐ 11. Stormwater pipe directly feeds wetland.

☐ 12. At least 10% of the area within 50 m that could run-off to AA is in land use likely to generate sediment or nutrient (fertilizer, animal manure, etc.) runoff to site (cropland, dirt roads, pasture, clearcut forest, OHV tracks, golf course, etc.). If surrounding land use is pasture or rangeland, check box only if ≥10% of area has disturbed soils or if density of animal dung is very high.

☐ 13. At least 10% of the area within 50 m that could run-off to AA is in land use likely to generate pollutants besides nutrients/sediment (paved roads, parking lots, houses, commercial buildings, oil and gas wells, mines, etc.)

☐ 14. Wetland is immediately adjacent and hydrologically connected to a lake or impoundment used by power boats.

☐ 15. Wetland is immediately adjacent and hydrologically connected to lake or stream with known algal blooms issues[1].

☐ 16. There are other sources of pollutants coming into wetland not listed above. List:

**Sites connected via surface flow to streams/rivers (including lakes along rivers). Determine portion of wetland watershed between site and nearest upstream major tributary or lake; this will be the *contributing basin.***

☐ *17. Wetland is within an incorporated city.*

☐ *18. Wetland directly receives water from stream or lake listed as impaired.*

☐ *20. ≥10% of contributing basin is composed of land use likely to generate pollutants (see list above).*

☐ *19. ≥10% of contributing basin is composed of land use likely to generate sediment or nutrients (see list above).*

**Valued by society**

☐ 21. Wetland is within 50 m of and at least occasionally has surface water discharge to stream, river, or lake.

☐ *22. Wetland is in area designated as category 1 or category 2 for anti-degradation (see KMZ file at https://deq.utah.gov/water-quality/antidegradation-reviews-water-quality).*

**Use UDWQ's Beneficial Uses and Water Quality Assessment Map at https://mapserv.utah.gov/surfacewaterquality**

☐ *23. Wetland is in a Category 4 or 5 Assessment Unit.*

**Notes about likeliness of water quality improvement functioning:**

## CONDITION ASSESSMENT METRICS

### Dominant Plant Species

**List all plant species that are *dominant*, using the Army Corps 50/20 Rule. Dominant species are those that individually or together account for >50% of total coverage in the layer, plus any species that by itself comprises ≥20% of the total. If there is not ≥5% absolute cover in a layer, that layer is combined with another layer.**

| Layer | Abs. cover | 20% | 50% | Species in the example layer have a total of 30% absolute cover. All species in the layer with ≥6% cover must be recorded, and the total recorded cover for the layer should add up to at least 15%. |
|---|---|---|---|---|
| ***Example layer*** | ***30%*** | **(30%*0.2)= *6%*** | **(30%*0.5)= *15%*** | |
| trees (DBH ≥ 7.6 cm) | | **(__%*0.2)=__*%*** | **(__%*0.5)=__*%*** | |
| sapling/shrubs (DBH < 7.6 cm) | | **(__%*0.2)=__*%*** | **(__%*0.5)=__*%*** | |
| herbs/grasses | | **(__%*0.2)=__*%*** | **(__%*0.5)=__*%*** | |
| woody vines | | **(__%*0.2)=__*%*** | **(__%*0.5)=__*%*** | |

| Species (Scientific Name) | Layer (Tree, Shrub, Herb, Vine) | % Absolute Cover | Native? |
|---|---|---|---|
| | | | Y N |
| | | | Y N |
| | | | Y N |
| | | | Y N |
| | | | Y N |
| | | | Y N |
| | | | Y N |

### Noxious Plant Species. List all noxious weed species observed at site.

**Commonly seen noxious weeds in Utah's wetlands include poison hemlock (*Conium maculatum*), musk thistle (*Carduus nutans*), Canada thistle (*Cirsium arvense*), houndstongue (*Cynoglossum officinale*), whitetop *(Cardaria draba*), broadleaved pepperweed (*Lepidium latifolium*), Russian olive (*Elaeagnus angustifolia*), quackgrass (*Elymus repens*), common reed (*Phragmites australis*), and saltcedar (*Tamarix* spp.)**

| Species (Scientific Name) | % Absolute Cover |
|---|---|
| | |
| | |
| | |
| | |
| | |

### VEGETATION COMPOSITION

### Relative Cover of Native Plant Species

| Rank | State |
|---|---|
| AB | AA contains >95% relative cover of native plant species. |
| C | AA contains 80–95% relative cover of native plant species. |
| C- | AA contains 50–80% relative cover of native plant species. |
| D | AA contains <50% relative cover of native plant species |

Comments:

### Absolute Cover of Noxious Weeds

| Rank | State |
|---|---|
| A | Noxious weeds absent. |
| B | Noxious weeds present, but sporadic (<3% absolute cover). |
| C | Noxious weeds common (3–10% cover). |
| D | Noxious weed abundant (>10%) cover. |

Comments:

*Absolute cover* is the percent of the ground covered by the vertical projection of a plant species, i.e., the percent that would be shaded by plants if the sun were directly overhead. Small gaps in the canopy can be ignored, but cover estimates for dense vs. sparse stands should differ. *Relative cover* is a measure of cover in relation to other species within a set area or other grouping. *Relative cover of native plant species* is the percent of all plant cover that is composed of native species, e.g., if half of the plant cover was composed of natives and half non-natives, you would have 50% relative cover of native species.

Site ID: Observers:

| LANDSCAPE CONTEXT | |
|---|---|
| **Percent buffer (Evaluate at edge of AA; buffer must extend 10 m along perimeter and 10 m from edge of AA to count; see list of buffer land cover classes, below.)** | |
| **Rank** | **State** |
| A | Buffer land cover surrounds 100% of the AA. |
| A- | Buffer land cover surrounds >75–<100% of the AA. |
| B | Buffer land cover surrounds >50–75% of the AA. |
| C | Buffer land cover surrounds >25–50% of the AA. |
| D | Buffer land cover surrounds ≤25% of the AA. |
| Comments: | |

| **Buffer Width (Evaluate up to 100 m from AA edge)** | | | |
|---|---|---|---|
| **Transect** | **Length (m)** | **Rank** | **State** |
| N | | A | Mean width >95 m |
| NE | | A- | Mean width >75 and ≤95 m |
| E | | B | Mean width >50 and ≤75 m |
| SE | | C | Mean width >25 and ≤50 m |
| S | | D | Mean width <25 or no buffer exists |
| SW | | Buffer land cover includes all natural land cover, rangeland, vegetated pastures that are not subject to mechanical vegetation removal (but not feedlots or holding pens with mostly bare soil), low-use tracks at grade that are predominantly vegetated and not maintained, vegetated levees, natural substrate ditches, and recreational features with low substrate disturbance (narrow, natural substrate hiking or biking trails) | |
| W | | | |
| NW | | | |
| *Mean* | | | |
| Comments: | | | |

| **Buffer Condition- Soil and Substrate (Evaluate in *buffer land cover only* within 100-m of AA edge)** | |
|---|---|
| **Rank** | **State** |
| A | Intact soils. Unnatural bare patches, pugging, and soil compaction are absent or extremely rare with minimal impact (e.g. one or a few shallow vegetated single-use ATV tracks). Cryptobiotic soil, if expected, is present and undisturbed. |
| B | Moderately disrupted soils. Some amount of bare soil, pugging, compaction or other disturbance exists, but extent and impact are minimal. Areas with more severe disturbances are absent or rare |
| C | Extensive moderately disrupted soils. Areas with more severe disturbance may occur in a few sections of the buffer or disturbance may be more widespread and of moderate impact. |
| D | Unnaturally barren ground, highly compacted soils, or other severe soil disturbance covers a moderate to large portion of the buffer or more moderate disturbance covers the entire buffer. |
| NA | No buffer land cover present. |
| Comments: | |

| **Buffer Condition-Vegetation** (**Evaluate in *buffer land cover only* within 100-m of AA edge; collect dominant plant species if nativity unknown**) | |
|---|---|
| **Rank** | **State** |
| A | Abundant (≥95%) ***relative*** cover native vegetation and little or no (<5%) cover of non-native plants. |
| B | Substantial (≥75–95%) ***relative*** cover of native vegetation and low (5–25%) cover of non-native plants. |
| C | Moderate (≥50–75%) ***relative*** cover of native vegetation. |
| D | Low (<50%) ***relative*** cover of native vegetation. |
| NA | No buffer land cover present. |
| Comments: | |

| **Percent Intact Landscape (Evaluate buffer land cover directly connected to site within 500 m buffer)** | |
|---|---|
| **Rank** | **State** |
| A | Intact: AA embedded in >90–100% unfragmented, natural landscape. |
| B | Variegated: AA embedded in >60–90% unfragmented, natural landscape. |
| C | Fragmented: AA embedded in >20–60% unfragmented, natural landscape. |
| D | Relictual: AA embedded in ≤20% unfragmented, natural landscape. |
| Comments: | |

## HYDROLOGIC CONDITION

**Major Water Sources (only check those that are substantial contributors to sites, put a star by dominant water source if known)**

| *Natural Sources* | *Unnatural Sources* |
|---|---|
| ___ overbank flooding from channel | ___ irrigation via direct application (incl. managed ditch) |
| ___ overbank flooding from lake | ___ irrigation via seepage (e.g. leaking ditch) |
| ___ groundwater discharge/high groundwater from spring or seep | ___ irrigation via tail water run-off (irrigation return flows) |
| ___ alluvial aquifer (elevated water table, us. near river/stream) | ___ discharge from impoundment release |
| ___ natural surface flow | ___ urban run-off/culverts |
| ___ direct precipitation | ___ pipes directly feeding wetlands |
| ___ direct snowmelt | ___ other (list)________________________________ |

**Hydroperiod (Evaluate state in relation to natural hydroperiod- i.e. a week change in duration is much longer for a playa than for a marsh)**

| Rank | State |
|---|---|
| A | The hydroperiod, including frequency and duration of inundation and drawdown, within the AA is natural. There are no major hydrologic stressors that impact the hydroperiod. There may be long-established, distant sources of groundwater or surface water extraction within contributing area to the AA, but these only have minimal impact on dampening the water levels in the AA and do not change the overall pattern of water level fluctuation within the AA. |
| B | Hydroperiod is predominantly controlled by natural hydrologic processes, but deviates slightly from natural conditions. The duration may be slightly longer or shorter due to decreases or increases in the amount of water reaching the AA or due to minor modifications affecting the inflow and outflow of water. The frequency of major inundation periods within a year is natural, though there might be one or two fewer or additional minor peaks of inundation. The site may be somewhat more susceptible to a change in inter-annual inundation frequency, but only in response to more severe drought or flood years. Potential deviations include:<br>• Small decrease in inundation duration (e.g., small diversions that remove water during peak inundation, small enlargement of channel exiting AA, small noticeable effects of nearby water withdrawals, slightly flashier floods due to cover of impervious surfaces in the contributing area)<br>• Small increase in inundation duration (e.g., minor inputs of tailwater irrigation, outflow slowed by small amount of sedimentation blocking channels, small increase in natural berm height, slightly more controlled water input due to dams on tributaries feeding the AA)<br>• Change in intra-annual frequency by one or two minor periods of inundation (e.g., secondary flooding in fall with duration and depth much less than primary flooding)<br>• Rare (only in extreme years) change in inter-annual flood frequency (e.g., due to impact of groundwater pumping or water withdrawals or management priorities) |
| C | The hydroperiod of the AA deviates moderately from natural conditions. The pattern of inundation and drawdown is still predominantly natural, but may be more noticeably shifted in duration or may occur in conjunction with more noticeable changes in frequency. Some potential deviations include more moderate examples of stressors to duration listed above as well as occasional (2 or 3 years out of 10) change in inter-annual flooding frequency |
| C- | The hydroperiod of the AA deviates substantially from natural conditions. A natural pattern of inundation and drawdown is still evident, but may be more dramatically shifted in duration and frequency, or may be secondary to anthropogenically created hydropatterns. The hydropattern may be predominantly or entirely created, though it still somewhat resembles a natural analogue. For example, seepage from a canal during the growing season may create conditions somewhat similar to a natural seep or spring. Artificially impounded sites that are inundated and allowed to draw down in a somewhat natural pattern will usually fall into this category. Some potential deviations include more severe examples of stressors to duration listed above as well as frequent (every 3 or 4 years) change in inter-annual flooding frequency |
| D | The hydroperiod is dramatically different from any natural wetland analogue. The duration and frequency of inundation may be completely artificially controlled. Natural hydrologic inputs to the wetland may be severely limited or eliminated. The wetland may be in steady decline and may not be a wetland in the near future. Sites are more likely to rate in this category when they experience drying conditions rather than simply because they receive artificial water inputs because the latter sites will often be at least tangentially analogous to a natural wetland. Sites in this category will often experiences extreme changes in the frequency of flooding. Examples of conditions that may lead to sites being rated in this category include:<br>• Extreme (relative to natural period) alteration of inundation duration (e.g., groundwater pumping causing spring to run dry except briefly in the spring)<br>• extreme (almost every year or several times per year for sites that are flooded annually) change in flooding frequency (e.g., dikes blocking all flow to site except during years of extreme floods, groundwater pumping or water withdrawal that leave sites dry most years, detention basins that undergo short fill and release cycles following heavy precipitation events) |

Comments:

Site ID: Observers:

| **Timing of Inundation** | |
|---|---|
| **Rank** | **State** |
| A | Site inundation has no to very little deviation from natural timing. Sites that fall into this category generally have no or only very distant stressors to the water sources in their contributing area and no on-site stressors that affect water input, including artificial water sources. |
| B | Sites have a small shift in inundation timing of hours up to several days or inundation timing is natural for the majority of inflow to sites, but there are either small additional inputs of water during the growing season at times when the site would not normally receive water input or moderate additional inputs of water near the end of the growing season. Examples of potential deviations include:<br>• accelerated timing of water input due to straightening of input channels<br>• accelerated timing of water input due to small or distant areas of impervious surface in the contributing area<br>• delayed timing of water input due to flow regulation on tributaries<br>• small inputs of irrigation water via seepage or tailwater runoff in addition to naturally timed influxes of water<br>• moderate levels of artificial fall inundation due to increased flow in channels at the end of irrigation season or moderate amount of water released from impoundments |
| C | Sites have a moderate shift in inundation timing of several days up to three weeks or inundation timing is mostly natural (shifted up to hours or days) for the majority of inflow to sites, but there are either moderate additional inputs of water in the middle of the growing season at times when the site would not normally receive water input or large additional inputs of water near the end of the growing season. Examples of potential deviations include:<br>• accelerated timing of water input due to moderate to large areas of impervious surface in the contributing area<br>• delayed timing of water input due to water control structures that more directly control input to sites<br>• water added to impoundments according to management schedule only somewhat in tune with seasonal patterns<br>• moderate inputs of irrigation water via seepage or tailwater runoff in addition to naturally timed influxes of water<br>• pumping of water into site at times when site would normally not receive input<br>• large levels of artificial inundation in the fall for management purposes |
| C- | Sites have a large shift in inundation timing of three weeks up to two months or inundation timing is somewhat natural (shifted up to days or weeks) for the majority of inflow to sites, but there are large additional inputs of water during the growing season at times when the site would not normally receive water input. Examples of potential deviations include:<br>• naturally timed water input almost entirely absent (or naturally small) and majority of water influx is now from irrigation return-flows, irrigation seepage, or wastewater effluent pipes during times that site would normally be dry<br>• site managed with very little regard to natural timing of water inputs (e.g., multiple large additional inundations throughout the dry season with only a little inundation during normal flood periods) |
| D | Sites have an extreme shift in inundation timing of over two months or there is a large shift of weeks to months in inundation timing as well as large additional inputs of water in the middle of the growing season during times when the site would not normally receive water. Sites that no longer receive natural water inputs due to anthropogenic stressors most years will also score in this category. Examples of potential deviations include:<br>• site completely dry except when it rains because pumping has eliminated natural groundwater supply<br>• site only flooded late in the growing season when water from up-gradient impoundments are released |
| Comments: | |

| **Algae Growth** **(Evaluate for wet sites whenever possible; can do both if site hydrology is very variable, <u>take photo if rated below B)</u>. Focus on dry, filamentous, or planktonic algae but take photos and make note if substrate algae appears especially excessive.** | | | |
|---|---|---|---|
| **Rank** | **State- Wet Sites** | **Rank** | **State- Dry Sites** |
| A | Water is clear with minimal algal growth and there is no visual evidence of degraded water quality. | AB | Site has little to no evidence of dried algal mats. |
| B | Algal growth is limited to small and localized areas of the wetland. Water may have a greenish tint or cloudiness | C | Site has moderate to large patches of dried algal mats. |
| C | Algal growth occurs in moderate to large patches throughout the AA. Water may have a moderate greenish tint or sheen. Sources of water quality degradation are apparent (identify in comments below). | D | Site has extensive dried algal mats. Mats may be relatively thick, cover much of the AA, and/or are matted around vegetation |
| D | Algal mats are extensive, blocking light to the bottom. Water may have a strong greenish tint and the bottom is difficult to see. There are obvious sources of water quality degradation (identify in comments below). | | |
| Comments: | | | |

| **Turbidity and Pollutants (evaluate visual signs of degradation not considering algae)** | |
|---|---|
| **Rank** | **State** |
| NA | No water present in AA |
| A | No visual evidence of degraded water quality. No visual evidence of turbidity or other pollutants. |
| B | Some negative water quality indicators are present, but limited to small and localized areas within the wetland. Water is slightly cloudy, but there is no obvious source of sedimentation or other pollutants. |
| C | Water is cloudy or has unnatural oil sheen, but the bottom is still visible. Sources of water quality degradation are apparent (identify in comments below). Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution. |
| D | Water is milky and/or muddy or has unnatural oil sheen. The bottom is difficult to see. There are obvious sources of water quality degradation (identify in comments below). Note: If the sheen breaks apart when you run your finger through it, it is a natural bacterial process and not water pollution |
| Comments, including possible sources of contamination. | |

| **Connectivity** **(Evaluate both for the area immediately adjacent to the AA edge and the whole-wetland. For very large wetlands, assessment can be made at the edge of the area approximately 500 m from the AA instead of the whole wetland, but make a note in the comments. Also, if wetland area narrows below 10 m in width, can consider that point the wetland edge)** | | |
|---|---|---|
| **AA edge** | **Whole-wetland** | **State** |
| A | A | Rising water has unrestricted access to adjacent areas without levees or other obstructions to the lateral movement of flood waters. Channel, if present, is not entrenched and is still connected to the floodplain (see entrenchment ratio in optional riverine metrics). |
| B | B | Unnatural features such as levees or road grades limit the amount of adjacent transition zone or the lateral movement of floodwaters, relative to what is expected for the setting, but limitations exist for <50% of the AA boundary. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. Channel, if present, is somewhat entrenched. If playa, surrounding vegetation does not interrupt surface flow. |
| C | C | The amount of adjacent transition zone or the lateral movement of flood waters to and from the AA is limited, relative to what is expected for the setting, by unnatural features for 50–90% of the boundary of the AA. Features may include levees or road grades. Flood flows may exceed the obstructions, but drainage out of the AA is probably obstructed. Channel, if present, may be moderately entrenched and disconnected from the floodplain except in large floods. If playa, surrounding vegetation may interrupt surface flow. |
| D | D | The amount of adjacent transition zone or the lateral movement of flood waters is limited, relative to what is expected for the setting, by unnatural features for >90% of the boundary of the AA. Channel, if present, is severely entrenched and entirely disconnected from the floodplain. If playa, surrounding vegetation may dramatically restrict surface flow. |
| Y N | Only 500 m area was considered when evaluating the “whole wetland” | |
| Comments: | | |

Site ID: Observers:

<table>
<tr><th colspan="2">Water Quality: For all wetlands, assess directly within AA and area within 500 m of AA that is likely to contribute runoff. Also, consider the frequency with which water travels through each stressor to reach the wetland. For depressional and riverine wetlands, also assess the contributing area for any channels that provide water to the site and for lacustrine sites, consider the water quality of the adjacent lake. If sites have most of the features listed under a rank, consider selecting one rank lower.</th></tr>
<tr><td>A</td><td>There are no water quality stressors likely to impact site. Within the AA, soils are intact with no evidence of damaging livestock grazing. Any anthropogenic stressors within 500 m up-gradient from the AA must be minor (e.g., small areas with unnatural bare ground or lightly grazed pasture, a few fertilized lawns, etc.) and unlikely to impact the site (e.g., separated from site by at least 50 m of thick vegetation and on a shallow slope from site). The land cover of the contributing area for any channels reaching sites is predominantly natural with no oil and gas extraction, mines, Superfund sites, or point source dischargers that are likely to impact the site's water quality.</td></tr>
<tr><td>B</td><td>Site likely to receive infrequent or minor inputs of water quality stressors. Stressors may include:<ul><li>occasional/light livestock grazing within site (evaluate based on soil disturbance that could lead to sedimentation and density of animal dung- if grazing appears very light and infrequent, may be an A)</li><li>up-gradient stressors within 500 m of site that are minor or somewhat buffered from site or well-buffered if more severe (e.g., run-off from dirt road with narrow buffer or expansive area of exposed sediment within 100 m vegetated buffer)</li></ul>For sites receiving most water from channels :<ul><li>entire contributing area has <20% development or cropland, though these land uses are absent or trace within 2 km of site</li><li>entire contributing area has few oil and gas wells, mines, or point source dischargers and all are distance from site</li><li>streams and lakes that contribute directly to the site are not listed on the 303d list</li></ul></td></tr>
<tr><td>C</td><td>Site likely to receive moderate input of water quality stressors. Stressors may include:<ul><li>moderate livestock grazing within site (evaluate based on soil disturbance that could lead to sedimentation and density of animal dung)</li><li>up-gradient stressors that occur within 500 m of the site that are more moderate in extent or severity and less well-buffered from site (e.g., run-off from low-density development directly reaching site or nutrient input from a farm; consider both the buffer between the stressor and slope; vegetated very low slope may be B and unvegetated very steep slope may be D)</li></ul>For sites receiving most water from channels:<ul><li>entire contributing area has ~20-60% development or cropland, though these land uses are less prevalent within 2 km of site</li><li>entire contributing area has a moderate number of oil and gas wells, mines, or point source dischargers that are distant from site or potentially a few that are closer to the site</li><li>streams and lakes that contribute to the site are not listed on the 303d list unless water quality is likely to improve before reaching the wetland (site is distant from impaired section, water flows through reservoirs or emergent vegetation that may help attenuate water quality stressors, etc.).</li><li>streams and lakes that contribute to site are listed as impaired on 303d list, but pass through vegetated areas before reaching site</li></ul></td></tr>
<tr><td>D</td><td>Site likely to receive substantial water quality stressors. Stressors may occur immediately adjacent or within sites or may be minimally buffered from sites (e.g., up a steep hill with very narrow or unvegetated buffer). Stressors may include:<ul><li>Very high intensity livestock grazing, irrigation water return flow, fertilizer and pesticide application, and erosion from fires, construction, off-road vehicles, and dirt roads directly discharging into sites. These stressors may be considered C if run-off from the features is likely to only occur infrequently, if slope is shallow, or if only a small area of the AA receives these stressors</li><li>Frequent heavy grazing within AA with large patches of bare earth and extensive addition of manure</li></ul>For sites receiving most water from channels:<ul><li>entire contributing area has>60% development or cropland</li><li>entire contributing area has a high number of oil and gas wells, mines, or point source dischargers</li><li>streams and lakes that directly contribute to the site are listed as impaired on the 303d list</li></ul></td></tr>
<tr><td colspan="2">Comments</td></tr>
</table>

## PHYSICAL STRUCTURE

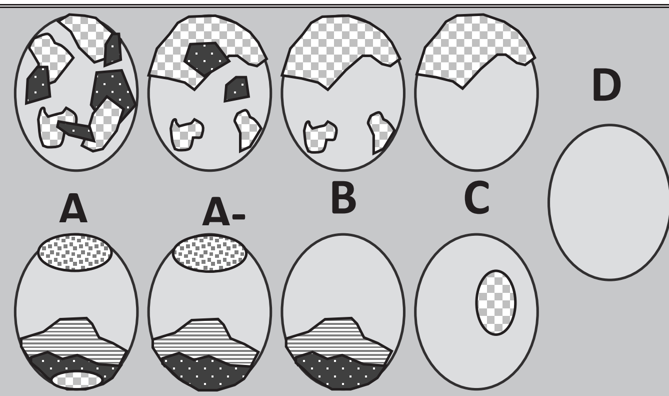
### Substrate and Soil Disturbance (Evaluate in terms of the combination of severity and extent)

| | |
|---|---|
| A | No soil disturbance within AA. Little bare soil OR bare soil areas are limited to naturally caused disturbances such as flood deposition or game trails OR soil is naturally bare (e.g., playas). No pugging, soil compaction, or sedimentation. |
| B | Minimal soil disturbance within AA. Some amount of bare soil, pugging, compaction, or sedimentation present due to human causes, but the extent and impact are minimal. Mild disturbance that does not show evidence of altering hydrology or causing ponding or channeling may occur across a large portion of the site, or more moderate disturbance may occur in one or two small patches of the AA. Any disturbance is likely to recover within a few years after the disturbance is removed. |
| C | Moderate soil disturbance within AA. Bare soil areas due to human causes are common and will be slow to recover. There may be pugging due to livestock resulting in several inches of soil disturbance. ORVs or other machinery may have left some shallow ruts. Sedimentation may be filling the wetland. The site could recover to potential with the removal of degrading human influences and moderate recovery times. |
| D | Substantial soil disturbance within AA. Bare soil areas substantially degrade the site and have led to severely altered hydrology or other long-lasting impacts. Deep ruts from ORVs or machinery may be present, or livestock pugging and/or trails are widespread. Sedimentation may have severely impacted the hydrology. The site will not recover without active restoration and/or long recovery times. |
| Comments | |

## VEGETATION STRUCTURE

### Horizontal Interspersion

**Evaluate number and arrangement of patches of water and distinct vegetation patches. Individual patches must be at least 10 m² (approximately 3.2 m x 3.2 m in a 0.5 ha AA) and each patch type must cover at least 5% of the AA. Distinct vegetation patches are patches that share similar physiognomy and species composition.**
**A SITE CAN HAVE A PATCH THAT IS >50% OF THE AREA BUT NOT <u>DOMINANT</u>; USE DIAGRAM TO INTERPRET TEXT.**




| Rank | State |
|---|---|
| A | High degree of horizontal interspersion: AA characterized by a very complex array of nested or interspersed zones with no single dominant zone. |
| A- | Moderate to high degree of horizontal interspersion: AA is characterized by a complex array of nested or interspersed zones with no single dominant zone |
| B | Moderate degree of horizontal interspersion: AA characterized by a moderate array of nested or interspersed zones with no single dominant zone. |
| C | Low degree of horizontal interspersion: AA characterized by a simple array of nested or interspersed zones. One zone may dominate others. |
| D | No horizontal interspersion: AA characterized by one dominant zone. |
| Comments | |

### Woody Debris

| Rank | State |
|---|---|
| NA | There are no obvious inputs of woody debris. Inputs are not available within site, along site edge, or along nearby up-gradient hydrologically connected flowpaths |
| AB | AA characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. For riverine wetlands, debris is sufficient to trap sediment, but does not inhibit stream flow. For non-riverine wetlands, woody debris provides structural complexity, but does not overwhelm the site. |
| C1 | AA characterized by small amounts of woody debris |
| C2 | Debris in AA is somewhat excessive. |
| D | AA lacks woody debris, even though inputs are available. |
| Comments: | |

Site ID: Observers:

| **shoreWoody Species Regeneration (see ratings chart, below)** | |
|---|---|
| **Rank** | **State** |
| NA | Woody species are naturally uncommon or absent. |
| A | All age/size classes of desirable (native) woody species present. |
| B | Age/size classes restricted to mature (full size) individuals and young sprouts. Middle age/size groups absent. |
| C1 | Stand comprised of mainly mature (full size) individuals, with seedlings and sapling (smaller individuals) absent |
| C2 | Stand mainly evenly aged/sized young sprouts that choke out other vegetation. |
| D1 | Woody species predominantly consist of decadent or dying individuals. Decadent individuals are those with greatly reduced growth, such as which often occurs at sites where species have been over-browsed. |
| D2 | AA has >5% canopy cover of *Elaeagnus angustifolia* (Russian olive) and/or *Tamarix* (tamarisk) or other invasive woody species. If you select this state, select an additional statement that describes native regeneration in AA. |
| Comments | |

**Woody Species Regeneration Age Classes**
**Information for guidance only; classes may differ for certain species. Classes are from** Burton, T.A., Smith, S.J., And Cowley, E.R., 2011, Multiple indicator monitoring of stream channels and streamside vegetation: U.S. Bureau of Land Management technical reference 1737-23, 155 p.

| **Class** | **Single-stemmed species (e.g., cottonwood)** | **Multi-stemmed species (e.g., most willows and alder)** |
|---|---|---|
| Seedling | Stem is <1 m tall or <2.5 cm in diameter at 50% of height from ground level. | 1 stem <0.5 cm in diameter at the base and <0.5 m tall. |
| Young (Middle) | Stem is >1 m tall and 2.5 cm to 7.6 cm in diameter at 50% of height from ground level. | 2 to 10 stems less than 1 m tall or 1 stem >0.5 cm in diameter at the base and less than 1 m tall |
| Mature | Stem is > 1 m tall and >7.6 cm in diameter at 50% of height from ground level. | >10 stems over 1 m tall |

| **Litter Accumulation** | |
|---|---|
| **Rank** | **State** |
| AB | AA characterized by normal amounts of herbaceous and/or deciduous litter accumulation for the wetland type. In some wetlands, this may mean that new growth is more prevalent than previous years' and that litter and duff layers in pools and topographic lows are thin. Undisturbed playas may be lacking in litter altogether. Marshes may have high levels of litter accumulation, but litter should not prevent new growth or be too dense to allow more than one species to persist. |
| C1 | AA characterized by small amounts of litter compared to what is expected |
| C2 | Litter is somewhat excessive. |
| D1 | AA lacks litter |
| D2 | Litter is extensive, often limiting new growth. |
| Comments (If site scores below AB, briefly describe litter and note potential causes): | |

**Topographic Complexity**
**Elevation gradients must be at least 15 cm in height difference and can include features such as benches, slopes of varying steepness, channels, and pools. Gradients must have an edge of at least 8 m (e.g., length of channel, perimeter of pools or higher elevation "island", length of edge between two slopes) or cover at least 5% of the AA. Micro-topography includes woody debris, boulders, sediment mounds, vegetation hummocks, tufted herbaceous litter, gently undulating terrain and other similar features**

| **Elevation Gradient** | **Description** (e.g., pools throughout site, main channel, high bench, etc.) | **Micro-topography (circle one)** |
|---|---|---|
| **Gradient 1** | | <10% micro-topography |
| **Gradient 2** | | ≥10-29% micro-topography |
| **Gradient 3** | | ≥30-49% micro-topography |
| **Gradient 4** | | ≥50% micro-topography |
| Comments: | | |

| SPECIES-SPECIFIC AMPHIBIAN METRICS<br>**Rank breeding waterbody characteristics for waterbodies within AA or larger waterbodies with shore in AA. If surface water typically present, but dried up, select C for types of waterbodies and estimate other breeding waterbody characteristics.** | |
|---|---|
| **COLUMBIA SPOTTED FROG** | |
| **Breeding Waterbodies Within AA** | |
| A | Waterbodies large enough not to dry up in summer and deep enough not to freeze solid at night during the breeding season with minimal flow. Examples include **beaver ponds, oxbows,** and **springs-fed pools.** |
| B | Stock ponds (excluding those that are spring-fed, which belong above); shallower sections of spring complexes (more likely to freeze or dry up). |
| C | Lotic systems (rivers or streams) OR lentic but very small or uniformly shallow (e.g., temporary pools, small puddles). |
| D | No surface water typically present at site (skip the next two metrics). |
| **Breeding Waterbody Substrate (in highest scoring waterbody listed above)** | |
| A | Deep organic, mud, or silt is common at bottom of waterbodies (soft enough to be burrowed into). |
| B | Substrate of deep mud/silt present but uncommon. |
| C | Gravel/sand predominant waterbody substrate with deep mud/silt absent OR substrate is hard-packed mud or silt. |
| D | Cobble, boulder, or bedrock predominant substrate with deep mud/silt absent. |
| **Vegetation in Breeding Waterbody Shallows (areas <1 m deep) (in highest scoring waterbody listed above)** | |
| A | Adequate vegetation in water to attach egg masses to and to provide cover from aquatic predators without completely shading water. At least 20% of waterbody shallows have some type of vegetation and no more than 50% of shallows have emergent vegetation (score one grade lower if emergent vegetation is very dense, e.g., hard to see through to water surface). |
| B | Waterbody shallows either have between 10 and 20% cover of any vegetation OR between 50 and 80% of emergent vegetation, potentially over-shading site (score one grade lower if emergent vegetation is very dense). |
| C | Waterbody shallows with either >1 to 10% vegetation OR between 80 and 95% emergent vegetation with few openings in the water (score one grade lower if emergent vegetation is very dense). |
| D | No or <1% vegetation in waterbody shallows or emergent vegetation densely covers entire waterbody. |
| **Overwintering Waterbodies (within 100 m of AA) (needs non-freezing water and oxygenation)** | |
| A | Waterbodies include well-oxygenated areas unlikely to freeze, particularly perennially flowing streams (including oxbows), springhead pools, or ponded water at least 1 m deep at deepest point. Waterbodies include ample hibernation features such as overhangs, holes, log debris, or loose soil that can provide protection from freezing. |
| B | Waterbodies include the above types, but hibernation features less common. |
| C1 | Waterbodies include the above types, but hibernation features extremely rare or absent. |
| C2 | Hibernation features present, but there are only marginally suitable waterbodies present (water not particularly well oxygenated or may freeze some years; this includes areas of shallow spring overflow). |
| D | No potential overwintering habitat near AA (e.g. there is no water present or all water is likely to freeze or dry up). |
| **BOREAL TOAD** | |
| **Breeding Waterbodies Within AA** | |
| A | Slow- or non-flowing water large enough not to dry up and deep enough not to freeze solid at night in summer including lakes, ponds (especially beaver ponds), and large pools (including artificially created ponds and pools). |
| B | lotic: low-velocity, low-gradient streams or springs. |
| C | lotic: rivers, streams OR lentic but very small or uniformly shallow: temporary pools, small puddles. |
| D | No surface water typically present at site (skip remaining metrics) |
| **Hibernation Features (within AA and 100 m buffer). Boreal toad hibernate <u>outside</u> of the water.** | |
| A | Features such as burrows (esp. ground squirrels), interstices of beaver dams, old beaver lodges, overhanging stream banks, rocky chambers near streams, cavities under boulders or tree roots, loose soil, and/or woody debris piles common and connected to summertime habitat. |
| B | Above features present but not abundant. Some area with features may be disconnected from summertime habitat due to low use roads or other low severity fragmentation, but some connected features present. |
| C | Above features present but rare and/or only present on very steep slopes or disconnected from summertime habitat by busy roads, development, or other severe fragmentation. |
| D | None of the above features present. |
| **Observed Hibernation Features** (circle one or more feature): None observed Burrows Beaver Dam Beaver Lodge Undercut Stream Bank Boulders Loose Soil Woody debris piles | |

Site ID: Observers:

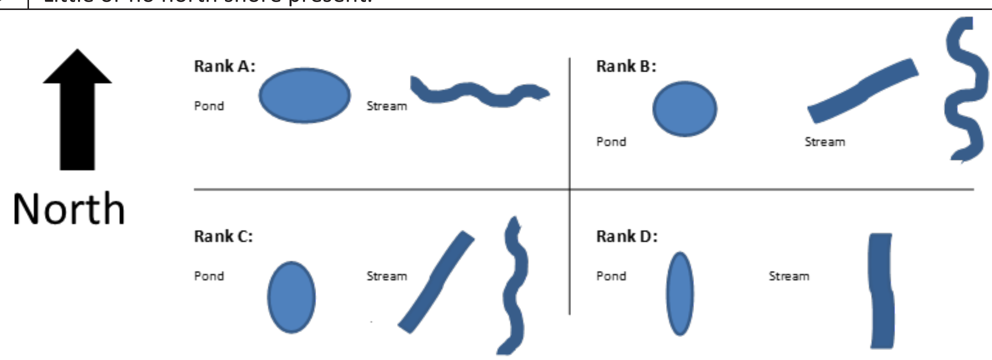
| Shrub | Tall Forbs | **Understory-Forming Shrubs or Tall Forbs (e.g., goldenrod, coneflower);** Evaluate along stream floodplain or in valley bottom within AA and buffer. Cover estimates pertain to area without standing water. Combination of areas with understory to prevent desiccation and open areas for basking is ideal. |
|---|---|---|
| A | A | Ample cover near waterbodies. Generally, this will entail 33 to 60% of the area along a stream floodplain or valley bottom near a pond or lake with moderate to dense cover of understory-forming species. |
| B | B | Moderate cover near waterbodies, with approximately 21 to 33% of area with moderate/dense cover, or cover abundant, but very patchy |
| C1 | C1 | Low cover near waterbodies, with approximately 5 to 20% of area with moderate/dense cover. |
| C2 | C2 | Overly abundant cover near waterbodies. Between 60% and 80% of non-water area along stream floodplain or valley bottom with understory species. Little basking habitat present |
| D1 | D1 | No or only a few scattered areas with cover present (<4% cover) |
| D2 | D2 | Extremely abundant cover near waterbodies. Over 80% of non-water area along stream floodplain or valley bottom with understory cover. Basking habitat extremely rare. |

**BREEDING WATERBODY CHARACTERISTICS FOR BOTH SPECIES**

**(evaluate in optimal waterbodies)**

| | **Slope and Water Depth Near Shore** |
|---|---|
| A | Mostly gentle slopes and/or large area, esp. along north shores, with gentle slopes; water <10 cm common. |
| B | Mixture of gentle and steeper slopes with some areas with <10 cm deep water; gentle slopes common but not predominant, not occupying the majority of the north shores. |
| C | Gentle slopes present, but uncommon. Few areas with water <10 cm deep. |
| D | All shorelines with steep slopes. Water <10 cm not present. |

| | **Presence of North Shore (Long Axis of Waterbody)** |
|---|---|
| A | Ample north shore present (shore on north side of waterbody). |
| B | Moderate amount of north shore present. |
| C | Minor amount of north shore present. |
| D | Little or no north shore present. |




**STRESSORS**

| | **Livestock [both boreal toad and CSF]** | | **Distance to impervious surface** |
|---|---|---|---|
| A | No evidence of livestock grazing in AA or buffer | A | >300 m |
| B | Low intensity grazing in buffer; no grazing in AA. | B | 200-300 m |
| C | High intensity buffer grazing or winter AA grazing, or low intensity AA summer grazing. | C | 100-200 m |
| D | High intensity grazing in AA in summer | D | <100 m |

| | **Mining** |
|---|---|
| Yes No | Evidence of current/historic mining in AA or buffer (mine tailings, mine shafts, etc.)? |

# URAP REFERENCE CARDS

## CONTENTS

## Key to HGM Classes

**1a.** Wetland is located on the shore of or adjacent to a waterbody (i.e., lake, impoundment) or in a valley, floodplain, or near a stream channel. Dominant water source is from waterbody or surface/subsurface connections with stream and not from precipitation, overland flow or groundwater……………………………………………………………………………………………..**2**

**2a.** Wetland located on the shore of or adjacent to a lake, pond, or impoundment AND wetland hydrology is predominantly influenced by bidirectional flows related to rising and falling waterbody levels…………………….**3**

**3a.** Wetland on shores of waterbody that is greater than 8 ha (20 acres) and ≥2 m deep at its deepest point. Waterbody may be natural (i.e., Great Salt Lake, Utah Lake) or artificial (many reservoirs)….**Lacustrine Fringe**

**3b.** Wetland adjacent to smaller and/or shallower waterbody………………………………………..**go to 6b in the key**

**2b.** Wetland is located in a valley, floodplain or near a stream channel OR downslope from a waterbody or impoundment. Wetland's dominant water source is unidirectional and horizontally spreading…………………..……**4**

**4a.** Wetland is located in a valley, floodplain or near a stream channel and water is from horizontal water movement from channel overbank flooding or subsurface hydrologic connections to the stream channel. Oxbows and that receive water from the stream are included in this classification, though beaver ponds are considered depressional……………………………………………………………………………………………………………….**Riverine**

**4b.** Wetland is located immediately downstream from an impoundment and receives water from impoundment release. Water typically does not reach site through a well-defined channel, instead spreading horizontally from the release site, though some shallow channels may be present……**…Impoundment Release**

**1b.** Wetland not as above. Main water source may be from precipitation, overland flow, or groundwater or water may be impounded stream water…………………………………………………………………………………………………………………………..**5**

**5a.** Wetland meets ***all*** of the following criteria: a) is located on a slope (can be very gradual or nearly flat); b) groundwater is the primary water source; c) surface water, if present, flows through the wetland in one direction and usually originates from seeps or springs; and d) water leaves the wetland without being impounded. **NOTE:** *Small channels can form within slope wetlands, but are not subject to overbank flooding. Surface water does not pond in these types of wetlands, except occasionally in very small and shallow depressions or behind hummocks (depressions are usually < 3 ft diameter and less than 1 foot deep)* ......................................................................**Slope**

**5b.** Wetland does not meet all of the above criteria…………………..……………………………………………………………….**6**

**6a.** Wetland is topographically flat with precipitation as the primary water source. Surface water and groundwater inputs may be present, but not significant (<10%). ………………………………………**…………………. Flats**

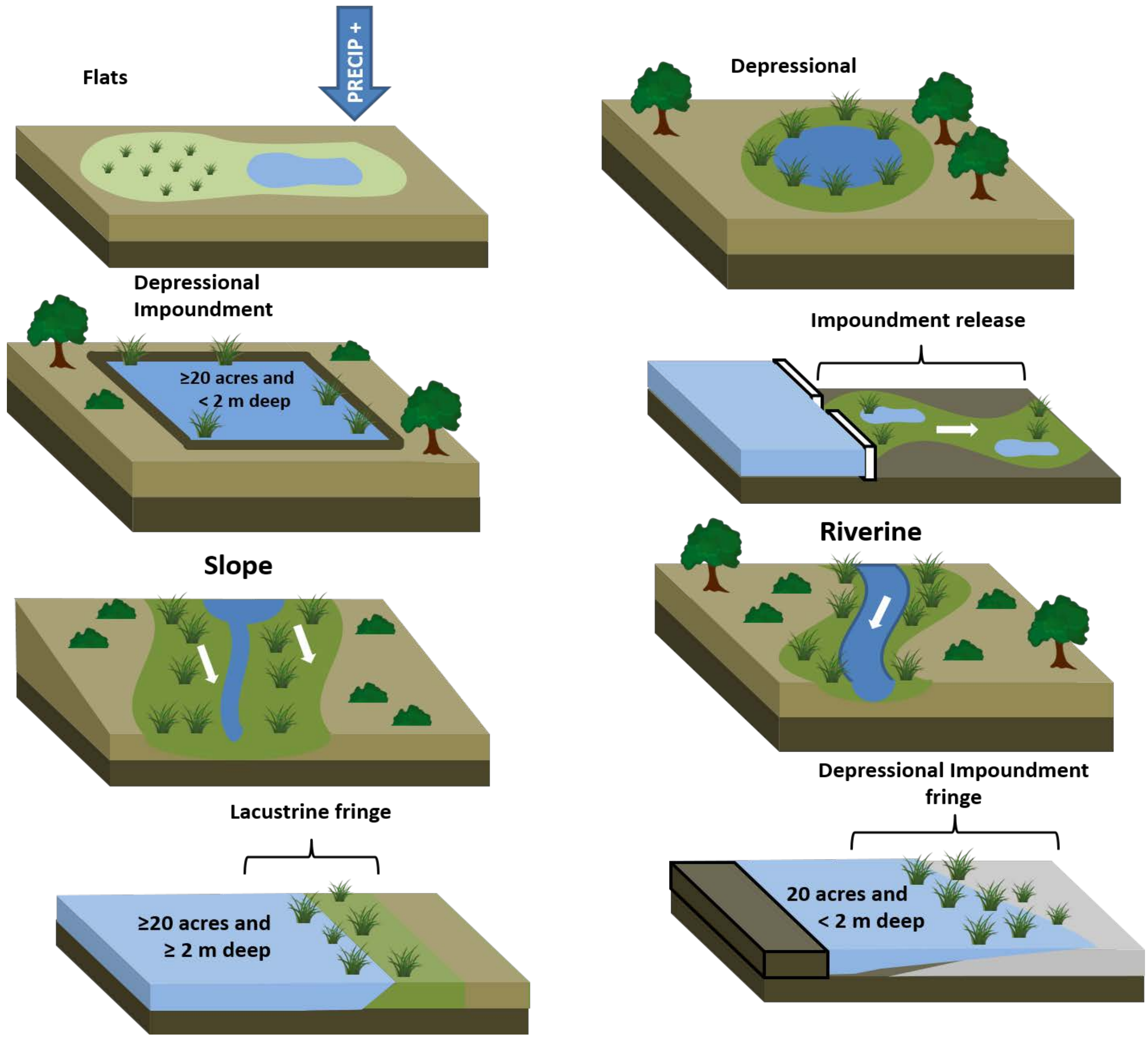
**6b.** Wetland not as above. Wetland either in flat area with high groundwater inputs (check water table) or in topographic depression or impounded area. ……………………………………………………………………………………………**7**

**7a.** Wetland located within or hydrologically controlled to artificial impoundment >8 ha (20 acres) in size (but <2 m deep- otherwise see Lacustrine Fringe)……………………………………………………………………………**8**

**8a** Wetland located within impounded area. Primary water fluctuations are vertical with rising and falling water levels due to steep impoundment sides and relatively even bottom surface level ………………………………………………………………………………………………………….**Depressional Impoundment**

**8b.** Wetland hydrologically controlled by impounded area. Primary water fluctuations are bidirectional, with water spreading and receding horizontally with changing water levels. Sites often on mudflats that gently slope toward impoundments………**Depressional Impoundment Fringe**

**7b.** Wetland in a topographic depression or impounded area where water ponds or is saturated to the surface at some time during the year OR wetland in flat area with no obvious depression with water level maintained by high groundwater. Water typically from precipitation, snowmelt, overland runoff, or intersection with groundwater table, but can also be from small (<8 ha) natural or artificial impoundment of streams. Outlet, if one exists, is generally higher than the deepest part of the depression……………………………………………………………………………………………………………**Depressiona**

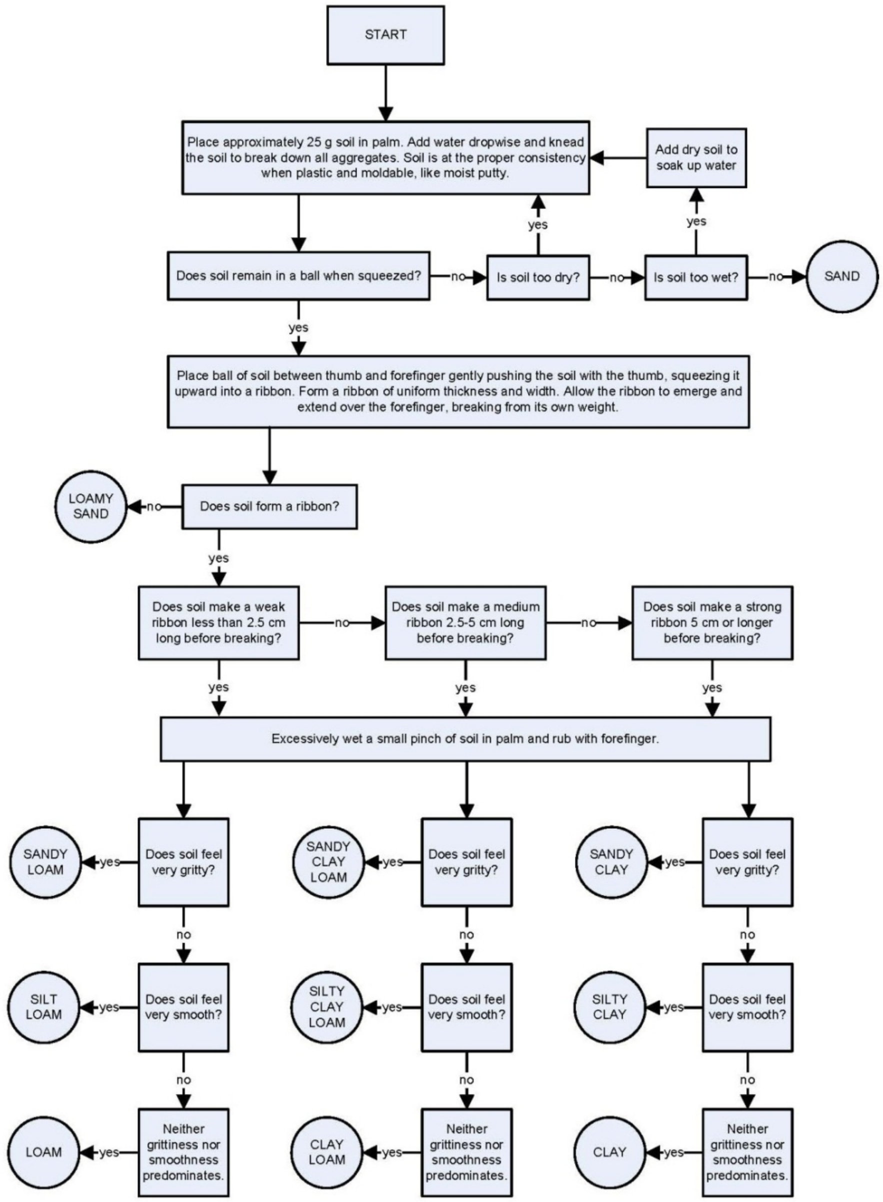

Flats
PRECIP +
Depressional
Depressional Impoundment
≥20 acres and
< 2 m deep
Impoundment release
Slope
Riverine
Depressional Impoundment fringe
Lacustrine fringe
≥20 acres and
≥ 2 m deep
20 acres and
< 2 m deep

## Buffer Land Cover Examples

| Buffer Land cover | Non-buffer Land Cover |
|---|---|
| • Vegetated natural and semi-natural areas including forests, grasslands, shrublands, wetlands, and open water<br>• Natural unvegetated areas including permanent snow or ice cover and natural rock outcrops or sandy and gravel areas.<br>• Old fields undergoing succession<br>• Rangeland[1]<br>• Partially vegetated pastures[1]<br>• Recently burned natural land with at least some vegetative recovery[1]<br>• Low use tracks such as single-use ATV tracks or undeveloped and unmaintained dirt tracks that are vegetated in the middle and only used once or a few times a year.<br>• Vegetated levees, natural substrate ditches<br>• Recreational areas with little substrate disturbance (bike, horse, and foot trails with narrow width of influence) | • Commercial and residential areas, parking lots, railroads and train yards<br>• Lawns, sports fields, traditional golf courses<br>• Dirt and paved roads<br>• Mined areas<br>• Agriculture including row crops, orchards, vineyards, clear-cuts<br>• Animal feedlots, poultry ranches, animal holding pens with mostly bare soil<br>• Severely burned land with little vegetative recovery<br>• Recreational areas with substantial disturbance (wide paths, paved areas, trash/dumping)<br>• Oil and gas wells<br>• Wind farms |

[1]These land cover types can vary considerably in the degree to which they serve as buffer cover. We will use the buffer condition-soil metric to help distinguish between soil disturbance-related features with varying degrees of buffer functionality.

## Soil Texture Flow Chart[1]




[1] Modified from S.J. Thien, 1979.*A flow diagram for teaching texture by feel analysis.* Journal of Agronomic Education. 8:54-55, by the NRCS. Accessed 2013.

## Assessment Area Soil and Substrate Disturbance Reference Card

**Consider the following when assessing soil and substrate disturbance**

1) **How widespread is damage?**
2) **What is the impact on vegetation? Areas with compacted soils often have little or no vegetation growing**
3) **What is the depth of disturbance? Is the disturbance deep enough to unnaturally channelize or pool water or to serve as an artificial dike?**

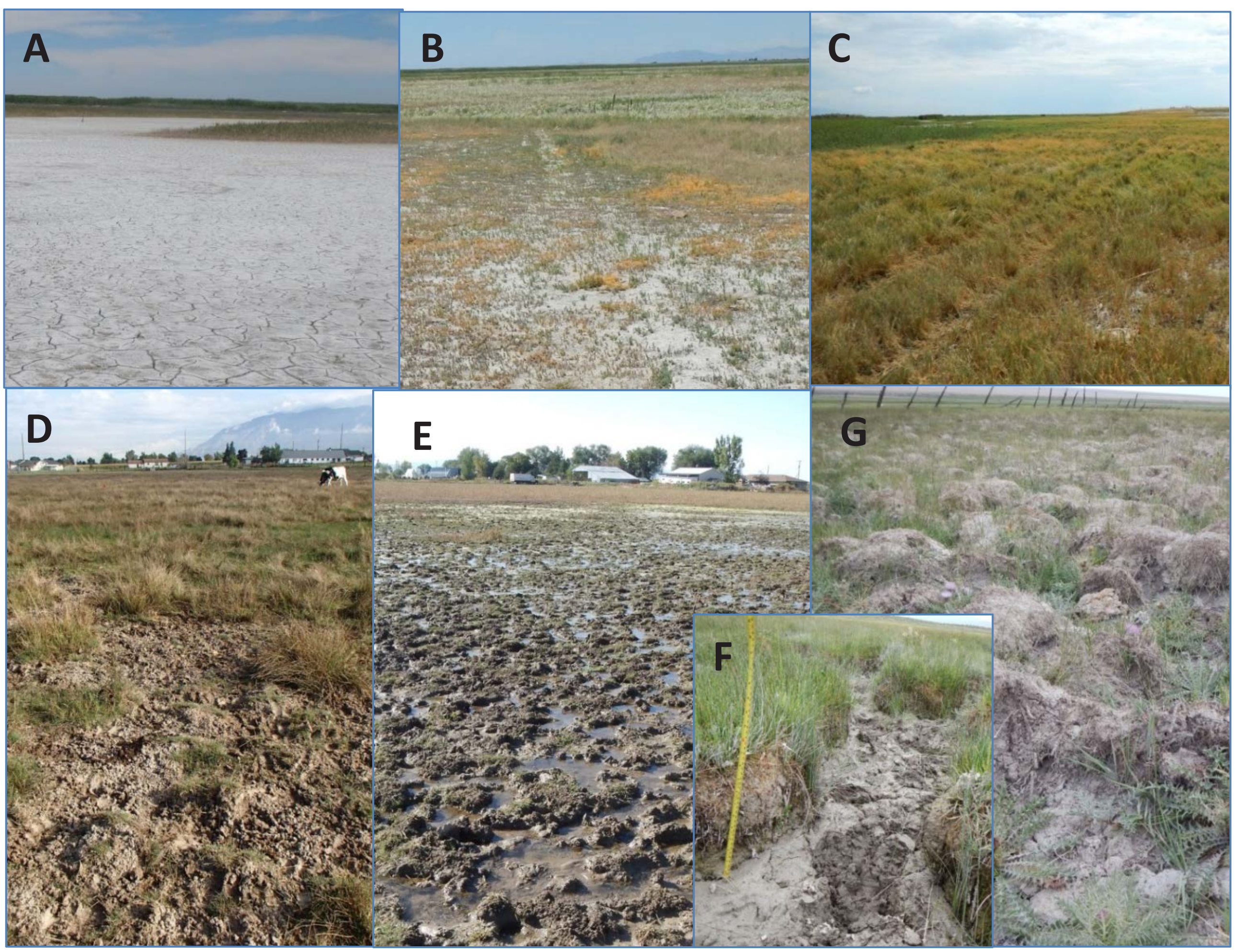
**Explanation of figures:**

**A** is a site with naturally bare soil with no signs of soil disturbance in this photograph, scored as A

**B** shows some soil disturbance where the ground is less vegetated than surrounding areas due to compaction; height of disturbance is too low to affect hydrology; site may be scored as A if this is only disturbance because mostly revegetated or as B if this level of disturbance is more frequent across site

**C** shows tracks through vegetation. If vegetation is merely toppled over due to tracks, site may be scored as A. If vegetation is stunted or not growing in due to compaction, site would likely score as B. May need to also take into account depth of any soil damage.

**D, E, F,** and **G** show soil disturbance due to grazing. Disturbance at site pictured in D was shallow and localized to only a few locations in site; site was scored as B. Disturbance at site pictured in E was moderately deep and found throughout entire site; site should be scored as C because damage is likely to recover on its own if cattle are removed. F and G show deep pugging that alters site hydrology and changes vegetation; site was scored as D.



# Appendix B

## Sample Site Packet Provided to Large Group Testing Participants with Office Evaluation Information and Site Maps

| **SITE ID** *FBWMA Meadow* | **OWNERSHIP:** *Utah Division of Wildlife Resources* |
|---|---|

**Site Hydrology**

Is site along a stream that has an evident dam within 5 km upstream? Yes No NA

Tally # of times site appears to have surface water in Google Earth and then write note about hydrology of site. *Water diverted off Farmington Creek travels west through canal and impoundments and then gets backed up by dike to the west/southwest of site, sometimes flooding site. Only parts of site appear wet in some of the "wet" years noted to the right. Mix of flood and sprinkler irrigated agricultural lands near area where Farmington Creek is diverted.*

| ***Months*** | ***Wet*** | ***Dry*** |
|---|---|---|
| April, May, June | *3* | *3* |
| July, August, Sept. | *0* | *8* |
| Oct. through March | *3* | *1* |

**Water Quality Indicators**

What is the impairment status of the Water Quality Assessment Unit where site is located? (2016 Assessment, https://mapserv.utah.gov/surfacewaterquality)

○ *Category 1 (fully supporting)* ○ *Category 2 (supporting, not all uses assessed)* ○ *Category 3 (insufficient data)*
○ *Category 4A (TMDL completed)* ○ *Category 4B or 4C (TMDL not required)* ○ *Category 5 (impaired)* *X Undefined*

If Category 4 or 5, list constituents impaired for:

Does site discharge to or receive surface water directly from lake or stream in unit listed above? ○ *discharge to* ○ *receive water from* *X neither*

Is site strongly influenced by another Water Quality Assessment Unit that is impaired (Category 4 or 5)? If so, does it ○ *discharge to* or *X receive water from* impaired unit? List impaired constituents and justify connection: *Farmington Creek is impaired for E. coli and copper. This creek is diverted into canals that end up feeding the site.*

Anti-degradation category: (https://mapserv.utah.gov/surfacewaterquality or kmz at https://deq.utah.gov/water-quality/antidegradation-reviews-water-quality)
○ *Category 1 (anti-degradation, new discharges banned)* ○ *Category 2 (anti-degradation, new discharges allowed)*
*X Category 3 (degradation may occur)*

Site within incorporated area or other municipal boundaries *Yes* *No*

Site in contributing basin that contains an incorporated area? *Yes* *No*

≥10% of contributing basin is composed of land use likely to generate sediments or nutrients. *Yes* *No*

≥10% of contributing basin is composed of land use likely to generate non-sediment/non-nutrient pollutants. *Yes* *No*

Other water quality stressors that may be coming into site? Describe. *Sediment and nutrient from nearby agricultural and pasture areas near where Farmington Creek is diverted may impact site even though <10% of contributing basin is composed of agricultural land cover*

**Wildlife Indicators**

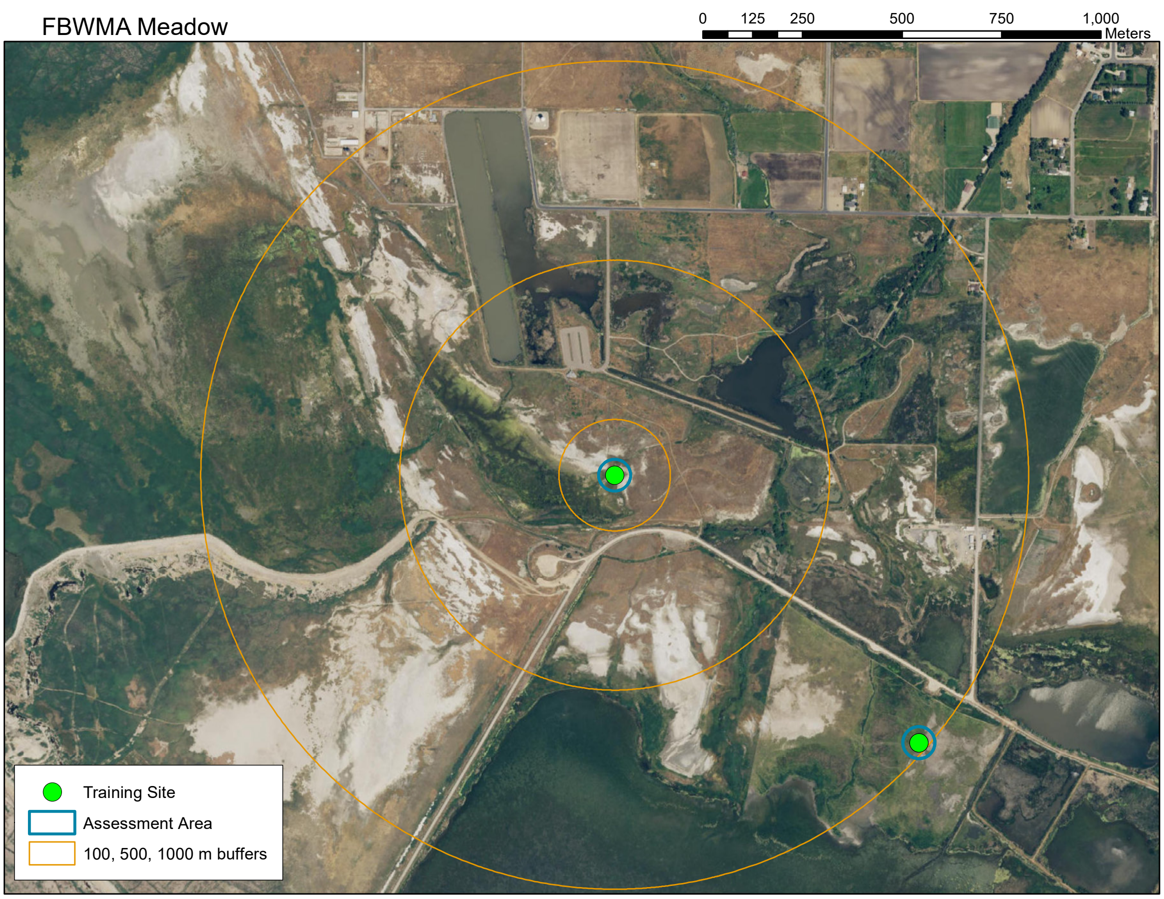
Go to the Utah Threatened, Endangered, and Sensitive Species Map (https://mapserv.utah.gov/surfacewaterquality) and navigate to site. Below, list all the wetland or riparian-associated wildlife and plant species known from the location, using either the link to the Utah Conservation Data Center on the map or the Utah Geological Survey preliminary sensitive species list to determine habitat associations.
**State Protection Status:** CS (conservation species); S-ESA (state and federal listing); SPC (Species of Concern)
**USESA Status:** PT (proposed); C (candidate); LE (listed, endangered); XN (experimental, non-essential); LT (listed, threatened)

T&E wetland species include Ute Ladies' Tresses (*Spiranthes diluvialis*), Navajo Sedge (*Carex specuicola*),Autumn buttercup (*Ranunculus aestivalis*), and Kanab Ambersnail (*Oxyloma kanabense*). Extant state protected wetland species include 4 amphibians (Arizona Toad, Columbia Spotted Frog, Great Plains Toad, Boreal Toad), 18 mollusks, 5 birds (American White Pelican, Bald Eagle, Bobolink, Long-billed Curlew, Short-eared Owl), and one each mammal (Preble's Shrew), snake (Smooth Greensnake), fish (Least Chub), and beetle (Coral Pink Sand Dunes Tiger Beetle). There are also many riparian and stream-dwelling species that are state or federally protected that may occasionally utilize wetlands.

| **Species Common Name** | **Date of Last Obs.** | **State Protection Status** | **USESA Status** | **Habitat Notes** | **Site Has Habitat Potential?** |
|---|---|---|---|---|---|
| *Least chub* | *1965* | *CS* | *None* | *Ponds, streams, springs* | Yes No |
| *Short-eared owl* | *2004* | *SPC* | *None* | *Open habitats such as grasslands and marshes, with small mammals* | Yes No |
| *Long-billed Curlew* | *2000* | *SPC* | *None* | *Dryish meadowlands with short grass (<30 cm) and shade; barren alkali flats* | Yes No |
| *Bobolink* | *2003* | *SPC* | *None* | *Wet meadow, flooded pasture* | Yes No |
| *Western Toad* | *1912* | *SPC* | *None* | *Higher elevation!!* | Yes No |
| *Bald Eagle* | *2000* | *SPC* | | *Nest in tall trees; habitat includes bodies of water with fish and waterfowl* | Yes No |
| *American White Pelican* | *1993* | *SPC* | | *Nest on islands; feed in waterbodies with fish* | Yes No |

Site has been proposed or finalized as critical habitat for federally listed wetland or riparian-associated wildlife or plant species? (https://fws.maps.arcgis.com/home/webmap/viewer.html?webmap=9d8de5e265ad4fe09893cf75b8dbfb77) Yes No


FBWMA Meadow
0 15 30 60 90 120
Meters
Training Site
Assessment Area
100 m buffer


FBWMA Meadow
0 125 250 500 750 1,000
Meters
Training Site
Assessment Area
100, 500, 1000 m buffers

# Appendix C

## Detailed Metric Results by URAP Component

***Table C1.*** *Krippendorff's α values for condition assessment metrics for agreement across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Metrics are sorted by the mean observer value, the mean α value for the four between-observer comparisons (which excludes the repeat testing). Values in gray indicate metrics with low variability, where at least one observer or one UGS team used only one rank on the metric or only one rank was used during one of the site visits.*

| Metric | Mean Observer Value | Experienced | Novice | Across UGS Teams | Large Group | Repeat Visits | Metric Notes and Recommendations |
|---|---|---|---|---|---|---|---|
| Turbidity and Pollutants | 0.19 | 0.76 | 0.23 | -0.03 | -0.18 | 0.11 | Novice team consistently lower than experienced team. Ask surveyors to bring back photos for sites rated below A or document with turbidity tube. Add photo guidance. Consider rewriting. |
| Woody Debris | 0.25 | 0.56 | 0.54 | -0.15 | 0.07 | 0.70 | Change wording and consider adding a B rating. May want to consider combining the litter accumulation. |
| Buffer Condition- Soil and Substrate | 0.32 | 0.18 | 0.80 | 0.07 | 0.22 | 0.41 | Novice team frequently rated sites lower than experienced team. Make sure surveyors spend adequate time in buffer. Continue to have surveyors walk buffer transects. Add photo guidance. |
| Connectivity - Assessment Area Edge | 0.35 | 1 | 0.42 | -0.05 | 0.03 | 1 | Rated as A at most sites. Sites often moved to avoid dikes or roads *within* sites, which may also bias sites away from having these features immediately adjacent to sites. May want to reconsider use or look to other protocols for a potential rewrite. |
| Percent Intact Landscape | 0.35 | 0.50 | 0.76 | 0.18 | -0.04 | 0.90 | Disagreements across UGS teams typically over whether a feature counted as buffer (e.g., dirt road, hay fields) or because estimate very close to thresholds between ranks. Create examples showing dirt roads versus single track. Consider checking in GIS. |
| Woody Species Regeneration | 0.36 | 0 | 0.94 | 0.49 | 0 | -0.14 | Low variability; may need to test at more sites with woody species. In large group testing, all teams scored metric as A or NA except one team at one site. |
| Connectivity - Whole Wetland | 0.39 | 0.79 | 0.17 | 0.32 | 0.29 | 0.85 | UGS teams never differed by more than one rank, though large group testing teams did. Challenging to define and evaluate "whole wetland." Consider rewriting or combining with connectivity- edge. |
| Overall Buffer | 0.46 | 0.65 | 0.36 | 0.82 | 0.02 | 0.57 | See notes for individual components. |
| Buffer Condition- Vegetation | 0.47 | 0.86 | 0.44 | 0.39 | 0.20 | 0.62 | Results likely highly dependent on botanical skills and survey time spent in buffer. Experienced team had the strongest botanical skills and highest rate of agreement. Ensure botanist on team and continue to have surveyors walk buffer transects. |
| Water Quality | 0.50 | 0.54 | 0.51 | 0.34 | 0.60 | 0.92 | UGS teams almost always within a rank. Rewrite for clarity. |
| Algae Growth - Wet | 0.53 | 0.62 | 0.46 | 0.35 | 0.65 | 0.42 | Combine dry and wet algae metrics together and offer more guidance on when to use NA. Add photo guidance. |
| Horizontal interspersion | 0.53 | 0.41 | 0.67 | 0.70 | 0.33 | 0.72 | Change metric from five ranks to four and rewrite. |
| Percent Buffer | 0.53 | 1 | 0.51 | 0.23 | 0.38 | 0.79 | Clarify what counts as buffer land cover. Teams disagreed about dirt roads and fill material. May need photos to help. |
| Litter Accumulation | 0.68 | 1 | 0.42 | 1 | 0.31 | 1 | Rated as AB at most sites, but UGS teams agreed on the one site rated below AB. Remind surveyors to take photographs and record causes for ratings below AB. |
| Relative Cover Native Species | 0.70 | | | | 0.55 | 0.67[1] | Moderate agreement in the large group testing, despite range of botanical skills of observers and substantial or higher agreement when calculated from vegetation data. |

***Table C1.*** *Continued.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Timing of Inundation | 0.71 | 0.92 | 0.78 | 0.60 | 0.54 | 0.47 | Rewrite to condense wording. Irrigation-influenced sites had the most disagreement in UGS testing. |
| Absolute Cover Noxious Species | 0.74 | 1 | 0.90 | 0.79 | 0.28 | 0.93[1] | Strong agreement except in large group testing. Make sure surveyors have appropriate resources to identify noxious weeds. |
| Substrate and Soil Disturbance | 0.75 | 0.79 | 0.82 | 0.66 | 0.74 | 0.80 | Disagreement always within a rank. Consider adding photo guidance. |
| Hydroperiod | 0.79 | 0.98 | 0.72 | 0.82 | 0.62 | 0.80 | Performed well with substantial variability across sites, though ratings often off by one half to one full rank. Condense language. |
| Buffer Width | 0.86 | 0.95 | 0.86 | 0.64 | 0.96 | 0.71 | Clarify what counts as buffer; UGS teams disagreed on dirt roads and hay fields. Novice UGS team also incorrectly ranked metric once based on buffer width transect values. Add photo examples. |
| Algae Growth - Dry Algae Mats | 0.86 | 1 | 1 | 1 | 0.43 | 0.24 | No variability in UGS internal testing, though differences in when NA used. Combine dry and wet algae metrics together and offer more guidance on when to use NA. Add photo guidance. Repeat testing results likely reflect some true differences in condition over time. Add photo guidance. |

[1]Metric rated using values calculated from intensive vegetation data.

***Table C2.*** *Krippendorff's α values for amphibian habitat metrics for agreement across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Metrics are sorted by the mean observer value, the mean α value for the four between-observer comparisons (which excludes the repeat testing). Values in gray indicate metrics with low variability, where at least one observer or one UGS team used only one rank on the metric or only one rank was used during one of the site visits.*

| Metric | Mean Observer Value | Experienced | Novice | UGS Teams | Large Group | Repeat Visits | Metric Notes and Recommendations |
|---|---|---|---|---|---|---|---|
| Slope and Water Depth Near Shore | -0.03 | 0.18 | 0.01 | -0.38 | 0.07 | -0.25 | Modify and add images to support ratings or remove. Always scored as A or B by UGS teams; one large group testing site had every possible score. |
| Waterbody Substrate | 0.30 | 0.35 | 0.56 | 0.40 | -0.11 | 0.76 | Difficult to evaluate when water not present at sites. When water is present, surveyors should check by hand. Not currently used in calculation of site suitability and potentially can be dropped. |
| Presence of North Shore | 0.47 | 0.72 | 0.50 | 0.74 | -0.07 | 0.88 | Decide how to rate at sites that are dry at the time of survey and at sites completely covered by vegetation (e.g., wet meadows). |
| Waterbody Vegetation | 0.56 | 0.60 | 0.92 | 0.70 | 0.04 | 0.24 | Scores ranged from A to D at many of the large group testing sites. Decide how to rate at sites that are dry at the time of survey. |
| Tall Forb Cover | 0.56 | 0.80 | 0.44 | 0.53 | 0.49 | 0.88 | Consider combining with shrub cover. Add photo guidance. |
| Overwintering Waterbodies | 0.61 | 0.92 | 0.63 | 0.24 | 0.66 | 0.61 | Consider adding a B option and combining C options. Add photo guidance. |
| CSF Breeding Waterbodies | 0.68 | 0.83 | 0.88 | 0.66 | 0.35 | 1 | Consider revising to make metric clearer for Great Salt Lake impoundments and spring systems. Add photo guidance. |
| Distance to Impervious Surface | 0.70 | 0.78 | 0.75 | 0.40 | 0.87 | 1 | Disagreement on whether gravel road counted as impervious; clarify. |
| Toad Breeding Waterbodies | 0.71 | 0.92 | 0.98 | 0.49 | 0.46 | 0.96 | Most disagreement was within a rank except at site with irrigation inputs and a dry springhead. |
| Hibernation Features | 0.76 | 0.65 | 0.91 | 0.82 | 0.67 | 1 | No changes recommended. |
| Shrub Cover | 0.83 | 1 | 0.88 | 0.74 | 0.73 | 1 | No changes recommended, though may consider combining with tall forb cover metric. |
| Livestock Use | 0.95 | 1 | 0.86 | 0.96 | 0.98 | 0.81 | No changes recommended. |

***Table C3.*** *Krippendorff's α values for wildlife checklist metrics for agreement across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Metrics are sorted by the mean observer value, the mean α value for the four between-observer comparisons (which excludes the repeat testing). Values in gray indicate metrics with low variability, where at least one observer or one UGS team used only one rank on the metric or only one rank was used during one of the site visits.*

| Metric ID | Metric Description | Mean Observer Value | Experienced | Novice | UGS Teams | Large Group | Repeat Visits |
|---|---|---|---|---|---|---|---|
| WQ5 | Gradual shores | -0.04 | -0.17 | 0.26 | -0.24 | -0.03 | 0.38 |
| HT12 | Diving duck habitat within 1 km | -0.01 | -0.24 | 0.74 | -0.55 | -0.01 | -0.25 |
| HT10 | Wildlife habitat within 1 km | -0.01 | -0.24 | 0.80 | -0.50 | -0.09 | -0.15 |
| HT4 | Shallow emergent water | 0.00 | 0.13 | -0.05 | -0.11 | 0.02 | 0.69 |
| HT16 | Shorebird habitat within 1 km | 0.05 | -0.24 | 1 | -0.55 | -0.03 | -0.41 |
| HT14 | Wading bird habitat within 1 km | 0.07 | -0.24 | 1 | -0.55 | 0.06 | -0.35 |
| HT13 | Dabbling duck habitat within 1 km | 0.08 | -0.24 | 1 | -0.55 | 0.10 | -0.33 |
| HT8 | Natural upland connected to site | 0.16 | 0.46 | 0 | -0.17 | 0.34 | 0.52 |
| SF3 | Animal burrows | 0.23 | -0.17 | 0.42 | 0.26 | 0.41 | 0.23 |
| SV2 | Habitat for sensitive piscivorous birds | 0.24 | 0 | 1 | 0 | -0.05 | 1 |
| LC2 | Aquatic connectivity barriers absent | 0.32 | -0.05 | 0 | 1 | 0.31 | 0 |
| HT2 | Shallow open water | 0.34 | 0.42 | 0.82 | 0.13 | 0.01 | 0 |
| HT5 | Dense emergent water | 0.36 | 0 | 1 | 0 | 0.43 | 0.46 |
| SO9 | Dragonflies or damselflies observed | 0.38 | 0.30 | 0.63 | 0.25 | 0.36 | 0 |
| VE1 | Diversity of plant species present | 0.39 | 0.26 | 0.65 | 0.46 | 0.17 | 0.29 |
| VE4 | Trees present | 0.43 | 0 | 0.75 | -0.05 | 1 | 0 |
| WQ7 | Submerged aquatic vegetation present | 0.44 | 0 | 1 | 0.63 | 0.11 | 0 |
| WQ2 | No apparent hydrologic alterations | 0.45 | 0.40 | 1 | -0.05 | 0.43 | 0.06 |
| LC4 | Undisturbed land for 300 m around site | 0.46 | 0.75 | 0.42 | 0.63 | 0.03 | 1 |
| VE2 | Problematic plant species uncommon | 0.46 | 0.75 | 0.48 | 0.63 | 0 | -0.15 |
| SV1 | Habitat for sensitive wildlife | 0.47 | 1 | 0.71 | 0.09 | 0.06 | -0.09 |
| SO7 | Amphibians observed | 0.48 | 1 | 1 | 0 | -0.07 | 1 |
| SV5 | Habitat for sensitive wading birds | 0.48 | 1 | 1 | 0 | -0.07 | 1 |
| SO8 | Aquatic mollusks observed | 0.49 | 0 | 1 | 1 | -0.03 | 0.23 |
| HT1 | Deep open water | 0.49 | 0.82 | 0.56 | 0.63 | -0.03 | 0.38 |
| SD2 | Minimal other disturbances | 0.50 | 0 | 1 | 0 | 1 | 1 |
| SF4 | Structural features in drier areas | 0.52 | 1 | 0.60 | 0.53 | -0.03 | 0.05 |
| WQ1 | No noticeable water quality issues | 0.58 | 0.72 | 1 | 0.29 | 0.30 | 0.43 |
| LC5 | Intact landscape within 1 km of site | 0.60 | 0.63 | 0.83 | 0.63 | 0.32 | 0.69 |
| HT7 | Wet meadow | 0.61 | 0.71 | 0.87 | 0.74 | 0.14 | 0.64 |
| SV7 | Habitat for sensitive shorebirds | 0.62 | 0 | 1 | 1 | 0.48 | 0 |
| VE6 | Woody vegetation recruitment healthy | 0.62 | 0.80 | 0.82 | 0.45 | 0.43 | 0.61 |
| HT24 | Year-round water for secretive marsh birds | 0.64 | 1 | 1 | 0.39 | 0.17 | 0.23 |
| SF2 | Roosting structures | 0.65 | 0.63 | 0.56 | 0.42 | 1 | 0.69 |
| SV10 | Critical habitat for T&E species | 0.68 | 1 | 0.75 | -0.05 | 1 | 1 |
| SO6 | Shorebirds observed | 0.68 | 1 | 0 | 1 | 0.72 | 0 |
| SV8 | Habitat for sensitive amphibians | 0.70 | 0.83 | 1 | 0.58 | 0.41 | 0.69 |
| LC1 | No major dams | 0.71 | 1 | 0.87 | 0.40 | 0.57 | 0.58 |
| SF1 | Undercut banks | 0.74 | 0.56 | 0.80 | 1 | 0.58 | 0.46 |
| SO2 | Diving ducks observed | 0.74 | 1 | 1 | 1 | -0.03 | 0 |
| HT3 | Deep emergent water | 0.75 | 1 | 1 | 1 | 0 | 1 |
| SD3 | Not used for recreation | 0.75 | 0 | 1 | 1 | 1 | 1 |
| SV6 | Habitat for sensitive secretive marsh birds | 0.77 | 1 | 1 | 1 | 0.07 | 1 |
| SO3 | Dabbling ducks observed | 0.78 | 1 | 1 | 1 | 0.11 | -0.07 |
| SO1 | Piscivorous birds observed | 0.78 | 1 | 1 | 1 | 0.11 | 0 |
| LC3 | Intact 30 m buffer | 0.78 | 0.30 | 0.82 | 1 | 1 | 1 |

*Table C3. Continued.*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| WQ4 | Site includes perennial springs. | 0.78 | 1 | 1 | 0.63 | 0.51 | 1 |
| VE3 | Site includes bulrush species | 0.79 | 1 | 0.75 | 0.75 | 0.64 | 1 |
| WQ3 | Perennial stream or canal present. | 0.79 | 1 | 0.65 | 0.83 | 0.68 | 0.76 |
| SV9 | Habitat for sensitive aquatic mollusks | 0.82 | 1 | 1 | 1 | 0.27 | 1 |
| WQ6 | Structural features present in water | 0.82 | 1 | 1 | 1 | 0.28 | 0.69 |
| HT22 | Year-round water for dabbling ducks | 0.83 | 1 | 1 | 1 | 0.31 | 0.69 |
| HT23 | Year-round water for wading birds | 0.83 | 1 | 1 | 1 | 0.31 | 0.69 |
| HT21 | Year -round water for diving ducks | 0.83 | 1 | 1 | 1 | 0.31 | 0.73 |
| VE5 | Wetland shrubs present | 0.85 | 1 | 0.82 | 0.56 | 1 | 0.29 |
| SO5 | Secretive marsh birds observed | 0.87 | 1 | 1 | 1 | 0.46 | 1 |
| SO10 | Beaver activity evident | 0.88 | 1 | 1 | 1 | 0.51 | 1 |
| HT26 | Year-round water for amphibians | 0.89 | 1 | 1 | 1 | 0.56 | 0.69 |
| HT27 | Year-round water for aquatic mollusks | 0.89 | 1 | 1 | 1 | 0.56 | 0.69 |
| HT19 | Year-round water for wildlife in general | 0.90 | 1 | 1 | 1 | 0.60 | 0.50 |
| SO4 | Wading birds observed | 0.93 | 1 | 1 | 1 | 0.72 | 0 |
| SD1 | Not grazed or lightly grazed | 0.93 | 1 | 1 | 1 | 0.72 | 0.69 |
| HT6 | Partially vegetated mudflat | 0.94 | 1 | 1 | 1 | 0.76 | 1 |

***Table C4.*** *Krippendorff's α values for water quality checklist metrics for agreement across observers (Experienced Team, Novice Team), across teams of observers (UGS Teams, Large Group), and across site visits (Repeat). Metrics are sorted by the mean observer value, the mean α value for the four between-observer comparisons (which excludes the repeat testing). Values in gray indicate metrics with low variability, where at least one observer or one UGS team used only one rank on the metric or only one rank was used during one of the site visits.*

| Metric ID | Metric Description | Mean Observer Value | Experienced | Novice | UGS Teams | Large Group | Repeat Visits |
|---|---|---|---|---|---|---|---|
| 18 | Receives water from impaired waterbody | -0.02 | -0.05 | -0.05 | 0 | 0.02 | 0.51 |
| 16 | Other sources of pollutants coming to wetland | 0.01 | -0.11 | 0.65 | -0.40 | -0.10 | 0.06 |
| 2 | Short persistent herbaceous vegetation | 0.02 | -0.05 | -0.11 | -0.05 | 0.30 | 1 |
| 5 | Seasonally ponded | 0.23 | 0.13 | 0.63 | -0.23 | 0.38 | 0.46 |
| 19 | Sediment or nutrient run-off in contributing basin | 0.31 | 0.25 | 0.65 | 0.13 | 0.23 | 0.51 |
| 9 | Low slope wetland | 0.50 | 1 | 0.63 | -0.05 | 0.41 | 0.22 |
| 20 | Other pollutant run-off in contributing basin | 0.54 | 0.63 | 0.80 | 0.42 | 0.32 | 0.69 |
| 12 | Sediment or nutrient run-off within 50 m of site | 0.55 | 0.82 | 0.80 | 0.46 | 0.10 | 0.57 |
| 14 | Adjacent to a lake used by power boats | 0.56 | 0 | 1 | 1 | 0.22 | 1 |
| 21 | Discharges to stream, river, or lake | 0.59 | 1 | 0.83 | 0.46 | 0.06 | 0.46 |
| 3 | Tall persistent herbaceous vegetation | 0.59 | 1 | 0.80 | 0.13 | 0.42 | 0.77 |
| 1 | Soil true clay or true organic | 0.59 | 1 | 0.75 | 0.25 | 0.37 | -0.36 |
| 15 | Adjacent to waterbody with known algal blooms issues | 0.62 | 0 | 1 | 1 | 0.46 | 1 |
| 17 | Within an incorporated city | 0.63 | 1 | 1 | 0.56 | -0.04 | 0.69 |
| 13 | Other pollutant run-off within 50 m of site | 0.65 | 0.80 | 0.80 | 0.56 | 0.44 | 0.69 |
| 10 | Homes likely to be on septic system | 0.66 | 1 | 0.63 | 1 | 0 | 1 |
| 6 | No or intermittently flowing outlet | 0.66 | 0.80 | 0.80 | 1 | 0.05 | 0.78 |
| 8 | Vegetation extending into lake or impoundment | 0.74 | 1 | 1 | 1 | -0.04 | 0.45 |
| 7 | Riverine with surface depressions | 0.77 | 1 | 0.63 | 1 | 0.44 | 0.22 |
| 11 | Stormwater pipe feeds wetland | 0.81 | 1 | 1 | 1 | 0.22 | 1 |
| 22 | Category 1 or category 2 for anti-degradation | 0.82 | 0.82 | 1 | 0.83 | 0.64 | 1 |
| 4 | Woody vegetation | 0.85 | 0.83 | 1 | 0.82 | 0.77 | 0.69 |
| 23 | Category 4 and/or 5 water quality assessment unit | 0.90 | 1 | 1 | 1 | 0.59 | 1 |

# Appendix D
# Comparison of Checklist and Metric-Based Water Quality Functional Assessments

## Background and Methods

The experienced UGS team tested within-team variability of the URAP water quality functional checklist and a metric-based water quality assessment approach from Washington State (Hruby, 2014) before the general method testing project began to determine which method to test in the project. Both methods divide indicators into wetland capacity, landscape potential, and societal value components, but differ in their scoring. The checklist approach notes presence/absence of features while the metric-based approach ranks condition of specific attributes using multiple states. The testing was conducted at 17 of the 19 sites used for testing vegetation methods. Observers were provided with field forms and the field manual from Hruby (2014) and the URAP field forms and were asked to score both the checklist items and metrics independently and then to discuss results with their field partner to obtain a final consensus result.

## Analysis and Results

A preliminary analysis was conducted to compare the two methods during the field season. Observers agreed on 94.0% of the 368 unique combinations of URAP checklist indicators and on 89.6% of the 163 unique combinations of Washington metrics. Surveyors were always within a rank of each other when they disagreed on the Washington metrics. We calculated a score for sites for each component by counting each feature marked as present in the URAP checklist and using the scores associated with each rank in the Washington protocol and then tabulated the number of times observers differed in raw scores for each component. Scores differed at 35.3% of sites for both the wetland capacity and landscape potential components for both the checklist and the metric approaches. In contrast, 17.6% of site scores differed for raw societal value score using the Washington metrics versus only 5.9% of sites using the URAP checklist. Based on the results of this preliminary analysis and the fact that the checklist approach was initially recommended by stakeholders, we used the URAP water quality functional checklist for the remainder of the field testing.

We conducted a more rigorous evaluation of the Washington metrics at the end of the field season when we had more time to evaluate the benefits and costs of using a checklist-based approach. We calculated Krippendorff's α values for individual metrics and an aggregated Washington water quality score. The Washington water quality assessment assesses wetlands by hydrogeomorphic class. We grouped similar metrics together across hydrogeomorphic classes to calculate Krippendorff's α for these aggregated metrics. We also used the Washington water quality metric scores to calculate overall scores within the wetland potential, landscape potential, and societal value categories and converted those categories to low, medium, and high ratings (Hruby, 2014). We calculated Krippendorff's α for the habitat suitability using the data type "ordinal" after converting the low, medium, and high classes to 0, 1, and 2.

We tested the riverine metrics at five sites, depressional metrics at seven sites, slope metrics at four sites, and lacustrine fringe metrics at one site. However, one of the depressional metrics in the wetland potential category was not rated at three sites and one of the slope metrics in the wetland potential category was not rated at one site, leading to a reduced sample size for those metrics. Three-quarters of the metrics had substantial or better agreement and only 19% had slight or worse agreement (table D1), though 21 of 37 tested metrics had no variation in the ratings, including five of the seven metrics with poor agreement (table D2). When we grouped similar metrics across hydrogeomorphic categories into eight aggregated metrics, one aggregated metric still had low variability and a Krippendorff's α value of 0. The remaining aggregated metrics had values ranging from 0.32 to 1. When metrics were converted to ranks (low, medium, high), Krippendorff's α values were 0.91 for wetland potential (four sites were not scored due to missing values), 0.80 for societal value, and 0.42 for landscape potential. Surveyors assigned wetlands the same rank at ≥83% of sites for each category and were always within one rank of each other. The landscape potential category had the lowest amount of variability in any category, with 13 sites rated as moderate by both observers.

## Conclusions

Though our preliminary analysis led us to use the URAP checklist to evaluate water quality function, it would be useful to consider using the Washington metrics moving forward. We found no evidence that checklists perform better than metrics. The two checklists used in the broader study had the highest percent of components rated as poor in the UGS team and large group testing and the wildlife indicator checklist also had the most disagreement in the repeat visit data. Furthermore, the Washington protocol already has a method for translating metrics into scores and aggregated results appear to be more reliable than individual metric values.

## References

Hruby, T., 2014, Washington State wetland rating system for eastern Washington–2014 update: Olympia, Washington, Washington Department of Ecology publication #14-06-030, 126 p.

***Table D1.*** *Percent of metrics in each Krippendorff's α category for different components of the URAP wetland assessment protocol across observers, for 37 unique metrics.*

| **Krippendorff's α** | **Percent of Metrics** |
|---|---|
| >0.80–1 | 70% |
| >0.60–0.80 | 5% |
| >0.40–0.60 | 5% |
| >0.20–0.40 | 3% |
| ≤0.20 | 16% |

***Table D2.*** *Krippendorff's α values for Washington water quality functional assessment metrics for agreement across observers for the experienced team, sorted by α value. Values in gray indicate metrics with low variability, where at least one observer used only one rank on the metric. Metrics starting with R were evaluated at riverine sites, S at slope sites, D at depressional sites, and L at lake fringe sites. Similar metrics were also grouped across hydrogeomorphic classes and analyzed, as shown by the metric group and group α.*

| Metric ID | Metric Description | α | Metric Group | Group α |
|---|---|---|---|---|
| R2.4 | Adjacent land use | -0.13 | Adjacent land use | 0.32 |
| S3.2 | Basin with known water quality issues | 0 | Basin with issues | 0 |
| L2.2 | Adjacent land use | 0 | Adjacent land use | 0.32 |
| D2.4 | Other sources of pollutants | 0 | Other pollutants | 0.47 |
| S2.2 | Other sources of pollutants | 0 | Other pollutants | 0.47 |
| S1.3 | Vegetation structure | 0 | Vegetation | 0.86 |
| D2.1 | Stormwater discharge | 0.35 | | |
| D3.3 | Identified as important for water quality | 0.46 | Identified as important | 0.76 |
| R1.1 | Surface depressions | 0.48 | | |
| R2.5 | Other sources of pollutants | 0.64 | Other pollutants | 0.47 |
| D1.1 | Surface water outlet | 0.71 | | |
| D1.4 | Seasonal ponding | 0.97 | | |
| D3.2 | Basin with known water quality issues | 1 | Basin with issues | 0 |
| L3.2 | Basin with known water quality issues | 1 | Basin with issues | 0 |
| D2.2 | Adjacent land use | 1 | Adjacent land use | 0.32 |
| S2.1 | Adjacent land use | 1 | Adjacent land use | 0.32 |
| L3.3 | Identified as important for water quality | 1 | Identified as important | 0.76 |
| R3.3 | Identified as important for water quality | 1 | Identified as important | 0.76 |
| S3.3 | Identified as important for water quality | 1 | Identified as important | 0.76 |
| D1.3 | Vegetation structure | 1 | Vegetation | 0.86 |
| L1.2 | Vegetation structure | 1 | Vegetation | 0.86 |
| R1.2 | Vegetation structure | 1 | Vegetation | 0.86 |
| D3.1 | Discharges to 303(d) waterbody | 1 | 303(d) waterbody | 1 |
| L3.1 | Lake on 303(d) list | 1 | 303(d) waterbody | 1 |
| R3.1 | Along 303(d) listed waterbody | 1 | 303(d) waterbody | 1 |
| S3.1 | Discharges to 303(d) waterbody | 1 | 303(d) waterbody | 1 |
| D1.2 | Clay or organic soil | 1 | Soil | 1 |
| S1.2 | Clay or organic soil | 1 | Soil | 1 |
| D2.3 | Septic systems | 1 | | |
| L1.1 | Average width of plants on lakeshore | 1 | | |
| L2.1 | Power boats on lake | 1 | | |
| L2.3 | Algal or nuisance aquatic plant issues | 1 | | |
| R2.1 | Incorporated city | 1 | | |
| R2.2 | Basin with incorporated city | 1 | | |
| R2.3 | Basin land use | 1 | | |
| R3.2 | TMDL limits on stream | 1 | | |
| S1.1 | Average slope of wetland | 1 | | |