Washington State Department of Natural Resources
Adaptive Management Program
Cooperative Management, Evaluation, and Research Committee
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July 25, 2022

Dear CMER Members,

In this letter we present a July update on the implementation progress for the Forested Wetland Effectiveness Project (FWEP) Chronosequence study based on (1) work conducted to date and (2) planning discussions within the Wetland Scientific Advisory Group (WetSAG).

Summary statement Full field implementation of the FWEP Chronosequence study was initially slated for August of 2022 to collect data in the new water year commencing on October 1, 2022. However, challenges with identifying sufficient replicate forested wetland sites, landscape complexity, and landowner permission issues will delay full field implementation until May of 2023. Site selection and permission activities are ongoing at this time.

Background information The Forested Wetland Effectiveness Project (FWEP) is a series of studies designed to understand how forested wetland ecosystem processes change over time following forest and forested wetland harvest under current forest practice rules. The first FWEP study is a chronosequence (space-for-time-substitution) that will observe and monitor hydrologic and biological attributes of forested wetlands within four stand age classes: 2-year-old, 10-year-old, 20-year-old, and greater than 40-year-old stands.

The FWEP Chronosequence study is a preliminary investigation that is intended to inform the design of subsequent research on forested wetlands during post-harvest stand regeneration. The Chronosequence study was designed in 2017-2019 and approved by CMER in 2020. Implementation was targeted for 2022, following the spring hiring of a CMER wetland scientist and coordination by WetSAG and contractors.

The study design requires 24 forested wetlands with adjacent Type N streams that:

- Are between 3-6 acres in size.
- Are Located within the Coast Range Level III ecoregion and the VwLMH (Very wet climate, winter seasonality, low aquifer permeability, mountainous terrain, high soil permeability) Hydrologic Landscape Class (approximately western Olympic Peninsula and the Willapa Hills).
- Were mature second- or third-growth forest preceding harvest.

- The surrounding harvest unit and forested wetland were harvested within the following age classes (six replicates of each):
    - 2 years ago (Roughly 2020).
    - 10 years ago (Roughly 2011-2012).
    - 20 years ago (Roughly 2001-2002)
    - Unharvested control (last harvested roughly 1980-84)

The implementation team began site selection and evaluation in earnest in spring of 2022 with a desktop exercise that identified candidate wetlands that potentially met the relevant study criteria (FWEP 2019 Chronosequence Study Design). Sites were identified through forest practice application (FPA) data, aerial imagery, hydrology GIS layers, and the Wetland Intrinsic Potential (WIP) tool. The WIP tool is a digital terrain-based mapping framework that identifies the probability of wetlands occurring on the landscape based on slope, and multiple criteria.

We found thousands of forested wetland sites within our study region and narrowed these candidate sites to hundreds of potentially suitable sites based on the above study criteria. Field assessment of desktop-identified potential sites took place in May-June of 2022 with the CMER wetland scientist, WetSAG members, and contractors assessing relevant sites. However, difficulties in securing landowner access/use permission reduced the pool of potential sample sites available for field-based evaluation.

Of the sites that were visited, several sites within each age class met the study design configuration of a forested wetland nesting within a harvest unit (Figure 1). These sites occurred on small slope or depressional wetlands, often with mineral soils, had a single outflow that could be instrumented, and did not have any atypical forest regeneration practices or adjacent land-use (e.g. retired bridges or railroad tracks, etc.).

While several appropriate candidate sites were identified within each age class, many sites that the desktop analysis yielded were not relevant for the study. These sites were either: (1) not wetlands, (2) the wetland had not been harvested within the appropriate timeframe, (3) were peatlands (bogs) and did not have mineral soils, (4) had landscape-scale geomorphic attributes that made them incomparable to other sites (e.g. floodplains of large rivers), or (5) had management histories that warranted further investigation.

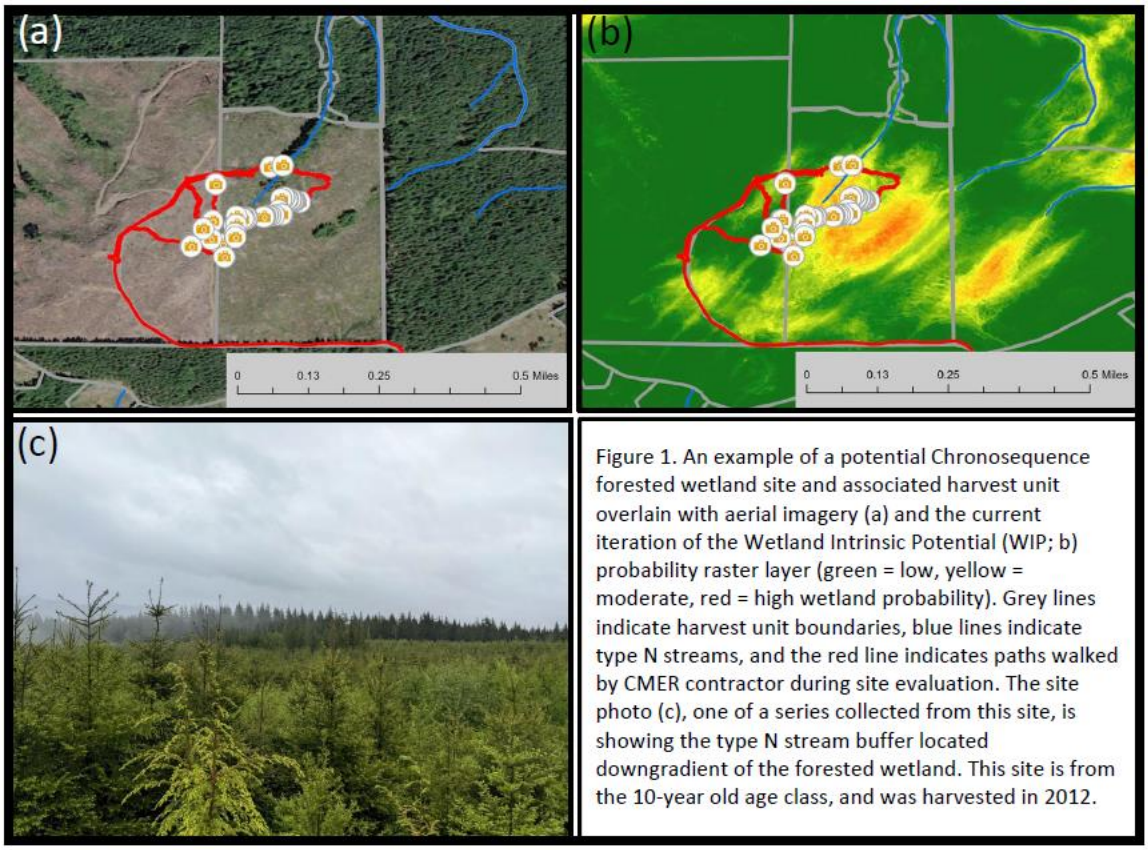

Figure 1. An example of a potential Chronosequence forested wetland site and associated harvest unit overlain with aerial imagery (a) and the current iteration of the Wetland Intrinsic Potential (WIP; b) probability raster layer (green = low, yellow = moderate, red = high wetland probability). Grey lines indicate harvest unit boundaries, blue lines indicate type N streams, and the red line indicates paths walked by CMER contractor during site evaluation. The site photo (c), one of a series collected from this site, is showing the type N stream buffer located downgradient of the forested wetland. This site is from the 10-year old age class, and was harvested in 2012.

Because the forested wetlands WetSAG and CMER staff visited did not yield a full sample set for the Chronosequence study, WetSAG proposes a change to the previously anticipated FWEP implementation timeline (See Appendix II for detailed timeline and deliverables). WetSAG proposes:

1. Revising the initial site selection based on updated WIP output and expanding the hydrologic landscape classes (to include both the VwLMH and VwLTH hydrologic landscape classes; see Appendix III for details), to identify additional probable wetland areas that overlap the candidate FPA pool. This will occur during the remainder of the summer of 2022.
2. Using field-collected FWEP Chronosequence site selection data to evaluate how forested wetlands differ based on management and regeneration histories, as overlain on wetland hydrogeomorphic attributes. This successional framework will further refine site selection to assure that the most representative wetlands are identified for inclusion in the site while also creating field-based hypotheses (for testing in future studies) on how the target forested wetlands may change over time from regeneration and management actions.
3. Delaying full study implementation, initially proposed as August 2022, by several months while site selection continues, to spring of FY 2023.

4. Installing a pilot implementation at four identified Chronosequence study sites, one of each age class within the study design, in Sept-Oct 2022.

This timeline revision is intended to ensure that field implementation is undertaken at the most representative and comparable sites and to identify any possible externalities that could influence study findings. Given the many natural and management attributes, as well as access issues, WetSAG anticipates needing more time to identify and validate sites prior to instrumentation and data collection. The pilot instrumentation at a full panel of one site of each treatment age class, will allow WetSAG to evaluate the effort required to implement the full chronosequence study as well as how well logger and camera equipment overwinters *in situ.* This preliminary data collection effort is intended to streamline full implementation, and will collect data at four study sites (1/6th of the total sites) which will remain Chronosequence study sites during full implementation.

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Appendix I: Chronosequence Study Summary (Phase I of FWEP):

The Chronosequence study strives to answer two sets of questions derived from the CMER work plan's critical questions:

1. How does forested wetland hydrology change over time following post-harvest forest stand development? Specifically:

> a. How does the hydrology of recently harvested forested wetlands compare to the hydrology of recently undisturbed second [or third] -growth forested wetlands?
>
> b. How does the timing, duration, and magnitude of flow and material transport differ between recently harvested and recently undisturbed second [or third] -growth forested wetlands?

2. How do forested wetland vegetation and canopy-mediated habitat conditions change over time following post-harvest forest stand development? Specifically:

> a. How does recently harvested forested wetland vegetation composition compare to recently undisturbed second [or third] -growth forested wetland vegetation over time?
>
> b. Do canopy and vegetation-mediated habitat attributes (e.g., inundation duration, soil, and wetland temperature, etc.) converge between recent post-harvest forested wetlands and recently undisturbed second [or third] -growth forested wetlands over time?

The chronosequence response variables include:

- water table depth;
- surface water hydroperiod;
- hydraulic surface connectivity;
- streamflow;
- basal area by species;
- understory species composition;
- stand age structure;
- leaf area index;
- effective shade;
- canopy shade;
- soil temperature, moisture, permeability, organic matter, pH, carbon, nitrogen, phosphorus;
- stream dissolved oxygen;
- stream turbidity;
- stream temperature.

Appendix II: Detailed timeline of FWEP Chronosequence activities during FY 2023

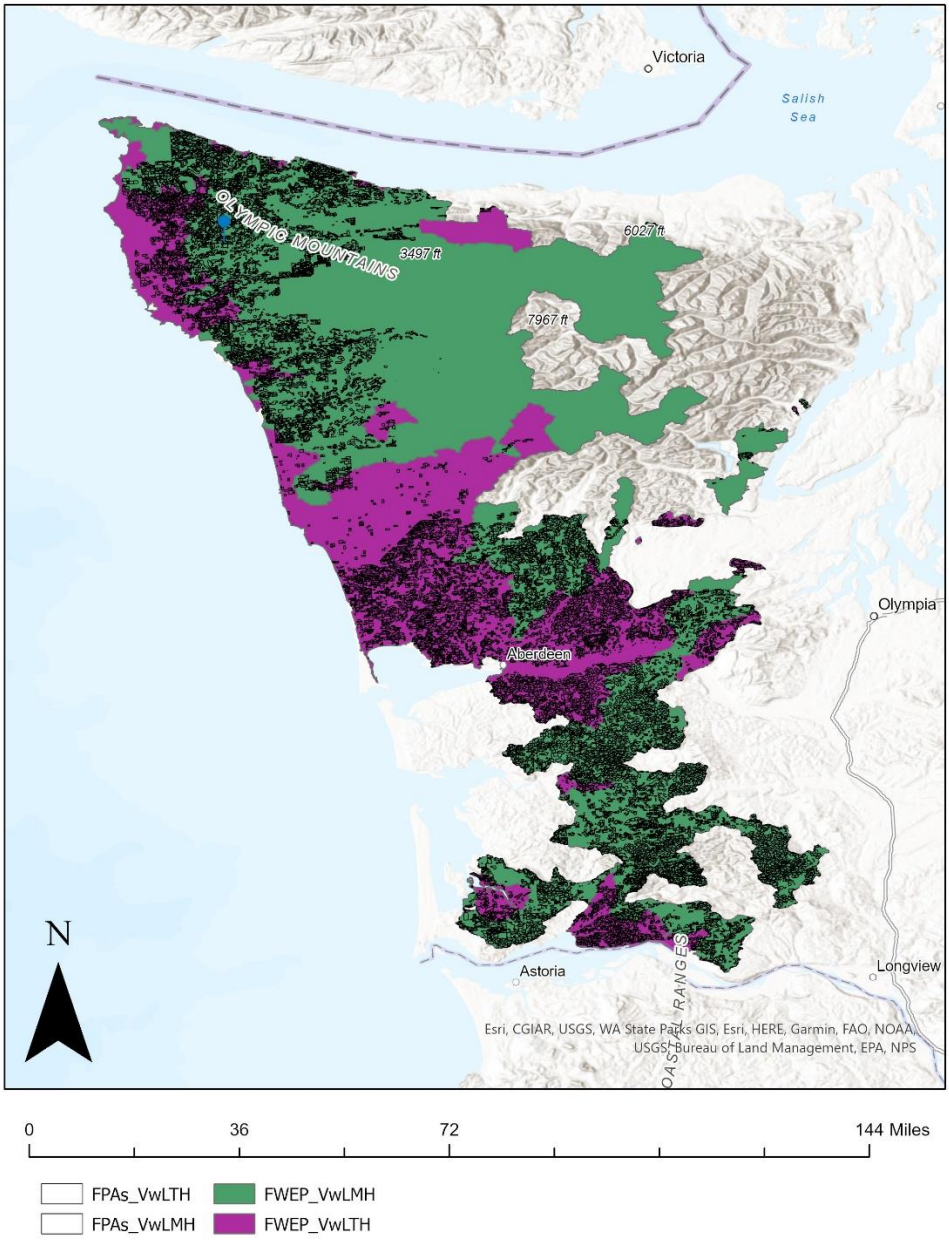
Table 1: Proposed FWEP Chronosequence tasks, timelines, and deliverables for Fall 2022 / Spring 2023.

Period	Tasks	Deliverables	Deliverable date
July – August 2022	Refine Wetland Intrinsic Potential (WIP) models • With ground truth data obtained through field evaluations of potential forested wetland sites conducted in May – July 2022. • With FPA data of known forested wetland positions. • With field surveys of forested wetlands conducted in ~2004 and ~2016 by previous CMER staff. • With previous WIP modeling efforts conducted in some, but not all, of the target FWEP WRIAs. • With additional field evaluations in the Willapa Hills region, landowner permissions pending.	Refined WIP models for the following WRIAs. • Lower Chehalis • Upper Chehalis • Elwha • Soleduc • Grays • Willapa • Lyre • Skokomish • Queets	31-August-2022
August 2022	Expand the temporal search window within the hydrologic landscape class (HLC) VwLMH (Very wet climate, winter seasonality, low aquifer permeability, mountainous terrain, high soil permeability) to generate a broader list of potential sites. • An initial site selection step limited our search to FPAs with an effective date within 3 years of targeted Chronosequence harvest dates. However, significant variably surrounding FPA effective date and actual harvest date has been observed. This warrants a further look at FPAs initially considered to be outside the	Additional sites for evaluation / inclusion in the final pool of potential available sites.	31-August-2022

	study's targeted Chronosequence harvest dates.		
August 2022	Expand the spatial search window into an additional HLC, the VwLTH (Very wet climate, winter seasonality, low aquifer permeability, transitional terrain, high soil permeability). • This HCL was initially identified as an additional secondary area to include in the study, if enough sites could not be found in the VwLMH HCL. Current field efforts to date have found that a high percentage of sites identified through desktop analysis are unsuitable. As such, it warrants expanding our study area into this region.	Additional sites for evaluation / inclusion in the final pool of potential available sites.	31-August-2022
July – Sept 2022	Identify and fully instrument 4 wetland sites within a single "block" or "bin" (see below for information regarding site blocking / binning). • 1 each from the 2, 10, 20, and 40+ year age classes. • Survey trees, and shrubs, but not herbaceous understory plants.	4 fully instrumented sites	1-Oct-2022
July – Dec 2022	Develop successional model for wetland site binning / blocking • Significant variability within forested wetlands has been found on the landscape, even within the fairly narrow confines of the study area. • This increases the challenge of finding replicate wetlands within age classes, as hydrogeomorphic setting interacts with management activities to produce differing successional pathways and timelines • Developing a successional model will allow us to capture and	Completed model, with associated methods write up, for submission to peer-reviewed publication, pending CMER approval process.	1-Jan-2023

	articulate the variability that exists within forest wetlands. • This will be used to refine the study focus on a subset of forested wetland types.		
July 2022 – Feb 2023	Continue landowner outreach and access permissions. Some landowners require a 2-step permission process. Step 1 for access to the site for evaluation, and Step 2 for inclusion in the study.	Permission to conduct site visits and include sites in the study.	Feb 2023
Sept 2022 – Mar 2023	Data collection and analysis of 4 sites instrumented in Sept of 2022. • This will allow us to assess and refine methods in advance of the full field implementation at the remaining 20 sites.	Report from initial pilot field implantation at 4 sites.	Mar 2023
Feb-Mar 2023	Complete contracting for groundwater well installation at the remaining 20 sites	Installation of groundwater wells	May 2023
May – June 2023	Additional fieldwork activities • Instrumentation of associated N type stream. • Installation of game cameras to monitor surface water connectivity. • Vegetation surveys (tree, shrubs, herbaceous plants).		Jun 2023

Appendix III:



Appendix III, Figure 1: The current FWEP – Chronosequence study region VwLMH hydrologic landscape class (green; Very wet climate, winter seasonality, low aquifer permeability, **mountainous** terrain, high soil permeability), and the additional hydrologic landscape class VwLTH (purple; Very wet climate, winter seasonality, low aquifer permeability, **transitional** terrain, high soil permeability). Black lines indicate FPA harvest unit polygons from 1998 to present.