EPA LEVEL II RAPID ASSESSMENT METHOD FOR NEVADA WETLANDS

Field Manual

June 2024 (Revised)

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EPA Level II Rapid Assessment Method for Nevada Wetlands Field Manual (Revised)

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Based on NatureServe's Ecological Integrity Assessment Framework, as adapted by the Colorado Natural Heritage Program and the Wyoming Natural Diversity Database.

Funding provided by U.S. Environmental Protection Agency, Region 9 Wetland Program Development Grant entitled *NDNH Wetland Protection Development- Data Mapping, Management and Springsnail Conservation- 99T65201*. Matching funds were provided by The Nature Conservancy.

Acknowledgements

We thank the assistance and input of the many people who attended workshops, worked with us in the field, and reviewed drafts of this manual and data sheets, including:

- Center for Ecological Management of Military Lands: Kate Huxter, Cheryl Bolton, Mia Claridy, Shirley Dao
- Nevada Department of Wildlife: Jasmine Kleiber, Larry Teske (retired)
- Nevada Division of Natural Heritage: Janel Johnson, Eric Miskow, Jim Morefield
- The Nature Conservancy: Kevin Badik, Michael Clifford, Lori Leonard, Louis Provencher, Chris Sega, Len Warren
- University of Nevada Reno: Paul Verburg
- US Forest Service: Jeanne Chambers, John McCann, Megan Brown, Harold Jones, William Nighthawk, Carly Norton, Nicole Spehn
- Wyoming Natural Diversity Database: Lindsey Washkoviak

Suggested citation: Bushman B, Saito L, Szabo K, McGwire K, Iosso C (Ed.). 2024. EPA Level II Rapid Assessment Method for Nevada Wetlands Field Manual (Revised). Carson City: Nevada Division of Natural Heritage.

Version date: June 3, 2024 (revised)

Cover photo: Hot springs wetland at River Fork Ranch, Nevada (B. Bushman)

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List of Acronyms

AA	Assessment Area
CNHP	Colorado Natural Heritage Program
DRI	Desert Research Institute
EIA	Environmental Integrity Assessment
GIS	Geographic Information System
GPS	Geographic Positioning System
NDNH	Nevada Division of Natural Heritage
NV RAM	Nevada Rapid Assessment Method
NWI	National Wetland Inventory
m	meter
RMRS	Rocky Mountain Research Station
TNC	The Nature Conservancy
USDA-FS	United States Department of Agriculture Forest Service
USEPA	United States Environmental Protection Agency
WPP	Wetland Program Plan
WYNDD	Wyoming Natural Diversity Database

SECTION 1: INTRODUCTION

The Nevada Wetland Rapid Assessment Method (NV RAM) is an assessment protocol developed under the U.S. Environmental Protection Agency (USEPA) National Wetlands Monitoring Workgroup's Level 1, 2 and 3 approach to wetland monitoring (USEPA, 2019). The NV RAM Level 2 assessment approach measures overall wetland condition with an emphasis on biological integrity and is based on other ecological integrity assessments (EIA) developed for the western United States (Lemly et al., 2016; Washoviak et al., 2018; USDA-FS, 2012). For the purposes of this manual, ecological integrity is defined as the structure, composition and function of an ecosystem operating within the bounds of natural or historic disturbance regimes, and the ability of an ecosystem to support and maintain a full suite of organisms with species composition, diversity, and function comparable to similar systems in an undisturbed state, which is similar to the definition provided by Lemly et al. (2016). Ecological integrity is typically assessed by measuring or quantifying certain aspects of wetland assemblages along with associated wetland attributes. The NV RAM uses quantitative vegetation metrics, plus physicochemical (i.e., soils and water quality) and biological data, to establish current ecological condition and is intended to be a method that can be performed by an experienced team of two people in four hours at one assessment area.

1.1 Purpose of the Nevada Wetland Rapid Assessment Method

The NV RAM was created to advance the strategies documented in the State of Nevada Wetland Program Plan, 2017-2022 (WPP), for improving Nevada wetland resource protection and restoration. Estimates suggest Nevada has lost (i.e., converted to another type of land cover or use) approximately 52% of its historic wetland acreage (NDNH, 2016). Despite the need by researchers and land managers for information to manage the state's water resources for various purposes, wetland data are decentralized with no single entity tracking the location, type (class) or condition of wetlands in Nevada, nor documenting the projects underway to protect, mitigate, or conserve these valuable natural resources. Responding to targeted stakeholder outreach, the primary impetus that guided the NV RAM development was the shared need of agencies for a cost-effective method for ambient wetland condition assessment within Nevada's hydrographic areas (i.e., groundwater administrative units) or within specific land management units (Appendix G- Nevada Assessment Expert Engagement Summary).

The field manual presented here is a product of a 2017 USEPA grant to NDNH entitled "Wetland Protection Development- Data Mapping, Management and Springsnail Conservation Grant- 99T65201" (NDNH, 2017; hereafter referred to as NDNH 2017 Project). Additional field testing and consultation with partners in 2023 and 2024 resulted in the 2024 revised version. NVRAM is intended to establish consistent methods for performing rapid assessments of Nevada wetlands to provide better knowledge of regional distribution and condition of wetland habitats across the state. NV RAM could be used by land or resource managers to measure wetland ecological integrity, target sites for restoration or protection, track changes over time, or identify stressors. Where specific assessment methods are required for permitting, users should follow guidance provided by those programs to identify the appropriate assessment method.

1.2 Nevada Wetland Rapid Assessment Method Development

The wetland mapping and assessment efforts by The Nature Conservancy of Nevada (TNC) and the Desert Research Institute (DRI) were developed according to the USEPA National Wetlands Monitoring Workgroup Wetland Monitoring and Assessment guidance definitions for Level 1 and 2 assessments, which "breaks assessment procedures into a hierarchy of three levels that vary in intensity and scale, ranging from broad, landscape-scale assessments (known as Level 1 methods), rapid field methods (Level 2) to intensive biological and physicochemical measures (Level 3)" (USEPA, 2019; Figure 1). As laid out by the USEPA approach, the NV RAM Level 2 assessment is structured to be able to validate and possibly correct information generated by Level 1 assessments using DRI's Wetland Analysis Toolbar (WetBar). While not addressed under this grant nor in this manual, a Level 3 biological assessment could be developed in the future. Several of the other existing assessment methods described in Section 1.4 include elements of a Level 3 assessment and could be considered for use in the interim.

DRI's Level 1 Wetland Analysis Toolbar is a *landscape assessment*, relying on coarse, landscape scale inventory information, gathered through remote sensing and stored in a geographic information system (GIS) format. The Level 1 assessment classifies wetlands according to information available through the National Wetland Inventory (NWI), the National Hydrography Dataset, and logical inferences from the amount of vegetation and frequency of flooding. An output of the DRI's product is a "Nevada Wetland Mapping Level 1 Report" that provides much of the information and data needed for the desktop-planning stage of the RAM, including tools to help infer a probable Assessment Area (AA) where the RAM will be focused and the times of year when the assessment will be most effective.

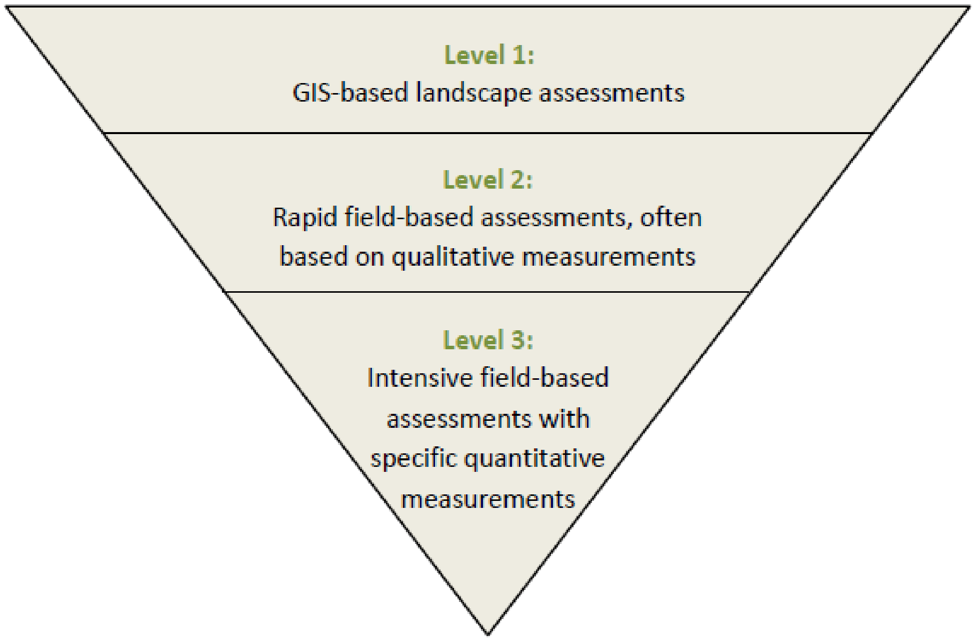


Figure 1. The USEPA National Wetlands Monitoring Workgroup Wetland Monitoring and Assessment guidance definitions for Level 1, 2, and 3 assessments (USEPA, 2019).

TNC's Level 2 NV RAM follows USEPA's Level 2 definition, as a "*rapid assessment* at the specific wetland site scale, using relatively simple, rapid protocols that are to be validated by and calibrated to Level 3 assessments" (USEPA, 2019). USEPA (2019) further notes that RAMs should "provide sound, quantitative information on the status of the wetland resource with a relatively small investment of time and effort."

The approaches recommended by Sutula et al. (2006) were applied for determining the most appropriate RAM for defined targets, as well as to help navigate the numerous considerations that inform RAM development. Development of the NV RAM involved engagement with wetland experts from Nevada and surrounding states to determine the appropriate approach, including identifying the RAM target applications and assessment endpoints for wetlands in Nevada. RAMs are by nature location-specific and often designed to meet specific agency management targets and there are many rapid assessment methods currently in use and under development in the region that overlaps with Nevada (Fennessy et al., 2004; Lemly et al., 2016; Collins et al., 2008; USDA-FS, 2012; Miller et al., TBD).

With the goal of developing a tool that establishes consistent methods for performing rapid assessments of Nevada wetlands and enables better knowledge of regional distribution and condition of wetland habitats across the state, the project team identified RAMs currently in use by federal or state agencies, and that covered specific ecoregions or wetland classes through extensive partner and stakeholder outreach throughout 2018 and 2019 (Figure 2, Appendix G). The verification stage (i.e., testing to determine whether the proposed RAM accurately measures stated assessment endpoints, Sutula et al., 2006) was initiated by TNC and interested stakeholders at two wetlands in the Mojave Desert and four wetlands in the Great Basin in May and July 2019. Following additional field testing and consultation with partners, NDNH created an updated version of the NV RAM in 2024. More details on the development and update process can be found in Appendix G.

1.3 Assessing Wetland Ecological Condition and Integrity versus Wetland Function

The NV RAM is built upon the EIA Method framework shared by many Natural Heritage Program-inspired wetland assessment programs in the Intermountain West (Washkoviak et al., 2018; Lemly et al., 2016). The framework was initially developed in 2004 by ecologists from four state Natural Heritage Programs across the U.S., as well as NatureServe and TNC ecologists, and three major reports have been published by NatureServe on the EIA Framework (Lemly et al., 2016; Faber-Langendoen et al., 2008; 2012). EIA frameworks provide a rapid and repeatable evaluation of the wetland ecological condition and have recently been successfully refined to meet specific assessment endpoints and targets by wetland programs in Colorado and Wyoming (Washkoviak et al., 2018).

Ecological, or biotic, assessment approaches that underlie EIAs are top-down approaches that use biological response, such as characteristic biota, wetland functions, and wetland class to indicate elements of impairment (e.g., hydrology, water chemistry, etc.). Functional assessments are bottom-up approaches that use observations of ecosystem functions that generally fall within the categories of hydrology, biogeochemistry, or physical habitat (e.g., geomorphology, hydrodynamics, etc.) to infer impacts to biota (Lemly et al., 2016). A rapid assessment method focused on ecological, versus functional, condition aligns with the NDNH WPP goal of developing tools that will guide users to actions that maintain and enhance the wetland condition of Nevada’s aquatic ecosystems, including wildlife and fish species (NDNH, 2016).

Sutula et al. (2006) stress the importance of articulating an assessment endpoint before initiating RAM development and suggests that an assessment endpoint can include assessment of wetland function, values, stressors, and other drivers of wetland condition. The NDNH WPP supports ecological integrity as the NV RAM assessment endpoint for wetland condition. Ecological integrity describes the ability of an ecosystem to support its structure, composition, and function within the bounds of natural or historic disturbance regimes, with high ecological integrity describing an ecosystem with complete structural components and ecological processes functioning optimally (Lemly et al., 2016). A RAM that establishes condition by way of EIA offers the ability to infer the impacts to basic physical drivers, and point to appropriate protection, restoration or mitigation actions. EIA can assess the degree to which, under current conditions, a system matches reference characteristics of similar systems with high ecological integrity (Lemly et al., 2016). The output of the NV RAM is an indication of ecological integrity.

1.4 Targets of NV Wetland RAM

The NDNH WPP (2022) provides guidance for the development of the NV RAM and infers the need for a single assessment endpoint that establishes basic condition for the various wetland classes occurring throughout Nevada.

Other RAMs have been adopted by agencies or are currently under development in Nevada that are tailored for groundwater dependent ecosystems (USFS 2022) that may better suit the needs of some agencies. The NV RAM Decision Matrix (Figure 2) guides users to the most appropriate RAM for a particular landowner or agency, a specific topographic or hydrologic setting, target ecosystem, or regulatory need. Some agencies like the Bureau of Land Management use the Proper Functioning Condition approach, but that approach is not included in Figure 2 because its level of detail is not equivalent to the USEPA Level 2 assessment. While several ecoregions span state lines, the NV RAM is intended for assessing wetlands in the Nevada portions of these ecoregions.

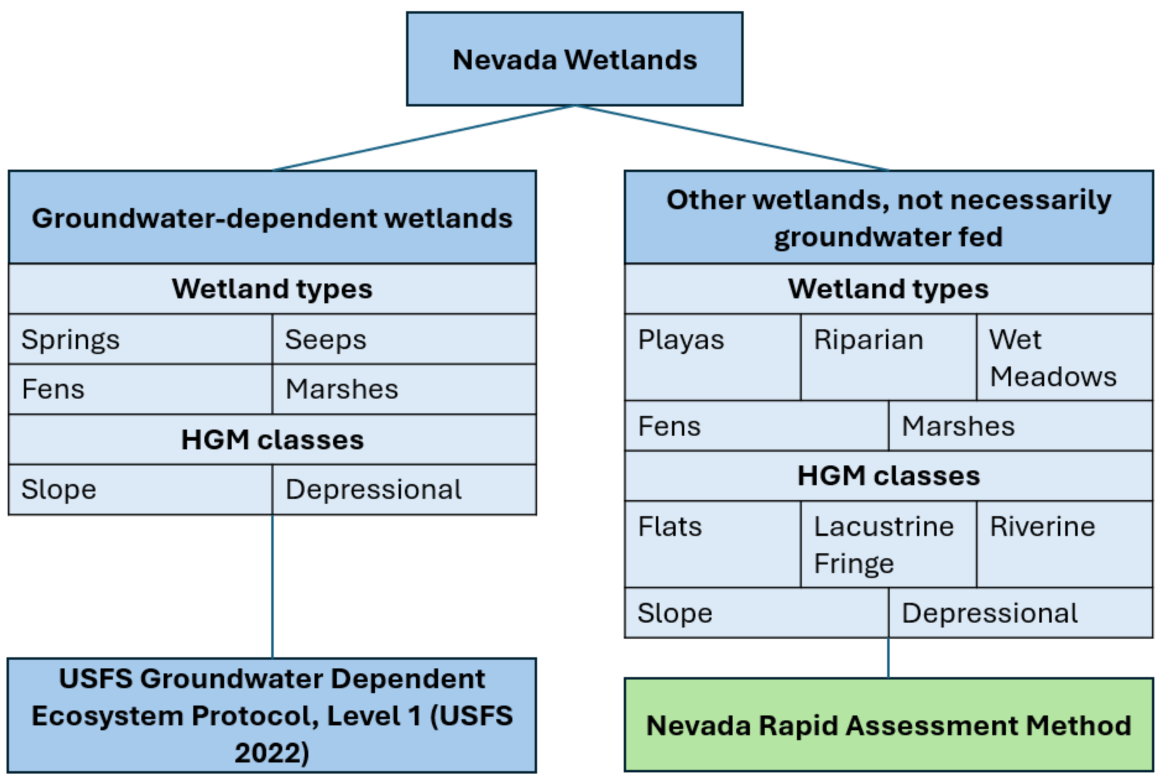


Figure 2. The NV RAM Decision Matrix. This NV RAM schematic guides users to the appropriate RAM for their geography, agency, or regulatory need within Nevada (USDA-FS, 2022; Merritt et al., 2017). The NV RAM can be used on springs, seeps, peatlands, fens, marshes and swamps that are large enough to accommodate the minimum assessment area.

The NDNH WPP (NDNH, 2023) calls for the "development of a monitoring and assessment strategy consistent with the 'Elements of a State Water Monitoring and Assessment Program for Wetlands' (USEPA, 2003) to characterize existing and historic wetlands in the state and provide an understanding of the function and condition of those wetlands to enable stakeholders to make informed management decisions." The NDNH WPP also calls for a cost-effective method that works for wetland monitoring within and among regions. To meet these goals, the NV RAM establishes a multiple (versus single) target application that uses consistent methods to collect wetland distribution and condition data for multiple wetland classes across Nevada. The consistent methods for the NV RAM were developed through discussions with likely end users and synthesis of a variety of potential protocols (Sutula et al., 2006). The stakeholders engaged in this project saw the benefit of enhancing the consistency of wetland assessment to assist them within their management and regulatory settings (Appendix G).

1.5 Wetland Classification

Building off the DRI's Wetland Analysis Toolbar, the classification frameworks selected for this RAM include the NWI (based on the Cowardin system) and the Hydrogeomorphic classification system (Cowardin et al., 1979; Brinson, 1993). The EIA framework upon which the NV RAM is based relies on the National Vegetation Classification System, which is a national, hierarchical ecological classification that is peer-reviewed and periodically updated (Faber-Langendoen et al., 2008). The wetland classification groups that occur in Nevada can be found in Appendix C.

SECTION 2: APPLYING THE NV WETLAND RAPID ASSESSMENT METHOD

The NV RAM field protocol is directly adapted from the Colorado Natural Heritage Program (CNHP) RAM and Wyoming Natural Diversity Database (WYNDD) (Lemly et al., 2016; Washkoviak et al., 2018), and is intended to be able to be applied by two experienced people in four hours or less at a given assessment area. The NV RAM can be applied in a variety of circumstances with varying study design approaches based on the assessment need. It is beyond the scope of this manual to fully outline study design options, but **random sampling** and **targeted sampling** represent the two most common types of study designs. Additionally, each assessment team will eventually implement the protocols according to their individual expertise and work style.

Random sampling involves sampling a randomly selected, statistically representative set of sites out of a much larger population. The benefit of a random design is that it provides the ability to make statistically defensible statements about the overall condition of wetlands across the population. If the goal of a study is to assess wetland condition across a large area (e.g., entire agency management unit or entire watershed), then a random design is preferable. Targeted sampling is used if one already knows the site or number of sites to assess and involves selecting a specific set of sites to sample without the need to make estimates about a larger population. Targeted sampling is most appropriate when there is a discrete number of wetlands to be assessed. For more detailed explanation of the two approaches, see Lemly et al. (2016).

For either type of study design, it is important to identify **available data sources** to help locate the population of interest. These data sources may be US Fish and Wildlife Service (USFWS) NWI maps, US Geological Survey (USGS) topographic maps, Natural Resources Conservation Service (NRCS) soil maps, local vegetation maps that depict wetlands, or aerial photography. There is an abundance of good data sources available online today that can help both identify potential sample sites and assess landscape scale metrics. Parallel to the preparation of the NV RAM, DRI was funded to generate Level 1 wetland analysis datasets for the state of Nevada. These datasets were produced with a wetland analysis toolbar developed for ArcMap GIS software by DRI called “WetBar.” WetBar uses available geospatial and satellite imagery to generate a Level 1 wetland report for the selected area and provides context for assessing wetland condition. WetBar is available at http://www.dri.edu/wetland-mapnv.

Another important consideration is how to define the **target population**. If random sampling is being used, understanding the limits of the target population is crucial for setting up an assessment area. If a targeted assessment is being done, it is just as important to know when the wetland ends and the upland begins. The NDNH WPP acknowledges that various agencies managing land and water in Nevada will have different targets and may use different criteria to classify wetlands based on their various objectives for statutory protection and management. Thus, the definition of wetlands in the WPP is intended to encompass all wet areas in Nevada that provide ecosystem services and habitat for plants, wildlife, and aquatic species including: wet meadows, seeps and springs, playas, riparian areas, perennial streams, and intermittent and ephemeral washes (NDNH, 2016). The USFWS definition of a wetland is used as it best represents the range of wetland types applied by resource managers familiar with Nevada's wildlife, water, and water-influenced vegetation resources:

> *Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.*
>
> *For purposes of this classification, wetlands must have one or more of the following three attributes:*
>
> *(1) at least periodically, the land supports predominantly hydrophytes,*
> *(2) the substrate is predominantly undrained hydric soil, or*
> *(3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. (Cowardin et al., 1979)*

2.1 Assessment Design: Desktop Assessment and Preparing for the Field

The Level 1 Wetland Analysis Toolbar (WetBar) developed by DRI can provide valuable insights for planning a Level 2 assessment. These include:

- inspection of high-resolution aerial or satellite imagery of current conditions and issues associated with site access,
- examination of SSURGO soils maps in order to understand within-site environmental variability,
- prior aerial imagery and time-series plots of satellite-based vegetation and hydrology indices to understand changes at the site over the past 35 years,
- plots of monthly-averaged satellite-based indices, temperature, and precipitation that indicate when the site may be inaccessible (e.g., snow-covered, flooded), and what the expected state of vegetation would be at the time of a field visit,
- locations of known springs in and around the site,
- a map indicating the frequency of inundation at the site,
- a map indicating the current expanse of inundation at the site,
- information from geospatial data sources that can provide information about transportation networks and jurisdictional and land-ownership boundaries, and
- automated delineation of candidate 40-meter radius sampling areas for the field crew superimposed on aerial imagery and digital files with GPS center coordinates.

The Level 1 products were used in the planning of Level 2, NV RAM testing during the summer of 2019. Having selected a general study area, the team explored the study areas with the Level 1 WetBar tool http://www.dri.edu/wetland-mapnv. This included an assessment of local patterns in hydrology and soils, assessment of accessibility and travel times, checking for indications of recent changes at the site, and selection of candidate sites for NV RAM

Assessment Areas (AAs) that might be used by the field crew. Having selected candidate AAs, the WetBar tool provided a report for the field crews that was used to orient them to the site before going into the field and to help guide the selection of the actual AAs.

In the future, it may be possible to utilize the Level 1 Wetland Analysis Toolbar (Wetbar) to automatically populate a number of fields in the Level 2 RAM field forms, such as Nevada State Engineer Hydrographic Area Name, HUC 10#, Site Ownership, GPS coordinates and road access, and imagery as a backdrop for the site sketch map.

Additional field work preparation for efficient implementation of the NV RAM includes gathering all the necessary field equipment (Appendix F) and using the Level 1 report to plan travel logistics to the site at the appropriate season for vegetation identification and access to the site after snow-melt runoff.

For efficient implementation of the NV RAM in the field, the soil profile description procedure, including digging an actual soil pit, and the water chemistry sampling, including water probe calibration, should be attempted prior to performing those procedures in the field.

2.2 Defining an Assessment Area (AA)

The basis of the NV RAM is identifying and establishing an assessment area (AA) in which data collection may be concentrated. For random sampling, the standard shape and size for each AA is a 40-m radius circle (i.e., 0.5 ha or 5,000 m^2). For targeted sampling, each AA can be of variable size and shape and can be bound by the entire wetland itself, if so desired. Ideally, the AA should be one wetland class and type (see Appendices A, B and C) and one hydrogeomorphic (HGM) type (see Appendix B), but this is not always possible. However, it is still possible to apply the NV RAM protocol in those cases. The AA may be bounded by land ownership or management units or be a specific project area slated for management action. The general principles to consider when establishing an AA are further explained in Section 2.3.c.

For either type of study design, there are a variety of available data sources to help define the boundaries of the AA, including the Wetland Analysis Toolbar described in Section 2.1, as well as the USFWS NWI maps, USGS topographic maps, NRCS soil maps, local vegetation maps that depict wetlands, or aerial photography.

2.3 Establishing the Assessment Area

2.3.a. Assessment Areas for Targeted Sampling

The NV RAM protocol is designed around a targeted sampling approach to accommodate various wetland assessment needs. A targeted AA can be of variable size and shape, or can be bounded by the entire wetland itself, and refined onsite to meet the objectives of the wetland assessors depending on the need. However, using the Level 1 Wetland Analysis Toolbar for the NV RAM Desktop Assessment phase directs assessors to initiate the process using the random, point-based sampling approach to establish the AA (refer to Section 2.3.b.). This is a simple way for assessors to identify a likely AA and orient themselves to the wetland site prior to embarking on the field work (refer to Section 2.1). Once in the field, the information and data collected on page 1 of the data sheet directs assessors to adjust the AA to meet the targeted assessment need.

2.3.b. Assessment Areas for Random Sampling

For random sampling designs, it is often preferable to define the initial AA as a standard area around a fixed point. Because wetlands are so variable in size, random sampling often employs what is called an area-based design. Each AA represents a specific area of wetland and, therefore, a specific proportion of the wetland resource under investigation. The recommended standard AA is a 40 m radius circle (i.e., 0.5 ha or 5,000 m^2) centered on the random target point. However, there can be considerable flexibility in establishing an AA depending on wetland size and shape.

Proper placement of the actual AA is crucial because it defines the area for most of the data collection. Before heading into the field, users should examine aerial photos of the point and should strategize the most likely placement of the initial AA based on observed wetland features surrounding the point. The Wetland Analysis Toolbar can be used to determine the likely AA. It can be useful to choose several potential AAs and then determine the best AA that meets your target wetland once in the field. Once in the field and the area surrounding the point has been identified to be suitable for sampling, the user will establish the actual AA to bound further sampling. The actual AA should be located in the closest possible suitable sample area from the original point. The user should always document the process used to move vegetation plots when the original (initial) center point and standard AA are not used.

2.3.c. General Principles

The following are general principles to consider when establishing an AA; however, it is not necessary to exactly adhere to these principles if they are not practical for a particular site:

1) The AA should be targeted for *only one* Nevada Wetland National Vegetation Classification (NVC) group (Appendix C) when possible. Changes in dominant soil type, vegetation, or hydrology, however, can indicate there are secondary wetland types present; if an area with multiple NVC wetland groups is surveyed, that should be clearly denoted on the sketch, in the description, and in the NVC section.
2) The AA should be 0.5 ha (5,000 m^2) where possible, but can be as small as 0.1 ha (1,000 m^2) if necessary.
3) The maximum AA length is 200 m, regardless of shape. The minimum AA width is 10 m, regardless of shape.
4) The AA should contain no more than 10% water >1 m deep. This includes water in a stream channel. The AA can cross and contain a stream channel that is <1 m deep (or the depth considered safe to wade by the field user, which may be different for different users and at

different stream velocities). The AA *should not* cross streams that are too deep to wade. When sampling a pond fringe with deep water in the center, the AA drawing should specifically indicate the AA edge where water is > 1 m.

5) The AA should contain no more than 10% upland inclusions.
6) Proximity to the original (initial) random point generally takes higher priority over retaining a standard 40 m circle AA shape. When there are >1 wetlands near the original point, but the closest sampleable wetland is smaller than one farther away, the closer wetland should still be sampled. However, if the difference between two potential sites is minimal, and one would make a standard AA possible, pick the most straightforward sample location. Use best professional judgment in the field to survey the original wetland point, in the most standardized way possible, realizing that the goal is to survey the wetland that the random point represents, but that many situations arise in the field that require slight modifications.

2.3.d. AA Layout Protocol in Brief

1) Determine AA shape: this may be a 40 m radius circle, or if size and shape constraints require an alternate shape: freeform, rectangle, or entire wetland.

2) For standard circular AAs, take a GPS point at the center and record the waypoint number, UTMs and error on the datasheet as the '**AA-Center.'** Record elevation, slope, and aspect at the AA-Center.

3) For non-standard AAs, it is not required to take a GPS point in the center, as it will likely be easier to determine in GIS based on the AA polygon. Record elevation and accuracy in a representative area of the AA.

4) Flag AA boundary. For standard **40 m radius** AAs, flag at least the cardinal directions. For **freeform** AAs, track the boundary using the GPS and flag as often as needed to visualize the AA. For **rectangular** AAs, flag at each corner, and at mid-points if helpful.

5) Take GPS points and photos from at least four standard locations on the edge of the AA looking in, either at the cardinal directions for **40 m radius** AAs or at four logical locations on the edge of **rectangular** or **freeform** AAs. Record the waypoint numbers, UTMs, accuracy, and photo number (e.g., AA-1, AA-2, etc.) on the datasheet.

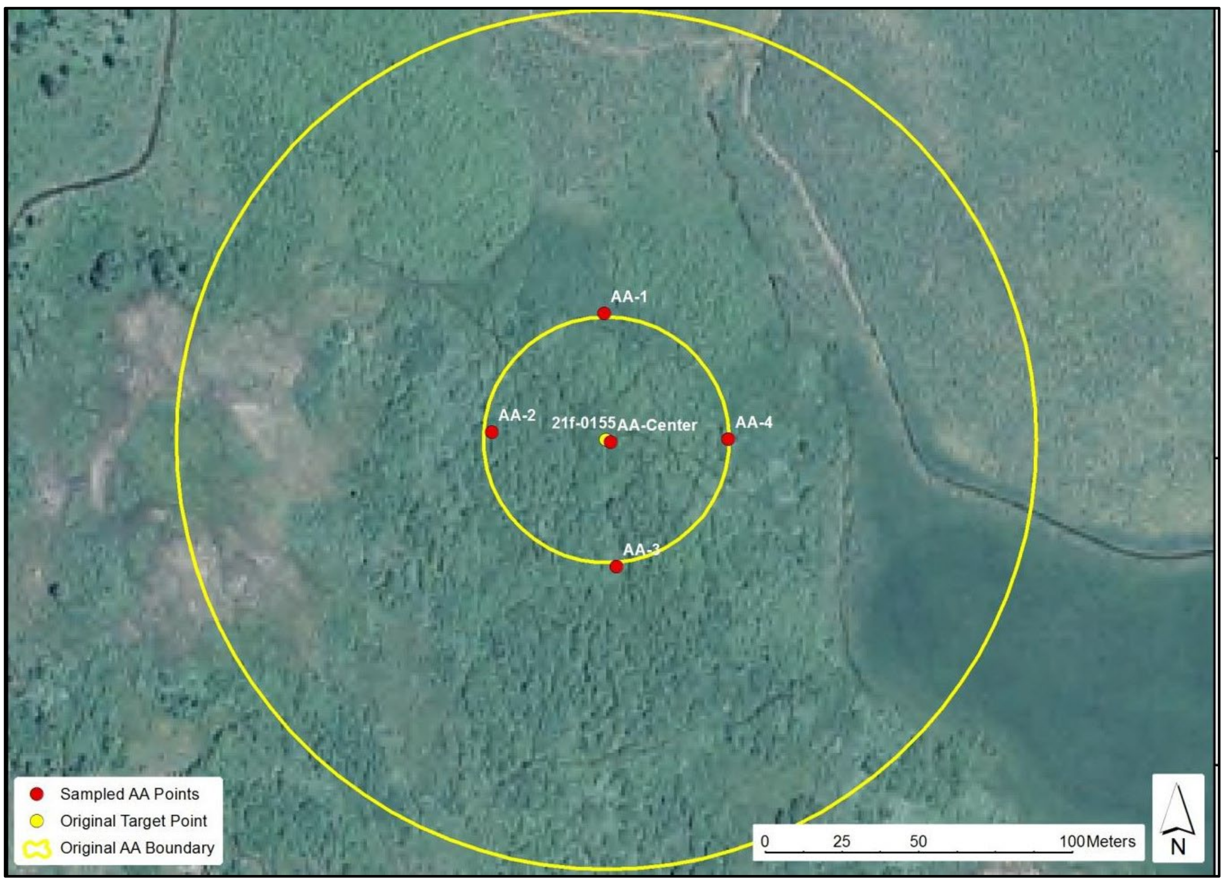
6) When AA boundaries are set, sketch the AA shape on the **Assessment Area Drawing** page of the data sheet (Figure 7). Ideally, this is done on the color aerial photo if possible. It is best to first draw in pencil then trace with a permanent marker.

2.3.e. Standard AA Layout – 40 m radius circle

The standard AA perimeter is a 40-m radius circle surrounding a center point (Figure 3A). Standard AAs may be shifted so the edge of the AA is up to 60 m from the original target point, meaning the center point of a shifted AA can be up to 100 m from the original point (Figure 3B).

The perimeter of the AA should be flagged and this process may vary depending on thickness of vegetation. Use judgment to maximize layout efficiency. Further details on flagging the perimeter in open vs. dense vegetation are provided below. Site photos can be taken as the AA is flagged (more common in open vegetation) or can be taken after the AA is flagged (more common in dense vegetation that is difficult to traverse). Flagging options include biodegradable forestry flagging in visible colors such as pink or orange (easiest in tall vegetation and woody areas) or pin flags (at least 36" tall, and easiest in short vegetation and open water). If it is not possible to stand on the cardinal azimuth of each AA edge (as in deep water), take the reference point UTMs and photos as close as possible to the target position as outlined in Section 2.3.d.4., and note in comments how the reference point(s) are offset.

A.



B.

Figure 3. Map of standard 40 m radius circle AA layout centered on the target point. **A.** The inner yellow circle is the targeted AA, and the outer yellow circle shows the 100 m envelope within which the AA could have been shifted. The yellow point is the target point and the red points are the AA-center and AA-perimeter photo points. **B.** The original target AA is show in yellow, and the shifted/sampled AA, in red. Images from Washkoviak et al. (2018).

In open vegetation, a 50-m tape is used to lay out the AA-perimeter. One person will stand at the center of the AA holding the end of a 50 m tape, and the other person will walk north from the center of the AA carrying the 50 m tape spool on the left side of their body until they reach 40 m. Use a compass or GPS to correct the azimuth to a cardinal direction, looking back at the center point. Then the person at the AA-perimeter will walk in a circle, flagging the boundary of the AA with either pin flags or flagging tape at each cardinal direction. At least four flags should be marked on the A-perimeter, one at each of the cardinal directions (i.e. N, E, S, W). Once the cardinal directions are flagged, site photos from the AA-Center towards the cardinal directions and the AA-waypoint can be taken. In open vegetation, additional perimeter flags can be placed at each of the ordinal directions (i.e. NE, SE, SW, NW). More points along the boundary may be marked to aid in visualizing the boundary of the AA, as appropriate.

If vegetation is dense or difficult to walk through with a 50 m tape, the GPS unit can be a helpful tool to assist with delineating the AA. Mark the center with the GPS, then use the "GO TO" function to measure a 40 m distance from the AA-center in a cardinal direction. The GPS "GO TO" function can be used to delineate each cardinal direction edge without use of the tape.

2.3.f. Alternate AA Layout 1 – Rectangle

If a 40 m radius circle does not fit within the wetland area, a rectangular shape may be used to delineate the AA (Figure 4). Compared to free-form AAs, rectangular AAs are easy to lay out because the layout is more standardized, and the perimeter does not need to be tracked with the GPS. First estimate the required dimensions to reach ~5,000 m^2. For example, a square AA should be 70.5 m on each side (70.5 m x 70.5 m = 4,970 m^2). If the wetland is 50 m wide, the rectangle should be about 100 m in length. Rectangular AAs may be centered on the point or their edges may be up to 60 m from the point, depending on the wetland area. However, rectangular AAs should only be used where the wetland area is generally straight, and the size of the AA is not compromised by bends in the wetland boundary. For this reason, rectangular AAs are not common. GPS waypoints and photos should be taken at each of the four corners of rectangular AAs looking diagonally into the AA.

2.3.g. Alternate AA Layout 2 – Freeform shape

When is not possible to lay out a standard or rectangular AA in 5000 m^2, the AA perimeter is usually confined by the size or shape of the wetland or by deep water. This is considered a freeform AA shape (Figure 5). If the wetland is small, the entire wetland will become the AA. If the wetland is larger but oddly shaped, the user should first estimate the general dimensions of the wetland using the aerial photos provided and strategize about the best way to lay out a 0.5 ha (5,000 m^2) AA. Based on this estimate, the perimeter of the AA is walked with the GPS in TRACK mode, flagging the edges as the perimeter is walked. It is important to visualize the AA layout before walking it out. Once visualized, one crew member leads and flags the AA perimeter while the second crew member follows with the GPS in TRACK mode. This keeps track edges smooth. Before walking the AA track, clear tracks on the GPS (this action will not clear previously saved tracks). When finished, switch out of track mode, use the GPS Area Calculation function to determine AA track size, and record the area of the actual AA in m^2. If the AA perimeter ends up significantly larger than 5,000 m^2 (~5,500 m^2 or larger), some portions of the area should be excluded to ensure the actual AA is comparable to others using the NV RAM protocol. The GPS track should be saved on the GPS unit and named by the Site ID.

In cases of wetlands along a pond fringe where the water gets deep (>1 m) or substrate becomes dangerously soft towards the center, a donut- or boomerang-shaped freeform actual AA may be necessary. In some cases, the deepest boundary of the wetland may not be wadeable in areas, and instead of a complete track, the AA is delineated by a partial track, with 2 to 4 extra waypoints along the deep boundary that are also noted on the AA drawing. The AA drawing should also clearly indicate the wetland perimeter, and should describe the portion of the edge that has track data and the portion to edit in the office. These resources will be referenced in the office to clip any non-target area out of the AA track in GIS.

Figure 4. Map of rectangular AA adjusted from the target AA-Center point. The yellow point is the initial AA-Center point and the yellow circle is the initial 40 m radius AA, which included unsampleable upland area. The red polygon represents the 5,000 m^2 rectangular actual AA delineated in the field and the red point is the center of the sampled AA. Image from Washoviak et al. (2018).

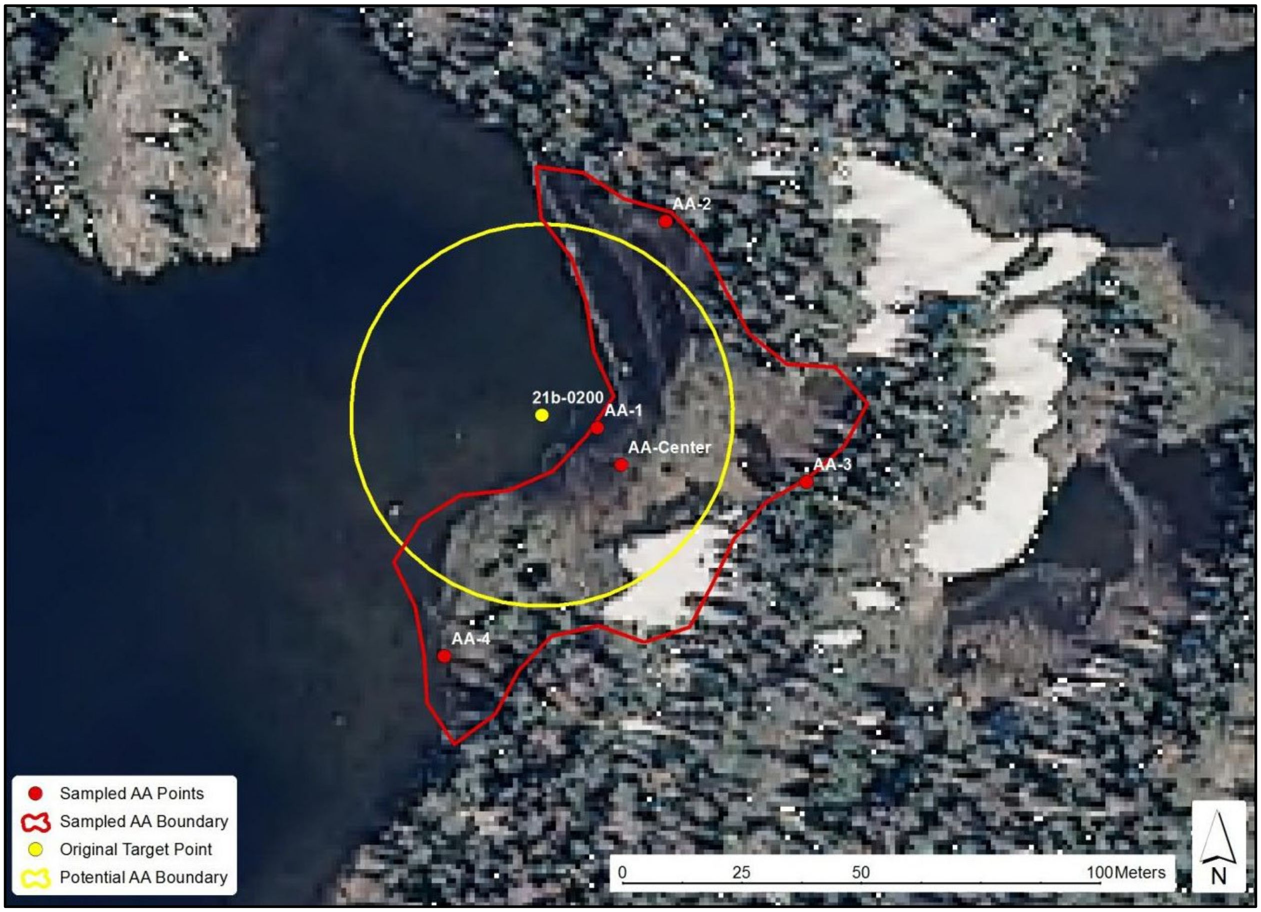


Figure 5. Example of a freeform AA. The yellow point and circle represent the original target point and initial AA, which included water too deep to sample. The red polygon represents the 5,000 m^2 freeform AA delineated in the field and the red point is the center of the sampled AA. Image from Washkoviak et al. (2018).

2.4 Describing the Assessment Area (AA)

The first page of the 2019 **NV Wetland RAM Data Sheets** contains general information about the site, much of which can be filled out with the aid of WetBar or other online tools. This information can be filled out once the user determines that a target sample area is located at or near the sample point. The following guidance will assist in filling out this section of the data sheet.

NOTE: Once each section of the data sheet is filled out, place an "X" in the red box located at the top right of each section box to confirm that the data from each section are fully recorded. At the end of the assessment, a check should be performed to ensure each red box is marked and all of the assessment information is complete.

2.4.a. Location and General Information

Site ID: The number/code of the original sample point; can be project specific.

Site Name: A descriptive name for the sample wetland.

Date: Date of sampling, written as month, day, year (e.g., July 12, 2016 or 7/12/2016).

Time Start and End: Time assessment begins and ends in military time.

Weather and Air Temperature: Circle the best description of recent precipitation. Take the air temperature with a thermometer and record in Celsius degrees.

State Engineer Hydrographic Area Name & HUC 10#: Populate from the Level 1 Assessment report, if available.

Site Ownership: Include the name of the site owner or manager, include the federal or state descriptor, if available.

Surveyors: The first initial and last name of field user members sampling the site (e.g., L. Saito, K. McGwire) and circle the name of the person recording the data.

Access Comments: Directions to the Assessment Area should specify a starting point (e.g. "From Reno" or "From I-80 heading W" or "From the 'x' trailhead outside of Lockwood"). Include route taken, approximate mileage traveled on dirt roads, trails, and off trail navigation, and parking location used. Also record any information that would be helpful if one were to revisit the site, such as access restrictions (e.g., parking limitations, keys needed, gate codes, or entry facilitation by agency person or landowner, permit needed) or if challenging structures/vegetation require an indirect approach. Some of this information may be obtained from the Level 1 Assessment report, if available.

2.4.b. Assessment Area and GPS Coordinates

Dimensions of AA: Mark appropriate lines with an "X". Standard AAs are the 40 m radius circle. Rectangular AAs are rectangular. Free-form AAs are adjusted to the shape of the wetland/target area boundary. Entire wetland indicates the AA represents the entire wetland type. **GPS AA Tracks** should be taken only for freeform and entire wetlands.

Target Wetland Type: Record if the wetland being assessed is the assessment area that was initially identified in the Level 1, pre-field work assessment.

AA Representativeness: If the AA encompasses the entire wetland, mark Yes. If the AA is part of a larger wetland or a complex of more than one wetland class, category and/or type, write the other descriptors from Appendices A, B, and C.

AA GPS Coordinates:

- **AA-Center:** If AA is a standard 40-m radius circle, record the center **waypoint number** and **UTMs**. Record **accuracy** once the error number appears to stabilize on the GPS unit. In non-standard AAs, the center point is not needed.
- **Elevation:** Record elevation at AA center in meters. For all GPS points, when >1 UTM Zone occurs in the study area, users should note the UTM Zone of all GPS points.

AA Photos:

The aim of AA photos is to represent the AA in photographs—as they say, a photo is worth 1,000 words. There are various standard photos that must be taken in each AA, with the photo numbers recorded:

1) Four standard AA positions (record photo number on **page 1- WP/Photo #**), with goal of presenting landscape context and vegetation communities,
2) Soil pit photos (record photo number on **page 3- Soil Profile Description**),
3) Unknown plant photos (record photo range on **page 5- Vegetation Species List**),
4) **Photos of anything notable**- When possible, it is helpful to have photos looking down at the entire wetland. Photo numbers should always be recorded when photo is taken outside the AA. When there are questions on how to record data, take photos and record their numbers to represent the issue in question, recording photo number and photo type on **page 2- Assessment Area Drawing**). Otherwise, not all photos within AAs must be labeled if they fall within the AA and are not standard photo.

You may include the **photo number** if it is visible on the camera's screen (change to "view" or "playback mode"). *Remember that the photo number is NOT the sequential number based on the count of photos taken since the camera was last erased. The photo number often starts with a three-digit number, a dash, and then a four- or five-digit number. Only the last four- or five-digit number is necessary to write down on the form. If sequential numbers are written on the field form, these data will be meaningless, as they are lost when uploading photos.*

A **photo placard** will be held in all four of the standard AA photos (**Figure 6**). Photo placards will be placed in a corner of the photo, taking up only a small portion of the frame, with as little arm or body visible as possible. The camera should be tilted to represent as much of the AA as possible, and photos should be reviewed for clarity before moving on. In dense vegetation, one may want to hold the camera higher and move branches directly in front of the camera out of the way. The **Site ID** should be written in full on the first line of the placard (e.g., 21i-191). The second line of the placard will contain the **aspect** that the photo is facing and the location of the photo (e.g., 140°/AA-4, 300°/AA-1, 90°/AA-1). Aspect should be rounded to the nearest 5 degrees in all photo points. *Make sure to set the declination of your compass.* **Date** should be written as MM/DD/YYYY (e.g., 07/07/2016). The standard photos can be taken while walking the perimeter of the AA, or after the AA perimeter is flagged. It is essential that two people participate in taking the placard photographs.

Figure 6. Example AA photo placard. Note placement of photo placard in corner and information written on placard: Point code, Aspect, and Date.

AA-1 through AA-4: These are the reference waypoints (**WP/Photo #**, **Aspect** and **UTM/Easting and Northing**), recorded at four standard locations on the AA perimeter, along with associated photos. It does not matter which directions are labeled AA-1 through AA-4 or what sequence they are taken in. In standard AAs, waypoints are recorded at the cardinal directions, facing the AA center. In rectangular AAs, waypoints are taken on the four corners, looking in towards center. In other non-standard AAs, these waypoints and photographs are better taken along the long and short midpoints of AA vertices, facing into the AA towards the center. In long linear or sinuous AAs, the two midpoints along the long vertices may not be directly across from each other, may instead may face the opposite bank, but the two midpoints along the short vertices should still face into the AA towards the center.

The user should make any notes necessary to describe how the AA was established and the reasoning behind the AA shape in the box for **AA Representativeness, Comments.** This will address whether the AA boundary was not standard because the wetland was too small, or whether non-standard because target area was shaped in a way that could not be assessed by a circular AA (such as a linear feature).

2.4.c. Classification of the Assessment Area

Starting at the bottom of the first page, the data sheet contains wetland classification information. Guidance is given below. For any classification where there is doubt, ambiguity, or further explanation is necessary, make note in the **Region** comment section below.

Cowardin Class, and **Cowardin Modifiers: Water Regime** and **Modifiers: Special:** Place an "X" next to the dominant wetland **System** and **Class,** and **Modifiers** from the Cowardin classification codes, using the definitions provided in **Appendix A**. If Class was pre-populated with Level 1 assessment data, verify or correct the Class. More than one **Special Modifier** selection may be made.

HGM Class: Select the appropriate HGM Class using the key provided in **Appendix B.** Pick only one dominant HGM Class.

NVC: Select and write in the **wetland NVC group classification(s)** from the descriptions provided in **Appendix C**.

NOTE: *It is recommended to revisit the wetland classes selected at the end of performing the rest of the RAM to double-check whether the selections fit after collecting the soil, water quality, and vegetation data. Change if necessary.*

2.5. Assessment Area Drawing and Description

Provide a drawing of the AA illustrating the AA shape, boundary, center point, landscape features, dominant vegetation and community types, drainage direction into and out of the wetland, and slope. Also, the standardized key provided on the AA Drawing data sheet should be used for the following: locations of photos (**diamond**), waypoints (**star**), soil pit(s) (**rectangle**), and water chemistry test(s) (**circle**). Human-made features such as culverts, berms, springboxes or impoundments should also be included in the sketch. Include a north arrow and approximate scale bar. The drawing can be done once the AA is established or it can be done after all sampling is complete, if you have a better understanding of the site. An example is provided in Figure 7.

For the AA description and comments, describe the wetland type, dominant vegetation, soils, and hydrology. Also include abiotic zones, habitat features present, general location, and any notable feature about the wetland that may not have been captured in the classification or other information on the first two pages. Also note surrounding vegetation and land use. This is the best place to sum up the major characteristics of the site in paragraph form.

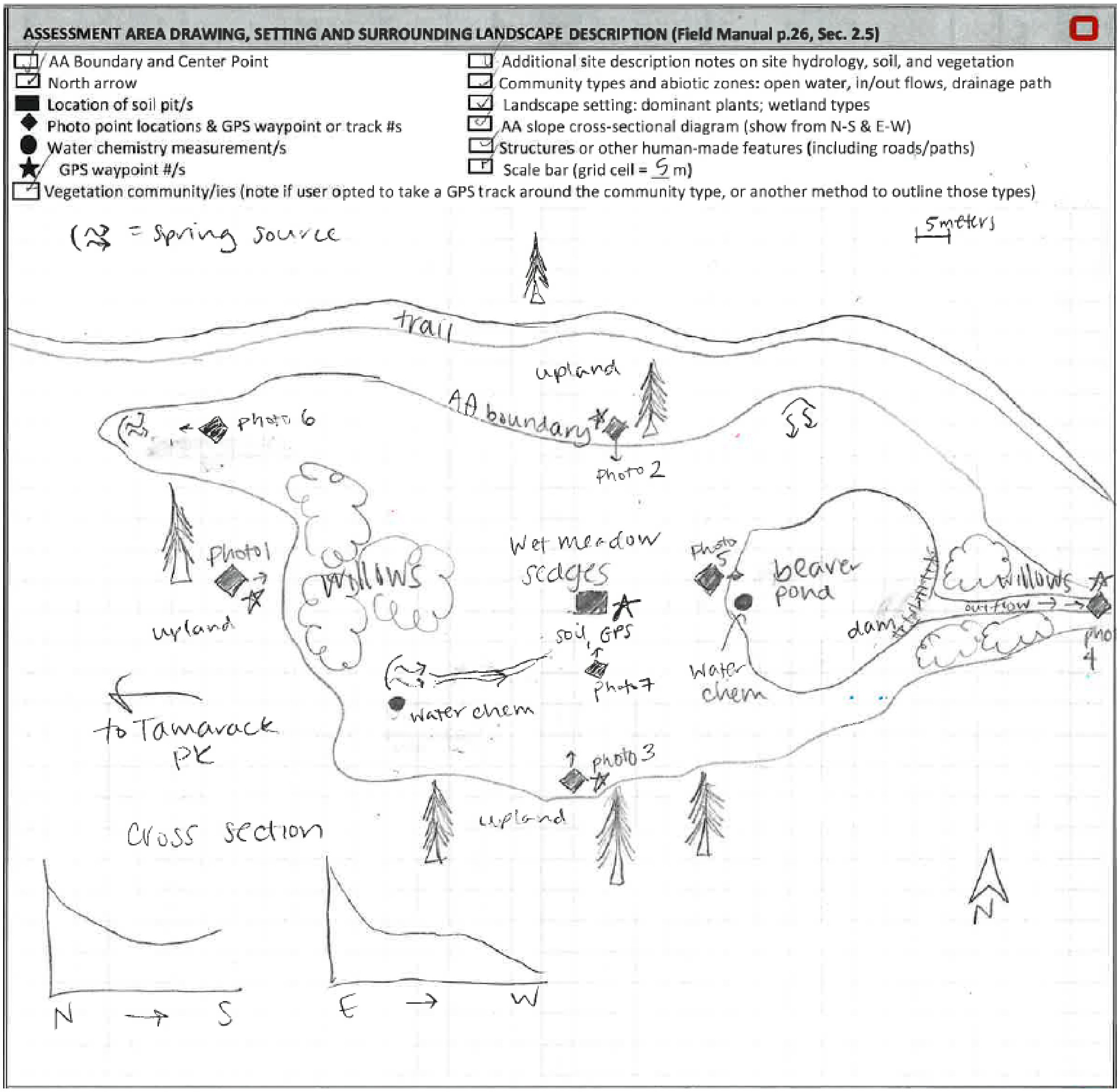


Figure 7. Example AA drawing, setting, and surrounding landscape description.

2.6 Soil Profile Description- Soil Pit Protocol

The location of soil pit(s) and water table sampling will be determined while laying out the AA. Care should be made not to trample the soil pit or water sampling locations while completing the assessment. If there is free-standing water in the soil pit, follow water chemistry sampling procedures in Section 2.7 to test water within the soil pits.

It is advised to review guidance in the U.S. Department of Agriculture, NRCS “Field Indicators of the Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.2” (2018) during the **assessment planning phase**. It is also recommended for at least one person from the project team to participate in a short soil assessment training or have some experience with soils assessment before departing for the field.

2.6.a. Soil Profile Description

Soil pits should be placed in vegetation communities that are representative of the AA and noted as a **representative pit** on the data sheet. If the vegetation and soil surface appear relatively homogenous, only one soil pit is necessary. If there is variability within the vegetation and soil, at least two soil pits should be dug to capture the range of variation within the site. Note the **soil pit number 1 or 2** on the data sheet. Additional soil pits may be deemed necessary if determined that two would not capture the AA variability. When soil pits are variable, indicate on the data sheet which soil pit best represents the AA.

Digging soil pits is difficult in standing water. If standing water is a significant part of the AA, it is advisable to pick a location on the edge of deep water, if possible. For all soil pits, take a GPS waypoint and record the **GPS WP number** on the field data sheet. Take photographs, if possible, of the pit and the soil profile that has been laid out. Mark all soil pits on the **site drawing**.

Follow these steps to dig the soil pit with a 40 cm sharp shooter shovel and a soil knife, and refer to photos in **Figure 8**:

1) Minimize ground surface disturbance by digging the soil pit only slightly larger than the width of the shovel, but wide enough to enable a clear view of the soil horizons on all sides. Soil pits will be dug to at least one shovel length depth (35 to 40 cm) when possible.
2) Use a soil knife to smooth the soil pit wall that faces the sun for illumination of the best view and photography of the soil horizons. Use the knife to poke and expose roots and feel for changes in the soil horizon and texture. Measure depth to bottom of pit using a measuring tape, with “0 cm” at ground-surface (Figure 8).
3) In the soil pit, identify and mark the distinct soil horizons/layers between ground surface and the bottom of the soil pit using pins or sticks. In riverine or lacustrine fringe wetlands, relatively thin alternating layers may be observed and can be grouped as one horizon/layer but note this in the “horizon-notes” (Figure 8).
4) Use the shovel to remove a core or slice that includes all horizons. If it is difficult to take an intact slice, use a trowel to remove material from each horizon. Lay it down next to the soil pit, possibly on a small tarp or piece of plastic. Take care to keep all layers/horizons intact and in order. A bucket auger can be used to examine the soil deeper in the profile if needed to find hydric soil indicators.
5) Describe each distinct horizon/layer in the soil pit and record the following information:
    a. **Horizon/Layer depth** (cm): Measured depth of each distinct layer/horizons, with 0 cm at ground-surface

b. **Matrix, color**: Use a Munsell Soil Color Chart (Munsell Soil Color Guide M50215B) to identify the code for moistened soil
c. **Dominant redox features**: Note the matrix's dominant redoximorphic features (mottles and oxidized root channels) and amount of redox features observed, as a percentage.
d. **Texture:** Determine the soil texture using the Soil Texture Flowchart (Appendix D)
e. **Roots**: Estimate the amount of roots as a percentage.
f. **Gravel:** Lay a slice or scoop of the layer/horizon on a small piece of tarp or plastic and estimate the amount of gravel as a percentage.
g. **Notes**: include any noteworthy observations about the layer/horizon

6) Use Appendix E to identify the **Hydric Soil Indicators** and check all that apply. Include any comments.

If previous soil survey information is known for the assessment area (e.g., NRCS soil survey, USGS report, etc.), write down the soil survey unit name and note if the soil pit matched the soil survey description.

Figure 8. Soil Profile Description procedures pictured here: (at left) determining soil pit depth with a measuring tape, and (at right) removing a soil core in order to identify and mark the soil horizon depths using small sticks at 3 cm and 6 cm.

2.6.b. Soil Pit Water Table and Chemistry

The water table will be measured in soil pits where groundwater is visible. Allow the soil pit to sit while describing the soil features before measuring depth to saturation and depth to free water. In sunny weather, while waiting for the water to fill and settle, shade the soil pit to avoid skewing the temperature and dissolved oxygen (DO) readings. Once the soil pit has equilibrated as much as possible, note on the data sheet the **water settling time,** measure the **depth to saturated soil** (0 cm at ground level) and **depth to free water**. Saturated soil can be identified by a sheen on the soil surface or water seeping and oozing into the soil pit. Free water is an approximation of the groundwater table, but in some cases may not represent the true groundwater table because it can take many hours for the water table to equilibrate. If free water is **not observed**, note whether the soil pit is **dry** or if it appears to be **slowly filling**. If free-standing water is observed, follow the instructions for **water chemistry sampling** found in Section 2.7.

2.7 Water Chemistry Sampling (for Soil Pits and General Water Chemistry Measurements)

Basic field measurements of water chemistry, including **temperature** in degrees Celsius **(°C)**, **pH**, **electrical conductivity** (EC) in microsiemens per millimeter **(µS/m)**, and **dissolved oxygen** (DO) in parts per million **(ppm)** should be taken using a handheld meter where water is present in the AA. Be sure to calibrate the handheld meter and log each calibration before collecting date on each day of use and keep the electrode(s) clean at all times. A small squirt bottle of water is helpful to carry in the field to keep the electrode clean before and after using it.

Water chemistry measurements can be sampled at different locations within the AA (e.g., in soil pits that fill with water or in a stream or pool alongside or within the AA). Be sure to record the associated units for each water chemistry parameter taken if not in the standard units on the data sheet. For all water chemistry sampling, note the **reading location** indicating where in the AA the data were collected, note the **GPS waypoint number (#)** and mark on the field form whether the sample was taken in **standing or flowing water**. Note the water chemistry sampling locations on the site AA drawing. In the **comments,** note the model name of the handheld water chemistry meter and when it was last calibrated. If more than two readings were collected, include the additional readings in this section.

To characterize groundwater-fed systems (e.g., fens, seeps or springs), it is best to take water chemistry measurements in soil pits where groundwater is evident. If the assessment interest is a particular animal such as amphibians, it is best to take water chemistry measurements in surface water. It is important to recognize that surface water parameters fluctuate widely during the day, throughout the season, and with varying water levels, and that soil pit water chemistry could be affected by the disturbance in digging the soil pit. A single measurement is only a snapshot.

2.8. General Animal Observations

Record any general animal observations on the table, noting species (if known) or common names of all organisms observed or encountered at or near the AA. Specifically look for the types of organisms listed the box above the table and mark the box “X” if observed, in addition to listing the species and/or its common name in the table; these organisms are of specific interest in Nevada. Note the photo # for any photos captured. If individuals are observed, write the number in the "# Individuals" column. If only a nest, tracks, or scat were observed, or calls were heard, note with a checkmark in the appropriate column. Record any additional information that can help quantify wildlife usage at the site.

2.9 Vegetation Sampling Protocols

No more than one hour should be spent on the full vegetation sampling process: species list, cover classes, and litter descriptions.

2.9.a. Vegetation Species List

The vegetation rapid assessment sample is based on a visual estimation of the AA. Walk the entire AA and compile a list of vegetation species' **scientific names or pseudonym/common names**. Any **unknown species** are entered on the table with a descriptive name. If the genus of the species is known, the descriptive name should include the genus name (e.g., Carex 1 sp. or Aster 2 sp). The descriptive name should also include some identifiable characteristics to distinguish multiple unknown species from the same genus (e.g., Carex sp. elongate black head or Carex sp. clustered brown head). If the genus is not known, the descriptive name should include any descriptors necessary (e.g., fuzzy round basal leaves or purple united corolla). All collected unknown species will receive a **collection number**, which will be a running sequential series of numbers that starts at every site. This collection number, and any **photo numbers** taken are written on the table row next to the species' names.

Next, estimate the percent of the AA that each plant covers by writing the appropriate cover class (1: Trace, 2: <1%, 3: 1-<2%, 4: 2-5%, 5: 5-<10%, 6: 10-<25%, 7: 25-<50%, 8: 50-<75%, 9: 75-<95%, and 10: >95%) in the **Cover Class** column. The covers of all plant species in the AA do not need to sum to 100%; it may be lower or higher due to bare ground or overlapping strata. See figure 9 below for a visual aid to estimating percent cover. Use the **Workspace** column to note if the species is invasive or nonnative, or add other pertinent details.

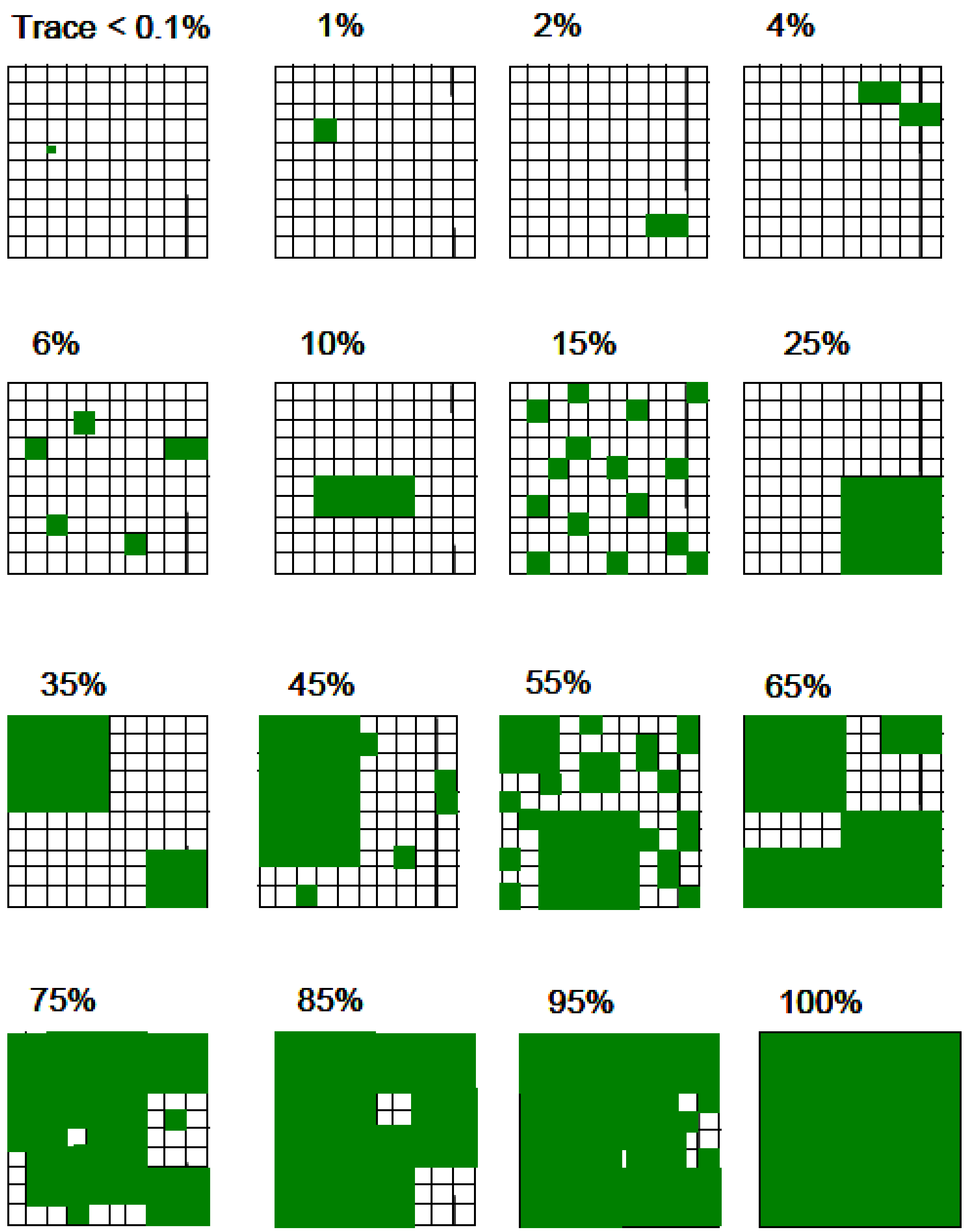


Chart 1. Examples of Percent Cover Estimates. Each large square = 100 m^2 module, grid squares = 1 m^2 (i.e., one grid square = 1% cover in a module), shaded areas represent cover of a vegetation stratum or of an individual species.

Figure 9. Example visualization of percent cover, from Lemly et al. 2016.

2.9.b. AA Cover Classes and Litter Descriptions

After completing the vegetation species list by community type, information on the cover classes and litter descriptions are recorded for the entire AA. Unless otherwise specified, cover is estimated in 1 or 5% increments.

Percent cover of the AA by **water** is recorded for the following: **standing water** or **running water** of any depth, **open water**, or **water with emergent** and **floating** or **submerged vegetation.**

Measure the **maximum water depth** in the AA and record it in centimeters.

Percent cover of the AA by **exposed ground** will be recorded using the bin categories for the following: **bare ground** with **soil, sand, or sediment**; **gravel or cobble ~2 – 250 mm** in diameter; and **bedrock, rock, or boulders >250 mm** in diameter. Exposed ground with **salt crust over any exposed ground** will also be noted using the same bin categories.

Percent cover by **litter** across the AA, including litter that is hidden beneath vegetation or water, is recorded. In cases where dense herbaceous vegetation covers the AA, this can be difficult to determine, as the current year's herbaceous vegetation can intermix with litter from previous years. Litter can also include standing dead herbaceous vegetation, particularly annual vegetation or dead attached leaves from the previous year, which would become litter once it fell over.

Depth of litter is estimated as an average of the depth (in cm) of litter in four representative areas within the AA. The measured litter height should not be trampled but should reflect the height at which it occurs naturally. Record the **litter depth at the 4 areas** on the datasheet in cm, and the **average of the 4 depths** should be entered in the far-right column.

Circle the **predominant litter type** among the following choices: **C** (coniferous), **E** (broadleaf evergreen), **D** (deciduous), **S** (sod/thatch), **F** (forb). Sod/thatch is used for graminoid litter (i.e., grass).

Percent cover of the AA by **standing and downed woody debris** is recorded for the following: **standing dead at greater** or **less than 5 cm at breast height,** and **downed coarse** or **woody debris.** The cover of woody debris is estimated based on whether it is standing or downed, and the diameter either at breast height or the average diameter of the debris. To differentiate downed debris from standing debris, use the 45° rule. If a tree is leaning more than 45° from upright, it is considered downed woody debris. If it is leaning less than 45° from upright, it is considered a standing dead tree or snag.

Percent cover of the AA by **other,** or nonvascular species, will be recorded for the following: **bryophytes, lichens,** and **algae.** For each species group, make sure to look underneath vegetation. The cover of these species groups is often underestimated because people do not look for them hiding among the leaves of graminoids or under shrubs.

2.9.c. Vertical Strata Cover and Height

For each vegetation strata, estimate height using the height classes. Estimate the cover of that strata in 1 or 5% increments. The summed percentages may not equal to 100% due to overlapping strata or bare unvegetated areas.

2.10 EIA Metrics Protocol

The EIA metrics portion of this protocol is designed to score wetlands on condition in a repeatable, scientifically defensible manner. These metrics are adopted directly from the Colorado EIA protocol (Lemly et al. 2016) but similar versions of this approach are used widely throughout the NatureServe/Heritage network.

The EIA metrics portion of the NVRAM protocol are optional and may not be appropriate for all surveyors or survey purposes. To accurately score each metric, surveyors should be familiar with the wetland type and expected species, structure, and hydrology at natural examples of that type. The EIA metrics portion of the protocol should be completed after vegetation protocols, as a species list will be needed to inform ratings. The following subsections come directly from the Colorado EIA field manual (Lemly et al. 2016) with minor modifications.

2.10.a. Landscape Metrics

Landscape metrics measure overall integrity of the landscape itself and the degree to which the wetland is connected to large-scale natural process.

Metric L1: Contiguous Natural Land Cover

Definition and Background: This metric measures the percent of the landscape within 500 meters of the AA that is contiguous with the AA itself, meaning there is an unfragmented connection to the AA. Fragmentation can dramatically impact natural processes such as seed dispersal, animal movement, and genetic diversity (Lindenmayer and Fischer 2006).

Metric Level: Level 1 (remote sensing) with Level 2 (rapid assessment) verification.

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: To assess this metric, examine land use patterns within a 500 m envelope of the AA. This is best done using the most recent aerial photography available. GIS layers of land use or land cover can also be used, but may not be as accurate as interpretation of aerial photography. When possible, walk through portions of the 500 m envelop to ground truth the photo. Identify the largest unfragmented block *that contains the AA* and estimate its percentage of the total area within the 500 m envelope (Figure 10). This percent of unfragmentated landscape can have small fragmentation inclusions (e.g., individual houses in a forested landscape, etc.), but roads that bisect the landscape form a hard boundary to the unfragmented block. Well-traveled dirt roads and major canals count as fragmentation, but hiking paths, non-tilled hayfields, open fences, and small lateral ditches can be included in unfragmented blocks (Table 2). For larger roads, such as highways where road fill and trash borders the road, the zone of the road’s influence should also be considered as fragmentation.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 1.

Table 1. Rating for Landscape Fragmentation

Rank	***Score***	***State***
Excellent (A)	4	Intact: AA embedded in 90–100% contiguous natural landscape.
Good (B)	3	Variegated: AA embedded in 60–90% contiguous natural landscape.
Fair (C)	2	Fragmented: AA embedded in 20–60% contiguous natural landscape.
Poor (D)	1	Relictual: AA embedded in <20% contiguous natural landscape.

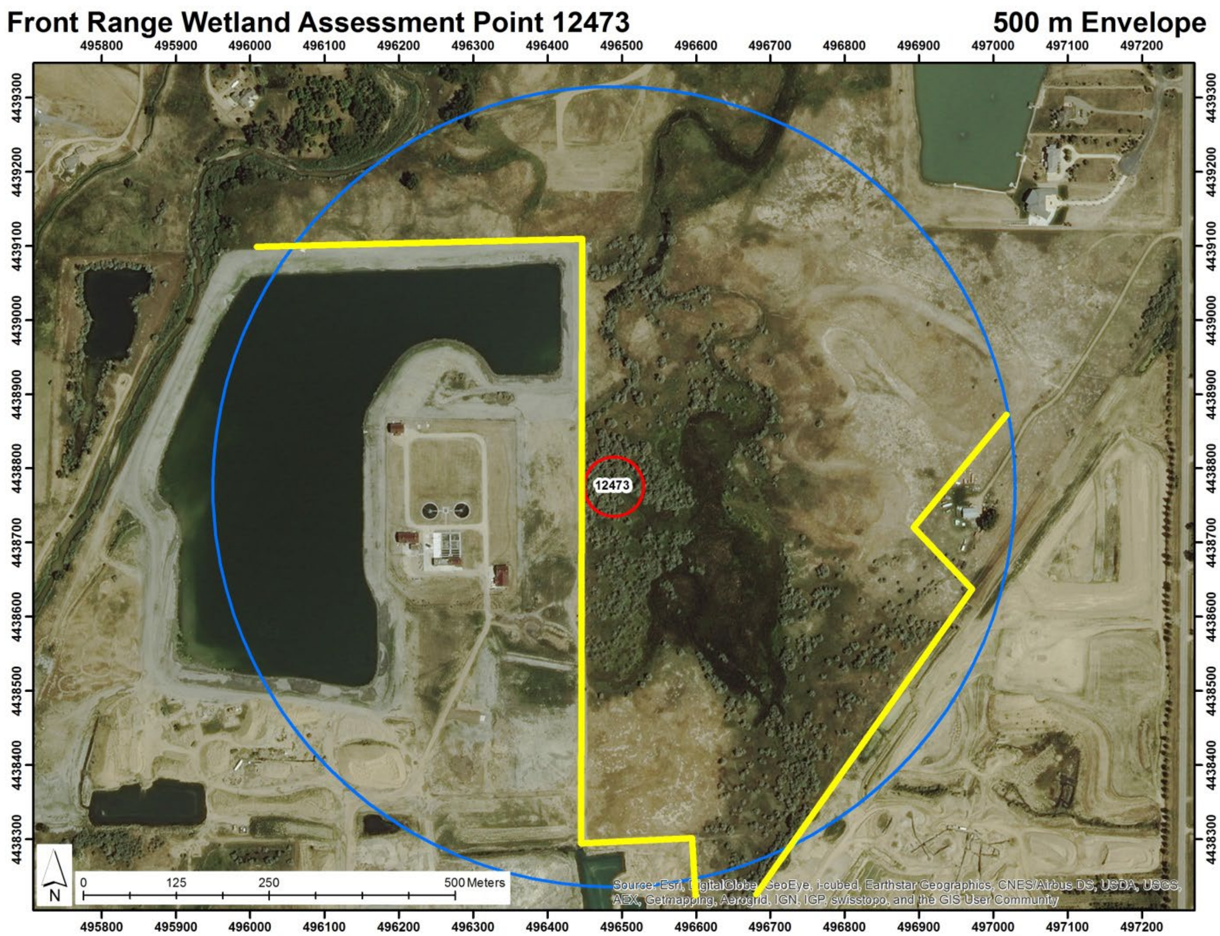


Figure 10. Example of calculating Metric L1: Contiguous Natural Land Cover. The AA is marked with a red circle. The 500 m envelope is marked with a blue circle. Yellow lines mark the edge of contiguous land cover in the 500 m radius envelope. In this example, only 58% of the 500 m envelope is contiguous with the AA, resulting in a C rating. The landscape is interrupted by roads and gravel extraction on the floodplain.

NOTE: If you define the AA as an entire wetland, the landscape with 500 m of the AA will be variable in size. The larger the wetland, the larger the landscape under consideration. If your study uses an area-based design with a fixed AA size (i.e., 01–0.5 ha), the landscape will be a more or less standard in size. In this case, the AA may be embedded within a larger wetland complex and some of the landscape under consideration may be continuous wetland area.

Metric References: Metric concept and thresholds adapted from Rondeau (2001), Rocchio (2006a-g), and Faber-Langendoen et al. (2008). The categorical ratings are based on McIntyre and Hobbs (1999) and Heinz Center (2002).

Table 2. Land covers that are included and excluded from unfragmented blocks and natural buffers.

Examples of Land Covers Included in Unfragmented Blocks or Natural Buffers	*Examples of Land Covers Excluded from Unfragmented Blocks or Natural Buffers*
○ Additional wetland/riparian area ○ Natural upland habitats ○ Nature or wildland parks ○ Bike trails ○ Foot trails ○ Horse trails ○ Low or open fences ○ Small power lines ○ Open rangeland with light grazing ○ Swales and ditches with natural substrate ○ Open water ○ Low vegetated levees ○ Non-tilled hay fields	○ Commercial developments ○ Residential developments ○ Paved roads ○ Dirt roads ○ Railroads ○ Parking lots ○ Lawns/nonnative landscaping ○ Golf courses ○ Sports fields ○ Urbanized parks with active recreation ○ Paved or heavily used pedestrian/bike trails (frequent traffic) ○ Trails or levees that are significantly built up with fill ○ Sound walls or high, solid fences that interfere with wildlife movements ○ Major power transmission lines ○ Wind farms, oil and gas wells ○ Ditches with hard substrate (concrete) ○ Intensive agriculture (tilled row crops, orchards, vineyards) ○ Dryland farming ○ Intensive livestock areas (horse paddocks, animal feedlots, poultry ranches) ○ Rangeland with intensive grazing

Metric L2: Land Use Index

Definition and Background: This metric measures the intensity of human dominated land uses in the surrounding landscape and is based on Hauer et al. (2002) and Mack (2006). The intensity of human activity in the landscape has a proportionate impact on the ecological processes of natural ecosystems. Assessing land use incorporates both "habitat destruction" and "habitat modification" (sensu McIntyre and Hobbs 1999), at least for non-natural habitats. In addition to simply converting natural habitat to non-natural land uses, the Land Use Index takes into account the intensity of that land use. The Land Use Index weights intensive land uses (urban development) more heavily than passive land uses (recreation).

Metric Level: Level 1 (remote sensing) with Level 2 (rapid assessment) verification.

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: The Land Use Index is measured by documenting surrounding land uses within 500 m of the AA. The assessment should be completed in the office using remote sensing imagery, such as aerial photographs, satellite imagery, or landcover datasets. Where feasible, the rating should be verified in the field, using roads or transects to verify land use categories. Ideally, both field data as well as remote sensing tools are used to identify an accurate percent of each land use within the landscape area, but remote sensing data alone can be used. This metric can be calculated as an automated GIS process using the National Land Cover Dataset[1] or the LANDFIRE Dataset[2], though both should be reviewed for accuracy.

To calculate a Land Use Index, estimate the percent of each land use category and calculate the corresponding category score based on land use coefficients (Table 9) and the following equation:

Land use category score = LU x PC⁄100

LU = Land use coefficient for each category

PC = % of adjacent area in each category

Do this for each land use category separately, then sum each category score to calculate the Total Land Use Score. If land uses overlap, use the more intensive land use for the calculation. For example, if 10% of the landscape contains unpaved roads (1 * 0.10 = 0.1), 30% is under moderate grazing (6 * 0.30 = 1.8), and 60% is natural vegetation (10 * 0.60 = 6.0), the Total Land Use Score would be 7.9 (0.1 + 1.8 + 6.0), for a rating of C.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 8.

Table 2. Rating for Land Use Index

Rank	***Score***	***State***
Excellent (A)	4	Land Use Index = 9.5–10.0.
Good (B)	3	Land Use Index = 8.0–9.49.
Fair (C)	2	Land Use Index = 4.0–7.99.
Poor (D)	1	Land Use Index = <4.0.

Table 3. Land use categories and coefficients. An example site is calculated below for illustration.

[1] The 2019 National Land Cover Dataset is available for download at https://www.sciencebase.gov/catalog/item/6345b637d34e342aee0863aa

[2] The LANDFIRE dataset is available for download at https://www.landfire.gov/

Land Use Categories[1]	*Coefficient*	*500 m Envelope*	
		% Area	*Score*
Paved roads, parking lots, domestic, commercial, and industrial buildings	0		
Gravel pit operation, open pit mining, strip mining, abandoned mines	0		
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	1	10%	0.1
Resource extraction (oil and gas)	1		
Tilled agricultural crop production (corn, wheat, soy, etc.)	2		
Intensively managed golf courses, sports fields, lawns	2		
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	3		
Heavy grazing by livestock	3		
Logging or tree removal with 50-75% of large trees removed	4		
Intense recreation (ATV use / camping / popular fishing spot, etc.)	4		
Permanent crop agriculture (hay pasture, vineyard, orchard)	4		
Dam sites and disturbed shorelines around water storage reservoirs. Include open water of reservoir is there is intensive recreation, such as boating.	5		
Old fields and other disturbed fallow lands dominated by nonnative species	5		
Moderate grazing on rangeland	6	30%	1.8
Moderate recreation (high-use trail)	7		
Selective logging or tree removal with <50% of large trees	8		
Light grazing on rangeland	9		
Light recreation (low-use trail)	9		
Natural area / land managed for native vegetation	10	60%	6.0
Total Land Use Score			7.9

Metric References: Metric and thresholds adapted from Hauer et al. (2002), Rocchio (2006a-g), and Faber-Langendoen et al. (2012).

2.10.b Buffer Metrics

This factor evaluates the overall area and condition of the natural buffer immediately surrounding the AA using three measures: perimeter of the AA with natural buffer, width of the natural buffer (up to 100 m from the AA), and condition of the natural buffer. Natural wetland buffers are vegetated areas free from intensive management that surround a wetland (see Table 2 for buffer land covers). These include forest, grasslands, shrublands, lakes, ponds, streams, or other wetlands. Some low impact land uses can be included in the buffer, such as light recreation and light grazing. Non-tilled, irrigated hay meadows can be counted as part of the buffer if they are not intensively managed or frequently harvested. Buffers serve to protect critical wetland functions, such as wildlife habitat and water quality, by limiting the invasion of nonnative species, filtering nutrients and pollutants, and reducing erosion and sedimentation (ELI 2008).

Unlike other standalone metrics, the three Buffer metrics scores for the three Buffer metrics are combined during the overall roll-up. Each metric measures a different but related aspect of the buffer. A buffer that surrounds the entire wetland is good, but much better if it is wide. And a wide buffer is all the better if it is in good condition. For this reason, we use the following formula, which uses a geometric mean, for combining the buffer metrics:

Buffer MEF Score = (((B1*B2)1/2) * B3)1/2

NOTE: If you define the AA as an entire wetland, the buffer metrics will evaluate the actual buffer around the wetland edge. However, if your study uses an area-based design with a fixed AA size (i.e., 01–0.5 ha), the AA may be embedded within a larger wetland complex and some of the buffer under consideration may be continuous wetland area.

Metric B1: Perimeter with Natural Buffer

Definition and Background: This metric measures the percent of the AA perimeter that is immediately surrounded by natural buffer land covers. Wetland buffers that fully surround a wetland offer greater protection than those that cover only part of the wetland. Exposed wetland edges are at greater risk of invasion and pollutant loading.

Metric Level: Level 1 (remote sensing) with Level 2 (rapid assessment) verification.

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: This metric can be assessed first using the aerial photography, but must be verified with field observation. Visually estimate the total percentage of the AA perimeter with adjacent land covers that provide a natural buffer (Table 4). To be considered as a buffer, a suitable land cover must extend out from the AA edge at least 5 m in width and continue for at least 10 m in length around the AA perimeter (Figure 11).

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 4.

Table 4. Rating for Buffer Extent

Rank	***Score***	***State***
Excellent (A)	4	Natural buffer surrounds 100% of the AA perimeter.
Good (B)	3	Natural buffer surrounds 75–99% of the AA perimeter.
Fair (C)	2	Natural buffer surrounds 25–74% of the AA perimeter.
Poor (D)	1	Natural buffer surrounds <25% of the AA perimeter.

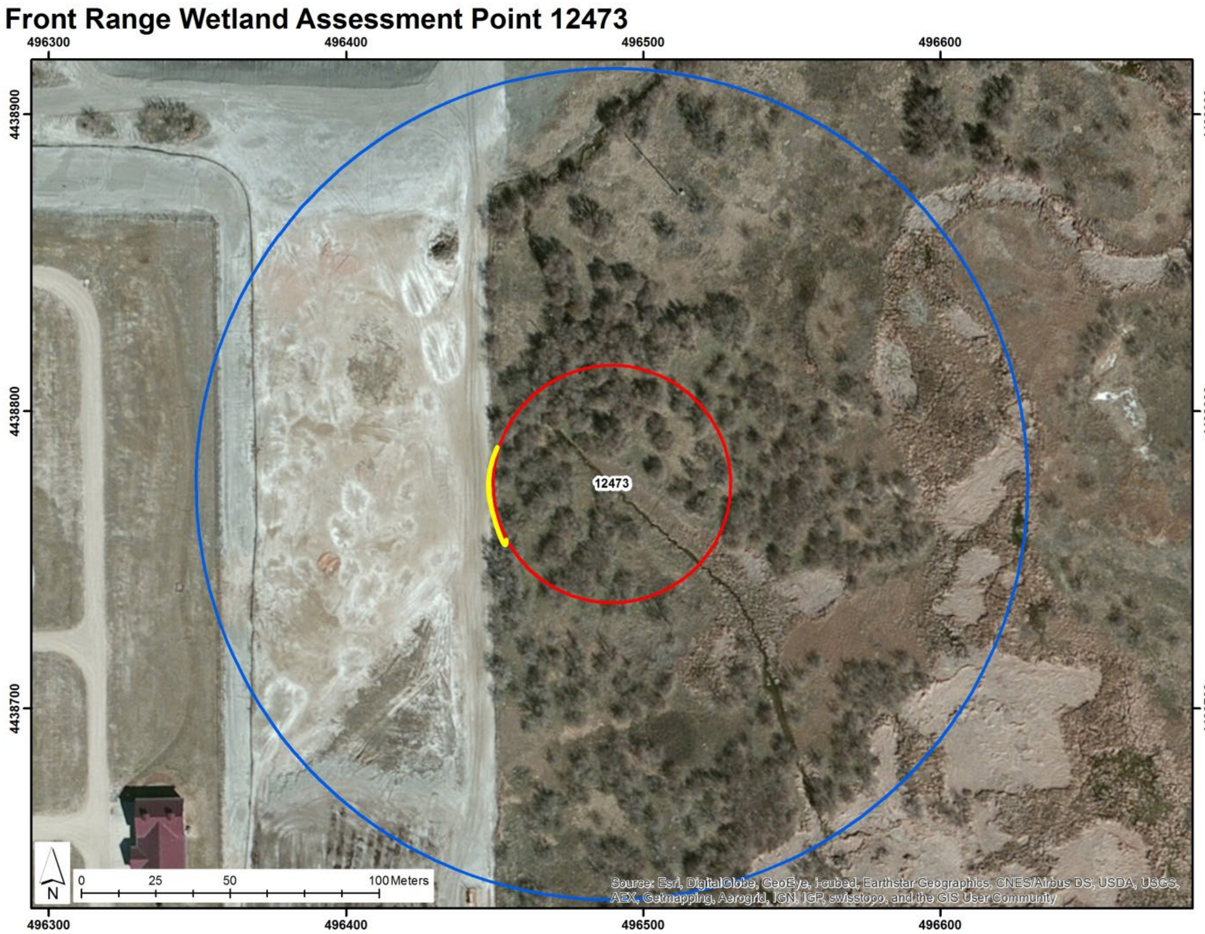


Figure 11. Example of calculating Metric B1: Perimeter with Natural Buffer. The AA is marked with a red circle. The yellow line indicates a portion of the AA perimeter lacking natural buffer.

Metric References: Metric and thresholds adapted from Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012). Similar metrics are used in many other assessment methods.

Metric B2: Width of Natural Buffer

Definition and Background: This metric measures the width of the natural buffer, up to 100 m from the AA edge. Like perimeter, the wider the buffer, the more effective it is at protecting wetland function. Through a synthesis of research on buffer, ELI (2008) report that buffers must be at least ~30 m (100 ft.) to effectively filter all three major water quality stressor of sediment, phosphorus and nitrogen. Wider buffers are even more effective for the removal of nitrogen. The effectiveness of buffer for wildlife habitat depends on the species, but should also be at least 30 m and likely up to 100 m or more to protect a range of native species.

Metric Level: Level 1 (remote sensing) with Level 2 (rapid assessment) verification.

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: This metric can be assessed first using aerial photography but must be verified with field observation. Use an aerial photo, either on a field map or in GIS, to draw eight lines radiating away from the edge of the AA along the cardinal and ordinal directions (N, NE, E, SE, S, SW, W, NW), up to 100 m from the AA perimeter (Figure 12). End each line when it encounters a non-buffer land cover, as they do in Figure 12 at the railroad. (Note that the buffer lines do cross a minor canal, but they would end at the canal if it was cement lined or a more major conveyance structure. These calls must be verified in the field.) Visually estimate the average distance between the edge of the AA and the edge of the buffer for each of these lines. Enter the length of each line in the worksheet on the back of the field form, calculate the average, and select the narrative description that matches the average.

For wetland polygons lacking a centroid from which eight spokes could reasonably radiate from, draw a line as near to the center of the wetland polygon's long axis as possible (Figure 12). Once you have determined the length of the line along the wetland's long axis, divide the line by five to pinpoint four equally spaced locations along the axis. At each of the four points, draw a line perpendicular to the axis such that it extends out 100 m on both sides of the wetland's perimeter.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 5.

Table 5. Rating for Buffer Width

Rank	***Score***	***State***
Excellent (A)	4	Average buffer width is at least 100 m.
Good (B)	3	Average buffer width is 75–99 m.
Fair (C)	2	Average buffer width is 25–74 m.
Poor (D)	1	Average buffer width is <25 m.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g), ELI (2008), Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012).

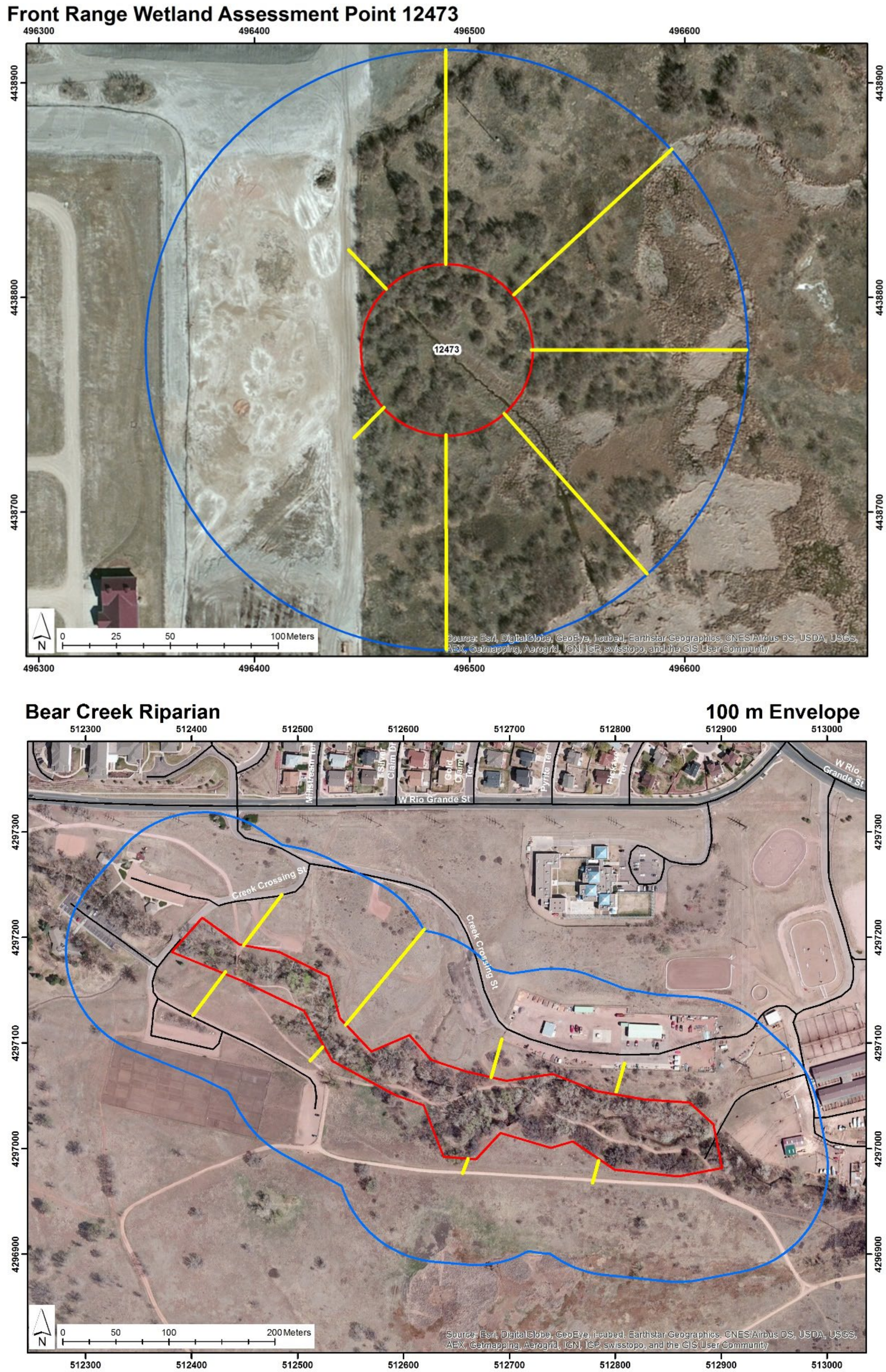


Figure 12. Examples of calculating Metric B2: Width of Natural Buffer. Top is with a circular AA. Bottom is a non-circular AA. The AAs are marked with red polygons. The 100 m envelopes are marked with blue polygons. Yellow lines extend to the edge of natural buffer land covers.

Metric B3: Condition of Natural Buffer

Definition and Background: The condition of the buffer can also limit its effectiveness. While a vegetated hay field (considered buffer) is better than parking lot (not considered buffer), it is far less effective at controlling nutrient loading and nonnative species dispersal than a native prairie or shrubland. This metric evaluates two aspects of buffer separately, the vegetation and soil/substrate disturbance. These two aspects are then averaged for a final buffer condition score.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: Walk through enough of the buffer to familiarize yourself with the dominant vegetation and any obvious signs of soil disturbance or dumping. Select one statement from *each* column on the form that best describes the buffer vegetation and buffer soils/substrate condition. Remember to look for nonnative hay grasses when evaluating vegetation in the buffer. Only consider *buffer areas* from B1 and B2 above. This metric is evaluating the condition of the *buffer itself,* not land covers determined to be non-buffer.

Metric Rating: Assign the metric ratings and associated scores based on the thresholds in Table 5. The two scores will be averaged in the scorecard calculations.

Table 5. Rating for Buffer Condition

Rank	*Score*	*State – Vegetation*	*State – Soils/Substrate*
Excellent (A)	4	Abundant (≥95%) relative cover native vegetation and little or no (<5%) cover of nonnative plants.	Intact soils, no water quality concerns, little or no trash, AND little or no evidence of human visitation.
Good (B)	3	Substantial (75–95%) relative cover of native vegetation and low (5–25%) cover of nonnative plants.	Intact or minor soil disruption, minor water quality concerns, moderate or lesser amounts of trash, AND/OR minor intensity of human visitation or recreation.
Fair (C)	2	Low (25–75%) relative cover of native vegetation and moderate to substantial (25–75%) cover of nonnative plants.	Moderate or extensive soil disruption, moderate to strong water quality concerns, moderate or greater amounts of trash, AND/OR moderate intensity of human use.
Poor (D)	1	Very low (<25%) relative cover of native vegetation and dominant (>75% cover) of nonnative plants OR no buffer exists.	Barren ground and highly compacted or otherwise disrupted soils, significant water quality concerns, substantial amounts of trash, extensive human use, OR no buffer exists.

Metric References: Metric and thresholds adapted from Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012).

2.10.c Vegetation Metrics

Vegetation condition is at the heart of the EIA method. Ecological and biological-based condition methods view vegetation (and other biological taxa) as able to synthetically express the range and degree of stress faced by the wetland over many years. Vegetation condition metrics are divided into two groups: vegetation composition and vegetation structure. We strongly encourage users of the EIA method to carry out a vegetation survey. The data collected from this exercise can greatly inform conclusions regarding overall wetland health.

Metric V1: Native Plant Species Cover (Relative)

Definition and Background: This metric measures the relative percent cover of native species in the AA. This metric is one measure of the degree to which native plant communities have been altered by human disturbance. Wetlands with high ecological integrity are dominated by native species, while increasing human disturbance can allow nonnative species to invade and even dominant wetlands. Nonnative species can displace native species, alter hydrology, alter structure, and affect food web dynamics by changing the quantity, type, and accessibility to food. Wetlands dominated by nonnative species typically support fewer native animals (Zedler and Kercher 2004).

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: This metric is calculated by dividing the total cover of native species by the total cover of all species. This is a relative cover measure, meaning that a nonnative species with 5% cover of the AA could only represent 2% relative total cover if there is extensive overlap of vegetation layer. With overlapping vegetation layers, the total cover of all species can be >100%. Alternatively, a nonnative species with 5% cover of the AA could represent 20% relative cover in a sparsely vegetated wetland like a playa. If a species list with cover values has been created, this measure can be easily calculated from the field data. Otherwise, make an ocular estimate of the relative percent cover. Unidentified species that are recorded on the plant list are not included in this calculation unless their nativity is known.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 6.

Table 6. Rating for Percent Cover Native Species

Rank	*Score*	*State*
Excellent (A)	4	AA contains >99% relative cover of native plant species.
Good (B)	3	AA contains 95–99% relative cover of native plant species.
Fair (C)	2	AA contains 85–95% relative cover of native plant species.
Fairly Poor (C-)	1.5	AA contains 60–85% relative cover of native plant species.
Poor (D)	1	AA contains <60% relative cover of native plant species.

Metric V2: Invasive Nonnative Plant Species Cover (Absolute)

Definition and Background: This metric measures the absolute percent cover of invasive nonnative plant species. An invasive species is defined as "a species that is nonnative to the ecosystem whose introduction causes or is likely to cause environmental harm." (Executive Presidential Order 1999, Richardson et al. 2000). Noxious weeds are nonnative species that have been designated by state agricultural authorities as injurious to agriculture, horticulture, natural habitats, humans, or livestock. They can aggressively take over from native vegetation and should be eradicated or managed when found. In addition to the official Noxious Weed Lists, we also consider kochia or burning bush (*Kochia scoparia* syn = *Bassia scoparia* or *Bassia sieversiana*) and Russian thistle (*Salsola tragus* syn = *Salsola iberica*) as invasive nonnative species for the purpose of this metric. Both are extremely common and aggressive. Other species may be considered at the user's discretion.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands, regardless of classification.

Measurement Protocol: This metric is the absolute cover of noxious weeds encountered in the AA. This metric is *not* relative cover. The cover of noxious weeds is *not* divided by the total cover of all species. If a species list with cover values has been created, this measure can be easily calculated from the field data by summing all invasive nonnative species. Otherwise, make an ocular estimate of the absolute cover of noxious weeds.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 7.

Table 7. Rating for Noxious Weeds

Rank	*Score*	*State*
Excellent (A)	4	Invasive nonnative species are absent from all strata.

Good (B)	3	Invasive species present, but sporadic (<4% absolute cover).
Fair (C)	2	Invasive species somewhat abundant (4–10% cover).
Fairly Poor (C-)	1.5	Invasive species abundant (11–30% cover).
Poor (D)	1	Invasive species very abundant (>30% cover).

Metric References: Metric and thresholds adapted from Rocchio (2006a-g), and Faber-Langendoen et al. (2008; 2012).

Metric V3: Native Plant Species Composition

Definition and Background: This metric measures the overall vascular plant species composition and diversity of native diagnostic species and native increasers (including the "native invasives" of Richardson et al. 2000). Every wetland type has a specific range of species that can be expected to dominate under reference or minimally disturbed conditions. Those species have naturally adapted to the environmental characteristics and disturbance regimes found within the wetland type. However, when disturbance (often human-induced) exceeds the natural range of variation, only those plants with wide tolerance to disturbance will survive. Conservative species (those with high fidelity to habitat integrity) will decline or disappear relative to the degree of disturbance (Wilhelm and Masters 1996). The integrity of ecosystems is optimized when a characteristic native plant species composition dominates the plant community, and suitable habitat exists for multiple animal species. Much of the natural microbial, invertebrate, and vertebrate species of wetlands respond to overall vegetation composition. Vegetation composition also reflects the interactions between plants and physical processes, especially hydrology. A change in vegetation composition, as a result of invasive and exotic plant invasions for example, can have cascading effects on system form, structure, and function.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands.

Measurement Protocol: Walk the AA and observe the abundance and diversity of native species and select a statement that best describes the composition. Look for native species diagnostic of the system vs. native increasers that may thrive in human disturbance. A species list with cover values can be very helpful rating this metric, or comparing one site to others of the same type. FQA indices, such as Native Mean C or the Floristic Quality Index (FQI) can be used to assess the metric.

The metric refers to both diagnostic and increaser species. Diagnostic species are native plant species whose relative abundance or constancy differentiates one type from another, including dominant species (those with high abundance or cover) and character species (those strongly restricted to a type). Together these species can indicate certain ecological conditions, typically that of minimally disturbed sites. Increaser species are native species whose dominance is indicative of degrading ecological conditions, such as heavy grazing or browse pressure (Daubenmire 1968). For some wetland types, particularly marshes and other depressional wetlands, increaser species can be more problematic than nonnative species due to excess nutrients. For the purpose of this metric, reed canarygrass (*Phalaroides arundinacea = Phalaris arundinacea*); giant reed (*Phragmites australis*); and cattails (*Typha* spp.), which all have both native and nonnative types, are considered native increasers.

This metric focuses on native plant composition and does not ask directly about nonnative plant species. To rate the metric, it is helpful imagine the wetland will all nonnative species removed. However, since the metric language asks whether native diagnostics species have been reduced in abundance, the metric does address nonnative indirectly. If the prevalence of nonnative species results in low cover of native species, the metric would be rated lower.

Metric Rating: Assign the metric rating and associated score based on the narrative criteria in Table 8.

Table 8. Rating for Native Plant Species Composition.

Rank	***Score***	***State***
Excellent (A)	4	Native plant species composition with expected natural conditions: i) Typical range of native diagnostic species present, AND ii) Native species sensitive to anthropogenic degradation are present, AND iii) Native species indicative of anthropogenic disturbance (i.e., increasers, weedy or ruderal species) absent to minor.
Good (B)	3	Native plant species composition with minor disturbed conditions: i) Some native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with low cover.
Fair (C)	2	Native plant species composition with moderately disturbed conditions: i) Many native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with moderate cover.
Poor (D)	1	Native plant species composition with severely disturbed conditions: i) Most or all native diagnostic species absent, a few remain in low cover, OR ii) Native species indicative of anthropogenic disturbance are present with high cover.

Metric References: Metric and thresholds adapted from Faber-Langendoen et al. (2008; 2012).

Metric V4: Vegetation Structure

Definition and Background: This metric measures overall structural complexity of the vegetation layers and growth forms, including presence of multiple strata, age and structural complexity of canopy layer, and evidence of the effects of disease or mortality on structure. In addition, this metric includes the accumulation and distribution of organic materials, both woody debris and litter. In wetlands, vegetation structure can have an important controlling effect on composition and processes. Structure is an important reflection of dynamic ecosystem processes, including hydrologic regime, regeneration, and nutrient cycling. More complex structure allows for many, small-scale habitat niches for both wildlife and plant species. Ecological diversity of a site is often correlated with the complexity of abiotic and biotic patches. Increased complexity leads to increased habitat niches and can enhance ecological processes.

For all systems, this metric also incorporated litter and organic inputs. The accumulation of organic material and an intact litter layer are integral to a variety of wetland functions, such as surface water storage, percolation and recharge, nutrient cycling, and support of wetland plants. Intact litter layers provide areas for primary production and decomposition that are important to maintaining functioning food chains. They nurture fungi essential to the growth of rooted wetland plants. They support soil microbes and other detritivores that comprise the base of the food web in many wetlands. The abundance of organic debris and coarse litter on the substrate surface can significantly influence overall species diversity and food web structure. Fallen debris serves as cover for macroinvertebrates, amphibians, rodents, and even small birds. Litter is the precursor to detritus, which is a dominant source of energy for most wetland ecosystems.

For woody systems, rating on Metrics V5 (Regeneration of Native Woody Species) and V6 (Coarse and Fine Woody Debris) can inform the overall rating of this metric.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands. Specific guidance provided by wetland type.

Measurement Protocol: During the vegetation survey or while walking through the AA, note the overall structure of the vegetation and the quantity and distribution of litter compared with expected condition. It can be helpful to refer to the AA sketch and the description of biotic and abiotic zone when thinking about the complexity of the site. Then select the statement that best describes the vegetation structure within the AA.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 9. Specific guidance is provided for marshes, meadows, and playas (Table 10) and for riparian areas (Table 11).

Table 9. General Rating for Vegetation Structure.

Rank	***Score***	***State***
Excellent (A)	4	Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.
Good (B)	3	Vegetation structure shows minor alterations from natural conditions.
Fair (C)	2	Vegetation structure is moderately altered from natural conditions.

Poor (D)	1	Vegetation structure is greatly altered from natural conditions.

Table 10. Specific Guidance for Marshes, Meadows and Playas.

Rank	***Score***	***State***
Excellent (A)	4	**All types:** Structural patches/zones are appropriate in number and type for the system (can be few in playas, fens, meadows). There is diversity in vertical strata within the herbaceous vegetation (some tall and some short layers and/or low cover of shrubs or trees, where appropriate). Litter and other organic inputs are typical of the system (i.e., playas should have low litter while meadows and marshes should have moderate amounts of litter).
Good (B)	3	***Marshes***: Cattail and bulrush density may prevent animal movement in some areas of the wetland, but not throughout. ***Meadows:*** Grazing and mowing have minor effects. Litter accumulation is slightly affected. ***Playas:*** Natural areas of bare ground are still prevalent, though non-native or weedy species may be encroaching.
Fair (C)	2	***Marshes***: Cattail and bulrush density may prevent animal movement in half or more of the wetland. Litter accumulation is high and dense. ***Meadows:*** Grazing and mowing have moderate effects. Litter accumulation is moderately affected. ***Playas:*** Natural areas of bare ground are present, but non-native or weedy species have filled in many area.
Poor (D)	1	***Marshes***: Cattail and bulrush density prevent animal movement throughout the wetland. Accumulated litter may fill in spaces between plants, further blocking movement. ***Meadows:*** Grazing and mowing greatly affect the structure of the vegetation and prevalence of litter. ***Playas:*** Natural areas of bare ground are absent due to an abundance of non-native or weedy species.

Table 11. Specific Guidance for Riparian Areas.

Rank	***Score***	***State***
Excellent (A)	4	AA is characterized by a complex array of nested or interspersed patches. Canopy (if present) contains a mosaic of different ages or sizes, including large old trees and obvious regeneration. Number of live stems is well within expected range. Shrub and herbaceous layers are complex, providing a diversity of vertical strata. Woody species are of sufficient size and density to provide future woody debris to stream or floodplain. Litter layer is neither lacking nor extensive.

Good (B)	3	AA is characterized by a moderate array of nested or interspersed zones with no single dominant zone, though some structural patches (especially open zones) may be missing. Canopy still heterogeneous in age or size, but may be missing some age classes. Vertical strata may be somewhat less complex than natural conditions. Woody debris or litter may be somewhat lacking.
Fair (C)	2	AA is characterized by a simple array of nested or interspersed zones. One zone may dominate others. Vertical strata may be moderately less complex than natural conditions. Site may be denser than natural conditions (due to non-native woody species) or may be more open and decadent. Woody debris or litter may be moderately lacking.
Poor (D)	1	AA is characterized by one dominant zone and several expected structural patches or vertical strata are missing. Site is either extremely dense with non-native woody species or open with predominantly decadent or dead trees. Woody debris and/or litter may be absent entirely or may be excessive due to decadent trees.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g) and Faber-Langendoen et al. (2008).

Metric V5: Regeneration of Native Woody Species [optional]

Definition and Background: This metric measures the regeneration of native woody species within the AA. Intensive grazing by domestic livestock, heavy browse by native ungulates, and/or alteration of natural flow regimes can reduce to eliminate regeneration of native woody plants (Elmore and Kauffman 1994). Species such as willow (*Salix* spp.) and cottonwood (*Populus* spp.) need episodic flooding to create new bare surfaces suitable for germination of seedlings (Woods 2001). In addition, base flows need to be high enough following flooding to maintain moist soil through the late summer in order for seedlings to survive and establish a deep root system. Lack of reproduction is indicative of altered ecological processes and has adverse effects on the integrity of a riparian area and its ability to provide wildlife habitat.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands where woody cover would be expected. This includes most riparian wetlands, though not every occurrence of them. A degree of familiarity with wetland systems across Nevada is needed to recognize where woody species should occur. Looking at aerial photography to understand landscape-scale hydrologic processes can help discern whether woody vegetation should be expected.

Measurement Protocol: During the vegetation survey or while walking through the AA, pay special attention to the regeneration of native woody species. Select the statement on the form that best describes regeneration within the AA. Keep in mind that healthy, functioning woody systems should contain a mix of age classes, indicating natural disturbance regimes. Consider the effects of grazing and other stressors on potential regeneration. *This metric is scored a N/A in naturally herbaceous wetlands.*

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 12.

Table 12. Rating for Regeneration of Native Woody Species

Rank	*Score*	*State*
N/A	--	Woody species are naturally uncommon or absent.
Excellent (A)	4	All age classes of native woody species present. Native tree saplings /seedlings and shrubs common to the type present in expected amounts and diversity. Regeneration in obvious.
Good (B)	3	Age classes of native woody species restricted to mature individuals and young sprouts. Middle age groups appear to be absent or there is some other indication that regeneration is moderately impacted.
Fair (C)	2	Native woody species comprised of mainly mature individuals OR mainly evenly aged young sprouts that choke out other vegetation. Regeneration is obviously impacted. Site may contain Russian Olive and/or Salt Cedar.
Poor (D)	1	Native woody species predominantly consist of decadent or dying individuals OR are absent from an area that should be wooded. Site may be dominated by Russian Olive / Salt Cedar.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g), and Faber-Langendoen et al. (2008; 2012).

Metric V6: Coarse and Fine Woody Debris

Definition and Background: Woody debris plays a critical role in riparian systems. There is extensive documentation of the importance of in stream wood for altering channel form and characteristics, enhancing aquatic and riparian habitat, retention of organic matter and nutrients (Wohl 2011).

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands where woody debris would be expected. This includes most riparian wetland types, though not every occurrence of them. Low gradient systems in open areas and systems with few natural trees will naturally have less woody debris. However, some woody debris can be found in all systems, even marshes and fens, if there are occasional large trees or tall shrubs. A degree of familiarity with wetland systems across Nevada is needed to recognize where woody debris should occur.

Measurement Protocol: During the vegetation survey or while walking through the AA, pay special attention to the amount of coarse and fine woody debris. Select the statement on the form that best describes the amount of woody debris within the AA. Riverine wetlands that have incised banks, no longer experience flooding, experience overgrazing, or are no longer at a dynamic equilibrium may lack. *This metric is scored a N/A in naturally herbaceous wetlands.*

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 13.

Table 13. Rating for Coarse and Fine Woody Debris

Rank	*Score*	*State*
N/A	--	There are no obvious inputs of woody debris.
Excellent / Good (A/B)	4	AA characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. There is wide size-class diversity of standing snags and downed logs in various stages of decay. 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.
Fair (C)	2	AA characterized by small amounts of woody debris OR debris is somewhat excessive. For riverine wetlands, lack of debris may affect stream temperatures and reduce available habitat.
Poor (D)	1	AA lacks woody debris, even though inputs are available.

Metric References: Metric and thresholds adapted from Faber-Langendoen et al. (2008) with input from the literature.

2.10.d Hydrology Metrics

Hydrology is the key driver and defining attribute for all wetlands. Without water, there would be no wetland. The EIA method assesses the condition of a wetland's hydrology through three inter-related metrics: water source (where the water is coming from); hydroperiod (the timing and duration of inundation or saturation); and hydrologic connectivity (the ability of water to both reach the wetland and move naturally through and beyond it). Because the metrics are interconnected, where when one metric rates poorly, it is likely that others will too. However, this is not always the case, particularly in managed situations where some natural attributes of hydrology can be mimicked while others cannot. Wetland size and distance from hydrology stressors can also temper the effects of alterations on hydrology. Examining the size and influence of hydrology stressors is helpful. To fully understand stressors, it is necessary to look significantly bound the AA itself, particularly for riverine features that have been impacted by diversion, withdrawals and additions far upstream.

Metric H1: Water Source

Definition and Background: This metric assesses the *direct inputs of water* to the AA, which are essential to the very existence of wetlands, especially during the growing season. The water inputs affect the processes, structure, and geomorphology of wetlands. Natural wetlands have developed in response to natural water sources. Artificial water sources often differ dramatically in terms of hydroperiod, sediment and nutrient loads, and predictability.

This metric compares the proportion of water that enters the wetland from natural vs. artificial sources. Natural water sources include precipitation, groundwater discharge, overbank flooding, etc. Examples of unnatural sources include storm drains that empty directly into the AA; pipes directly controlling water inputs (even if for wildlife habitat purposes); urban or agricultural runoff; and irrigated sources via direct irrigation application and sub-irrigated water from ditch seepage. Sub-irrigation water sources can appear natural (and some land managers view them as naturalized), but they are not considered natural in the EIA method if the source would be depleted if the pipe or ditch was turned off.

It is important to understand potential water sources in different topographic locations and wetland types. Is the wetland in a natural geomorphic floodplain where it could be tied into alluvial groundwater? Or is the wetland in a dry landscape, but downslope from one or more ditches that cut across the slope? Plant and soil indicators of water source permanence and consistency are useful to consider. For instance, the presence of peat (>16 inches of organic soil) does confirm a natural groundwater source (at least in part), because the rate of peat accumulation (~8 in/1,000 yrs: Chimner et al. 2002) is slow enough that true peat could not have formed since European settlement.

Metric Level: Level 2 (rapid assessment) with some Level 1 (remote sensing) background information.

Metric Application: Use for all wetlands. Specific guidance provided by wetland type.

Measurement Protocol: Review the aerial photos and topographic maps for potential sources. It is important to look at the larger landscape, not just the immediate surroundings. In riverine systems, inputs and controls to the water source are examined up to ~2 km upstream from AA, but with greater emphasis on the most immediate water sources, and decreasing emphasis with distance from AA. In non-riverine systems, inputs are generally examined in closer proximity to the site. Look for direct channels or saturated zones indicating flow paths. Then walk the AA and buffer to confirm the dominant source of water. Use the checklist on the field form (Table 14) to identify all major water sources influencing the AA. Mark all inlets on the aerial photo and those within the AA on the site sketch. New development such as new roads or oil and gas wells should be noted. If there is an indication that inflow during the growing season is controlled by artificial water sources, explain in comments. Once all available information is gathered, select the statement on the form that best describes the water sources feeding the AA during the growing season.

Table 14. Potential water source checklist. Natural sources are on the left; non-natural sources are on the right.

Potential Water Sources	
_____ Overbank flooding	_____ Irrigation via direct application
_____ Alluvial groundwater	_____ Irrigation via seepage
_____ Groundwater discharge	_____ Irrigation via tail water run-off
_____ Natural surface flow	_____ Urban run-off / culverts
_____ Precipitation	_____ Pipes (directly feeding wetland)
_____ Snowmelt	_____ Other:

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 15.

Table 15. Rating for Water Source.

Rank	*Score*	*State*
Excellent (A)	4	Water sources are natural. Site hydrology is fed by precipitation, groundwater, natural runoff, or natural flow from an adjacent freshwater body. The system may naturally lack water at times, even for several years. There is no indication of direct artificial water sources, either point sources or non-point sources. Land use in the local watershed is primarily open space or low density, passive use with little irrigation.
Good (B)	3	Water sources are mostly natural, but also include occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic sources include developed land or irrigated agriculture that comprises < 20% of the immediate drainage area, some road runoff, small storm drains or other minor point source discharges. No large point sources control the overall hydrology.
Fair (C)	2	Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage area or moderate point source discharges into the wetland, such as many small storm drains or a few large ones or many sources of irrigation runoff. The key factors to consider are whether the wetland is located in a landscape position that supported wetlands before irrigation / development *AND* whether the wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers or natural stream channels that now receive substantial irrigation return flows).
Poor (D)	1	Water sources are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or another artificial hydrology). Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises > 60% of `the immediate drainage basin of the AA, or the presence of major drainage point source discharges that obviously control the hydrology of the AA. The key factors to consider are whether the wetland is located in a landscape position that likely never supported a wetland prior to human development *OR* did support a wetland, but is now disconnected from its natural water source. The reason the wetland exists is because of direct irrigation, irrigation seepage, irrigation return flows, urban storm water runoff, or direct pumping.

Metric References: Metric and thresholds adapted from Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012).

Metric H2: Hydroperiod

Definition and Background: This metric assesses the characteristic frequency, timing, extent, and duration of inundation or saturation of a wetland during a typical year, compared to an unaltered state. Riverine wetlands may have seasonal cycles that are governed by rainfall and runoff. Depressional and lacustrine wetlands may have daily variations in water height that are governed by diurnal increases in evapotranspiration. Slope wetlands that depend on groundwater may have relatively slight seasonal variations in hydroperiod.

Regardless of wetland type, alterations to the water source can result in changes in to the hydroperiod, such as raising or lowering water levels or altering flow rates and timing. Alterations to the hydroperiod are best considered in light of the potential hydrologic modifications impacting the site and its contributing watershed. Some alterations reduce the amount, frequency and timing of water on site (e.g., upstream dams and diversions, onsite ditches moving water out of the wetland, groundwater wells that can lower local groundwater tables), while other alterations actually contribute additional water to the wetland, either by adding greater volume of water to the system (trans-basin diversions or other diversions that add water, urban storm water inputs, agricultural runoff) or by impounding water and altering the timing of drawdown. Pits in playa wetlands, berms to form stock ponds, or impoundments caused by road grades or inadequate culverts are examples of alterations that alter the timing of drawdown. For fens in the subalpine, even small scale ditching can dramatically change the hydroperiod and dry peat bodies, leading to decomposition and loss of plant diversity.

Hydroperiod can be closely connected to water source. In most cases, the water source rating can be viewed as limiting the hydroperiod rating. If the water source is predominantly artificial, the hydroperiod may score a correspondingly low score. However, the two are not always rated the same. Some sites may have completely natural water sources (e.g., riparian shrublands along mountain streams), but their hydroperiod may be significantly impacted by dams and diversions immediately upstream. On the other hand, some wetlands with entirely managed water sources may still mimic a natural hydroperiod, or at least approximate natural seasonality. For entirely artificial wetlands, consider the management purpose of the wetland and whether the hydroperiod mimics a natural analogue, such as a natural floodplain depression or a natural seeping slope. Best professional judgment will be needed to rate this metric for artificially controlled wetlands. Good notes on the rationale for metric rating will be essential in these cases.

Metric Level: Level 2 (rapid assessment) with some Level 1 (remote sensing) background information.

Metric Application: Use for all wetlands. Specific guidance provided by wetland type.

Measurement Protocol: Review aerial photography and topographic maps to identify hydrologic stressors and modifications. Remember to look upstream of the AA in riverine systems, as the largest hydrologic alterations may be well outside the AA. This may involve using large-scale maps, such as an atlas or gazetteer, while in the field. If it is possible to obtain and reference GIS layers of dams, local diversions, trans-basin diversions, and groundwater wells, they can help inform the degree of alteration. Compare the GIS-based information with observed effects of hydroperiod alterations in-field. New development, such as new roads or oil and gas wells, should be noted on the field form for later reference. During the site walk through, look for indicators of altered hydroperiod (Tables 16 and 17). Once all available information is gathered, select the statement that best describes the alteration to the hydroperiod during the growing season.

Table 16. Hydroperiod Field Indicators for Evaluating Riverine / Riparian Wetlands**.**

Condition	***Field Indicators***
Indicators of Channel Equilibrium / Natural Dynamism	• The channel (or multiple channels in braided systems) has a well-defined usual high water line or bankfull stage that is clearly indicated by an obvious floodplain or topographic bench that represents an abrupt change in the cross-sectional profile of the channel throughout *most* of the site. • The usual high water line or bankfull stage corresponds to the lower limit of riparian vascular vegetation. • The channel contains embedded woody debris of the size and amount consistent with what is available in the riparian area. • Leaf litter, thatch, wrack, and/or mosses exist in most pools. • Active undercutting of banks or burial of riparian vegetation is limited to localized areas and not throughout site. • There is little evidence of recent deposition of cobble or very coarse gravel on the floodplain, although recent sandy deposits may be evident. • There are no densely vegetated mid-channel bars and/or point bars. The lack of this vegetation indicates flooding at regular intervals.
Indicators of Active Aggradation / Excessive Sediment	• The channel through the site lacks a well-defined usual high water line. • There is an active floodplain with fresh splays of sediment covering older soils or recent vegetation. • There are partially buried tree trunks or shrubs. • Cobbles and/or coarse gravels have recently been deposited on the floodplain. • There are partially buried, or sediment-choked, culverts.
Indicators of Active Degradation / Excessive Erosion	• Portions of the channel are characterized by deeply undercut banks with exposed living roots of trees or shrubs. • There are abundant bank slides or slumps, or the banks are uniformly scoured and unvegetated. • Riparian vegetation may be declining in stature or vigor, and/or riparian trees and shrubs may be falling into the channel. • The channel bed lacks any fine-grained sediment. • Recently active flow pathways appear to have coalesced into one channel (i.e., a previously braided system is no longer braided). • There are one or more nick points along the channel, indicating headward erosion of the channel bed.

Table 17. Hydroperiod Field Indicators for Evaluating Non-Riverine Wetlands.

Condition	***Field Indicators***
Reduced Extent and Duration of Inundation or Saturation	• Upstream spring boxes, diversions, impoundments, pumps, ditching, or draining from the wetland. • Evidence of aquatic wildlife mortality. • Encroachment of terrestrial vegetation. • Stress or mortality of hydrophytes. • Compressed or reduced plant zonation. • Drying organic soils occurring well above contemporary water tables.
Increased Extent and Duration of Inundation or Saturation	• Berms, dikes, or other water control features that increase duration of ponding (e.g., pumps). • Diversions, ditching, or runoff moving water into the wetland. • Late-season vitality of annual vegetation. • Recently drowned riparian or terrestrial vegetation. • Extensive fine-grain deposits on the wetland margins.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 18.

Table 18. Rating for Hydroperiod.

Rank	***Score***	***State***
Excellent (A)	4	Hydroperiod is characterized by natural patterns of inundation/saturation and drawdown and/or flood frequency, duration, level and timing. There are no major hydrologic stressors that impact the natural hydroperiod. Riparian channels are characterized by equilibrium conditions with no evidence of severe aggradation or degradation indicative of altered hydrology.
Good (B)	3	Hydroperiod inundation and drying patterns deviate slightly from natural conditions due to presence of stressors such as: flood control/water storage dams upstream; berms or roads at/near grade; minor pugging by livestock; small ditches or diversions removing water; or minor flow additions from irrigation return flow or storm water runoff. Outlets may be slightly constricted, but not to significantly slow outflow. Riparian channels may have some sign of aggradation or degradation, but approach equilibrium conditions. Playas are not significantly impacted pitted or dissected. *If wetland is artificially controlled,* the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).
Fair (C)	2	Hydroperiod inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: flood control/water storage dams upstream or downstream that moderately effect hydroperiod; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; shallow pits within playas; ditches or diversions 1–3 ft. deep; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. Riparian channels may show distinct signs of aggradation or degradation. *If wetland is artificially controlled,* the management regime approaches a natural analogue. Site may be passively managed, meaning that

		the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.
Poor (D)	1	Hydroperiod inundation and drawdown patterns deviate substantially from natural conditions from high intensity alterations such as: significant flood control / water storage das upstream or downstream; a 4-lane highway; large dikes impounding water; diversions > 3ft. deep that withdraw a significant portion of flow, deep pits in playas; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be significantly constricted, blocking most flow. Riparian channels may be concrete or artificially hardened. *If wetland is artificially controlled,* the site is actively managed and not connected to any natural season fluctuations.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g), Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012).

Metric H3: Hydrologic Connectivity

Definition and Background: This metric assesses the ability of water to flow to, across and out of the wetland laterally, or to accommodate rising flood waters without persistent changes in water level that can result in stress to wetland plants and animals. Assessment of this metric is based predominantly on field observation and is different by wetland type. For riverine wetlands, an important aspect of hydrologic connectivity is the degree of channel entrenchment, which limits the amount of water that can reach floodplain wetlands and can be estimated from visual clues. For certain wetland types, including playas and fens, artificial connectivity may actually degrade the site by adding excess water or causing drying.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands. Specific guidance provided by wetland type.

Measurement Protocol: Search the AA for hard obstacles that impound and constrain flood waters, such as retaining walls, road grades, or entrenched banks. For playas and fens, look for artificial connectivity that may degrade the site. Use best professional judgment to determine the overall condition of the hydrologic connectivity and *s*elect the statement that best describes the AA.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Tables 19-22.

Table 19. Rating for Hydrologic Connectivity for Riverine / Riparian Systems.

Rank	***Score***	***State***

Excellent (A)	4	Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain. Channel is not entrenched.
Good (B)	3	Minimally disconnected from floodplain. Up to 25% of stream banks may be affected by dikes, rip rap, and/or elevated culverts. Channel may be somewhat entrenched, but overbank flow occurs during most floods.
Fair (C)	2	Moderately disconnected from floodplain due to multiple geomorphic modifications. Between 25-75% of stream banks may be affected by dikes, rip rap, concrete, and/or elevated culverts. Channel may be moderately entrenched and disconnected from the floodplain except in large floods.
Poor (D)	1	Channel is severely entrenched and entirely disconnected from the floodplain. More than 75% of stream banks may be affected by dikes, rip rap, concrete and/or elevated culverts. Overbank flow never occurs or only in severe floods.

Table 20. Rating for Hydrologic Connectivity for Marshes and Meadows.

Rank	***Score***	***State***
Excellent (A)	4	No unnatural obstructions to lateral or vertical movement of surface or ground water. Rising water in the site has unrestricted access to adjacent upland, without levees, excessively high banks, artificial barriers, or other obstructions to the lateral movement of flood flows.
Good (B)	3	Minor restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Up to 25% of the site may be restricted by barriers to drainage. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.
Fair (C)	2	Moderate restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Between 25−75% of the site may be restricted by barriers to drainage. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.
Poor (D)	1	Essentially no hydrologic connection to adjacent landscape. Most or all stages may be contained within artificial banks, levees, or comparable features. Greater than 75% of the site is restricted by barriers to drainage.

Table 21. Rating for Hydrologic Connectivity for Playas.

Rank	***Score***	***State***
Excellent (A)	4	Surrounding land cover / vegetation does not interrupt surface flow. No artificial channels feed water to playa.
Good (B)	3	Surrounding land cover / vegetation may interrupt a minor amount of surface flow. Artificial channels may feed minor amounts of excess water to playa.
Fair (C)	2	Surrounding land cover / vegetation may interrupt a moderate amount of surface flow. Artificial channels may feed moderate amounts of excess water to playa.
Poor (D)	1	Surrounding land cover / vegetation may dramatically restrict surface flow. Artificial channels may feed significant amounts of excess water to playa.

Table 22. Rating for Hydrologic Connectivity for Fens.

Rank	*Score*	*State*
Excellent / Good (A / B)	4	No artificial connectivity with the surrounding water bodies that may cause unnatural drying.
Fair (C)	2	Partial connectivity (e.g., ditching or draining to dry the fen).
Poor (D)	1	Substantial to full artificial connectivity that has obvious effects of drying the peat body.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g), Collins et al. (2008), CWMW (2012), and Faber-Langendoen et al. (2008; 2012).

2.10.e Soil Metrics

Soils play a key role in overall ecological integrity. Many of the biogeochemical processes integral to wetland functioning take place within the soil. Disturbance to the soil surface can disrupt these processes, hindering plant growth, slowing or increasing decomposition rates, and altering hydrologic flow paths.

Metric S1: Substrate / Soil Disturbance

Definition and Background: This metric assess the degree to which human impacts have disturbed the natural soil or substrate. Common sources of disturbance include: fill or sediment dumping; human recreation, either foot traffic of motorized vehicles; and cows that can cause unnatural hummocks (pugging), which in turn can alter the wetland hydrology and disrupt soil process like organic accumulation. A lack of soil horizons can indicate the substrate was filled or tilled when it is not otherwise obvious. It is important to rate this metric according to wetland type. For example, bare patches may be a sign of unnatural disturbance in many wetlands. Playas, however, should have bare ground with compact soils. In playas, extra sediment on top of the naturally compacted soil can be an indicator of undesirable disturbance. Because it can be difficult to assess the degree of compaction in playas as they fill and close with water, best professional judgment will be needed.

Metric Level: Level 2 (rapid assessment).

Metric Application: Use for all wetlands. Specific guidance provided by wetland type.

Measurement Protocol: Select the statement on the form that best describes the substrate or soil disturbance within the AA, in the context of the wetland ecosystem.

Metric Rating: Assign the metric rating and associated score based on the thresholds in Table 23.

Table 23. Rating for Soil / Substrate Disturbance

Rank	*Score*	*State*

Excellent (A)	4	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.
Good (B)	3	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. The depth of disturbance is limited to only a few inches and does not show evidence of altering hydrology. Any disturbance is likely to recover within a few years after the disturbance is removed.
Fair (C)	2	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. Damage is obvious, but not excessive. The site could recover to potential with the removal of degrading human influences and moderate recovery times.
Poor (D)	1	Substantial soil disturbance within AA. Bare soil areas substantially degrade the site and have led to 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.

Metric References: Metric and thresholds adapted from Rocchio (2006a-g) and Faber-Langendoen et al. (2008; 2012).

2.11 Post-Assessment Activities

2.11.a. In Field Activities

<u>Final Review of RAM Field Forms</u>: As the AA data are recorded and completed for each section, an "X" should have been made in each of the red boxes located at the top-right of each section. Before completing the RAM and leaving the field, check that each red box is marked and the data from each section is fully recorded and written legibly. Revisit the wetland classification selected at the beginning of the visit to make sure that it still seems appropriate after site visit data have been collected.

<u>Assessment Area Inspection:</u> Walk the AA and pull any flagging, fill all soil and water quality pits. Perform an equipment-check to ensure all equipment has been collected and returned to the vehicle before leaving.

<u>Equipment Cleaning:</u> Check and clean off footwear and clothing of mud or seeds to prevent inadvertently transporting seeds to other wetland sites and to prevent cross-contamination between wetland sites, especially white-top seed. Also, wash off all trowels and knives.

2.11.b. In Office

<u>Database:</u> If the NVRAM Survey123 form was used in the field to collect data electronically, upload the completed forms at the earliest opportunity. If paper forms were used, they should

be scanned and uploaded to a secure location, with photos and other related materials, upon return to the office. Data should be entered promptly into the Nevada Wetlands Hub once available (in development, expected 2025; additional details on its use will be added in a future NVRAM field guide revision).

SECTION 3: Future Work and Recommendations

3.1 Development of tools to streamline NVRAM data collection, entry, and storage

Survey123 is an Esri app that allows electronic geospatial data collection on a phone or tablet. Survey123 is widely used in the natural resources field to streamline data entry and is compatible with ArcGIS and other Esri tools. A Survey123 version of NVRAM, funded through an EPA Wetland Program Development Grant, is currently in development and expected to be ready for general use by 2025. Although surveying with paper forms will always be an option, some surveyors prefer to use Survey123 as it facilitates quick and easy data entry.

Wetland data in Nevada is currently split amongst numerous partners in different formats that are rarely publicly accessible. A central wetlands database to store NVRAM data and other Nevada wetland information is critical for collaboration, data sharing, and analysis. For this reason, a Nevada Wetlands ArcGIS Online Hub ("Nevada Wetlands Hub") is currently in development. The Nevada Wetlands Hub development is funded through an EPA Wetland Program Development Grant and is expected to be operational by 2025. The Nevada Wetlands Hub will serve as a repository for wetland data and wetland information, with some data publicly available and some only available to data contributors or managers. The Nevada Wetlands Hub will facilitate data entry from the NVRAM Survey123, data sharing between partners, and general awareness of available Nevada wetland information.

When the NVRAM Survey123 and Nevada Wetlands Hub are available and operational, the NVRAM field guide will be updated to include information on how these resources can be accessed and used to support NVRAM data collection, entry, and storage.

3.2 NVRAM trainings and tutorials

The last step of RAM development is implementation with outreach and training for intended users (Sutula et al. 2006). NVRAM trainings should be periodically offered to partners who are interested in implementing NVRAM, ideally with a multi-day class involving lectures and field practice. Additionally, a series of short video tutorials should be developed that can be used as an introduction or a refresher for practitioners. Videos could cover topics such as choosing the assessment area, water quality meter calibration, soil protocols, data entry into the database, and more. Availability of training resources will create a larger community of qualified NVRAM surveyors, ensure standardization of survey techniques by different users, and increase the amount of wetland data collected with NVRAM throughout the state.

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Appendix A. Cowardin Systems, Classes, Water Regimes, and Special Modifiers

The descriptions are ordered from driest to wettest and are modified from Cowardin et al. (1979) as cited in Lemly et al. (2016).

Cowardin System

Upland (UPL): Non-wetland areas on land.

Palustrine (P): All wetlands sampled within the REMAP project will fall under the Palustrine Cowardin System because they are vegetated. This system includes all wetlands dominated by trees, shrubs, and emergent, herbaceous vegetation. Wetlands lacking vegetation are also included in this system if they are less than 8 hectares (20 acres) and have a depth less than 2 meters (6.6 feet) in the deepest portion of the wetland.

Cowardin Classes

Aquatic Bed (AB): Wetlands with vegetation that grows on or below the water surface for most of the growing season.

Emergent (EM): Wetlands with erect, rooted herbaceous vegetation present during most of the growing season.

Scrub-Shrub (SS): Wetlands dominated by woody vegetation that is less than 6 meters (20 feet) tall. Woody vegetation includes tree saplings and trees that are stunted due to environmental conditions.

Forested (FO): Wetland is dominated by woody vegetation that is greater than 6 meters (20 feet) tall.

Unconsolidated Bottom (UB): Wetlands that have a muddy or silty substrate with at least 25% cover

Unconsolidated Shore (US): Wetlands with less than 75% areal cover of stones, boulders, or bedrock AND with less than 30% vegetative cover AND are irregularly exposed due to seasonal or irregular flooding and subsequent drying.

Water Regime Modifiers

Intermittently Flooded (IF): The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity. Weeks, months, or even years may intervene between periods of inundation.

Temporarily Flooded (A): Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season. Plants that grow both in uplands and wetlands are characteristic of the temporarily flooded regime.

Saturated (ST): The substrate is saturated to the surface for the entire year. This modifier is applied to fen like areas and some depressional wetlands and saturated meadow systems with stable water tables regardless of their connectivity.

Seasonally Saturated (SS): The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present. This modifier is applied to fen like areas with stable water tables regardless of their connectivity.

Seasonally Flooded (SF): Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

Semi-permanently Flooded (SPF): Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Intermittently Exposed (IE): Surface water is present throughout the year except in years of extreme drought. This is applied to large ponds and shallow lakes where the water does not appear likely to dry up.

Permanently Flooded PF): Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes. Mostly applied to deepwater habitats such as lakes where there is no chance drying.

Special Modifiers

Beaver (b): This modifier describes wetlands that are formed within and adjacent to streams by beaver activity.

Excavated (x): This modifier describes wetlands that were created through the excavation of soils. Excavated may include restored wetlands.

Partially ditched/drained (d): This modifier describes manmade alterations to wetlands including ditches.

Diked/impounded (h): This modifier describes manmade alterations to wetlands where impoundments or dikes have been added.

Farmed (f): This modifier describes wetlands that have been altered due to farming practices.

Spoil (s): This modifier refers to manmade alterations to wetlands where spoils from mining activity form the substrate.

Reservoir (r): This modifier describes wetlands that are formed adjacent to artificially constructed ponds or lakes.

Channel (c): This modifier describes wetlands that are formed adjacent to artificially constructed channels, such as canals or ditches.

Spring-box (sb): This modifier describes wetlands that are formed adjacent to human-made spring-boxes.

Appendix B: Field Key to the Hydrogeomorphic (HGM) Classes

1a. Entire wetland unit is flat and precipitation is the primary source (>90%) of water. Groundwater and surface water runoff are not significant sources of water to the unit ....**Flats HGM Class**

1b. Wetland does not meet the above criteria; primary water sources include groundwater and/or surface water**... go to 2**

2a. Entire wetland unit meets ***all*** of the following criteria: a) the vegetated portion of the wetland is on the shores of a permanent open water body at least 8 ha (20 acres) in size; b) at least 30% of the open water area is deeper than 2 m (6.6 ft); c) vegetation in the wetland experiences bidirectional flow as the result of vertical fluctuations of water levels due to rising and falling lake levels…………………………….**Lacustrine Fringe HGM Class**

2b. Wetland does not meet the above criteria; wetland is not found on the shore of a water body, water body is either smaller or shallower, OR vegetation is not affected by lake water levels**…………………………………………………………………………………………………go to 3**

3a. Entire wetland unit meets ***all*** the following criteria: a) wetland unit is in a valley, floodplain, or along a stream channel where it is inundated by overbank flooding from that stream or river; b) overbank flooding occurs at least once every two years; and c) wetland does not receive significant inputs from groundwater. **NOTE:** *Riverine wetlands can contain depressions that are filled with water when the river is not flooding such as oxbows and beaver ponds*...**Riverine HGM Class**

3b. Wetland does not meet the above criteria; if the wetland is located within a valley, floodplain, or along a stream channel, it is outside of the influence of overbank flooding or receives significant hydrologic inputs from groundwater………………………………… **go to 4**

4a. Entire wetland unit meets ***all*** the following criteria: a) wetland is on a slope (slope can be very gradual or nearly flat); b) groundwater is the primary hydrologic input; c) water, if present, flows through the wetland in one direction and usually comes 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 < 3ft diameter and less than 1 foot deep).* .... **Slope HGM Class**

4b. Wetland does not meet all of the above criteria. Entire wetland unit is located in a topographic depression in which water ponds or is saturated to the surface at some time during the year. **NOTE:** *Any outlet, if present, is higher than the interior of the wetland.*...**Depressional HGM Class**

Appendix C. National Vegetation Classification Wetland Types in Nevada

The National Vegetation Classification (NVC) is a hierarchical ecological classification system with widespread use across the US, particularly in Heritage programs, LANDFIRE, and other national products. The NVC is regularly updated and peer-reviewed. The 2024 revision of NVRAM replaced the earlier classification used with NVC to increase interstate and inter-organization compatibility. Descriptions of NVC wetland groups found in Nevada are excerpted below from Faber-Langendoen et al. (2019). Full descriptions and information on lower-level classifications within the group types (i.e. alliance and association levels) can be found at the links.

Rocky Mountain-Great Basin Montane Riparian Forest

(*Picea engelmannii – Picea pungens – Populus angustifolia* Riparian Forest)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.849252/Picea_engelmannii_-_Picea_pungens_-_Populus_angustifolia_Riparian_Forest_Group

This group contains woodlands dominated by cottonwood, conifer and aspen that line montane streams. Dominant tree species usually include *Abies lasiocarpa, Picea engelmannii, Pinus ponderosa, Juniperus scopulorum*, and/or *Populus angustifolia*; other important species include *Pseudotsuga menziesii, Picea x albertiana*, and *Populus tremuloides*. Other trees possibly present but not usually dominant include *Alnus incana, Abies concolor, Abies grandis, Pinus contorta*, and *Juniperus osteosperma*. Shrub cover tends to be limited but may include *Alnus incana, Betula occidentalis, Cornus sericea, Crataegus rivularis, Forestiera pubescens var. pubescens, Ribes* spp., *Rosa woodsii, Salix* spp., and others. The herbaceous undergrowth can be lush to depauperate. Herbaceous species include *Calamagrostis canadensis, Carex aquatilis var. aquatilis, Carex obnupta, Carex pellita, Equisetum arvense, Heracleum maximum, Ranunculus alismifolius, Senecio bigelovii var. bigelovii, Streptopus amplexifolius*, and *Veratrum californicum*. This riparian group includes seasonally flooded forests found at montane to subalpine elevations of the Intermountain West region. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet); farther north, elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderately wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins.

Rocky Mountain-Great Basin Swamp Forest

(*Thuja plicata - Picea engelmannii / Lysichiton americanus* Swamp Forest Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.849242/Thuja_plicata_-_Picea_engelmannii_-_Lysichiton_americanus_Swamp_Forest_Group

This forested wetland/swamp group is dominated by conifers with diagnostic hydric undergrowth vegetation. Dominant conifers include *Abies grandis, Abies lasiocarpa, Picea engelmannii, Picea glauca* (and their hybrid), *Pinus contorta, Pseudotsuga menziesii, Thuja plicata*, and/or *Tsuga heterophylla*. Aquatic obligate herbs include *Alopecurus aequalis, Calamagrostis canadensis, Carex disperma, Carex vesicaria, Dryopteris* spp., *Eleocharis palustris, Lysichiton americanus, Mitella breweri, Mitella pentandra, Phalaris arundinacea, Senecio triangularis*, and/or *Streptopus amplexifolius*. Typical wetland shrubs such as *Alnus incana, Cornus sericea, Rhamnus alnifolia*, and *Salix* spp. may also be present. These occur on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland), and can occur on steeper slopes where soils are shallow over unfractured bedrock (aka on seeps). This group is indicative of poorly drained, mucky areas, and areas are often bathed in a mosaic of moving and stagnant water. It can also occur around vernal ponds (usually <1 m but can be as much as 2 m deep) that usually fill with water over the fall, winter and early spring, but then at least partially dry up towards the end of the growing season. Trees that ring these ponds shade the water and influence the hydrology of the ponds themselves. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Stands are usually dominated by conifers, but can have hardwoods mixed or dominant. These wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables.

North American Warm Desert Riparian Low Bosque & Shrubland

(*Prosopis glandulosa - Prosopis velutina - Baccharis* spp. North American Warm Desert Riparian Low Bosque & Shrubland Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857323/Prosopis_glandulosa_-_Prosopis_velutina_-_Baccharis_spp_North_American_Warm_Desert_Riparian_Low_Bosque_Shrubland_Group

This group consists of riparian scrub found along low-elevation (<1100 m) perennial or intermittent streams and rivers throughout the warm desert regions of the southwestern U.S. The vegetation is low scrub or shrubland, not tall trees. Dominants include scrub *Prosopis glandulosa* and *Prosopis velutina*, and shrubs *Baccharis salicifolia, Pluchea sericea, Salix geyeriana, Shepherdia argentea*, and/or *Salix exigua*. Woody cover is relatively dense, especially when compared to drier washes. Dominant species, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation is dependent upon annual rise in the water table or annual/periodic flooding and associated sediment scour for growth and reproduction.

Arid West Interior Freshwater Marsh & Wet Meadow

(*Schoenoplectus* spp. - *Typha* spp. Interior Freshwater Marsh Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848817/Schoenoplectus_spp_-_Typha_spp_Interior_Freshwater_Marsh_Group

These arid west freshwater marshes are found at all elevations below timberline throughout the western interior basins and mountains of western North America. Vegetation is characterized by a lush, dense herbaceous layer with low diversity, sometimes occurring as a monoculture. Structure varies from emergent forbs which barely reach the water surface to tall graminoids that reach as tall as 4 m high. Dominant species include *Carex pellita, Carex praegracilis, Eleocharis palustris, Juncus arcticus ssp. littoralis, Paspalum distichum, Schoenoplectus americanus, Schoenoplectus pungens, Typha domingensis, Typha latifolia*, and species of *Bidens, Cicuta, Cyperus, Mimulus*, and *Phalaris*. This group includes shallow freshwater to brackish waterbodies found in bottomlands along drainages, in river floodplain depressions, cienegas, oxbow lakes, below seeps, frequently flooded gravel bars, low-lying sidebars, in-fill side channels, small ponds, stockponds, ditches and slow-moving streams, perennial streams in valleys and mountain foothills, as well as in small depressions gouged into basalt by Pleistocene floods, channeled scablands of the Columbia Plateau and within dune fields in the intermountain western U.S. These wetlands are mostly small-patch, confined to limited areas in suitable floodplain or basin topography. They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is on or above the surface for most of the growing season. A consistent source of freshwater is essential to the function of these communities. Soils are muck or mineral or muck over a mineral soil, and water is high-nutrient. It is often found along the borders of ponds, lakes or reservoirs that have more open water. Some occurrences are interdunal wetlands in wind deflation areas, where sands are scoured down to the water table. The water table may be perched over an impermeable layer of caliche or clay.

North Pacific-Columbia Plateau Vernal Pool

(*Downingia* spp. - *Callitriche* spp. - *Eryngium* spp. North Pacific Vernal Pool Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848810/Downingia_spp_-_Callitriche_spp_-_Eryngium_spp_North_Pacific_Vernal_Pool_Group

This group includes herbaceous wetlands that surround and occur within shallow ephemeral water bodies found in depressions among grasslands, shrub-steppe and open woodlands on exposed volcanic scablands in northern Nevada. Due to drawdown characteristics, vernal pools typically form concentric rings of similar vegetation. Given their relative isolation in upland-dominated landscapes, many endemic plant species are found in vernal pools. Characteristic species are predominantly annual and diverse. Characteristic species in these communities include *Callitriche marginata, Callitriche* spp., *Camissonia tanacetifolia, Deschampsia danthonioides, Downingia elegans, Elatine* spp., *Eleocharis* spp., *Epilobium densiflorum, Eryngium petiolatum, Eryngium vaseyi, Grindelia nana, Isoetes orcuttii, Juncus uncialis, Myosurus minimus, Navarretia leucocephala ssp. diffusa, Pilularia americana, Plagiobothrys* spp., *Plagiobothrys figuratus, Plagiobothrys scouleri, Polyctenium williamsiae, Polygonum polygaloides ssp. confertiflorum, Polygonum polygaloides ssp. polygaloides, Psilocarphus brevissimus, Psilocarphus elatior, Psilocarphus oregonus, Trifolium cyathiferum, Triteleia hyacinthina*, and *Veronica peregrina*. In northern Nevada, most of the species by biomass are perennials and include *Carex douglasii, Juncus arcticus ssp. littoralis, Muhlenbergia richardsonis*, and species of *Eleocharis, Polygonum, Rumex*, and *Polyctenium*. Hardpan vernal pools occur on soils with an indurated clay or cemented (Si or Fe) layer that retains water inputs throughout some portion of the spring, and that typically dry down completely into early summer months. Thus this group only occurs where there is hummocky micro-relief. These wetlands tend to be acidic wetlands. On the Columbia Plateau many pools are located on massive basalt flows, andesite or rhyodacite caprock. Inundation is highly irregular, sometimes not occurring for several years. Depressions usually (but not always) fill with water during winter and spring. They are generally dry again within nine months, though in exceptional times they can remain inundated for two years in a row. Water is from rainfall and snowmelt in relatively small closed basins, on average probably no more than 5-15 times the area of the ponds themselves. Pools are depressions with no outflows. Soils when present are typically silty clay, sometimes with sandy margins. Ponds range from very small (3 sqm) to large depressions (1600 sqm).

Temperate Pacific Freshwater Mudflat

(*Eleocharis obtusa - Eragrostis hypnoides - Ludwigia palustris* Temperate Pacific Freshwater Wet Mudflat Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848805/Eleocharis_obtusa_-_Eragrostis_hypnoides_-_Ludwigia_palustris_Temperate_Pacific_Freshwater_Wet_Mudflat_Group

This group consists of communities that occur on freshwater mudflats found scattered throughout the temperate regions of the western U.S. and Canada. They are dominated mainly by low-statured annual plants and range in physiognomy from sparsely vegetated mud to extensive sods of herbaceous vegetation. The predominant species include *Crassula aquatica, Eleocharis obtusa, Eragrostis hypnoides, Gnaphalium palustre, Lilaeopsis occidentalis, Limosella aquatica*, and/or *Ludwigia palustris*. In the Pacific Northwest, they occur primarily in seasonally or tidally flooded shallow lakebeds and on floodplains, especially along the lower Columbia River. During any one year, they may be absent because of year-to-year variation in river water levels. Mudflats must be exposed before the vegetation develops from the seedbank.

Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland

(*Salix exigua* - *Crataegus* spp. - *Forestiera pubescens* Rocky Mountain-Great Basin Riparian Shrubland Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857235/Salix_exigua_-_Crataegus_spp_-_Forestiera_pubescens_Rocky_Mountain-Great_Basin_Riparian_Shrubland_Group

These short to tall shrublands (0.5-5 m in height) occur along streams at and below lower treeline, that is, not up in the mountains, but in between mountain valleys and lowlands of the Interior West. Dominant shrubs include *Acer glabrum, Artemisia cana, Artemisia cana ssp. bolanderi, Artemisia cana ssp. viscidula, Artemisia tridentata ssp. tridentata, Cornus sericea, Crataegus douglasii, Crataegus rivularis, Dasiphora fruticosa ssp. floribunda, Forestiera pubescens, Oplopanax horridus, Philadelphus lewisii, Prunus virginiana, Rhus trilobata, Rosa nutkana, Rosa woodsii, Salix exigua, Salix irrorata, Salix melanopsis, Shepherdia argentea*, and *Symphoricarpos* spp. Herbaceous layers are often dominated by *Athyrium filix-femina, Carex flava, Carex* spp., *Elymus trachycaulus, Equisetum arvense, Deschampsia cespitosa, Festuca idahoensis, Galium triflorum, Glyceria striata, Gymnocarpium dryopteris, Heracleum maximum, Iris missouriensis, Juncus arcticus ssp. littoralis, Juncus* spp., *Leymus cinereus, Maianthemum stellatum, Muhlenbergia filiformis, Muhlenbergia richardsonis, Pascopyrum smithii, Poa cusickii*, and *Poa secunda*. Introduced forage species such as *Agrostis stolonifera, Poa pratensis, Phleum pratense*, and the invasive annual *Bromus tectorum* are often present in disturbed stands. Streams are permanent, intermittent, and ephemeral. Stands occur in steep-sided canyons or in broad flat valleys. They can be large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. They also are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches, and they can occur in depressional wetlands and non-alkaline playas. Stands may also occur on upper benches away from active channel movement. Willow-dominated shrublands require flooding and bare gravels for reestablishment. Stands are maintained by annual flooding and hydric soils throughout the growing season. Sites are subject to temporary flooding during spring runoff. The water table is often just below the ground surface. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks and upper benches, and occasionally on hillslope springs. This group occurs around the edges and between the mountain ranges of the Great Basin and along the lower eastern slope of the Sierra Nevada at about 1220 m (4000 feet) in elevation. Climate is generally semi-arid.

Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh

(*Carex* spp. - *Calamagrostis* spp. Montane Wet Meadow & Marsh Group) https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857274/Carex_spp_-_Calamagrostis_spp_Montane_Wet_Meadow_Marsh_Group

This group contains the wet meadows found in low and high montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1000-3600 m) in mountain ranges of the intermountain Interior West. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis, Calamagrostis stricta, Carex bolanderi, Carex exsiccata, Carex illota, Carex microptera, Carex scopulorum, Carex utriculata, Carex vernacula, Deschampsia cespitosa, Eleocharis quinqueflora, Glyceria striata, Juncus drummondii, Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species include *Camassia quamash, Cardamine cordifolia, Dodecatheon jeffreyi, Phippsia algida, Rorippa alpina, Senecio triangularis, Trifolium parryi*, and *Veratrum californicum*. Common but sparse shrubs may include *Betula glandulosa, Salix* spp., *Vaccinium macrocarpon*, and *Vaccinium uliginosum*. Wet meadows occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs.

Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland

(*Caltha leptosepala - Carex nigricans - Kalmia microphylla* Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857258/Caltha_leptosepala_-_Carex_nigricans_-_Kalmia_microphylla_Subalpine-Alpine_Snowbed_Wet_Meadow_Dwarf-shrubland_Group

These are high-elevation communities dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from upper subalpine to alpine (1500-3600 m) depending on latitude. These types occur as large meadows in subalpine valleys, as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this group are mineral or with a thin (<40 cm) organic layer over mineral layers (aka not peatland). Soils show hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This group often occurs as a mosaic of several plant associations, often dominated by graminoids such as *Carex illota, Carex lachenalii, Carex nigricans, Carex vernacula, Deschampsia cespitosa, Juncus drummondii*, and forbs *Caltha leptosepala, Trollius laxus, Phippsia algida, Rorippa alpina, Sibbaldia procumbens*, and *Trifolium parryi*. Often scattered to moderately dense dwarf-shrubs are present, especially *Dasiphora, Kalmia, Salix* or *Vaccinium*, which when present form alpine dwarf-shrublands. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Western Montane-Subalpine Riparian & Seep Shrubland

(*Salix* spp. - *Alnus* spp. - *Betula occidentalis* Riparian & Seep Shrubland Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857292/Salix_spp_-_Alnus_spp_-_Betula_occidentalis_Riparian_Seep_Shrubland_Group

These are montane to subalpine riparian shrublands occurring as narrow bands or broad shrublands and are found throughout the Rocky Mountain cordillera from New Mexico north into Montana and northwestern Alberta. They also occur in mountainous areas of the interior Intermountain West and on the Colorado Plateau. This group often occurs as part of a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. Shrubs range from short to tall (0.5-15 m). The shrub species that can be dominant reflect the large elevational gradient of this group and include *Alnus incana, Alnus oblongifolia, Alnus viridis, Betula occidentalis, Betula glandulosa, Betula occidentalis, Cornus sericea, Salix bebbiana, Salix boothii, Salix brachycarpa, Salix drummondiana, Salix eriocephala, Salix geyeriana, Salix monticola, Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these wet shrublands is either conifer or aspen forest. Stands occur on streambanks, stream benches and alluvial terraces in steep narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels, as well as steep moist avalanche chutes. This group is generally found at higher elevations, but can be found anywhere from 1500-3475 m. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this group are associated with beaver activity.

North American Desert Alkaline-Saline Marsh & Playa

(*Distichlis spicata - Puccinellia lemmonii - Salicornia* spp. Alkaline-Saline Marsh & Playa Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848861/Distichlis_spicata_-_Puccinellia_lemmonii_-_Salicornia_spp_Alkaline-Saline_Marsh_Playa_Group

This group is found in the intermountain western U.S. Associations are composed of densely vegetated seasonal wetlands, saltwater emergent marshes to barren and sparsely vegetated playas (generally <10% plant cover). Characteristic species may include *Allenrolfea occidentalis, Atriplex* spp., *Distichlis spicata, Grayia spinosa, Leymus cinereus, Leymus triticoides, Muhlenbergia* spp., *Poa secunda, Puccinellia lemmonii, Salicornia* spp., *Sarcobatus vermiculatus*, and *Triglochin maritima*. Soils and standing water (if present) are alkaline. Salt crusts are common where there are actively drying ponds, that can have saltgrass beds in depressions and sparse shrubs around the margins. Playa flats are intermittently, seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. During exceptionally wet years, increased precipitation can dilute soil salt concentrations which may allow less salt-tolerant species to become established or more abundant. Some stands occur on floodplains, along the margins of perennial lakes, and in alkaline closed basins, with extremely low-gradient shorelines.

North American Desert Alkaline-Saline Wet Scrub

(*Sarcobatus vermiculatus - Atriplex* spp. Alkaline-Saline Wet Scrub Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848848/Sarcobatus_vermiculatus_-_Atriplex_spp_Alkaline-Saline_Wet_Scrub_Group

This group occurs in intermountain basins, typically near drainages on stream terraces and flats or as rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This group consists of open to moderately dense shrublands dominated by *Atriplex lentiformis, Atriplex parryi, Atriplex polycarpa, Atriplex spinifera, Allenrolfea occidentalis, Salicornia rubra, Sarcobatus vermiculatus, Sesuvium verrucosum*, and/or *Suaeda moquinii*. Stands may be monotypic or have lesser abundance of other shrubs such as *Atriplex canescens, Atriplex confertifolia, Atriplex gardneri, Artemisia tridentata ssp. wyomingensis, Artemisia tridentata ssp. tridentata, Artemisia cana ssp. cana, Baccharis* spp., *Krascheninnikovia lanata*, and others. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Calamovilfa longifolia, Distichlis spicata* (where water remains ponded the longest), *Eleocharis palustris, Pascopyrum smithii, Poa pratensis, Puccinellia nuttalliana*, or *Sporobolus airoides* herbaceous types.

Rocky Mountain Alkaline Fen

(*Kobresia myosuroides - Carex buxbaumii* Alkaline Fen Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.856702/Kobresia_myosuroides_-_Carex_buxbaumii_Alkaline_Fen_Group

This group occurs infrequently throughout the Rocky Mountains from Colorado north into Canada. It is confined to specific environments defined by groundwater discharge, soil chemistry (neutral to alkaline), and peat accumulation of at least 40 cm. Vegetation is dominated by graminoids and low shrubs and includes *Carex buxbaumii, Carex cusickii, Carex limosa, Carex saxatilis, Carex utriculata, Kobresia* *myosuroides*, and *Kobresia simpliciuscula*. Shrubs include *Betula glandulosa* and several *Salix* spp. Fens form at low points in the landscape or on slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels and cold winter temperatures lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, soil chemistry is alkaline to neutral with nutrients high in base cations. Nitrogen (N) and potassium (K) are usually still limiting plant growth in rich fens. Rich fens are strongly influenced by geology and occur where limestone, dolostone, marble or where glacially-derived materials are calcareous. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests.

Rocky Mountain Acidic Fen

(*Carex aquatilis* - *Carex lasiocarpa* - *Sphagnum* spp. Rocky Mountain Acidic Fen Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.856688/Carex_aquatilis_-_Carex_lasiocarpa_-_Sphagnum_spp_Rocky_Mountain_Acidic_Fen_Group

Fens usually occur as a mosaic of several plant associations dominated by *Carex aquatilis, Carex livida, Carex lasiocarpa, Carex limosa, Dulichium arundinaceum, Ledum glandulosum*, and *Trichophorum cespitosum*. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests. This group is confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation of at least 40 cm. Fens form at low points in the landscape or on slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Acidic fens are restricted to areas where bedrock is noncalcareous (e.g., sandstone, basalt, quartzite, granite). Constant high water levels and cold winter temperatures lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, soil chemistry is acidic and nutrients are low. Iron fens are the exception where the pH is low (acidic) but nutrients are high.

Western North American Temperate Freshwater Aquatic Vegetation

(*Nuphar* spp. - *Potamogeton* spp. - *Lemna* spp. Freshwater Aquatic Vegetation Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.849107/Nuphar_spp_-_Potamogeton_spp_-_Lemna_spp_Freshwater_Aquatic_Vegetation_Group

This group consists of freshwater aquatic herbaceous vegetation found throughout the temperate regions of western North America. Elevation ranges from near sea level to 2750 m (9000 feet). They generally do not tolerate freezing or drought. They are small patch in size, confined to lakes, ponds, oxbows, and slow-moving portions of rivers and streams that may become mudflats. These waterbodies may be part of large wetland complexes with emergent vegetation, shallow water pools, as well as large deep water areas. In large bodies of water, they are usually restricted to the littoral region where penetration of light is the limiting factor for growth. A variety of rooted or floating aquatic herbaceous species may dominate, including *Azolla* spp., *Nuphar polysepala, Polygonum* spp., *Potamogeton* spp., *Ranunculus* spp., and *Wolffia* spp. Submerged vegetation, such as *Myriophyllum* spp., *Ceratophyllum* spp., and *Elodea* spp., is often present. These communities occur in water too deep for emergent vegetation, generally between 2-8 m depth.

Western North American Ruderal Marsh, Wet Meadow & Shrubland

(*Poa pratensis - Conyza canadensis - Cirsium arvense* Ruderal Marsh, Wet Meadow & Shrubland Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.857308/Poa_pratensis_-_Conyza_canadensis_-_Cirsium_arvense_Ruderal_Marsh_Wet_Meadow_Shrubland_Group

This group contains disturbed wet meadows found in lowland, montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (sea level to 3600 m). Vegetation is dominated by non-native species such as *Agrostis gigantea, Agrostis stolonifera, Alopecurus pratensis, Bromus inermis, Conyza canadensis, Cirsium arvense, Sonchus* spp., *Lactuca serriola, Phalaris arundinacea, Phragmites australis ssp. australis, Poa bulbosa, Poa palustris*, and *Poa pratensis*. Native species may be present but are so low in abundance that the original native plant association is impossible to determine. These can be wet meadows, wet emergent marshes, coastal backwater dunes, sloughs, open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Due to disturbance, soils may be compacted.

Western Arid Ruderal Lowland Riparian Forest and Scrub

(*Tamarix* spp. - *Elaeagnus angustifolia* Ruderal Riparian Forest & Scrub Group)

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.848769/Tamarix_spp_-_Elaeagnus_angustifolia_Ruderal_Riparian_Forest_Scrub_Group

This group consists of low-elevation riparian areas, seeps and springs throughout the southwestern U.S. and into Mexico that are dominated by non-native invasive woody species. Present to abundant species include *Elaeagnus angustifolia, Myoporum laetum, Phoenix canariensis, Prunus mahaleb, Robinia pseudoacacia, Schinus molle, Schinus terebinthifolius, Tamarix* spp., *Ulmus pumila*, or *Washingtonia robusta*. Salt-cedar habitats tend to support fewer species and individuals than native habitats. If present, native species contribute less than 10% relative cover. Elevation ranges from sea level to above

2135 m (7000 feet). Sites are typically streambanks and benches, floodplains and canyons with permanent, intermittent or temporary waterflow.

Temperate Developed Wooded Wetland

https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.884095/Temperate_Developed_Wooded_Wetland_Anthro-group

This type includes stands of abandoned planted non-native trees or escaped stands. Some species may be native to other parts of the U.S., but are not native in the West. These species include *Populus alba, Robinia pseudoacacia*, and other escapees that require a moist setting to survive in the arid western U.S. They may be in yards of abandoned houses or along roadsides, lakeshores, canyon bottoms and riparian areas, usually not too far from settlements and towns.

Appendix D: Simplified Key to Soil Texture

Simplified Key to Soil Texture
(Adapted from Brewer and McCann 1982)

Place about three teaspoons of soil in the palm of your hand. Take out any particles ≥ 3 mm in size.

A. Does soil remain in ball when squeezed in your hand palm?

Yes, soil does remain in a ball when squeezed.. **B**

No, soil does not remain in a ball when squeezed... **sand**

SAND Sand (class unknown)
Very coarse texture..COSA Coarse sand
Moderately coarse texture... MESN Medium sand
Moderately fine texture.. FISN Fine sand

B. Add a small amount of water until the soil feels like putty. Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Does soil make a ribbon?

Yes, soil makes a ribbon; though it may be very short...**C**

No, soil does not make a ribbon...**loamy sand**

Very gritty with coarse particles..COLS Coarse, loamy sand
Moderately to slightly gritty with medium to fine particles.........MELS Medium to very fine, loamy sand

C. Does ribbon extend more than one inch?

Yes, soil extends > 1 inch...**D**

No, soil does not extend > 1 inch...Add excess water

Soil feels gritty or not smooth.. **sandy loam or loam**

LOAM Loam (class unknown)
Very gritty with coarse particles..MCSL Moderately coarse, sandy loam
Moderately gritty with medium to fine particles........................MESA Medium to very fine, sandy loam
Slightly gritty ....MELO Medium loam

Soil feels very smooth...**silt loam**

MESIL medium silt loam

D. Does ribbon extend more than 2 inches?

Yes, ribbon extends more than 2 inches, and does not crack if bent into a ring..........................**E**

No, soil breaks when 1–2 inches long; cracks if bent into a ring.....................Add excess water

Soil feels gritty or not smooth..**sandy clay loam or clay loam**
Moderately to very gritty... MFSA Moderately fine sandy clay loam
Slightly gritty or not smooth... MFCL Moderately fine clay loam

Soil feels very smooth...**silty clay loam or silt**
Moderately fine texture..MFSL Moderately fine silty clay loam
Very fine texture.. MESI Medium silt

E. Soil makes a ribbon 2+ inches long; does not crack when bent into a ring................Add excess water

Soil feels gritty or not smooth...**sandy clay or clay**
Moderately to very gritty... FISA Fine sandy clay
Slightly gritty or not smooth... FICL Fine clay
CLAY Clay (class unknown)

Soil feels very smooth...**silty clay**

FISC Fine silty clay

UNKN = UNKNOWN PEAT = PEAT MUCK = MUCK

Appendix E: Notes on Hydric Soil Indicators for the Mountain West (from Lemly et al., 2016)

Does the soil layer have…

Organic matter ≥ 40 cm thick (you can combine layers of Peat, Muck, and Mucky Peat) Look at **A1**

≥ 20 cm thick (you can combine layers of Peat, Muck, and Mucky Peat) Look at **A2, A3**

Mucky Mineral texture

Look at **S1, F1**

Smells like rotten eggs?

Look at **A4**

A Gleyed Matrix with a Hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, 5PB

Look at **S4** if texture is Sand or Loamy Sand and **F2** for all other textures

A stripped matrix (Faint, splotchy patterns of 2 or more colors)
Look at **S6**

Redox concentrations in the first 15 cm and is in a depression
Look at **F8**

Chroma ≤ 2

Value ≥ 4

This layer could be a depleted matrix. Look at **A11, A12, F3**

Value ≤ 3

w/ redox concentrations

Look at **S5** if texture is Sand or Loamy Sand and, **F6** for all other textures

w/ redox depletions

Look at **S6** if texture is Sand or Loamy Sand and, **F7** for all other textures

Brief Indicator Descriptions

All Soil Types

A1. Histosol: Organic soil material ≥ 40 cm think within the top 80 cm.

A2. Histic Epipedon: Organic soil material ≥ 20 cm thick above a mineral soil layer. Aquic conditions or artificial drainage required, but can be assumed if hydrophytic vegetation and wetland hydrology are present.

A3. Black Histic: Very dark organic soil material ≥ 20 cm thick that starts within 15 cm of soil surface. Color: hue = 10YR or yellower; value ≤ 3; chroma ≤ 1. Aquic conditions or artificial drainage not required. Rare in our region.

A4. Hydrogen Sulfide: Rotten egg odor within 30 cm of the soil surface due to the reduction of sulfur. Most commonly found in areas that are permanently saturated or inundated; almost never at the wetland boundary.

A11. Depleted Below Dark Surface: Depleted (colorless) layer ≥ 15 cm that starts within 30 cm of the soil surface. Color: chroma ≤ 2. Redox features required if color = 4/1, 4/2, 5/2. Layers above must be dark. See Table 1 for specifics.

A12. Thick Dark Surface. Depleted (colorless) layer ≥ 15 cm that starts below 30 cm of the soil surface. Color: chroma ≤ 2. Redox features required if color = 4/1, 4/2, 5/2. Layers above must be dark. See Table 1 for specifics. Not common in our region

For the remaining indicators, unless otherwise indicated, all mineral layers above the indicators must have a dominant chroma of ≤ 2 or the layers with dominant chroma of > 2 must be < 15 cm thick.

Sandy Soil Types

Sandy soil indicators are generally shallower and thinner than loamy/clayey soil indicators.

S1. Sandy Mucky Mineral: A layer of mucky modified sandy soil material ≥ 5 cm starting within 15 cm of the soil surface. Limited in our region, but found in swales associated with sand dunes.

S4. Sandy Gleyed Matrix: Gleyed matrix that occupies ≥ 60% of a layer starting within 15 cm of the soil surface. No minimum thickness required. Gley colors are not synonymous with grey colors. They are found on the Gley page. Rare in our region; only found where sandy soils are almost continuously saturated.

S5. Sandy Redox: Redox features in a depleted (colorless) layer ≥ 10 cm that starts within 15 cm of the soil surface. Color: chroma ≤ 2. See Table 1 for specifics. Most common indicator in our region of the wetland boundary for sandy soils.

S6. Stripped Matrix: A layer starting within 15 cm of the surface in which iron/manganese oxides and/or organic matter has been stripped and the base color of the soil material is exposed. Evident by faint, diffuse splotchy patterns of two or more colors. Stripped zones are ≥ 10% and ~1–3 cm in diameter.

Loamy / Clayey Soil Types

Loamy/clayey soil indicators are generally deeper and thicker than sandy soil indicators.

F1. Loamy Mucky Mineral: A layer of mucky modified loamy or clayey soil material ≥ 10 cm starting within 15 cm of the soil surface. Difficult to tell without testing.

F2. Loamy Gleyed Matrix: Gleyed matrix that occupies ≥ 60% of a layer starting within 30 cm of the soil surface. No minimum thickness required. Gley colors are not synonymous with grey colors. They are found on the Gley page.

F3. Depleted Matrix: Depleted (colorless) layer ≥ 5 cm thick within 15 cm or ≥ 15 cm thick within 30 cm of the soil surface. Color: chroma ≤ 2. Redox features required if color = 4/1, 4/2, 5/2. See Table 1 for specifics. Most common indicator at wetland boundaries.

F6. Redox Dark Surface: A dark surface layer with redox features. Depth and location: ≥ 10 cm thick entirely within 30 cm of the mineral soil. Matrix color and redox features: matrix value ≤ 3 and chroma ≤ 1 with ≥ 2% distinct, prominent redox concentrations OR matrix value ≤ 3 and chroma ≤ 2 with ≥ 5% distinct, prominent redox concentrations. The chroma can be higher with more redox features. Very common indicator to delineate wetlands, though difficult to see in soils with high organic matter.

F7. Depleted Dark Surface: A dark surface layer with redox depletions. Depth and location: ≥ 10 cm thick entirely within 30 cm of the mineral soil. Matrix color and redox depletions: matrix value ≤ 3 and chroma ≤ 1 with ≥ 10% redox depletions OR matrix value ≤ 3 and chroma ≤ 2 with ≥ 20% redox depletions. The chroma can be higher with more redox depletions. Redox depletions themselves should have value ≥ 5 and chroma ≤ 2. Rare in our region.

F8. Redox Depressions: A layer ≥ 5 cm thick entirely within 15 cm of soil surface with ≥ 5% distinct or prominent redox concentrations in closed depressions subject to ponding. No color requirement for the matrix soil, but only applies to depressions in otherwise flat landscapes.

	A11	***A12***	***F3***	***S5***
Depleted matrix extent	≥ 60%	≥ 60%	≥ 60%	≥ 60%
Depleted matrix color	chroma ≤ 2	chroma ≤ 2	chroma ≤ 2	chroma ≤ 2
Redox requirements	≥ 2% distinct or prominent redox concentrations ***if matrix color is*** 4/1, 4/2, 5/2	≥ 2% distinct or prominent redox concentrations ***if matrix color is*** 4/1, 4/2, 5/2	≥ 2% distinct or prominent redox concentrations ***if matrix color is*** 4/1, 4/2, 5/2	≥ 2% distinct or prominent redox concentrations
Starting within	< 30 cm	≥ 30 cm	see below	> 15 cm
Min thickness	15 cm or 5 cm if fragmental soil material	15 cm	**5 cm** within 15 cm of soil surface OR **15 cm** within 25 cm of soil surface	10 cm
Color of layers above	***loamy/clayey*** value ≤ 3 chroma ≤ 2 ***sandy material*** value ≤ 3 chroma ≤ 1 70% coated with organic material	***all types to 30cm*** value ≤ 2.5 chroma ≤ 1 ***all types below 30 cm and above depleted matrix*** value ≤ 3 chroma ≤ 1 ***all sandy material*** 70% coated with organic material	no requirements	no requirements

Table E1. Comparison of indicators with depleted matrices and redox features.

Appendix F: Nevada Wetland RAM Field Equipment and Supplies List

Field staff supplies:

- Sun protection: Sun hat, Sunscreen, Long-sleeve shirt, Sunglasses
- Rain jacket
- Bug protection: Bug spray, Long pants
- Muck boots (or field shoes or waders, depending on site)
- Gallon drinking water
- Field pack
- Lunch/field snacks

Documents:

- NV RAM Data Sheets
- Nevada Wetland Rapid Assessment Method Appendices
- NV RAM Field Manual (excerpts)
- NV Wetland Level 1 “Wet Bar” Report for each site
- NV plants 4 condition assessment (S Swanson, 2016)

General Equipment:

- 1- Large plastic tub, for equipment
- 1- Retractable tape-measure, at least 50 meters (for assessment area)
- 1- Digital Camera, plus charged batteries
- 2- SD cards for camera
- 1- Dry erase board, at least 8” x 11” (for photo #, compass aspect, date)
- 2- Dry erase markers
- 1- GPS Unit, plus extra batteries
- 10 – Flags, 4 at least 36” tall, plus a variety of heights for various wetland vegetation
- 1- Roll of flagging
- 1- Compass
- 2- Clipboards
- 1- Air temperature thermometer
- 4- Mechanical pencils w/erasers
- 1-box gallon zip-lock bags
- 1- Long blade shovel (for soil pits)
- 1- Soil trowel
- 1- Soil knife with depth markings
- 1- Stiff tape-measurer, at least 30 cm (for soil and water chemistry pits)

- 10- Small pins to mark soil layer differentiations
- 2- Squirt bottle
- 1- Cup for water chemistry sample
- 1- Small magnifying glass
- Water chemistry meter: Temp (C), pH, Electrical Conductivity (dS), Dissolved Oxygen (DO)
- 1 - Plant Press
- Small tarp/piece of plastic
- Extra water and hard bristle brush (for cleaning footwear of mud and seeds)
- Bleach solution (for cleaning gear if site harbors invasive pests, e.g. quagga or zebra mussels or mud snails)

Field Guides:

Vegetation-

- Noxious weeds of Nevada: https://agri.nv.gov/Plant/Noxious_Weeds/Noxious_Weed_List/
- Nevada Nuisance weeds field guide: https://naes.agnt.unr.edu/PMS/Pubs/1399_2019_01.pdf
- Wetland plants of Colorado: https://cnhp.colostate.edu/cwic/library/field-guides/
- Field guide to intermountain sedges: https://www.fs.usda.gov/rm/pubs/rmrs_gtr010.pdf
- Field guide to intermountain rushes: https://www.fs.usda.gov/rm/pubs_int/int_gtr306.pdf
- Field guide for identification of intermountain riparian woody plants: https://www.nrcs.usda.gov/plantmaterials/idpmcpu12618.pdf

Soils-

- Munsell Soil Color Chart
- U.S. Army Corps of Engineers. 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0). Hydric soil key for the arid west region, Section 3.
- U.S. Department of Agriculture, Natural Resources Conservation Service. 2018. Field Indicators of the Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.2.

Appendix G. Nevada Wetland RAM Engagement, Development, and Updates

2019 Expert Engagement Summary

Extensive partner and stakeholder outreach activities were conducted throughout the development of the NV RAM in 2018 and 2019. The core NV RAM development team, represented by the authors of this manual, convened meetings, workshops and field trips to gather input from developers of other western U.S. RAMs and feedback from likely users from Nevada. The goal was to synthesize this input into a RAM capable of addressing multiple wetland targets and the variety of wetland classes found in Nevada and to meet the NDNH WPP (2017) call for a cost-effective RAM that works for wetland monitoring within and among regions. A common theme heard from targeted stakeholder outreach was the agencies' needs for a cost-effective method for ambient wetland condition assessment within Nevada's hydrographic areas (i.e., groundwater administrative areas) or within specific land management units. The stakeholders engaged in this project expressed that they saw the benefit of enhancing the consistency of wetland assessments, and enabling better knowledge of regional distribution and condition of wetland habitats across the state.

In early June 2018, a virtual meeting of regional wetland assessment experts occurred that included Jeanne Chambers (USDA-FS Rocky Mountain Research Station), Don Faber-Langendoen (NatureServe), Eric Stein (Southern CA Coastal Water Research Project), and Joanna Lemly (CO Natural Heritage Program). These wetland experts have been directly involved in developing many of the existing RAMs successfully deployed throughout the Western US. Their advice included identifying likely end users, surveying potential assessors regarding their needs for a NV wetland RAM, exploring how to leverage existing efforts and RAM frameworks, and suggesting processes for RAM development.

We developed a survey that was distributed in June 2018 to 67 likely NV RAM users and/or water resource managers. We received a 37% (25) response rate from 12 organizations, including the Bureau of Land Management (BLM), US Fish and Wildlife Service (USFWS), National Park Service (NPS), USDA Natural Resources Conservation Service (NRCS), USDA Forest Service (USDA-FS), US Geological Survey (USGS), Nevada Division of Environmental Protection (NDEP), Nevada Department of Transportation (NDOT), Nevada Department of Wildlife (NDOW), The Nature Conservancy (TNC), University of Nevada Cooperative Extension (UNCE) and Colorado State University (CSU[3]). The eight-question survey covered the following topics and provided the following input (*question topics are **bold- italicized***):

1. Respondents foresaw ***using a wetland RAM*** primarily for restoration planning.

[3] CSU's Center for Environmental Management on Military Lands (CEMML) conducts wetland monitoring on military sites in Nevada.

2. Assessing general wetland ecological health was the ***priority objective for a RAM to be useful for their organization's work.*** Assessing relative wetland ecosystem resiliency; prioritizing wetlands for restoration, management actions, and protection; and synthesizing management strategies for different wetlands types also ranked high.
3. The National Wetlands Inventory was the ***wetland classification system*** reported as most useful for their work. Cowardin, NDOW, and Hydrogeomorphic systems also ranked high. Several respondents indicated they use Proper Functioning Condition which was not an option on our list.
4. The ***wetland types or classes prioritized most for rapid assessment*** included streams, including riparian zones, meadows, and freshwater marshes. Springs were indicated frequently under the "other" category. BLM commented that prioritization of wetlands for assessment may be broader than by type or class to include resource values, risk factors, and potential for responses to management.
5. Wetland vegetation, wet meadow vegetation, and riparian vegetation were the ***wetland dependent species most targeted by their work***. Birds, fish, and macroinvertebrates also ranked high.
6. Eight organizations have ***clearly articulated management or work goals,*** or ***objectives or targets related to wetlands***. USDA-FS has an acres-to-restore target and TNC has species-specific targets, whereas USFWS includes both. BLM is tied to the Proper Functioning Condition assessments. NDOT and NRCS are guided by regulatory compliance. CSU provides wetland assessment services to military installations and is thus tied to their wetland targets.
7. Eight agencies/organizations have ***used a wetland RAM*** from another state or agency, or their organization ***requires an existing wetland RAM***.

Other survey takeaways included that the state agencies do not seem to have a consistent mandated approach. However, federal agencies have approaches they tend to use but are not always consistently used within an agency. There was not a clear takeaway on which classification system would be best; although NWI was the classification system most selected as useful, there were two respondents who indicated they would not use it, and a couple of comments about its lack of utility. Target species of interest to most respondents were vegetative (i.e., riparian, wet meadow, or wetland vegetation). The notion that wetland rapid assessments could be useful for multiple objectives and purposes was clear. The survey also elicited responses that strongly encouraged building upon existing protocols.

The core team, plus Dr. Jeanne Chambers of the USDA-FS Rocky Mountain Research Station, further refined the RAM parameters during a July 2018 tour of 12 central and northern Nevada wetland sites, many of which Dr. Chambers and her team have studied for decades. The discussion centered on identifying the Nevada wetland types lacking assessment method coverage and which targets and endpoints would align with the needs of Nevada's primary water resource managers: NDNH, BLM, USDA-FS, and NDOW. The core team was also joined by Larry Teske (NDOW, retired) and John McCann (USDA-FS Hydrologist).

The survey results and tour feedback directly influenced the parameters of the NV RAM and the decision to build the NV RAM upon the work of the CNHP and WYNDD. Subsequent outreach to the WYNDD RAM authors resulted in the decision to build the NV RAM upon their most recent refinements to the protocol for the Little Snake Basin in southern Wyoming (Washkoviak et al., 2018).

An initial draft of the NV RAM was shared at a workshop in February 2019 held at the DRI offices in Reno and Las Vegas. Remote connection was also available for the workshop. Twenty participants attended from the following agencies and organizations: USFWS, Colorado State University (CEMML), TNC, USDA-FS, Department of Defense, NDOW, USDA-NRCS, DRI, BLM, NDNH, University of Nevada Cooperative Extension, Nevada Division of Environmental Protection, Nevada Department of Transportation, USGS, Intermountain West Joint Venture, and US-EPA. Agreement on the approach, classification systems and use of the WYNDD RAM framework was reached by the attendees, and suggested refinements to the protocol were applied to the draft NV RAM.

The draft NV RAM was tested during the in-field verification stage in May and July 2019 to determine whether the protocol accurately measured the stated assessment endpoints for Nevada specific wetlands, and could be performed within the two-person, four-hour EPA guidance for a Level 2 assessment. In May 2019, two Mojave desert wetland sites were assessed by TNC, Colorado State-CEMML and NDNH wetland experts and field staff. The Warm Desert Riparian, Arid West Emergent Marsh, and Saline Meadow wetland types were tested at TNC's Torrance Ranch and 7J Ranch. In July 2019, three Great Basin (TNC's McCarran and River Fork Ranches, and the USFWS Stillwater National Wildlife Refuge) and one Eastern Sierra (Dog Valley) wetland sites were assessed. Note that Dog Valley is located just over the California border. While the site served as a proxy for slope wetland sites farther east in Great Basin that for logistical reasons the team was not able to access in July, it also provided an opportunity to try the NV RAM in the Eastern Sierras. Across the four sites assessed in July, the draft NV RAM was tested at the following wetland types: Depression Alkaline, Saline Wetland, Arid West Emergent Marsh, Warm Desert Riparian, Meadow Complex, Montane Meadow, and Wet Meadow. See Appendix C for descriptions of these Nevada wetland types. Wetland experts and field staff from USDA-FS, NDOW, USFWS, University of NV-Reno, TNC, NDNH, and DRI performed the July assessment and provided detailed feedback.

Collectively the input and detailed feedback provided through these meetings, workshops and field verification assessments informed the Draft NV RAM.

2024 Update Summary

In 2023 and 2024, Chantal Iosso, the Wetland Program Coordinator at NDNH, completed the recommendations for future work identified in the 2019 draft NVRAM field manual and made other updates to create a revised non-draft version. She conducted consultation with potential users of NVRAM, including partners at the USDA-FS, BLM, FWS, NDOW, and Pyramid Lake

Paiute Tribe. She also completed additional field testing of NVRAM. The largest change included the addition of EIA ranking metrics, which was a need identified in the 2019 version and by partners in later consultations. These EIA metrics have been field tested, validated, and calibrated by several programs throughout the country in the NatureServe/Heritage program network; the version employed here is adapted from the Colorado 2016 EIA protocol. The optional ranking metrics section facilitates scoring wetland condition in a repeatable, reliable manner following the established NatureServe/Heritage program approach.

The resulting 2024 NVRAM includes the following changes from the 2019 NVRAM:

1. Ecological Integrity Assessment ranking metrics were added, from the Colorado 2016 EIA.
2. A grid was added to the sketch page background to facilitate drawing the site to scale. Surveyors may still annotate a printout of satellite imagery instead.
3. A text box was added for a narrative description and comments about the assessment area.
4. Redox, roots, and gravel qualitative descriptor choices in the Soil Profile Description section on field sheets were replaced by percentage estimations, to increase specificity.
5. The “general wetland categories” section has been replaced with NVC wetland groups found in Nevada and a location to note any classification issues on the field form. Appendix C has been updated with the NVC wetland groups.
6. The default electrical conductivity measurement has been changed to microsiemens from decisiemens in the 2019 version, because the water chemistry instruments used by NDNH (Hanna brand water testers) measure in microsiemens by default. Measurements taken with water testers that measure in alternate metrics should be converted to microsiemens before data entry.
7. The section to list community types, their stratum heights, and percentage of the AA has been removed. Vegetation height and cover by strata was added to the cover class section on page 7 of the field sheets.
8. A measurement of the max water depth at the time of survey was added to page 7 of the field sheets.
9. Additional cover classes (10 rather than 5 in the 2019 version) for the vegetation species list have been added to increase specificity and ability to evaluate differences between surveys.
10. Suggested future work (NVRAM field testing and EIA metric development) initially found in the 2019 NVRAM Section 3: Future Work and Recommendations was implemented in the 2024 revised NVRAM. Section 3 has been updated to reflect current and future work related to NVRAM.
11. Minor adjustments were made to the field manual text for clarity, such as replacing the Nevada Natural Heritage Program with the Nevada Division of Natural Heritage and adding newer references where relevant.

APPENDIX H: Nevada Wetland Rapid Assessment Method Data Sheets

Nevada Wetland Rapid Assessment Method (RAM) Data Sheets

Pre-field Survey entry (*) information available from the NV Level 1 Wetland Mapping Tool, "WetBar". Verify or correct information during field survey activities. Attach Level 1 Wetland Analysis Toolbar Report to data sheets.

LOCATION AND GENERAL INFORMATION* (Field Manual p. 25, Sec. 2.4.a.) ☐

Site ID: ________________ **Site Name**:____ **Date**:______________________

Time Start: _________ **Time End**: _________ **Weather**: Recent rain/Rain/Snowfall/Snow on ground/No current, recent precip. **Air Temp (°C)** _______

State Engr Hydrographic Name:___________________________ **HUC 10#**: _______________________ **Site Ownership^**: __________________

Surveyors (circle recorder):____ *^Federal/state land descriptor*

Access Directions/Comments (Note permit requirements, changes to driving directions, or difficulties accessing the site):

ASSESSMENT AREA AND GPS COORDINATES* (Field Manual p. 25, Sec. 2.4.b.) ☐

Dimensions of AA:

____ **40 m radius circle** _____ **Rectangle**: Width ___________ Length ___________ Area __________

____ **Freeform:** Min 10 m wide; Max 200 m long **AA-Track #**:_____________________ **Freeform area**:_____________________

____ **Entire wetland** (Complete AA Representativeness section) **AA-Track #**:________

AA Representativeness: Is AA the entire wetland?______Yes _____No. IF NO, is AA representative of larger wetland or complex? ___Yes ____No Provide comments. If part of complex, indicate if other HGM or Cowardin classes, or general wetland categories & type are present (**Appendix A, B, C**):

AA GPS Coordinates: AA-Center Waypoint #:________________
(NAD 83) UTM Zone: _______ Easting:____Northing: ________________________________
Accuracy (+/-): ______________ Elevation (m):_________________

AA Photos ☐ **40 m radius circle**: Take from AA-Center point, looking out in 4 cardinal directions; *ONLY INCLUDE WP/Photo # and Aspect.*
☐ **Freeform**: Take from 4 points on AA edge looking-in OR ☐ **Rectangle:** From 4 corners, looking diagonal at opposite corner. *INCLUDE UTMs.*

AA-1	WP/Photo #:__________	Aspect:____________	UTM/Easting: ______________________	Northing:____
AA-2	WP/Photo #:__________	Aspect:____________	UTM/Easting: ______________________	Northing:____
AA-3	WP/Photo #:__________	Aspect:____________	UTM/Easting______________________	Northing:____
AA-4	WP/Photo #:__________	Aspect:____________	UTM/Easting______________________	Northing:____

CLASSIFICATION OF ASSESSMENT AREA* (Field Manual p. 28, Sec. 2.4.c./Appendix A, B, & C) ☐

Cowardin Class* Pick *one class for the dominant wetland type.* If using *NV Level 1 Wetland Analysis,* populate with National Wetland Inventory Class.

System: ___ Palustrine _____ Upland

Class: ______ Aquatic Bed _____ Emergent _____ Scrub-Shrub
_____ Forested _____ Unconsolidated Bottom _____ Unconsolidated Shore

HGM Class*

____Riverine ____Lacustrine Fringe

____Depressional ____Slope _______Flats

Cowardin Modifiers: Water Regime (helps describe wetland origin)

_____Intermittently Flooded/IF _______Seasonally Flooded/SF
_____Temporarily Flooded/TF ______Semi-Permanently Flooded/SPF
_____Saturated/ST ______Intermittently Exposed/IE
_____Seasonally Saturated/SS _____Permanently Flooded/PF

Cowardin Modifiers: Special (Optional)

_____ Beaver (b) _______ Farmed (f)
_____ Excavated (x) + _______ Spoil (s)
_____ Partially ditched/drained (d) _______ Reservoir (r)
_____ Diked/Impounded (h) _______ Channel (c)
+ *Excavated may include restored wetlands* _______Springbox (sb)

NVC: Note appropriate group classification(s) from Appendix C, and any classification comments. **Fidelity** (circle one): **HIGH MED LOW**

____

____

ASSESSMENT AREA DRAWING, SETTING AND SURROUNDING LANDSCAPE DESCRIPTION (Field Manual p.28, Sec. 2.5) ☐

☐ AA Boundary and Center Point
☐ North arrow
■ Location of soil pit/s
◆ Photo point locations & GPS waypoint or track #s
● Water chemistry measurement/s
★ GPS waypoint #/s
☐ Additional site description notes on site hydrology, soil, and vegetation
☐ Community types and abiotic zones: open water, in/out flows, drainage path
☐ Landscape setting: dominant plants; wetland types
☐ AA slope cross-sectional diagram (show from N-S & E-W)
☐ Structures or other human-made features (including roads/paths)
☐ Scale bar (grid cell = __ m)
☐ Vegetation community/ies (note if user opted to take a GPS track around the community type, or another method to outline those types)

Assessment Area Description and Comments: Provide an overall site description, including details on site hydrology, soil, and vegetation. ☐

____
____
____
____
____
____
____
____

SOIL PROFILE DESCRIPTION – SOIL PIT 1 ☐ Representative Pit? (Field Manual p. 30, Sec. 2.6/ Appendices D & E)

SP GPS WP#: _______ (NAD 83) UTM Zone: _____ Easting:__________________Northing: ________________

IF NO FREE-STANDING WATER observed: ☐Pit filling slowly OR ☐Pit appears dry

Water Settling Time (s):______Depth to saturated soil (cm):_____________Depth to free water (cm):____________Temp (°C)_____ pH________ EC (dS/m)_____________ DO (ppm)_

Horizon Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	%	Texture Appendix D	Roots %	Gravel %	Notes

Hydric Soil Indicators: See **Appendix E** for descriptions. Check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
____Mucky Mineral (S1/F1)
____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Concentrations (S5/F6/F8)
____Redox Depletions (S6/F7)
___Surface Salt Crusts
___Translocated Salts

Comments:

SOIL PROFILE DESCRIPTION – SOIL PIT 2 ☐ Representative Pit? *2 or MORE PITS ONLY NEEDED IF GREAT VARIABLITY ACROSS ASSESSMENT AREA*

SP GPS WP#: _______ (NAD 83) UTM Zone: _____ Easting:__________________Northing: ________________

IF NO FREE-STANDING WATER observed: ☐Pit filling slowly OR ☐Pit appears dry

Water Settling Time (s):____Depth to saturated soil (cm):_____________Depth to free water (cm):____________Temp (°C)_____ pH________ EC (dS/m)_____________ DO (ppm)_

Horizon Depth (cm)	Matrix Color (moist)	Dominant Redox Features Color (moist)	%	Texture Appendix D	Roots %	Gravel %	Notes

Hydric Soil Indicators: See **Appendix E** for descriptions. Check all that apply to pit.

____Histosol (A1)
____Histic Epipedon (A2/A3)
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____Hydrogen Sulfide Odor (A4)
____Gleyed Matrix (S4/F2)
____Depleted Matrix (A11/A12/F3)
____Redox Concentrations (S5/F6/F8)
____Redox Depletions (S6/F7)
____Surface Salt Crusts
___Translocated Salts

Comments:

GENERAL ANIMAL OBSERVATIONS – Record any animal observations from AA in the table. Specifically look for the organisms of interest in Nevada from the list below. If animal presence observed without visible sighting, check the columns by which the observation was made. (Field Manual p. **32, Sec. 2.8**)

Check AA for the following organisms: ** invasive in Nevada*

___ Springsnails (Pyrgulopsis, Fluminicola, Juga, Tryonia) ___ Nonnative snails (***New Zealand Mud Snail****, ***Melanoides****) ___ ***Crayfish****
___ Amphipods ___ Odonata (dragonflies and damselflies) ___ Mussels (***Quagga*****, Western Pearlshell, etc.) ___ Horses and burros ___ Cattle
___ Fish ___ Amphibians (frogs, toads, ***bullfrogs****)

Animal & Brief Comments:	Photo #	# Individuals	Nest	Vocal	Tracks	Scat

WATER CHEMISTRY – Take > than 1 reading if AA represents larger wetland **or** complex with different wetland classes. **Field Manual p. 32, Sec. 2.7**

Reading 1 Location:_______________ GPS Waypoint #______________ Time: ________ (NAD 83) UTM Zone: _______ Easting:___________________________________Northing: ___________________	**Standing or Flowing (Circle)**
Temp (°C)___________ pH ______________ Electrical Conductivity/EC (dS/m)____________ Dissolved Oxygen/DO (ppm)__	
Reading 2 Location:______________________ GPS Waypoint #______________ Time: ________ (NAD 83) UTM Zone: _______ Easting:____________________________Northing: ___________	**Standing or Flowing (Circle)**
Temp (°C)___________ pH ______________ Electrical Conductivity/EC (dS/m)____________ Dissolved Oxygen/DO (ppm)__	

COMMENTS- Note the water meter model and last calibration. Enter additional Reading location, GPS Waypoint, and measurements if more than 2 reading collected.

VEGETATION SPECIES LIST (Field Manual p. 33, Sec. 2.9.a., Appendix C) Spend no more than 1 hour total on the Vegetation section. Walk the entire AA and note as many species as possible and their cover class within the AA. Note photos or collections.

Cover Classes 1: trace 2: <1% 3: 1–<2% 4: 2–<5% 5: 5–<10% 6: 10–<25% 7: 25–<50% 8: 50–<75% 9: 75–<95% 10: >95%

Scientific Name or Pseudonym/Common name	Coll #	Photos	Cover Class	Notes

VEGETATION SPECIES LIST (Field Manual p. 33, Sec. 2.9.a., Appendix C) Additional Page. Add more pages as needed.

Cover Classes 1: trace 2: <1% 3: 1–<2% 4: 2–<5% 5: 5–<10% 6: 10–<25% 7: 25–<50% 8: 50–<75% 9: 75–<95% 10: >95%

Scientific Name or Pseudonym/Common name	Coll #	Photos	Cover Class	Notes

AA COVER CLASSES & LITTER DESCRIPTION (Field Manual p. 35, Sec. 2.9.b.) *Spend no more than 1-hour total on the Vegetation RAM.* ☐

Estimate cover as a percent in 1 or 5% increments, unless otherwise noted.

WATER	
Standing water of any depth - vegetated or not	
Running water of any depth - vegetated or not	
Open water - plant canopy cover < 10%	
Water with emergent vegetation	
Water with floating or submerged vegetation	
Max water depth in AA at time of survey, cm. **Depth:**	
EXPOSED GROUND	
Bare ground – soil / sand / sediment	
Bare ground – gravel / cobble (~2–250 mm)	
Bare ground – bedrock / rock / boulder (>250 mm)	
Salt crust all cover - <u>including over vegetation or litter cover</u>	
LITTER	
All cover - including under water or vegetation	
Depth of litter (cm) – average of four non-trampled locations where litter occurs: **Depth 1** cm **Depth 2** cm **Depth 3** cm **Depth 4** cm **Ave. depth:**	
Predominant litter type (**C** = coniferous, **E** = broadleaf evergreen, **D** = deciduous, **S** = sod/thatch, **F** = forb)	
DEBRIS	
Standing dead trees, >5 cm diameter at breast height	
Standing dead shrubs or small trees, <5 cm diameter at breast height	
Downed coarse woody debris - fallen trees, rotting logs, >5 cm diameter	
Downed fine woody debris, <5 cm diameter	
OTHER	
Bryophytes - all cover, including under water, vegetation or litter cover	
Lichens - all cover, including under water, vegetation or litter cover	
Algae - all cover, including under water, vegetation or litter cover	

VERTICAL STRATA COVER AND HEIGHT. Estimate cover in 1% or 5% increments. Estimate height using the classes below. ☐

Height Classes 0: <0.2 m **1**: 0.2–0.5 m **2**: 0.5–1m **3**: 1–2 m **4**: 2–5 m **5**: 5–10 m **6**: 10–15 m **7**: 15–20 m **8**: 20–35 m **9**: 35–50 m **10**: >50 m

Vertical Vegetation Strata	Height	Cover
T1 Dominant canopy trees (>5 m and >30% cover)		
T2 Subcanopy trees (>5 m but < dominant canopy height) or trees with sparse cover		
S1 Tall shrubs, tree saplings or seedlings (>2m)		
S2 Short shrubs (<2m)		
HT All herbaceous		
H1 Graminoids (grass and grass-like plants)		
H2 Forbs (all non-graminoids)		
AQ Submerged or floating aquatics		

ECOLOGICAL INTEGRITY ASSESSMENT (EIA) – METRICS

Adopted from the Colorado Wetland EIA Field Form (Lemly et al. 2016). See page 36, section 2.10.

LANDSCAPE METRICS ☐

L1. CONTIGUOUS NATURAL LAND COVER		L2. LAND USE INDEX	
Select the statement that best describes the **contiguous natural land cover** within the 500 m envelope surrounding the AA. See list of natural land covers in the field manual.		Select the statement that best describes the intensity of surrounding land use. Use the **Land Use Index** Worksheet (last page) to calculate the Land Use Index score.	
Intact: AA embedded in 90–100% contiguous natural land cover.	**A**	Land Use Index = 9.5–10.0	**A**
Variegated: AA embedded in 60–90% contiguous natural land cover.	**B**	Land Use Index = 8.0–9.4	**B**
Fragmented: AA embedded in 20–60% contiguous natural land cover.	**C**	Land Use Index = 4.0–7.9	**C**
Relictual: AA embedded within <20% contiguous natural land cover.	**D**	Land Use Index = <4.0	**D**

Landscape comments:

BUFFER METRICS ☐

B1. PERIMETER WITH NATURAL BUFFER		B2. WIDTH OF NATURAL BUFFER	
Select the statement that best describes the **perimeter of the AA with natural buffer**. Buffer land covers must be ≥ 5 m wide and extend along ≥ 10 m of the AA perimeter. See list of buffer land covers in the field manual.		Select the statement that best describes the **width of the natural buffer**. Estimate the width of buffer land covers along eight lines radiating out from the AA at the cardinal and ordinal directions (N, NE, E, SE, S, SW, W, NW) and average their width. Estimate up to 100 m.	
Natural buffer surrounds 100% of the AA perimeter.	**A**	Average buffer width is 100 m	**A**
Natural buffer surrounds 75–99% of the AA perimeter.	**B**	Average buffer width is 75–99 m	**B**
Natural buffer surrounds 25–74% of the AA perimeter.	**C**	Average buffer width is 25–74 m	**C**
Natural buffer surrounds <25% of the AA perimeter.	**D**	Average buffer width is <25 m	**D**

B3. CONDITION OF NATURAL BUFFER

Select the statement that best describes the **natural buffer condition**. Select one statement per column. Only consider the actual natural buffer measured in metrics above. *Remember to look for **non-native hay grasses** when evaluating native / non-native vegetation in the buffer.*

Abundant (≥95%) relative cover native vegetation and little or no (<5%) cover of non-native plants.	**A**	Intact soils, no water quality concerns, little or no trash, AND little or no evidence of human visitation.	**A**
Substantial (75–95%) relative cover of native vegetation and low (5–25%) cover of non-native plants.	**B**	Intact or minor soil disruption, minor water quality concerns, moderate or lesser amounts of trash, AND/OR minor intensity of human visitation or recreation.	**B**
Low (25–75%) relative cover of native vegetation and moderate to substantial (25–75%) cover of non-native plants.	**C**	Moderate or extensive soil disruption, moderate to strong water quality concerns, moderate or greater amounts of trash, AND/OR moderate intensity of human use.	**C**
Very low (<25%) relative cover of native vegetation and dominant (>75% cover) of non-native plants OR no buffer exists.	**D**	Barren ground and highly compacted or otherwise disrupted soils, significant water quality concerns, substantial amounts of trash, extensive human use, OR no buffer exists.	**D**

Buffer comments:

VEGETATION COMPOSITION METRICS

V1. NATIVE PLANT SPECIES COVER (RELATIVE)		V2. INVASIVE NONNATIVE PLANT SPECIES COVER (ABSOLUTE)	
Select the statement that best describes the relative cover of **native plant species** within the AA.		Select the statement that best describes the absolute cover of **invasive nonnative plant species** within the AA. Use list provided in the manual.	
AA contains >99% relative cover of native plant species.	**A**	Invasive nonnative species are absent from all strata.	**A**
AA contains 95–99% relative cover of native plant species.	**B**	Invasive species present, but sporadic (<4% absolute cover).	**B**
AA contains 85–95% relative cover of native plant species.	**C**	Noxious weeds somewhat abundant (4–10% cover).	**C**
AA contains 60–85% relative cover of native plant species.	**C-**	Noxious weeds abundant (10–30% cover).	**C-**
AA contains <60% relative cover of native plant species.	**D**	Noxious weed very abundant (>30% cover).	**D**

V3. NATIVE PLANT SPECIES COMPOSITION

Select the statement that best describes the **native plant species composition** (species abundance and diversity) within the AA. Look for native species diagnostic of the system vs. native increasers that may thrive in human disturbance.

Native plant species composition with expected natural conditions: i) Typical range of native diagnostic species present, AND ii) Native species sensitive to anthropogenic degradation are present, AND iii) Native species indicative of anthropogenic disturbance (i.e., increasers, weedy or ruderal species) absent to minor.	**A**
Native plant species composition with minor disturbed conditions: i) Some native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with low cover.	**B**
Native plant species composition with moderately disturbed conditions: i) Many native diagnostic species absent or substantially reduced in abundance, OR ii) Native species indicative of anthropogenic disturbance are present with moderate cover.	**C**
Native plant species composition with severely disturbed conditions: i) Most or all native diagnostic species absent, a few remain in low cover, OR ii) Native species indicative of anthropogenic disturbance are present with high cover.	**D**

Vegetation composition comments:

VEGETATION STRUCTURE METRICS

V4. VEGETATION STRUCTURE (VERTICAL AND HORIZONTAL)

Select the statement below that best describes the **overall vertical and horizontal structure** within the AA. Vertical structure relates to the number of vertical vegetation strata. Horizontal structure relates to the number and complexity of biotic and abiotic patches within the wetland/riparian area. See reference card for potential structural patches. Assess each site based on the expected conditions within its Ecological System type. For woody systems, rate regeneration and woody debris individually on next page, then consider those ratings in the overall assessment of structure.

Herbaceous systems: Marsh, Meadow, Playa	***Woody systems: Riparian and Floodplain***	
General: Vegetation structure is at or near minimally disturbed natural conditions. Little to no structural indicators of degradation evident.		**A**
Structural patches/zones are appropriate in number and type for the system (can be few in playas, fens, meadows). There is diversity in vertical strata within the herbaceous vegetation (some tall and some short layers and/or low cover of shrubs or trees, where appropriate). Litter and other organic inputs are typical of the system (i.e., playas should have low litter while meadows and marshes should have moderate amounts of litter).	AA is characterized by a complex array of nested or interspersed patches. Canopy (if present) contains a mosaic of different ages or sizes, including large old trees and obvious regeneration. Number of live stems is well within expected range. Shrub and herbaceous layers are complex, providing a diversity of vertical strata. Woody species are of sufficient size and density to provide future woody debris to stream or floodplain. Litter layer is neither lacking nor extensive.	

<u>General:</u> *Vegetation structure shows minor alterations from natural conditions.*		B
Marshes: cattail and bulrush density may prevent animal movement in some areas of the wetland, but not throughout. ***Meadows:*** grazing and mowing have minor effects. ***Playas:*** natural areas of bare ground are still prevalent, though non-native or weedy species may be encroaching.	AA is characterized by a moderate array of nested or interspersed zones with no single dominant zone, though some structural patches (especially open zones) may be missing. Canopy still heterogeneous in age or size, but may be missing some age classes. Vertical strata may be somewhat less complex than natural conditions. Woody debris or litter may be somewhat lacking.	
<u>General:</u> *Vegetation structure is moderately altered from natural conditions.*		C
Marshes: cattail and bulrush density may prevent animal movement in half or more of the wetland. ***Meadows:*** grazing and mowing have moderate effects. ***Playas:*** natural areas of bare ground are present, but non-native or weedy species have filled in many area.	AA is characterized by a simple array of nested or interspersed zones. One zone may dominate others. Vertical strata may be moderately less complex than natural conditions. Site may be denser than natural conditions (due to non-native woody species) or may be more open and decadent. Woody debris or litter may be moderately lacking.	
<u>General:</u> *Vegetation structure is greatly altered from natural conditions.*		D
Marshes: cattail and bulrush density prevent animal movement throughout the wetland. ***Meadows:*** grazing and mowing greatly affect the structure of the vegetation and prevalence of litter. ***Playas:*** natural areas of bare ground are absent due to an abundance of non-native or weedy species.	AA is characterized by one dominant zone and several expected structural patches or vertical strata are missing. Site is either extremely dense with non-native woody species or open with predominantly decadent or dead trees. Woody debris and/or litter may be absent entirely or may be excessive due to decadent trees.	

V5. REGENERATION OF NATIVE WOODY SPECIES		**V6. COARSE AND FINE WOODY DEBRIS**	
Select the statement that best describes the **regeneration of native woody species** within the AA.		Select the statement that best describes **coarse and fine woody debris** within the AA.	
Woody species are naturally uncommon or absent.	**NA**	There are no obvious inputs of woody debris or woody species are naturally uncommon.	**NA**
All age classes of *native* woody species present. Native tree saplings /seedlings and shrubs common to the type present in expected amounts and diversity. Regeneration in obvious.	**A**	AA characterized by moderate amount of coarse and fine woody debris, relative to expected conditions. There is wide size-class diversity of standing snags and downed logs in various stages of decay. 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.	**A/B**
Age classes of *native* woody species restricted to mature individuals and young sprouts. Middle age groups appear to be absent or there is some other indication that regeneration is moderately impacted.	**B**		
Native woody species comprised of mainly mature individuals OR mainly evenly aged young sprouts that choke out other vegetation. Regeneration is obviously impacted. Site may contain Russian Olive and/or Salt Cedar.	**C**	AA characterized by small amounts of woody debris OR debris is somewhat excessive. For riverine wetlands, lack of debris may affect stream temperatures and reduce available habitat.	**C**
Native woody species predominantly consist of decadent or dying individuals OR are absent from an area that should be wooded. Site may be dominated by Russian Olive / Salt Cedar.	**D**	AA lacks woody debris, even though inputs are available.	**D**

Vegetation structure comments (including regeneration and woody debris):

HYDROLOGY METRICS ☐

H1. WATER SOURCE

Check off all *major* water sources in the table to the right. Select the statement below that best describes the **water sources** feeding the AA during the growing season.	_____ Overbank flooding _____ Alluvial aquifer _____ Groundwater discharge _____ Natural surface flow _____ Precipitation _____ Snowmelt	_____ Irrigation via direct application _____ Irrigation via seepage _____ Irrigation via tail water run-off _____ Urban run-off / culverts _____ Pipes (directly feeding wetland) _____ Other:

Water sources are natural. Site hydrology is fed by precipitation, groundwater, natural runoff, or natural flow from an adjacent freshwater body. The system may naturally lack water at times, even for several years. There is no indication of direct artificial water sources, either point sources or non-point sources. Land use in the local watershed is primarily open space or low density, passive use with little irrigation.	**A**
Water sources are mostly natural, but also include occasional or small amounts of inflow from anthropogenic sources. Indications of anthropogenic sources include developed land or irrigated agriculture that comprises < 20% of the immediate drainage area, some road runoff, small storm drains or other minor point source discharges. No large point sources control the overall hydrology.	**B**
Water sources are moderately impacted by anthropogenic sources, but are still a mix of natural and non-natural sources. Indications of moderate contribution from anthropogenic sources include developed land or irrigated agriculture that comprises 20–60% of the immediate drainage area or moderate point source discharges into the wetland, such as many small storm drains or a few large ones or many sources of irrigation runoff. The key factors to consider are whether the wetland is located in a landscape position that supported wetlands before irrigation / development *AND* whether the wetland is still connected to its natural water source (e.g., modified ponds on a floodplain that are still connected to alluvial aquifers or natural stream channels that now receive substantial irrigation return flows).	**C**
Water sources are primarily from anthropogenic sources (e.g., urban runoff, direct irrigation, pumped water, artificially impounded water, or another artificial hydrology). Indications of substantial artificial hydrology include developed or irrigated agricultural land that comprises > 60% of `the immediate drainage basin of the AA, or the presence of major drainage point source discharges that obviously control the hydrology of the AA. The key factors to consider are whether the wetland is located in a landscape position that likely never supported a wetland prior to human development *OR* did support a wetland, but is now disconnected from its natural water source. The reason the wetland exists is because of direct irrigation, irrigation seepage, irrigation return flows, urban storm water runoff, or direct pumping.	**D**

Water source comments:

H2. HYDROPERIOD ☐

Select the statement below that best describes the **hydroperiod** within the AA (extent and duration of inundation and/or saturation). Search the AA and 500 m envelope for hydrologic stressors (see list on following pages). Use best professional judgment to determine the overall condition of the hydroperiod. For some wetlands, this may mean that water is being channelized or diverted away from the wetland. For others, water may be concentrated or increased. *Please add comments on next page.*

Hydroperiod is characterized by natural patterns of inundation/saturation and drawdown and/or flood frequency, duration, level and timing. There are no major hydrologic stressors that impact the natural hydroperiod. Riparian channels are characterized by equilibrium conditions with no evidence of severe aggradation or degradation indicative of altered hydrology.	**A**
Hydroperiod inundation and drying patterns deviate slightly from natural conditions due to presence of stressors such as: flood control/water storage dams upstream; berms or roads at/near grade; minor pugging by livestock; small ditches or diversions removing water; or minor flow additions from irrigation return flow or storm water runoff. Outlets may be slightly constricted, but not to significantly slow outflow. Riparian channels may have some sign of aggradation or degradation, but approach equilibrium conditions. Playas are not significantly impacted pitted or dissected. *If wetland is artificially controlled,* the management regime closely mimics a natural analogue (it is very unusual for a purely artificial wetland to be rated in this category).	**B**

Hydroperiod inundation and drying patterns deviate moderately from natural conditions due to presence of stressors such as: flood control/water storage dams upstream or downstream that moderately effect hydroperiod; two lane roads; culverts adequate for base stream flow but not flood flow; moderate pugging by livestock that could channelize or divert water; shallow pits within playas; ditches or diversions 1–3 ft. deep; or moderate flow additions. Outlets may be moderately constricted, but flow is still possible. Riparian channels may show distinct signs of aggradation or degradation. *If wetland is artificially controlled,* the management regime approaches a natural analogue. Site may be passively managed, meaning that the hydroperiod is still connected to and influenced by natural high flows timed with seasonal water levels.	**C**
Hydroperiod inundation and drawdown patterns deviate substantially from natural conditions from high intensity alterations such as: significant flood control / water storage das upstream or downstream; a 4-lane highway; large dikes impounding water; diversions > 3ft. deep that withdraw a significant portion of flow, deep pits in playas; large amounts of fill; significant artificial groundwater pumping; or heavy flow additions. Outlets may be significantly constricted, blocking most flow. Riparian channels may be concrete or artificially hardened. *If wetland is artificially controlled,* the site is actively managed and not connected to any natural season fluctuations.	**D**
Hydroperiod comments:	

H3. HYDROLOGIC CONNECTIVITY ☐

Select the statement below that best describes the degree to which **hydrology within the AA is connected to the larger landscape** throughout the year, but particularly at times of high water. Consider the effect of impoundments, entrenchment, or other obstructions to connectivity that occur within the surrounding landscape, if those impoundments clearly impact the AA.

Marsh / Meadow variant	***Playa variant***	***Riverine / Riparian variant***	
No unnatural obstructions to lateral or vertical movement of surface or ground water. Rising water in the site has unrestricted access to adjacent upland, without levees, excessively high banks, artificial barriers, or other obstructions to the lateral movement of flood flows.	Surrounding land cover / vegetation does not interrupt surface flow. No artificial channels feed water to playa.	Completely connected to floodplain (backwater sloughs and channels). No geomorphic modifications made to contemporary floodplain. Channel is not entrenched.	**A**
Minor restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Up to 25% of the site may be restricted by barriers to drainage. Restrictions may be intermittent along the margins of the AA, or they may occur only along one bank or shore. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.	Surrounding land cover / vegetation may interrupt a minor amount of surface flow. Artificial channels may feed minor amounts of excess water to playa.	Minimally disconnected from floodplain. Up to 25% of stream banks may be affected by dikes, rip rap, and/or elevated culverts. Channel may be somewhat entrenched, but overbank flow occurs during most floods.	**B**
Moderate restrictions to the lateral or vertical movement of surface and ground water by unnatural features such as levees, road grades or excessively high banks. Between 25–75% of the site may be restricted by barriers to drainage. Flood flows may exceed the impoundments, but drainage back into the wetland may be incomplete due to the impoundments.	Surrounding land cover / vegetation may interrupt a moderate amount of surface flow. Artificial channels may feed moderate amounts of excess water to playa.	Moderately disconnected from floodplain due to multiple geomorphic modifications. Between 25-75% of stream banks may be affected by bikes, rip rap, concrete, and/or elevated culverts. Channel may be moderately entrenched and disconnected from the floodplain except in large floods.	**C**

Essentially no hydrologic connection to adjacent landscape. Most or all stages may be contained within artificial banks, levees, or comparable features. Greater than 75% of the site is restricted by barriers to drainage.	Surrounding land cover / vegetation may dramatically restrict surface flow. Artificial channels may feed significant amounts of excess water to playa.	Channel is severely entrenched and entirely disconnected from the floodplain. More than 75% of stream banks may be affected by dikes, rip rap, concrete and/or elevated culverts. Overbank flow never occurs or only in severs floods.	**D**
Hydrologic connectivity comments:			

PHYSIOCHEMICAL METRICS

S1. SUBSTRATE / SOIL DISTURBANCE

Select the statement below that best describes disturbance to the substrate or soil within the AA. For playas, the most significant substrate disturbance is sedimentation or unnaturally filling, which prevents the system's ability to pond after heavy rains. For other wetland types, disturbances may lead to bare or exposed soil and may increase ponding or channelization where it is not normally. For any wetland type, consider the disturbance relative to what is expected for the system.

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.	**A**
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. The depth of disturbance is limited to only a few inches and does not show evidence of altering hydrology. Any disturbance is likely to recover within a few years after the disturbance is removed.	**B**
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. Damage is obvious, but not excessive. The site could recover to potential with the removal of degrading human influences and moderate recovery times.	**C**
Substantial soil disturbance within AA. Bare soil areas substantially degrade the site and have led to 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.	**D**
Substrate / soil comments and photo #'s:	

Land Use Index Worksheet

Land Use Categories [1]	*Coefficient*	*500 m Envelope*	
		% Area	*Score*
Paved roads, parking lots, domestic, commercial, and industrial buildings	0		
Gravel pit operation, open pit mining, strip mining, abandoned mines	0		
Unpaved roads (e.g., driveway, tractor trail, 4-wheel drive roads)	1		
Resource extraction (oil and gas)	1		
Tilled agricultural crop production (corn, wheat, soy, etc.)	2		
Intensively managed golf courses, sports fields, lawns	2		
Vegetation conversion (chaining, cabling, rotochopping, clearcut)	3		
Heavy grazing by livestock	3		
Logging or tree removal with 50-75% of large trees removed	4		
Intense recreation (ATV use / camping / popular fishing spot, etc.)	4		
Permanent crop agriculture (hay pasture, vineyard, orchard)	4		
Dam sites and disturbed shorelines around water storage reservoirs. Include open water of reservoir is there is intensive recreation, such as boating.	5		
Old fields and other disturbed fallow lands dominated by non-native species	5		
Moderate grazing on rangeland	6		
Moderate recreation (high-use trail)	7		
Selective logging or tree removal with <50% of large trees	8		
Light grazing on rangeland	9		
Light recreation (low-use trail)	9		
Natural area / land managed for native vegetation	10		
Total Land Use Score			

Buffer Width Worksheet

1: ____________ 5: ____________

2: ____________ 6: ____________

3: ____________ 7: ____________

4: ____________ 8: ____________

Average width: ________________________