Proposal: Pilot Project – Process-based Watershed Restoration of the Bayberry Watershed

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1 Executive Summary

1.1 Problem Statement

Despite the high ecological value of the Bayberry watershed, upstream degradation and shifting climatic patterns likely threaten underlying hydrologic functions. Observed channel incision and loss of floodplain connectivity may be leading to premature seasonal drying. This is anticipated to be exacerbated by more episodic and extreme precipitation events in the coming years.

To protect this critical habitat and enhance water retention capacity, a landscape-scale restoration is desired. This initiative will focus on stabilizing the watershed's hydrology and replacing invasive annual grasses with native vegetation to ensure the ecosystem can sustainably continue to provide water and valuable habitat to the region.

1.2 Proposed Solution: Low-Tech Process-Based Restoration (LTPBR)

This proposal seeks approval for a pilot project utilizing **Low-Tech, Process-Based Restoration (LTPBR)** principles. Unlike traditional high-engineering stream management approaches, LTPBR focuses on restoring the watershed to a naturally self-sustaining state by enabling natural processes—such as water flows and native plant growth—to do much the work. This low-impact methodology primarily uses simple, hand-built structures (e.g., brush dams, brush packing) and native plantings with minimal material cost and labor, making it suitable for large-scale, sustainable restoration efforts.

- Project Goals: improve hydrology, increase biodiversity, establish

Scalability.

1.3 Pilot Project Scope & Methodology

The pilot project will focus initially on the **northern extent of the Bayberry watershed** (North of Ygnacio Valley Road). The project is structured into three phases:

- **Phase 1: Collection & Analysis (Planning):**

  Comprehensive mapping and site assessment using satellite imagery and ground observation to identify current geomorphic conditions, risks, recovery potential, and optimal locations for interventions.

- **Phase 2: Decision Support (Design):**

  Stakeholder review and selection of 3–7 targeted interventions. Success metrics will be formally defined during this phase.

- **Phase 3: Application & Evaluation (Implementation):**

  Installation of selected, low-tech structures and native plantings, followed by evaluation against the established success metrics to analyze future potential improvements for expansion.

1.4 Conclusion and Risk Mitigation

The pilot project is designed to be highly conservative regarding risk. By restricting work to hand-built structures with no heavy equipment, we ensure that all installations are nearly or completely reversible and localized entirely within the study area, minimizing impacts on surrounding infrastructure or watershed segments. Continuous monitoring throughout all phases will provide a robust understanding of restoration effectiveness, providing a data-driven foundation for expanding successful techniques across the entire Bayberry watershed.

2 Problem Statement

The Bayberry watershed has been documented to provide habitat for many native birds, insects, mammals, reptiles, and amphibians. The pond itself is often used by western toads and pacific tree frogs for breeding. Upstream of the pond is a marsh and grassland savanna community, along with two ephemeral springs that provide small pools of water for part of the dry season. The watershed is also host to many native plants, including extensive stands of native juncus.

The pond area has been the focus of a long-running restoration effort and now has a large community of native plants and provides habitat for much local flora and fauna. The group carrying out the restoration effort has observed the pond dries out quite soon after the start of the dry season and there is a desire to improve water retention in the watershed as a whole. There are also observations that the watershed above the pond does not appear to retain water as long as it used to. Those observations and desires led to the investigation of the suitability for a larger Bayberry watershed restoration.

Field observations show a likely degraded watershed in at least a few sections of the watershed area immediately above the Bayberry pond. Observations show some deeply incised channels with low in-stream structure. Subsequent analysis, based on field observations, also shows many areas have low connectivity to the valley bottom and larger flood plain.

The effects of climate change in the area are predicted to lead to increasingly episodic precipitation interspersed with prolonged warm spells (Huang et al. 2020). Under those conditions, we hypothesize that the current landscape of the watershed will likely continue to degrade and is not well suited to retaining larger amounts of runoff. In addition, a preliminary review of local rainfall data in recent years points towards a trend of larger but less frequent precipitation events. Regardless of the underlying cause of this possible change, increasingly episodic rainfall events may place greater demands on the watershed to retain water between precipitation events.

There is also a desire to improve the habitat of the watershed with locally-sourced native plants. Field surveys have shown that much of the watershed is currently covered with non-native annual grasses.

3 Objective

The primary objective of this restoration project is to sustainably increase the watershed's capacity to retain water from precipitation events and sustain moisture between events.

The objective of this pilot project specifically, is to establish the restoration group's familiarity with the chosen restoration implementation and to observe and adapt based on the pilot project results to provide a better foundation for a larger restoration in the watershed.

A secondary objective is to provide a low-tech, volunteer centered, region specific, restoration "tool-kit" for other restoration groups in the area to use.

4 Request

Note: this proposal received a general understanding of support from the Walnut Creek Open Space Foundation Restoration Committee at a meeting on August 3rd, 2026. The committee requested the next steps to include details on implementation and monitoring which are attached to this report now as appendices.

This proposal requests approval to conduct a pilot project consisting of site assessment, monitoring, and the implementation of small-scale, low-risk structures in the lower Bayberry watershed, over the course of the next year, by the Bayberry Pond restoration group.

5 Background

The Bayberry Pond watershed is a tributary of Pine Creek. The Pine Creek watershed and Diablo Valley, in general, were subjected to intense ecological degradation since the introduction of European domesticated cattle in the late 18th century (Bolton 1930). This led to the replacement of perennial grasses and herbaceous flowering plants with non-native grasses. The removal of native vegetation and overgrazing led to larger runoffs producing increased erosion, debris flows, and landslides (Mero, n.d.) and in 1862, due to unusually large levels of rainfall and lack of perennial bunch grasses to hold the soil together, millions of tons of soil eroded across the Diablo Valley (Mero, n.d.). This left a watershed prone to rapid storm runoff and incised channels, preventing water from percolating into the water table. This, in turn, made it more difficult for native vegetation to re-establish (Hamilton et al. 1999) and less water for local fauna during the hot, dry summers as the springs and streams no longer ran or had diminished flows in the dry season.

There was also likely further degradation caused by the installation of Ygnacio Valley Road in 1956 and the mining activities by the Cowell Cement Company.

Grazing continues in the northern portion of Lime Ridge today, including the lower portion of the Bayberry watershed.

6 Goals

For the Bayberry restoration project, our team aims to increase flora and fauna biodiversity and overall quantity of plants and animals that sustain themselves from the Bayberry watershed. A critical component of this, we believe, is to extend the duration of water availability. This would provide water later into the dry season for birds, insects, mammals, and reptiles as well as provide improved habitat for amphibian breeding.

Our team also has the goals of achieving these outcomes in ways that are self-sustaining over the long-term and improve our ability to carry out restoration projects at scale, as the amount of degraded landscapes is large and the resources to restore them are comparatively small.

7 Introduction of the Pilot Project Proposal

To meet our goals, we are proposing a pilot project based on the principles of Low-Tech, Process-Based Restoration (LTPBR) for Upper Watersheds (Upper Watershed PBR) as outlined in the Sonoma Resource Conservation District's guide (Dolman et al. 2025) and The LTPBR Design Manual (Wheaton et al. 2019).

The pilot project would be focused on learning how our team can apply the principles of LTPBR specifically in the Bayberry watershed and to increase monitoring activities so we can better evaluate the results.

7.1 Background on LTPBR

The current watershed restoration paradigm is most often based on an engineering approach to stream management. While this approach may have its applications, a low-tech process-based method can provide similar or better outcomes at lower cost (Wheaton et al. 2019). It is also much more approachable for a larger number of people, thus we hypothesize it will provide a better model for many local watershed restorations, including for Bayberry.

The principle ideas of LTPBR are:

- Watersheds should be restored to a naturally sustaining place where they need little or no future interventions.
- Over long time horizons, the naturally sustaining state of a watershed is one in which the water flows are fully connected to their flood plains across valley bottoms; also known as an "anastomosing state".
- Restoration should take advantage of naturally occurring processes, such as water flows, to "do the work" for us, where possible.
- Restoration under LTPBR can be carried out using "low-tech" methods, primarily or completely with volunteer labor and hand tools and at low material cost.

The end result of a successful LTPBR project is one in which as much as possible of the water flow spans the valley bottom (known as "Stage 8 anastomosing state"). In the long-term, this leads to reduced sediment flows, arrested incision, attenuated peak flows, recharged groundwater, sequestered carbon, created habitat, and raised water tables.

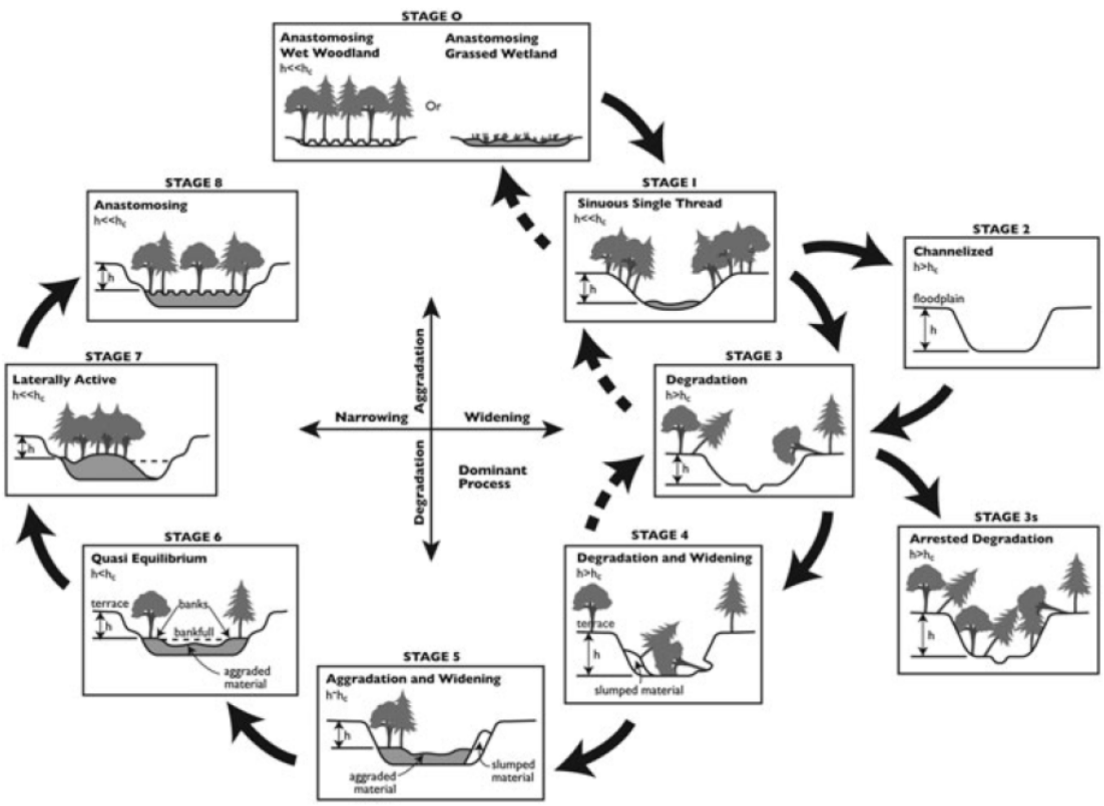

Figure 1: Stream evolution model (Cluer and Thorne 2013)

As shown in figure 1, degraded watersheds are in stages one through seven and the goal is to restore the watershed to stage eight or stage zero. (The difference in target between stage zero and stage eight is whether or not stage zero is possible as oftentimes existing infrastructure or other constraints make stage zero not a feasible restoration target.)

The primary methods of applying LTPBR in Upper Watersheds, like Bayberry, are:

- Building low-tech structures such as:
  - Brush packing
  - Brush Check Dams
  - One Log Dams/Single Rock Dams
  - Brush Wattles
  - Logs on Contour
  - "Switch" (rock or log structure reconnecting historical channels)
- Plantings:
  - Woody plants: native shrubs such as coyote bush
  - Perennial bunch grasses, likely stipa, leymus, carex, juncus
  - Live willow stakes

The structures are further documented in: (Dolman et al. 2025).

8 Pilot Project Proposal

8.1 Goals

The goals of this specific pilot project are:

- increase familiarity with LTPBR
- gain experience implementing LTPBR techniques in the Bayberry watershed
- improve monitoring capabilities to evaluate the pilot and potential expansion of the pilot to more extensively restore the Bayberry watershed

8.2 Process

8.2.1 Phase 1: Collection & Analysis – Understanding Problems & Opportunities (Planning)

Using satellite imagery and on-site observations, map out the current state of the watershed including:

- Mapping available valley bottom areas
- Identifying any risks to infrastructure, resources, habitat
- Assessing current geomorphic and riparian conditions (identifying the stage of each section)
- Evaluating recovery potential
- Locating potential vegetative and seed sources

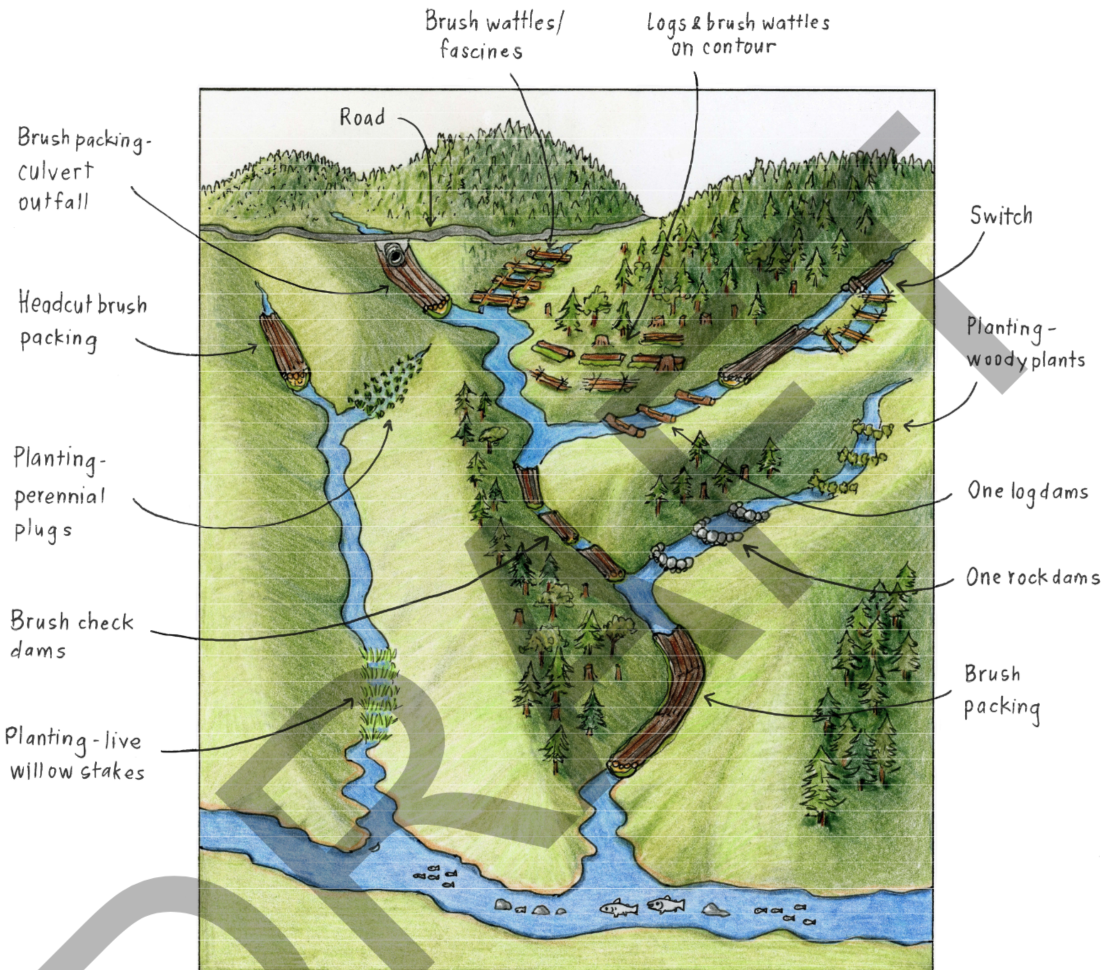

Figure 2: Upper Watershed PBR Example (Dolman et al. 2025)

8.2.2 Phase 2: Decision Support – Understanding the Solution (Design)

For the design phase:

- Selecting 3-7 targeted interventions based on pilot project goals
- Conducting stakeholder reviews
- Finalizing intervention sites
- Defining formal success metrics

8.2.3 Phase 3: Application & Evaluation – Understanding the Results (Implementation)

- Gathering materials and installing structures
- Evaluating success against established metrics
- Analyzing future possibilities for process improvements.

8.3 Bayberry Watershed

The target area for this pilot project is the northern extent (North of Ygnacio Valley Road) of the Bayberry watershed as highlighted figure 3. Later expansions of the project could find it beneficial to expand the application to the south side of Ygnacio Valley Road but the initial focus is on the area closer to the current Bayberry restoration efforts.

8.4 Risk Management

We anticipate low risk for the currently proposed project due to several key factors:

- Reliance strictly on hand-built structures with no heavy equipment.
- Absence of water flow alterations that would significantly impact areas outside the lower watershed.
- No placement of structures near existing hard infrastructure.
- Complete or near-complete reversibility of all installations.
- Continuous monitoring throughout the project lifecycle."

Safety precautions would also be taken during the construction of structures such as training and wearing relevant PPE.

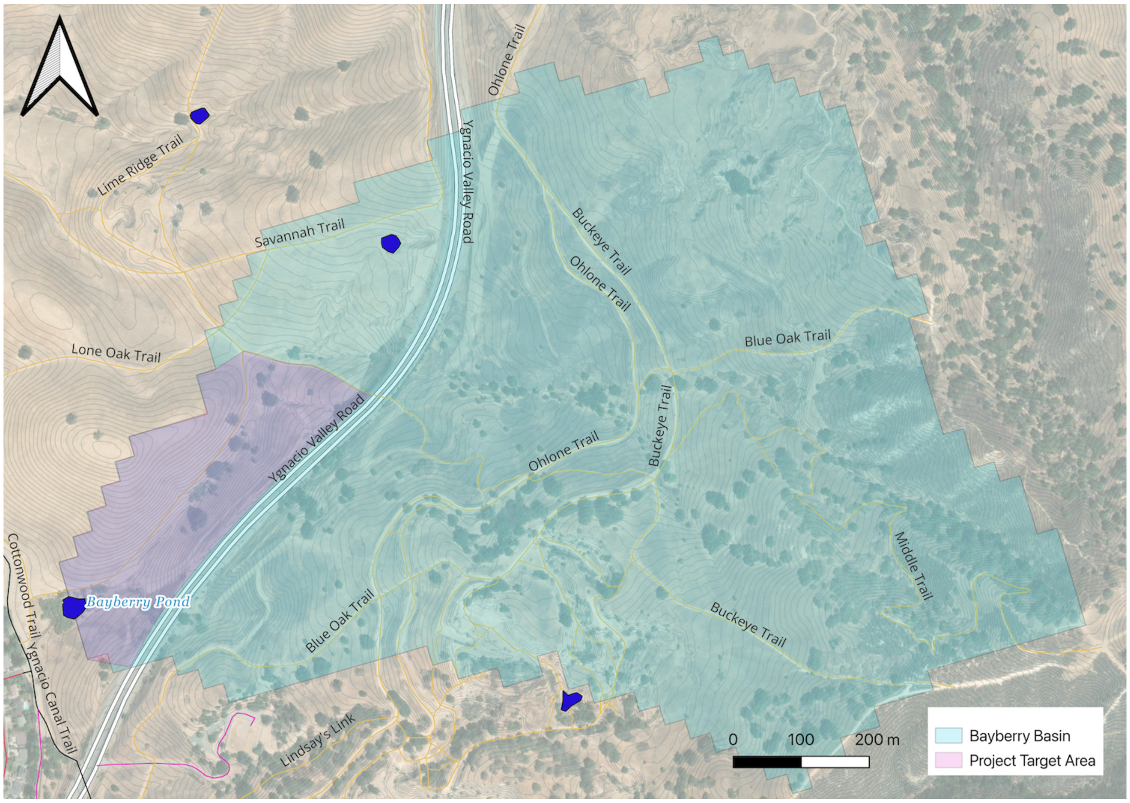

Figure 3: Bayberry watershed

9 Appendix A: Process Phase 1 – Planning

Figure 4 shows the existing water channels as well as the extent of the valley bottom. It also highlights a few notable features including: channel headcuts, culvert outflows and a point with ephemeral springs.

The mapping was done based on satellite imagery, USGS 1 meter Digital Elevation Model, and an onsite survey performed on July 28th, 2026.

The onsite survey revealed a mix of geomorphic conditions. Some sections were deeply incised to about 1.5 meters, while other areas had little or no incision. At the start of the incised sections there were severe headcuts.

Other observations from the survey include:

- About 70% of the valley bottom is a non-native, annual grassland community.
- There are a number of mature cottonwood, willow, and valley oaks.

  Some valley oaks were observed with healthy numbers of young oaks in their vicinity but neither the cottonwood nor the willow trees had any indication of propagation.
- A few small stands of coyote bush were observed, both in the channels and on the valley margins.
- Non-native olive trees on valley margins which appeared to be spreading.
- Leymus stands on valley margins in some sections.

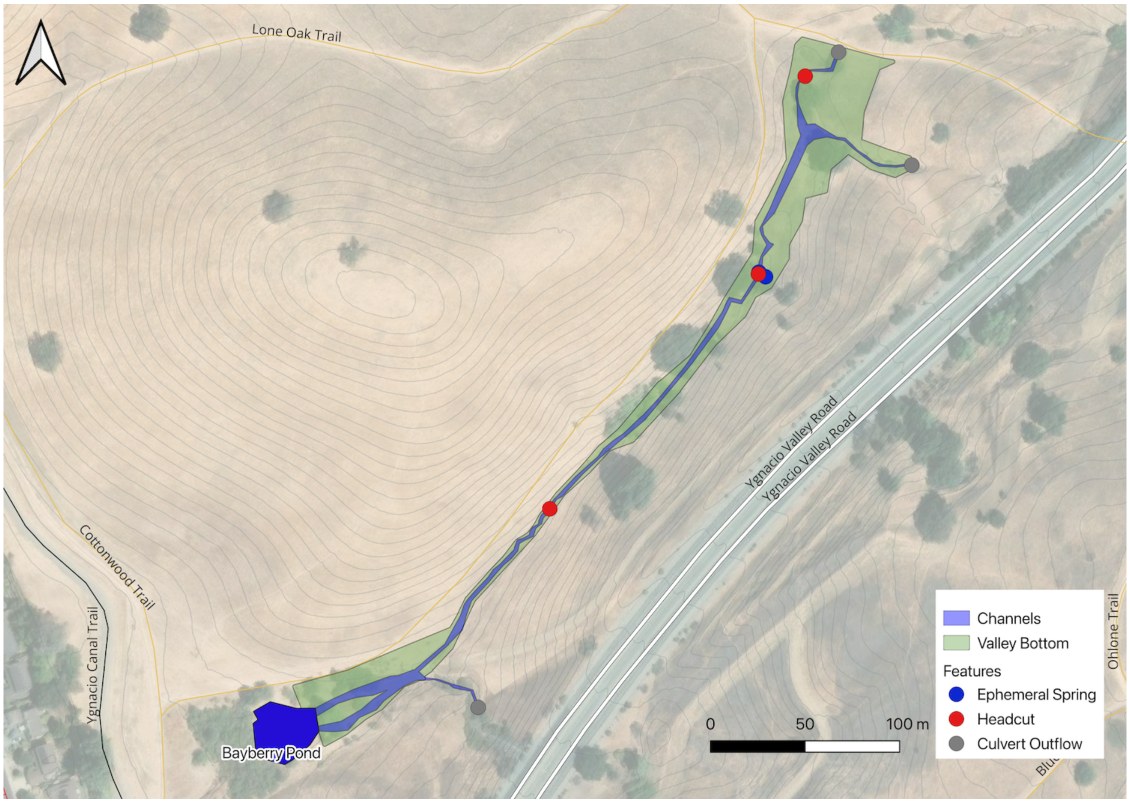

Figure 4: Valley Bottom Map

- Large areas of native Juncus rushes along with a few native sedges.
- A few elderberry bushes.
- Significant impact from grazing cattle on nearly all observed species.

9.1 Impacts & Risks

There are two hardened culvert paths that drain into the study area. The flow from the lower one enters right at the start of the study area and was not included in the survey. The second hardened culvert is near the top of the studied area. It is heavily armored with rocks and no significant erosion was observed. There also appears to be a third, smaller and un-armored culvert in the main channel at the very top of the study area that is likely partially collapsed.

There are two trails that interact with the study area. There is an unlabeled single-track footpath that follows the contour of the north hillside about 4-6 meters in elevation above the valley bottom. And there is also a 2 meter wide trail that passes immediately above the top of the study area, the "Lime Ridge Trail". It passes over the collapsed culvert mentioned above and later passes under Ygnacio Valley Road.

Ygnacio Valley Road runs parallel to the valley bottom, about 60 meters to the southwest, and 6-13 meters above the valley bottom, in elevation.

There is no expected impact on existing infrastructure. None of the existing infrastructure is in or near to the extent of the valley bottom. Also, none of the proposed interventions are expected to have any significant impact on any existing infrastructure due to the distance and/or relation to the infrastructure. The culverts do empty into or near the valley bottom but are all upstream and uphill from the proposed interventions and no impact on them is expected.

According to an environmental study done nearby in south Lime Ridge in 2021 (Bartosh, n.d.) that has some similar characteristics to this study area, there is a total of 23 special-status fish and wildlife species that could potentially occur in the impacted area. After reviewing the list of 23 species and their characteristics it was deemed unlikely that the proposed interventions would have any negative impact on the special status fish and wildlife, due to the nature and small scale of the interventions.

9.2 Recovery Potential

The total **identified recovery potential** is approximately 7,000 m^2, or about **80% of the total valley bottom**. The pilot project is much narrower in scope with the potential recovery being on the order of a few hundred square meters.

A small but significant portion of the recovery area is near the bottom of the study area and was not considered in this process as it is a part of the existing Bayberry restoration project. Most of the recovery potential lies in the upper half, with a strong inverse correlation to the gradient of the valley bottom. There is a higher gradient section in the lower half that has severe incising, and it is believed important to target the incising with interventions, but most of the recoverable valley bottom exists in the upper section.

9.3 Vegetative and Seed Sources

The survey documented plant species distributions and identified viable sources for seed and cutting collection. It was also noted where existing woody material is available. That information is not included here but it was confirmed that material needed for creating the treatments does exist locally in the basin, although it could be useful to find a secondary source as the existing material was not overly abundant.

10 Appendix B: Process Phase 2 – Design

For implementing the pilot project, three small "focus areas" were selected out of the mapped recovery area. These areas are denoted in Figure 5. Focus areas were chosen to make implementation and planning easier. The areas were selected based on the interventions they needed and the geomorphic conditions. The goal was to find a set of areas that allowed for piloting a large range of interventions across a varied set of geomorphic conditions.

10.1 Area 1

The defining characteristic of Area 1 is a steep gradient and a deeply incised channel with an aggressive headcut in a predominantly non-native annual grassland. As visualized in Figure 6, the primary interventions are: brush packing at the headcut and two brush check dams in the incised channel.

The primary goal for Area 1 is to see how well the proposed structures withstand high force flows and what impact they have on the incision and headcut.

Success for Area 1 would look like:

- The interventions remain intact through the wet season.

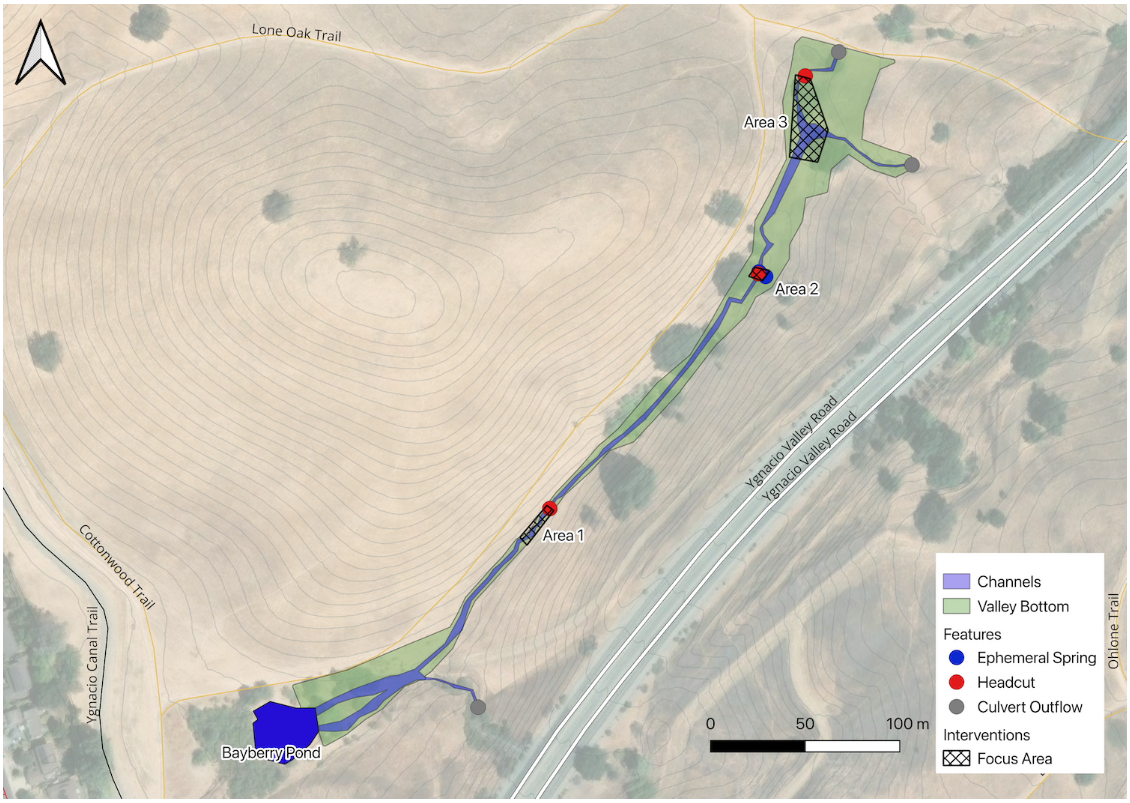

Figure 5: Valley Bottom Map with Focus Areas

- The headcut does not progress upstream.
- The interventions can be observed slowing and capturing water and sediment.

10.2 Area 2

Area 2 is significantly different from Area 1 with:

- Less gradient
- Larger accessible valley bottom
- 2-3 ephemeral springs
- A small incised hill with a headcut formed near one of the springs

Area 2 has also been observed to stay hydrated the longest into the dry season. Area 2 is closer to the desired recovery state with existing woody debris, a large population of Juncus, as well as existing brush and trees. The proposed interventions are visualized in Figure 7.

The primary goal with Area 2 is to see how the intervention affects an area that is already closer to the desired recovery state.

Success for Area 2 would look like:

- The intervention remains intact through the wet season.

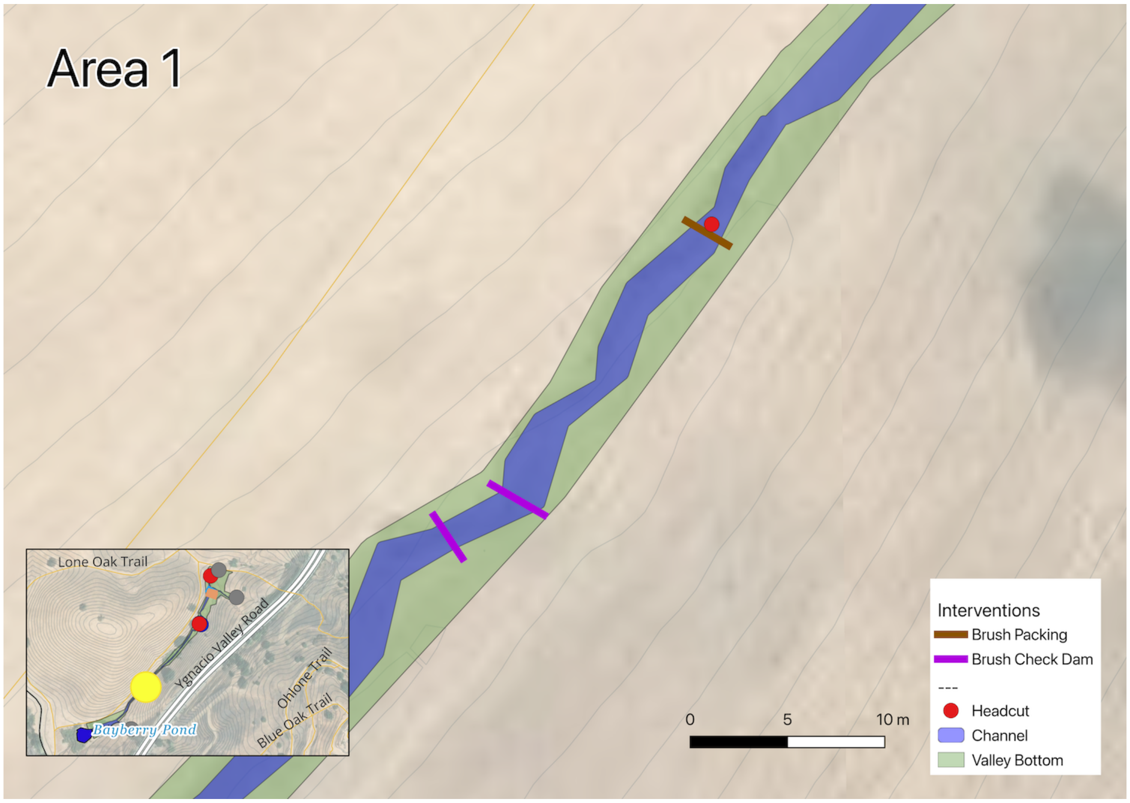

Figure 6: Focus Area 1 Interventions Map

- The headcut does not progress upstream.
- The surrounding vegetation does not appear to be negatively impacted.

10.3 Area 3

Area 3 is where most of the effort would be applied. It is a wider and flatter area with a large amount of recovery possible. It currently exists primarily as a non-native annual grassland with some Valley Oak trees. The upper portion features deeply incised channel, whereas lower portion flows unconfined. The proposed interventions are visualized in Figure 8.

- Brush packing is proposed at the headcut.
- A flow-diversion "switch" is proposed where the flow exits the channel.

  The goal would be to get the water to use a larger portion of the valley bottom.
- To supplement the switch a set of additional interventions are proposed.

  These interventions include: "logs on contour", Juncus plantings, Willow stake plantings, and Coyote bush or other woody plant plantings. The goal is to encourage the water flow to spread out across the valley bottom while also slowing it down using the supplementary interventions.

Success for Area 3 would look like:

- The interventions remain intact through the wet season.

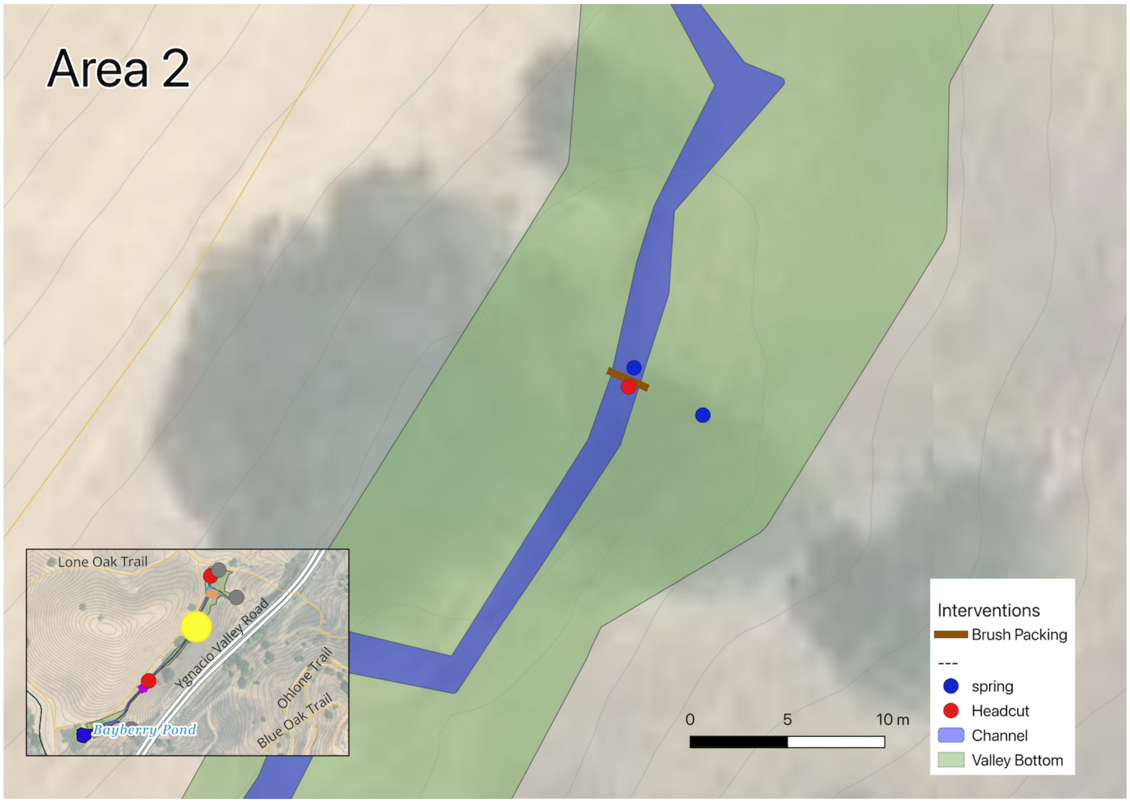

Figure 7: Focus Area 2 Interventions Map

- The "switch" operates successfully by pushing some of the flow out of the existing low-point along the valley bottom margin.
- The headcut does not progress upstream.
- The supplementary interventions are observed to slow down and capture some of the water.
- The plantings establish successfully.

11 Appendix C: Recovery Success Metrics

11.1 Monitoring Objectives

The primary monitoring objectives will evaluate:

- Localized precipitation patterns and event structure.
- Moisture persistence in the lower Bayberry watershed.
- Vegetation persistence in the lower Bayberry watershed.
- Bayberry pond persistence.
- Direct soil-moisture measurements.

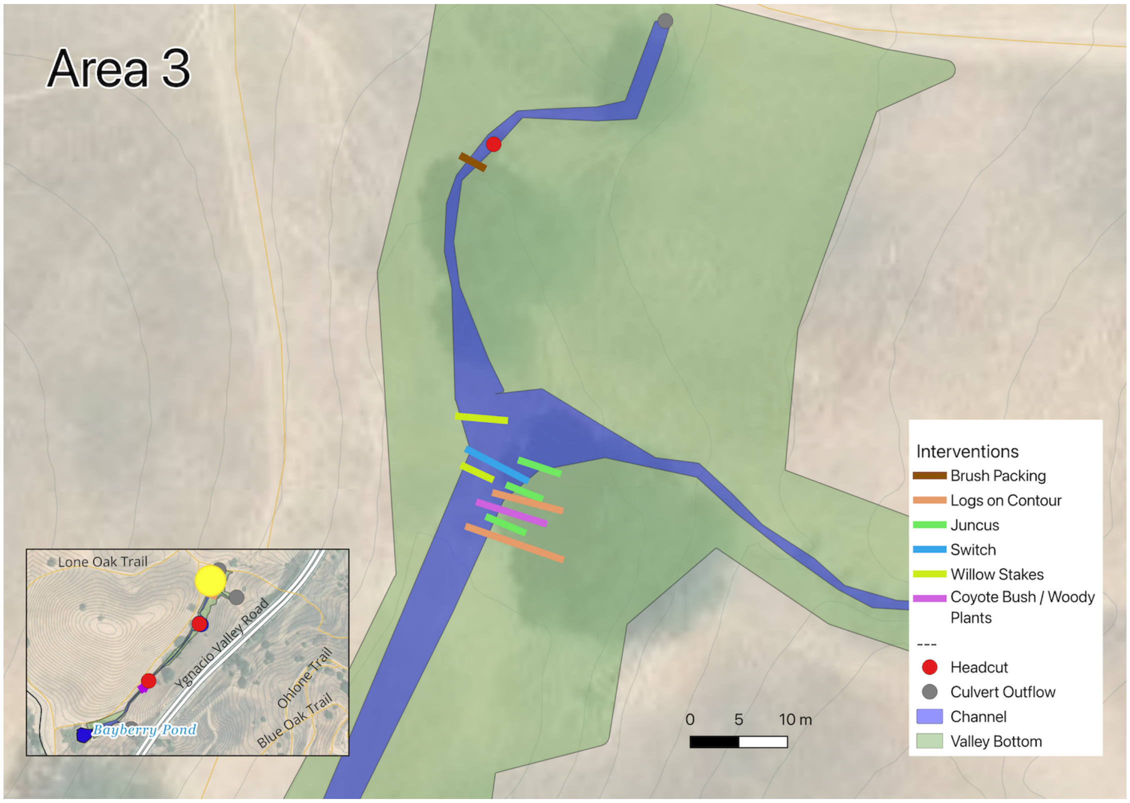

Figure 8: Focus Area 3 Interventions Map

11.2 Types

There are two primary monitoring types:

- Monitor and evaluate within the treatment watershed against itself within a historical context.
- Monitor and evaluate, using the same methods as in the treatment watershed, a nearby control watershed.

11.3 Methods

- Remote sensing: NDVI and Moisture Index

Using historical Sentinel-2 imagery to establish a pre-restoration baseline and future imagery to evaluate system response.

For fixed treatment and control watershed polygons, calculate:

NDVI – vegetation activity/persistence. Moisture Index (MI) – (B8A - B11) / (B8A + B11)

It is hypothesized, with sufficient time after treatments, that NDVI and MI wet-season characteristics will persist later into the dry season before showing predominantly dry-season characteristics.

- Field vegetation surveys

CNPS rapid vegetation assessment surveys will be conducted in the treatment and control watersheds to establish a baseline and on a regular basis after treatment begins.

It is hypothesized that vegetation will respond to the treatments by demonstrating a growing coverage area of riparian and marsh community species in a larger area.

- In-ground moisture sensors

In-ground moisture sensors will be placed at strategic locations in the treatment and control watershed to "ground truth" the remote sensing data as well as to provide baseline and post-treatment datasets.

It is hypothesized that the moisture sensors will demonstrate an increasing length of time the ground moisture is elevated beyond dry-season norms, longer into the dry season.

- Remote sensing & field observations of Bayberry Pond persistence

A pre-treatment remote sensing operation was performed utilizing Planet Labs imagery, to create a historical dataset detailing when the Bayberry pond is full vs dry. This dataset will be augmented post-treatment with field observations or remote-sensing, if needed.

It is hypothesized that the pond will persist later into the dry season after treatments.

11.4 Factors

There are likely many factors that influence the monitored variables. These factors will be evaluated to determine which ones appear to have a significant effect on the watershed. The primary way in which this will be determined is by searching for correlations between variables based on the available historical remote sensing data. Variables which demonstrate a meaningful correlation will be used to adjust the monitored results during analysis.

Possible factors include:

- Precipitation, including
  - Total water year precipitation
  - Frequency, timing, and volume of precipitation events
  - Timing of late-season events
- Cloud cover & marine layer
- Atmospheric temperature

It is also important to point out that this project is not trying to demonstrate that LTPBR techniques alone provide a benefit. In addition to LTPBR interventions, the project includes vegetation management—specifically the removal of non-native vegetation, especially non-native annual grasses, as well as the planting of native vegetation. This project and the success metrics are based on a holistic restoration approach, not limited to just water retention related improvements.

11.5 Evaluation Timing

An initial evaluation will be performed after the first year of interventions. At this point it will be too early to conclude much from the quantifiable data. However, there will likely be a lot to learn related to the implementation and how it responded to a wet season. Evaluations will focus on field observations during rain events as well as the effect that rain events had on structures built for the interventions. Assuming the first year of the pilot project goes well, the restoration can be expanded to include a much larger number of interventions within the watershed.

Evaluations should then be performed at 5, 10, 15, and 20 years post treatment.

12 Appendix D: Relation to Locally Relevant Regulations

In this pilot project, the proposal is:

- Less than 5 acres of interventions
- Less 500 feet of cumulative linear interventions
- Is not a compensatory mitigation project
- Has the primary purpose of habitat restoration
- Will take less than 5 years of construction
- Is being carried out by volunteers

For those reasons, along with the defined purposes and impacts, this proposal likely qualifies under CDFW's HREA (Habitat Restoration and Improvements Act) (n.d.–a) and the "Water Board Order for Small Habitat Restoration Projects" (n.d.–b) for streamlined permitting.

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