Level 3 Action Effectiveness Monitoring Plan Design

The purpose of this document is to provide an outline for building a Level 3 action effectiveness monitoring (AEM) plan. This guide is intended to help you prepare your AEM plan for the AEM Level 3 workshop presentation. In many cases, Level 3 AEM can be used to evaluate the success of many restoration actions relative to established criteria (e.g. 7-day average daily max temperature) or reference conditions. This is not intended to be a comprehensive guide, but rather a general outline for determining the appropriate amount and location of Level 3 AEM at a site.

This document is divided into two sections. Section 1 provides an overview of important elements to be included in a Level 3 AEM plan. Section 2 provides an example of how a Level 3 AEM plan can be designed for a restoration site.

1 Elements of a Level 3 Action Effectiveness Plan

1.1 Pre-project design or baseline monitoring

Pre-project monitoring required for feasibility assessment and/or design will determine the location of pre-restoration monitoring of water surface elevation and temperature. The location of photo points and sediment accretion for pre-project monitoring will be determined after a restoration design has been completed. It is necessary to capture the location (with Lat/Lon or UTMs) of monitoring points and other necessary metadata measurements[1] when collecting pre-project data.

1.2 Project monitoring goals and objectives

An AEM plan should show direct linkages between your restoration objectives and the responses you will be measuring (monitored indicators). Understanding how Level 3 metrics relate to restoration actions can provide valuable information about the effectiveness of a restoration action. A monitoring matrix is a useful tool to show linkages between restoration actions and monitoring. Below is a brief explanation of each component of the monitoring matrix. Your monitoring plan should include these monitoring matrix elements. An example of how these components correspond with a Level 3 AEM plan can be found in Table 1 of Section 2.

[1] *Oncor* database protocols – specifics on this will be covered at the AEMR Level 3 workshop

The following monitoring matrix elements should be identified in every Level 3 AEM Plan:

Limiting Factor – A regional condition that limits ecosystem productivity for outmigrating juvenile salmonids. Limiting factors are the basis for restoration actions and are intended to be broad overarching ideas. For example, capacity/quality or access opportunity of estuarine and tidal-fluvial ecosystems for outmigrating salmonids. *Note: site-specific constraints can also be useful information (e.g. site water temperature).*

Restoration Actions – Actions chosen to address the limiting factors.

Goal– The overall purpose of the restoration action(s).For example, restore 86 acres of tidally-influenced shallow water habitat in the LCRE for outmigrating juvenile salmonids.

Objective(s) – The desired outcome(s) of a Project. Project objectives should be specific, measurable, attainable or realistic, and time-bound. Measurable objectives can be compared to a reference condition or an environmental standard and used to assess if restoration goals are being met by a particular time period. *Note: some objectives may be met in a very short period of time, while others will take longer to succeed.*

Monitored Indicator – A value used to indicate the status, condition, or trend of a resource or ecological process; intended to answer questions posed by the objectives.

1.3 Placement of post -restoration action effectiveness monitoring

With monitoring goals, objectives, indicators outlined, it is time to determine the potential placement of monitoring indicators on the ground in relation to restoration actions at the site.

Water Surface Elevation and Temperature

The primary site for data loggers at restoration sites is near the mouth of the tidal reconnection site, but within the hydrological constriction (Roegner et al 2009). It will be important to have at least one water surface/temperature data logger in the same location for pre- and post-monitoring in order to attribute changes at the site to restoration actions instead of interannual variability.

Sediment Accretion

Sediment accretion stakes should be set prior to restoration in an area likely to be inundated and should be measured once before hydrological reconnection (Roegner et al 2009). Sediment accretion stakes should be placed in a location expected to accrete or erode sediments and are often placed along transects perpendicular to tidal channels. The distribution of stakes at different elevations along a given transect allows measurement of sediment changes under a variety of water level/flow conditions.

Photo Points

Collectively, photo Points should cover the entire restoration site. Photo points should be located at vantage points offering views of expected areas of change (Roegner et al 2009). Although photos are qualitative, they can provide valuable information about the ecological trajectory of the restoration site.

1.4 Next Steps

Record the locations of pre-restoration monitoring locations in case equipment has to be removed during construction. With an established monitoring plan and potential locations, the next step is to determine when and where sediment accretion and photo points should be established pre-restoration.

As you move forward with action effectiveness monitoring it will be important to familiarize yourself the appropriate data collection (Roegner et al 2009) and data management methods. Understanding and using these methods will allow you to derive metrics which will be important for determining the trajectory of your restoration project.

2 Site Example

The example below illustrates how the elements of the monitoring matrix correspond with a Level 3 AEM plan. The monitoring matrix helps determine the when and where of monitoring indicators.

2.1 Pre-project design or baseline monitoring

Figure 1 shows the location of water level/temperature data loggers that were established for project feasibility and design. Sediment accretion and photo points will be established after a restoration design is completed for the site.

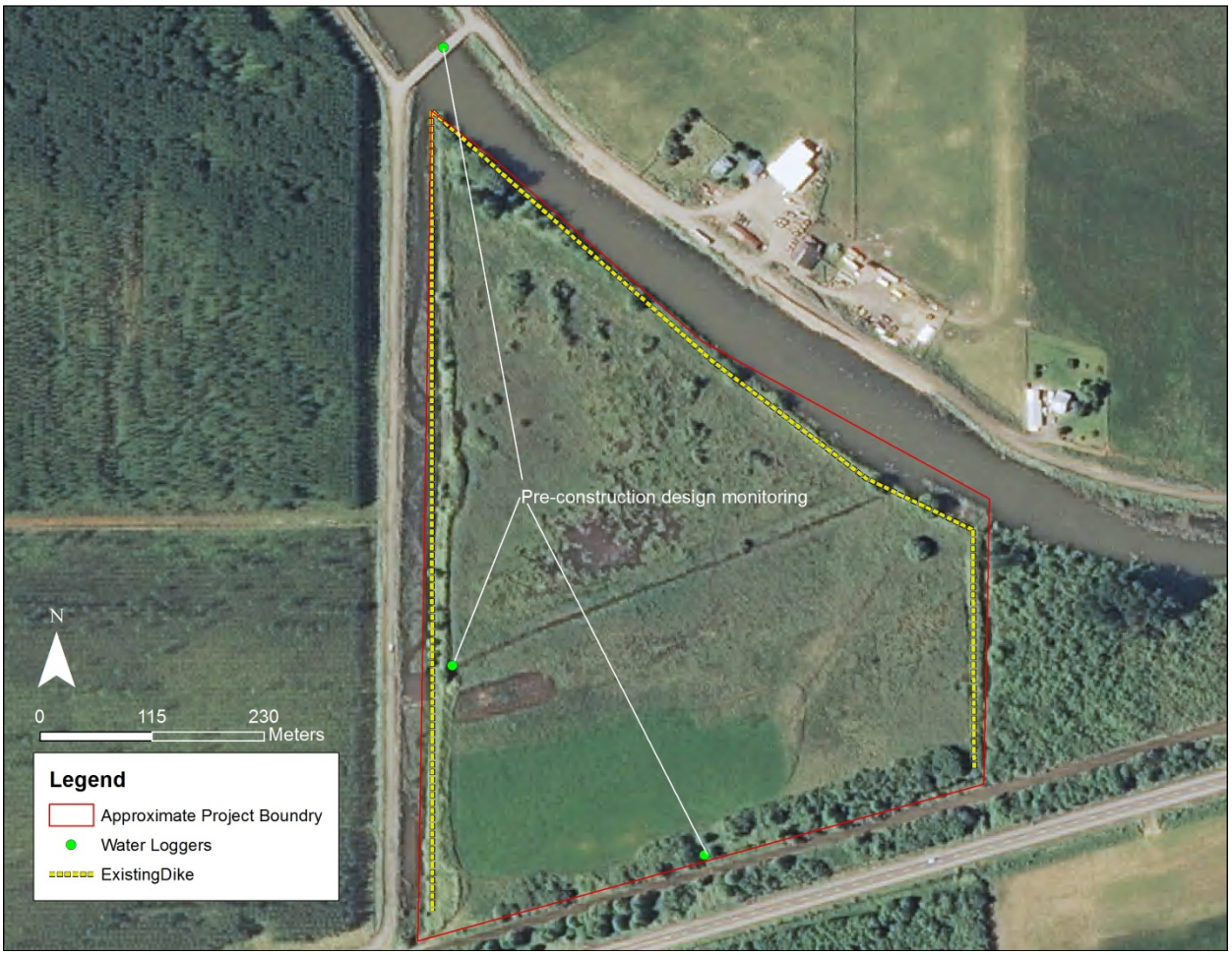

Figure 1**:** Example restoration site pre-construction. The dike around the site is preventing access to potential habitat.

2.2 Define project monitoring goals and objectives

Table 1 shows a monitoring matrix which links restoration actions to specific monitoring indicators.

A. *Limiting Factor* **-** In Figure 1, the restoration site is behind a dike. The dike is preventing access to potential habitat. Therefore, a limiting factor is "Access" (Table 1). Even with restored access to the site, additional restoration work will need to be completed to create or improve habitat for juvenile salmonids; consequently, "Habitat" is identified as another additional factor.
B. *Restoration Actions* – To address the limiting factor of "Access", a dike breach has been identified. To address "habitat", a suite of restoration actions have been identified (Table 1).
C. *Goal (Hypothesis)* – In Table 1, one goal is "Restore tidal exchange to allow for inundation to improve access to emergent wetland habitat". This goal relates directly to the dike breach identified in restoration actions.
D. *Objectives* – In Table 1, the Objective of "Water temperature suitable during juvenile salmonid outmigration periods – April through June" can be quantified and compared to established temperature standards set by NOAA or state agencies for that particular location or watershed.

E. *Monitored Indicators* – To meet the Objective of "Water temperature suitable during juvenile salmonid outmigration periods – April through June" it will be necessary to have water temperature loggers in a restored channel area. By measuring water temperature and then calculating the seven day maximum daily temperature during this time period, one can determine if the NOAA threshold of a maximum temp of 18°C is being exceeded at the site or determine if the water temperature is suitable for juvenile salmonids.

Table 1: The monitoring matrix outlines how restoration actions relate to monitored indicators through goals and quantifiable objectives. Level 3 AEM is highlighted in yellow.

A. Limiting Factor	B. Restoration Actions	C. Goal (Hypothesis)	D. Objectives	E. Monitored Indicators
Access	Dike Breach	H1- Restore tidal exchange to allow for inundation to improve access to emergent wetland habitat	Water surface elevation depth and timing provide access to restored habit during juvenile salmonid outmigration period – April through June Water temperature suitable during juvenile salmonids outmigration period – April through June	1. Water surface elevation 2. Temperature
Habitat	Create Tidal Channels	H2- A diversity of wetland/riparian habitat types should evolve with changes in topography	Increase edge habitats and topographic diversity to promote native plants and increase food web production	1. Photo Monitoring 2. Sediment Accretion 3. Channel Cross Sections 4. Macroinvertebrate sampling
	Native Re-vegetation o Exotic Control o Planting	H3- Soil scrape down to promote native vegetation diversity and assemblages, decrease invasive plants	Plant native vegetation communities at similar elevations as reference sites 5-year maintenance of plantings to promote establishment	1. Vegetation Transects 2. Photo Monitoring

2.3 Placement of post -restoration action effectiveness monitoring

In Figure 2, the proposed dike breaches and constructed channels are shown. Based on potential restoration locations and the outlined objectives, placement of post restoration Level 3 monitoring can be identified (Figure 3). It is important to put water surface/temperature data loggers (WSET), sediment accretion stakes, and photo points at locations where the greatest amount of expected change related to restoration is to occur.

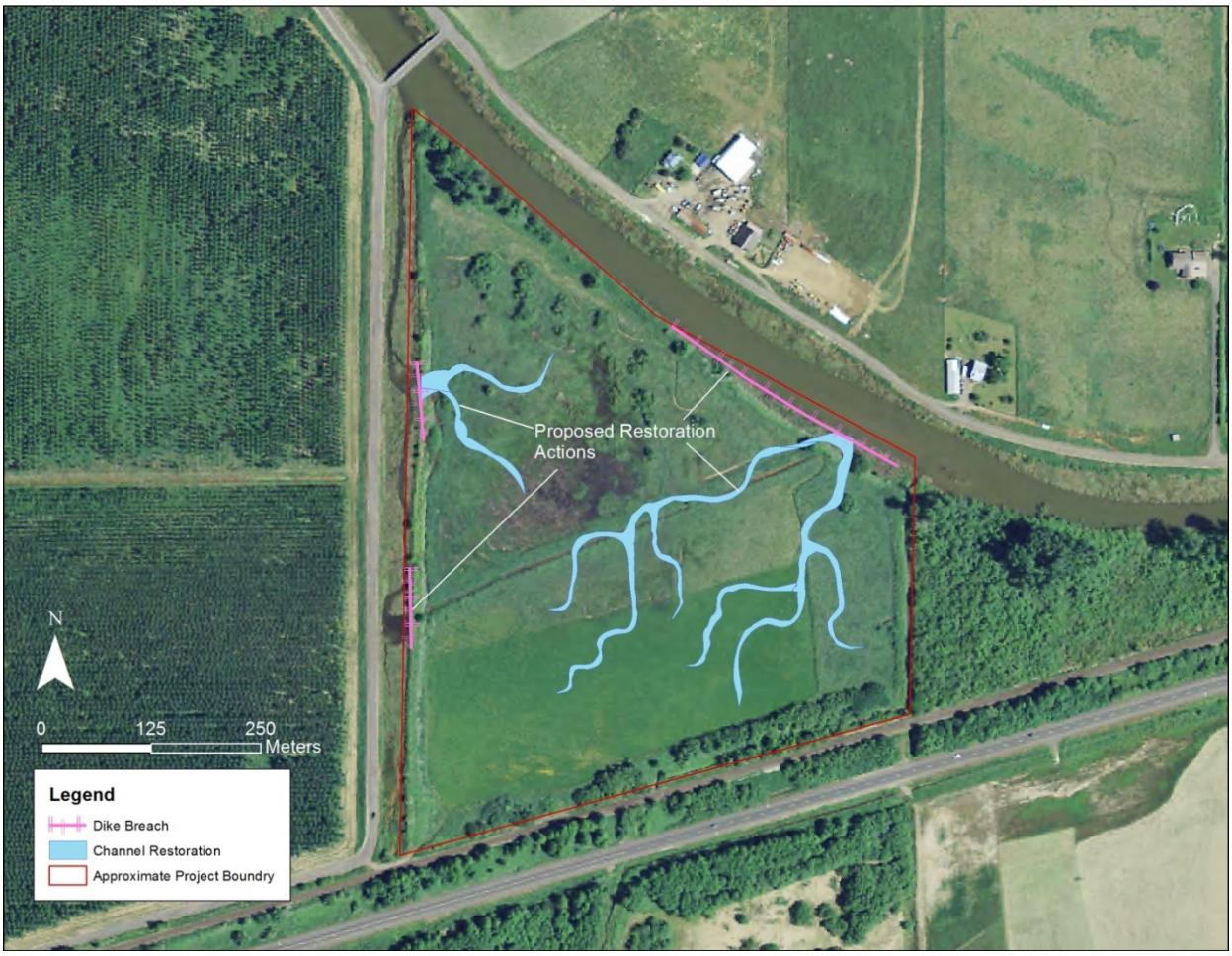

Figure 2: Proposed location of restoration actions.

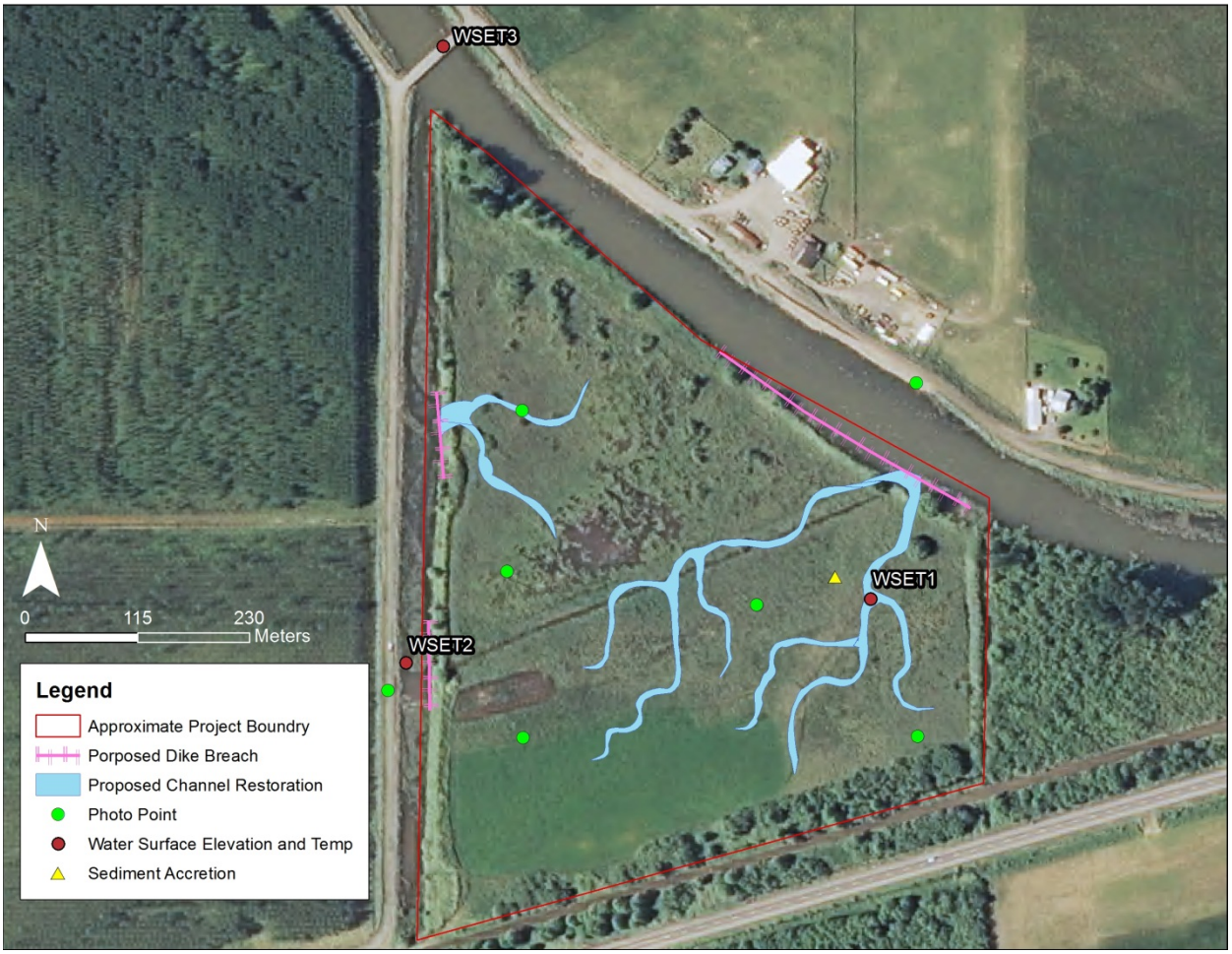

Figure 3: Proposed restoration actions and Level 3 AEM measurement locations. WSET - Water surface elevation/temperature data loggers

Water Surface Elevation and Temperature

In Figure 3, water surface/elevation temperature (WSET1) will be placed in the largest constructed channel. WSET2 will be placed at the dike breach in the west channel and WSET3 placed in the same location as pre-construction monitoring. WSET1 and WSET2 will capture changes related to restoration actions, while WSET3 will act as a control measurement location. It will be important to have at least one water surface/temperature data logger in the same location pre and post monitoring in order to attribute changes at the site to restoration actions instead of interannual variability.

Sediment Accretion

In Figure 3, the sediment accretion stakes were placed near the largest dike breach and constructed channel. This area was chosen because it is expected to be regularly inundated, which may lead to the erosion or deposition of sediment.

Photo Points

Finally, photo points were placed throughout the site to capture changes to the landscape due to restoration actions. Areas targeted include areas of the restoration not captured by other monitoring indicators. Although photos are qualitative, they can provide valuable information about the ecological trajectory of the restoration site.

2.4 Conclusion

Using the monitoring matrix can be helpful for linking restoration actions to goals, objectives, and Level 3 AEM. Having a clear understanding of how Level 3 AEM addresses objectives and goals helps determine the appropriate placement of measurements at the restoration site.

If you have any questions about designing your Level 3 AEM plan or general questions related to action effectiveness monitoring contact Matthew Schwartz at the Lower Columbia Estuary Partnership (mschwartz@estuarypartnership.org, 503-226-1565 x223).

References:

Roegner, G.C., H.L. Diefenderfer, A.B. Borde, R.M. Thom,E.M. Dawley, A.H. Whiting, S.A. Zimmerman, and G.E. Johnson. 2009. Protocols for monitoring habitat restoration projects in the lower Columbia River and estuary. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-97, 63 p.