

Progress Report: EMC 18-003 Alternative Meadow Restoration

Date: April 10, 2022

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Project Goal and Objectives:

The goal is to quantify the effect on water quantity, water quality, and soil disturbance before and after meadow restoration, allowed by FPR 933.4 [e], on meadows in the Cascade mountains.

Specific objectives to meet this goal:

Objective 1. Quantify the hydrologic response from removal of encroached *Pinus contorta* to restore meadow and wet area habitat across varied locations.

Objective 2. Determine if key water quality metrics are affected by meadow restoration and WLPZ removal in Rock Creek Meadow by evaluation of streambed sediment and stream temperatures within and downstream of the restoration site.

Objective 3. Quantify the amount of soil disturbance and compaction within the WLPZ following meadow restoration.

Progress towards the project's stated goals and objectives:

Objective 1: The measurement and quantification of transpiration of *Pinus contorta* in the Rock Creek pre-restoration meadow has been completed. I am now working to understand the post restoration evapotranspiration, after the removal of the *Pinus contorta* to quantify the differences in the meadow water budget. All groundwater and soil moisture data has been filtered into a database for comparison of pre and post restoration, the final analysis will occur following this spring runoff season. Preliminary results for the response of meadow vegetation will be included for Rock Creek.

Objective 2: Pretreatment and post treatment surveys of pool habitat, pool to riffle ratio, and particle size distribution have been completed. Stream temperature above and below the restoration site have been collected every year streamflow has occurred pre- and post-treatment. Comparisons between the water quality, as evaluated by the above metrics, is being completed with anticipated completion by end of summer of 2022.

Objective 3: Pre- and post- treatment transects at 4 sites in the WLPZ at Rock Creek Meadow have been surveyed to quantify ground disturbance following WLPZ removal for meadow restoration. An additional ground disturbance survey will occur in spring 2022 to quantify the ground disturbance one year after the Dixie Fire.

Pre- and post-treatment soil bulk density measurements have been collected. Little difference was found between soil bulk density before and after WLPZ removal, suggesting low soil compaction from the WLPZ removal operations. It is our belief the high amount of organic material in the WLPZ soil buffered the soil from equipment compaction. A third survey will occur in late spring 2022 to re-evaluate the results 2 years after restoration and following the Dixie Fire.

Impediments to progress encountered to date:

One year pre-restoration and two years of post-restoration monitoring in Rock Creek Meadow and an additional 3 years of post-restoration monitoring at Marian Meadow was funded. The previous two water years, 2020-2021 have been abnormally dry. The combined precipitation of two water years is lower than an average annual precipitation for the area. This has confounded interpretation of hydrologic and water quality effects. Rock Creek has not had streamflow in the spring following restoration. Groundwater levels were not detectable by our 3 m deep instruments. A request was made, and is in progress, to extend this project to allow quantification of an additional runoff season, 2022, to enable a more representative comparison to the pre-restoration conditions.

The plan for completion:

Hydrologic measurements and analysis of the two meadow pairs will be ongoing through summer 2022. Soil disturbance surveys will occur in late May or early June. The final report will be drafted with two MS theses completed by the end of summer, one is already completed. It is my plan to give the final report to the EMC in fall 2022 as well as a presentation to the Board of Forestry as needed at that time.

Unanticipated results that could lead the project in new directions:

The Dixie Fire burned the watersheds and meadows in this study in summer 2021. The effect of the fire is a confounding variable that cannot be removed from the evaluations. I will do my best to interpret the findings within the context of this new, unplanned disturbance.

Extremely dry water years before and after the Rock Creek restoration treatment has made it almost impossible to detect change in the hydrology. In the Marian Meadow these 2 years represented years 5 and 6 post treatment. The hydrologic response in the restored meadow dropped to pre-restoration groundwater and soil moisture conditions in the two dry years. Due to the high snow fall in December 2021 and the fire's removal of vegetation we have already seen a significant change in the hydrology this year. Extending this project into this summer will allow me to explore and document this for the final report.